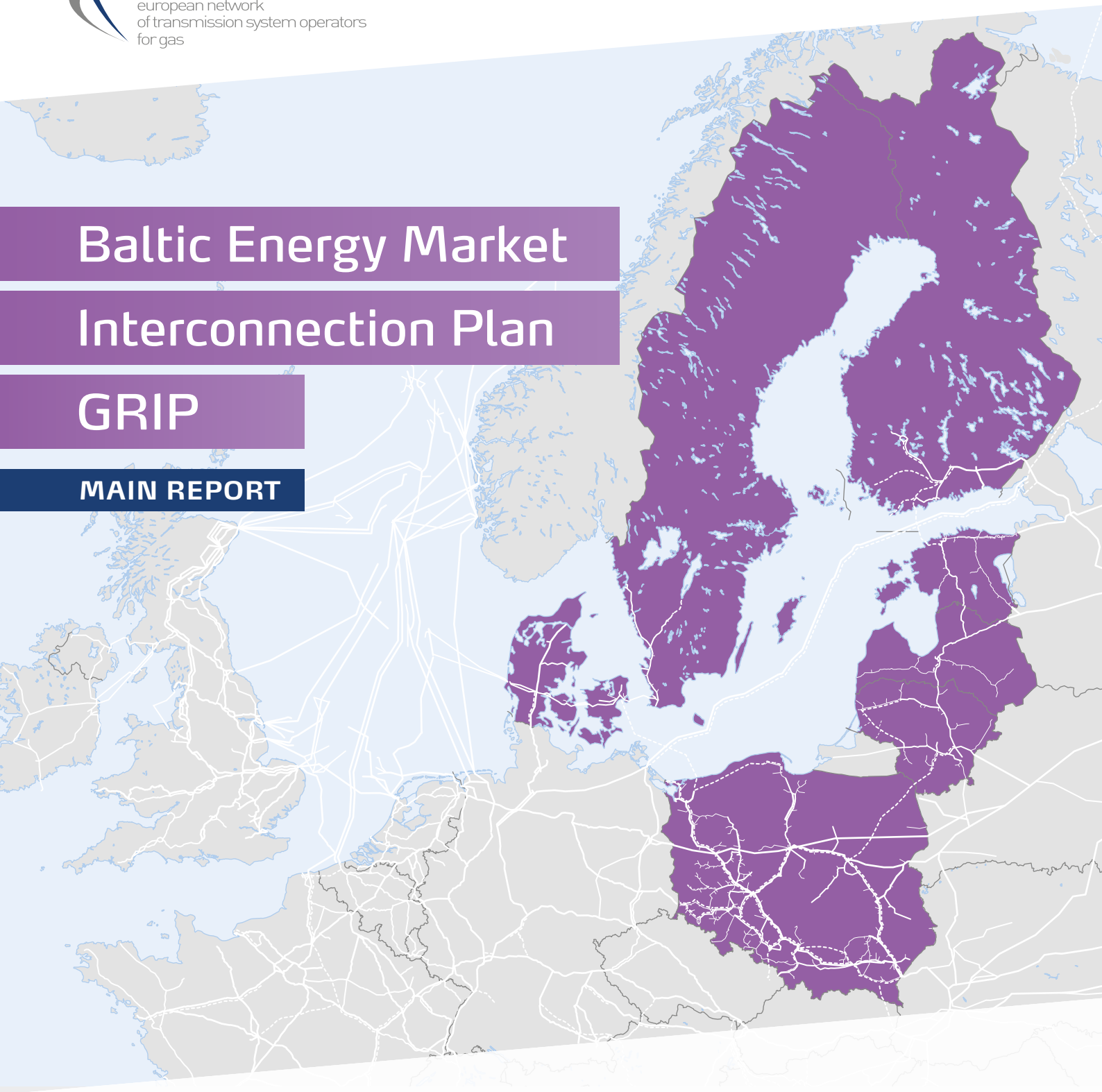
entsog
european network
of transmission system operators
for gas

GAS REGIONAL INVESTMENT PLAN
2017

Baltic Energy Market Interconnection Plan GRIP

MAIN REPORT



Amber Grid
conexus BALTIC GRID
elering
ENERGINET
Gasum
GAZ system
SWEDEGAS

Table of Content

Executive Summary

The completion of the gas internal market, increase of security of supply and fostering of competition are the main priorities outlined in the European Union's (EU) energy policy. The Regulation No. 347/2013 on guidelines for trans-European energy infrastructure aims to accelerate the development of infrastructure projects having regional importance, so called "Projects of Common Interest" (PCI) in certain priority corridors. The second EU-wide List of PCIs was adopted by the European Commission (EC) on 18 November 2015. It consists of about 200 energy infrastructure projects, including 10 gas infrastructure projects in the BEMIP region.

If implemented, these projects will significantly change the gas markets in the region, firstly by interconnecting currently separate sub-regions such as 1) Finland, 2) Estonia, Latvia and Lithuania, 3) Poland, 4) Denmark and Sweden, and integrating even four Member States (Finland, Estonia, Latvia and Lithuania) into a common European gas market, and secondly by enhancing diversification of gas supply sources (access to global LNG markets and Norwegian continental shelf). Since the last BEMIP GRIP report, LNG terminals have been commissioned in Klaipėda, Lithuania, and Świnoujście, Poland. Both terminals diversify gas supplies in the Baltic Sea countries. For the countries in the region that rely, either fully or to a large extent, on a single supplier this is a major shift, bringing from one side more choices and opportunities for the gas market players, and from another side requiring adequate changes in legislation and commercial practices of gas companies to accommodate an increased market complexity.

With respect to the role of the gas in the energy market, the expected paths differ within the region. Based on the demand scenarios in ENTSOG's TYNDP 2017, demand is expected to decrease in Denmark, Estonia and Finland in both scenarios: European Green Revolution and Blue Transition. According to European Green Revolution, gas demand is expected to remain stable or slightly decrease in all countries of the BEMIP region except for Poland, where demand is expected to increase in all scenarios. Poland, with its high demand, dominates both scenarios. From 2015 to 2025, the European Green Evolution foresees an increase in demand of 3 % in the region while the Blue Transition expects 33%. If the high share of Polish demand is excluded, the total demand in the region from 2015 to 2025 is expected to decrease by 11 % in the European Green Evolution scenario and increase by 2 % in the Blue Transition scenario. This increase is mainly driven by an expected soaring demand in the largest market of the region – Poland expects gasification of new areas in the country, substitution of coal-fired-furnaces with the ones supplied with gas and a wider use of gas power plants for electricity generation.

Despite the fact that gas consumption in the region is expected to increase, the forecasted changes should be in line with the EU's climate policy, as major increases will be for the substitution of much more polluting fuels – coal for electricity production and district heating in Poland and oil products for bunkering purposes. Another growing tendency in the overall region is that the gas is being used increasingly as a back-up fuel for renewables based production of heat and electricity.

In comparison with the second edition, this GRIP maintains the same framework, providing a description of the region's gas markets, development in the offgrid area and including analysis of expected developments of grid-related gas demand and supply, and evaluating the potential contribution of infrastructure projects to these developments. The document provides an update of regional initiatives in both the Eastern and Western Baltic regions. The results of the analysis accomplished by ENTSOG focused on modelling gas supply flows in several disruption cases in the region are provided.

This GRIP presents a detailed analysis of the impact of the enlisted gas infrastructure projects on the development of the region's gas market. The information on the projects proposed herein, including third-party projects, of the countries belonging to the BEMIP region is provided in the Annex.

Image courtesy of Gasum

1 Introduction

Image courtesy of Elering

The third Gas Regional Investment Plan (GRIP) of the Baltic Energy Market Interconnection Plan (BEMIP) region was prepared by the following national Transmission System Operators (TSO) from the BEMIP region: Gasum Oy (Finland), Elering AS (Estonia), JSC Conexus Baltic Grid (Latvia), GAZ-SYSTEM S.A. (Poland), Energinet.dk (Denmark), Swedegas AB (Sweden) and AB Amber Grid (Lithuania). Gasum Oy had the role of coordinating the preparation of this edition of BEMIP GRIP.

The present publication is an update to the second GRIP publication of BEMIP published in May 2014.

Article 12 of Regulation 715/2009 stipulates that inter-TSO cooperation is to be promoted and facilitated at a regional level with the aim of creating a competitive internal market for natural gas, fostering the consistency of their legal, regulatory and technical framework and facilitating integration of the isolated gas systems. In order to contribute to the fulfilment of these tasks every two years the TSOs have to publish GRIPs based on regional cooperation.

Apart from the legal obligation to produce GRIPs, TSOs in the BEMIP region aim to raise awareness of the need for developing the regional gas market and infrastructure projects in the context of regional cooperation. The BEMIP region can be characterised as highly dependent on a single supplier and member countries have a relatively low level of interconnections. The implementation of the major gas infrastructure projects will increase the regional security of supply, diversification of sources and routes, as well as their interdependence and cross-border impact in the region.

The TSOs involved in preparing the GRIP of the BEMIP region expect that this report will provide useful information to its readers and will contribute to the process of making investment decisions and granting support for the projects in need of such support. The TSOs welcome comments and proposals for the improvement of this document that could be of use for future GRIPs publications

2 Summary of the Regional Market

Image courtesy of Conexus

2.1 Energy Policy

The BEMIP region is often regarded as a heterogeneous one, not only in terms geographical coverage but also in the context of differences between the energy markets that are present in particular countries of the region. However, a closer look at their energy markets may give a more nuanced picture. Namely, a number of features can be identified that are either common across the region or are relevant in most cases.

First of all, the political focus has been put on the reduction of greenhouse gas emissions and enhancement of the domestic sources of energy. The promotion of renewables and the introduction of important regulatory changes in Baltic countries had an impact on the competitive position of natural gas vis-à-vis other sources of energy. This was one of the major reasons behind the decreasing gas demand in recent years in some countries and uncertainty regarding the role of natural gas in the future.

On the other hand, the shift towards renewable sources fostered the process of exploring the untapped potential of biogas and biomethane and, in the longer run, also renewable gases. TSOs in the Baltic region analyse the possibilities of opening the gas infrastructure to different sources of renewable gases, thus supporting the contribution of natural gas towards a low-carbon economy.

Natural gas is well placed to play its role in this process in the mid- to long-term future. This can also be achieved since there is still potential for natural gas to replace more polluting fossil fuels such as coal, lignite and oil shale in the electricity production and coal in the heating sector. In addition, there is room for LNG and CNG to contribute towards emission reductions in the transport sector. Since enhanced environmental standards defined by the International Maritime Organisation and the European Union apply to the Baltic Sea, gas operators are cooperating with other parties in the region to establish the infrastructure necessary to facilitate the use of LNG, CNG and hydrogen in the maritime and inland transport.

Policy makers in the Baltic region also attach importance to the development of gas infrastructure to guarantee secure supplies. Some of the first projects with the aim of providing diversified supplies have already been implemented, such as the LNG terminals in Klaipėda and Świnoujście. Other diversification projects are planned to follow suit. These include the extension of existing and construction of new LNG terminals (including small-scale ones) and the NO-DK-PL project (Baltic Pipe) that will provide direct access to Norwegian supplies.

Cross-border interconnections between the countries in the region such as Balticconnector, Baltic Pipe and GIPL are also given priority. Enhancement of interconnections between the three Baltic States, including the introduction of reverse flow on Latvian-Estonian interconnection along with enhancement of flexibility of Inčukalns UGS in Latvia and Latvian—Lithuanian interconnection are essential for developing the joint Baltic and Finnish gas market with a possible single entry-exit zone. This is due to the fact that implementing these projects will enhance the distribution of gas between gas systems and they are also expected to improve competition in the markets. There is also an understanding amongst the Baltic States that infrastructure developments are essential in order to increase the affordability of natural gas for consumers and bridge the gap between gas prices in the region and the more developed markets in North-West Europe.

Finally, political choices accounted for the need to join the European process with the aim of achieving a liberalised internal market for gas. It is worth noting that significant changes have already taken place in a number of Baltic countries. The process of TSO unbundling, the implementation of European network codes and other measures such as the establishment of gas exchanges create the basis for viable regulatory framework that can be used for further development of the regional market. The actions taken to create a single market area in the Baltic states and Finland and the measures to integrate the gas infrastructure in the West Baltic area (Poland, Denmark and Sweden) showcase that this process has already been ongoing and is gradually progressing.

Image courtesy of Swedegas

2.2 Market Players

The BEMIP region has, in all, seven Transmission System Operators (TSOs) that own natural gas grids in their respective countries: Energinet.dk in Denmark, Gasum Oy in Finland, Swedegas in Sweden, Elering in Estonia, AS Conexus Baltic Grid in Latvia, AB Amber Grid in Lithuania and GAZ-SYSTEM S.A. in Poland. Energinet.dk and Elering own both electricity and gas grids in the respective countries.

The majority of TSOs in the BEMIP region operate as ownership-unbundled TSOs, except Gasum Oy. On 2 January 2017, a new company (JSC Conexus Baltic Grid) commenced operations as a Latvian TSO, and this was established through the unbundling from AS Latvijas Gaze. JSC Conexus Baltic Grid includes the transmission and storage of natural gas. The energy law in Latvia stipulates that the TSO must be unbounded from the DSO and the DSO from sales by 31 December 2017. The energy law of Latvia also states that, as of 3 April 2017, the natural gas market of Latvia must be fully opened. This will allow other entities to trade and sell natural gas. Households will have the opportunity to choose to either stay as a related user or continue to purchase natural gas for regulated tariffs.

Gasum Oy is a vertically integrated company acting as a wholesaler of gas in addition to its TSO activities. The unbundling of Gasum Oy will be performed when the right to derogate from it expires. At the same time, GAZ-SYSTEM S.A. is an unbundled operator of the transmission system in Poland and additionally performs the function of an independent system operator on the Polish section of the Yamal-Europe pipeline.

Over 50 distribution companies operate in the BEMIP region. In Poland, the leading DSO is Polska Spółka Gazownictwa sp. z o.o., in Estonia – AS Gaa-sivõrgud and in Lithuania – AB Energijos Skirstymo Operatorius. In Denmark, the distribution system network is divided into six distribution areas covered by four distribution companies: HMN Naturgas, Nature Energy Distribution, Gasforsyningen Aalborg and Danish Gas Distribution (owned Energinet.dk). In Sweden, five distribution areas are owned and operated by E.ON Gas Sverige, Göteborgs Energi Gasnät, Kraftringen nät, Varberg Energi and Öresundskraft.

The structure of supply chain of natural gas and the number of players in it differs by countries. In 2016, approximately 20 supply companies and 25 transport shippers operated in Denmark; licenses to import natural gas were held by three companies in Estonia and by nearly 10 companies in Lithuania. In Poland there were over 100 shippers, with the oil and gas company PGNiG being the major player engaged in import and production of natural gas; nine suppliers of natural gas operated in Sweden's gas market.

Since 2014, the BEMIP's region's access to liquefied natural gas (LNG) market has been enhanced. Lithuania, Poland and Finland commissioned new LNG terminals: in December 2014, a terminal was launched in Lithuania (by AB Klaipėdos Nafta); in June 2016, a terminal was launched in Poland (by Polskie LNG S.A., a subsidiary of GAZ-SYSTEM S.A.), and in September 2016, Pori LNG import terminal was put into operation in Finland (by Skangas Ltd.). Direct access to regasification capacities in the region will further improve in the upcoming years as GAZ-SYSTEM made an investment decision in April 2017 to upgrade the terminal in Świnoujście from the existing 5 bcm/y to 7.5 bcm/y.

Finland's LNG terminals provide access to LNG deliveries outside the gas pipeline network. The major player in Finland's LNG market is Skangas. Gasum Oy, together with Skangas, participates in Manga-consortium, which is responsible for the implementation of the LNG terminal in Tornio (Finland). Another LNG terminal project by Haminan Energia has still been in its pre-FID phase. Estonia's Paldiski LNG terminal and Tallinn LNG terminal are both part of the 2nd List of PCI and have been developed by Gaas OÜ and Vopak E.O. S. AS, respectively. Swedegas has an ongoing LNG terminal project in Gothenburg and it is in pre-FID phase.

Baltic Connector Oy is the company responsible for the Baltic Connector project implementation in Finland. There are more than 10 underground gas storage (UGS) facilities in the BEMIP region, the majority of them being in Poland. PGNiG owns and operates seven UGS facilities connected to Poland's gas transmission system. Energinet.dk Gas Storage owns and operates two UGS facilities in Denmark. In addition, two UGS facilities are located in Sweden and Latvia. Skallen UGS facility is owned by Swedegas. In Latvia, Inčukalns UGS is owned and managed by AS Conexus Baltic Grid.

During recent years, the number of players entering the wholesale and retail gas market has increased in the BEMIP region. Gasum Oy has exclusive rights to sell natural gas in Finland's market. In Poland, more than 60 companies were active in trading in gaseous fuels, in 2016; Lithuania had approximately 10 gas supply companies engaged in trade of natural gas; in Estonia, the number of gas trade companies has increased since opening the market and there were seven gas supply companies active in trading of natural gas in 2016. After opening the Latvian market on 3 April 2017, more than 20 gas trading companies have been registered by now, however, it is not known how many of them will be active in the gas market.

Image courtesy of Energinet.dk

2.3 Energy Mix

Natural gas has been an important source of primary energy in all countries in the BEMIP area.

Currently, the highest shares of gas in the energy mix are seen in Denmark, Lithuania and Latvia with percentages between 20 and 30%.

In Estonia, Finland and Poland the share of natural gas in the energy mix ranges between 5 and 15%.

Poland has the highest absolute demand for gas with a yearly consumption of around 195 TWh/y. Also Poland is the only country where gas demand is expected to rise in the future. In the other BEMIP countries, future demand is expected to stabilise or decrease slightly in upcoming years. The main reason for this is the transition from fossil to renewable energy sources in accordance with national energy plans.

In general, the countries have a rather diversified energy mix with oil, wood fuels and coal being the major energy sources. Natural gas is typically ranked third or fourth with regard to its share in the national energy mix. However, in Lithuania the share is the second highest after oil, while in Finland and Sweden gas is only ranked fifth in the energy mix.

In the region gas is typically used for heating, industrial purposes and households. In some countries natural gas also is an important fuel for power production (and CHP).

Figure 2.1 shows the distribution of energy sources in the national energy mixes (2015 Eurostat data).

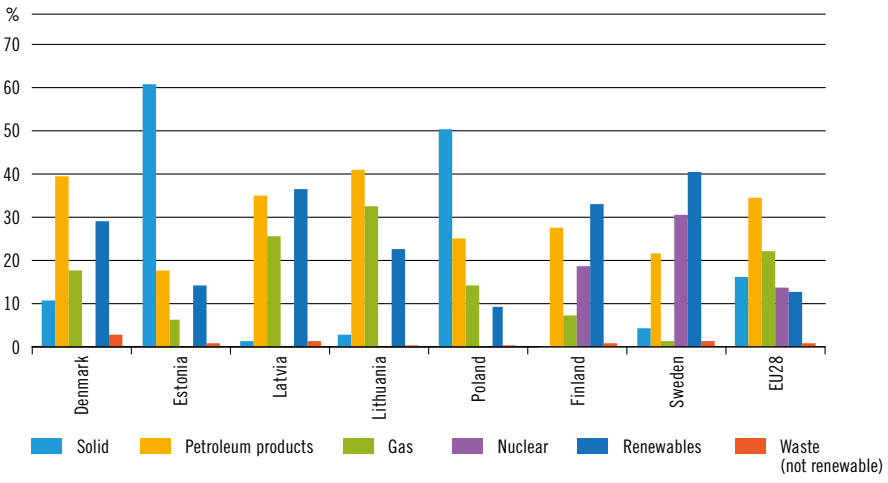


Figure 2.1: Distribution of energy sources in the national energy mixes, in % (Source: Eurostat)

2.4 Market Indicators, Supply and Demand

Since the infrastructure of the BEMIP region is still insufficiently interconnected, there are actually separate gas markets in Finland and in the Baltic countries with different supply and demand patterns. Not long ago Finland, Estonia, Latvia and Lithuania were fully dependent on a single gas source from Russia. However, after commissioning the Klaipėda LNG terminal in Lithuania, now only Finland depends almost entirely on natural gas supplied from Russia.

Latvia presently only uses gas from Russia but it is expected that this situation will change in 2017 when the gas market opens there. Due to favourable LNG prices, Estonia already in 2015 received more than 20 % of its gas from Lithuania, and if necessary, Lithuania can receive almost all of its gas needs from the terminal.

In contradiction to the East-Baltic region, Polish gas is not only imported but also produced locally. In 2016, the majority of gas was imported from Russia (112.1 TWh). The share of other sources was much lower, with supplies from other EU Member States at 28.5 TWh and national production injected into the transmission system amounting for 24.8 TWh. 2016 marked the first year of commercial operations at the terminal in Świnoujście and the LNG supplies via the facility reached 11.2 TWh.

In cooperation the Polish TSO, GAZ-SYSTEM, and the Danish TSO, Energinet.dk, construction of the NO-DK-PL project (Baltic Pipe) is being planned that will provide a direct connection between Norwegian supplies and Central-Eastern Europe and the Baltic region by 2022. The capacity of the Baltic Pipe is up to 10 bcm/y and will significantly contribute to the diversification of supply and have major importance for development of the market in the region. It is also envisioned to reverse a capacity of 3 bcm/y from Poland back towards Denmark.

Denmark is another country that has its own gas and hence its gas network was initially constructed to transport gas from the North Sea. Currently, Denmark already receives some natural gas from Germany. But with the foreseen decline in gas production in the Danish North Sea, the country will become more dependant on gas supplied from Germany, and this will impinge on its current security of supply. Sweden receives gas from Denmark via pipeline and in recent years some developments have taken place in small-scale LNG terminals.

In some countries, biogas is also an important source of energy, but in other BEMIP countries it is slowly picking up. Denmark, Finland and Sweden are countries where biogas already plays an important role. It is expected that biogas will become an important fuel for cars in Estonia.

Poland is the BEMIP country where an increase of gas demand is forecasted. The general trend in all other countries of the BEMIP region is replacement of natural gas by renewables, which is supported by the energy policies of the respective countries. The largest gas market of the region is obviously Poland with an annual gas demand that is considerably higher than all other countries combined.

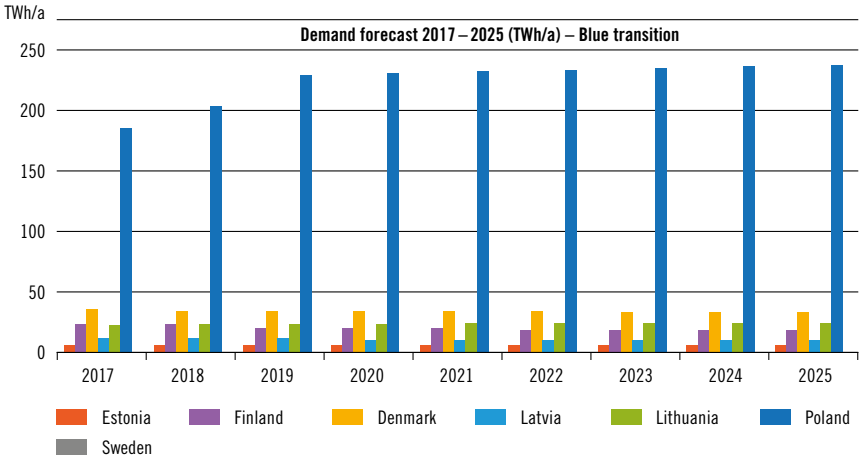


Figure 2.2: Demand forecast (TWh/a) in 2017–2025 – TYNDP Blue transition scenario

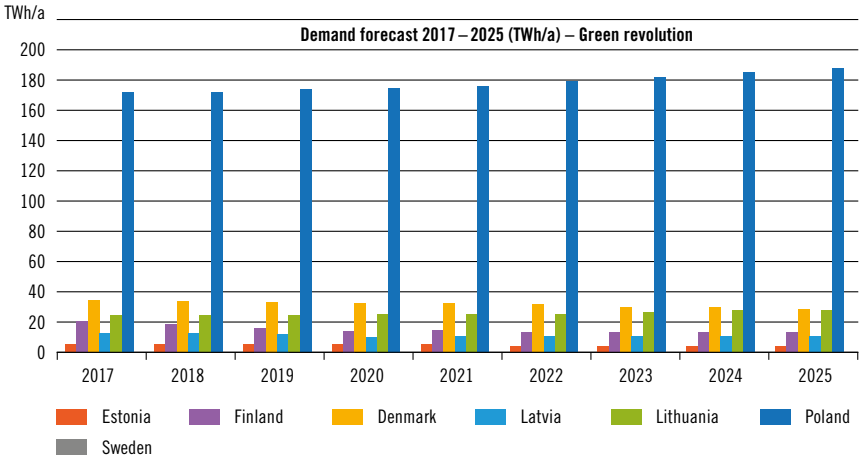


Figure 2.3: Demand forecast (TWh/a) in 2017–2025 – TYNDP Green revolution scenario

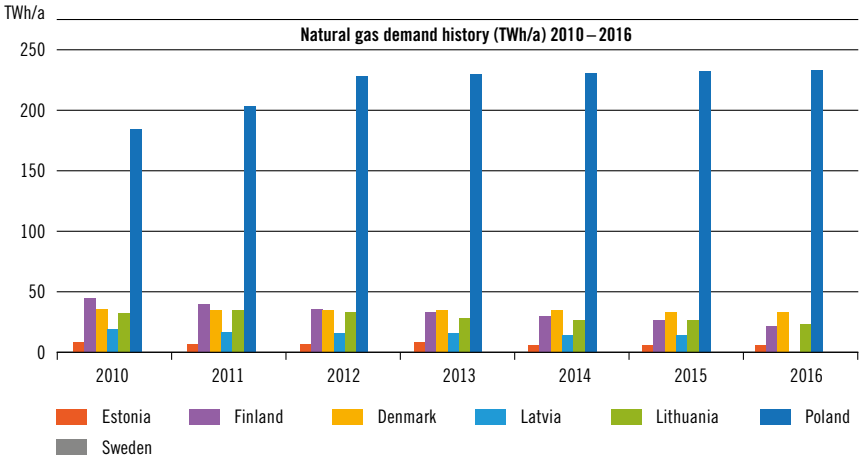


Figure 2.4: Demand (TWh/a) in 2010–2016

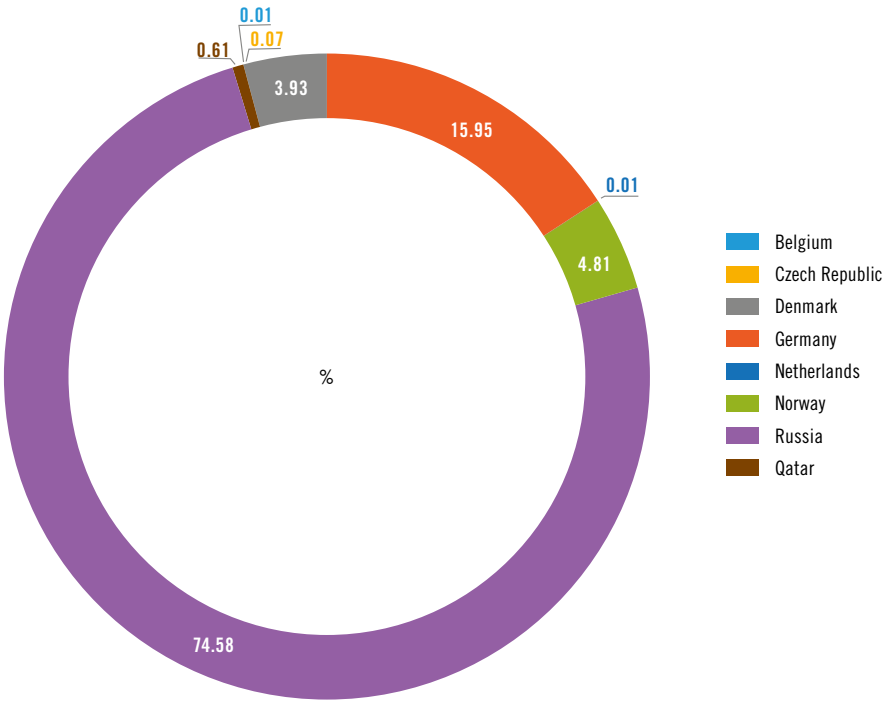


Figure 2.5: The sources of natural gas supply in the BEMIP region

There are four gas exchanges operating in the region: Kaasupörssi in Finland, Get Baltic in Lithuania, Polish Power Exchange (also for electricity) and Gaspoint Nordic in Denmark, which is the most liquid in the region. In 2016, the traded volume on Gaspoint Nordic corresponded to 68 % of Danish consumption, compared to 58 % in 2015.

In order to deliver the competitive regional gas market, Finland, Estonia, Latvia and Lithuania, have been actively working on a single regional gas market with a single entry-exit zone. The preliminary goal is to have harmonised market rules and unified entry-exit tariffs by 2020, in line with the commissioning dates of the new infrastructure projects GIPL and Balticconnector as well as enhancements to Estonia–Latvia and Latvia–Lithuania and Inčukalns UGS. The regional TSOs, NRAs and related ministries have established working groups to work on the different harmonisation topics of the regional market.

.

2.5 Legal Framework Development

Natural gas markets and systems of the BEMIP region countries are regulated by their respective legal acts on natural gas and energy. All the countries of the BEMIP region have implemented Directive 2009/73/EC of the European Parliament of the Council of 13 July 2009 concerning common rules for the internal market in natural gas except Finland.

In accordance with Directive 2009/73/EC, Denmark, Sweden, Estonia, Latvia, Lithuania and Poland have deregulated their natural gas markets, including the unbundling of TSO from vertically integrated sales companies. The six countries (Denmark, Estonia, Latvia, Lithuania, Poland and Sweden) have implemented a number of EU network codes (e.g. balancing rules, interoperability, capacity booking and allocation methodology for transmission capacity) and are working on implementing the codes that have recently came into force.

The directive also allows deviations from the regulations concerning the deregulation of the natural gas market for countries with only one principal supplier of natural gas. Finland has used this exemption so far, but has taking actions to deregulate their natural gas markets and systems. In Finland, a new Natural Gas Market Act is expected to enter into force in the first part of 2018. The new act will introduce structural changes to the gas market even in cases where Finland continues to use the exemption of the directive, but at the same time the proposed structural changes remain compatible with the requirements of the directive in case the exemption is not used anymore. At the beginning of 2016, the Latvian Parliament adopted amendments to the Energy Law, providing for full ownership unbundling of the vertically integrated JSC "Latvijas Gaze", which resulted in the establishment of two sister companies by spinning-off gas transmission and storage business areas in accordance with the provisions of Gas Directive 2009/73/EC by the end of 2017. As of 3 April 2017, the gas market in Latvia is officially opened.

In the BEMIP region, there are plans for setting up regional gas markets and balancing zones. For example, Denmark and Sweden are working on a joint balancing model and the Baltic countries, together with Finland, are planning on setting up a regional gas market with a single entry-exit zone. If these plans materialise, it is expected that national laws will have to be changed in order to comply with harmonised market rules and tariffs in the region.

Furthermore, Finland, Estonia, Latvia, Lithuania are composing joint plans in accordance with the Regulation (EU) No 994/2010 of the European Parliament and of the Council of 20 October 2010 concerning measures to safeguard security of gas supply and repealing Council Directive 2004/67/EC. In 2012, Estonia, Latvia and Lithuania carried out a joint risk assessment (JRA) of security of gas supply. JRA was prepared by Focus Group on Regional Cooperation composed of representatives of the Competent Authorities, the national regulatory authorities and transmission system operators of the countries and the European Commission.

In 2016, EC JRC completed an updated version of the JRA and work is being done on Joint Preventive Action Plans (JPAP) and Joint Emergency Plans (JEP). Also, in 2013 representatives of the Republic of Finland joined the Focus Group on Regional Cooperation. As after construction of Balticconnector, Finland will be part of the joint gas supply system and it was agreed by the members of the group that Finland should be included in JPAP.

2.6 Offgrid Market Development in the Area of LNG and Biogas

Offgrid market development in the area of LNG and biogas in the BEMIP region is rather active in Finland, Sweden and Poland, which is most probably caused by new market opportunities brought by LNG and the limited geographical coverage of natural gas transmission system.

The offgrid development is partly realised by a local biogas plants that provides biogas to the adjacent gas user which may be industry, heating, gas filling station or CHP unit. Also local distribution networks can be formed around the biogas production like a satellite network. Furthermore, offgrid solutions are often served as by using pressurised containers or LNG, especially in Sweden this solution of pressurised containers called "flak" is rather widely used.Another development evolves LNG terminals (including those not connected to the main gas infrastructure) which may supply also gas consumers by a local distribution grid or serve another offgrid location by truck transportation. These LNG terminals are often also used for LNG fuelled ship bunkering purposes. Market interest for this kind of services is visible for instance in Poland where the number of LNG cisterns loaded at the terminal in Świnoujście increased rapidly after putting the facility into commercial operations.

A growing demand for LNG in Poland and other countries in the region together with legal framework promoting sustainable fuels in the transport sector cause that a number of different options are currently under consideration to increase regasification capacity and to offer new LNG services at the terminal in Świnoujście. These services include rail-loading, bunkering, reloading to smaller vessels and the development of LNG refuelling stations. LNG reloading onto smaller vessels may also be provided at the FSRU terminal that is planned for implementation in the Bay of Gdańsk.

The offgrid development has been going on in Sweden for a long time and also rather good progress has also been made in Finland. In Sweden and Finland, there are several biogas production plants that are not connected to the grid. Some similar development takes place in other countries in the region as well, but as noted earlier, the geographical coverage of gas transmission and distribution systems limits the need of offgrid development. As an example, Sweden and Finland is analysed in more detail in the following.

In Sweden, the total amount of produced biogas was about 1.95 TWh in 2015 whereas in Finland it was 0.7 TWh in 2014. In Sweden, the amount of biogas injected into the gas transmission or distribution grid was about 500 GWh in 2015 (ten biogas plants), which means that majority of biogas in Sweden is used in offgrid applications. In Finland, grid injection in 2014 was about 100 GWh (four biogas plants) indicating similar development as in Sweden. The largest biogas consumer in Sweden was automotive transport at about 60 % while in Finland it was heating with a share of about 60 %. There are 282 biogas plants in Sweden (in 2015) and there were 43 in Finland in 2014. In Sweden, a political goal is to increase biogas production to 15 TWh/a by 2030 while, in Finland, biogas production is estimated to reach 2 TWh/a by 2030. In order to reach these targets, a remarkable degree of offgrid development will be required.

In Denmark, the greatest increase in biogas production was witnessed in 2016. The final numbers for 2016 are expected to exceed 2,500 GWh 2/3 of which have been offgrid applications (local CHP units etc.), while 1/3 was upgraded to biomethane and injected into the natural gas network. In Denmark, the trend is towards upgrading and injection of biogas into the gas system.

In Sweden, the development of offgrid LNG terminals has also been developed further than in other countries with Finland in second place. In Sweden, the Lysekil (30,000 m³) and Nynäshamn (20,000 m³) LNG import terminals have been in operation already for longer time, in Finland the Pori terminal (30,000 m³) was commissioned in autumn 2016 and another offgrid terminal in Tornio (50,000 m³) will be commissioned in 2018. In Sweden, there is also a plan to build one LNG terminal in Gothenburg (connected to the transmission grid) and one offgrid LNG terminal in Gävle. The logistical solution for the offgrid LNG terminals consists of LNG supply vessels and distribution of LNG by trucks to customer terminals. Offgrid LNG consumption in Sweden has grown rapidly in recent years.

In Latvia at the moment there are no established offgrid LNG terminals. In the field of biogas production, Latvia currently has 54 biogas plants, seven of which are waste landfills, one is domestic waste water, two are food waste and waste water and 44 are agricultural biogas plants. The total amount of biogas generated was about 192 million m³ in 2015. Biogas is mainly used to generate electricity or for cogeneration plants (electricity and heat). The total installed electric capacity is 60 MW. In 2015, the total amount of electric energy generated was about 392 GWh (in 2014 – 334 GWh). Biogas production equipment is working at an average capacity of 80 %.

Image courtesy of Gasum

2.7 Other Influencing Market Factors

The gas markets in the Baltic region and in Central-Eastern Europe are mostly supplied with gas from the Eastern direction by means of three major transmission corridors that run through Ukraine, Belarus and the Baltic Sea. In addition, the Baltic states and Finland can import Russian gas through several smaller transmission corridors. In total, the technical capacity of cross-border interconnection points from Russia to the EU Member States amounts to approx. 267 bcm/y.

The volume of Gazprom supplies to the European countries (including Turkey) was historically at a level of 140–150 bcm/y. Even in 2016 when the level reached 167 bcm, the infrastructure to export Russian gas was used globally at about 67 % capacity. Thus there was still approx. 100 bcm/y of reserve technical capacity. This shows that existing technical capacities currently far exceed the volumes of gas delivered from Russia.

In this context, plans to put an additional 55 bcm/y capacity into operation as part of Nord Stream 2 project will have a number of negative implications for the gas markets in the Baltic Sea region and in Central-Eastern Europe. The project may well endanger the security of gas supply and, for instance, introduce competition by redirecting gas flows from the existing corridors and concentrating the bulk of supplies in a single one. This is likely to increase the cost of gas transportation in the region and translate into higher gas prices for the gas customers in local markets.

In addition, Nord Stream 2 may well result in even higher dependency on Russian gas in the European gas market. This will negatively affect assumptions, parameters and cost-effectiveness, and thus the possibility of implementation, of infrastructure investments planned by TSOs and other project promoters. In line with EU energy policy objectives these projects, especially in the Baltic Sea region, aim to diversify gas supply sources, foster competition and better integrate individual markets. What is important from the perspective of the market players, the planned projects are generally implemented according to European aquis and the Third Energy Package in particular, so interested shippers may fully access infrastructures in a transparent manner and benefit from these new developments.

The Kaliningrad region is located within the region and thus has an impact on gas supply. In the Kaliningrad region, the yearly demand for natural gas is 22–23 TWh. The gas to the region is supplied via Belarus and Lithuania by Gazprom. In 2013, the first phase of the project of the Kaliningrad underground gas storage facility (UGS) was commissioned. The capacity of the UGS might be increased in the future, since it provides a possibility of overcoming fluctuations in gas demand, reducing peak loads and providing flexibility and reliability of gas supply in the Kaliningrad region. By the end of 2017, it is planned to complete the LNG project involving FSRU.

.

Image courtesy of Gasum

3 National Market Development

Image courtesy of GAZ-SYSTEM

3.1 Denmark

3.1.1 ENERGY POLICY

The Danish government has a long-term objective that Denmark is to become independent of fossil fuels by the year 2050 and that while pursuing this objective Denmark must continue to be one of the leading countries in the green transition.

The basis for this is a broad parliamentarian agreement (2012–2020) focusing on increased energy efficiency, more renewable energy, smart grid strategy, better framework for biogas and electricity/biomass in the transport sector.

Recently the Danish government has established an Energy Commission that will analyse and assess trends in the energy sector and make recommendations for a cost-effective Danish energy policy for the period 2020–2030. The Energy Commission is expected to publish recommendations for the Danish energy policy in 2017.

The national energy policy is also reflecting the commitments to the international climate agreements and the EU targets. International cooperation is seen as vital for handing the climate issue and ensuring a more cost effective energy transition.

More recently, Denmark has taken initiative to host the annual EU Energy Infrastructure Forum that is facilitating the development of the European gas and electricity infrastructure that is in need of significant developments estimated to 200 billion euros towards 2020.

The current energy policy has on the one hand resulted in increasing production of biogas, but on the other hand, it has also resulted in reduced consumption of natural gas. This is due to increased energy efficiency and increased use of tax exempted biomass for CHP. The current government has no coherent strategy for the use of natural gas in the transport sector.

3.1.2 MARKET PLAYERS

Owners of the physical infrastructure include:

- **Energinet.dk** is the gas transmission company in Denmark that owns and operates the natural gas transmission system. Energinet.dk ensures the large gas pipelines to be available on equal term to all who want to transport gas in Denmark. The capacity is sold through PRISMA at competitive transmission tariffs.
- **HMN Naturgas, Nature Energy Distribution, Gasforsyningen Aalborg and Danish Gas Distribution** (owned by Energinet.dk). They own and operate the distribution system, which is divided into six distributions areas.
- **Energinet.dk Gas Storage** owns and operates the two gas storage facilities in Denmark, one at Stenlille on Zealand, and one at Lille Torup in Northern Jutland. Energinet.dk Gas Storage offers flexible and custom-made storage products.

There is a consolidation-taking place in the Danish gas market. In 2014, Energinet.dk acquired the gas storage facility (Stenlille) from DONG Energy and created one company, Energinet.dk Gas Storage that owns and operates the two gas storage facilities in Denmark. In autumn 2016, Energinet.dk took over the ownership of DONG Gas Distribution and renamed the company “Danish Gas Distribution” (Dansk Gasdistribution).

Moreover, the Danish Ministry of Finance has stated that Energinet.dk also must buy the DONG offshore gas pipeline from the North Sea Platforms to Jutland (and the corresponding oil pipeline in the North Sea). There is a still ongoing negotiation taking place.

There are around 25 registered transport shippers in the Danish transmission system including companies with primary business interest in the adjacent Swedish gas system. Approximately, 20 supply companies offer gas on competitive terms to smaller consumers with additional specialised suppliers catering to large-scale industrial users.

Gas is traded bilaterally on Gas Transfer Facility (GTF) and multilaterally on the gas exchange, Gaspoint Nordic (GPN). In 2016 the traded volume on GPN corresponded to 68 % of the Danish gas consumption.

Energinet.dk is working on ensuring the Danish (and Swedish) market as well connected to the European market. The Danish gas market provides many options, among others efficient transport of gas in and out of Germany and Sweden, customer-oriented gas storage and a gas exchange offering secure and transparent trading.

3.1.3 ENERGY MIX

Figure 3.1 shows the distribution on sources of the energy consumption in Denmark. The energy mix is dominated by coal, oil and natural gas. Renewable energy amounts to 29 % of the energy consumption in 2015.

Figure 3.2 shows the subdivision of gas demand into sectors: households, power and heat and other industry and transportation. Both historic and a projection for the future is shown.

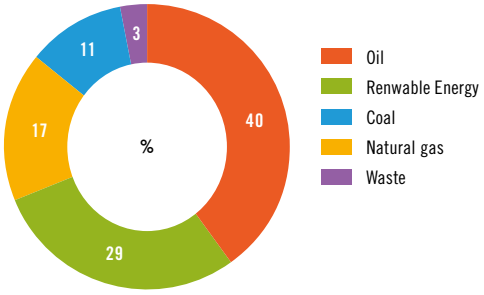


Figure 3.1: Distribution on sources of total energy consumption in Denmark, 2015

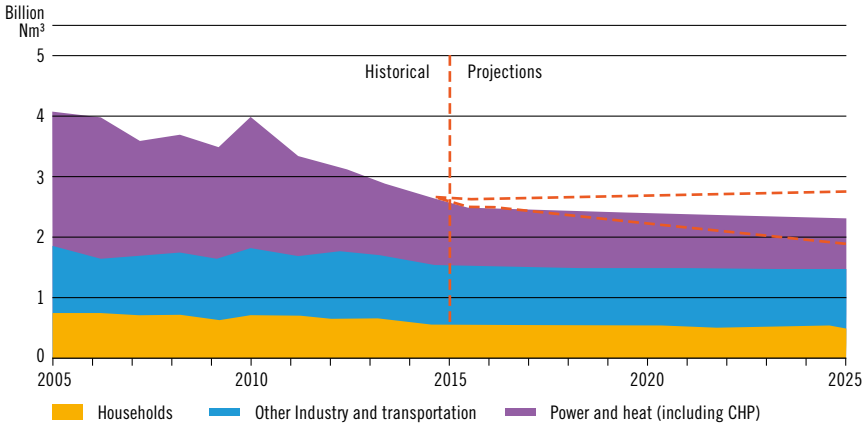


Figure 3.2: Development of overall gas consumption 2005–2025 subdivided into consumption sectors

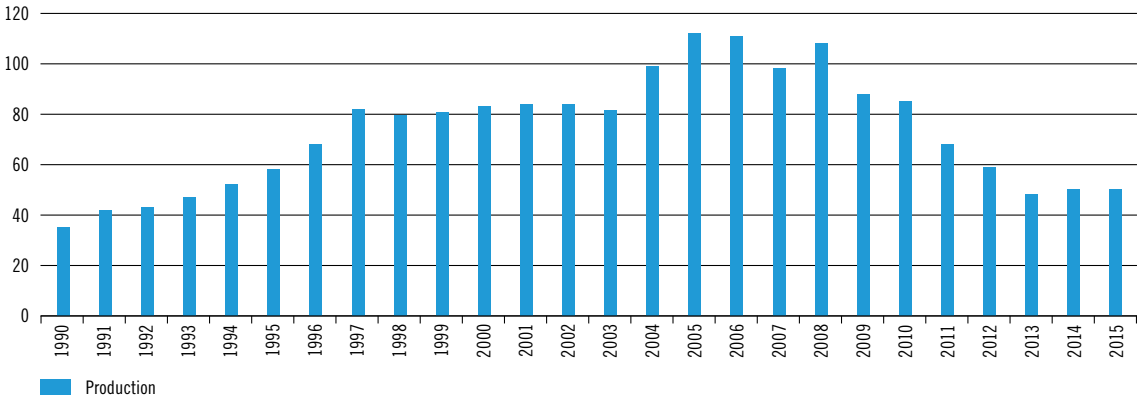


Figure 3.3: Danish production of natural gas since 1990. Numbers in TWh/year.

Figure 3.3 displays the Danish natural gas production from the North Sea since 1990. It follows that the production has declined significantly since 2008, where the production was about 110 TWh/y to about 50 TWh/y in 2015.

Danish gas from the North Sea flows mainly via pipes to Denmark, where it covers Danish consumption (see figure 3.1). Part of the gas is transited through Denmark to Sweden and gas is also exchanged with Germany across the Danish-German border. This exchange can be a net-export (2010–12, 2014) or a net-import (2013). From the North Sea some of the Danish gas is transported directly to the Netherlands (figure 3.4).

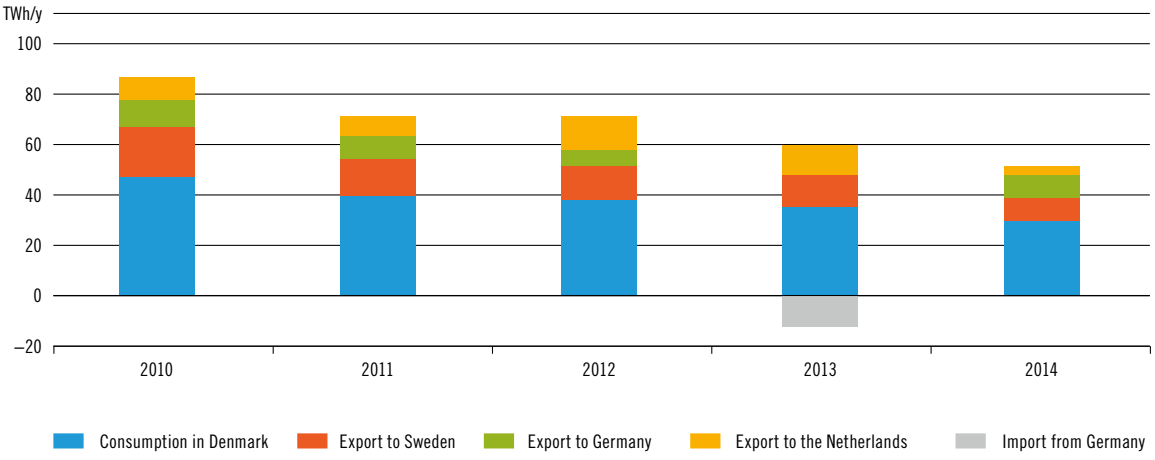


Figure 3.4: Distribution of net-production from the North Sea, 2010–2014.

3.1.4 MARKET INDICATORS, SUPPLY AND DEMAND

Gaspoint Nordic (the Danish Gas Exchange) was established in 2007. After some years with limited liquidity, the traded volume has increased significantly, and the exchange is regarded among the shippers to be a reliable trading platform with sufficient gas to supply the market.

Currently, the price of the day- ahead product at Gaspoint Nordic follows closely the price development at the gas exchanges GASPOOL and NCG in Germany. However, at Gaspoint Nordic, it is only possible to trade short-term products, and the future market is missing.

There have been two major market changes helping to boost the liquidity at Gaspoint Nordic. In October 2014, Energinet.dk introduced a new balancing model, which is in line with the European Balancing Network Code. With this change, the shippers became responsible for balancing their deliveries and offtakes when trading at e. g. Gaspoint Nordic. Moreover, Energinet.dk trades at Gaspoint Nordic in case of commercial imbalance. This has helped to boost liquidity.

In addition, the capacity between Denmark and Germany has been expanded stepwise. This has removed the bottleneck at Ellund (border point to Germany). Today, large amounts of gas enter the Danish gas market – either from the North Sea or from Germany. So, there is enough gas to ensure a well-defined liquid market price.

In July 2016, Energinet.dk signed an agreement to sell its 50 % shareholding in Gaspoint Nordic, making the company a full member of EEX Group. Following this change in ownership, the Danish natural gas products currently traded at Gaspoint Nordic will be opened on the PEGAS platform, which is a platform covering most of the European gas exchanges. It is expected that this change will open for an accelerated market development and an extended product offering.

3.1.4.1 Supply and demand

Currently, the Danish gas-market is well supplied with gas from the North Sea and import of gas from Germany. Even biogas is now being supplied directly into the Danish gas transmission system. Historically, most of the biogas has entered the system at distribution level and consumed locally.

In the coming years, the balance is expected to become tighter.

Figure 3.5 shows the forecast of the Danish gas production until 2037. It follows that the decline will continue in the years ahead.

In April 2016 Maersk Oil, the co-owner of the largest production platform (Tyra) in the Danish part of the North Sea, has (on behalf of the consortium DUC) announced that it was considering closing down Tyra. This would cut off by far the majority of the gas which currently is retrieved from the Danish part of the North Sea and further reduce the supply in comparison to the forecast in figure 3.5. However, recently (start of 2017) it has been decided that Tyra will only be temporarily closed (2018–20) due to technical restructuring of the platform. The production will be resumed by 2021.

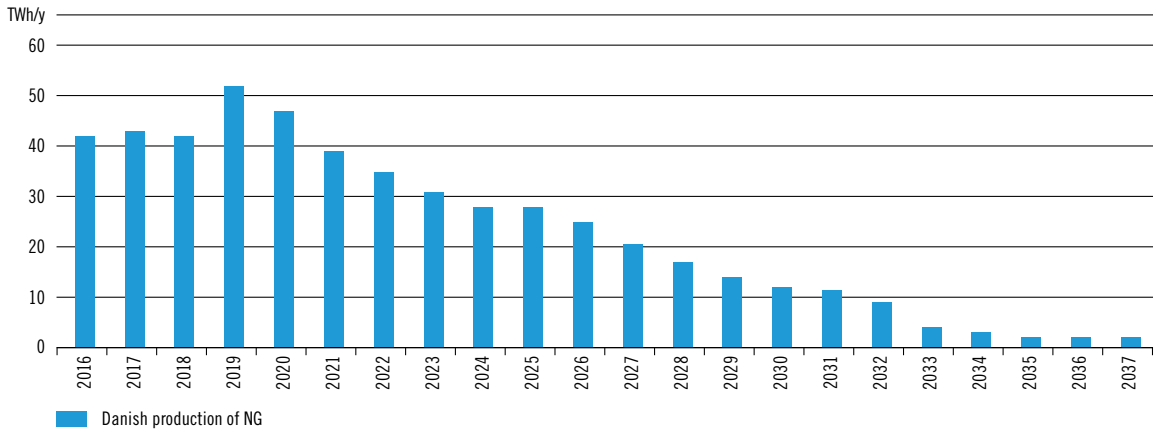


Figure 3.5: Forecast of future Danish gas production from the North Sea

The Danish gas system was originally designed to have one primary source, the North Sea. Since then, pipelines to Germany have been expanded, so that currently there are two large supply routes. When production in the North Sea declines, the Danish gas system will gradually return to a situation with one primary source of supply. For there to be supply problems, it will take an extremely hard and long winter, the likes of which has never been seen in the life of the Danish gas system. However, as supply is eventually reduced to a single large source (Germany), the system will be more vulnerable.

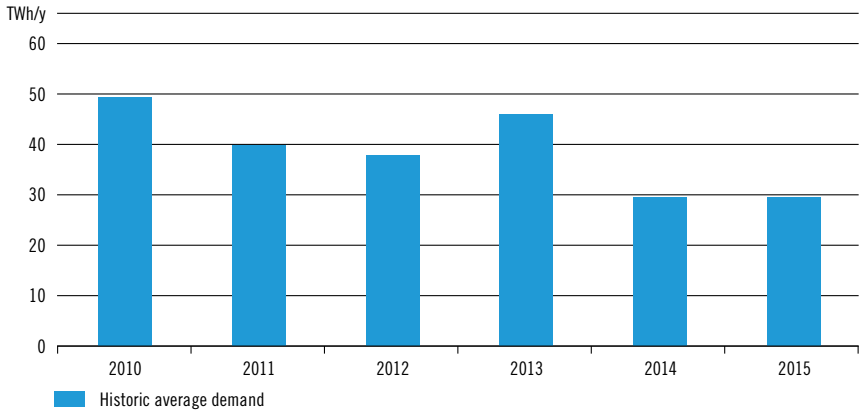


Figure 3.6: Historic demand in Denmark

The historic Danish demand is depicted in figure 3.6. The demand has decreased since 2010 from about 50 to 30 TWh/y in 2015.

The future demand in the Green and Blue TYNDP scenarios is shown in figures 3.7 and 3.8 respectively.

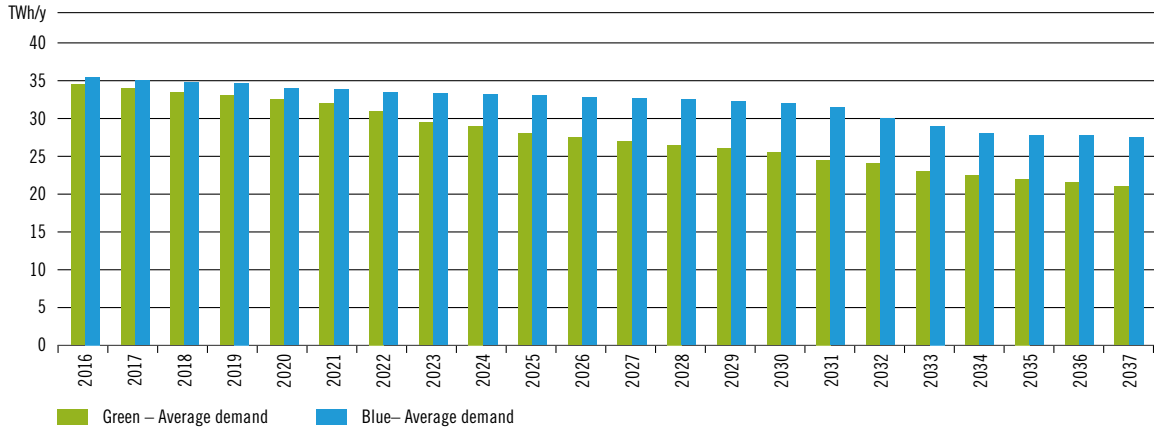


Figure 3.7: Future Danish gas demand in Green and Blue scenario (TWh/y)

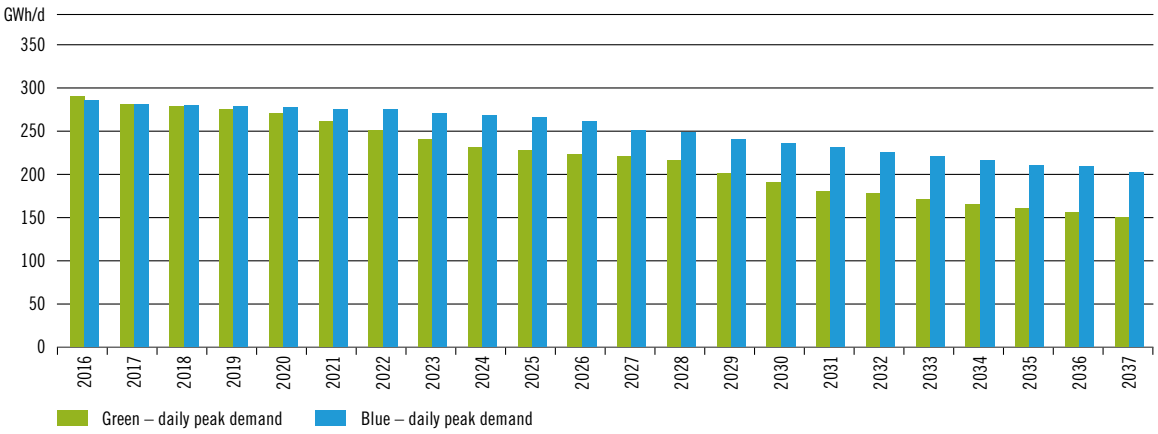


Figure 3.8: Future Danish daily peak gas demand in Green and Blue scenario (GWh/d)

3.1.5 LEGAL FRAMEWORK DEVELOPMENT

The function of the natural gas market is regulated by the Natural Gas Act, where the latest version is dated October 2011.

During the last couple of years, Energinet.dk has implemented different European network codes. The latest one to be implemented was the balancing network code in October 2015. As a next step, Energinet.dk and Swedegas (the Swedish TSO) together are working on a joint balancing model.

Currently, only one network code, the CMP (Congestion Management Principle) has not been implemented.

3.1.6 OFFGRID MARKET DEVELOPMENT IN THE AREA OF LNG AND BIOGAS

The trend in Denmark is to upgrade biogas to biomethane and inject it into the natural gas system.

While nearly all biogas produced in 2012 (1,200 GWh) was used offgrid for local electricity and heat production (local CHP) the biogas production in 2016 (about 2,500 GWh) was disposed with 1/3 being upgraded to biomethane and injected into the gas system.

Image courtesy of Sønderjysk Biogas Bevtoft A/S

3.2 Estonia

3.2.1 ENERGY POLICY

The current version of Estonian Energy Strategy was adopted in 2009. Since then, there have been a number of changes and trend shifts in the energy sector and a new strategy is being developed. The new strategy is presently in a draft status and is expected to be adopted during 2017. The main objective of the new Estonian Energy Strategy is to guarantee availability of affordable and environmentally sustainable fuels and energy. The objective is to be achieved by efficiently working fuel and power markets. The strategy foresees 45 % of energy demand satisfied by renewable energy and 70 % reduction in CO_2 emissions by 2030. In gas sector by 2030, the largest supply source shall not have over 70 % market share, largest supply company shall not have over 32 % market share and the gas market concentration shall be lower than 2000 measured in HHI[1)].

In gas sector, the security of supply, supply source diversification and affordable prices are expected to be delivered by open and competitive regional gas market. For this reason Estonia is abandoning the derogation granted in Directive 2009/73/EU and is opening the gas market. Abandoning the derogation is in final steps and Estonia has already gone through TSO unbundling from the vertically integrated gas supplier in 2015. The gas market opening has already shown results, as the number of gas suppliers has increased promptly and gas is entering Estonia from new sources.

Although gas presently plays a minor role (about 7 % of gross energy demand) in the Estonian energy mix, a role for gas is nonetheless foreseen in the future. An increase in gas demand is expected from the transport sector, due to competitive fuel prices, maritime fuel requirements and EU renewable energy goals. In order to meet the tougher emission requirements in maritime transport, LNG will likely increase its share as a fuel. To meet the EU goal of 10 % renewable fuels in transport, biomethane is expected to play an important role for Estonia. Decrease of natural gas demand in previous years has been caused by national focus on renewable energy and energy efficiency. With funding from national support mechanisms, many district heating networks have switched fuels from gas to biofuels. The national support is given in the form of feed-in premiums for renewable electricity production from CHPs and in the form of investment grants for biofuel boilers. Further, constant efforts on increasing energy efficiency have reduced the total district heating demand.

1) HHI – Herfindahl-Hirschman index

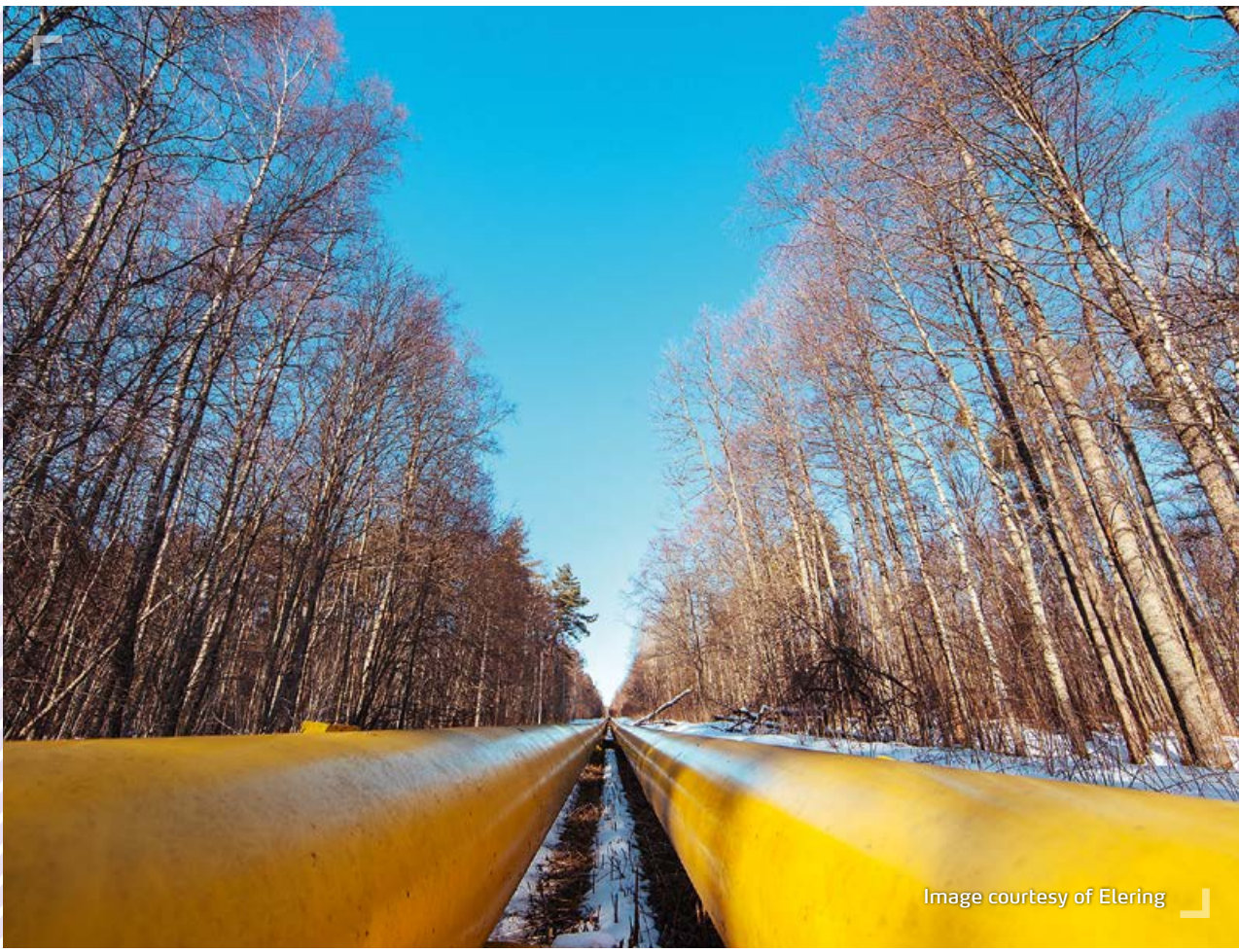


Image courtesy of Elering

3.2.2 MARKET PLAYERS

Elering AS is the Estonian gas Transmission System Operator (TSO). The gas transmission system was unbundled from sales company in 2015 and since then Elering has the system responsibility and other TSO duties.

Since the unbundling of TSO, the number of gas sales companies has increased rapidly. Presently there are six Balance Responsible Parties with a balance agreement with Elering:

- Baltic Energy Partners OÜ
- Scener OÜ
- Eesti Energia AS
- Alexela Energia AS
- Eesti Gaas AS
- Electrum Eesti OÜ

An important development since beginning of 2015 is gas imported from Lithuania. About 20 % of all gas consumption in 2015 was imported from Lithuania, through Latvia, which is a major shift from 100 % Russian imports in the previous years.

There are two ongoing LNG terminal development projects in Estonia, which are included in the 2nd PCI list. The projects are Paldiski and Tallinn LNG terminals, which are promoted by Balti Gaas OÜ and Vopak E.O.S. AS, respectively.

There are over twenty distribution grid companies operating in Estonia. The largest of the distribution companies is AS Gaasivõrgud.

3.2.3 ENERGY MIX

The energy mix of Estonia can be seen in the figure below:

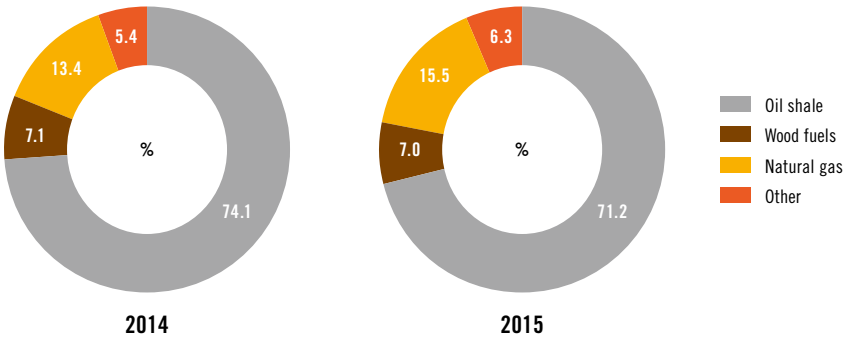


Figure 3.9: Supply of primary energy by energy sources in Estonia. In 2013 and 2014 the total supply of primary energy were 69,992 GWh/year and 69,447 GWh/year, respectively (Source: Statistics Estonia).

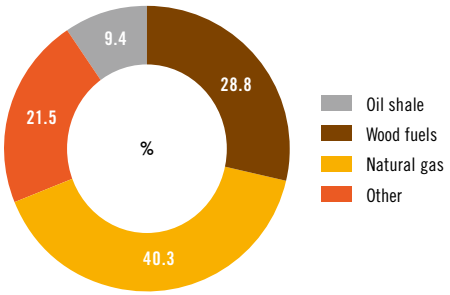


Figure 3.10: Energy sources for heat production (Source: Statistics Estonia)

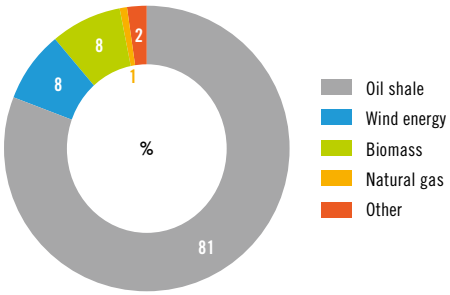


Figure 3.11: Energy sources for electricity production (Source: Elering)

The most used energy sources in Estonia (oil shale and wood fuels) are local energy sources. Natural gas, even though having a small share in the energy mix, has always been an important energy source in the energy mix, mainly contributing to heating sector.

Figures 3.10 and 3.11 show primary energy sources used for heat production in 2015 (Source: Statistics Estonia) and electricity production by fuel sources in 2015 (Source: Elering). The total supply of primary energy in 2014 for heat production was 10,319 GWh/year. The total production of electricity in 2015 was 9,062 GWh/year.

3.2.4 MARKET INDICATORS, SUPPLY AND DEMAND

Natural gas to Estonia is supplied from Russia and/or through Latvia from Lithuania. In 2014, all of the natural gas was imported from Russia. In 2015, after the completion of Klaipėda LNG terminal, 20.3 % of imported natural gas was imported from Lithuania.

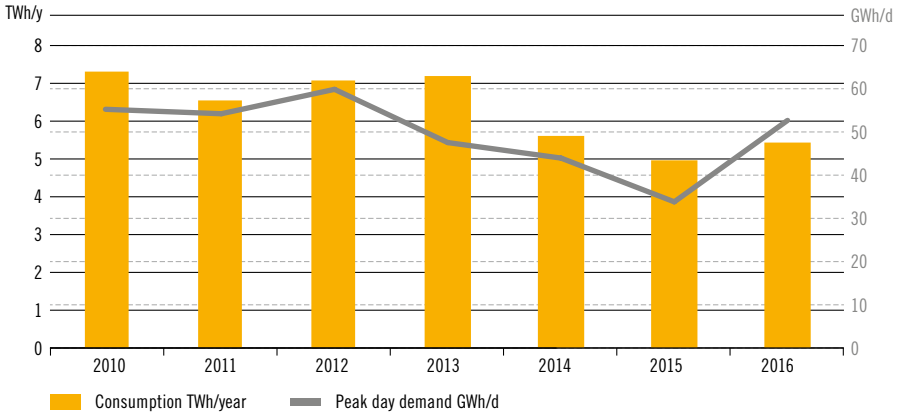


Figure 3.13: Historical natural gas consumption and peak day demand in Estonia during 2010–2016 (Source: Elering)

Natural gas consumption in Estonia has been in a declining trend. Over the last ten years natural gas consumption has decreased by more than half (Figure 3.13). There are many factors behind the decline in Estonia:

- Decreased consumption by industrial users. A number of major natural gas users have stopped using natural gas or stopped their production operations.
- Decreased use in heat production. There is a trend in district heating to switch from natural gas to renewable energy sources.
- Increased energy efficiency. Due to increased energy efficiency, both households and industrial users require less energy.
- Natural gas is considered as a politically problematic energy carrier due to single supply source.

Peak-day gas demand has been significantly lower during the last few years as well, which is more connected to the warmer winters in the last few years. This is further confirmed by the colder 2016 January month, when gas demand reached 52.7 GWh/d.

As seen from the figure below today more than half of the natural gas consumed in Estonia is used in the energy sector (mainly for district heating purposes). Other larger users of the natural gas are the industry, households, businesses and public service sector.

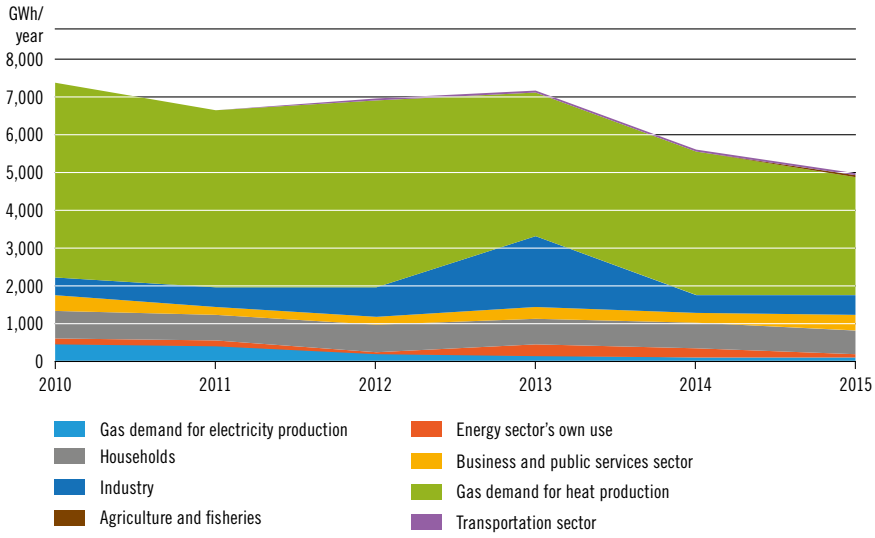


Figure 3.14: Historical natural gas consumption by market sectors during the period 2010–2015 (Source: Statistics Estonia)

For the next ten years, it is foreseen that the gas demand will more or less stabilise at the current level. A slight decrease is expected from the fuel switch in the district heating sector, which in turn is compensated slightly by the expected gas demand increase in the transportation sector.

The total forecasted demand and the forecasted peak-day demand for the different ENTSOG TYNDP scenarios are provided in table 3.1 below.

YEARLY GAS DEMAND AND PEAK-DAY DEMAND FORECAST FOR THE PERIOD OF 2017–2025

		2017	2018	2019	2020	2021	2022	2023	2024	2025
BLUE SCENARIO	YEARLY GAS DEMAND [GWh/year]	5,660	5,730	5,801	5,873	5,936	5,915	5,895	5,877	5,860
	PEAK-DAY DEMAND [GWh/day]	52.8	52.8	52.9	52.9	53.0	53.0	53.1	53.1	53.2
GREEN SCENARIO	YEARLY GAS DEMAND [GWh/year]	5,157	4,992	4,838	4,695	4,554	4,363	4,181	4,008	3,843
	PEAK-DAY DEMAND [GWh/day]	50.3	48.1	45.9	43.8	41.9	40.0	38.2	36.5	34.8

Table 3.1: Yearly gas demand and peak-day demand forecast for the period of 2017–2025 (Source: Elering)


Image courtesy of Elering

3.2.5 LEGAL FRAMEWORK

The Estonian natural gas market and system are regulated by the Natural Gas Act. The Act is in force since 2003 and latest version is in force from January 2016. The Natural Gas Act governs the activities related to the import, transmission, distribution and sale of natural gas by way of gas networks, and connection to networks. The Act has implemented Directive 2009/73/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in natural gas. The directive gives Estonia the option to deviate from the regulations concerning the deregulation of the natural gas market as long as the country has only one principal supplier of natural gas.

Regardless of the exemption, Estonia has deregulated the natural gas market, and the TSO has been unbundled from the vertically integrated sales company. Estonia is working on implementing all EU legislation, including network codes as they come into force. Latest developments are the standard balancing rules for market participants and capacity booking and allocation methodology for transmission capacity.

Estonia, together with Latvia, Lithuania and Finland, is working on the establishment of a regional gas market. The vision is to have a regional gas market with a single entry-exit zone and the accompanying harmonised market rules and tariffs. The regional gas market and single entry-exit zone vision will also be reflected in the next versions of national legislation.

3.2.6 OFFGRID MARKET DEVELOPMENT IN THE AREA OF LNG AND BIOGAS

3.2.6.1 Biomethane

According to the Renewable Energy Directive 2009/28/EU, by the year 2020 the share of renewable energy used in the transportation sector must be 10 % from the total amount of liquid fuels used in the transportation sector. The amount of transportation fuels consumed today in Estonia is approximately 8.5 TWh/year of which 67 % is diesel fuel and 33 % is gasoline fuel. The share of electricity, LPG, CNG, and biofuels in the transportation sector has been marginal so far. Estonia has set a goal to develop biomethane production, which uses local resources, and to start widely using biomethane in the transportation sector.

The total biomethane potential in Estonia is estimated to be 4.7 TWh/year (483 mcm/year). The main resources for the production of biomethane would be biomass from grasslands (83 %) and agricultural production residues (9.8%).

In order to realise biomethane's potential, a number of measures have been introduced. The government has introduced a measure that provides financial support to filling station projects that include biomethane and natural gas filling possibilities. In addition, gas quality requirements have been defined that allow the injection of biomethane into the transmission grid. Elering is also developing a green gas certificate system. The certificates can be issued for biomethane that is produced and injected into the gas network, but also for biomethane that is produced offgrid.

Presently there is no biomethane production or injection into the grid, but several projects are under development.

3.2.6.2 LNG

Offgrid LNG market is slowly developing in Estonia. In recent years a small number of companies with high energy demand have switched to small-scale LNG solutions. The companies switching to LNG are usually located in remote places to where the natural gas grid does not reach. The reason for switching to LNG is that other fossil fuel prices (e. g. diesel) are more expensive and environmentally more damaging. In addition, some companies require heat energy with specific properties that are not possible or feasible to produce from biomass. Offgrid LNG is imported from Russian or Poland's natural gas liquefaction facilities and from larger nearby LNG terminals (located in Sweden, Finland and Lithuania).

Starting in January 2017, a LNG-fuelled fast ferry is operating on Tallinn–Helsinki route. The ferry is owned and operated by Estonian ship company Tallink. The ferry – *Megastar* – is first of its kind in the region and can take 2,800 passengers onboard. The total volume of LNG tanks is 600 cubic meters.

3.3 Finland

3.3.1 ENERGY POLICY

The previous version of the national energy and climate strategy from 2013 was revised in 2016 by a ministerial working group on energy and climate policy, appointed by the government of Finland.

The National Energy and Climate Strategy outlines the actions that will enable Finland to attain the targets specified in the Government Programme and adopted in the EU for 2030, and to systematically set the course for achieving an 80–95 % reduction in greenhouse gas emissions by 2050. With minor exceptions, Finland will phase out the use of coal for energy. The share of transport biofuels will be increased to 30 %, and an obligation to blend light fuel oil used in machinery and heating with 10 % of bioliquids will be introduced. The minimum aim is to have 250,000 electric and 50,000 gas-powered vehicles on the roads. The share of renewable energy in the end consumption will increase to approx. 50 % and the self-sufficiency in energy to 55 %. The domestic use of imported oil will be halved as planned.

The main objectives of the strategy update include ensuring that the national targets in the long-term energy and climate objectives set by the EU are achieved. The main national targets of the strategy are to identify how over 50% share of renewable energy during 2020s is achieved at the same time when use of coal will be abandoned by 2030 and the use of imported oil products will be cut in half from the current level by the end of 2020s compared to the level in 2005. Coal might be used for energy back-up purposes but no new coal-fired power plants will be built. Biogas is mentioned specifically in the strategy and the production and use of biogas will be supported by the state. Additionally, the share of renewable fuels in transportation will be increased in order to reduce greenhouse gas emissions from traffic. Furthermore, the government of Finland established in 2015 a series of spearhead projects in several areas of society in order to enhance the competitiveness of Finland and to achieve the general political objectives. One of the spearhead projects is called: “Towards carbon neutral, clean and renewable energy in a cost effective manner”. During recent years the taxation of fuels has also changed remarkably, the taxation is based on two components: energy content based component and CO_2-emission based component.

The National Energy and Climate Strategy mentions that Balticconnector pipeline construction between Finland and Estonia enables the opening and renewal of gas markets in Finland. This means that the derogation from gas directive will be abandoned and gas markets will be fully opened to competition from 2020 onwards. Price regulation of pipeline gas will also be abandoned and a virtual trading point will be established. The target is to create regional gas markets consisting of Finland and the Baltic states. Transmissions system operations will be unbundled from the gas sales part of the company.

Regarding the role of natural gas, the strategy targets means that the market share for natural gas will remain, albeit lower than before. Especially the taxation of natural gas for heat production and combined heat and power production has increased 6–8-fold during past five years, while natural gas used in industry is still untaxed. This together with very low electricity prices has caused the use of natural gas in heating and CHP-segments to decrease about 40 % during past 5 years. This development has also raised the question how to preserve the electricity generating capacity in Finland while most of the natural gas based CHP plans are at standstill.

The strategy and energy policy have thus far generated some possibilities for natural gas in Finland. Renewable energy targets together with the lack of tax-burden creates possibilities for sustainable biogas production and market development, which has actually boosted the development of biogas sector in Finland in grid-connected and offgrid applications. In addition to political incentives to biogas production and market development, Finland has also allocated some investment subsidies.

The energy policy supports the development of gas as transportation fuel. A network of gas-filling stations, both in form of compressed gas and LNG (Liquefied Natural Gas) is gradually expanding for on-grid and offgrid locations. Both biogas and natural gas are sold in these filling stations and the tendency towards biogas is increasing constantly. The energy policy supports also the development of LNG-infrastructure, which is enabling the replacement of other fossil fuels in offgrid locations and marine segment. Terminals would enable transport of natural gas to locations outside the natural gas pipeline network, thereby increasing the diversity and reliability of energy supply, while helping to reduce emissions, particularly in the industrial sector where other fossil fuels are used.

In 2008, the International Maritime Organisation agreed on a revised version of the so-called MARPOL Annex VI, which sets the limits on sulphur oxide (SO_x) and nitrogen oxide (NO_x) emissions from ship exhausts. In 2012, the EU adopted a directive that requires the sulphur content in the fuel of vessels plying the Baltic Sea, North Sea and English Channel to be reduced to 0.1 % in 2015. Also, the IMO's Tier III environment protection rules for NO_x reduction in defined Emission Control Areas (ECAs), will apply to ships keeled after January 2016. In order to meet the new environmental requirements, which apply to the above-mentioned areas, emission reduction measures must be employed. Hence, the role of LNG as a marine fuel will be enhanced but major developments in LNG storage and bunkering terminals must be introduced. To encourage further development of LNG infrastructure, the Government of Finland has supported the construction of LNG terminal by investment grants.

In order to enhance the functioning of the gas market, competitive gas prices and security of supply, a proposal of new Natural Gas Market Act has been prepared, which would implement the requirements of European harmonised gas market model either nationally with some exceptions or fully, if Finnish gas market would be connected to the European gas market. The new Natural Gas Market Act is expected to be issued to the parliament for approval in spring 2017. The current proposal targets to the gas market opening. The market opening depends on the existence of pipeline connection between Finland and Estonia and connecting the Baltic gas system to the rest of the European gas system by GIPL-project. The Balticconnector project, for which the final investment decision was made in autumn 2016 connects Finnish gas system to the Baltic States in 2020. The existence of the interconnector enables also the possibility to integrate Finnish gas market to the merged Baltic gas market, creation of which is under evaluation at the moment by the Regional Gas Market Coordination Group (RGMCG) where the ministry, regulator and TSOs' representatives of the Baltic countries and Finland are members.

3.3.2 MARKET PLAYERS

Gasum is the sole importer and wholesaler on the natural gas market in Finland. There are 23 local distribution companies in Finland. Less than 5% of the natural gas is supplied by the local distribution companies and the number of households using natural gas for heating is about 5,000 and for cooking about 21,000. The rest is supplied directly from the transmission system. Gasum is the only TSO in Finland and has been appointed system responsible of the Finnish natural gas system. Gasum is a vertically integrated company acting as a wholesaler of gas in addition to the TSO activities. Unbundling of Gasum will be performed when the right to derogate from it expires.

Baltic Connector Oy, a state owned company founded in 2015 to act as a promoter for the Balticconnector project is one player in natural gas market in Finland in the sense of infrastructure development projects.

In the LNG market, the major player is Skangas where majority of shares is owned by Gasum. Skangas operates in LNG market in the Baltic Sea and has LNG terminals in Norway, Sweden and Finland. Gasum together with Skangas participates also the Manga-consortium, which is constructing a LNG terminal in north of Finland in Tornio. The Manga-consortium includes SSAB, EPV Energia, Gasum and Outokumpu. Skangas and Manga have their LNG-terminal projects already in progress whereas the LNG-terminal project of Haminan Energia is still pre-FID phase. The Haminan Energia terminal would be located in the south coast of Finland, in the city of Hamina, and would be the only LNG-terminal in Finland having a grid connection.

The biogas market is more fragmented. The number of biogas producers is high and quite often a local small-scale solution to utilise waste as energy. Gasum is an owner and operator of four biogas production plants that are injecting upgraded biogas to the gas transmission grid. Haminan Energia owns and operates one biogas plant, which is injecting upgraded biogas to the natural gas distribution grid. The injected biogas is upgraded to reach minimum of 95% methane content. The total number of biogas production plants in 2015 in Finland was 43 and biogas was utilised from 40 landfills. Some market consolidation has taken place recently, when Gasum acquired two biogas production companies and holds now total of 10 biogas production or upgrading plants.

Image courtesy of Gasum

3.3.3 ENERGY MIX

Finland has a rather diversified energy mix which can be seen from the graph below:

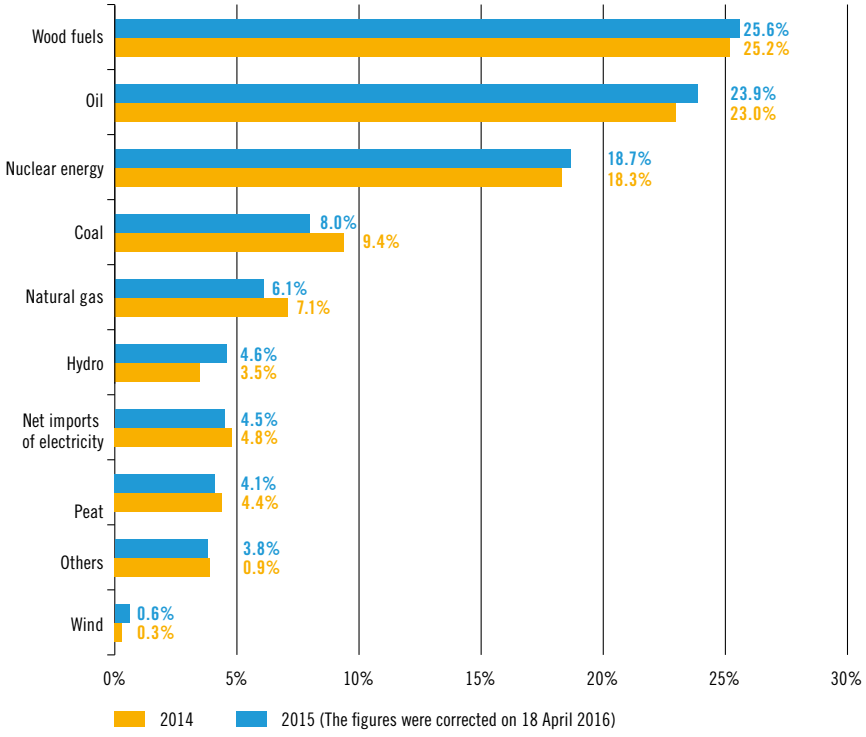


Figure 3.15: Total energy consumption by sources, 2015 (Source: Statistics Finland).

In 2015 natural gas accounted for about 20 % of the fuels used in the production of district heat and CHP production as shown in the figure 3.17 and about 6 % of the electricity production as shown in figure 3.16. On the scale of the whole country, natural gas accounts some 6 % of the use of primary energy.

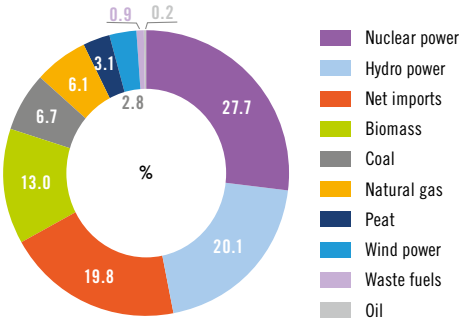


Figure 3.16: Electricity supply by energy sources 2015 (82.5 TWh) in Finland (Source: Energy Finland)

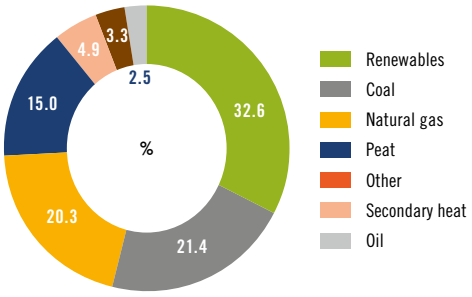


Figure 3.17: Fuel consumption in production of district heat and CHP in 2015 in Finland – fuel consumption 52.0 TWh (Source: Energy Finland)

3.3.4 MARKET INDICATORS, SUPPLY AND DEMAND

The natural gas supply in Finland is based mainly on import from Russia. Sufficient access to natural gas is ensured on the basis of a supply contract that is valid until 2030s. Increasing amount of biogas is produced and utilised in Finland and gradually starting from 2016, the supply of LNG will also increase.

The structure of the Finnish natural gas market differs from that of the common European market, where the supply of natural gas to private households and other small consumers plays an important role. In Finland, the vast majority of natural gas is supplied and consumed by major natural gas users, i.e. industrial enterprises, power plants and district heating plants. Local supply of natural gas accounts for less than 5 % of the total consumption.

In past years, natural gas has accounted for around 8–9 % of Finland's overall energy consumption but its market share has been decreasing. Natural gas has had a key role in the combined production of electricity and heat by industry and the power plants of communities. Within recent five years, due to the decreasing demand and low market price of electricity combined with higher taxes on natural gas, the share of gas in CHP and heat production has decreased about 40 % in past five years.

About 1/2 of all natural gas consumed in Finland is used in the co-generation of electricity and heat and the remaining part is used mainly in industries. Other important uses are the production district heat as well as various industrial processes and feed stock for chemical industry. Natural gas sales are affected by weather conditions, price development in the electricity and fuel markets, and industrial utilisation rate.

A clear reduction was seen in Finnish natural gas consumption in past five years, with the consumption levels also falling below the longer-term average. In 2015 a total of 26.0 TWh at net caloric value, equivalent to 28.9 TWh at gross caloric value of natural gas was consumed in Finland. The development of the gas consumption in Finland can be seen in the graph below:

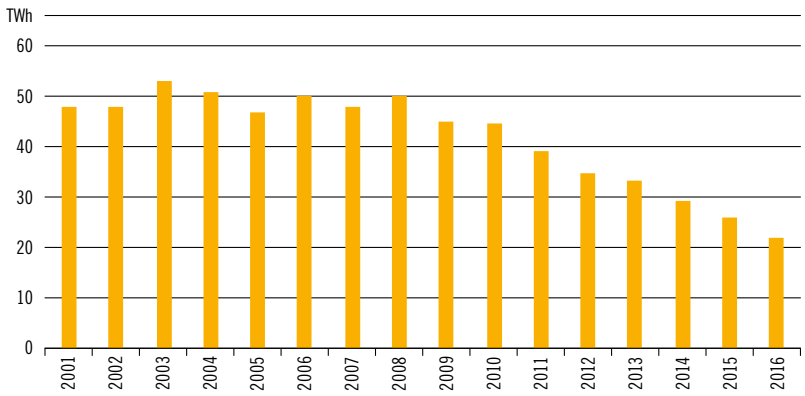


Figure 3.18: Development of natural gas consumption, TWh (at gross caloric value) (Source: Gasum)

A total of 20 % of district heat and CHP production and 6 % of electricity production in Finland were fuelled by natural gas in 2015. The use of natural gas in the combined heat and power (CHP) production has been for long term the largest sector using natural gas. In the future, the biggest use of natural gas seems to be industry sector. The current structure of the natural gas consumption can be seen in the graph below:

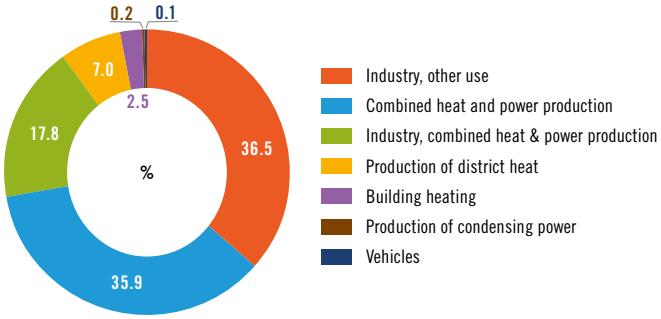


Figure 3.19: Natural gas consumption by market sectors, 2015 (Source: Suomen Kaasuyhdistys)

Gas used in the distribution in 2015 in Finland was about 22 GWh at net caloric value, equivalent to 24 GWh at gross caloric value and it was mainly used in manufacturing. The share of each category is shown below.

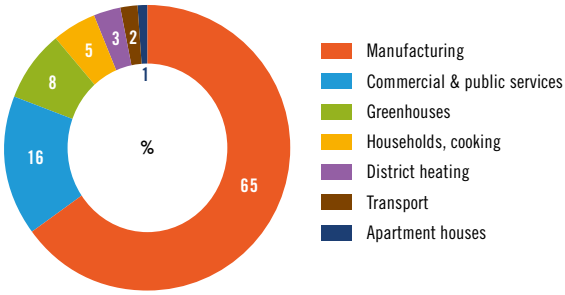


Figure 3.20: Natural gas consumption by market sectors in distribution, 2015 (Source: Suomen Kaasuyhdistys)

The forecast of gas transmission system related gas consumption is presented in the Table 3.2 below.

FORECASTS FOR NATIONAL DEMAND, FINLAND										
		2017	2018	2019	2020	2021	2022	2023	2024	2025
PEAK DEMAND										
mcm/day	LOW SCENARIO	12.4	12.2	10.6	10.3	10.3	10.1	10.1	10.1	9.8
	HIGH SCENARIO	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1
GWh/day	LOW SCENARIO	137.9	135.5	117.9	114.8	114.8	111.9	111.9	111.9	108.4
	HIGH SCENARIO	167.5	167.5	167.5	167.5	167.5	167.5	167.5	167.5	167.5
YEARLY DEMAND										
bcm/year	LOW SCENARIO	2.3	2.3	2.0	1.9	1.9	1.9	1.9	1.9	1.8
	HIGH SCENARIO	2.9	2.9	2.7	2.6	2.6	2.6	2.6	2.6	2.6
TWh/year	LOW SCENARIO	26.0	25.6	22.2	21.6	21.6	21.1	21.1	21.1	20.4
	HIGH SCENARIO	32.0	32.0	29.8	29.3	29.3	29.3	29.3	29.3	29.3
Gross calorific value: 11.08 kWh/cm³										

Table 3.2: Forecasts for National demand, Finland

Gasum's subsidiary Gas Exchange Ltd maintains an online marketplace "Kaasupörssi" for natural gas short-term market and secondary market trading. Trading takes place in the Gas Exchange online service, which is open around the clock every day of the year. The number of transactions during the year 2015 was 80,000, which corresponds to an average of 217 executed transactions a day. In 2015, 3.8 % of whole gas consumption in Finland was sold through the Gas Exchange.

3.3.5 LEGAL FRAMEWORK DEVELOPMENT

The current Natural Gas Market Act that entered into force in 2000 and was updated in 2013 has implemented Directive 2009/73/EY of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in natural gas. The Directive allows Finland to deviate from the regulations concerning the deregulation of the natural gas market as long as the country has only one principal supplier of natural gas, because Finland has not been connected to the natural gas network of any other EU Member State.

Due to this, the Finnish natural gas market has not been deregulated in the literal sense of the word. Only the so-called secondary market in natural gas has been deregulated, and the deregulation concerns only parties that meet certain requirements. Users or retailers of natural gas, who purchase over 5 mcm of natural gas per year, whose metering is based on remote reading and whose pricing has been agreed upon after the Natural Gas Market Act entered into force can participate in the operation of the secondary market in the Gas Exchange. Kaasupörssi operates the secondary market trading platform.

A proposal of the new Natural Gas Market Act has been prepared by the ministry of employment and the economy during 2014–2016 and it is expected that the new Act will be issued for approval to the Parliament of Finland in spring 2017. The new Natural Gas Market Act would enter into force probably in 2018. The proposed Act

will introduce to the Finnish natural gas market structural changes. The structural changes in the proposed Act will be compatible with the requirements in the case of derogation removal. The main changes of the proposed Act are:

- Implementation of European Network Codes as far as applicable
- Establishing of an entry-exit system and Virtual Trading Point (VTP)
- Establishing a national data hub
- Introduction of new balancing regime
- Opening of retail market for competition
- Removal of the wholesale gas regulation
- Third party access for biogas, LNG and gas supplied via Balticconnector, full third party access if derogation will be removed together with other implications due to application third directive package fully.

The Energy Authority (EA) supervises compliance with the Natural Gas Market Act and promotes the operation of a competitive natural gas market. EA also regulates the natural gas transmission services and a new regulatory regime was introduced in beginning of 2016 for a duration of eight years, i. e. two four-year regulatory periods. The regulatory regime resembles the previous one, but includes now the regulation of offgrid LNG terminals, where a third party access will be implied due to the national grants for the investments, this will apply to Pori/Skangas and Tornio/Manga terminals which are under construction upon commissioning. The regulatory regime for natural gas transmission system is based on the WACC and regulatory asset base (RAB). RAB is calculated based on the rebuild value in the beginning of the period and straight-line depreciation of asset value according the expected lifetime and age. The regulatory regime includes, as earlier, the incentives for efficiency and security of supply, a new incentive was introduced for innovation. The regulatory regime was changed from post-tax to pre-tax methodology.

3.3.6 OFFGRID MARKET DEVELOPMENT IN THE AREA OF LNG AND BIOGAS

Biogas production is steadily increasing in Finland and as a renewable energy, is supported by the energy policy. The total amount of biogas produced in Finland in 2014 was 155.5 mcm[2)] (in 0°C reference temperature) and 84,5 % of the produced amount was utilised and the rest was flared. The total amount of energy utilised in 2014 as biogas was 613 GWh at net caloric value, corresponding 681 GWh at gross caloric value. From digestion, the amount of produced biogas was 61.5 mcm (in 0 °C reference temperature) and from landfills 94 mcm (in 0 °C reference temperature).

Gasum is one of the leading producers of biogas in Finland. Gasum has introduced biogas production facilities in conjunction with the natural gas transmission network so that biogas generated from biomass can, after processing, be fed into the transmission network and supplied to customers. In addition, Gasum acquired in 2015 two biogas production companies and today produces about 300 GWh/a (at net caloric value) of biogas, wherefrom about 100 GWh (at net caloric value) is injected to the gas transmission grid. Waste based biogas production potential in Finland is estimated to be about 15 TWh/a and agriculture production based (field biomass and manure) biogas production potential is estimated to be additional 10 TWh/a. Furthermore, synthetic biogas can be produced using methods such as wood waste gasification. The future scenario for synthetic biogas in Finland could include few large bio-SNG facilities that are capable of producing approximately 5 TWh/a of energy.

2) Finnish biogas register, http://www.biokaasuyhdistys.net/media/Biokaasulaitosrekisteri2014.pdf

The National Energy and Climate Strategy published in 2016 support the production and use of biogas by various means. The strategy states that target is to increase the production and use of biogas by influencing the EU-regulations and especially EU's state support regulations so that it enables the supporting of biogas production. Also national regulations will be clarified so that they support the production and use of biogas. Production and use of biogas will receive incentives at least at the same level than earlier. The use of agriculture biomasses will be supported in biogas production.

Biogas is mainly utilised at the moment as a local solution to produce heat and power, but increasingly, via the injection of upgraded biogas into the gas transmission system, it is possible to use biogas more widely. Biogas use has been increasing in the transportation, industry and heat production segments. In order to facilitate the market development, Gasum has introduced in 2013 a voluntary biogas certificate system, where the bio-component can be traded and used separately from the physical biogas flow. Additionally, there are some plans to introduce biogas liquefaction facilities in order to have liquefied biogas that can be transported by using the same equipment as is used in LNG.

In order to account biomass produced gas as a biogas, it has to fulfil the sustainability requirements according to the EU and national requirements. The legislation is currently in revision while the new ILUC directive will be implemented. The state of Finland does not tax biogas currently as natural gas is taxed in order to incentivise the use. In the transportation sector an obligation to include a minimum amount of biofuels in the total amount of transportation fuel distributed is used as an incentive to increase the biofuel use as well. Currently this distribution obligation is not applied to biogas. In the renewal of the national legislation, the incentives applied to biogas will be evaluated and possibly changed in the near future.

Natural gas and biogas use in the transportation has been relatively low in Finland during past years and currently the number of cars using gas as a fuel is above 2,000. There are about 120 heavy duty vehicles using gas as fuel on top of the cars. The demand on heavy duty transportation is expected to increase rapidly. Gasum is currently implementing four LNG filling stations to Finland. The development is dependent mainly on availability of gas-fuelled cars and existence of sufficient amount of filling stations. The number of filling stations will be increased in the near future both in the gas grid area and offgrid locations based on natural gas, biogas and LNG. The promotion towards car importers to provide gas-fuelled models into the market is also in the focus. With this development it is expected that number of gas fueled cars will increase in the coming years.

Currently the LNG market development in Finland happens mainly in offgrid areas in the western, middle and northern part of the country. The development of LNG infrastructure provides excellent support to market development, which is mainly in industry, energy production, ship bunkering and the transportation sectors. LNG will be mainly used to substitute other more expensive fuels like oil and propane. The expected LNG market growth in Finland is difficult to estimate, but it is expected to be in the range of 5–10 TWh/a by 2020.

Power-to-gas is the functional process of the conversion of electrical power into a gaseous energy carrier such as hydrogen or methane. It is an efficient technology for storing the exceeding energy in the form of methane for later use. There is national interest to utilise power-to-gas technology in Finland and the global developments in power-to-gas technologies are closely followed.

3.4 Latvia

3.4.1 ENERGY POLICY

The milestones of the Energy policy in Latvia are highlighted in the *Long Term Energy Strategy 2030 – Competitive Energy for the Society* approved by the Cabinet of Ministers on 28 May 2013:

- Security of supply – uninterrupted energy delivery and well developed infrastructure;
- Competitiveness- energy based on market principles, which promotes development of the economy and its competitiveness in the region and in the World;
- Sustainability- reduction of dependence on imported energy, promotion of the new effective renewable technologies, improvement of energy efficiency.

In particular, the aim is to reduce imported energy at least to 50 % and to increase the share of renewables at least up to 50 %.

Based on the Energy Strategy 2030, the Ministry of Economics elaborated Basic Principles of Energy Policy for 2016–2020, which was approved by the Cabinet of Ministers on 9 February 2016. The energy policy favour renewable and domestic energy sources: share of renewables in gross final consumption of energy shall increase to 40 %. In addition, provisions of the EU Energy Efficiency Directive will be implemented in order to improve energy efficiency.

3.4.2 MARKET PLAYERS

JSC "Latvijas Gāze" was the only player in the natural gas market in Latvia until end of 2016. According to the share purchase agreement, which was signed with the strategic investors in 1997, JSC "Latvijas Gāze" has exclusive rights on transmission, storage, distribution until April 2017 and license for sale of natural gas, as well as unlimited and exclusive rights to use Inčukalns Underground Gas Storage for the same period. JSC "Latvijas Gāze" carried out transmission, distribution, storage and sale of natural gas in compliance with the licenses issued by the Public Utilities Commission. However, referring to the amendments to the Energy Law, which were adopted by Parliament on 11 February 2016, JSC "Latvijas Gāze" was unbundled. By spinning-off the transmission and storage business areas, a new joint TSO and SSO commenced operation at the beginning of 2017. The new company is the joint stock company "Conexus Baltic Grid". After opening the Latvian gas market on 3 April 2017, in total more than 20 gas-trading companies have been registered until now from Latvia, Lithuania and Estonia. However, currently it is not possible to assess how many of these will be active in the market.

3.4.3 ENERGY MIX

In 2014, the total consumption of primary energy resources in Latvia amounted to 51.7 TWh Natural gas remained the main resource for heat energy and electric energy generation. The total consumption of natural gas reached 12.6 TWh, which corresponds to 24.4 % of the total primary energy consumption. However, the share of natural gas has decreased from 27.8 % to 24.4 % in the past three years. In the consumption of primary energy sources, firewood with its total consumption of 15.5 TWh was the most widely used local energy resource, and its share increased from 25.3 % to 30.0 % due to commissioning of the new woodchip heat-production units. Electricity generated at hydropower and wind-power stations constituted to 4.4 TWh.

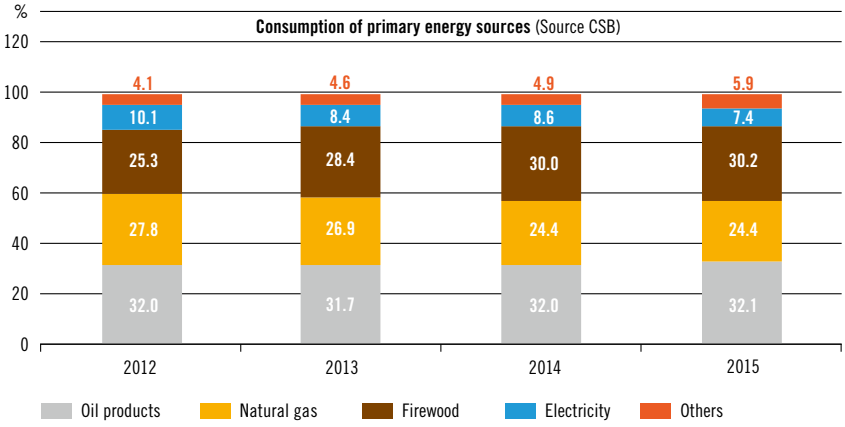


Figure 3.21: Consumption of primary energy resources in Latvia


Image courtesy of Conexus

3.4.4 MARKET INDICATORS, SUPPLY AND DEMAND

Latvia's gas supply system is not connected to the EU's common gas grid, and Latvia has one main gas supplier: JSC Gazprom. However, since the beginning of 2015 when the Klaipėda LNG terminal commenced its operation, it has been possible to supply natural gas to Latvia from this terminal.

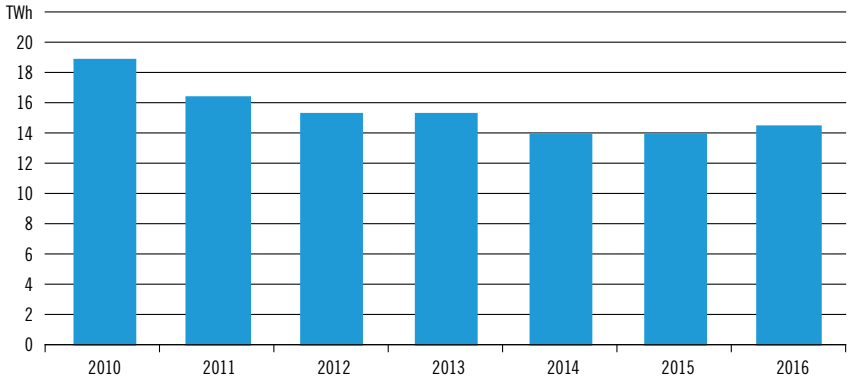


Figure 3.22: Natural gas sales in Latvia (TWh)

The largest consumers of natural gas are the power company JSC "Latvenergo" and heat supply enterprises. The Riga region accounts for about 65 % of the total natural gas consumed in Latvia.

Demand for natural gas in Latvia mainly is driven by natural gas price, weather conditions and changes in natural gas consumption for power production. Consumption of natural gas is also influenced by general development of the economy, isolation of houses and, largely, usage of alternative energy sources. The last years were not favourable for increase of demand for natural gas.

Regarding the future, due to an energy policy in Latvia where renewables are preferred over conventional fuels, we cannot expect an increase of natural gas consumption.

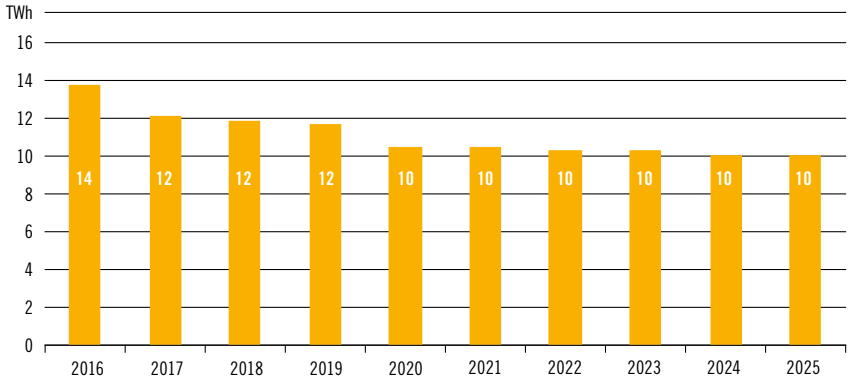


Figure 3.23: Forecast of natural gas sales in Latvia (TWh)

YEARLY GAS DEMAND AND PEAK DAY DEMAND FORECAST FOR THE PERIOD OF 2017–2025									
	2017	2018	2019	2020	2021	2022	2023	2024	2025
YEARLY GAS DEMAND (TWh)	12.02	11.81	11.59	10.44	10.44	10.22	10.22	10.01	10.01
PEAK DAY DEMAND (GWh)	126.6	126.6	126.6	126.5	126.5	126.4	126.3	126.2	126.2

Table 3.3: Yearly gas demand and peak day demand forecast for the period of 2017–2025

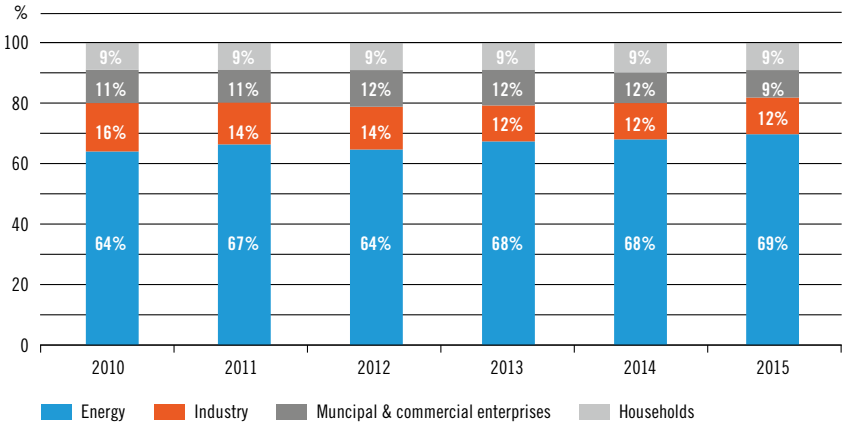


Figure 3.24: Natural gas sales by industries (%)

In total, JSC "Latvijas Gāze" has 443.6 thousand customers including 432.2 thousand residential customers who consume only 9 % of total gas sold in Latvia.

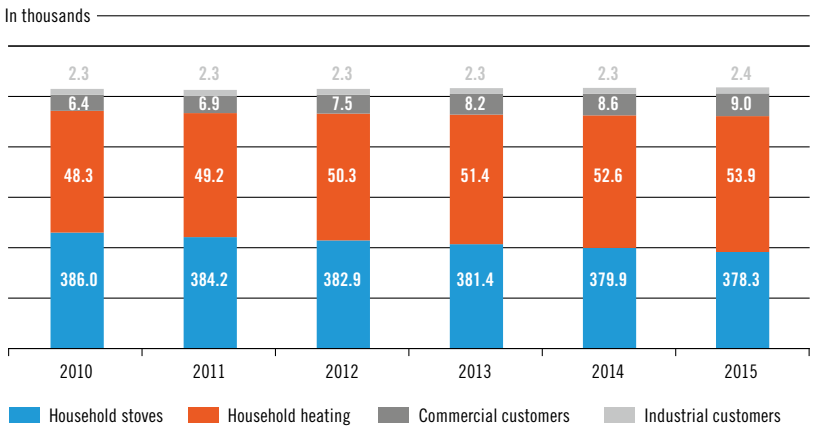


Figure 3.25: Number of gas customers (in thousands)

The total number of customers in Latvia continues to increase except those who use gas only for cooking.

3.4.5 LEGAL FRAMEWORK DEVELOPMENT

On 11 February 2016 Latvian Parliament adopted amendments to the Energy Law providing for full ownership unbundling of the vertically integrated JSC "Latvijas Gāze", which resulted in establishment of two sister companies by spinning-off gas transmission and storage business areas in accordance with the provisions of Gas Directive 2009/73/EC from the beginning of 2017. The next step is to split the distribution and sales businesses by the end of 2018.

3.4.6 OFFGRID MARKET DEVELOPMENT IN THE AREA OF LNG AND BIOGAS

In Latvia at the moment there are no established offgrid LNG terminals and biogas amounted to about 392 GWh in 2015.

Image courtesy of Conexus

3.5 Lithuania

3.5.1 ENERGY POLICY

Lithuania's National Energy Strategy emphasises the main provisions for determining development of energy sector, its implementation directions up to 2030 and guidelines for 2050. The key priorities include energy security, diversification of energy supply, energy efficiency and integration of Lithuania's energy network with the energy systems of the European Union (the EU).

During the last decade Lithuania's energy sector has been successfully restructured in compliance with applicable requirements of legal acts of the EU, possibilities for the diversification of energy resources have been established, measures for environmental protection have been applied, etc. Lithuania has successfully coped with the task of implementing the EU's Third Energy Package, which stipulates the unbundling of gas transmission, distribution and supply functions.

Lithuania's gas sector has aimed to secure gas transmission to Lithuania's consumers and efficiently develop its gas transmission system by integrating it into the European gas market network and bringing possibilities for the diversification of energy sources. Klaipėda Liquefied Natural Gas terminal (the LNG terminal), which was put into operation in December 2014, was one of Lithuanias's main achievements and it introduced competition to the gas sector and substantively increased energy security in the Baltic region. Thus, it has allowed for energy source diversification in the Baltic region.

3.5.2 MARKET PLAYERS

Natural Gas Market Value Chain consists of natural gas supply, transmission and distribution.

In 2016, nearly 10 importers operated in Lithuania, out of which the major ones were AB Achema, UAB Lietuvos Dujų Tiekimas and UAB LITGAS. In 2016, natural gas imports amounted to 24.2 TWh for users in Lithuania and other Baltic States: over 60 % of the gas originated from the Klaipėda LNG terminal and the remainder came from Russia.

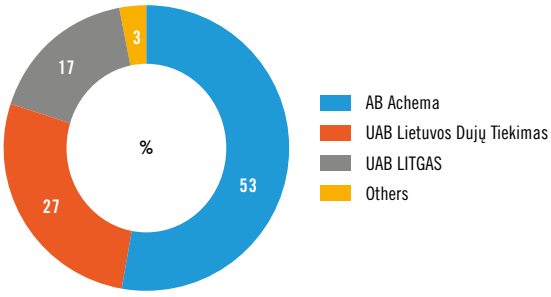


Figure 3.26: The major importers of natural gas to Lithuania, 2016 (%)
(Source: AB Amber Grid)

There has been one operator, AB Amber Grid, in the natural gas transmission network, and six distribution system operators in Lithuania. More than 30 % of gas consumed in Lithuania was supplied via distribution grids in 2016. Lithuania's major gas distribution company was AB Energijos Skirstymo Operatorius (ESO), which accounted for 99 % of Lithuania's total gas quantities distributed in 2016.

In Lithuania, the offshore LNG terminal is operated by AB Klaipėda Nafta. The LNG terminal is based on the Floating Storage and Regasification Unit technology. The total storage capacity of the LNG facility is 170,000 m³ of LNG, while the regasification capacity amounts to 10.3 mcm/d (~122 GWh/d). The LNG terminal is connected to the gas grid of AB Amber Grid by an 18 km long linking pipeline.

3.5.3 MARKET INDICATORS, SUPPLY AND DEMAND

In 2015, Lithuania's total energy consumption amounted to 83 TWh. The dominating fuels were oil products and natural gas, whose respective shares in the primary energy balance stood at 36.4 % and 29 %.

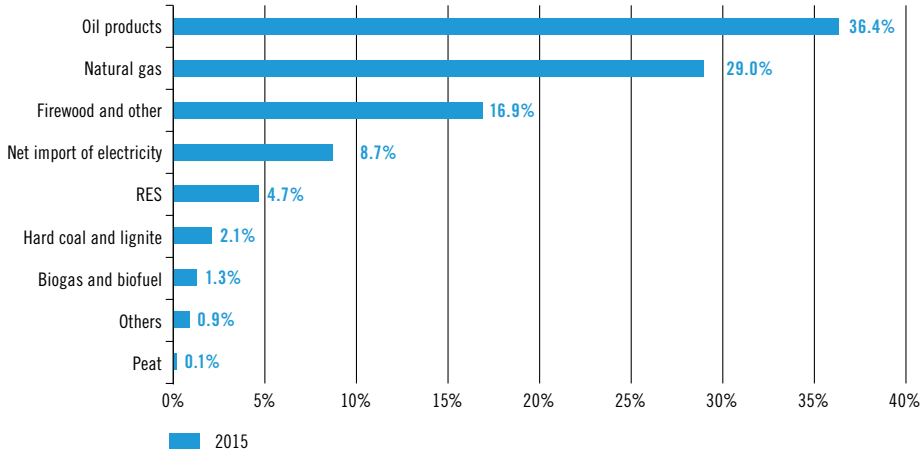


Figure 3.27: Structure of energy consumption, Lithuania, 2015 (Source: Statistics Lithuania)

3.5.3.1 Supply and demand

Until late 2014, gas imported from Russia was the only option available for Lithuania and the other Baltic States. The Baltic region's natural gas market had no alternative suppliers. The situation turned around with the launch of the new LNG terminal in Lithuania. The LNG terminal opened up the possibility for market players to import LNG supplies from global markets.

Furthermore, 2015 marked the completion of the Klaipėda-Kuršėnai gas transmission pipeline. With its enhanced throughput capacity, the gas pipeline enabled the exploitation of the full potential of the LNG terminals' capacities and facilitated transportation of gas supplies both within Lithuania and to the other Baltic States.

Despite the importance of natural gas in Lithuania's economy, the demand for natural gas has been decreasing in recent years. This is mainly due to the increasing use of biofuel in the heating sector, energy efficiency, reduced gas consumption for generation of electricity, etc.

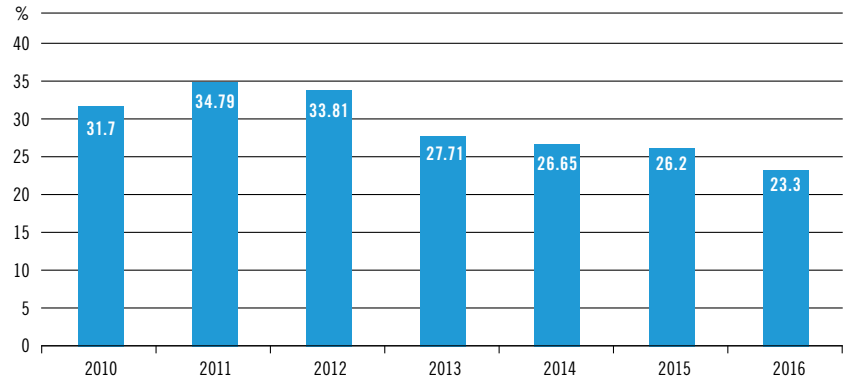


Figure 3.28: Development of natural gas consumption in Lithuania (TWh), 2010–2016 (Source: AB Amber Grid)

In 2016, the volume transported via transmission network to Lithuania's consumers amounted to 23.3 TWh, i. e., a decrease of 11 % compared to 2015. In 2016, 0.5 TWh of natural gas was transported to the gas consumers of the other Baltic States and 23.5 TWh to the Kaliningrad Region of the Russian Federation. In Lithuania, the major share of gas was used for the production of fertilisers (53 %).

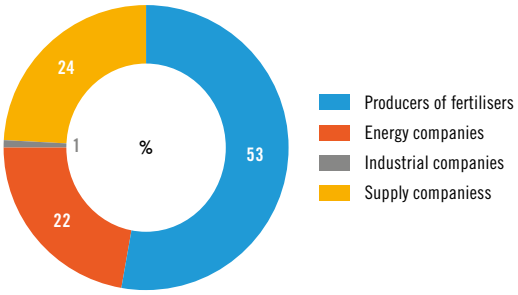


Figure 3.29: Natural gas transmission by sectors in Lithuania, 2016 (Source: AB Amber Grid)

In 2016, the largest daily gas transmission volume from Belarus to Lithuania amounted to 224 GWh, 99 GWh to the Kaliningrad Region of the Russian Federation, 90 GWh from the LNG terminal.

The forecast for Lithuania's natural gas demand and peak day demand for 2017–2026 is provided in Figures 3.30 and 3.31.

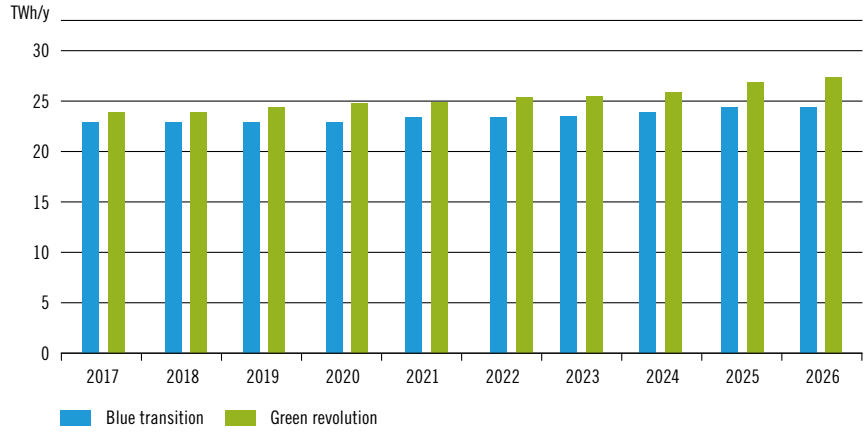


Figure 3.30: Forecast for yearly demand in Lithuania, 2017–2026
(Source: AB Amber Grid, according to ENTSOG scenarios, TYNDP 2017)

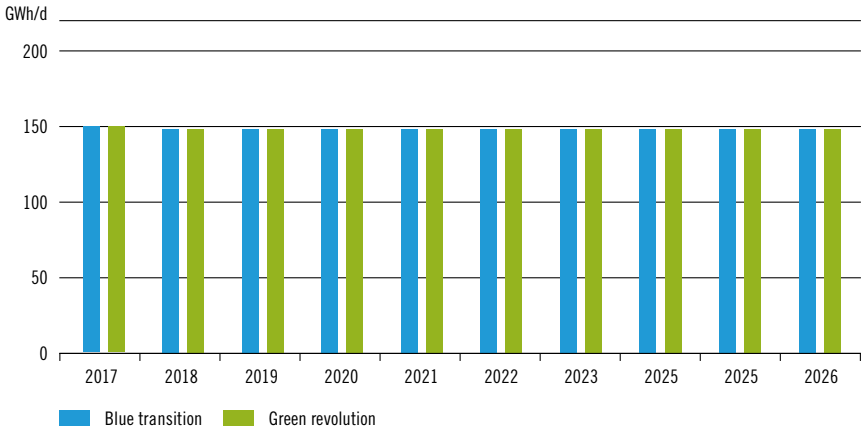


Figure 3.31: Forecast for peak demand in Lithuania, 2017–2026
(Source: AB Amber Grid, according to ENTSOG scenarios, TYNDP 2017).

UAB GET Baltic has been operating in Lithuania's market since 2012. It maintains a web-based fully automatised electronic trading system for short-term market trading in natural gas. The trade is carried out by the continuous trading method every day during a trading session.

3.5.4 LEGAL FRAMEWORK DEVELOPMENT

The main provisions of the EU directives and regulations in energy sector have been transposed to the national legislation. The Energy Law, the Natural Gas Law and the Liquified Natural Gas Terminal Law are the key legal acts governing the natural gas sector in Lithuania.

The Energy Law sets out the main principles of energy policy, energy sector development and regulation, effective usage of energy and energy resources in Lithuania.

The Natural Gas Law establishes the general principles of organisation and functionality of gas sector activities, the operation of gas enterprises and their interrelation as well as relations with customers when supplying, distributing, transmitting, liquefying and storing natural gas.

The Liquefied Natural Gas Terminal Law stipulates the main requirements of the establishment of the terminal, its operation and activity.

3.5.5 OFFGRID MARKET DEVELOPMENT IN THE AREA OF LNG AND BIOGAS

There are nearly 40 offgrid biogas-fired plants with total installed capacity of more than 30 MW in Lithuania. The main producers of biogas are the sectors of agriculture, industry, landfills and waste water treatment companies.

Image courtesy of Amber Grid

3.6 Poland

3.6.1 ENERGY POLICY

Poland's Energy Policy towards 2030 was adopted by the Council of Ministers in November 2009. The document contains a long-term strategy of the energy sector development and demand forecasts for energy sources. The Policy identifies six main areas in the energy sector: energy efficiency, security of supply, diversification of energy production, renewable energy, competitiveness and limitation of impact of energy on the environment.

Natural gas constitutes an important element of the national energy strategy. The document provides for further development of the gas market, inter alia through a stable outlook for investments in the gas system and cross-border connections, as well as diversification and security of supply. According to the Policy, the total demand for natural gas in Poland is expected to increase.

Image courtesy of GAZ-SYSTEM

3.6.2 MARKET PLAYERS

All activities related to the transmission of gas in Poland are fully separated from generation and sales operations. Gas Transmission Operator GAZ-SYSTEM S.A. (hereafter GAZ-SYSTEM) was established in 2004. The company is responsible for the transportation of natural gas and the operation of the transmission network in Poland. GAZ-SYSTEM operates on the basis of a licence issued by the President of the Energy Regulatory Office (ERO) which is valid until 2030. In addition, the company performs the function of an independent system operator (ISO) on the Polish section of the Yamal-Europe pipeline.

In line with Art. 3 of Regulation 715/2009 GAZ-SYSTEM was granted a certificate of independence in connection with the operation of the company's own transmission networks on 22 September 2014. In addition, on 19 May 2015 GAZ-SYSTEM also received a certificate of independence under the ISO model with respect to its operation of the Polish section of the Yamal-Europe pipeline that is owned by EuRoPol GAZ s.a.

Polskie LNG S.A. (Polskie LNG) is a daughter company of GAZ-SYSTEM that was established for the purpose of constructing and operating of the LNG terminal in Świnoujście. The facility has been commercially operational since June 2016. Polskie LNG currently offers short and long-term services embracing regasification of LNG and LNG-reloading to truck cisterns to all interested parties in an open and non-discriminatory manner.

The capital group of Polish Oil and Gas Company (PGNiG) holds a major position in the market. It is the biggest importer and gas producer in the country. It owns and operates UGS facilities connected to the transmission system in Poland via the storage company (Gas Storage Polandsp. z o.o.). Furthermore, the main distribution system operator (Polska Spółka Gazownictwa sp. z o.o.) remains within the vertically integrated structure of PGNiG.

Polish Power Exchange (PolPX) provides a platform for trading in electricity, natural gas, production limits (specifically for electricity generation), emission allowances and property rights. Gas trading was introduced in December 2012.

An increasing number of other market players are entering the wholesale and retail gas market in Poland. Based on the data published by the Energy Regulatory Office, 172 players held a licence to trade in gaseous fuels at the end of 2015 (increase from 141 a year before). Among them 63 companies are active in that market (compared to 59 at the end of 2014). The share of these market participants in the gas market increases year by year and it reached the level of approx. 20 % at the end of 2015.

3.6.3 ENERGY MIX

The structure of energy consumption in Poland is closely linked with significant resources of raw materials (mostly coal and lignite, to a much lesser extent natural gas) that are located in Poland. Total energy consumption in Poland amounted to 94.9 Mtoe in 2014. The Polish energy mix is dominated by solid fuels that accounted for 51.2 % of total energy consumption. The second largest source of primary energy is petroleum with its share in energy mix totalled 25.7 %. Natural gas is the third major source of primary energy in Poland and accounted for 13.3 % in total energy consumption. Finally, other sources, including renewables cover 9.9 % of the mix. The share in natural gas in the energy mix has increased by 2.35 % since 2000.

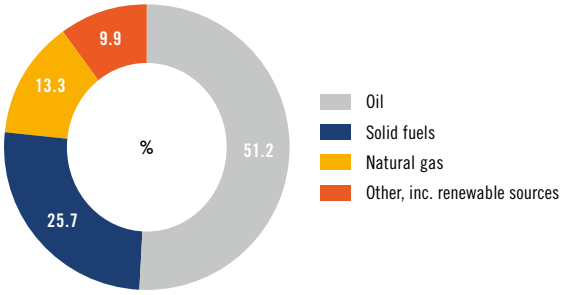


Figure 3.32: Energy mix in Poland, 2015 (Source: Ministry of Energy)

The structure of electricity generation in Poland is also dominated by solid fuels as the share of coal in the national electricity production accounts for 50.62 %, while lignite covers 33.11 %. The role of other sources is limited. Wind energy sources and other renewables are responsible for 6.25 %, industrial power plants – 6.03 %, gas power plants – 2.59 % and finally hydro power accounts for 1.4 %.

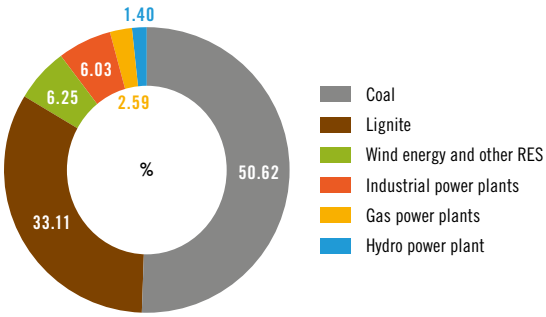


Figure 3.33: Electricity production by fuel in 2015 (Source: PSE S.A.)

3.6.4 MARKET INDICATORS, SUPPLY AND DEMAND

The demand for gas transmission services has been gradually increasing from the level of approx. 175 TWh in 2010 to approx. 195 TWh in 2016. The growth was mostly observed among industrial and residential customers.

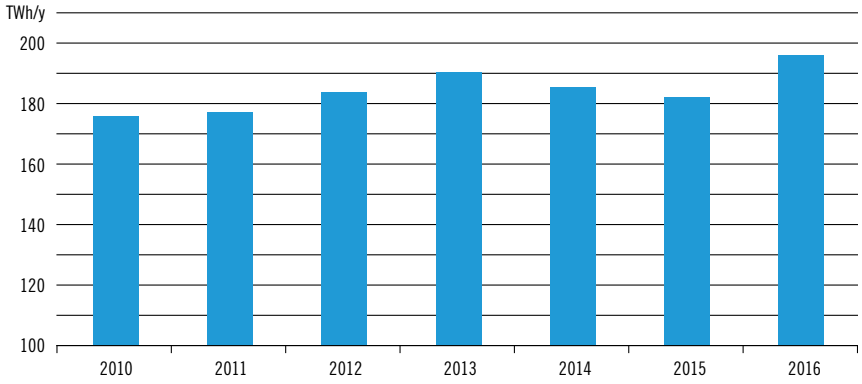


Figure 3.34: Yearly demand for natural gas in Poland (Source: GAZ-SYSTEM)

In the years to come, demand is expected to continue increasing due to gasification of new areas in the country, substitution of coal fired-furnaces with the ones supplied with gas and a wider use of gas power plants in the electricity generation.

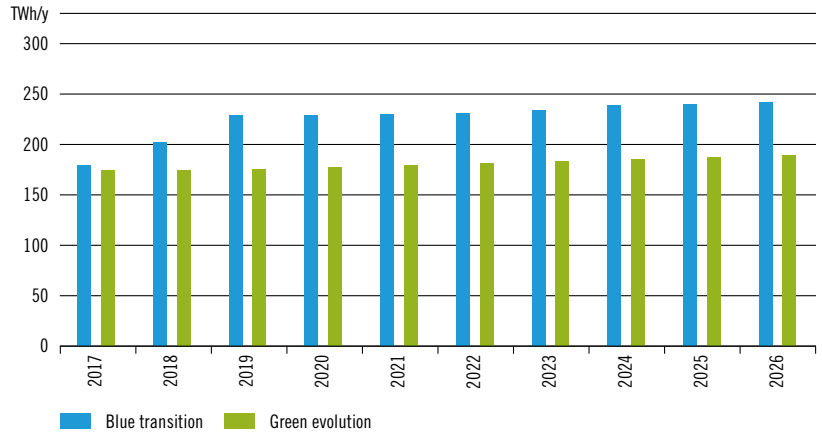


Figure 3.35: Yearly demand for natural gas in Poland (Source: GAZ-SYSTEM)

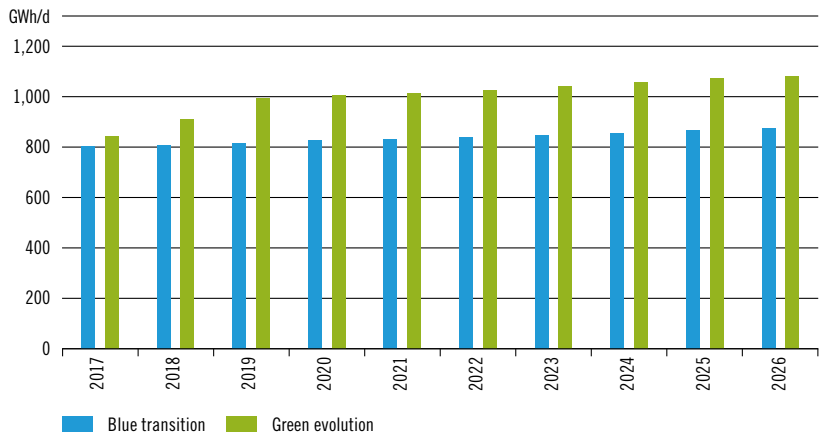


Figure 3.36: Peak demand for natural gas in Poland (Source: GAZ-SYSTEM)

Natural gas supplies by means of the transmission infrastructure in Poland amounted for 176.6 TWh in 2016. As far as import is concerned, 112.1 TWh of gas was transported from the eastern direction, 28.5 TWh came from other EU Member States like Germany and the Czech Republic, while the remaining 11.2 TWh was imported via the terminal in Świnoujście. Indigenous production that was injected to the transmission system was at the level of 24.8 TWh in 2015.

The commissioning of investment projects in recent years has led to better integration of the gas infrastructure in Poland with adjacent systems in the EU. This allowed for the supply of gas from new sources and contributed to enhanced diversification of supply. However, despite the progress made, the share of Russian gas still remains at a high level. Therefore, there is a need for implementing new projects that will further improve competition between upstream suppliers on the Polish market and will enable the transmission of gas from new sources via the Polish system to other countries in the Baltic region and Central-Eastern Europe.

Since 2012 gas trading on the exchange market in Poland is conducted by means of PolPX. In the gas sector, the operations of PolPX embrace the instruments on the intraday, day ahead and forward markets. Since 2014 the volume of gas traded on PolPX has increased significantly and it reached the level of 114 TWh in 2016. The growth was largely driven by a gas release programme that introduced an obligation to sell significant volumes of gas on the exchange market.

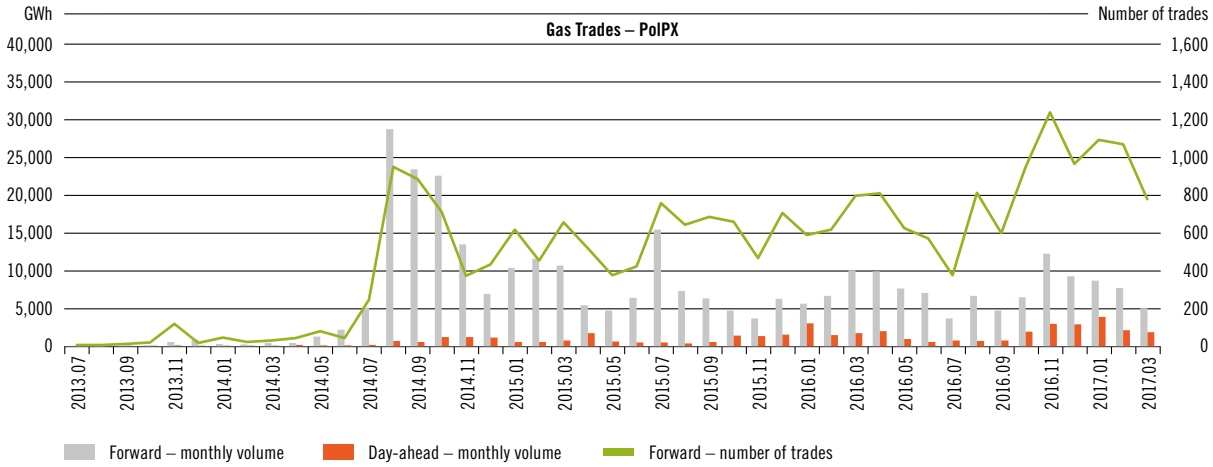


Figure 3.37: Gas trades at PolPX (Source: GAZ-SYSTEM)

As part of the European process to liberalise the rules governing the functioning of the gas market in the EU, GAZ-SYSTEM has implemented relevant provisions of currently applicable European network codes and guidelines. This resulted in the introduction of a number of amendments to the transmission network code that enhanced liquidity and competition on the gas market in Poland. The most important changes include for instance the introduction of a new framework transmission contract, virtual point and OTC virtual point and market-based balancing services. In addition, standardised capacity products were put in place. GAZ-SYSTEM also developed a new capacity allocation platform (GSA Platform) to allocate capacity at interconnection points.

3.6.5 LEGAL FRAMEWORK DEVELOPMENT

The Energy Law is the main act governing the energy market in Poland. This law encompasses electricity, gas, heat and renewable energy sectors. The objective of the energy law is to establish the conditions for: sustainable development of the country, energy security, economical and rational use of energy sources, development of competition and fulfilment of obligations arising from international agreements, European law and more. The Energy Law was amended to implement relevant provisions referring to the gas sector as provided for in the Third Energy Package.

The transmission network code of the national transmission system and transmission network code of the Polish section of the Yamal-Europe pipeline have been developed by GAZ-SYSTEM and approved by ERO. The network codes have been amended in the recent years to implement the European network codes dealing with congestion management procedures, capacity allocation mechanisms, balancing and interoperability.

There are also other legal acts concerning the gas market in Poland. In particular, these encompass the law on compulsory reserves of fuel and natural gas, regulations pertaining to the functionality of the gas system and regulations pertaining to principles of tariff calculation and gas trade settlements.

3.6.6 OFFGRID MARKET DEVELOPMENT IN THE AREA OF LNG AND BIOGAS

With a growing demand for LNG in Poland and other countries in Central-Eastern and Baltic regions, GAZ-SYSTEM is investigating the possibilities for extending the scope of LNG services. The LNG terminal in Świnoujście was put into commercial operation in June 2016. The terminal offers its regasification capacities to all interested shippers and it additionally constitutes a base for the development of small-scale LNG services. The facility was designed to reload LNG onto truck cisterns at two dedicated reloading platforms. Since the introduction of these services in July 2016, there has been a significant increase in interest from market players in LNG truck loading. As illustrated on the graph below over 850 LNG cisterns were loaded by customers in Poland and in other countries in the period between June 2016 and February 2017.

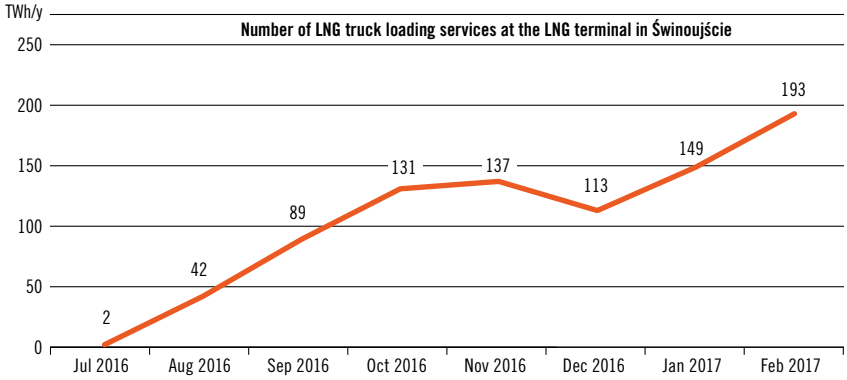


Figure 3.38: Number of LNG truck loadings in Świnoujście LNG terminal (Source: GAZ-SYSTEM)

A number of different options are currently under consideration both to increase regasification capacity and to offer new LNG services such as rail loading, bunkering, reloading to smaller vessels. These developments will further increase the efficiency of the terminal, will create conditions for new market areas based on LNG to emerge and will additionally contribute towards optimal use of the facility.

3.6.6.1 LNG Logistics

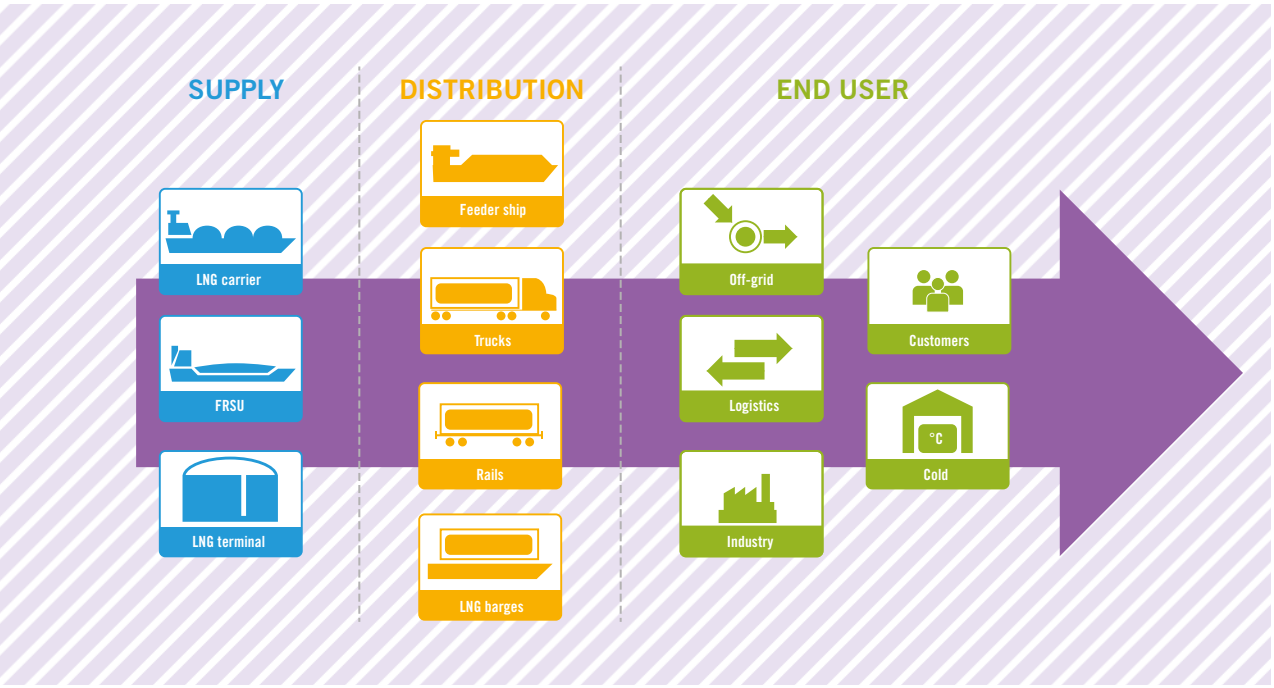


Figure 3.39: LNG logistics (Source: GAZ-SYSTEM)

Description of additional services that are under consideration:

- **Truck/rail container.** The project assumes installation of a truck loading station in order to provide LNG loading services to intermodal transport with the ISO system (20 ft, 40 ft) and specialised LNG railcar wagon.
- **Offgrid (satellite) plants** contribute towards balancing peak demand and delivering LNG to areas that are not connected to a wider gas network. Such decentralised energy supply provides local authorities and municipal utilities with grid-independent district heating supply and ensures that industrial consumers with a high energy demand profile are provided with natural gas by independent suppliers.

  Typical solution consists of storage tank, vaporisers, system control and connection to the local grid. Storage tanks (vertical and horizontal), depending on customer needs, have the volume of 10–1,000 m^3 and the design pressure range of 8–17 bar. Ambient air vaporisers do not need energy supply. Alternatively, they use steam or cogeneration plants and this solution consumes approx. 2 % of the processed gas. A piping system interconnects the entire system. Most of the components are fully automatic or semi-automatic in order to deliver gas at the required pressure and temperature.
- **CNG/LNG refuelling stations.** The main purpose of the project is to use the GAZ-SYSTEM infrastructure to create a network of CNG and LNG fuelling stations for road transport. Trucks and busses using mixed diesel and natural gas or fitted with converted fuel systems are able to tank fuel at local gas stations that are equipped with specific gas compressors designed to work with the pressure up to 25 MPa. Input pressure at a gas station should not be lower than 3 MPa and not exceed 8.4 MPa. Water dew point should be at –25 °C. Before CNG is injected into a vehicle fuel tank the moisture and impurities are removed and natural gas is odorised.

- **Bunkering/feeder vessel.** The small and medium-sized LNG carriers are used to distribute LNG from import terminals to intermediate stations. There are two categories that can be distinguished: “bunker vessels” and “feeders”. LNG can be transported via barges which may be equipped with self-propulsion system. In general, the capacity of the “bunker vessels" ranges from 1,000 to 10,000 m³.

  The basic aim of "feeder vessels" is to distribute marine LNG fuel on a regional level to points along the coastline. The size and dimensions of the "feeder vessels" may vary considerably depending on market demand and other factors such as the depth of the port. Typical capacity for a cargo ship varies between 7,000 and 20,000 m³.

The successful promotion of LNG as a marine fuel depends on safe and effective supply companies. Regulatory framework for LNG as a marine fuel is under development in Poland.

LNG transport chain in Poland

There are three main ways of supplying LNG: as a marine fuel ship-to-ship, truck-to-ship and LNG terminal-to-ship via pipeline.

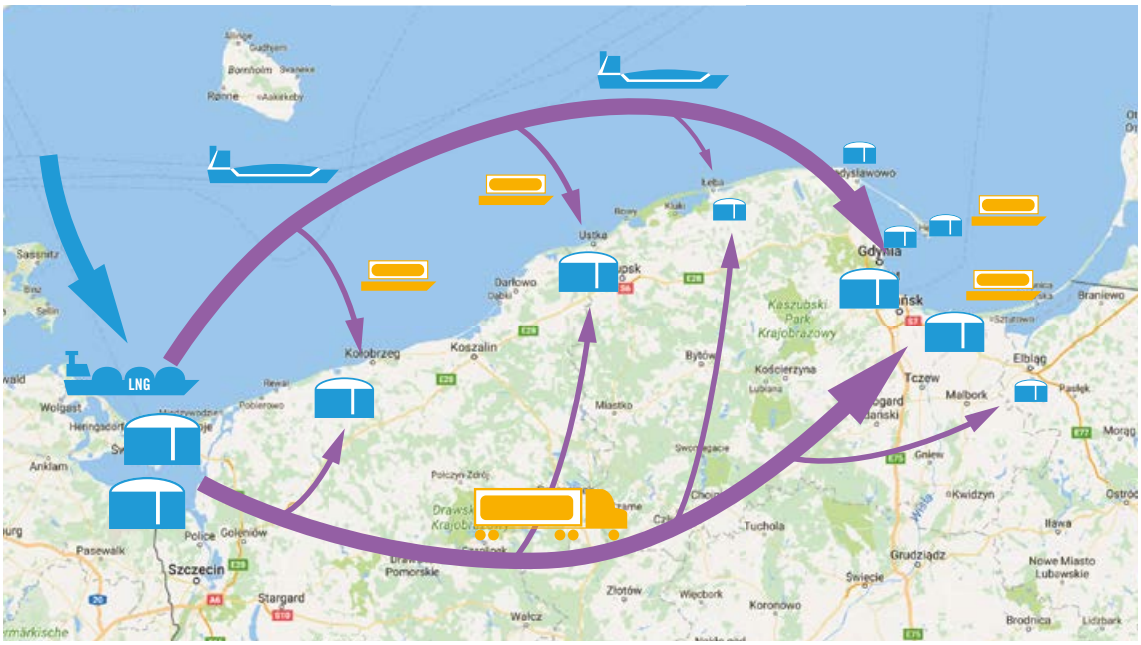


Figure 3.40: LNG transport and logistics chain in Poland (Source: GAZ-SYSTEM)

Small scale services at the FSRU unit. GAZ-SYSTEM considers the implementation of a FSRU terminal in the Bay of Gdańsk. The unit is planned to offer regasification services, LNG reloading onto smaller vessels and LNG storage services.

3.7 Sweden

3.7.1 ENERGY POLICY

The Swedish government has declared that Sweden shall have zero net emissions of greenhouse gases to the atmosphere by the year 2050, and will thereafter have negative emissions. The Swedish energy policy is based on the same three cornerstones as assessed within the framework of the EU energy cooperation. The policy thus seeks to accommodate:

- Ecological sustainability
- Competitiveness
- Security of supply

In a broad parliamentary energy policy agreement on 10 June 2016, it was decreed that Sweden shall have a robust electricity system with high reliability, low environmental impact and with access to electricity at competitive prices. The goal for 2040 is 100 % renewable electricity production. This is a goal, not an end date prohibiting nuclear power and it does not mean the closure of nuclear power through political decisions. A goal for energy efficiency for the time period 2020–2030 shall be developed and be approved no later than 2017.

Swedish nuclear power, which together with hydropower accounts for the larger part of Sweden's energy supply, is facing major investment needs to meet the new safety requirements. The Swedish Radiation Safety Authority has decided that these new requirements must be met by 2020, otherwise the reactors may not continue operation. Nuclear power must bear its own costs, and the principle that nuclear power should not be subsidised remains. New reactors are allowed to be built at existing sites, up to a maximum of ten reactors.

Hydropower has held a central role in Sweden's renewable electricity supply. A continued high production of hydropower is an important part of the efforts to achieve an increased share of electricity from renewable energy sources. No larger expansion of hydropower is planned but an upgrade of existing plants with modern environmental permits will take place.

The renewable energy will continue to be expanded. Sweden has a good potential for renewable electricity production, and it is reasonable to assume that Sweden is a net exporter of electricity also in the long term. By, for instance, efficient use of existing hydro power and bio energy the power output can be increased. The power issue is important to consider when it comes to expansion of renewable electricity production. Considerations must be taken to the varying needs over the year and situations with low electricity prices.

3.7.2 MARKET PLAYERS

Swedegas in the only gas TSO in Sweden and in June 2013 Swedegas was appointed system responsible for the Swedish natural gas system. Before that, Svenska Kraftnät, a state owned authority, had that responsibility. Since 15 April 2015, Swedegas is owned by the Spanish and Belgian TSOs – Enagás and Fluxys (50% each).

The Swedish natural gas system consists of five distribution areas which are owned and operated by the distributors (DSOs): E.ON Gas Sverige, Göteborgs Energi Gasnät, Kraftringen nät, Varberg Energi and Öresundskraft. The transmission grid is also connected to a smaller underground gas storage, Skallen, owned and operated by Swedegas.

There are nine Gas Suppliers (GS) active on the gas market from which the end-users can choose. Each GS are connected to one of the five Balance Administrators (BA) who have the financial responsibility for ensuring that the balance between gas supplied and withdrawn is maintained at the supply and offtake points covered by the BA.

The DSOs and the end users directly connected to the Swedegas transmission grid book capacity in the grid. End users in the DSOs book capacity from the DSOs.

Sweden only has one interconnection point, Dragør, where gas can be transferred from Denmark to Sweden. The BAs can via Shippers in Denmark book capacity at Dragør and then supply the Swedish customers. This means that there is an absence of booking procedures for capacity in Sweden between the TSO and the BAs.

Image courtesy of Swedegas

3.7.3 ENERGY MIX

The energy mix in Sweden is dominated by biofuel, oil, hydro and nuclear. The total energy supply 2015 amounted 525 TWh with a net electricity export of 23 TWh.

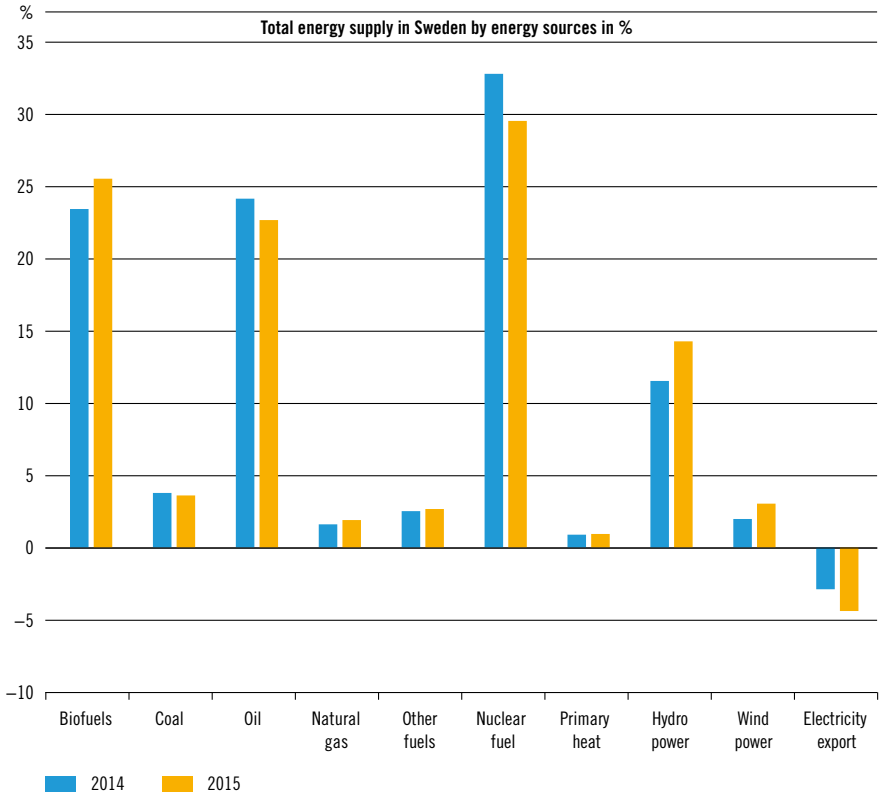


Figure 3.41: Total energy supply by energy sources in TWh, 2015 (Source: Swedish Energy Agency)

In 2015, mainly hydro and nuclear power accounted for the most part of electricity production as seen below.

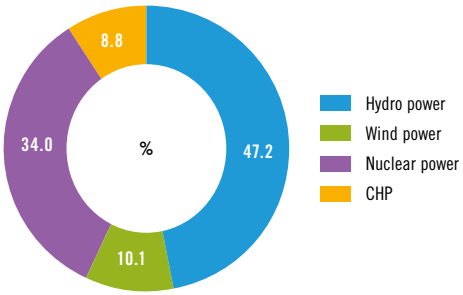


Figure 3.42: Electricity production (net production) by type of power, 2015
(Source: Swedish Energy Agency)

Regarding the fuels used for district heat and CHP production, biofuels accounts for the largest part.

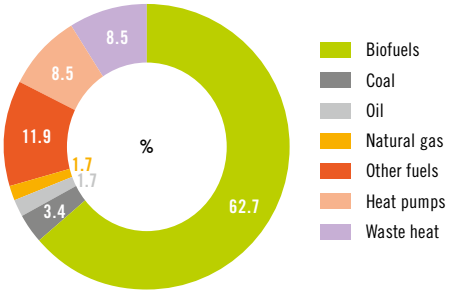


Figure 3.43: Fuels used for district heat and CHP production, 2015
(Source: Swedish Energy Agency)

All the natural gas is imported from Denmark through the interconnection point, Dragør. The total yearly volume of natural gas (and biogas) is usually around 10 TWh but in 2010 the system had a peak of 19 TWh. This was due to a cold winter and the fact that the gas-fired CHP plants were used at a high level. In 2015 the total yearly volume was 10 TWh.

3.7.4 MARKET INDICATORS, SUPPLY AND DEMAND

The Swedish gas market is mainly based on imports from Denmark. An increasing volume of biogas each year is the other input volume in the gas system (Ten biogas facilities are connected to the transmission or distribution grids). There are two LNG terminals in Sweden but they are not connected to the transmission grid.

The volume of natural gas distributed in Sweden has been quite stable during the last years. It is hard to predict how the volume of natural gas will change in the future. Much depends on the future of the three nuclear plants in Sweden, which has been much debated in recent years.

The gas market, connected to the transmission grid, has approximately 37,000 customers of which households amount to 33,400. Half of the households use natural gas for heating and cooking while the rest use it for cooking only. However, these customers use only 2% of the total amount of the consumed gas. The remaining customers consist of CHP units, district heating units and larger industries. The 60 largest customers use approximately 80% of the total volume.

An LNG terminal is planned to be built in Gothenburg and would then be connected to the transmission grid. By this new source of gas the system would be less vulnerable.

YEARLY GAS DEMAND AND PEAK-DAY DEMAND FORECAST FOR THE PERIOD OF 2017–2025

		2017	2018	2019	2020	2021	2022	2023	2024	2025
BLUE SCENARIO	YEARLY GAS DEMAND [GWh/year]	10,944	11,822	12,699	13,577	13,659	13,741	13,823	13,905	13,987
	PEAK-DAY DEMAND [GWh/day]	91.0	92.0	93.5	95.0	95.0	95.0	95.0	95.0	96.0
GREEN SCENARIO	YEARLY GAS DEMAND [GWh/year]	10,944	11,254	11,563	11,873	12,019	12,165	12,311	12,457	12,603
	PEAK-DAY DEMAND [GWh/day]	91.0	92.0	93.5	95.0	95.0	95.0	95.0	95.0	96.0

Table 3.4: Yearly gas demand and peak day demand forecast for the period of 2017–2025

3.7.5 LEGAL FRAMEWORK DEVELOPMENT

The Swedish gas market is regulated by the Natural Gas Act from 2005. Energimarknadsinspektionen (Ei) is the acting regulator (NRA) who ensures that actors on the gas market comply with the Natural Gas Act. The Third Energy Package was fully implemented in 2012.

The market model for the natural gas market was finalised in 2007 and is based on the electricity market model. The Danish market is used by the gas actors to book capacities. Hence, no capacity trading between shippers and the TSO exists in Sweden.

Swedegas is together with the market working on implementation of EU legislation and specifically the network codes. The balancing network code has been implemented with an interim solution and more network codes will be implemented the upcoming years.

Swedegas and Energinet.dk (Danish TSO) are investigating if a joint balancing zone can have net positive effects on the development of the Swedish and Danish gas markets. A project will be launched to analyse the expected cost and benefits and recommend a decision (go/no go) to the respective decision bodies of Swedegas and Energinet.dk in 2017.

3.7.6 OFFGRID MARKET DEVELOPMENT IN THE AREA OF LNG AND BIOGAS

Gasnätet Stockholm is a regional gas grid not connected to the transmission grid. It consists of two parts – one grid for households and industries, and one for vehicles. The grid is supplied by trucks with LNG (from the LNG terminal in Nynäshamn) and by three biogas facilities. In 2015, 65,000 customers in the grid was supplied by more than 200 GWh natural and biogas.

There are a few more small gas grids in Sweden not connected to the transmission grid. They usually have one or a few biogas facilities supplying the customers.

Since the biogas and LNG markets are foreseen to grow in Sweden, more regional gas grids may be needed in the future to augment the current transmission grid in south-western Sweden.

Image courtesy of Gasnätet Stockholm

4 Infrastructure

Image courtesy of Gasum

4.1 Short Introduction of Planned Regional Projects in 2017–2026 + Regional Map

In the BEMIP region there are planned in total 16 pipeline projects, seven LNG terminal projects and three UGS projects. The projects aim to bring a number of benefits to the countries of the BEMIP region. Some of the benefits include increasing security of gas supply, integrating isolated gas markets, improving competition in the region and diversifying gas supplies.

The planned projects of the BEMIP region are listed in the tables below and illustrated on the below map. The list provides general parameters of the projects. Full description of the projects can be found in the Annex.

TRANSPORT BY PIPELINES PROJECTS				
Project ENTSOG code	Project name	Project promoter	Project status	PCI status
DENMARK				
• TRA-N-428	(Mirror) Baltic Pipe	Energinet.dk	Non-FID	PCI
• TRA-N-394	Gassled – Danish upstream system	Energinet.dk	Non-FID	Non-PCI
TRA-N-780	Nybro-Interconnector PL–DK – reinforcement	Energinet.dk	Non-FID	Non-PCI
ESTONIA				
TRA-N-895	Balticconnector	Elering AS	Advanced	PCI
TRA-N-915	Enhancement of Estonia–Latvia interconnection	Elering AS	Advanced	PCI
FINLAND				
TRA-N-928	Balticconnector Finnish part	Baltic Connector Oy	Advanced	PCI
LATVIA				
TRA-N-382	Enhancement of Latvia-Lithuania interconnection (Latvian part)	JSC Conexus Baltic Grid	Non-FID	PCI
LITHUANIA				
TRA-N-341	Gas Interconnection Poland–Lithuania (GIPL) (Lithuania's section)	AB Amber Grid	Advanced	PCI
TRA-N-342	Enhancement of Latvia–Lithuania interconnection (Lithuania's part)	AB Amber Grid	Non-FID	PCI
POLAND				
TRA-N-212	Gas Interconnection Poland-Lithuania (GIPL) PL section	GAZ-SYSTEM S.A.	Advanced	PCI
TRA-N-247	North-South Gas Corridor in Western Poland	GAZ-SYSTEM S.A.	Advanced	PCI
TRA-N-273	Poland–Czech Republic interconnection (PL section)	GAZ-SYSTEM S.A.	Advanced	PCI
TRA-N-275	Poland-Slovakia interconnection (PL section)	GAZ-SYSTEM S.A.	Advanced	PCI
TRA-N-245	North-South Gas Corridor in Eastern Poland	GAZ-SYSTEM S.A.	Non-FID	PCI
TRA-N-271	Poland-Denmark interconnection (Baltic Pipe) PL section	GAZ-SYSTEM S.A.	Non-FID	PCI
TRA-N-621	Poland-Ukraine Interconnector (PL section)	GAZ-SYSTEM S.A.	Non-FID	Non-PCI

• Project not marked on the map

Table 4.1: List of pipeline projects planned in the BEMIP region

LNG IMPORT TERMINALS PROJECTS				
Project ENTSOG code	Project name	Project promoter	Project status	PCI status
ESTONIA				
LNG-N-079	Paldiski LNG Terminal	Balti Gaas	Advanced	PCI
LNG-N-962	Tallinn LNG	Vopak E.O.S. AS/ Vopak LNG Holdings B.V/ Port of Tallinn AS	Non-FID	PCI
LATVIA				
LNG-N-912	Skulte LNG	AS Skulte LNG terminal	Advanced	PCI
LITHUANIA				
LNG-N-824	LNG Terminal in Klaipėda	AB Klaipedos Nafta	Non-FID	Non-PCI
POLAND				
LNG-N-272	Upgrade of LNG terminal in Świnoujście	GAZ-SYSTEM S.A.	Non-FID	PCI
• LNG-N-947	FSRU Polish Baltic Sea Coast	GAZ-SYSTEM S.A.	Non-FID	Non-PCI
SWEDEN				
LNG-N-032	Project GO4LNG LNG terminal Gothenburg	Swedegas	Advanced	PCI

• Project not marked on the map

Table 4.2: List of LNG import terminal projects planned in the BEMIP region

UNDERGROUND GAS STORAGE FACILITIES PROJECTS				
Project ENTSOG code	Project name	Project promoter	Project status	PCI status
LATVIA				
UGS-N-374	Enhancement of Inčukalns UGS	JSC Conexus Baltic Grid	Advanced	PCI
LITHUANIA				
UGS-N-034	Syderiai	Lietuvos Energija	Non-FID	Non-PCI
POLAND				
UGS-N-914	UGS Damasławek	GAZ-SYSTEM S.A.	Non-FID	Non-PCI

Table 4.3: List of underground gas storage projects planned in the BEMIP region

Figure 4.1: Map of planned infrastructure projects in the BEMIP region

4.2 Denmark

4.2.1 GAS TRANSMISSION AND DISTRIBUTION NETWORK DEVELOPMENT

The natural gas transmission network covers most of Denmark and runs a total of approx. 950 km in length. The oldest sections were built in the 1980s and the most section in 2013, when a project co-financed by the EU resulted in a doubling of the connection to Germany and a compressor station to provide the required pressure. A maintenance program ensures that the system will be able to remain safe and operational for decades to come. The central control room is located by the compressor station in Egtved (see figure 4.2) and is always staffed. The control centre facilitates the supply of gas from the Danish part of the North Sea and from Germany as well as the export to Germany and Sweden. The system is furthermore linked to two storage facilities. Both the transmission system and the storage facilities are owned by Energinet.dk.

Figure 4.2: The Danish gas production, storage and transmission system

The gas reaches the majority of the customers through 17,000 km of distribution pipelines owned by four distribution companies, which are among the active players on the retail market. In 2016, Energinet.dk has bought one of the distribution companies. Energinet.dk is also in the process of buying the offshore natural gas pipelines from DONG together with other assets.

Currently, a feasibility study (partly financed by the EU) conducted by Energinet.dk and GAZ SYSTEM (Polish Gas TSO) is investigating the basis for linking the Danish and Polish gas markets through a new transmission line (Baltic Pipe) with PCI status. With respect to this, it is being studied how the Danish and Norwegian gas systems could be linked in order to increase security of supply for the Danish and Polish markets. The study will be concluded at the beginning of 2017.

4.2.2 CONSOLIDATION OF THE DANISH GAS INFRASTRUCTURE

Currently, a consolidation of the Danish gas infrastructure is taking place. Energinet.dk acquired the gas storage facility Stenlille in 2014[3)] and 30 September 2016 took ownership over one of the four gas distribution companies in Denmark (DONG's distribution grid).

Moreover, Energinet.dk is obliged to acquire DONG's offshore gas pipeline from the North Sea Platforms to the mainland (and the corresponding oil pipeline in the North Sea). At the time of writing, negotiations are still on-going.

4.2.3 BIOGAS INFRASTRUCTURE DEVELOPMENT

2016 is expected to undergo the largest increase in biogas production. At the current rate, production is expected to exceed 2,500 GWh, of which more than one-third will be upgraded to biomethane and injected into the natural gas network. In comparison, the total production in 2012 was 1,200 GWh, which was nearly all used for production of electricity and heat. This trend is expected to continue with an estimated total production of approx. 4,200 GWh in 2020, where more than 1,500 GWh is expected to be upgraded and injected into the natural gas network.

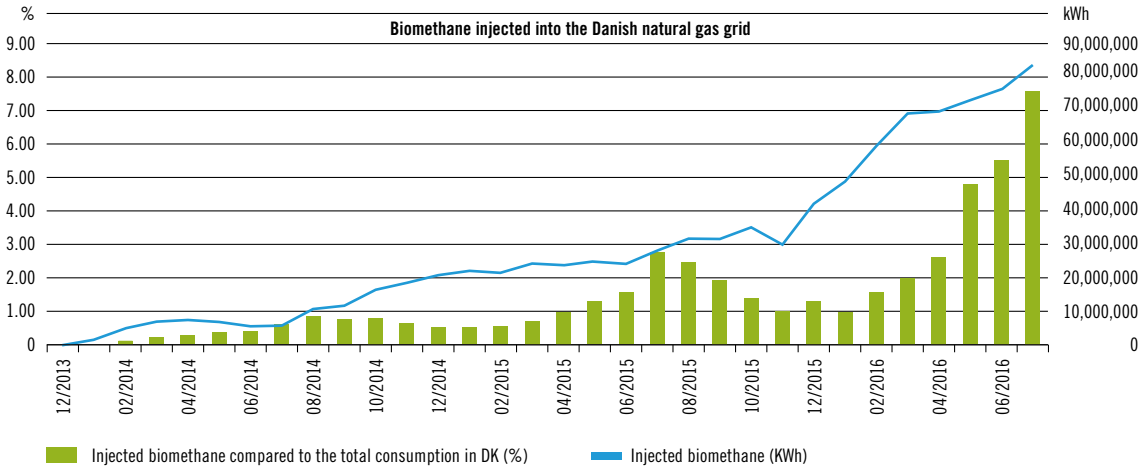


Figure 4.3: Historical development of biomethane injected into the Danish natural gas grid (Source: Energinet.dk)

Biomethane infrastructure – upgraded biogas injected to the grid – is developing rather rapidly in Denmark, see figure 4.3.

By July 2016, 18 plants have been interconnected since 2014 and a number of other plants are to be connected. One biomethane plant is connected directly to the transmission grid while the rest are connected at the distribution grid level. The Danish Energy Authority estimates that biomethane in the grid could reach 5 % of total Danish gas consumption by 2018.

In a limited number of distribution grids injection of biomethane will exceed local gas consumption during summer breaks if current trend is continued. This development will call for new market – or technical solutions (e. g. flexibility services or reverse flow plants).

3) Following the purchase of the Stenlille storage facility, both Danish storage facilities are now owned by Energinet.dk as a separate commercial company – Energinet.dk Gas Storage.

Figure 4.4: Biogas upgrading plants connected to the natural gas grid in Denmark (Source: Energinet.dk)

4.2.4 DEVELOPMENT IN GAS FILLING STATIONS

Energinet.dk supports market actors in establishing alternative fuel structures by providing access to analyses, data etc. but is not investing in the CNG nor LNG infrastructures. Energinet.dk is also active in international collaboration and information exchange within this area. DSOs have been active in facilitating and investing in the CNG infrastructure.

CNG is characterised by a first-mover market where municipalities with climate goals are the main actors for using CNG in local fleets of buses, garbage trucks etc. The Danish Government is planning for electric vehicles in the light-duty vehicle market, for instance, through tax reductions. Gas is only being considered as fuel for heavy-duty vehicles. The expectation is a modest expansion of CNG infrastructure and fleets in the coming years. Changes in taxation schemes are deemed necessary for large-scale expansion.

LNG is not being used or promoted for heavy-duty vehicles. The majority of existing refuelling points are intended for bus fleets and garbage-collection trucks. 13 CNG refuelling stations are in operation in ten cities. Approx. 13 new stations are in planning or under consideration. Figure 4.5 shows the existing and planned gas filling stations in Denmark.

Figure 4.5: Existing and planned gas filling stations in Denmark (Source: Energinet.dk)

Several Danish harbours are looking into LNG bunkering and/or small scale liquefaction stations, seeing a potential growing market for LNG for ships.

4.2.5 LNG INFRASTRUCTURE DEVELOPMENT

A limited LNG infrastructure is being established in Denmark, but small scale liquefaction projects are under consideration in several ports. Expectations of expanding maritime LNG market are a main driver for projects.

LNG is used by three ferries – *Prinsesse Isabella* of Samsø Rederi and *MS Stavangerfjord* and *MS Bergensfjord* of Fjordlines. *MS Stavangerfjord* and *MS Bergensfjord* are the first and largest cruise ferries in the world to use "single fuelled LNG engines", meaning that the ships are powered exclusively by LNG.

Image courtesy of Fjordlines/Espen Gees

4.3 Estonia

The Estonian gas transmission pipeline is owned and operated by Elering, the joint transmission system operator for electricity and gas. Estonian gas transmission pipeline consists of 885 km of transmission pipeline, three gas measuring stations and 36 gas distribution stations.

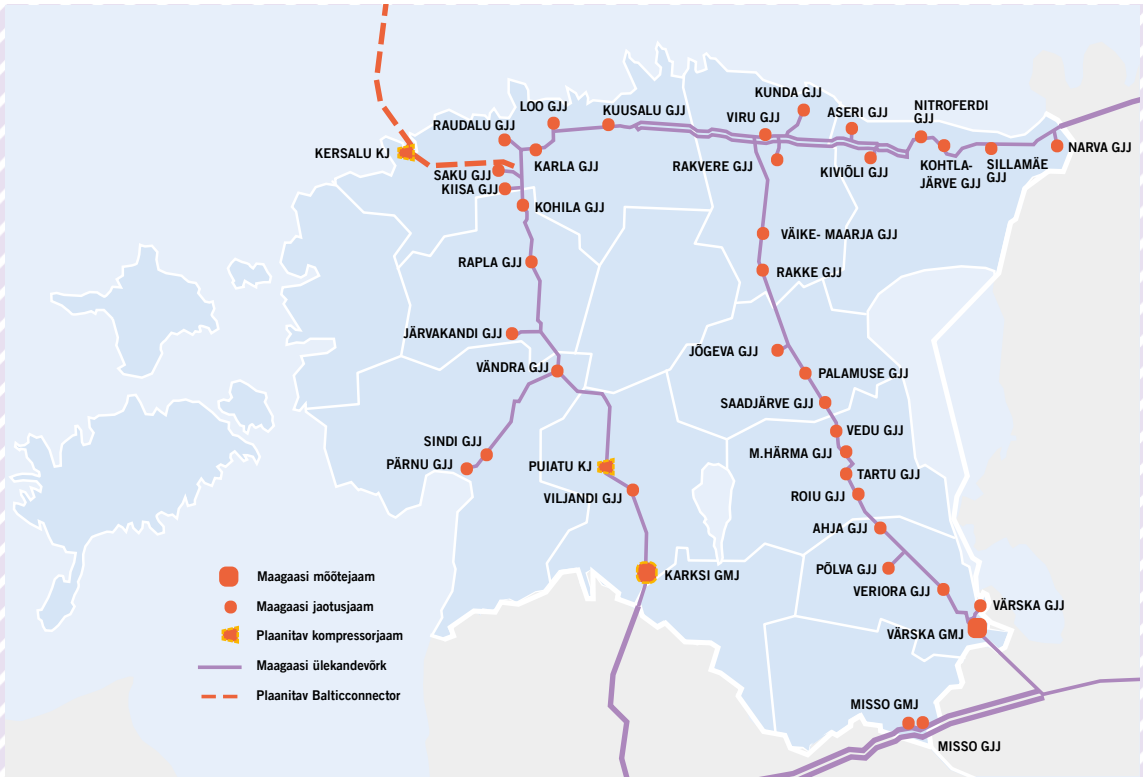


Figure 4.6: Gas transmission network of Estonia

4.3.1 GAS TRANSMISSION NETWORK

Currently the gas transmission network is connected to Russian (at Värska GMS and Narva interconnection point) and to Latvian (at Karksi GMS) gas networks. Majority of the pipeline was built 30–60 years ago. A newer branch pipeline to Pärnu was built ten years ago. Also two parallel pipelines are crossing Estonia in the southeast area. The parallel pipelines are used for gas transportation between Russia and Latvia.

Majority of the pipeline is designed to operate at 50 bar (Maximum operating pressure). Currently only the northern pipeline (connecting Tallinn and Narva interconnection point) is limited to 30 bar.

During the summer season gas is typically supplied through Värska GMS and Narva interconnection point. During the winter season gas is typically supplied from Inčukalns UGS through Karksi GMS and Värska GMS.

PIPELINE INFORMATION OF ESTONIAN GAS TRANSMISSION NETWORK				
Pipeline	**Length [km]**	**DN (nominal Diameter) [mm]**	**MOP (Maximum Operating Pressure) [barg]**	**Age [years]**
Vireši–Tallinn	202.4	700	49,6	25
Vändra–Pärnu	50.2	250	54,0	11
Tallinn–Kohtla-Järve I	97.5	200	≤ 30	64
Tallinn–Kohtla-Järve II	149.1	500	≤ 30	49
Kohtla-Järve–Narva	45.1	350/400	≤ 30	57
Tartu–Rakvere	133.2	500	42.5	38
Izborsk–Värska GMS	10.1	500	50.8	42
Värska GMS–Tartu	75.6	500	44.6	42
Izborsk–Inčukalns	21.3	700	49.2	33
Pskov–Riga	21.3	700	51.4	45
Branch pipelines	79.2			
Total	885			

Table 4.4: Pipeline information of Estonian gas transmission network

4.3.2 PIPELINE DEVELOPMENT PROJECTS

Currently, there are two major gas transmission development projects underway in Estonia – Balticconnector pipeline and Enhancement of Estonia-Latvia interconnection project (PCI 8.1.1 and 8.2.2, respectively). The projects will connect the Baltic and Finnish gas networks and help to diversify sources and routes, and will enable competition on the regional gas market.

The Balticconnector project consists of a subsea bidirectional pipeline between Inkoo, Finland and Paldiski, Estonia along with grid enhancements in both countries. The transit capacity of the offshore pipeline will be 81.2 GWh/d and the compressor stations in Finland and Estonia enable transit flows between the two countries.

The Enhancement of Estonia-Latvia interconnection project consists of making the Karksi GMS bi-directional (currently gas can only flow into Estonia from Karksi GMS), increasing the capacity of GMS and building of compressor station in Puiatu. The compressor station in Puiatu is necessary for enabling transit flows between Finland and Baltic countries.

4.3.3 LNG TERMINAL PROJECTS

Currently there are two LNG terminal development projects in Estonia with a regional scope. The LNG terminals would serve the regional gas market of Finland and Baltic countries and increase the security of supply of the region. Paldiski LNG terminal's planned capacity is 180,000–320,000 m³ of LNG and Tallinn LNG terminal's planned capacity is 320,000 m³ of LNG.

4.4 Finland

4.4.1 GAS TRANSMISSION AND DISTRIBUTION NETWORK DEVELOPMENT

The network of natural gas pipelines covers the south-eastern and southern parts of Finland. In this area, Gasum is the natural gas transmission network system operator in Finland. Gasum owns the pipelines needed for natural gas transmission and is responsible for network maintenance and development.

Figure 4.7: Natural gas transmission network, Finland

The natural gas transmission network covers the south-eastern and southern parts of Finland and totals around 1,300 km in length. The oldest part of the transmission pipeline system was built in the early 1970s and major enlargements were made in 1980s and 1990s. The last major extension to the transmission pipeline system was built in the 2000s. Preventative maintenance helps to ensure the transmission network remains safe and reliable. The central control room of the transmission system is located at Gasum's Natural Gas Centre in Kouvola. The central control room is staffed 24/7 throughout the year. The length of natural gas distribution system is about 2,000 km.

The gas distribution system is owned and operated by 23 different distribution companies in Finland and most of those are at the same time retail gas sellers and distribution system operators. The total length of the gas distribution system in Finland is about 2,000 km.

At the moment, the only gas transmission development project in Finland is the Balticconnector pipeline. The Balticconnector pipeline, which is promoted by Baltic Connector Oy, consists of a subsea bi-directional pipeline between Inkoo, Finland

and Paldiski, Estonia along with grid enhancements in both countries. The transit capacity of the offshore pipeline will be 81.2 GWh/d, 300,000 cm/h and the compressor stations (CS) in Finland and Estonia enable transit flows between Finland to Estonia. Once commissioned, the Balticconnector will connect the Finnish and Baltic gas infrastructures. The Balticconnector will play an important role in integrating Finnish gas markets to the Baltic gas markets. Once the market area is interconnected, there is a possibility of implementing a single merged market zone for Finland and the Baltic States.

The Balticconnector project is a PCI project and the promoter received major EU grants in 2016. The investment decision was made in autumn 2016 and the commissioning of the pipeline will take place early 2020.

4.4.2 BIOGAS INFRASTRUCTURE DEVELOPMENT

Biogas infrastructure is developing rather rapidly and it can be categorised in two: digestion plant sand methane collection from landfills. In 2015, there were 43 digestion biogas plants in Finland and 40 landfills, where biomethane is collected. Five of the digestion based biogas plants were connected to the gas transmissions or distribution pipelines in 2016.

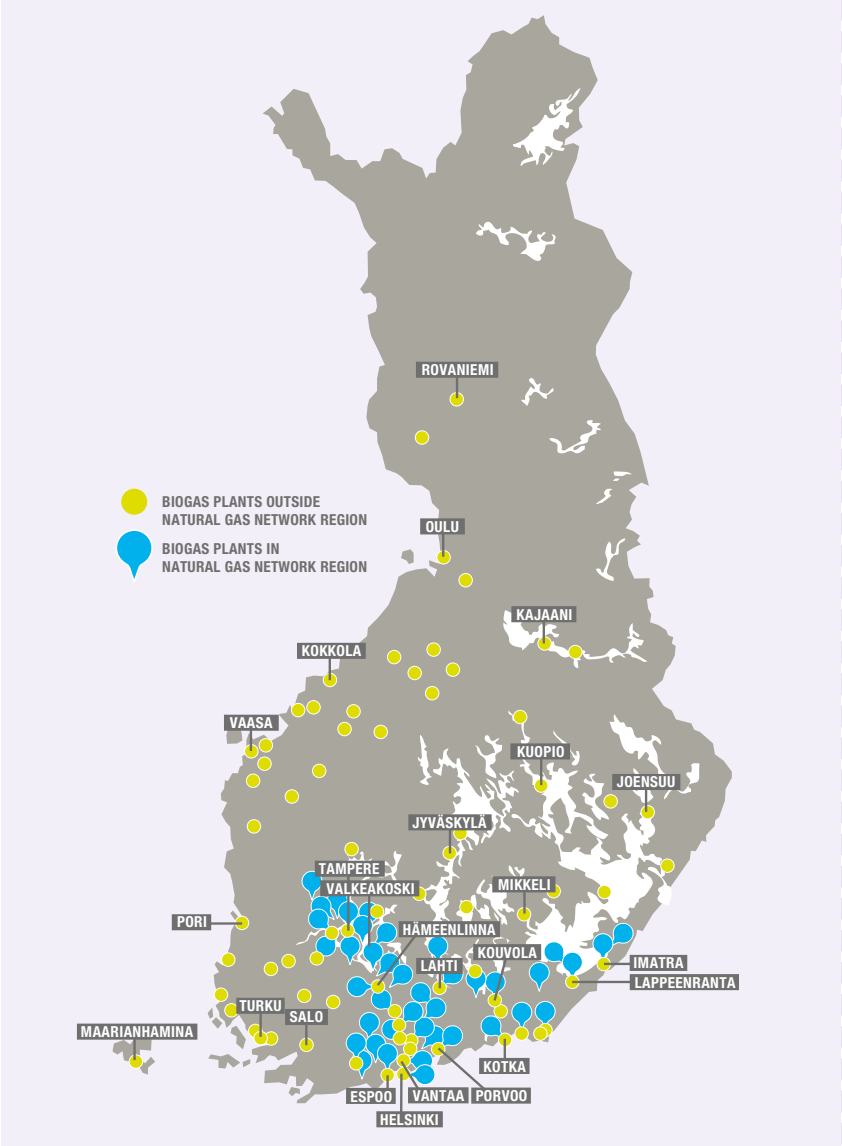


Figure 4.8: Biogas plants in Finland (Source: Suomen Kaasuyhdistys)

4.4.3 GAS FILLING STATION DEVELOPMENT

The development of filling station network in Finland has been developing during recent years steadily and there are about 24 filling stations for CNG in the southern part of Finland. Gasum is the major operator of filling stations and has currently 18 stations. The number of filling stations is going to increase in the near future remarkably, while Gasum announced their target of building 35 more stations by 2025. The stations will include grid-connected stations and offgrid filling stations that are supplied either by local biogas production or by containers supplying CNG or LNG. Additionally Gasum commissioned two LNG filling stations for heavy vehicle use in 2016, and two more in 2017.

4.4.4 LNG INFRASTRUCTURE DEVELOPMENT

The LNG infrastructure is currently under construction in Finland. Pori terminal was developed by Skangas and was commissioned in autumn 2016. The Tornio terminal was developed by the Manga consortium and will be commissioned at the beginning of 2018. The Pori terminal capacity is 30,000 m³ and a distribution pipeline will supply LNG to the local industry while trucks supply LNG to other industries and energy producers. The terminal will be also be utilised to ship bunkering. The Tornio terminal has a capacity of 50,000 m³ and it will supply local industry via local pipelines and other locations via trucks. Ship bunkering is also possible from the Tornio terminal. Haminan Energia Oy is planning to build a LNG terminal to be connected into the local gas distribution system in the city of Hamina. The terminal is in the engineering phase and planned capacity is 30,000 m³. The Hamina project schedule targets a commissioning date in 2019.

Image courtesy of Gasum

Figure 4.8: CNG-filling stations in Finland (Source: Gasum)

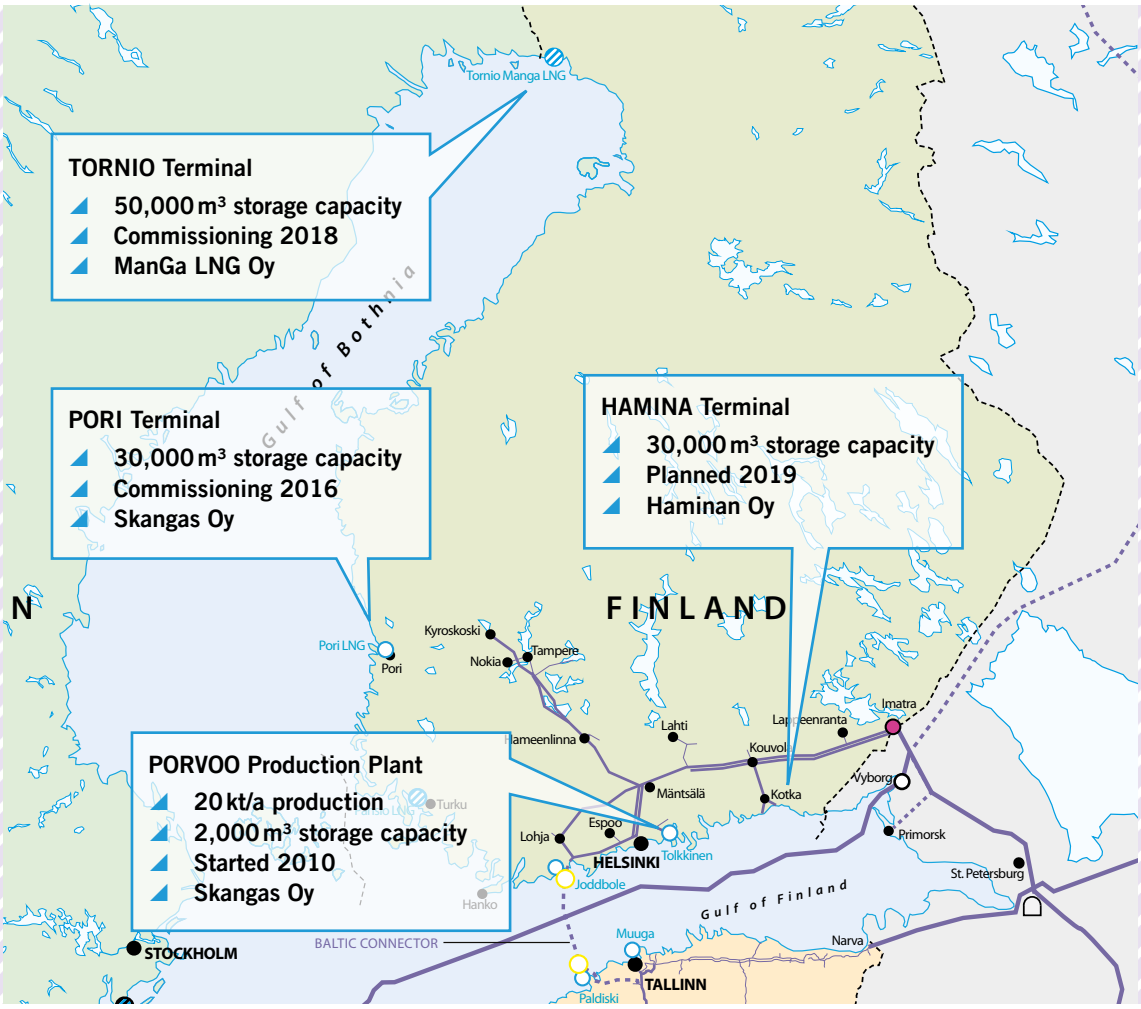


Figure 4.9: LNG import and production infrastructure in Finland

4.5 Latvia

There is no indigenous gas production in Latvia, and all gas consumed in the country is imported from Russia through two 700 mm pipelines. This is performed only during the warm period of the year (April-September) when part of the received gas is injected into Inčukalns Underground Gas Storage, while the rest is delivered directly to consumers. During winter, gas from the underground facility was formerly delivered to Latvian customers, as well as customers in Estonia and NW Russia thus securing reliable gas supply for the whole region.

However, in summer of 2016 only volumes of gas to be used by customers in Latvia were injected into the storage following the decision of Gazprom not to use Incukalns UGS for customers in Russia since after enhancement of gas transmission network in the Russian NW region there are enough capacities in the network to supply customers directly by pipeline.

Latvia has gas connection to Lithuania. Due to several reasons during 2015, the natural gas price in Lithuania was lower than in Estonia. Almost 100 million m³ were delivered from Lithuania to Estonia via Latvia through this connection. This interconnection is also used in emergency cases for gas supplied to Lithuania or in cases of construction works or other situations when there is a need to supply some customers in Latvia from the Lithuanian side. It is expected that the importance of this interconnection will increase after the gas market opens in Latvia in 2017 and, especially, after commissioning the gas interconnection between Poland in Lithuania (GIPL). The project of enhancing the Latvia–Lithuania interconnection is included in the list of the Projects of Common Interest.

Latvian gas is interconnected with Estonia. However, it can currently only be used to supply gas supply to Estonia from Latvia and it was mainly used to supply customers in Estonia from Inčukalns UGS.

Since the first natural gas supplies to Latvia began in 1962, part of the gas network is old and the entire transmission system is designed for annual consumption of up to 4 bcm, more than two times the current consumption level in Latvia. After privatisation of JSC “Latvijas Gāze” in 1997, assessment of the technical state of infrastructure was carried out and the entire gas supply system in Latvia was modernised step-by-step.

Extensive modernisation was performed over the past decade, and from 1997 until the end of 2015, JSC “Latvijas Gāze” spent 447 million euros modernising and improving safety.

4.5.1 GAS TRANSMISSION AND DISTRIBUTION SYSTEMS

Figure 4.10: Natural gas infrastructure in Latvia.

The total length of the gas transmission pipelines in Latvia is 1,193 km. The first gas transmission pipeline to Latvia was built in 1962. In general, 25 % of pipelines are more than 40 years old. However, since the entire network is covered by the cathode-protection system and is inspected on a regular basis, defects are quickly repaired and the pipelines remain in good condition.

The total length of the gas distribution network in Latvia is 5,040 km. There is a well-developed cathode protection system in place for metal pipelines. In general, all gas regulation stations and units recently are reconstructed or replaced with modern ones, as well as cathode protection system. The entire distribution system is supervised by SCADA.

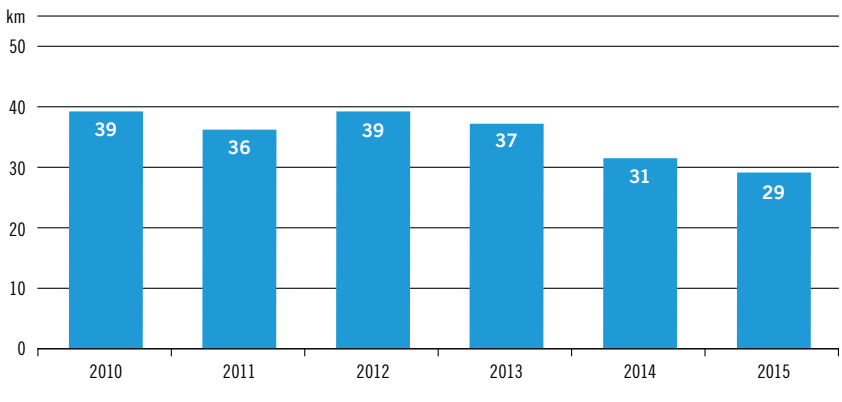


Figure 4.11: Construction of new distribution pipelines (km)

4.5.2 INČUKALNS UNDERGROUND GAS STORAGE

Total volume of Inčukalns UGS is 4.4 bcm, including working gas volume of 2.3 bcm.

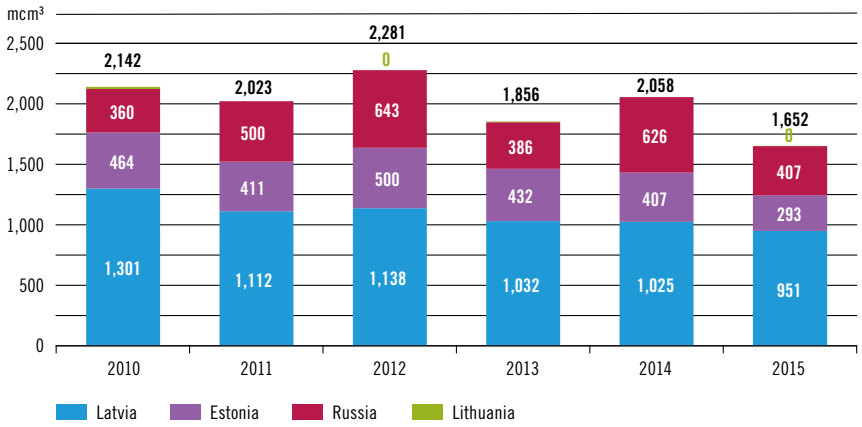


Figure 4.12: Natural gas supply from Inčukalns UGS per country (million m³)

Since Inčukalns UGS commenced operation back in 1968, overall modernisation were required in order to meet the modern gas storage standards. Before work commenced, a few technical studies were carried out with the aim of deciding on the necessary modernisation and replacement measures. For example, the German company "UGS Mittenwalde GmbH" performed a safety analysis for Inčukalns UGS and a few technical studies were performed by "Gazpromenergodiagnistica". In December 2011, scientific institute VNIIGAZ completed extensive investigation of the equipment condition at the Inčukalns UGS site and, based on the results, created modernisation plans for the technical equipment and specified improvements for operational safety at Inčukalns Underground Gas Storage. Based on these studies, a modernisation and safety improvement plan was developed and is being implemented on a step-by-step basis. Within the framework of the European Energy Program for recovery modernisation of 17 wells in Inčukalns UGS were financed from European EERP fund. The enhancement project for Inčukalns UGS is included in the 1st and 2nd list of European Projects of Common Interest. Taking into consideration the changing market situation in the Eastern Baltic region, JSC "Conexus Baltic Grid" is commencing a feasibility study on to increase the flexibility of storage and thus use it as a strategic storage for security of supply, which is co-financed by CEF fund.

Taking into consideration the latest developments in the region, including, decrease of gas consumption, as well as uncertainty regarding the volumes of gas kept in storage by JSC "Gazprom" in the future, which has negative impact on Inčukalns UGS commercial performance, it is important to realise that without successful operation of the storage it is not possible to realise an efficient and safe supply of gas for the entire region. Since th East-Baltic region has no natural gas production facility, Inčukalns UGS is the only absolutely reliable source of gas there. Moreover, such projects as GIPL and Balticconnector will benefit from the successful implementation of the Inčukalns UGS enhancement project.

4.6 Lithuania

Lithuania's gas transmission system consists of 2,115 km of high pressure, 70 gas distribution stations and gas metering stations, and two compressor stations (42.2 MW).

The gas transmission pipeline is interconnected with the Belarus gas system (maximum cross-border capacity 325.4 GWh/d), through which gas is supplied to Lithuania's consumers and transported to the Kaliningrad Region of the Russian Federation, the LNG terminal in Klaipėda with maximum capacity of 122.4 GWh/d, a bi-directional interconnection with Latvia, providing maximum cross-border capacity from Latvia with 65.1 GWh/d, and to Latvia with 67.6 GWh/d. The gas transmission system of Lithuania is also interconnected with the Kaliningrad Region of the Russian Federation (maximum cross-border capacity: 109.2 GWh/d).

In 2015, AB Amber Grid implemented the capacity enhancement project for the Klaipėda–Kiemėnai pipeline, which was included in the EU PCI list. A second line of the pipeline (110 km in length and 800 mm in diameter) was constructed from Klaipėda, thereby them to take full advantage of the capacity offered at the LNG terminal. The project opened up a possibility to diversify gas supply sources in the Baltic region at a higher level, created conditions for full exploitation of the capacity offered by the LNG terminal, and ensured safe and reliable functioning of the natural gas system.

Another PCI – Gas Interconnection Poland–Lithuania (GIPL project) – is being implemented. The purpose of the GIPL project is to integrate the Baltic State gas markets into a single EU gas market, to diversify the gas supply sources, and to improve the safety of gas supply. AB Amber Grid is responsible for the implementation of the GIPL project in Lithuania, whereas the Polish TSO is responsible for implementing the GIPL project in Poland. In June 2016, the Lithuanian Government approved the GIPL project's special plan, and, in September 2016, the construction permits were obtained. The completion of the project is planned for 2021.

The enhancement project for the Latvia–Lithuania interconnections aims to increase the capacity of the gas systems interconnection between Latvia and Lithuania, thus ensuring safe and reliable supply of natural gas, achieving a more effective use of infrastructure and improving the gas market integration of the Baltic States. The implementation of the project will also contribute to creating better conditions for the use of Latvia's UGS.

4.7 Poland

At the end of 2016, the gas transmission system in Poland consisted of high-pressure gas pipelines with a total length of 10,989 km, 67 entry points, 983 exit points, 896 gas stations, 15 compressor stations and 44 system nodes. The transmission network consists of two cooperating systems covering high- and low-calorific gas.

The gas network in Poland is connected to the European grid, but mainly along the East-West axis. There are six major physical entry points into the transmission network that are located in Drozdowicze (IP with Ukraine), Wysokoje (Belarus), Lwówek and Włocławek (on the Yamal-Europe pipeline), Lasów (Germany), Cieszyn (the Czech Republic). As of June 2016, the transmission system in Poland can also be supplied via the LNG terminal in Świnoujście. The Polish system is also connected with Ukraine in Hermanowice. This point is used to export gas to Ukraine.

GAZ-SYSTEM S.A. completed an investment plan in 2015 that consisted of the construction of the LNG terminal in Świnoujście and more than 1,200 km of new gas pipelines. The majority of domestic pipelines were constructed in north-western Poland to enable efficient distribution of gas from Świnoujście throughout Poland. In addition, GAZ-SYSTEM launched a new cross-border interconnection at the Czech Republic to Cieszyn in September 2011, upgraded an existing interconnection at Lasów to Germany in January 2012 and finally expanded a metering station in Mallnow at the Polish-German border enabling virtual and physical reverse flow at the Polish section of the Yamal-Europe pipeline. The implementation of these projects fostered Poland's energy security through the creation of technical conditions to diversify the natural gas supply.

The working gas volume and injection/withdrawal capacity of the storage facilities in Poland have increased in recent years with the commissioning of investment projects by the storage operator. The working volume currently amounts for approx. 32.5 TWh. The storage operator and GAZ-SYSTEM plan to extend this further.

As part of its 2016–2025 investment plan, GAZ-SYSTEM, in cooperation with the Danish TSO – Energinet.dk, plans to implement the NO–DK–PL project (Baltic Pipe) that will provide a direct access to Norwegian supplies at up to 10 bcm/y for Central-Eastern Europe and the Baltic region at the latest by 2022. Reverse capacity of 3 bcm/y from Poland to Denmark is also foreseen. The company is also investigating the potential for increasing regasification capacity and providing new services at the LNG terminal in Świnoujście. The following additional services are currently considered for ongoing studies: transhipment, bunkering, rail loading and enhanced track loading (the service is already offered). The FSRU terminal in the Bay of Gdańsk is also considered as an alternative investment to the NO–DK–PL project.

GAZ-SYSTEM is cooperating with Amber Grid to implement Gas Interconnection Poland–Lithuania (GIPL). The GIPL project is aimed at establishing a bidirectional interconnection between the gas transmission systems in Poland and Lithuania in order to integrate the isolated gas markets in the Baltic States with the European gas market grids. The project is instrumental in creating an interconnected, diversified and competitive gas market in the East Baltic region.

In addition, more than 2,000 km of new gas pipelines in western, southern and eastern Poland are in planning. Further expansion of the domestic transmission system and the construction of cross-border interconnections with the Czech Republic, Slovakia and Ukraine will enhance Poland's energy security. This will also contribute considerably to the development of an integrated regional gas network that will be able to receive directly significant volumes of gas supplies coming from new sources. The above-mentioned investments together with appropriate regulatory framework are expected to provide the basis for a competitive and secure gas market in the region.

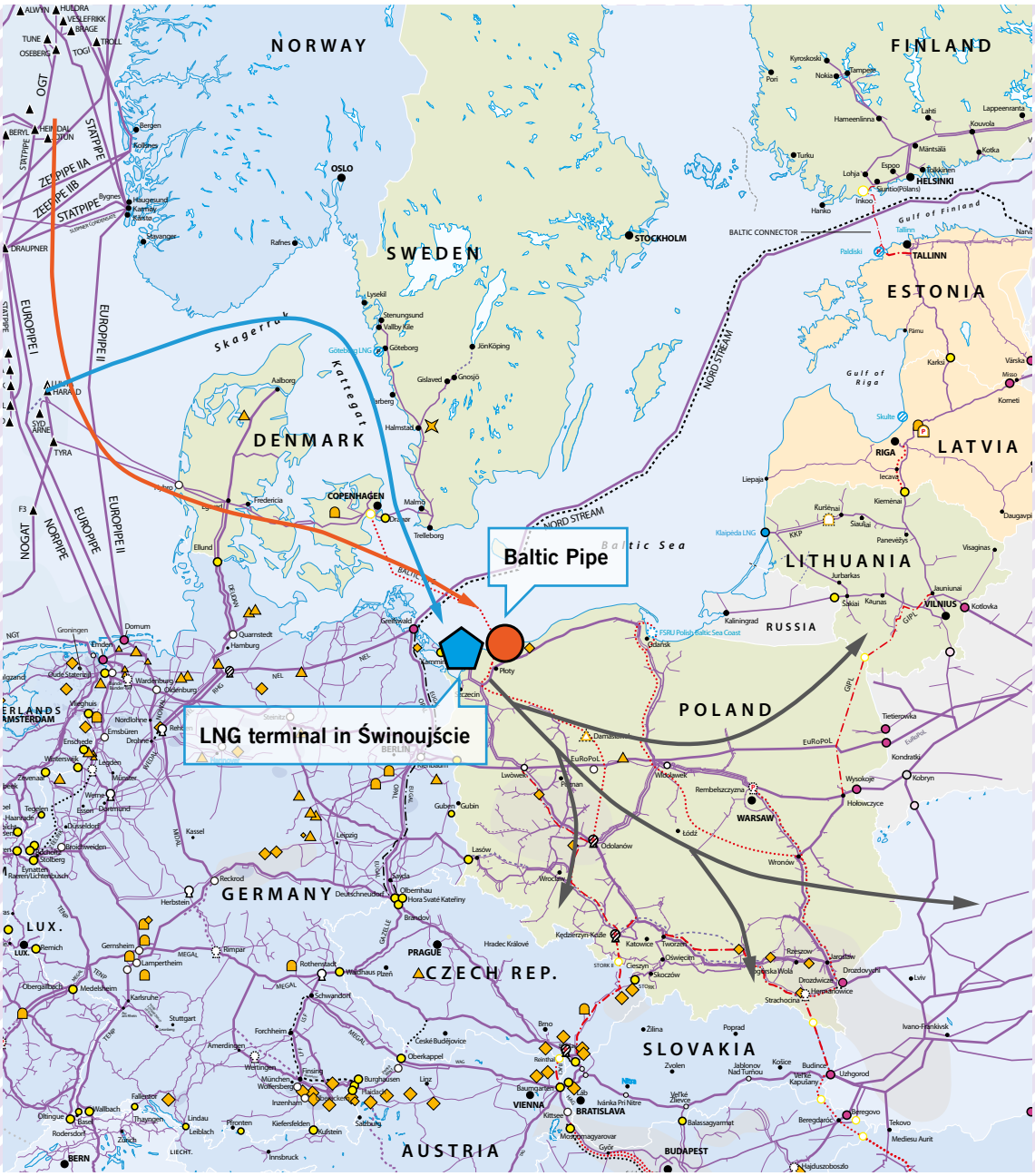


Figure 4.13: Supply and transmission corridors based on Norwegian supplies and LNG

4.8 Sweden

4.8.1 GAS TRANSMISSION AND DISTRIBUTION NETWORK DEVELOPMENT

The construction of the Swedish transmission grid began in 1985. Three years later the grid reached Gothenburg. In 2004, the latest major expansion was made which led to today's transmission grid.

The transmission grid consists of 601 km pipelines, 41 measuring and regulator stations and six gas metering stations located in south-western Sweden. The grid is connected to about 26,000 km of distribution grids. The system has a pipeline interconnection with the Danish gas system with a maximum cross border capacity of 88 GWh/day. This pipeline interconnects Dragør in Denmark with Klagshamn, Sweden. Due to Swedish legislation the gas is odourised on the Swedish side by adding a special chemical in Klagshamn.

The transmission system is connected to an UGS, Skallen storage facility. This rock cavern storage facility, characterised by high input and withdrawal capacity, has a capacity of 10 mcm and can handle pressure in excess of 200 bar. The size of the storage does not allow seasonal storage but is limited to peak-shaving services.

Sweden has a vulnerable supply position due to the single cross-border point in the gas system. This weakness has been mitigated primarily by the Ellund project (increasing capacity between Germany and Denmark). The upcoming LNG terminal in Gothenburg and increasing biogas production will also strengthen the supply position.

Figure 4.14: Natural gas transmission system

4.8.2 BIOGAS INFRASTRUCTURE DEVELOPMENT

Production of biogas is increasing every year and in 2015 there were 282 facilities in Sweden producing almost 2 TWh. Ten of the facilities are connected to the gas grid and they injected around 0.5 TWh. More than 1.1 TWh was used as fuel for vehicles.

The two largest sites are Gobigas and Jordberga and they are both connected to the transmission system. Gobigas is producing biogas through thermal gasification of biofuel and forest residue. It is one of the largest sites of its kind and it was put into operation in 2014. Jordberga, also commissioned in 2014, is an anaerobic digestion plant which mainly uses locally produced energy crops as raw material.

Swedegas is a member of Green Gas Commitment and have therefore committed to a CO_2 neutral gas supply by 2050.

4.8.3 GAS FILLING STATION DEVELOPMENT

The CNG market has grown considerably in Sweden until recent years when it has slowed down. In 2015, almost 1.6 TWh was used as CNG and over 70 % of this share was from biogas. The number of public filling stations was 161.

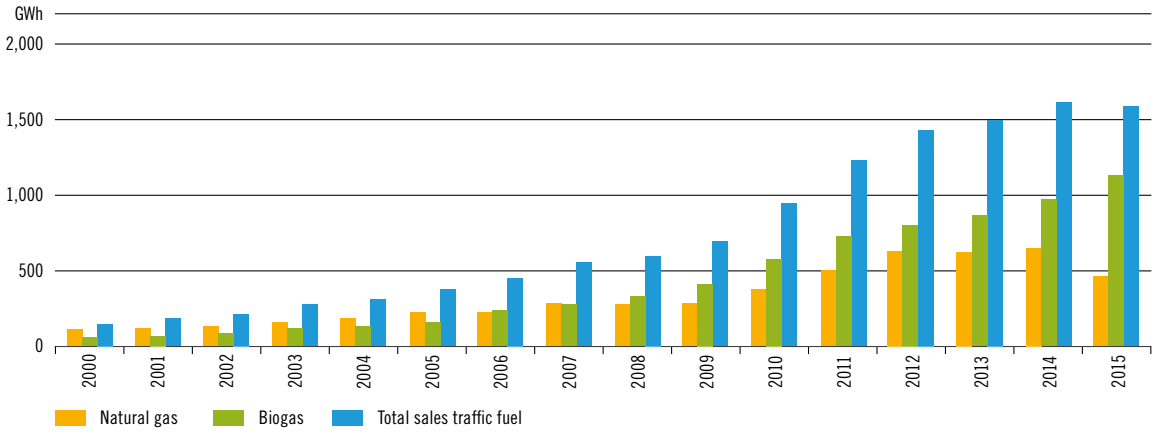


Figure 4.15: Development of CNG divided into natural gas and biogas (Source: Statistiska Centralbyrån)

4.8.4 LNG INFRASTRUCTURE DEVELOPMENT

In Sweden, two LNG terminals are in operation. One has been in operation since 2011 and is located in Nynäshamn, south of Stockholm, and offers a storage capacity of 9,300 tons. Only local refineries are connected to this terminal. The other consumers (industries and the city of Stockholm) are supplied with gas by trucks. In Lysekil, on the Swedish west coast, an LNG terminal has been in operation since 2014. As for Nynäshamn LNG terminal, a small local distribution grid is connected to refineries while other consumers are supplied by truck.

In Gothenburg, an LNG terminal is planned to be built and this terminal, in contrast to the two mentioned above, will be connected to the transmission grid. The project has PCI status, has been granted an environmental permit and a concession application is pending. An open-access terminal to promote competition is at a planning stage at the port of Gothenburg, where anyone who wishes to supply LNG to the Swedish market can contract capacity. Except a connection to the transmission system, the terminal will support railcar loading, truck loading, storage and bunkering. The market segment will consist of regional grids, heavy trucks, offgrid industry, marine and the transmission grid.

5 Modelling Results

Image courtesy of Amber Grid

5.1 ENTSOG TYNDP Modelling Cases

In the TYNDP 2017 report ENTSOG performed several models with different combinations of demand, supply and infrastructure scenarios together with calculation of several indicators. The analysis results can be found from the ENTSOG TYNDP 2017 report and they are not further analysed in this report.

The infrastructure scenarios in the TYNDP 2017 report are categorised as shown in the Figure 5.1 below. The differences in the infrastructure scenarios between the TYNDP 2017 modelled scenarios and BEMIP GRIP additional cases regarding the infrastructure are only between the Low and Advanced infrastructure scenario in the TYNDP 2017. The differences are listed in table 5.1.

This means that there is no additional value obtained from 2nd PCI list and High scenarios of TYNDP 2017 modelling compared to the BEMIP GRIP analysis. Nevertheless, the TYNDP 2017 analysis included more indicators than included in this BEMIP GRIP report.

INFRASTRUCTURE DIFFERENCES BETWEEN TYNDP 2017 AND BEMIP GRIP MODELLINGS

TYNDP 2017 infrastructure scenario	BEMIP GRIP infrastructure case	Difference
Low	Low + GIPL	Compared to TYNDP 2017, BEMIP GRIP scenario includes also: – GIPL project
Advanced	Low including all PCIs in the Baltic States (LT, LV, EE)	Compared to TYNDP 2017, BEMIP GRIP scenario includes also: – Tallinn LNG – Enhancement of Latvia-Lithuania interconnection – Upgrade of LNG terminal in Świnoujście – Baltic Pipe – North–South Gas Corridor in Eastern Poland projects
2nd PCI list	Low including all PCIs in the BEMIP countries	No difference
High	High including all PCIs in the region	No difference

Table 5.1: Infrastructure differences between TYNDP 2017 and BEMIP GRIP modellings

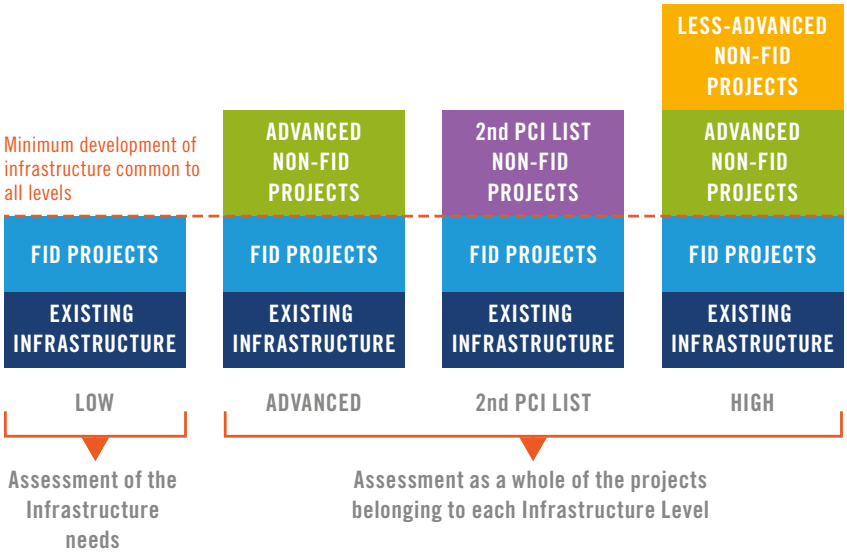


Figure 5.1: Infrastructure Levels (Source: TYNDP 2017)

5.2 BEMIP GRIP Additional Cases

For the BEMIP GRIP 2017 report ENTSOG modelled the various scenarios to complement TYNDP scenarios as specified by the working group.

After consultating with ENTSOG, the analysis for the BEMIP GRIP report was performed on the cases presented in table 5.2 below.

ENTSOG MODELLED CASES FOR BEMIP GRIP REGION				
DEMAND SCENARIO	**DEMAND CASES**	**DISRUPTION CASES**	**INFRASTRUCTURE CASES**	**YEARS TO BE MODELLED**
BLUE SCENARIO	**1-DAY DESIGN CASE (DC)**	No Russian supply to Finland and Baltic States	Low + GIPL	2017 2020 2025
		No Russian supply to Baltic States	Low with PCIs in Baltic states (LT, LV, EE)	
GREEN SCENARIO	**14-DAY UNIFORM RISK CASE (2-W)**	No supply from Belarus to Lithuania	Low including all PCIs in the BEMIP countries	

Table 5.2: ENTSOG modelled cases for BEMIP GRIP regions

The infrastructure cases in the additional BEMIP GRIP cases have an important impact on the results of each country, especially the Baltic States and Finland. Therefore, the content of each infrastructure case needs to be described in more detail.

Low + GIPL

This infrastructure case includes the projects in the BEMIP region listed in 2017 TYNDP under the "Low Infrastructure Level" scenario, meaning that the existing infrastructures and infrastructure projects with FID status (whatever their PCI status is) and in addition to this, the GIPL-project which is the interconnector between Poland and Lithuania.

Low with PCIs in Baltic states (LT, LV, EE)

This infrastructure case includes BEMIP projects listed in 2017 TYNDP under the "Low Infrastructure Level" scenario, meaning that the existing infrastructures and infrastructure projects with FID status (whatever their PCI status is) and also all projects with PCI status in the Baltic States. More specifically, the projects with PCI status in the Baltic States are presented in the Table below.

In this infrastructure case, it should be noted that the pipeline connections between Poland and Lithuania (GIPL) and Estonia and Finland (Balticconnector) contain only the part within the Baltic States and these projects will not increase any import capacities to or from the Baltic States. The intention of BEMIP GRIP was not to model the case as it was done, but instead to include the Polish section of GIPL and the Finnish section of Balticconnector in the infrastructure case. Because of this error, the analysis results in this scenario do not contribute additional information outside the Baltic States. Due to time and resource limitations, ENTSOG was not able to perform the analysis again with the intended infrastructure case.

PROJECTS INCLUDED IN THE LOW WITH PCIs IN BALTIC STATES (LT, LV, EE) INFRASTRUCTURE CASE			
Type	**Code**	**Name**	**Type**
ESTONIA			
Pipeline including CS	TRA-N-895	Balticconnector	TRA
Pipeline including CS	TRA-N-915	Enhancement of Estonia–Latvia interconnection	TRA
LNG Terminal	LNG-N-079	Paldiski LNG Terminal	LNG
LNG Terminal	LNG-N-962	Tallinn LNG	LNG
LATVIA			
Storage Facility	UGS-N-374	Enhancement of Inčukalns UGS	UGS
Pipeline including CS	TRA-N-382	Enhancement of Latvia–Lithuania interconnection (Latvian part)	TRA
LITHUANIA			
Pipeline including CS	TRA-N-341	Gas Interconnection Poland-Lithuania (GIPL) (Lithuania's section)	TRA
Pipeline including CS	TRA-N-342	Enhancement of Latvia–Lithuania interconnection (Lithuania's part)	TRA

Table 5.3: "Low Infrastructure Level" projects with PCIs in Baltic states (LT, LV, EE)

Low including all PCIs in the BEMIP countries:

This infrastructure case includes the BEMIP projects listed in 2017 TYNDP under the "Low Infrastructure Level" scenario, meaning that the existing infrastructures and infrastructure projects with FID status (whatever their PCI status is) and also all projects with PCI status in the BEMIP GRIP region. More specifically, BEMIP projects with PCI status are presented in the table 5.4 below.

PROJECTS INCLUDED IN LOW INCLUDING ALL PCIs IN THE BEMIP COUNTRIES INFRASTRUCTURE CASE			
Type	**Code**	**Name**	**Type**
DENMARK			
Pipeline including CS	TRA-N-428	(Mirror) Baltic Pipe	TRA
ESTONIA			
Pipeline including CS	TRA-N-895	Balticconnector	TRA
Pipeline including CS	TRA-N-915	Enhancement of Estonia–Latvia interconnection	TRA
LNG Terminal	LNG-N-962	Tallinn LNG	LNG
LNG Terminal	LNG-N-079	Paldiski LNG Terminal	LNG
FINLAND			
Pipeline including CS	TRA-N-928	Balticconnector Finnish part	TRA
LATVIA			
Storage Facility	UGS-N-374	Enhancement of Inčukalns UGS	UGS
Pipeline including CS	TRA-N-382	Enhancement of Latvia-Lithuania interconnection (Latvian part)	TRA
LITHUANIA			
Pipeline including CS	TRA-N-341	Gas Interconnection Poland-Lithuania (GIPL) (Lithuania's section)	TRA
Pipeline including CS	TRA-N-342	Enhancement of Latvia-Lithuania interconnection (Lithuania's part)	TRA
POLAND			
Pipeline including CS	TRA-N-212	Gas Interconnection Poland-Lithuania (GIPL) – PL section	TRA
Pipeline including CS	TRA-N-247	North–South Gas Corridor in Western Poland	TRA
Pipeline including CS	TRA-N-273	Poland–Czech Republic interconnection (PL section)	TRA
Pipeline including CS	TRA-N-275	Poland–Slovakia interconnection (PL section)	TRA
LNG Terminal	LNG-N-272	Upgrade of LNG terminal in Świnoujście	LNG
Pipeline including CS	TRA-N-271	Poland–Denmark interconnection (Baltic Pipe) – PL section	TRA
Pipeline including CS	TRA-N-245	North–South Gas Corridor in Eastern Poland	TRA
SWEDEN			
LNG Terminal	LNG-N-032	Project GO4LNG LNG terminal Gothenburg	LNG

Table 5.4: "Low Infrastructure Level" projects including all PCIs in BEMIP

5.3 Indicators

The ENTSOG analysis results were presented to the BEMIP working group in December 2016 and the working group decided to analyse the results based on two indicators

- Remaining Flexibility and
- Disrupted Rate

The Remaining Flexibility measures the resilience of a Zone as the additional share of demand each country is able to cover before no longer being able to fulfil its demand without creating new demand curtailment in other Zones. The value of the indicator is set as the possible increase in demand of the Zone before an infrastructure or supply limitation is reached somewhere in the European gas system.

The Remaining Flexibility of the Zone Z is calculated as follows (steps 2 and 3 are repeated independently for each Zone):

- 1. Modelling of the European gas system under a given climatic case
- 2. Increase demand of Zone Z by 100 %
- 3. Modelling of the European gas system in this new case

The Remaining Flexibility of the considered Zone is defined as 100 % minus the percentage of disruption of the additional demand. The higher the value, the better the resilience is. A zero value would indicate that the Zone is not able to fulfil its additional demand and a 100 % value would indicate that it is possible to supply a demand multiplied by a factor two.

The Disrupted Rate is the amount of disrupted demand for a given Zone as relative share /percentage. This amount is calculated in a Cooperative mode, that is, under the flow pattern maximising the spreading of the disrupted demand (in order to reduce the relative impact on each Zone). This means that, if possible, all the Zones will share the same disrupted rate.

5.4 Results

The modelling results of BEMIP GRIP additional cases are presented on the maps. The scope of modelling results is limited in the chapter to the Blue Transition scenario and disruption cases happening under design case. All results are available in the annex to the BEMIP GRIP. Based on the modelling results, an analysis of each individual country was made in the subchapters to follow. The analysis of TYNDP 2017 modelling is not included in this report while it can be found already in TYNDP 2017 report.

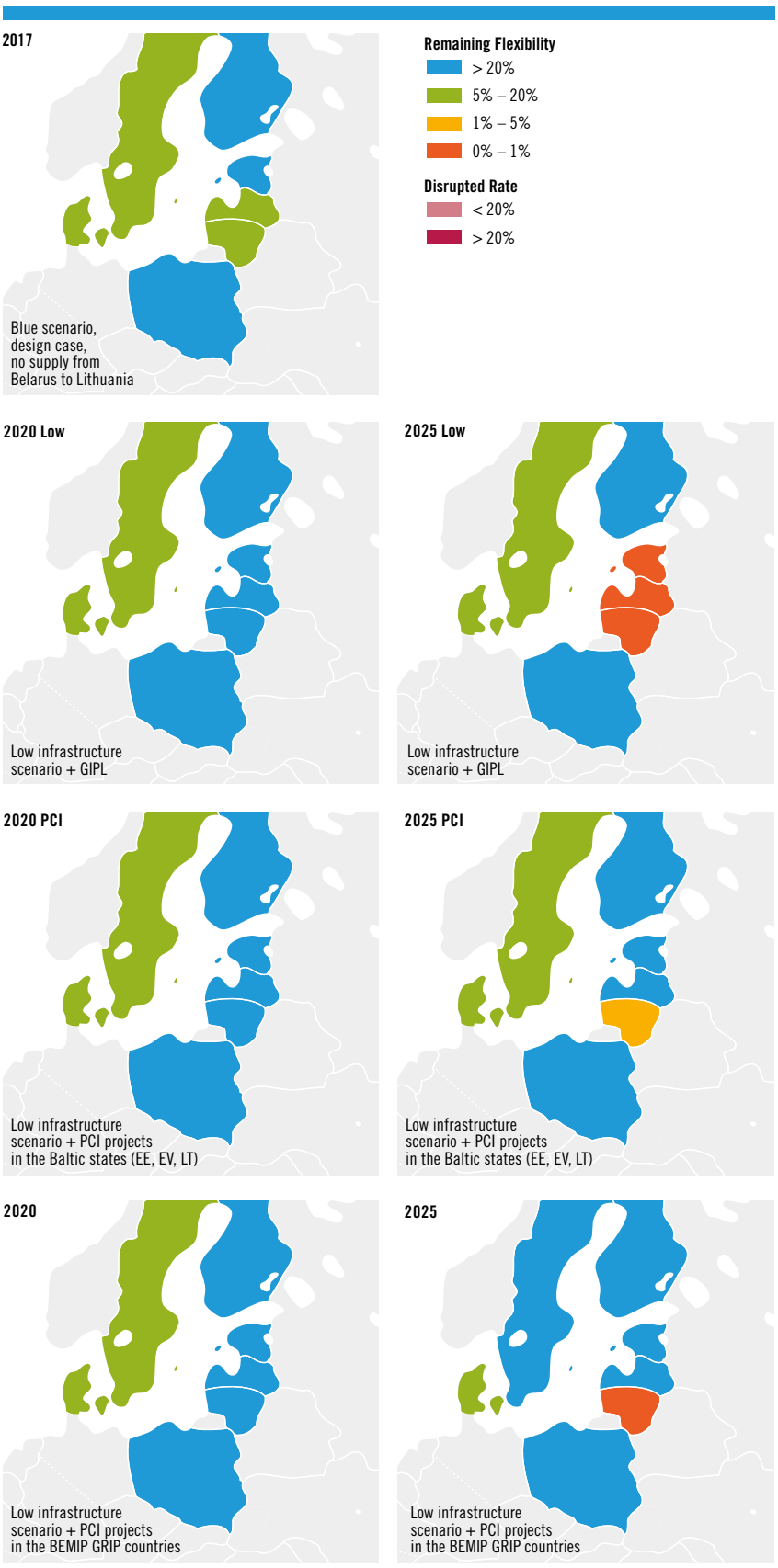


Figure 5.2: Blue scenario, design case, no supply from Belarus to Lithuania

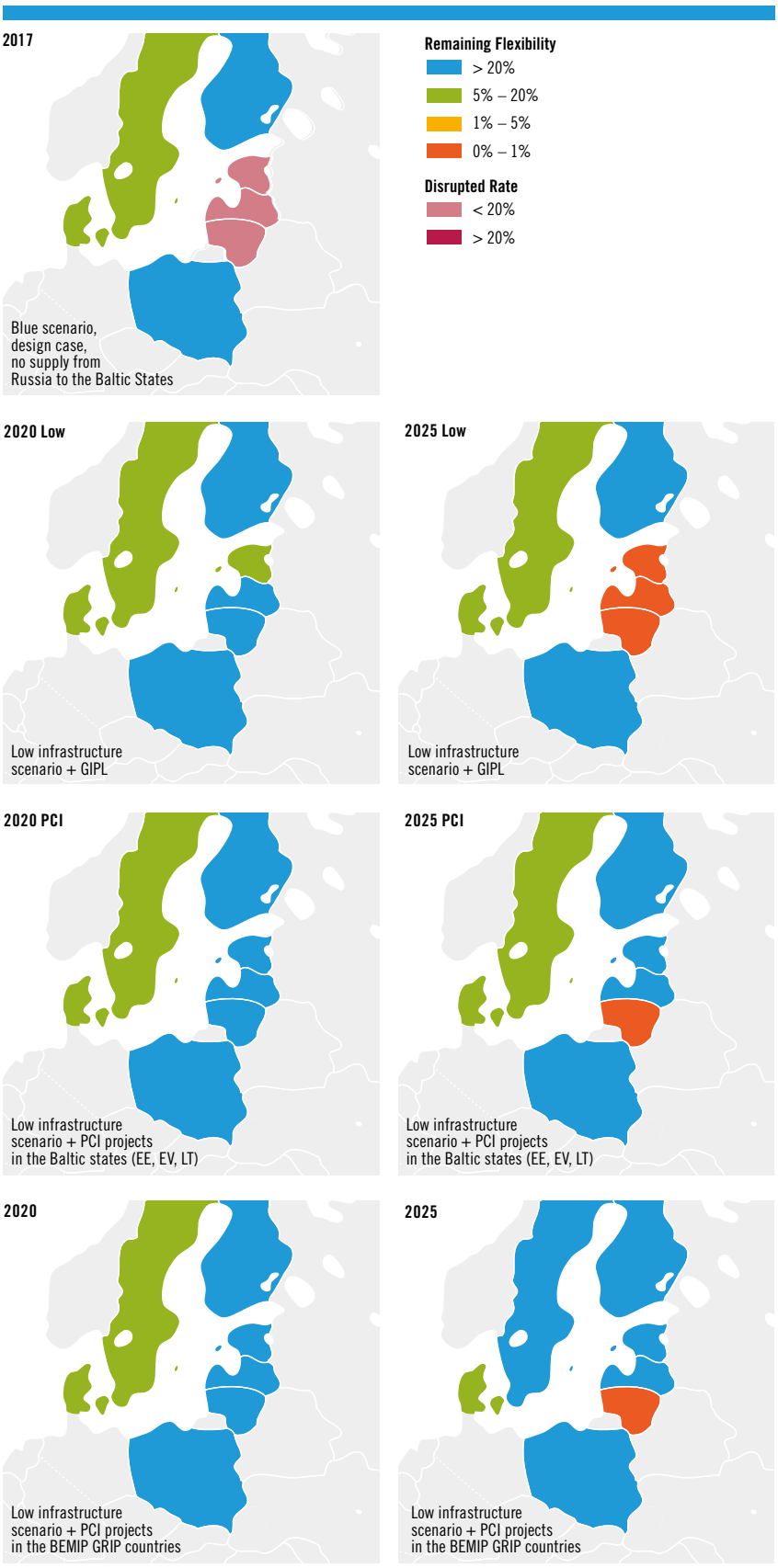


Figure 5.3: Blue scenario, design case, no supply from Russia to the Baltic States

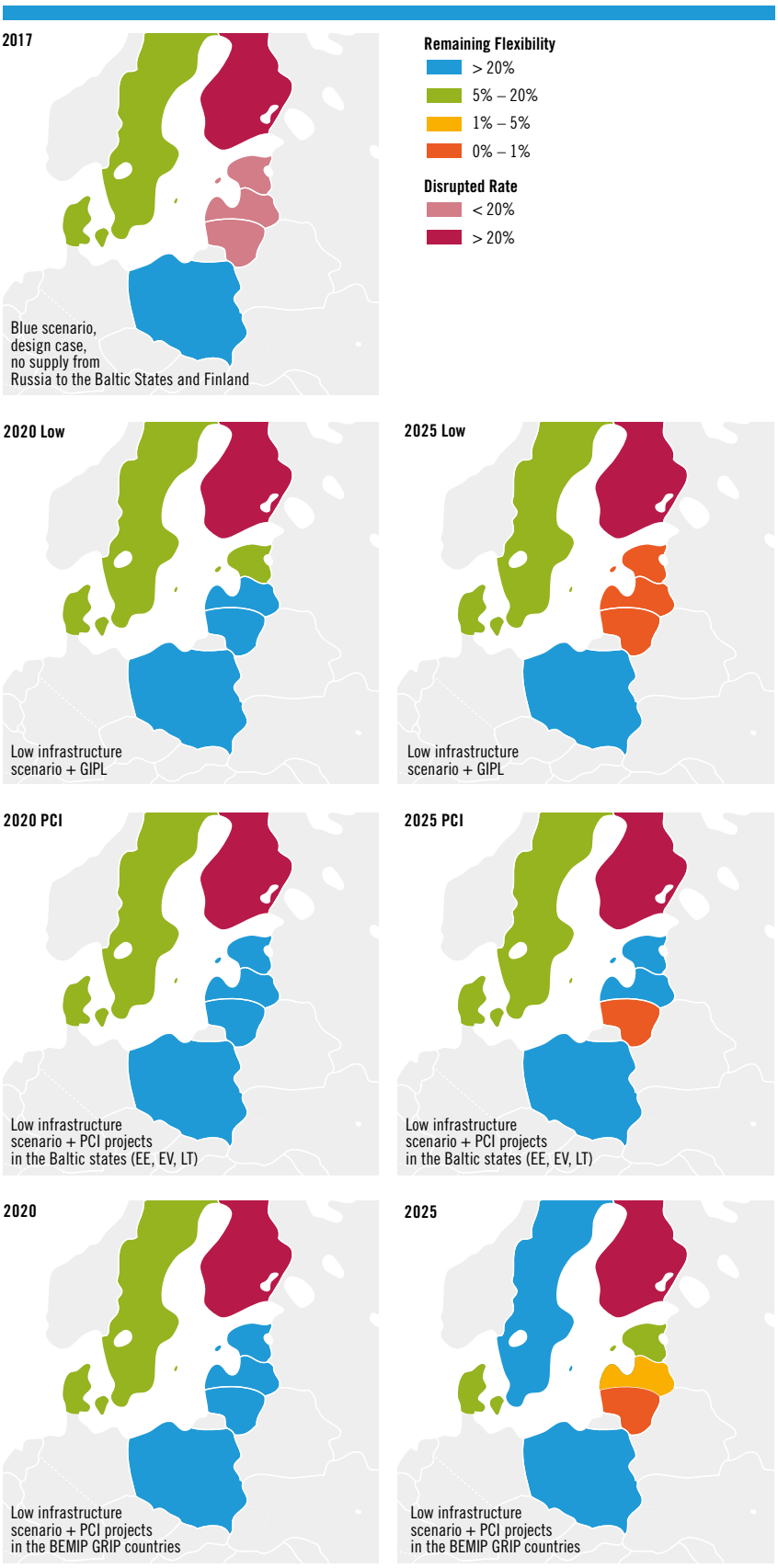


Figure 5.4: Blue scenario, design case, no supply from Russia to the Baltic States and Finland

6 Analysis of Modelling Results by Country

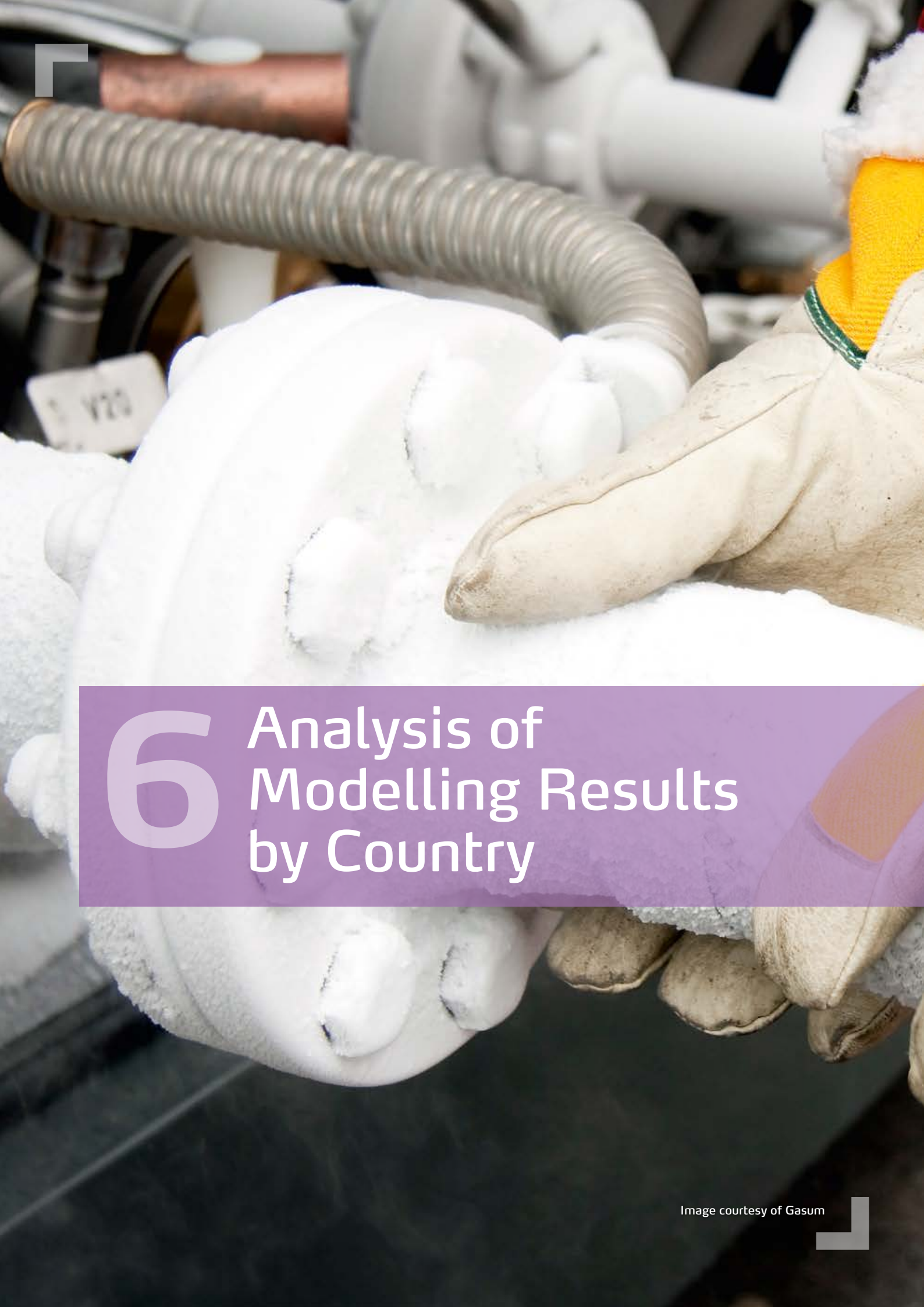


Image courtesy of Gasum

6.1 Denmark and Sweden

Remaining Flexibility

Denmark is Sweden's supplier of gas. Until 2022, Denmark will only be indirectly connected to the other BEMIP GRIP countries (via Germany). In 2022, Baltic Pipe between Denmark and Poland is planned to be commissioned. Baltic Pipe is one of the PCI projects in the third infrastructure scenario (Low+PCI projects in the BEMIP GRIP countries). The impact of Baltic Pipe can be seen in the simulation results for both Denmark and Sweden for 2025:

Blue Transition scenario:

- For Denmark the remaining flexibility increases from 7% to 16% in "Design Case" and from 18% to 28% in demand case "2W" (constant high demand in two weeks). For Sweden the remaining flexibility increases from 6% to 33% in "Design Case" and from 12% to 42% in demand case "2W".

Green scenario:

- For Denmerk the remaining flexibility increases from 31% to 43% in "Design Case" and from 43% to 58% in demand case "2W". For Sweden the remaining flexibility increases from 21% to 48% in "Design Case" and from 21% to 51% in demand case "2W".

Disruption rate

The disruption rate is zero for Denmark and Sweden in all cases. This follows from the fact that the remaining flexibility in all simulation cases is positive.

6.2 Estonia

Remaining Flexibility

New infrastructure greatly improves the gas supply security in different gas disruption scenarios. This is illustrated by the increase in remaining flexibility in scenarios with more of the PCI list projects implemented. The analysis of disruption scenarios emphasises the value of infrastructure in extreme supply situations.

In most cases of supply disruption between Belarus and Lithuania, the remaining flexibility for Estonia remains in the range of 55 % to 100 %. For this disruption case, the only instances where the remaining flexibility is lower in the range of 0 % to 38 %, is for the Low+GIPL scenario in 2025. This is because the model assumes that the Klaipėda LNG terminal will stop operating in 2024 since the current lease contract for the floating terminal will elapse in this year. This implies that GIPL alone cannot provide enough flexibility for Estonia as an alternative supply source during high-gas demand periods. To increase flexibility for Estonia, interconnectors like Balticconnector and potentially LNG terminals are needed in addition to GIPL.

For the Russian gas supply disruption to the Baltic States, the remaining flexibility is 0 % for all cases with 1-day design case demand and for the year 2017. Results show that the projects listed in all three infrastructure scenarios help to increase the remaining flexibility for the following years. The only exception is again the low+GIPL scenario for the year 2025, in which case the remaining flexibility goes back to 0 %. This is because the model assumes that the Klaipėda LNG terminal will stop operating in 2024 since the current lease contract will elapse in this year. It highlights the fact that the GIPL alone cannot provide sufficient gas supplies for the Baltic States in cases of serious disruption.

For Russian disruptions of gas supply to Finland and the Baltic States, the situation remains similar as in the previous disruption case – the remaining flexibility is low in 2017 for high-gas demand periods, but the projects in all three infrastructure scenarios help to increase the remaining flexibility for the following years.

Disrupted Rate

For all three infrastructure scenarios with a 1-day design case, a disrupted rate occurs for Estonia in 2017. The only exception where no disruption occurs is for the supply disruption from Belarus to Lithuania. This implies that further infrastructure projects are needed to help Estonia to deal with peak demand situations in case of gas supply disruptions from Russia. The projects modelled in the infrastructure scenarios for the following years help to decrease the disrupted rate to zero in most cases.

The scenario where a disrupted rate still occurs is for the low+GIPL scenario in the year 2025. The reason is the same as mentioned before – the model assumes that the Klaipėda LNG terminal will stop operating in 2024. The same conclusion can be derived here as with the remaining flexibility, namely that GIPL alone is not sufficient as an alternative supply source for Estonia during high-gas demand periods and gas supply disruptions. In order to have no disrupted rate, in addition to GIPL, interconnectors like Balticconnector and potentially LNG terminals are needed.

6.3 Finland

Remaining Flexibility

Since Finland is supplied by a single supply source (Russia) until the Balticconnector pipeline between Finland and Estonia is commissioned (estimated in 2020), it is evident that Finland's remaining flexibility is zero in all cases where supply from Russia is disrupted. This does not mean that Finland's security of energy supply is endangered, since it has a rather extensive back-up fuel system relying on biogas, LNG and alternative fuels.

When fuel supply disruptions do not impact Finland (i. e., "No RU supply to the Baltic States" and "No supply from BY to LT" cases), the remaining flexibility is always above zero for Finland which means that the supply is sufficient to cover all gas needs in the country and hence there is sufficient flexibility. When comparing the Blue Transition and Green demand scenarios with each other, it can be seen that the remaining flexibility is higher in the Green demand scenario and thus the supply capacity is higher in demand than in the Blue Transition scenario.

In the infrastructure scenario where the Balticconnector is in place by 2025, the remaining flexibility for the 14-day demand case remains above zero also in cases where gas supplies from Russia to Finland are disrupted. This is not the case for the demand situation design case, where the remaining flexibility is still zero in Russian gas supply disruption. If GIPL pipeline (and other PCIs in the region) exists and the

14-day average demand remains lower than the design case demand, gas supply to Finland via Balticconnector is sufficient to maintain the 14-day average demand level but not the design-case level (1-day demand) in the Blue Transition case. The remaining flexibility is above zero, meaning sufficient supply compared to the demand, for the design case (1-day demand) and 14-days demand case in the Green scenario. Based on the analysis, in order for Balticconnector to provide Finland with sufficient remaining flexibility for the Blue Transition and Green scenarios by 2025, all PCI projects in the BEMIP region (especially GIPL and projects in the Baltic States) will have to be commissioned.

Disrupted Rate

The disrupted rate to Finland is mainly relevant in the disruption case where supplies to Finland and the Baltic States are disrupted, being at almost 100 % in all cases regardless of the demand scenario (Green or Blue) and infrastructure scenario. An exception is in the case when all infrastructure projects (especially GIPL, Balticconnector and other projects in the Baltic States) are commissioned in 2020 and 2025. This would mean that all PCI projects will have to be commissioned in the Baltic states in order to have a noteworthy positive impact on Finland. In other words, the implementation of only the GIPL or PCI projects in the Baltic States would not benefit Finland.

In the infrastructure scenario where all PCI projects are commissioned in the BEMIP GRIP region, the positive impact to the disruption rate in Finland is full for 2025 and almost full in 2020 in the 14-day disruption case of both the Green and Blue transition scenarios but not in the demand case. Thus, implementing all PCI projects in the BEMIP GRIP region would not be sufficient to increase capacity to Finland in a peak demand scenario.

6.4 Latvia

Security of supply in Latvia is guaranteed by Inčukalns UGS, and it is a key element for the security of supply of the entire East-Baltic region. However, in order to provide this guarantee, a certain level of the remaining gas in the storage shall be maintained. This would greatly influence the modelling results. BEMIP GRIP 2017 modelling does not include this kind of analysis, but it clearly shows that by implementing PCIs, including enhancement of Inčukalns UGS, remaining flexibility for Latvia and also for Estonia and Lithuania would increase while the disruption rate would decrease.

It shall also be noted that due to expiration of the leasing agreement for the floating unit of Klaipėda LNG terminal in 2024, for modelling purposes it is assumed that there will be no gas supplied through Klaipėda LNG terminal starting from 2025, which also has negative impact on gas supply security for the region, including for Latvia.

Even if all gas supply routes are cut off, Latvia alone would not experience any winter gas shortages in cases of Russian or Belarus gas supply disruptions under the condition that sufficient volumes of gas are injected into storage. Since cooperative approach was used for modelling purposes, the lack of the Klaipėda LNG terminal would also result in a lack of gas in the region, especially in cases of gas supply disruption from Russia.

In cases of Russian gas supply disruptions, which is the most challenging case for the whole region, GRIP modelling results indicate that the remaining flexibility for Latvia is currently 0 % under the Blue Transition scenario for FID projects +GIPL and implementation of GIPL increases it to only 29 %. However, construction of the regional PCIs, which also includes enhancement of Inčukalns UGS, improves the remaining flexibility for Latvia to an acceptable level of 68–77%. The Green scenario produces

similar results. Also, in the case of gas supply disruption through Belarus, which has a lesser effect on Latvia than Russian disruptions, implementation of the regional PCIs significantly increases remaining flexibility. The obvious conclusion is therefore that implementation of regional PCIs is essential to increasing security of supply.

Another measure of security of supply is the disrupted rate, which refers to the share of unsupplied demand. The results of calculating the disruption rate for Latvia follows the same pattern as the remaining flexibility. Currently Latvia would experience a lack of gas in cases of Russian gas supply disruptions on peak demand days, but no shortage of gas in cases of Belarus disruptions. In order to meet gas demands in cases of Russian gas supply disruptions, regional PCIs shall be implemented. The modelling method of BEMIP GRIP 2017 does not allow the impact of different regional projects on security of supply to be compared, but it shows that the construction of new and enhancing interconnections alone is not sufficient to providing the necessary security of supply for the BEMIP region.

6.5 Lithuania

Remaining Flexibility

Under the Belarus supply disruption scenario, Lithuania will experience a remaining flexibility of nearly 20 % for the design case and 40 % for 2-week demand in a short-term. If supply limitations from Russia to the Baltic States and Finland are considered, the remaining flexibility remains close to zero over the short term, i. e., Lithuania will hardly be able to fulfil its additional demand.

The modelling results indicate that the negative impact of disruption will be mitigated if PCIs projects in Lithuania are commissioned. Consequently, the remaining flexibility will increase for all infrastructure scenarios analysed in Lithuania.

From 2025 on, the Klaipėda LNG Floating Storage Regasification Unit (FSRU) is no longer considered in the modelling of the Low infrastructure level. This is due to the fact the FSRU leasing agreement will expire by then, and that the operator has not made a decision on whether to purchase the FSRU (the continued operation of Klaipėda LNG terminal is considered for the High infrastructure level). It will result in a decrease of the remaining flexibility to almost zero for all disruption cases under infrastructure scenarios modelled for 2025 (i.e., continued operation of Klaipėda LNG terminal is considered for the High infrastructure level not taken into account as a separate modelling case). Lithuania will not be able to fulfil its additional demand even the GIPL pipeline is in operation.

Disrupted Rate

In Lithuania, the disrupted rate indicator is mainly relevant when the “No RU supply to the Baltic States” and “No RU supply to the Baltic States and Finland” supply limitations are considered. In the short-term, the disruption rate is under 6 % for design case demands through different scenarios considered. According to the modelling results, completion of PCI projects in Lithuania will remove the supply limitation, which will result in a decrease of disrupted rate indicator to zero starting from 2020.

Due to the fact that the Klaipėda LNG is not available from 2025 (if the Low infrastructure level is considered), the disrupted rate indicator increases up to nearly 20 % if the design case demand is analysed.

6.6 Poland

The disruption scenarios investigated in BEMIP GRIP do not directly influence the functioning of the gas network in Poland. The modelling results show that Poland has, in all assessed cases, a high degree of remaining flexibility. This potential could be shared with adjacent systems in the Baltic Sea region once relevant projects are commissioned. This relates in particular to the GIPL project that will link the Baltic States and Finland with the main EU gas grid and additionally Baltic Pipe that will integrate the countries in the West Baltic region.

The cross-border interconnection between Poland and Lithuania could be used to mitigate the negative effects of gas supply disruptions to the East Baltic region by transporting gas from alternative sources and routes. In this case, Norwegian supplies via the NO–DK–PL project could be a viable option. The same can also apply to LNG from the terminal in Świnoujście. Furthermore, the Baltic Pipe project will provide a new route to supply Denmark and Sweden with LNG. Therefore, it may well help both countries to increase the limited remaining flexibility that is apparent in these assessments.

Image courtesy of GAZ-SYSTEM

.

7 Conclusions

Image courtesy of Amber Grid

The BEMIP region, consisting of Denmark, Estonia, Finland, Latvia, Lithuania, Poland and Sweden is considered from the gas market perspective as a connected market, while actually it consists of the few separate gas markets. West Baltic States (Denmark, Poland and Sweden) are connected to the European gas market whereas the Baltic States (Estonia, Latvia and Lithuania), are interconnected but isolated from the European gas market. Finally, the Finnish gas market is completely isolated from the gas markets of other EU states.

Therefore, the gas markets are at different development stages and there are a high number of gas market-related activities ongoing in the each area. The development in each area is targeted towards the goals set by the EU's energy policy for gas markets that is presented in the form of the EU's energy union strategy aiming at creating security, solidarity and trust; a fully-integrated internal energy market; energy efficiency; decarbonising the economy and research, innovation and competitiveness. The gas market in the West Baltic Sea area has already implemented the harmonised gas market model set by the EU-wide network codes together with the planned Denmark and Sweden gas market merger, the Baltic States are currently working on implementing the network codes together with an integrated market formation and Finland is planning a full gas market opening in a few years.

The enablers to achieve EU's target of a diversified and fully-integrated internal energy market in gas are the planned gas infrastructure projects in the region. There is a high number of EU-supported projects including those in the second PCI list. Since the previous GRIP report, the infrastructure in the region has developed well. The commissioning of Klaipėda LNG terminal in the end of 2014 introduced another source and route of supply to the Baltic States. The LNG terminal in Świnoujście that was put into commercial operations in June 2016, provided a new source of supply and opened new market opportunities based on LNG in Poland and neighbouring countries.

The infrastructure developments are planned to continue in the near future. In this context it is worth noting that the initiation of the Balticconnector will integrate Finnish gas markets to the Baltic States in 2020 and finally, when realised, the GIPL project will link the east Baltic Sea region to the European gas markets. Instead of permanent closure of Danish Tyra gas field it will be closed only temporarily until 2021 and the closure will impact the gas supply to Denmark and Sweden so that the region will be dependent of the gas supply from Germany.

NO–DK–PL project (Baltic Pipe) is planned for implementation to provide a direct access to Norwegian supplies for the Baltic region and Central-Eastern Europe in the perspective of 2022. The regasification capacities at the LNG terminal in Świnoujście will be increased. While the FSRU terminal in the Bay of Gdańsk is currently under consideration.

Even though there is a high number of investment projects in the region, it is not fully supported by the gas demand forecasts. In most of the states gas demand is expected to diminish, Poland being the only one forecasting high growth in gas demand. The EU's strategy for gas markets supports the investments to enhance diversification and market integration, increase the security of supply and reduce the carbon dioxide emissions, but overall, investments in decreasing markets creates a challenging situation for the investors and therefore the financial support from the EU is crucial. Parallel to the investments in infrastructure in gas grid, the development of gas market in off-grid area is developing well. In Sweden and Finland the gas market has been developing rapidly in biogas sector and creating the off-grid LNG infrastructure. This development challenges the traditional grid based gas infrastructure and at the same time enhances the decarbonisation process by biogas use. In addition, Poland saw a number of market developments taking place after the LNG terminal in Świnoujście entered into commercial operations in 2016.

In general, the regional gas market is in a changing situation, especially in the Eastern Baltic region where implementation of the common market zone by 2020 is under preparation. Construction of the Balticconnecor and enhancement of interconnections between three Baltic Countries and flexibility of Inčukalns UGS in Latvia are essential for development of the functioning joint Baltic and Finnish gas market with the possible single entry-exit zone. The infrastructure projects that increase gas security of supply and create more competition may well have a positive effect on conditions for market development (gas demand) in the future. In general, the use of gas instead of other fossil fuels will help EU member states to achieve their decarbonisation targets that can be seen as one driver of gas demand growth in Poland as well. New investments are also planned to foster market competition, decrease gas prices and subsequently increase affordability of natural gas as a fuel on the markets. Furthermore, the use of biogas and LNG either via the gas grid or in offgrid locations is also growing and will support the positive decarbonisation development as well.

Abbreviations

ACER	The European Agency for the Cooperation of Regulators
bcm	Billion normal cubic meters
BEMIP	Baltic Energy Market Interconnection Plan
BR	Balance Responsible
CAM	Capacity Allocation Mechanism
CBA	Cost Benefit Analysis
CEE	Central East European
CEF	Connecting Europe Facility
CHP	Combined Heat and Power
CMP	Congestion Management Principle
CNG	Natural Gas Refuelling Point
CS	Compressor Station
DSO	Distribution System Operator
EC	European Commission
EIA	Environmental Impact Assessment
ENTSOG	European Network of Transmission System Operators for Gas
ERO	Energy Regulatory Office
EU	European Union
FID	Final Investment Decision
FSRU	Floating Storage and Regasification Unit
GIR	Gas Infrastructure Reinforcement
GM	Gas Metering
GPN	Gas Point Nordic
GRIP	Gas Regional Investment Plan
GS	Gas Supplier
GTF	Gas Transfer Facility
IP	Interconnection Point
ISO	Independent System Operator
LNG	Liquefied Natural Gas
mcm	Million normal cubic meters
NC	Network Code
PCI	Project of Common Interest
RE	Renewable Energy
SNG	Synthetic Natural Gas
SoS	Security of Supply
TEN-E	Trans-European Energy Networks
TF	Task Force
TPA	Third Party Access
TSO	Transmission System Operator
TYNDP	European Ten-Year Network Development Plan
UGS	Underground Gas Storage

Country Codes (ISO)

AL	Albania
AT	Austria
AZ	Azerbaijan
BA	Bosnia and Herzegovina
BE	Belgium
BG	Bulgaria
BY	Belarus
CH	Switzerland
CY	Cyprus
CZ	Czech Republic
DE	Germany
DK	Denmark
DZ	Algeria
EE	Estonia
ES	Spain
FI	Finland
FR	France
GR	Greece
HR	Croatia
HU	Hungary
IE	Ireland
IT	Italy
LT	Lithuania
LU	Luxembourg
LV	Latvia
LY	Libya
MA	Morocco
ME	Montenegro
MK	FYROM
MT	Malta
NL	Netherlands, the
NO	Norway
PL	Poland
PT	Portugal
RO	Romania
RS	Serbia
RU	Russia
SE	Sweden
SI	Slovenia
SK	Slovakia
TM	Turkmenistan
TN	Tunisia
TR	Turkey
UA	Ukraine
UK	United Kingdom

Assumptions

Country	**Gross calorific value, kWh/m³ Temperature (0°C)**
Finland	11.08
Estonia	11.30
Latvia	11.16
Lithuania	11.40
Poland	11.03
Denmark	12.10
Sweden	12.01

List of Tables

List of Figures

2 SUMMARY OF THE REGIONAL MARKET

3 NATIONAL MARKET DEVELOPMENT

4 INFRASTRUCTURE

5 MODELLING RESULTS

Legal Disclaimer

The TSOs have prepared this GRIP based on information collected and compiled from their internal sources, received from ENTSOG and from other sources. The TSOs do not audit or verify the veracity or accuracy of any such information. The content of the GRIP (hereinafter referred to as "Content") is provided on an "as is" basis. The TSOs as well as their directors, officers, employees or agents (hereinafter referred to as "TSO Parties") do not guarantee the accuracy, completeness or timeliness of the Content. The TSO Parties are not responsible for any errors or omissions, regardless of the cause, for the results obtained from the use of the Content. In no event shall TSO Parties be liable to any party for any direct, indirect, incidental, exemplary, compensatory, punitive, special or consequential damages, costs, expenses, legal fees, or losses, including, without limitation, lost income or lost profits and opportunity costs, in connection with any use of the Content. All analyses and forecasts are mere statements of opinion as of the date they are expressed and not statements of facts or recommendations. When making decisions of any nature, any party shall rely exclusively on its own information, forecast, skill, judgment and experience and not on the Content.

Publisher: ENTSOG AISBL
Avenue de Cortenbergh 100
1000 Brussels, Belgium

Coordinator: Gasum Oy

Co-Authors: BEMIP GRIP working group members from Gasum Ltd (Finland), Elering AS (Estonia), JSC Conexus Baltic Grid (Latvia), GAZ-SYSTEM S.A. (Poland), Energinet.dk (Denmark), Swedegas AB (Sweden) and AB Amber Grid (Lithuania)

Design: DreiDreizehn GmbH, Berlin | www.313.de

ENTSOG AISBL

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

info@entsog.eu
www.entsog.eu