



**JOINT RISK ASSESSMENT
OF SECURITY OF GAS
SUPPLY OF ESTONIA,
LATVIA, LITHUANIA
2012**

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Executive Summary

Joint risk assessment of security of gas supply of Estonia, Latvia and Lithuania is carried out to meet the requirements of 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. Joint risk assessment is prepared by Baltic Energy Market Interconnection Plan (BEMIP) Focus Group on Regional Cooperation composed of representatives of the Ministries responsible for the energy industry, transmission system operators and regulatory authorities of the Member States.

Joint risk assessment provides outlook for the regional energy mix, functioning of regional gas market, examines possibilities of physical gas flows, assesses the existing natural gas supply physical infrastructure, the political and administrative risks, runs causality risk scenarios, risk impact scenarios and response scenarios, establishes supply disruption risk matrix and defines gas supply disruption risk mitigation measures for the inclusion in the Preventive Action plan.

The share of gas in the Baltic region's overall energy mix is around 26%, however, the role of gas in the countries is different. While the share of gas in the total energy mix of Lithuania and Latvia is around 30%, in Estonia it is 11%. In general, gas plays the largest role in the Lithuanian and Latvian energy sector due to, in particular, large industrial customers (fertilizer company Achema AB) and the power and district heating sector respectively. In Estonia gas plays important role in heating sector both in direct residential use as well as in boiler houses and combined power and heat production. For example Estonia largest city Tallinn district heating sector is currently up to 70% dependent on gas. Therefore, through the district heating sector natural gas also plays a pivotal role in residential heating.

It is forecasted that after the decrease of gas consumption in 2009 due to the economic recession the consumption will slightly increase within the next 5 years, after that stagnation of gross gas consumption until 2020 and a slight decrease afterwards until 2030 is foreseen. The estimated natural gas consumption in 2015 might be up to 6.65 billion m³ and in 2020 up to 6.96 billion m³.

All three Baltic countries are fully dependent on gas imports from the same main supplier, Gazprom OAO. The current infrastructure doesn't physically allow gas purchases from another source than Russia. Dependency of the Baltic States on a single supplier suggests the usage of gas supply for the region as a measure to achieve the respective political targets.

The markets in Estonia, Latvia and Lithuania are essentially dominated by a single vertically integrated incumbent operator: Lietuvos dujos AB, Latvijas Gāze AS, Eesti Gaas AS. Under the 3rd Energy Package, explicit derogations (qualifying as an isolated market) will continue for Latvia and Estonia but not for Lithuania.

All natural gas import operations in Estonia, Latvia and Lithuania are handled on the basis of a long term supply agreements. These contracts contain clauses regulating gas supply technical conditions (pressure, calorificity etc.), volumes of supply and storage (annual and monthly), gas storage and transmission charges, gas price calculation issues, conditions of payments, conditions for revisions of contracts, other liabilities, as well as take-or-pay clause. Gas import prices are linked to the price of oil. Contracts with Gazprom OAO also contain a ban imposed on the gas companies to resell gas to the third parties without Gazprom OAO permission. Long-term contracts for Lithuania and Estonia expire in 2015 and in 2030 for Latvia.

Three Baltic countries are interconnected but intra-Baltic flows are essential only emanating from the Latvian storage and only in the winter to primarily Estonia and, to a much lesser degree, Lithuania.

The infrastructure standard N-1 for Estonia is 59.7%, for Latvia - 153.85% and for Lithuania - 27.4%. It means that in the event of a disruption of the single largest gas supply infrastructure only in Latvia the capacity of the remaining infrastructure is able to satisfy total gas demand of the country during a day of exceptionally high gas demand statistically occurring once every twenty years.

Considering all three countries as a whole in the event of a disruption of the single largest gas supply infrastructure - natural gas supply line Minsk-Vilnius, the infrastructure standard N-1 is 129.73%. Although infrastructure standard N-1 calculations show that in the event of the largest capacity disruption the capacity of the remaining infrastructure should be able to satisfy total gas demand, response scenarios demonstrate that there will be gas shortage in the region due to internal bottlenecks. The main bottlenecks in the system are the capacity of meter stations on the borders as well as the Inčukalns underground gas storage facility (hereafter -UGS) send-out capacity in the spring.

The assessment of risk of gas supply disruption has been worked out by applying the method of risk scenarios. Three types of scenarios were drawn up in this study:

- Risk causality scenarios;
- Risk impact scenarios;
- Response scenarios.

Risk causality scenarios serve to describe the possible ways of errors that lead to a gas supply disruption. The task of a risk impact scenario is to describe the variety, scope, gravity and area of influence of potential consequences of the unwelcome event if it occurs. Response scenarios, for their part, reveal the capability of the system to react properly in the cases of a variety of unwelcome events.

In the Baltic gas supply system, gas is received through two pipelines from Russia and Belarus and in winter from the Inčukalns UGS.

The possible cause of a gas supply disruption in the Baltic gas transmission pipelines could be an accident at the Inčukalns UGS. However, probability of such accident is very low because most important technical systems of the storage can be replaced by parallel systems. Based on the information included in the Safety report of the Inčukalns UGS the probability of a well failure is $P_{(well)} 8.0 \times 10^{-3}$. The technological equipment of the Inčukalns UGS is connected via pipelines of 42 km in total length. Assuming the average of the probabilities of a full collapse of pipelines used in the Safety report, it follows that the probability of a pipeline failure is $P_{(pipeline)} = 3.8 \times 10^{-2}$. Consequently, an incident on a section of technological pipelines at the Inčukalns UGS is possible once in 26 years on average. Due to the modern technological equipment and safety automation, the probability of an incident at the gas collection points is not high. In the Safety report, this probability is rated as 10^{-3} to 10^{-5} . This means that an incident of gas collection point technological equipment could occur not more than once per 100 years on average. Much more problematic is the capability of the Inčukalns UGS to feed the required gas volume if there is a gas shortage in the Baltic region. Over the last 10 years, such a necessity has already emerged twice - in 2004 and 2012. In both cases, the Inčukalns UGS was technically unable to supply the required gas volume. Consequently, this risk cannot be eliminated without building a fourth gas collection point.

The other two reasons of possible absence of gas in the gas transmission pipelines of the Baltic gas supply system are related to gas pipeline accidents in the territory of Russia or Belarus. Over the last twenty years, 3 accidents have been registered on the gas transmission pipeline Valdai-Pskov-Riga. Two accidents occurred in 2000, whereas the third, a minor leakage, took place in 2005. In all these cases, the consumers in Russia were supplied gas from Inčukalns UGS.

No accidents have been registered on the Belorussian gas transmission pipeline from Minsk to Kotlovka over the last 20 years. Assuming that the frequency of accidents in the territory of Belarus is equal to the Baltic States' overall and having regard of the lengths of pipelines from Kotlovka to Minsk, the probability of gas not being delivered from Belarus through Kotlovka is $P = 7.8 \times 10^{-3}$.

The probability of a gas branch-off accident is $P = 1.9 \times 10^{-2}$ in Latvia, $P = 9.2 \times 10^{-2}$ in Lithuania and $P = 1.0 \times 10^{-2}$ in Estonia. The probability of an accident for a gas transmission pipeline of one kilometre in length equals $P = 5.7 \times 10^{-5}$ in Latvia, $P = 2.9 \times 10^{-5}$ in Lithuania and $P = 6.9 \times 10^{-5}$ in Estonia, while for the Baltic States overall it is $P = 4.5 \times 10^{-5}$. This means that in the territory of Latvia an accident of gas transmission pipelines is likely to happen once in 15 years on average, in Lithuania once in 17 years on average, in Estonia once in 18 years on average, and once in 6 years on average in any Baltic state. In comparison, accident probabilities used in risk assessments in the Netherlands $P = 7.1 \times 10^{-5}$ and in the USA $P = 3.1 \times 10^{-4}$. The calculated probabilities of gas transmission pipeline accidents are not high, which indicates that the gas supply system in the Baltic States is safe.

In order to mitigate the risks of all kinds of external exposure, there are safety barriers in the form of systematic technical supervision of gas supply system, airborne monitoring of varied regularity. SCADA has been introduced in the gas supply systems of all Baltic States. Along with technical safety barriers the contractual are used. For the Baltic States the safety barriers for long period disruptions are the gas supply agreements with the Russian Federation on gas supplies and with Belarus on gas transit to Lithuania and Kaliningrad.

At the first stage 9 response scenarios were analyzed with the aim to select scenarios with the most negative impact for deeper analysis. Based on this preliminary analysis, comparing the adverse effects of individual scenarios, four scenarios (directions) of natural gas supply disruption in the coldest winter month of the year with a duration of 3 and 15 days were selected for a more detailed assessment:

- disruption of natural gas supply from the Inčukalns UGS;
- disruption of natural gas supply from Kotlovka;
- disruption of natural gas supply from Kotlovka and Izborsk;
- disruption of natural gas supply from the Inčukalns UGS and from Kotlovka or Izborsk.

The matrix of Baltic gas supply disruption risk provides a clear summary of all results of the Baltic States' gas supply risk assessment. The scale of probabilities of the matrix has been selected based on the event probabilities obtained in the risk assessment. The scale of consequences, for its part, has been divided into four segments of assessment of severity: losses to gas supplier; losses for gas consumers; harm to the environment; danger to human health and life.

The matrix reveals the following risks of medium significance that has to be mitigated:

- suspended gas supply from Belarus to Lithuania;
- gas transmission pipeline accident in the territory of Latvia;
- gas supply from Russia to the Baltic States is suspended;

- Inčukalns UGS fails to supply the required gas volume;
- technical accident on gas transmission pipeline Izborsk-Pskov;
- gas transmission pipeline accident in the territory of Lithuania.

Based on the comprehensive analysis, the following recommendations for enhancing the safety of the regional gas supply system have been prepared:

1. Activities related to improvement of operation safety, increase of injection and withdrawal capacities and possible expansion of Inčukalns UGS (adjustments for transit gas compression, modernization of wells, installation of new compressor units, construction and modernization of gas collection facilities);
2. Increase of Kiemenai GMS capacity to 12 mcm per day and construction of necessary connection. Construction of a new gas pipeline "Riga- Vilnius" (Ø500);
3. Construction of reverse connection for Karksi GMS and increase of capacity to 10 mcm per day;
4. Construction of connection transmission pipelines "Iecava – Liepaja" and "Panevezys – Klaipeda". Construction of GMS (95km, Ø400);
5. Construction of connection transmission pipelines "Riga – Daugavpils" and "Vilnius – Visaginas". Construction of GMS (40km, Ø400);
6. Hydraulic calculation software for management and supervision (including database) for gas transmission network system;
7. Construction of LNG terminal.

In compliance with the requirements of 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 Joint Preventive Action Plan could be established. If Joint Preventive Action Plan will be established, it should contain the above-mentioned measures and other measures needed to remove or mitigate the risks identified according to the risk assessment.

1. Market - supply- demand

1.1. Development of energy mix

The Baltic States rely on several types of energy production. Currently, the effects of the global economic downturn has resulted in lower energy consumption than in previous years, but industry experts believe that the pre-crisis demand levels will be restored within the next five years.

Solid fuels dominate the primary energy supply of **Estonia**, representing 56% of total supply and being far above EU-27 average of 18% (see Fig.1). Oil, natural gas and renewable sources contribute 41% on aggregate. The share of natural gas in total primary energy consumption in 2010 was 11%. Renewable sources 6% share in primary energy supply is equal the EU-27 average of 6%.

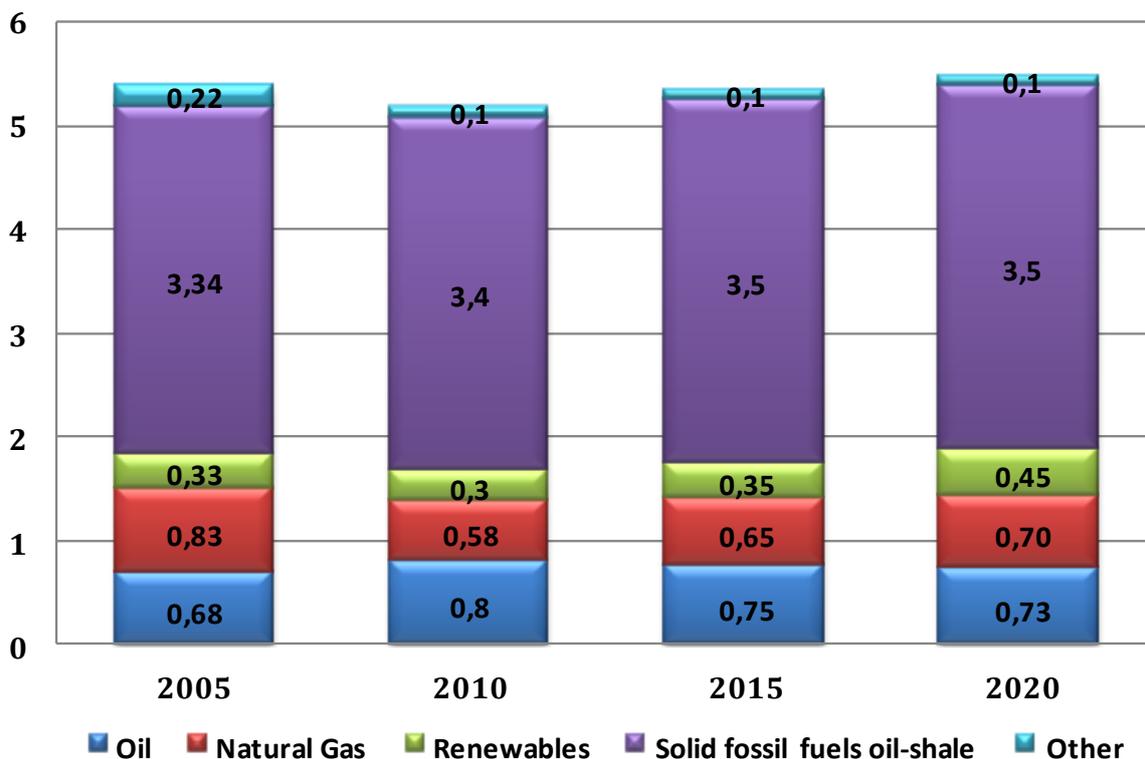


Figure 1. Primary energy consumption in Estonia in 2005-2020, mtoe

Primary energy supply of **Latvia** is evenly shared between renewable sources; natural gas and oil (see Fig.2). The share of renewable sources in total consumption in 2010 was 35.8% which is very significantly above the EU-27 average (6%). The share of natural gas in total primary energy consumption in 2010 was 28%. In 2010 the level of self-sufficiency with primary energy resources was 35.9%. Electricity generation is primarily based on renewable sources (mainly hydro) with a growing share of natural gas, mainly replacing oil as a fuel.

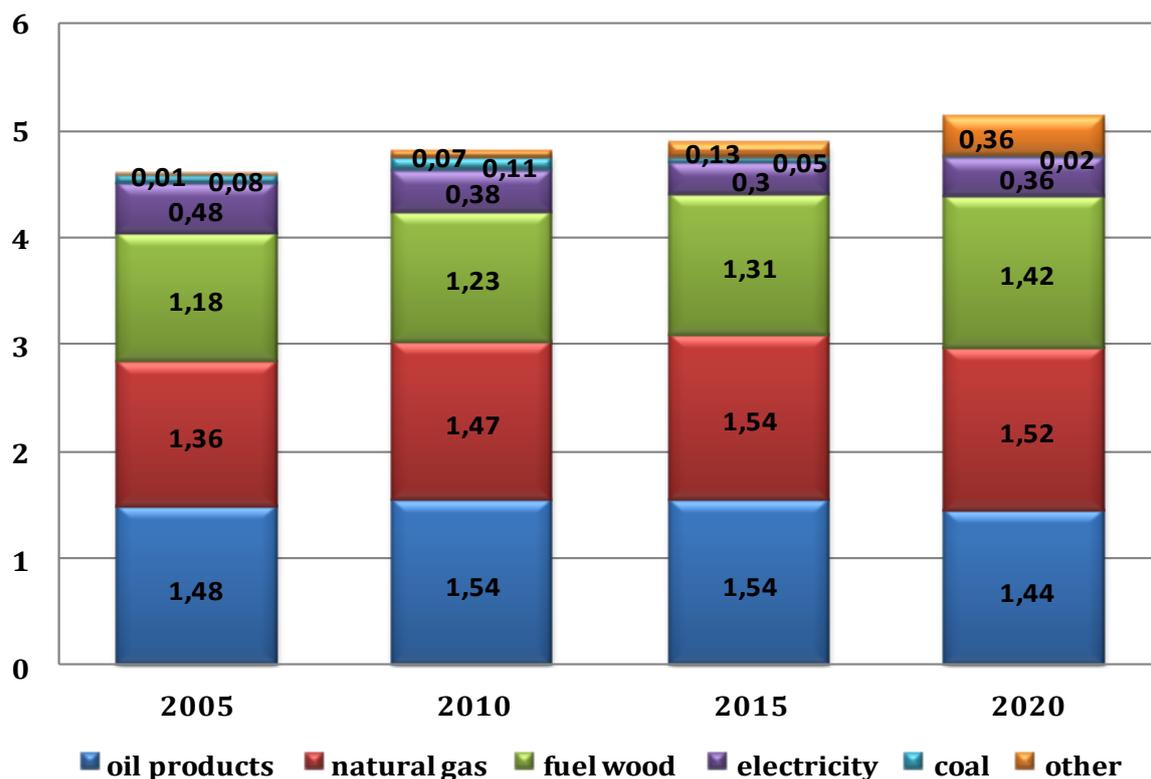


Figure 2. Primary energy consumption in Latvia in 2005-2020, mtoe

The energy supply of **Lithuania** till 2010 primarily depended on nuclear energy with a share nearly double the EU-27 average, with significant shares of natural gas and oil (see Fig.3). Lithuania imported mainly oil and natural gas from the Russian Federation. The share of natural gas in total primary energy consumption in 2010 was 35%. In recent years, Lithuania from a net electricity exporter becomes an electricity importer. The share of renewable sources has been steadily increasing, accounting for 7% of primary energy supply.

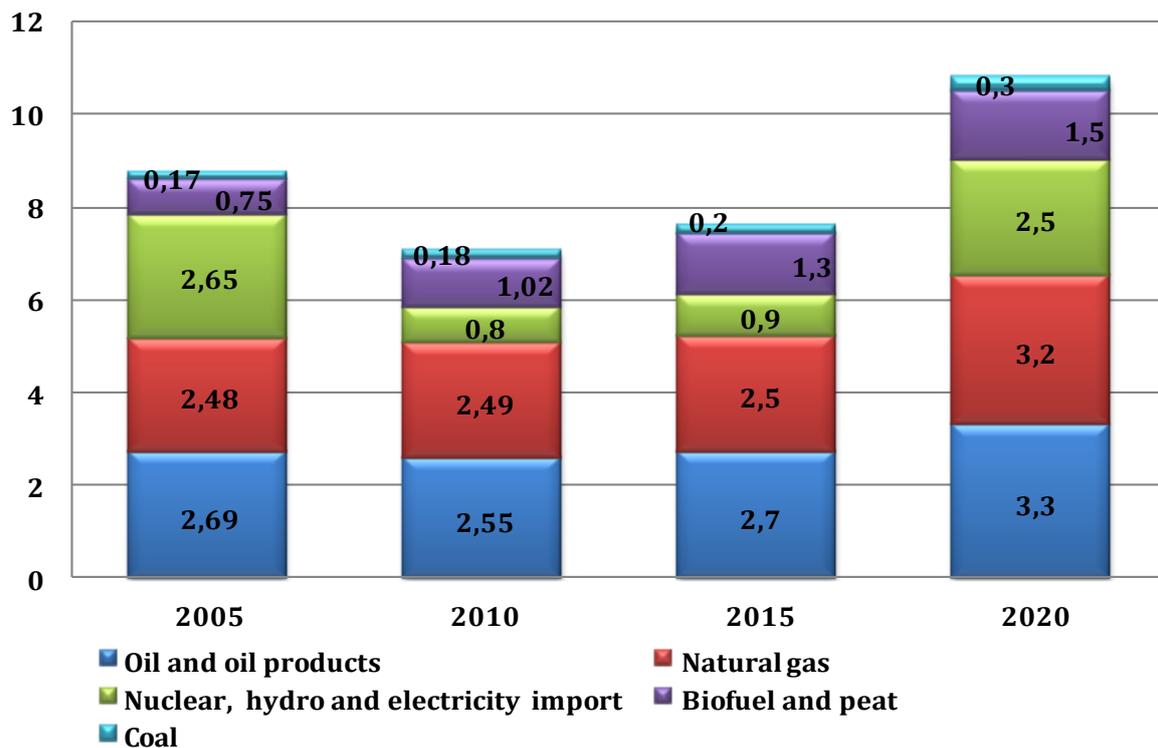


Figure 3. Primary energy consumption in Lithuania in 2005-2020, mtoe

In 2010, the consumption of primary energy resources in Baltic States amounted to 16.60 mtoe (see Fig. 4), which was supplied by local energy resources and the inflow of primary resources from Russia and CIS countries, as well as from the EU and other countries in the world.

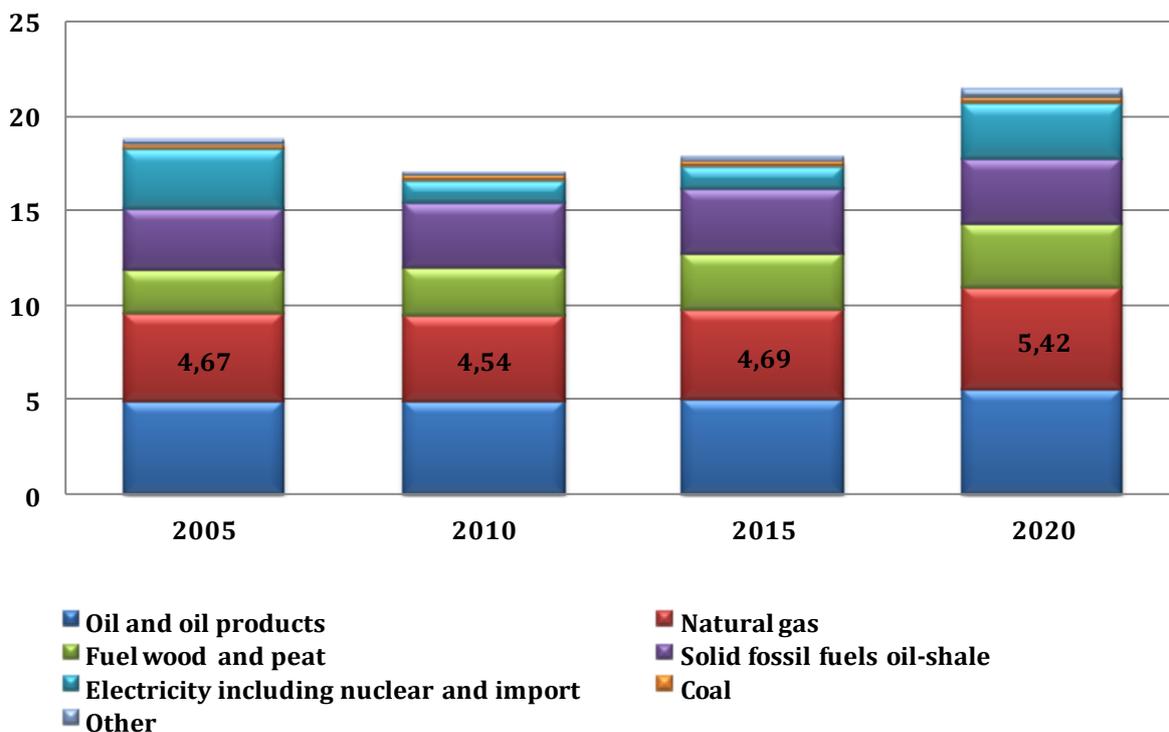


Figure 4. Primary energy consumption in the Baltic States in 2005-2020, mtoe

The share of gas in the Baltic region's overall energy mix was around 25% in 2005, however it has increased to 26% since the shutdown of the Ignalina Nuclear Power Plant in Lithuania at the end of 2010 (see Fig. 5).

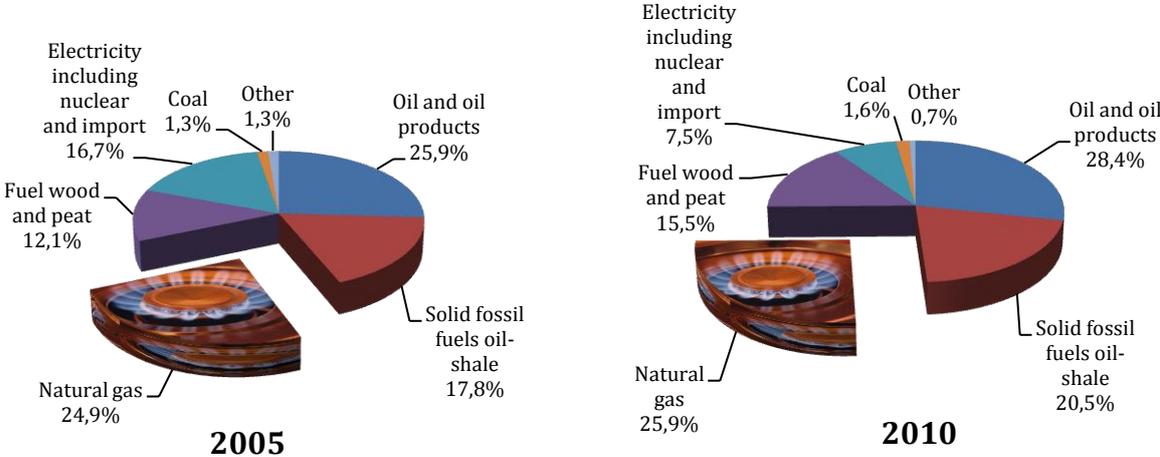


Figure 5. Structure of primary energy consumption in the Baltic States in 2005 and 2010, %

The role of gas in these countries is, however, different. While the share of gas in the total energy mix of Lithuania and Latvia is around 30% (LT -35%, LV - 28% in 2010), in Estonia it is 11%. In Latvia 45% of electricity was generated from gas in 2010 and Latvenergo AS, the biggest consumer, accounted for 0.6 bcm of consumption. In Estonia gas plays important role in heating sector both in direct residential use as well as in boiler houses and combined power and heat production. For example Estonia largest city Tallinn district heating sector is currently up to 70% dependent on gas. Nevertheless Estonia's power generation is based mainly on oil shale (91% in 2008). Therefore there is a relatively small share of gas in both the energy and electricity mix of Estonia.

1.2. Development of gas demand

The breakdown of natural gas use in the Baltic States shows both differences and similarities. Firstly, it can be said that direct residential gas use is very limited in the region, ranging from 6% Estonia to 9% in Latvia and Lithuania. Therefore Combined heat and power plants/Heat plants feeding the district heating systems typically take up over half of the gas, although in Lithuania this value is somewhat lower. The share of natural gas as fuel source for the district heating system is also varied. It plays the biggest role in Latvia and Lithuania with an 81% and 78% share respectively, while in Estonia its share reaches 47%. Finally, gas is used to differing degrees as petrochemical feedstock, the share being most prominent in Lithuania due to the large fertilizer company Achema AB.

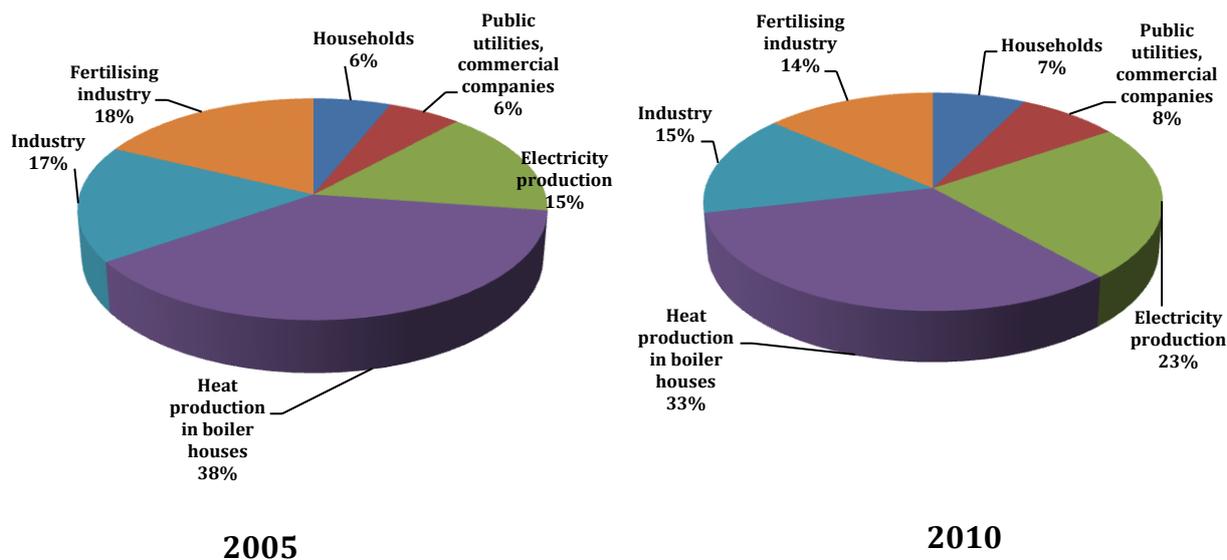


Figure 6. The structure of natural gas consumption in Baltic States in 2005 and 2010, %

Natural gas consumption in the Baltic States over the course of a year is explicitly irregular, the difference between the summer season and the winter season is up to four times. Gas supply profile for 2010 is reflected in the Figure 7, where the seasonal character of the gas supply profile can be seen.

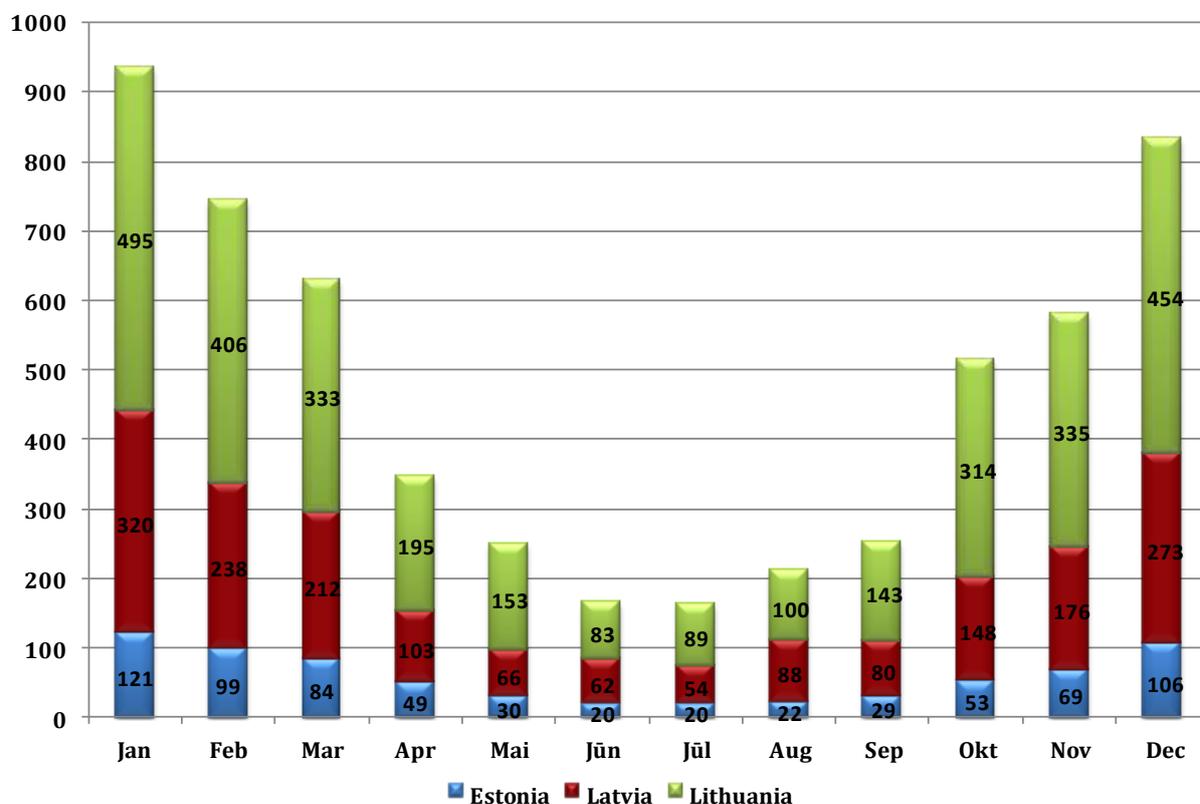


Figure 7. Natural gas consumption in the Baltic States in 2010, million m³

Gas consumption in the three Baltic States decreased sharply after 1991 from over 9 bcm to over 4.9 bcm in 2009. Lithuania is the biggest market with a consumption of around 3 bcm, Latvia at 1.5 bcm and Estonia under 1 bcm. Thus the total consumption of the three countries is equal to 5.8 bcm in 2010, which is smaller than the size of the neighbouring Polish gas market, which is 14 bcm.

The forecast of natural gas consumption may change depending on natural gas demand and especially on its use in electricity production.

It is very difficult to assess the future position that gas will play in the energy mix of the Baltic States. The trends of natural gas consumption are influenced by the overall development of national economy, heat insulation of buildings, the use of modern and economical gas burning equipment, as well as changes in the proportion of alternative types of fuel. It is forecasted that after the decrease of gas consumption in 2009 due to the economic recession the consumption will slightly increase within the next 5 years. After that the 2009 update of the EU PRIMES model foresees a stagnation of gross gas consumption until 2020 and a slight decrease afterwards until 2030. Key assumptions are e.g. the continued pivotal role of oil shale in Estonia, a new nuclear power plant in Lithuania and very dynamic growth of biomass for power generation in Latvia, along with strong development of wind-based power generation in the entire region.

The estimated natural gas consumption in 2015 might be up to 6.65 billion m³ and in 2020 up to 6.96 billion m³ (see Figure 8).

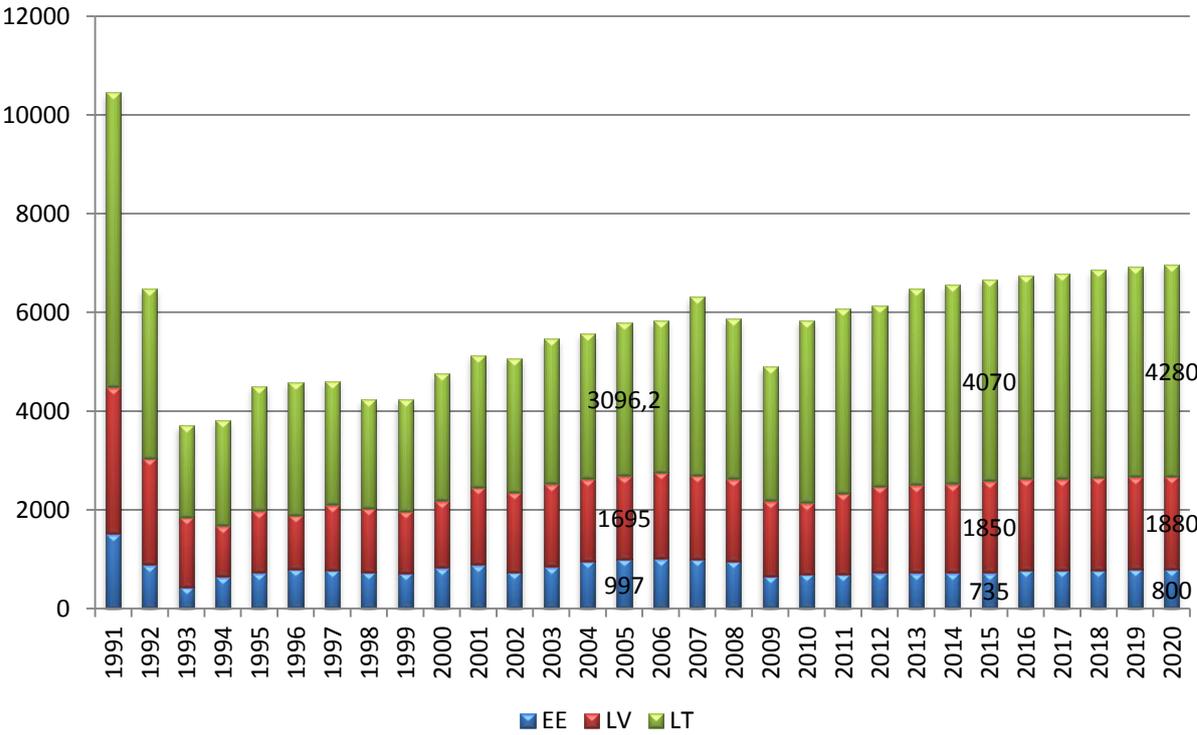


Figure 8. Natural gas consumption in the Baltic States in 1991–2020, million m³

Given that natural gas is the cleanest-burning fossil fuel as well as the most flexible source of power production (which is often necessary to balance intermittent generation from renewable sources), its share may become larger in case there is a need for an alternative source.

1.3. Supply quantities by routes

The three Baltic countries are interconnected and the transmission system is owned by the respective national vertically integrated gas companies but intra-Baltic flows are essential only emanating from the Latvian storage (and only in the winter) to primarily Estonia and, to a much lesser degree, Lithuania (see Figure 9). Balance of supply volumes directly through interconnections with Russia or from Inčukalns UGS in Latvia depends on season and/or other considerations (commercial etc.).

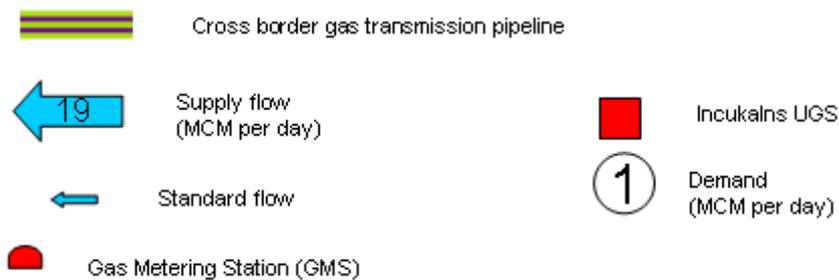


Figure 9. Natural gas network and gas flows of the Baltic States

Cross-border interconnection points

Point type	Location	System operator #1	Country		System operator #2	Country	Technical physical capacity, mcm/d
Cross-border IP	<u>Karski</u>	Eesti Gaas AS 	EE	>	Latvijas Gāze AS 	LV	
		Latvijas Gāze AS 	LV	>	Eesti Gaas AS 	EE	7
Non-EU	<u>Värskä</u>	Gazprom OAO 	RU	>	Eesti Gaas AS 	EE	4
Non-EU	<u>Korneti</u>	Gazprom OAO 	RU	>	Latvijas Gāze AS 	LV	20
		Latvijas Gāze AS 	LV	>	Gazprom OAO 	RU	12
Cross-border IP	<u>Kiemenai</u>	Latvijas Gāze AS 	LV	>	Lietuvos dujos AB 	LT	2*
		Lietuvos dujos AB 	LT	>	Latvijas Gāze AS 	LV	5
Cross-border IP	<u>Sakiai</u>	Gazprom OAO 	RU	>	Lietuvos dujos AB 	LT	11
Non-EU	<u>Kotlovka</u>	Beltransgaz 	BY	>	Lietuvos dujos AB 	LT	31

* Currently joint Lithuanian-Latvian project "Enhancement of bi-directional interconnection capacity between Latvia and Lithuania" is under implementation and starting from 2014, the bi-directional interconnection capacity at Kiemenai will be expanded to approx. 5 mcm/day.

Estonia

The Estonian natural gas system is interconnected with transmission networks located in Latvia and Russia.

In the period from May to October the gas system is mainly supplied with gas directly from Russia. From November to April gas is basically supplied from the Inčukalns UGS through the Karksi gas metering station (hereafter – GMS) with capacity 7 million m³/day or from Russia through the Värška GMS with maximum capacity 4 million m³/day at 40 bar inlet pressure.

Capacities of gas entry point for Estonia (Pin 40 Bar)

Entry point	Max supply million m ³ /day
Karski GMS Vireši – Tallinn (D -700mm; MOP - 55bar)	6,96
Värška GMP Izborsk-Tartu-Rakvere (D – 500mm; MOP – 55bar)	4,08
Narva LKS Petersburg-Kohtla-Järve (D – 350-400mm; MOP – 38bar) closed <i>In emergency situations opened Pin 22 Bar, max Q=0.5 mcm/day</i>	

Maximum daily natural gas consumption in Estonia in the winter of 2006

Date	Consumption, mcm/day	Air temperature, °C
January 19 2006	6,678	-21,1

Maximum daily natural gas consumption in Estonia in the winter of 2010

Date	Consumption, mcm/day	Air temperature, °C
January 27, 2010	5,302	-21,8

Maximum daily natural gas consumption in the spring of 2010

Date	Consumption, mcm/day	Air temperature, °C
April 07, 2010	2,147	+2,8

Minimum daily natural gas consumption in Estonia in the summer 2010

Date	Consumption, mcm/day	Air temperature, °C
July 17, 2010	0,496	21,6

Latvia

In Latvia there is no indigenous gas production, and all gas consumed in the country is imported from Russia by two 700 mm pipelines only in summer, when part of received gas is injected into Inčukalns UGS, but the rest is delivered to the consumers.

Capacities of gas entry and exit point for Latvia

Entry and exit point	Max supply, million m ³ /day
<i>Summer season, gas injection in the storage</i>	
Entry point	
Korneti GMS	16-20
Kiemenai GMS	5
Exit points	
Inčukalns UGS (injection)	16-17
Karski GMS	7
<i>Winter season, gas withdrawal from the storage</i>	
Entry points	
Inčukalns UGS (withdrawal)	24
Kiemenai GMS	5
Exit points	
Korneti GMS	12
Karski GMS	7
Kiemenai GMS	2*

* Currently joint Lithuanian-Latvian project "Enhancement of bi-directional interconnection capacity between Latvia and Lithuania" is under implementation and starting from 2014, the bi-directional interconnection capacity at Kiemenai will be expanded to approx. 5 mcm/day.

Inčukalns UGS is used not only for customers in Latvia, but also for needs of consumers in Estonia, Lithuania and Northwest Russia thus securing reliable gas supply for the whole region. During the winter, about 1 bcm of natural gas is transmitted to Russia and Estonia.

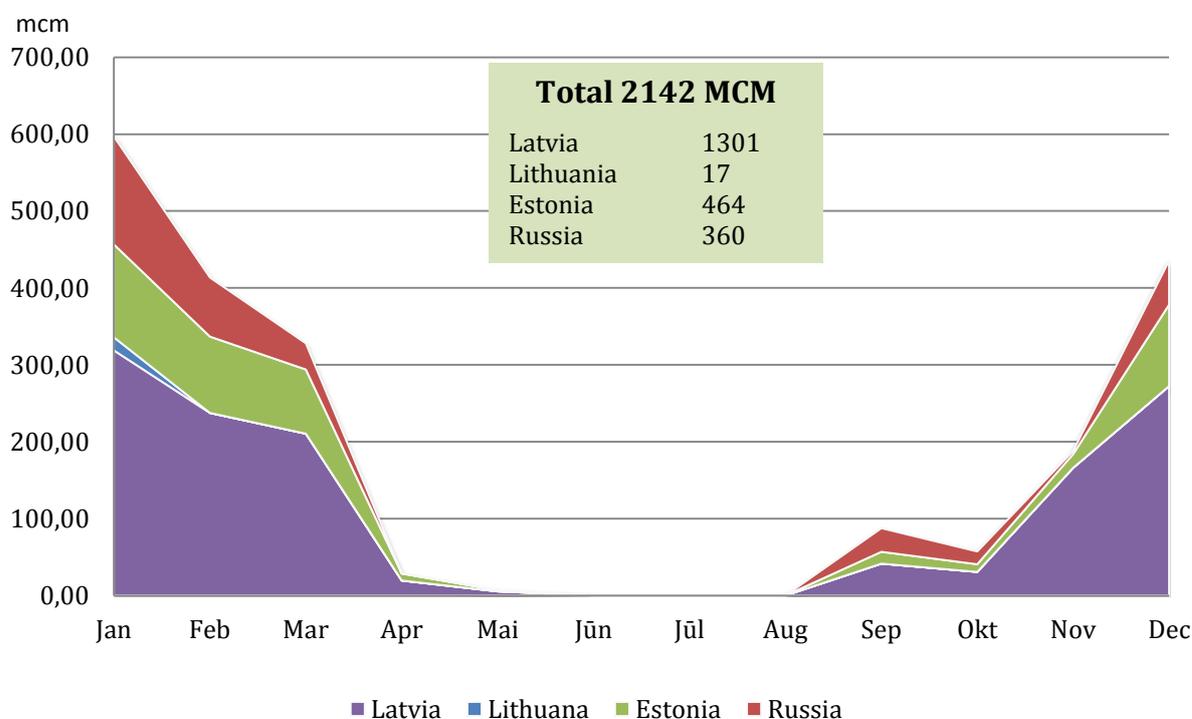


Figure 10. Natural gas supply from Inčukalns UGS in 2010

Latvia's natural gas transmission system was developed 40 years ago, and the following principles were the cornerstone for the process:

- 1) Natural gas is supplied to Latvia along the Latvian-Russian pipeline only during the warm period of the year (April-September), and it is accumulated in the underground gas storage facility in Inčukalns;
- 2) During the winter, gas from the underground facility is delivered to Latvian customers, as well as transmitted to Estonia and back to Russia;
- 3) There is also a connection to Lithuania, but, currently, it is only used as an emergency backup system for the supply of a limited region in Lithuania;
- 4) The transmission system was designed for annual consumption of up to 4 bcm in Latvia – more than two times above the current consumption.

Maximum daily natural gas consumption in Latvia in the winter of 2010 was the following:

Date	Consumption, mcm/day	Air temperature, °C
January 24	12.46	-17.4

Minimum daily natural gas consumption in Latvia in the summer of 2010:

Date	Consumption, mcm/day	Air temperature, °C
July 13	1.42	+28

Lithuania

The Lithuanian natural gas system is interconnected with transmission networks located in Latvia, Belorussia and Russia.

Capacities of gas entry and exit point for Lithuania

Entry and exit point	Max supply, million m ³ /day
Kiemenai GMS (LT -> LV)	5*
Kiemenai GMS (LV -> LT)	2*
Kotlovka GMS (BY -> LT)	31
Sakiai GMS (LT -> RU)	11

* Currently joint Lithuanian-Latvian project "Enhancement of bi-directional interconnection capacity between Latvia and Lithuania" is under implementation and starting from 2014, the bi-directional interconnection capacity at Kiemenai will be expanded to approx. 5 mcm/day.

Via Lietuvos dujos AB - operated and controlled/managed transmission system, the Lithuanian consumers are supplied with gas by two main suppliers – Lietuvos dujos AB and UAB „Dujotekana“, whereas direct purchases of gas from Gazprom OAO is made by AB „Achema“ and KTE for their own needs. Natural gas to Druskininkai region is supplied from Belarus by a separate distribution pipeline under UAB „Intergas“. Natural gas supplier is UAB „Haupas“, taking a very small share of gas supply market. Each of the abovementioned companies have a limited gas quota defined by a long term agreements.

Scheme of natural gas supply in Lithuania has been settled and unchanged for some time. The last variations took place in 2004 with the introduction of one more gas supplier into the domestic gas supply market – UAB "Kauno termofikacijos elektrinė" (Kaunas CHP Plant (hereinafter – KTE). So far natural gas is imported to Lithuania by 5 Lithuanian gas supply companies: Lietuvos dujos AB, UAB „Dujotekana“, UAB „Haupas“, AB „Achema“ and KTE.

Considering technological features of transmission system under Lietuvos dujos AB, such flows are distinguished:

1. Pabradė–Visaginas.
2. Jauniūnai–Kaliningrad.
3. Jauniūnai–Panevėžys–Klaipeda.

Central part of Lithuania with gas supply via Jauniūnai–Kaliningrad branch is distinguished by larger volume of gas consumption due to the developed industrial and energy sector. Average consumption by the consumers in this region is up to 4.5 times higher than that of all remaining consumers.

The largest amount of natural gas towards Jauniūnai–Panevėžys–Klaipeda direction is consumed at the remotest point, in Klaipeda city where natural gas consumption makes up to 30 percent of the total gas amount supplied via the said natural gas supply line.

Technical capacities of Panevėžys–Klaipeda line introduce limitations on the potential supply of natural gas amount. In winter time the required natural gas amount is supplied by availing of Panevėžys compressor station.

The amount of gas available in the transmission system for the supply of consumers in the event of supply interruptions is dependent on the system diameters in the pressure system. According to Lietuvos dujos AB, the said amount may vary between 13 and 17 million m³.

1.4. Functioning of the market

All Baltic States are fully dependent on gas imports from the same main supplier, Gazprom OAO. The existing infrastructure doesn't physically allow gas purchases from another source than Russia. This results in a significant dependence in physical and commercial terms. The dependence may be somewhat different with respect to the country's exposure to gas in its energy mix, which is currently larger in the case of Lithuania and Latvia than in Estonia.

The markets in all three countries are essentially dominated by a single vertically integrated incumbent operator: Eesti Gaas AS, Latvijas Gāze AS and Lietuvos dujos AB (up to 50 percent of total gas market) respectively for Estonia, Latvia and Lithuania. Gazprom OAO and E.ON Ruhrgas International GmbH are key shareholders in all three companies.

Network tariffs and prices are regulated in all three countries. Even though all three markets are regulated the methodologies applied may differ from country to country. Thus tariff and prices or formulas for calculating them must be approved by the appropriate authority.

The entire East Baltic area is covered by derogations under the 2nd Gas Directive 2003/55/EC. Under the 3rd Energy Package, explicit derogations (qualifying as an isolated market) will continue for Latvia and Estonia but not for Lithuania. According to Art. 49(1) (subparagraph 3) of Gas Directive 2009/73/EC, the derogations for Estonia and Latvia fall once they are "directly connected to the interconnected system of any Member State other than Estonia, Latvia, Lithuania and Finland." Consequently in case the above infrastructure priorities are met, these Member States will have to apply the provisions of the 3rd Energy Package, including the provision to establish national entry-exit regimes and to implement effective unbundling in their gas networks.

Estonia

Although Article 49 of Directive 2009/73/EC concerning common rules for the internal market in natural gas provides a derogation for Estonia and does not require ownership unbundling of the transmission system from gas producer and seller as long as any Baltic State or Finland is not directly connected to the interconnected natural gas network of any other Member States than Estonia, Latvia, Lithuania or Finland, Estonia has the right despite the derogation provided in the directive to establish national provisions which conform to the requirements of the directive by their content and purpose. Compared to the time of application for the derogation, the energy markets have changed both globally and in the Baltic Sea region. By changing the current preconditions it will be possible to create additional opportunities for the further development of the gas market by bringing to the market both alternative suppliers of liquefied natural gas and creating new associations. Proceeding from the developments in the gas market and main provisions of the EU third energy package for ensuring the security of supply and settling conflicts of interest, Estonia has set itself the aim of liberalisation of the gas market.

Based on the analysis of the economic impact of the energy package of the European Commission in the implementation of the electricity and gas market package and on the experience of other Member States Estonia reached the conclusion that in Estonia the most proportionate actually functioning system operator model from the aspects of the development of the gas market is a transmission system operator independent of the seller or importer, which will make it possible to develop the gas market according to the principles of the directive. On 6 June 2012 the Estonian Riigikogu approved amendments of natural gas act. The legislative amendment sets 1 January 2015 as the date by which the completion of the liberalisation of the gas market should be carried through. Latest by that date, the network operator who owns the transmission network, owns or operates measurement systems at state border and who has been certified and designated as system operator according to Article 3 of Regulation (EC) No 715/2009 of the European Parliament and of the Council, shall be the system operator.

Wholesale market has currently one dominant player (Eesti Gaas AS), as chemical industry undertaking (fertilizer producer) Nitrofert has presently halted its activities.

Retail market consists of Eesti Gaas AS and 24 small retail undertakings.

Similar to wholesale and retail market the market of gas transmission and distribution services is concentrated. AS EG Võrguteenus is the system operator of the combined gas network, providing transmission and distribution services, unbundling of accounts is required for both services and other activities. The total number of gas distribution undertakings in Estonia, including AS EG Võrguteenus, is 25 and that is a relatively large number. The market share of distribution services of AS EG Võrguteenus reaches ca 91% and the undertaking has 43.5 thousand customers. AS EG Võrguteenus as a system operator is responsible for the balance of the system. The remaining distribution network operators are as a rule relatively small, only two of them have sales volumes over 10 000 thousand m³/year and the number of their customers does not exceed a thousand. The total market share of distribution services of small gas networks is only 9%.

In accordance with the Natural Gas Act all network tariffs and methodologies for calculating connection fees are approved by the Estonian Competition Authority. The price of balancing gas and the fees for gas transit do not require approval, the Competition Authority applies so-called ex-post control or price supervision. Gas price is not fully regulated and all customers buy gas at market price. Only the market dominant company - currently Eesti Gaas AS, has to approve the sales margin, as a component of the price for households. For dominant gas company gas pricing for households is based on the

principle that the weighted average price of gas sold includes the import price and the sales margin. The dominant gas company must have approval of the value of the margin from the competition authority. Eesti Gaas AS itself forms its sales price on the basis of the import price and the approved margin. At the end of each calendar year the company makes a settlement of accounts (recalculation) based on the actual volume supplied to the household customers.

Latvia

At present, the Latvijas Gāze AS is the only enterprise in the natural gas market. Latvijas Gāze AS by conditions of share purchase agreement has exclusive rights on transmission, storage, distribution until year 2017 and license for sale of natural gas as well as unlimited and exclusive right to use Inčukalns UGS for the period of twenty years in Latvia. Latvijas Gāze AS carries out transmission, distribution, storage and sale of natural gas in compliance with the licences issued by the Public Utilities Commission.

Amendments to the “Energy Law” made on May 26, 2005 prescribe the main conditions for opening the natural gas market and were developed, taking into account the Directive 2003/55/EC of the European Parliament and of the Council concerning common rules for the internal market in natural gas. The law includes issues concerning operation of systems, duties and rights of market participants, as well as competition opportunities in the natural gas market.

On 3 December 2009, the Saeima adopted a decision to postpone liberalisation of the natural gas market in Latvia until 4 April 2014.

Taking into account the requirements of the EU directives, any “new market” of natural gas where the first supply in the framework of a long-term supply agreement has been rendered less than 10 years ago is entitled not to apply liberalisation of the natural gas market. The first natural gas supply rendered in the framework of a long-term supply agreement of 18 July 2003 was on 5 April 2004 therefore the natural gas market liberalization date has been set for 4 April 2014. After this day according to the 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 and repealing Directive 2003/55/EC the third party access to the transmission and distribution system will be implemented, all users of natural gas will be free to choose the natural gas supplier, as well as the end users that have a connection with the transmission system will be free to choose the supplier without restrictions, informing the supplier or transmission system operator in advance.

Besides gas supply business environment in the region and the gas supply agreements in force practically exclude third parties, except regional transmission system operators, access to Inčukalns UGS. During winter the availability of natural gas in the Northwest region of Russia is not sufficient to ensure natural gas supply to the Baltic States and Kaliningrad region that could cover their total demand. Consequently, the gas market in Latvia may only be open formally. At the same time, it can be expected that already now the opening of gas market and division of Latvijas Gāze AS, in Latvia’s situation, would considerably increase the tariffs for end users as the company’s operational costs would increase. Therefore, opening of the market would not ensure the suppliers with new natural gas obtaining opportunities in short-term.

The tariff calculation methodologies have been developed in conformity with the Energy Law, the Law on Regulators of Public Utilities, regulations related to the supply and use of gas, as well as other legal acts which are in force in the Republic of Latvia. The methodologies are applied when determining transmission, storage, distribution and supply service tariffs.

Tariffs for the gas supply services are approved by the Regulator. The Regulator also sets the principles on how the gas acquisition price is included in end-user tariffs. End-user tariffs are differentiated in accordance with the annual consumption level of customers. The final price of natural gas consists of the prices of services, the price of imported natural gas, excise tax and VAT.

There are two tariffs approved for transmission – one – for the pipeline system connecting Estonia, Lithuania and Russia in the Latvian territory, the second – for the services of the transmission system's part serving for the national supply only and is applied only to national consumers .

For underground gas storage services, the Regulator approves three tariffs – injection, storage and withdrawal.

All tariffs are applied to all users of the transmission system and storage equally.

The rate of return on capital is specified by the Public Utilities Commission based on regulatory asset base principle.

Since gas market of Latvia is closed there is no regulation for cross border trade, import and export.

Alternative gas supplies would become possible if the Russian gas market is liberalised, if connections to other EU countries and Norway are ensured, or the LNG storage and/or regasification plant were built. All of this would require significant investments, and these investments would not be cost-effective at the present level of total annual consumption of natural gas.

Lithuania

Activities of natural gas sector are regulated by issuing licences or defining prices. Gas companies of natural gas sector must hold licences for the following types of activities: transmission, distribution, storage and supply. Licences are issued by the State Commission of Pricing and Energy Control (hereinafter – the Commission) as per the set procedure. A licence to undertake gas transmission activity in Lithuania is held by a single Lietuvos dujos AB Company, which owns all gas supply pipelines. Nomenclature of state regulated prices in natural gas sector is determined by Part 1 Article 23 of Law on Natural gas – the prices of natural gas transmission, distribution, liquefaction, storage, supply, connection of household consumers and system balancing.

Prices are regulated by the Commission by defining upper limits of the regulated prices for the period of five years. Actual prices of natural gas transmission, distribution and the gas prices not exceeding the limit values for regulated consumers on an annual basis (for household consumers - every six months) are set by gas companies. If non-observance of pricing methodology by gas companies is found by the Commission, it is entitled to unilateral determination of actual regulated prices of gas.

Regulated prices are set in accordance with Parts 5–8 Article 23 of Law on Natural gas and the Commission- approved methodologies: Methodology on calculation of upper limits of natural gas transmission and distribution prices (approved of by 13 October 2009 Resolution No. 03-157 of the State Commission of Pricing and Energy Control) and Methodology on calculation of upper limits of natural gas supply prices (approved of by 13 October 2009 Resolution No. 03-158 of the State Commission of Pricing and Energy Control) and methodologies on calculation of fees of connection of new natural gas consumers (approved of by 17 November 2008 Resolution No. 03-187 of the State Commission of Pricing and Energy Control).

Establishment of the main guidelines for regulation of normative profit of natural gas infrastructural activities and limitation of its upper limit to 5 percent for transmission, distribution, liquefaction and storage types of activities is enforced by Law on Natural gas. Setting of upper limits of transmission, distribution, liquefaction and storage prices takes into account the historical value of asset employed in the licensed activities of the gas company. The value of asset is validated and approved by the Commission relying on principles for valuation of asset employed in the licensed activities of gas companies. Methodologies on the determination of regulated prices shall provide for necessary investments to secure an efficient and safe performance of the systems and normative profit to secure the said performance. Gas transmission and distribution prices are established disregarding gas transportation distance – "postmark" principle. Gas transmission and distribution prices for non-household consumers are set and differentiated on the gas amount and capacity basis. Gas distribution prices for household consumers are differentiated based on the amount of consumption. Principles of differentiation of gas amount and capacity are contained in pricing methodologies. Prices for every company involved in regulating activity are set by the Commission individually. Upon decision of the Commission upper limits of gas transmission and distribution prices may be subject to revisions due to the changed inflation rate, imported gas prices, charges/taxes, gas transportation amount, legislative requirements, fulfilment of investments by the gas companies as coordinated with the Commission or in case of deviations from indices defined in this methodology by the gas companies.

Upper limits of natural gas transmission and distribution prices for the period of 1 January 2009 to 31 December 2013 were set by the Commission Decision No. 03-170 of 31 October 2008 and revised by the Commission Decision No. 03-192 of 30 October 2009 taking into account the changed stipulations of Law on Natural gas limiting the potential profit of up to maximum 5 percent from the value of asset employed for the licensed activities (cf. with former 8.05 percent) and other coefficients include in the price calculation. The current upper limit of natural gas transmission price is 39.03 Lt/1000 m³.

Transit transportation of gas along the territory of the country (to Kaliningrad) is not the regulated activity thus it is separated from the regulated activities by segregating costs, profit, transportation amount.

From 1st of August, 2011 the Law amending the Law on natural gas and the Law on implementation of the Law amending the Law on natural gas entered into force which implement the requirements of Directive 2009/73/EC and Regulation No. 994/2010. The aforementioned laws implement the first and foremost model prescribed by the Directive 2009/73/EC on unbundling natural gas transmission from extraction and supply activities, i.e., ownership unbundling of the transmission system operators. The Article 40 of the new Law on natural gas provides that natural gas transmission in the Republic of Lithuania shall be unbundled from natural gas extraction and supply, by unbundling the ownership of the transmission system and/or of the Transmission System Operator from natural gas undertakings engaged in extraction and/or supply. These provisions aim to ensure that the Transmission System Operator operates independently from commercial interests. The aim of selecting this way is to provide maximum benefits to Lithuanian customers and increase the national energy security. The Law on Implementation of the new Law on natural gas foresees that natural gas undertakings not in compliance with the unbundling requirements may conclude and perform any transactions (sale of property, transfer of shares, assignment of rights, transfer of shareholders' rights, shareholders agreement, reduce and enlarge of share capital or any other transaction) on their own initiative (Article 3) or perform all necessary actions of reorganization provided in the Civil Code and Law on Companies in order to set up separate natural gas companies complying with the

requirement of unbundling (Article 4). On 28 October, 2011 the Government adopted the order “On the implementation plan on separation of operation and control of natural gas companies non-compliant with the Law on Natural Gas”. According to the aforementioned order Lietuvos dujos AB must complete the separation of its operational activities (transportation, distribution and supply) by 31 October 2014. Lietuvos dujos AB must submit a detailed action plan for the separation of operational activities and control to the National Control Commission for Prices and Energy by 31 March 2012.

1.5. Natural gas as a reserve fuel

Estonia

Natural gas is reserve fuel for biomass CHP plants in Tartu, Pärnu and Tallinn. It is also reserve fuel for oil-shale powered CHP blocks in Narva power station.

Estonian electricity transmission system operator Elering is currently constructing its emergency reserve electrical power plant with electrical capacity of 250 MW. First 100 MW stage will be ready by 2013 and second 150 MW by 2015. These reserve capacities are using natural gas as primary fuel.

Lithuania

7 heat supply companies with heat generating facilities, which have no potential of storage or use of other fuels, conclude uninterrupted gas supply contracts and gas reserves for such consumers are stored at an underground gas storage facility by Lietuvos dujos AB. The total amount of gas stored for these consumers is not that large and make 1.2 million m³.

1.6. Contractual issues

Long term gas supply agreements for a period of 20-30 years are a well-known practise in Western Europe. It is pointed out by European union of the natural gas industry “Eurogas” and the officials of the European Commission that long-term gas supply contracts are considered for Europe to be an important element of gas supply security since they provide secure circumstances for long term investments in gas supply technologies and infrastructure.

All natural gas import operations in Estonia, Latvia and Lithuania are handled on the basis of a long term supply agreements. These contracts contain clauses regulating gas supply technical conditions (pressure, calorificity etc.), volumes of supply and storage (annual and monthly), gas storage and transmission charges, gas price calculation issues, conditions of payments, conditions for revisions of contracts, other liabilities, etc.. When needed, gas supply contracts are subject to updating. Annual amount of natural gas, its quarterly breakdown and other issues is specified in additional agreements.

As it is common in gas business, contracts for all three countries contain so called take-or-pay clause, where the buyer has agreed to take a certain volume of gas and pay for it even in case this volume is not consumed (usually 80% - 85% of the whole volume). Depending on provisions of the contract, often it is possible to carry over certain volume of gas, which is not consumed in particular year, to the next year, which allows eliminating losses caused by occasional deviations from the agreed volumes. However, in case of prolonged decrease of gas consumption this clause can cause significant economic loss to the buyer. Nevertheless, all typical long term contracts contain take-or-pay provision in order to protect investments made by the supplier for gas delivery.

Natural gas purchase prices in long-term contracts are linked to the price of oil and calculated according to the formulas. In order to guarantee gas price competitiveness with

other fuels the price calculation is based on 9 months (in case of Estonia and Latvia) or 6 months (in case of Lithuania) average of heavy fuel oil price (with 1% sulphur content) and gasoil price in Northwest Europe quoted in USD and exchange rate between Euro and USD. Payment to gas suppliers is made in Euro. Formula of gas purchase price is usually subject to revisions by the end of a year.

Contracts with Gazprom OAO also contain a ban imposed on the gas companies to resell gas to the third parties without Gazprom OAO permission.

Long-term contracts for Lithuania and Estonia expire in 2015 and for Latvia in 2030.

Estonia

Eesti Gaas AS has agreement with Gazprom OAO for the supply volumes of natural gas up to 7.0 million m³/day until the end of 2015. However, with regard to the capacity of the pipeline of EG Võrguteenus with Russia it is necessary to take into account the possible demand for gas and network services for up to 0.7 million m³ a day of the chemical industry undertaking Nitrofert.

Existing natural gas supply contracts concluded by Eesti Gaas AS

Gas purchaser/ purchaser of storage services	Gas supplier/ Provider of gas storage services	Contract validity period	Comments
Eesti Gaas AS	Gazprom OAO	2015	Long-term gas supply contract
Eesti Gaas AS	Itera Latvija SIA		Annual contract

Latvia

All import operations are handled by Latvijas Gāze AS on the basis of a long term supply agreement among Latvijas Gāze AS, Gazprom OAO and Itera Latvija SIA where conditions of natural gas supply and storage for Latvia are set (see table below).

Existing natural gas supply contracts concluded by Latvijas Gāze AS

Gas purchaser/ purchaser of storage services	Gas supplier/ Provider of gas storage services	Contract validity period	Comments
Latvijas Gāze AS	Gazprom OAO	2004–2030	Long-term gas supply contract
Latvijas Gāze AS	Itera Latvija SIA	2004-2030	Long-term gas supply contract
Lietuvos dujos AB	Latvijas Gāze AS	2011/2012	Annual contract
Eesti Gaas AS	Latvijas Gāze AS	2011/2012	Annual contract

In February of the year 2009 Latvijas Gāze AS signed new gas supply contracts with Gazprom OAO and Itera Latvija. These new contracts ensure the supply of needed gas

amounts to Latvia until the year of 2030, which is a significant element for long term security of energy supply in Latvia. Previously such agreements were concluded until 2015.

Conditions of gas storage in Inčukalns UGS for Estonia and Lithuania are set in respective storage contracts with Lietuvos dujos AB and Eesti Gaas AS. These contracts are annual contracts, which are updated every season. Both contracts also contain clauses on mutual cooperation in case of gas supply disruption or other emergency cases. In particular, according to the agreements the issues of changes of gas flows and operation regimes in case of emergency have to be considered and adjusted without delay taking into consideration technical capacities of gas transmission systems of respective countries and Inčukalns UGS. Moreover, the agreements also coordinate procedures of carrying out gas network repair works affecting neighbouring countries, and determine procedure of documenting of the events.

Lithuania

The table below includes information on concluded natural gas supply contracts by Lithuanian companies.

Existing natural gas supply contracts concluded by the Lithuanian companies

Gas purchaser/ purchaser of storage services	Gas supplier/ Provider of gas storage services	Contract validity period	Comments
Haupas UAB	Gazprom OAO	2003–2015	
Achema AB	Gazprom OAO		
Lietuvos dujos AB	Gazprom OAO	2000–2015	
Dujotekana UAB	Gazprom OAO	2001–2013	Supplied until 3rd quarter of 2008
Dujotekana UAB	LT Gas Stream AB	2008–2012	Started supply since 4th quarter of 2008
Kauno termofikacijos elektrinė UAB	Gazprom OAO	2004–2017	

All companies mentioned in the table are entitled to the extension of contracts. The majority of natural gas companies operate under long-term contracts irrespective of the location where natural gas is purchased from: Russia, Norway, Algeria or other gas supply countries. Long-time guarantees are needed by both, consumers and gas extraction companies, which plan investments into very expensive extraction and transportation infrastructure.

The validity period of the majority of long-term natural gas supply contracts will expire in the forthcoming 2–5 years thus in due time gas supply companies will have to initiate negotiations to fix contract conditions for the next period.

Contracts with Gazprom OAO do not fully guarantee uninterrupted gas supply. It is proved by the fact of interrupted gas supply to Lithuania via Belarus during 18– 20 February 2004. On 18 February 2004 gas transit to Lithuania via Belarus was limited and then stopped for other reasons than those of technical origin between Belarus and Gazprom OAO.

Since instantaneous transactions (SPOT) on the global natural gas market make just an insignificant share they are viewed as meeting specific demands of exceptionally individual consumers.

1.7.Demand flexibility

Estonia

Pursuant to the EU Directive 2004/67, which lays down the measures for securing gas supplies, the Ministry of Economic Affairs and Communications elaborated proposals for amending the Natural Gas Act that were approved by the Parliament in March 2007. For securing of gas supplies the following measures are set out.

In the period from 1 October to 1 May the household customer's supply with gas may not be interrupted nor limited. In the same period, gas supply may not be interrupted nor limited to an undertaking supplying residential space heating and which has no possibility to use fuel other than gas. Gas supply may be interrupted if there is a danger for people's life, health, property or environment is endangered, as well as upon an agreement between parties. Since 1 July 2008 a heat supply undertaking with an annual estimated production volume over 500 000 MWh per network area is required to facilitate a possibility of using a reserve fuel, in order to secure heat supply during 3 days. This applies to one large heat producer located in Tallinn.

Latvia

For Latvia main flexibility tool is Inčukalns UGS. Gas supply system of Latvia is constructed to ensure gas consumption of 4 bcm per annum. The actual consumption is about 1.6 bcm a year. There is a capacity reserve of approximately 30%. The maximum amount of gas which could be withdrawn from Inčukalns UGS is 24 million m³ per day. That is the only limitation in case of congestion.

Due to capacities in pipeline system as well as availability of Inčukalns UGS, Latvijas Gāze AS is able to fulfil requirements of customers without interruptibility therefore there are no interruptible customers in Latvia.

Lithuania

Fuel switching (Storage of alternative fuels): reserves of energy resources are held by the energy companies over 5 MW heat or electricity production facilities, which generate electricity or heat for sale. The amount of energy resources to be stored shall equal the rate of consumption in 1 month. By 1 January 2010 a number of facilities over 5 MW of heat or electricity production accounted for 120 in Lithuania. The reserves stored most often include – bio-fuel, shale oil and diesel fuel. The accumulated amount of reserve fuel made 206096 toe, which is more than prescribed in the law.

Non-household consumers which generate electricity or heat for their own needs (not for sale) are entitled to make their own decision on the accumulation of reserves. One of the options they may choose to be the consumers of interrupted supply and in case of gas supply interruption gas supply to them would be discontinued immediately.

1.8.Transmission / transit obligations, solidarity

Eesti Gaas AS, EG Vörguteenus AS, Latvijas Gāze AS, Lietuvos dujos AB, Gazprom OAO and Gazprom Transgaz Sankt-Petersburg have solidarity agreement of cooperation between TSO-s. In particular, agreements with the gas supplier provide for mutual cooperation in case of gas supply disruption or other emergency cases. According to the agreements the issues of changes of gas flows and operation regimes in case of emergency have to be considered and adjusted without delay taking into consideration technical capacities of gas

transmission systems of respective countries and Inčukalns UGS. Moreover, the agreements also coordinate procedures of carrying out gas network repair works affecting neighbouring countries, and determine procedure of documenting of the events.

In addition, in July of 2011 Regulations on coordinated actions of Dispatching Centres in case of accidents and extraordinary situations were signed by the SIA Gazprom Transgaz Sankt-Petersburg, Latvijas Gāze AS and Eesti Gaas AS. The regulations were prepared with the aim to secure coordinated activities of dispatching centres in order to eliminate accidents on cross-border transmission pipelines. These regulations contain detailed procedures of action of every Dispatching Centre in case of emergency with the aim to restore gas supply as soon as possible.

On March 28, 2011 Latvijas Gāze AS and Lietuvos dujos AB signed an agreement that among other issues sets procedure of coordination of activities of Dispatching Centres in case of accidents and emergency situations and provides for immediate adjustment of gas flows depending on technical conditions and capacities.

1.9. Public Service Obligations, security of supply standards

Estonia

According to the current Natural Gas Act:

The network operator who does not engage in sales shall appoint a seller for its network area unless other sellers supplying gas to customers operate in that area. (Chapter 3 Article 22)

The seller of gas who has the greatest market share within a network area is required to sell gas to all household customer who have a network connection and who are located within its network area if customers so desire. (Chapter 1, Article 9)

According to the Article 9¹ the gas undertaking in a dominant position on the market does not have the right to refuse to sell gas to household customer, if the customer requests that gas be sold (obligation to supply).

According to the Article 26¹ protected consumer to whom the norm of security of supply provided for in Article 8 of Regulation (EU) No 994/2010 of the European Parliament and of the Council is applied is household consumer connected to the distribution network and undertaking producing heat for heating residential premises, who cannot use other fuel than gas as fuel.

Organizational, economic and legal bases of social welfare are stipulated in Social Welfare Act. Social benefits are considered in Chapter 4 of Social Welfare Act.

Latvia

The Latvijas Gāze AS is the only trader of natural gas in Latvia, and its exclusive license obliges it to supply natural gas within the covered zone. At this time this refers to all of Latvia, and the obligation exists as long as deliveries are technologically possible and economically feasible.

Public Service Obligations are imposed on company by Article 5 of Energy Law:

(1) Energy supply merchants are regulated merchants who in accordance with requirements specified in a licence shall ensure safe, continuous and stable supply of existing and potential energy users with electricity, thermal energy, gas or other type of energy and fuel in economically justified quantity and quality in conformity with

environment protection conditions. The operations of energy supply merchants shall be regulated in accordance with the Law on Regulators of Public Utilities.

Lithuania

The following obligations in line with the public interest are stipulated by the legal acts regulating the natural gas sector activities:

1. Regulation of natural gas supply price by defining the upper limits of gas supply price.
2. Requirements for supply companies to perform the supply of last resort to the household consumers. Law on natural gas provides rules on the regulated supply of last resort to household consumers and consumers at the facilities with energy production capacity of under 5 MW and no reserve fuel is available, i.e. gas supply according to public interest obligations. Eligible consumer has the right to choose another company than that performing the supply of last resort. This way no limitations on the consumer's selection are imposed while obligations are imposed on supply companies alone.
3. Safeguarding of supply security. Gas companies shall always be ready to act under potential extreme condition in energy sector or in case of possible interruption of gas supply and plan preventive measures to secure gas supply reliability and technical safety of gas systems. In the event of extreme condition in energy sector or possible interruption of gas supply associated with risk posed to the system safety, in emergency situations, risk towards human health or safety, gas companies must immediately undertake all reasonable measures to resume gas supply reliability and technical security of gas systems.
4. Requirements for supply companies to store gas stocks for household consumers. Uninterrupted natural gas supply to household consumers is ensured by holding and storage of gas based on a respective schedule: since 1 September 2008 gas reserves accumulated for household consumers should be sufficient to meet the supply demand for the period of 10 days with additional 10 days each year until the level of 60 days is reached. The quantity of gas reserves is calculated on the basis of average value of actual gas consumption during the cold period of the last 3 years. Gas amount consumed by household consumers in 10 days makes 10 million m³. 0,405 bcm (40 days of consumption) of gas is stored in Inčukalns UGS facility in Latvia (data for August, 2011).

Market - supply- demand Conclusions

- ✓ Small individual gas market size;
- ✓ Market structure – dominance of external supplier;
- ✓ Main supplier - Gazprom OAO, since existing infrastructure doesn't physically allow gas purchases from another source than Russia;
- ✓ The countries are connected to each other to some degree via respective interconnectors;
- ✓ The markets are essentially dominated by a single vertically integrated operator;
- ✓ Under the 3rd Energy Package, explicit derogations (qualifying as an isolated market) will continue for Latvia and Estonia but not for Lithuania.
- ✓ It is foreseen that after the economic recession in 2009 the consumption of gas will slightly increase within the next 5 years after that the gross gas consumption will remain unchanged until 2020.

2. Physical infrastructure

2.1.Characteristics of infrastructure

The three Baltic States are connected to each other via respective interconnectors between Lithuania and Latvia and Latvia and Estonia. Nevertheless, the interconnections are insufficient for any significant trading purposes and all three countries are in any event supplied directly from Russia (via Belarus in the case of Lithuania). Furthermore the only storage (Inčukalns, with a working capacity of 2.3 bcm) in the region is located in Latvia but it is effectively (2/3 of the working gas volume) controlled (i.e. booked) by Gazprom OAO on a long-term basis, which is using it to supply the St. Petersburg area in the winter.

Estonia

AS EG Võrguteenus (EGV) is the operator of transmission network and also operates the largest distribution network of natural gas in Estonia.

The Estonian natural gas system is interconnected with transmission networks located in Latvia and Russia.

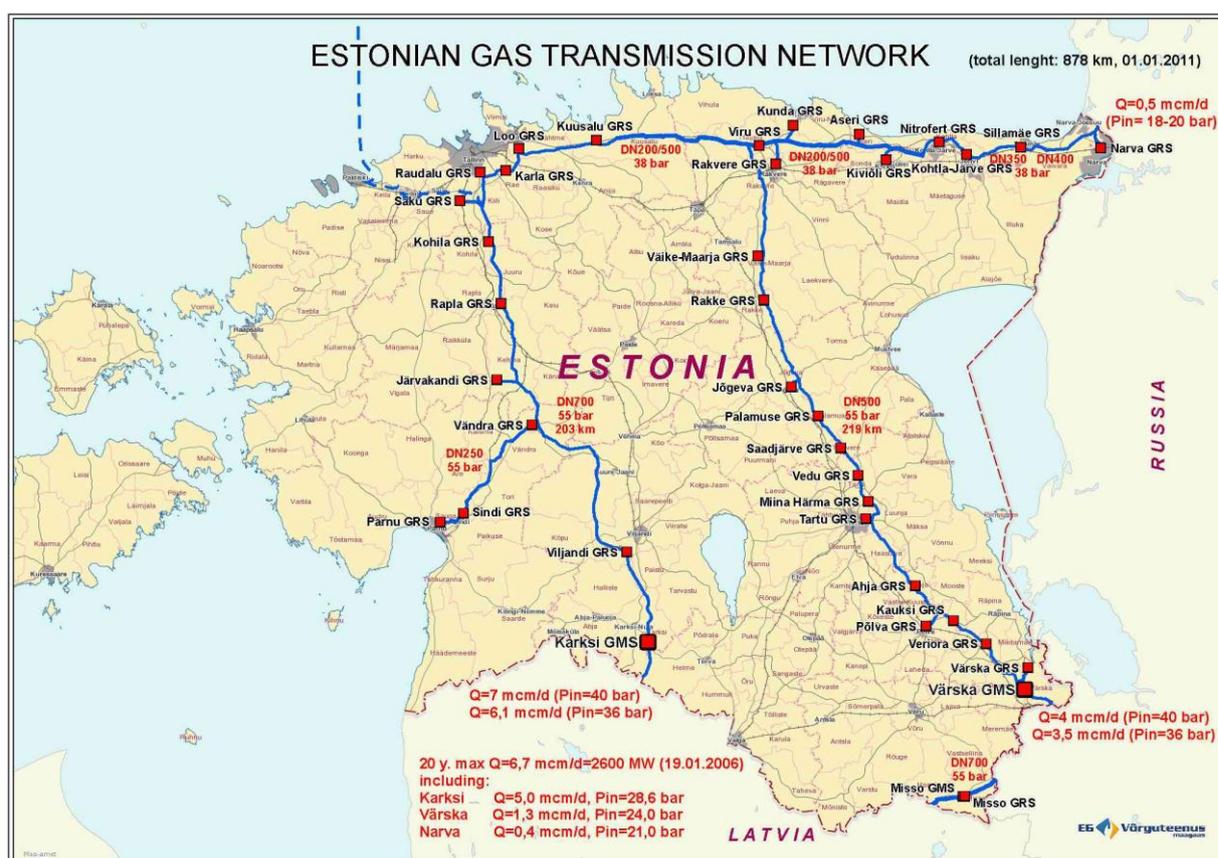


Figure 11. Gas transmission network of Estonia

The interconnections of Estonian transmission network (see Figure 11):

- with the Russian transmission network Izborsk–Tartu–Rakvere (DN 500) through transmission pipelines and Värskas GMS, the maximum input capacity 4 000 thousand m³/day.

- with the Latvian transmission network Vireši–Tallinn (DN 700) through transmission pipelines and Karksi GMS, the maximum input capacity is 7 000 thousand m³/day.
- in addition, the Estonian transmission network has a third interconnection (DN 400) (usually closed) with the Russian transmission network in Narva (north-east Estonia) that is not used in normal circumstances. It is possible to import gas through the Narva interconnection by special agreements with the gas system operator of North-Western Russia (Gazprom Transgaz Sankt-Petersburg) depending on the operation regime of their gas system.

The maximum input capacity of the two connections, at 40 bar inlet pressure, is 11 000 thousand m³/day (at 36 bar inlet pressure up to 9.6 million m³/day) of which up to 62% have been used so far at peak loads of 6.7 million m³/day . Taking into account the limitations of the Russian transmission system on its territory (before reaching Narva), the interconnection cannot be deemed as operational. Consequently, in planning of supply and the regime of operation of the gas system Estonia can rely only on the cross-border interconnection with Russia through Värskas GMS and the connection with Latvia through Karksi GMS. In case of disruption of supply from Latvia (Inčukalns UGS) the only supply route will be interconnection with Russia with capacity of 4 million m³/day.

Gas is transported into the Estonian gas transport system through Värskas and Karksi GMSs, the system holds 34 gas distribution stations and transmission pipelines with total length of 878 km.

Description of the gas transmission system in Estonia

No	Gas pipeline	Year of putting into operation	Length, km	Conventional diameter, mm	Operating pressure, bar	Age, years
1.	Vireši–Tallinn	1991/92	202,4	700	50	19
2.	Vändra–Pärnu	2005/06	50,2	250	50	5
3.	Tallinn–Kohtla-Järve I	1951/53	97,5	200	30	58
4.	Tallinn–Kohtla-Järve II	1962/68	149,1	500	30	43
5.	Kohtla-Järve–Narva	1960	45,1	350/400	30	51
6.	Tartu–Rakvere	1979	133,2	500	50	32
7.	Izborsk–Tartu	1975	85,7	500	50	36
8.	Pskov–Riga	1972	21,3	700	50	39
9.	Izborsk–Inčukalns	1984	21,3	700	50	27
10.	Branch lines		72,2			
	TOTAL:		878			

During the period from November to March the necessary pressure level in the Estonian gas system is maintained by the Inčukalns UGS, but during the period from April to October

pressure level is maintained by the Russian transmission system's compressor stations in Izborsk.

Maximum transfer capacity of the system and peak load

Years	Peak load		Max transfer capacity of the system	
	1000 m ³ /day	MW	1000 m ³ /day	MW
2001	5400	2099	7000	2721
2002	5000	1944	7100	2760
2003	5500	2138	7800	3032
2004	5100	1982	8300	3226
2005	5200	2021	10400	4043
2006	6700	2604	10500	4081
2007	6400	2488	10700	4159
2008	5200	2021	10900	4237
2009	4300	1671	11000	4276
2010	6000	2332	10900	4276

Maximum historic consumption of last 20 years is 6.7 million m³/day.

The Estonian gas transmission system today has sufficient pass-through capacity and until 2016 there will be no capacity deficit. The problem for Estonia is not the limitations of the transmission capacity, but the possibility of inlet pressure drop below the agreed limit (35 bar) at the Estonian border in the case of peak load of gas consumption.

Latvia

After privatization of Latvijas Gāze AS in 1997, assessment of technical state of infrastructure was carried out step by step and modernization of the whole gas supply system in Latvia was started.



Figure 12. Gas transmission network of Latvia

Inčukalns Underground Gas Storage

Total volume of Inčukalns UGS is 4.4 bcm, including working gas volume of 2.35 bcm. Inčukalns UGS started its operation in 1968, and therefore it had been necessary to assess technical conditions of the equipment in the storage. In this respect few technical studies had been carried out with the aim to decide on necessary modernization and replacement measures. For example, German company "UGS Mittenwalde GmbH" in 2003 performed Inčukalns UGS safety analysis. Few technical studies had been performed by "Gazpromenergodiagnostica" in 2007-2009.

In addition, a risk assessment study for Inčukalns UGS was carried out by the Latvian risk assessment company "Risks un audits" applying risk assessment method elaborated by US company "Trinity Consultants". In general, risks of technical accidents, natural catastrophes and other external risks were analyzed with the method of Error Logistical Analysis. This risk assessment shows that occurrence of any risks at Inčukalns UGS is low, however, higher probability scores earned:

- accident at compressor facility;
- accident at gas gathering facility;
- accident on gas wells;
- accident at methanol facility.

At the end of 2011 in order to update available information and prepare a programme for the further modernization of Inčukalns UGS the concept for equipment modernization and safe operation of Inčukalns UGS was prepared.

Based on these studies, updated program on necessary measures for modernization and increase of safety of supply will be worked out.

Gas transmission network

First gas transmission pipeline to Latvia was built in 1962, followed by the two next pipelines in 1966 and 1967. In general, almost 25% of pipelines are older than 40 years. The transmission system is radiate and provides natural gas supply to major cities - Riga, Daugavpils, Aizkraukle Preiļi, Iecava, Liepaja, Dobeles, Cēsis, Valmiera, Jelgava, Jūrmala, Bauska, Ogrē, Riga, Līvāni, Rezekne, and Saldus. The total length of transmission pipelines is 1240 km. Pipeline corrosion protection is provided by 102 electrochemical protection facilities, while continuing optimal transmission mode is monitored via SCADA system.

In order to assess conditions of pipelines in 1999 Giprospekgazm AO, the leading research institute in gas branch in Russia, analyzed gas supply system in Latvia and elaborated the "Action plan for gas supply system development till 2010 and concept till 2030." Another study "Further development of gas transmission system in Latvia and its technical and economic assessment" was performed in 2008. In this study gas transmission network of Latvia was studied, and particular measures proposed for increasing of safety of supply, as well as development plans of the whole gas supply system were worked out. Based on these studies program for inspection of pipelines and repair of discovered defects is elaborated. It is expected that by the end of 2013 all gas transmission pipelines in Latvia will be inspected and all major defects will be repaired.

Description of the gas transmission system in Latvia

No.	Gas pipeline	Year of putting into operation	Length, km	Conventional diameter, mm	Max pressure, bar	Age, years
1.	Vilnius-Riga	1962	42.33	500	40	49
2.	Iecava-Liepaja	1966	209.64	500/350	36	45
3.	Riga-Inčukalns UGS I	1967	41.75	700	40	44
4.	Pskov-Riga	1972	160.63	700	47	39
5.	Riga-Inčukalns UGS II	1978	41.74	700	40	33
6.	Riga- Panevežys	1983	84.03	700	40	28
7.	Izborsk-Inčukalns UGS I	1987	162.51	700	47	24
8.	Riga-Daugavpils	1988	203.00	500	25	23
9.	Vireši-Tallinn	1994	88.00		45	17
10.	Upmala-Rezekne	2001/2005	66.71		55	10/6
11.	Branch lines		137.41			
	TOTAL:		1,237.8			

Gas distribution network

The total length of gas distribution network is almost 4720 km, and only around 1600 km are polietilene pipelines. Therefore, there is well developed cathode protection system in place. In general, all gas regulation stations and units recently are reconstructed or replaced with modern ones, as well as cathode protection system. The whole distribution system is supervised by SCADA. Taking into consideration above mentioned facts as well as local character of damages that can be caused by failure of gas distribution system, impact of risk of malfunctioning of part of gas distribution system has the lowest implications comparing to any other part of the gas supply system.

As it was mentioned before, extensive modernization works were carried out in the last decade, and from 1997 till 2008 including, Latvijas Gāze AS for modernization and improvement of safety have spent LVL 174 million.

However, still there are facilities that shall be modernized, and therefore in December of 2009, the Council of the Latvijas Gāze AS approved the Latvijas Gāze AS action plan for increase of reliability of gas supply system for 2010 to 2015 providing for an investment of 50.62 million LVL (see Market-supply-demand Ch 5). In general, major part of these investments is planned for further modernization of Inčukalns UGS and inspection and repairs of gas transmission pipelines.

Natural gas commercial metering on Latvian-Russian border is performed by GMS “Korneti”, on Latvian-Estonian border by GMS “Karksi” (Estonia), on Latvian-Lithuanian border by GMS “Kiemenai” (Lithuania).

Lithuania

The total length of natural gas networks in Lithuania makes approximately 9.5 thousand km, of which the transmission pipelines account for 1.8 thousand km and distribution networks are 7.7 thousand km long (see Fig.14). From 2010 two gas compressor stations are in use:

- Panevezys gas compressor station (installed in 1974);
- Jauniunai gas compressor station (installed in 2010).

Natural gas is supplied to all larger urban areas of Lithuania.

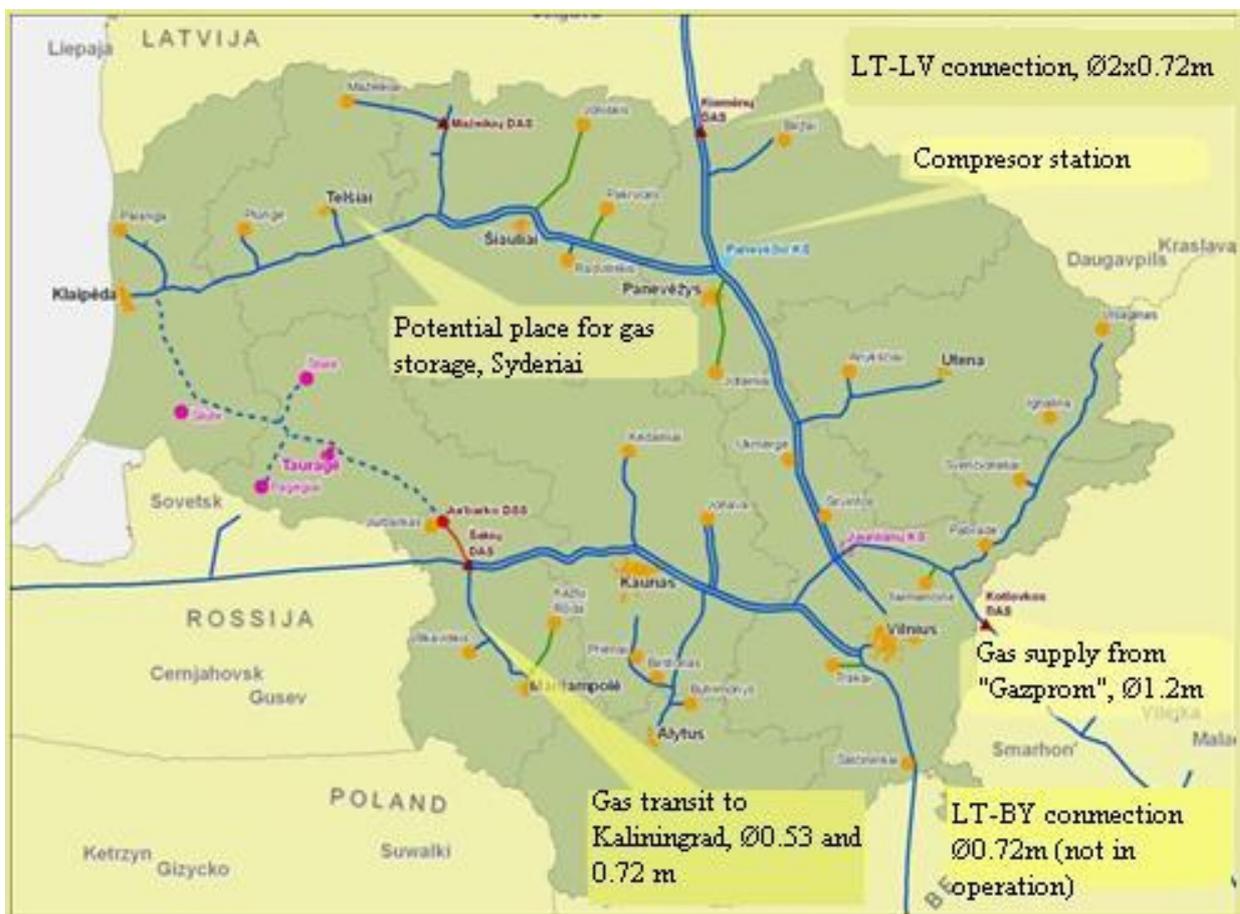


Figure 13. Gas transmission network of Lithuania

Lietuvos dujos AB operates 1.8 thousand km of gas transmission system by means of which natural gas through the operating transmission system is transmitted under gas pressure not exceeding 55 bar. In 2011, it is planned to begin the construction of new gas pipeline Jurbarkas-Taurage (DN 400, L-34.9 km).

Gas supply transmission system

No	Gas pipeline	Year of putting into operation	Length from, km	Length to, km	Pressure, bar	Conventional diameter, mm
	Vilnius–Kaliningrad	1983	0.0	40.1	55	700
		1983	40.1	68.2	50	800
		1981	68.2	102.2	55	700
		1970	102.2	183.4	55	500
		1985	102.2	183.4	55	700
	Vilnius–Kaunas	1962	0.0	39.2	55	700
		1962	39.2	81.9	55	350
	Ivacevici–Vilnius–Riga	1980	190.8	225.97	55	700
		1980	225.97	244.9	47	700
	Ivacevici–Vilnius–Riga	1961	256.3	388.65	55	500
		1961	388.65	416.83	53	500
		1961	416.83	445.79	46	500
	Pipelines to Klaipeda	1968	155.8	221.48	47	300
	Pipelines to Šiauliai	1964/1998	0.0	73.7	53	350 and 1000
		1964/1998	73.7	155.8	55	350 and 500

Natural gas pressure is limited in some oldest sections of gas transmission pipelines (e.g. Ivacevici–Vilnius, Vilnius–Kaunas) as no technical condition has been checked yet by diagnostic probing. Nevertheless, it has no influence on the supplied amount of natural gas due to its pressure supplied from Belarus making 37 bar.

2.2. Development of infrastructure

In order to solve isolated gas market situation it is decided to develop LNG terminal within the framework of Baltic Energy Market Interconnection Plan (BEMIP). All three countries have shown their strong interest in offering the location for the LNG terminal. As a result each country has included its own LNG project in Ten-Year Network Development Plan 2011-2020 or BEMIP Gas Regional Investment Plan 2012 - 2021.

It is clear that only one LNG terminal is feasible in the region taking into account its limited annual gas consumption. Despite tense discussions in 2011 the three Baltic States were however unable to agree on place for the terminal therefore the European Commission is currently developing an independent study on the best location for a regional LNG terminal. Results of this study are expected to be ready in autumn 2012.

Estonia

According to Ten-Year Network Development Plan 2011-2020 and BEMIP Gas Regional Investment Plan 2012 - 2021 the following projects will be developed in Estonia:

Name of the project	Paldiski LNG Terminal
Type of project	LNG terminal
Expected costs	400 (in10 ⁶ EUR)
Name of the sponsors and their shares	AS Balti Gaas 100%
Date of commissioning:	2015
FID:	2013

Technical Information			
Annual capacity		2.4-3 (in 10 ⁹ Nm ³ /y)	
LNG storage capacity		320,000 (in m ³ LNG)	
Project			
Project	FID	Commissioning	Remarks
Pipes			
Balticconnector (incl. compressor stations)	Non-FID FID: 2014	2016-2018	TEN-E project BEMIP Name of the sponsors: Gasum Oy, AS Eesti Gaas
Technical Information			
Total length of new pipes		Offshore pipeline length 80 km (50 km – in the territory of Estonia and 30 km – in the territory of Finland), onshore pipeline (Kiili –Paldiski) length 46 km	
Diameter range of news pipes		500mm	
Interconnections		(in 10⁶Nm³/d)	Remarks
Balticconnector		7.2	
Compressors		(in MW)	
Paldiski		35	

Though Paldiski LNG terminal project is considered under the BEMIP umbrella there are currently three LNG terminal projects under development. In addition to the abovementioned Paldiski the other two are Muuga LNG project and Sillamäe LNG project which are planned to develop at the respective harbours. The planning procedures have been started.

In 10-year perspective: renovation of pipelines between Narva and Kohtla-Järve (North-East Estonia).

Summary information on potential projects to enhance gas supply security

Row No.	Name	Planned capacity	Planned investments, million euro	Implementation time
1.	Connection of the Estonian and Russian gas system in Narva City	7,0 mcm / day		2015
	Total. Innterconnector Ivangorod-Narva-Tallinn 200 km	2,4 bcm/year	155	2021
2.	Connection of the Estonian and Finnish gas Grid (Balticconnector)	2,5 bcm/ year	125	2016

3.	Construction of liquefied natural gas (LNG) regional terminal in Paldiski	2,5 bcm/ year	350	2016
4.	Karksi gas measuring station reverse-flow (EE-LV interconnection)	7,0 mcm / day	3	2015

Necessary investments in domestic transmission networks (million EUR)

Title	2011	2012	2013	2014	2015
System of gas transmission pipelines	2,5	6,3	14,0	18,0	22,0

Latvia

According to Ten-Year Network Development Plan 2011-2020 and BEMIP Gas Regional Investment Plan 2012 - 2021 the following projects will be developed in Latvia:

Name of the project	Construction of LNG terminal in Latvia			
Type of project	LNG terminal			
Expected costs	300-350 (in 10 ⁶ EUR)			
Name of the sponsors and their shares	Depending on chosen project development structure different financing options will be assessed and investors attracted. It is prerequisite that investors shall be independent for the current gas suppliers for Latvia			
Date of commissioning:	2015-2017 (depending on on-shore or off-shore solution) End of permitting phase: 2013-2014			
FID:	2014-2015			
Technical Information				
Annual capacity	2.5-3 (in 10 ⁹ Nm ³ /y)			
LNG storage capacity	75,000 (in m ³ LNG)			
Project	FID	Commissioning	Remarks	
<u>Pipes</u>				
LV-LT interconnection (Enchantment of bi-directionality)	2009	2013	Modernization Panevezys gas compressor station, Modernization of 17 wells in Inčukalns UGS and construction of receiving trap for inspection gauges and underwater pass over Daugava River under EEPR program.	

<p>Enhancement of bi-directional interconnection capacity between Latvia and Lithuania up to 124,2 GWh/d</p>		<p>The project could be implemented in 3-4 year time after FID will be taken depending on time needed for obtaining necessary permissions</p>	<p>Expansion of Kiemeni GM-station, construction of gas pipeline 40 km from Riga to Iecava (DN 500) including underwater pass.</p> <p>In case gas interconnection between Lithuania and Poland will be build, the increase of capacity of Lithuania – Latvia interconnection would create more opportunities for using Inčukalns UGS and cross-border gas trade</p>
<p><u>Storage facilities</u></p>			
<p>Inčukalns</p>	<p>Non-FID 2012</p>	<p>2020, but depends on availability of financing</p>	<p>In case of construction of LNG terminal in Latvia, Inčukalns UGS will be used for storing gas from the LNG terminal, thus considerably decreasing costs of construction of LNG terminal (storage capacities) as well as offering beneficial conditions for gas purchase in summer at a lower price.</p> <p>When interconnection between Lithuania and Poland will be built, Inčukalns UGS can be used for storage of gas not only for Latvia, Estonia and Lithuania, but also for Poland, and expansion of the</p>

			storage shall be considered.
Technical Information			
Total length of new pipes		1.7 km	
Diameter range of news pipes		500-700mm	
Interconnections			
		(in 10⁶Nm³/d)	Remarks
Kiemenai		Entry: 0.7 Exit: 3.9	
Compressors			
		(in MW)	
Panevezys		7.7	Modernization
Storage facilities			
		Deliverability (in 10⁶Nm³/d)	Working gas Volume (in 10⁹Nm³)
Inčukalns		6	0.875

In 2009, in order to ensure uninterrupted natural gas supply to users and safe operation of the gas supply system, the company developed a Plan of measures for the improvement of safety of the gas supply system of the Latvijas Gāze AS 2010-2015. The plan was prepared based on adjudgment regarding the technical condition of equipment and the possibilities of its modernization. The plan of measures envisages investment in safety improvement in the total amount of 50.6 million LVL.

Necessary investments for safety increase

Title	Total investments, thousand EUR						TOTAL
	2010	2011	2012	2013	2014	2015	
Inčukalns Underground Gas Storage	13730	9006	9974	9178	3770	3998	49658
System of gas transmission pipeline	3799	2604	2661	1921	1594	996	13575
System of gas distribution pipelines	1900	2405	1295	1202	1074	911	8786
GRAND TOTAL	19429	14015	13930	12301	6438	5905	72019

Lithuania

According to Ten-Year Network Development Plan 2011-2020 and BEMIP Gas Regional Investment Plan 2012 - 2021 the following projects will be developed in Lithuania:

Name of the project	Klaipeda LNG Terminal
Type of project	LNG terminal
Expected costs	
Name of the sponsors and their shares	Klaipedos nafta AB is considered to be one of the shareholders and other shareholders will be determined at a later stage of the project
Technical Information	
Annual capacity	2-3 (in 10 ⁹ Nm ³ /y)

Daily send-out capacity	Up to 4 (in 10 ⁶ Nm ³ /d)
LNG storage capacity	60,000 (in m ³ LNG)
Time Schedule	
Probable date of commissioning and the main milestones	Commissioning: 2014 FID: March, 2012 End of permitting phase: 2012-2013
Project development phase reached	Planned/under consideration
IGA, Mandate Letter, LLI Tender, FEED	Project of LNG terminal is endorsed by the Lithuanian Government 21 July 2010 – Government decision on the development of LNG terminal project 25 February 2009 – Project endorsed in the Government Programme Action Plan 2008-2012 27 December 2007 – Project endorsed in the national energy strategy implementation plan 2008-2012 and programs of action 17 June 2009 – Klaipeda LNG terminal is part of BEMIP endorsed by the Baltic Sea states and EC Government approves Klaipeda LNG Plan http://www.ingwordnews.com/government-approves-klaipeda-lng-plant-lithuania/

Project			
Project	FID	Commissioning	Remarks
<u>Pipes</u>			
LT-PL interconnection (GIPL)	Non-FID	Commissioning: 2016 at the earliest FID: 2013	TEN-E: Project of common interest GIPL would provide an access to the EU gas markets and create an opportunity of using the Polish LNG terminal in Świnoujście for the Baltic states and using of the Inčukalns UGS for Poland.
Klaipeda-Jurbarkas	FID in 2011	2013	Partial financial support (about 50%) from the EU Regional Development Fund. Gas pipeline Jurbarkas - Klaipeda will create a circular natural gas

			transmission system in Lithuania contributing thus to the reliability of gas supply in Lithuania, especially for Western part of Lithuania. It will also enable proper functioning of LNG terminal in Klaipeda.
Storage facilities			
Syderiai	Non-FID	Commissioning: 2018 FID: 2014 End of permitting phase: 2015-2016	TEN-E: Project of common interest Syderiai UGS will be part of Lithuanian national gas system. Lithuania's goal – diversification of gas supply sources for Lithuania and other Baltic states. Underground gas storage would work efficiently with these interconnections: <ul style="list-style-type: none"> • LT bi-directional interconnection with Latvia including access to underground gas storage in Latvia – Inčukalns; •LT interconnection with Belarus; • LT bi-directional interconnection with Poland; Syderiai UGS operation in combination with LNG terminal would have summer/winter demand balancing, access to spot market and diversification of gas supply.
Technical Information			
Total length of new pipes		Approx. 350km	

Diameter range of news pipes	600-800mm	
<u>Interconnections</u>	<u>(in 10⁶Nm³/d)</u>	<u>Remarks</u>
LT-PL interconnection	8.2	Annual volume:3bcm
Kiemenai (LT-LV)	Entry: 0.7 Exit: 3.9	
<u>Compressors</u>	<u>(in MW)</u>	
Panevezys	7.7	Modernization
Jauniūnai	3x11,3	Construction Finished in 2010
<u>Storage facilities</u>	<u>Deliverability</u> <u>(in 10⁶Nm³/d)</u>	<u>Working gas</u> <u>Volume</u> <u>(in 10⁹Nm³)</u>
Syderiai	1	0.5

Lietuvos dujos AB plans during 2009–2013 included the investments amounting to 678 million Litass. Around 560 million Litass is intended for the development of gas transmission systems. It should be mentioned at this point that the investment planning assumed the state share of 178 million Litass to be allocated for implementation of strategic projects.

It is stated in the Note of the Commission on the determination of upper limits of natural gas transmission and distribution to Lietuvos dujos AB for 2009–2013 with the aim to control technical conditions of the ageing pipelines and to observe the instructions of the State energy inspectorate at the same time, that gas transmission pipelines will be checked by means of diagnostic probing. For the purpose probe launching and receipt compartments will be mounted in the main gas supply pipelines of Lithuania. The following investments are projected: 48 million Litass are planned for upgrading of gas distribution stations aimed at better reliability of their performance, 31.5 million Lt for upgrading of gas transmission system, 12 million Lt for upgrading of Panevėžys gas compressor station and around 26 million Lt is intended for other investments. Investments financing sources include depreciation and amortisation funds, loans and income derived from connection fees.

2.3. Diagnostics of gas transmission pipelines

In order to ensure uninterrupted operation of the system, the internal diagnostics of gas transmission pipelines (hereafter - GTP) and due aversion of the found damage has been set as priority. The internal diagnostics of pipes is carried out with the purpose to determine the maximum permissible operating pressures on the GTPs in order to be able to maintain a higher pressure in the future when the volume of gas to be transmitted might grow.

Internal diagnostics GTP is carried out by the Latvijas Gāze AS in cooperation with the Estonian, Lithuanian and Russian operators, which provide an opportunity to assess the technical condition of GTP across their entire length and eliminate the identified faults. By the end of 2010, the Latvijas Gāze AS had completed diagnostics to gas pipelines at the 70% of the total length of GTPs (see Figure 14). Despite the considerable expenses, the diagnostics completed so far confirm their necessity and usefulness. After the inspection of the defects found during the internal diagnostics and the analysis of their dangerousness, the programme of repair of gas pipeline defects is developed. The elimination of defects is due to extend till 2014.

In Estonia the internal diagnostics of the following pipelines was made:

- In 2005/2006 Vireši – Tallinn;
- In 2006 Izborsk - Tartu and Tartu – Rakvere.

It is planned to perform internal diagnostics of gas pipelines Tallinn - Kohtla-Järve II and Kohtla-Järve – Narva.



Figure 14. Map of gas transmission pipelines diagnostic

In Lithuania mandatory inspections of technical state of all gas pipelines are performed at least once in five years by Technical Supervision Service which is a public accredited institution for assessing technical condition of potentially dangerous equipment:

- In 2011, internal diagnostics of gas pipeline Riga-Panevezys-Riga (DN700, L-140 km) was performed.
- In the near future it is planned to perform internal diagnostics of gas pipelines Minsk-Vilnius (DN1200, L- 63.3 km) and Kaunas-Kaliningrad (DN 500 and 700, L- 2 x 83 km).
- In 2010, diagnostics (external methods) of gas pipeline Siauliai - Klaipeda (DN 325, L-115 km) was performed.

2.4. Infrastructure standard

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 requires continuous operation of the natural gas infrastructure in the case of disruption of the single largest element of the system, compliance with the so-called N-1 criterion if the disruption occurs in the regime of peak load.

The N-1 criterion means assessment of the situation in the event of disruption of the single largest gas infrastructure delivery connection. If in the event of interruption it is possible to rearrange deliveries without any supply disruption, the N-1 criterion is met.

N-1 criterion:

$$N - 1 [\%] = \frac{EP_m + P_m + S_m + LNG_m - I_m}{D_{max}} \times 100, \quad N - 1 \geq 100\%$$

where:

EP_m – Technical capacity of entry points (in mcm/d), other than production, LNG and storage facilities covered by P_m, S_m and LNG_m, means the sum of the technical capacity of all border entry points capable of supplying gas to the calculated area;

P_m – Maximal technical production capability (in mcm/d) means the sum of the maximal technical daily production capability of all gas production facilities which can be delivered to the entry points in the calculated area;

S_m – Maximal technical storage deliverability (in mcm/d) means the sum of the maximal technical daily withdrawal capacity of all storage facilities which can be delivered to the entry points of the calculated area, taking into account their respective physical characteristics;

LNG_m – Maximal technical LNG facility capacity (in mcm/d) means the sum of the maximal technical daily send-out capacities at all LNG facilities in the calculated area, taking into account critical elements like offloading, ancillary services, temporary storage and re-gasification of LNG as well as technical send-out capacity to the system;

I_m – means the technical capacity of the single largest gas infrastructure (in mcm/d) with the highest capacity to supply the calculated area. When several gas infrastructures are connected to a common upstream or downstream gas infrastructure and cannot be separately operated, they shall be considered as one single gas infrastructure;

D_{max} – means the total daily gas demand (in mcm/d) of the calculated area during a day of exceptionally high gas demand occurring with a statistical probability of once in twenty years.

The N-1 criterion for Estonia is not met. The infrastructure standard N-1 for Estonia is 59.7% for the reason that in planning of supply and the regime of operation of the gas system Estonia can rely only on the cross-border interconnection with Russia through Värskä and the connection with Latvia through Karksi. Taking into account the limitations of the Russian transmission system before Narva the interconnection cannot be deemed as operational. In case of disruption of the largest infrastructure in Estonia - cross-border connection with Latvia, the gas loss would amount to 7.0 mcm/day.

The single largest gas supply infrastructure for Latvia is Inčukalns UGS, and since in the event of its disruption remaining infrastructure is capable to cover total demand the infrastructure standard N-1 for Latvia is bigger than 100% ie.153.85%.

The existing infrastructure standard N-1 for Lithuania is 27.4 p% and there is no possibility to rearrange deliveries without any supply disruption. To meet the set requirements by just applying measures in the development of gas supply infrastructure, the capacities of gas supply should be increased to 12.3 mcm/day.

Taking into account, as mentioned above, that only in Latvia existing infrastructure has sufficient capacity to met N-1 criterion it is appropriate to considering all three countries as a whole in the event of a disruption of the single largest gas supply infrastructure. In case of three Baltic States it is gas transmission pipeline Minsk–Vilnius.

Calculation of the N-1 for the Baltic States (information about Index see above)

Index	Value
EP_m Interconnections by pipeline Entry capacity Estonia: – from Russia 4 mcm/d Entry capacity Latvia: – from Russia 20 mcm/d; Entry capacity Lithuania: – from Belorussia 31 mcm/d	55
P_m	0
S_m Withdrawal capacity of Inčukalns UGS	24
LNG_m	0
I_m Throughput of the main natural gas supply line Minsk–Vilnius	31
D_{max} Estonia 6.7mcm/d Latvia 12mcm/d Lithuania 18 mcm/d	37

* for more information see Annex 1

$$N - 1 = \frac{55 + 0 + 24 + 0 - 31}{37} \times 100 = 129.73\%$$

Since infrastructure standard **N-1 for the Baltic States** is bigger than 100% ie. **129.73%**, in the event of a disruption of transmission pipeline line Minsk–Vilnius, the capacity of the remaining infrastructure is able to satisfy total gas demand of the region during a day of exceptionally high gas demand statistically occurring once every twenty years.

There are several ways to make the infrastructure standard even higher. The integration of Baltic gas market to European gas market and Latvian geographical position – being the centre of Baltic region – will ensure possibilities to develop Inčukalns UGS in the future. The gas storage can be expanded up to 3.2 bcm. Without improvement of interconnection capacities between Latvia, Lithuania and Estonia expansion of Inčukalns UGS will proved expected results. LNG terminal project also could be seen as additional activity in the field of security of supply which could ensure gas supply in case of damage in gas-pipelines, at periods of increased demand or if the gas consumption rapidly increases in Baltic States and it could not be ensured by gas through pipelines.

2.5. Bottlenecks in the system

In the calculation of regional infrastructure standard N-1 only region's entry capacities are taken into account. However the calculation does not take into account the capacity of intra-Baltic flows. Although infrastructure standard N-1 for the Baltic States is 129.73 meaning that in the event of the largest infrastructure disruption the capacity of the remaining infrastructure should be able to satisfy total gas demand, the analysis in the chapter 4.4. Response Scenarios will show that in some occasions there could be gas shortage in the region because of the intra-Baltic flow capacity limitations.

A capacity limitation on the Latvian/Lithuania and the Latvian/Estonian border is mainly due to the size of meter station. However the technical condition of the pipelines themselves also needs some improvement.

In the summer of 2009, the largest engineering consultation company of the Nordic states Ramboll Group presented the study, Future Development of the Energy Gas Market in the Baltic Sea Region, developed at the EC order. In order to eliminate the issue of energy „gas islands”, the research recommends investments primarily in the increase of the capacity of the gas connection of Latvia-Lithuania, as well as in the construction of gas pipelines connecting Poland-Lithuania (Amber) and Estonia-Finland (Balticconnector).

In 2010 the project for the enhancement of capacity of the gas pipeline connection and the improvement of security of gas supply between Latvia and Lithuania prepared by the Latvijas Gāze AS jointly with the Lietuvos dujos AB received grant form European Energy Program for Recovery. Till 2011, within the framework of the project, it is planned to reconstruct 15 wells at the Inčukalns UGS, to build a new gas passage over Daugava, to build a new pig receiver in Latvia, as well as to modernize the gas compressor station of Panevėžys and part of the Lithuanian gas pipeline system.

It is assumed that the capacity of the connection based on the existing pipelines can be increased up to 10 mcm/day.

It is necessary to bear in mind that the daily quantities of gas delivered from the Inčukalns UGS depend on the season and technical limitation, i.e. the send-out capacity of Inčukalns

UGS. At extremely low outside temperatures and in the spring, after a long and cold winter, the send-out capacity from the Inčukalns UGS was not high enough to fully ensure sufficient security of supply for large consumers of gas in Estonia, Latvia, Lithuania and Pskov. The most crucial was situation for Estonia as in spring, when the amount of gas in the Inčukalns UGS falls and the gas pressure drops, the gas pressure on the Estonian border could not ensure delivery of required quantities of gas to all customers. During the winter 2005/2006 Estonian customers have been near to real gas deficit. Due to Inčukalns UGS modernization and replacement measures taken within joint Lithuanian-Latvian project "Enhancement of bi-directional interconnection capacity between Latvia and Lithuania" as well as within the framework of investment program of Latvijas Gāze AS technical limitations are almost eliminated. Now the main issue that each country should carefully consider is amount of gas reserve kept in Inčukalns UGS in order to cover exceptionally high demand.

Physical infrastructure

Conclusions

- ✓ Three Baltic countries are interconnected but intra-Baltic flows are essentially only emanating from the Latvian storage and only in the winter to primarily Estonia and, to a much lesser degree, Lithuania;
- ✓ Since infrastructure standard N-1 for the Baltic States is 129.73%, in the event of a disruption of the single largest gas supply infrastructure - natural gas supply line Minsk-Vilnius, the capacity of the remaining infrastructure should be able to satisfy total gas demand of the region during a day of exceptionally high gas demand statistically occurring once every twenty years;
- ✓ The main bottlenecks in the system are the capacity of meter stations on the borders as well as the Inčukalns UGS send-out capacity in the spring. However the technical condition of the pipeline itself also needs some improvement.
- ✓ The develop of Inčukalns UGS to 3.2 bcm, the increase of the capacity of GMS in the future as well as construction of regional LNG terminal will provide the enhancement of the infrastructure standard;
- ✓ The pipeline projects Lithuania-Poland and Estonia-Finland, the reinforcement of the existing interconnectors between the three Baltic States, as well as the apparently necessary storage expansion/new storage projects are more appealing when being considered on a regional scale.

3. Political-administrative environment

3.1. Political and economic risks

Gas supply security makes a constituent part of the national security. This issue is given much attention by the European Union. Safeguarding of a stable supply of energy for the alliance member states is a strategic task of the North Atlantic Treaty Organisation (NATO).

The Russian company Gazprom OAO is main natural gas supplier of all three Baltic States. The Government of Russia exercises a significant influence on the activities of the largest company in the country at the same time availing of gas supply issues for the achievement of its political goals.

Recently, the issues of supply of energy and resources have become the key axis of the development of relations between the EU and Russia. Taking into account a solid dependence on the Russian gas (25 percent of the EU and 100 percent of the Baltic States consumed gas is supplied from Russia) and application of policy of gas supply discontinuation for transit countries by Gazprom OAO since 2004 (under direct participation of the superiors of the Russian Government) economic and political reasons have become even closer related to gas supply reliability.

Irrespective of global recession of economy, the growing demand of energy sources worldwide fails to meet the supply, the growing of which fails. At present and in the future energy export countries may utilise the situation like this for political purposes. Russia holds the largest gas reserves in the world. Due to historical setting, the Baltic Region is infrastructural dependent on a single supplier. Monopolisation of the Russian energy sector, the vertical of which covers the areas of extraction, production, transportation, sale and transit, suggests the availing of gas supply for the region as a measure to achieve the respective political targets.

Since the Baltic States are receiving gas only from Russia and no other gas is available there, commercial disputes may arise regarding gas purchase price and other conditions of gas supply agreement (e.g. Take-or-Pay). For countries that have other supply sources by pipeline or LNG terminals, it is much easier to agree on more favourable commercial conditions. Unbeneficial commercial conditions in case of the Baltic States cannot cause immediate gas supply interruption, however due to unattractive price gas can lose in competition with other fuels.

3.2. Probability of terrorist attacks

The Baltic States are not considered the elevated risk countries regarding terrorist attacks, however, due to its NATO membership and participation at international missions, of course, terroristic attacks on their infrastructure cannot be excluded.

"Europol"-developed report on the terrorist situation and trends in the European Union divides the terrorist organisations in terms of the origin of their motivation with this being a direct reflection of the existing situation in the EU countries. 5 terrorism trends are distinguished: Islamic terrorism; ethnic nationalistic and separatism, left creed terrorism, right creed terrorism and terrorism evoked by individual problems.

Due significant variations in a number of terroristic attacks in EU during the recent years one cannot derive a clear tendency of variations in a number of planned and accomplished attacks.

A risk of Islamic terrorism might have been probable in the Baltic States due to participation in military missions in Iraq and Afghanistan. Nevertheless, there were no terroristic attacks during 2006–2008 and one may further assume low probability of such attacks. Other type manifestations of terrorism in the Baltic States are also inactive and not directed towards any actual infrastructure objects and on the whole the risk of terrorism towards the natural gas supply security is very low indeed.

For Latvia government Action Plan for fighting terrorism has been prepared, and was successfully introduced in April 2003. The Plan improved co-operation of state institutions in measures for the prevention and fighting of terrorism. The main aim of the Plan was to prevent opportunities for terrorists to use the territory of Latvia, its banking system and other means, to achieve their goals. In order to strengthen co-ordination among the various state institutions involved in fighting terrorism, a Counter-Terrorism Centre was established under the auspices of the Security Police.

Political-administrative environment

Conclusions

- ✓ Dependency of the Baltic States on a main supplier Gazprom OAO suggests the usage of gas supply for the region as a measure to achieve the respective political targets (low probability);
- ✓ Commercial disputes may arise regarding gas purchase price and other conditions of gas supply agreement (e.g. Take-or-Pay);
- ✓ There may be a situations of conflict of interest in taking steps to put in place infrastructure for the diversification of gas supply until effective unbundling is carried out;
- ✓ The Baltic States are not considered the elevated risk countries regarding terrorist attacks.

4. Risk impact scenarios

4.1. Method of analysis

The assessment of risk of gas supply disruption has been worked out by applying the method of risk scenarios.

Three types of scenarios were drawn up in this study:

- Risk causality scenarios;
- Risk impact scenarios;
- Response scenarios.

Each of the risk scenarios drawn up has its own function in the description and evaluation of the risk of gas supply disruption. **Risk causality scenarios** serve to describe the possible ways of errors that lead to a gas supply disruption. These scenarios also feature safety barriers designed to interrupt the development of errors by preventing them to cause the unwelcome basic event. In this study, it is a gas supply disruption. Based on the risk causality scenario drawn up, it is possible to calculate the overall probability of the unwelcome event as well as to describe the impact of each identified error on the overall probability of the event.

The task of a **risk impact scenario** is to describe the variety, scope, gravity and area of influence of potential consequences of the unwelcome event if it occurs. The risk assessment features a description of the reasons of gas disruption and the impact of their consequences in each of the Baltic States, breaking down into three levels:

- on a local scale
- on a national scale
- on a regional scale

Response scenarios, for their part, reveal the capability of the system to react properly in the cases of a variety of unwelcome events.

4.2. Risk causality scenarios

The risk causality scenarios reveal the causes of possible gas disruptions and describe the safety barriers present in the gas supply system with a view to duly detect possible issues and to avoid gas disruption. Referring to importance of Inčukalns UGS in the ensuring of appropriate gas supply in the region and to the gas industry past experience three types of gas disruption risk causality scenarios - gas supply disruption from Inčukalns UGS, gas supply disruption for 3 days and gas supply disruption for 15 days were defined and analysed. Considering that for each type of defined gas disruptions the possible causes of disruption differ risk causality scenarios have been drawn up for every types of gas disruption.

4.2.1. Gas disruption from Inčukalns UGS risk causality scenario

The operation of the Inčukalns UGS vastly differs between the summer and winter seasons. In summer, natural gas, mainly received via pipeline from Izborsk in Russia, is injected through the facility's compressors into the porous earthy rocks. In the winter season, for its part, natural gas is withdrawn from the underground storage and fed into the natural gas transmission pipelines after purification. Thus, the operation of the Inčukalns UGS can influence the process of natural gas supply to consumers only during the winter season. Figure 15 shows the risk causality scenario for the operation of the Inčukalns UGS,

graphically explaining the possible issues in the operation of technological equipment at the Inčukalns UGS, which might result in a full or partial failure to feed natural gas from the facility into the natural gas transmission pipelines.

Natural gas is injected into and withdrawn from the underground rocks through specially drilled wells. There are 93 wells available for the technological needs of the Inčukalns UGS. Natural gas from the wells through pipelines reaches gas collection points where it is purified and then its pressure is reduced to suit for transportation. According to the description of natural gas storage and the disruption from Inčukalns UGS risk causality scenario in Figure 15, natural gas from the earth entrails will not reach the gas collection point (hereinafter – GCP) if the well fittings are damaged, there is no natural gas in the well operation range or the gas pipeline connecting the well with the GCP is damaged.

In order to reduce the probability of such issues, the technical services of the Inčukalns UGS systematically monitor the technological equipment and control via geological survey and observation wells the location of the natural gas “bubble” injected underground. These measures are identified as safety barriers in the risk scenario. The parameters of natural gas injection and withdrawal are determined and controlled by the dispatchers of the unified Latvian Dispatcher Department of the gas supply operator and the Inčukalns UGS, the operation of which is marked in the risk scenario as another safety barrier.

Based on the information included in the Safety report of the Inčukalns UGS that the probability of damage of old-type well fittings is – 1.2×10^{-4} and considering that there are 66 technological wells so equipped, we can calculate the probability of a well failure:

$$P_{(\text{well})} = P_{(\text{damage})} \times N = 1.2 \times 10^{-4} \times 66 = 8,0 \times 10^{-3}$$

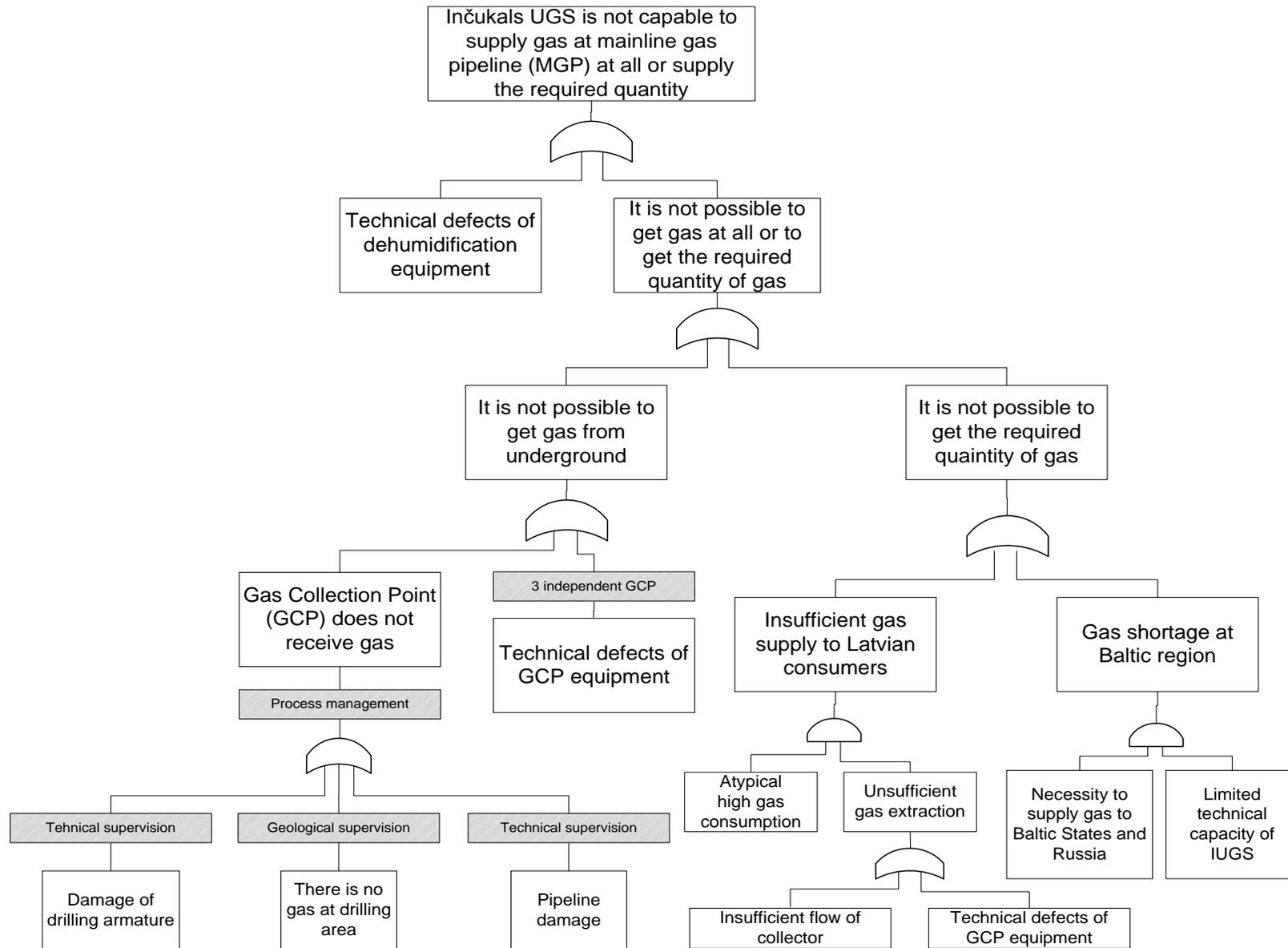
Taking into account that the employees of the geological service of the Inčukalns UGS continuously monitor the location of gas „bubble” by applying modern methods of diagnostics, as well as the sufficient experience of operating the facility, the probability of the „bubble” leaving the operation area of technological wells is very low.

The technological equipment of the Inčukalns UGS is connected via pipelines of 42 km in total length. Assuming the average of the probabilities of a full collapse of pipelines used in the Safety report, it follows that the probability of a pipeline failure is $P_{(\text{pipeline})} = 3.8 \times 10^{-2}$. Consequently, an incident on a section of technological pipelines at the Inčukalns UGS is possible once in 26 years on average.

Natural gas supply to the gas transmission pipelines can be fully or partially suspended if the technological equipment at the gas collection point itself fails to function properly for some reason. There are 3 recently modernized gas collection points at the Inčukalns UGS. Due to the modern technological equipment and safety automation, the probability of an incident at the gas collection points is not high. In the Safety report, this probability is rated as 10^{-3} to 10^{-5} . This means that an incident of GCP technological equipment could occur not more than once per 100 years on average.

Considering that there are 3 gas collection points in operation at the Inčukalns UGS, the failure of one GCP at normal gas consumption would not cause substantial problems for the gas supply of any country which received gas from the Inčukalns UGS especially for Latvia.

Figure 15. Gas disruption from Inčukalns UGS risk causality scenario



The right branch of the chart in Figure 15 covers risk scenarios related to high gas consumption in Latvia or the Baltic region.

Based on long-term data regarding gas consumption in Latvia, it can be concluded that atypically high gas consumption in some of the winter months is possible practically every third year. Upon intense gas consumption, all three gas collection points are engaged. However, even then there is a possibility of the Inčukalns UGS failing to supply the gas volume needed for the Latvian consumers. The intensity of gas available for withdrawal largely depends on the area of gas extraction. The decisive factors are the distance from the well to the GCP, as well as the throughput of the connecting manifold.

The current gas manifolds have insufficiently large diameters, and in multiple storage areas too many wells are connected to them resulting in technical limitations as to the gas volume extractable from underground. Assuming that these technical limitations might take place only in one season of intense consumption out of 10, the probability of the Latvian consumers not receiving the required gas volume is relatively high, $P_{(\text{manifold})} = 3 \times 10^{-2}$. Consequently, due to the limited throughput of gas manifolds, limitations in gas supply might occur at least once in 33 years. In order to reduce this probability, it would be useful to increase the diameters of manifolds or build as many direct pipelines connecting the gas wells with the gas collection points as possible.

Even more severe issues may occur if a GCP fails during intense consumption, but the probability of such an event is not very high. According to the information of the Safety report, GCP operation failures entailed by technical defects of the technological equipment could occur not more than once in 100 years. Thus, the overall probability of the Inčukalns UGS failing to supply the gas volume required for the Latvian consumers is $P_{(\text{Latvia})} = 4 \times 10^{-2}$.

Much more problematic is the capability of the Inčukalns UGS to feed the required gas volume if there is a gas shortage in the Baltic region. Over the last 10 years, such a necessity has already emerged twice – in 2004 and 2012. In both cases, the Inčukalns UGS was technically unable to supply the required gas volume. Consequently, this risk cannot be eliminated without building a fourth gas collection point. As adjudged by specialists of Gazprom, the construction of the fourth GCP would allow for increasing the facility's gas preparation capacity by 25%.

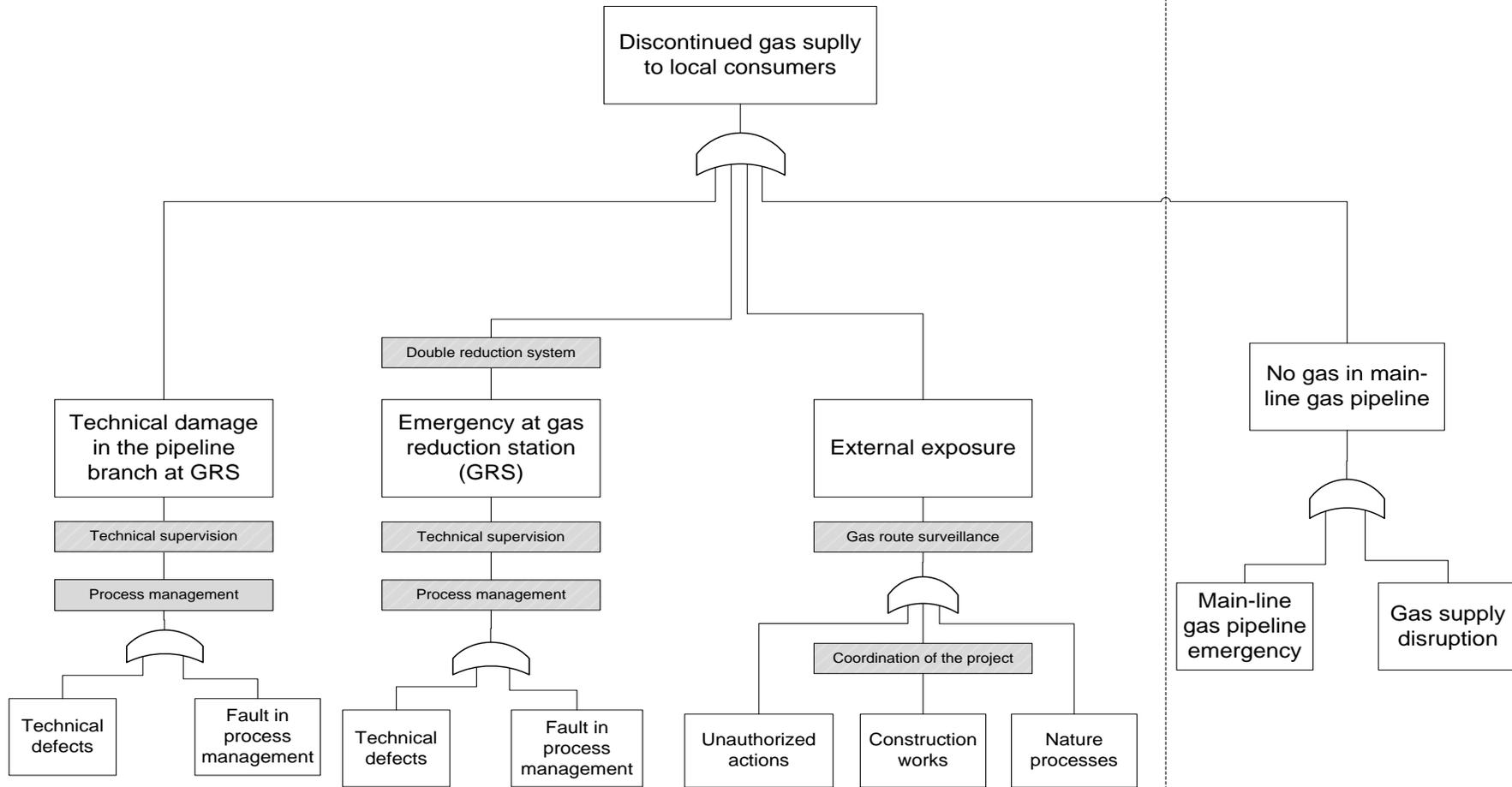
After the initial purification and pressure reduction at the GCP, natural gas is additionally dried, and only then it arrives at the gas transmission pipeline. Currently there is only one drying unit at the Inčukalns UGS. Thus, if this equipment gets damaged, natural gas supply is suspended or natural gas is fed into the transmission pipelines with improper technical parameters. Despite the probabilities of failure of the drying units being with a power of 10^{-6} and lower, a second gas drying unit is due for commissioning at the Inčukalns UGS in the first half of 2012 to increase the security of natural gas supply.

4.2.2. 3-day gas disruption risk causality scenario

Another risk causality scenario discussed is one that reveals the reasons of brief – 3-day – gas disruptions. Basically such gas disruptions may occur on a gas pipeline branch-off from a gas transmission pipeline to a gas regulation station (thereafter - GRS) or can be caused by emergency at GRS, or external exposure (unauthorized actions, errors in construction activities near gas pipelines, as well as the threat implied by natural processes). The experience of accidents in the Baltic States shows that the elimination of this kind of accidents is possible within 3 days. A graphical representation of a risk causality scenario is shown in the Figure 16.

Figure 16.

3-day Gas Supply Disruption Risk
Causality Scenario



The prepared risk causality scenario is based on the data of analysis of accidents occurred in the past and theoretically possible events that may result in gas supply disruptions.

In the risk scenarios, the individual events are joined with the logical symbol „or”, which means that, when calculating the probability of an event placed higher in the risk scenario, the sum of probabilities of all lower-placed event variations is taken into account. For instance, technical damage on a pipeline can be caused by technical defects alone and process management errors alone, but it is also possible that both events take place simultaneously.

Characteristics of gas pipeline branch-offs to GRS

Country	Number of GRS	Total length of branch-offs, km	Average age, years
Latvia	43	137	29
Lithuania	65	663	24
Estonia	37	72	23
Baltic States	145	872	25

Obviously the most common reason of gas supply disruption is external exposure, which has twice resulted in disrupted gas supply to consumers in Latvia. One accident was registered in 2003 on the branch-off to the GRS Stars, while the other took place in 2010 on the branch-off to the GRS Brocēni. In the first case, the accident was entailed by unauthorized action; in the other one – legal construction activities near gas pipelines. Lithuania has seen one pipeline accident on a branch-off to a GRS – it occurred in 1996, and material deficiencies were found to have been the cause. There have been no notable pipeline branch-off defects in Estonia. Thus, over the whole time of operation of the gas supply system, the Baltic States have experienced 3 substantial accidents on gas pipeline branch-offs from a gas transmission pipeline to a GRS.



The gas branch-off to GRS „Stars” (Latvia) cut with a trench plough and the heavy equipment burnt in the accident

With the number of accidents occurred in the Baltic States, the number of GRS branch-offs and the length of their operation in mind, it is possible to determine the probability of disruption of gas supply to any GRS caused by external exposure: $P = 8.3 \times 10^{-4}$. This means that accidents on gas pipeline branch-offs to GRS in any of the Baltic States can be expected once in 8 years on average. Applying the overall probability of an accident to the number of GRS branch-offs in each country, it was determined out that in Latvia $P = 3.6 \times 10^{-2}$, in Lithuania $P = 5.4 \times 10^{-2}$, and in Estonia $P = 2.3 \times 10^{-2}$.

The other option of calculating the probability of branch-off accidents is based on the proportion of the number of accidents registered on branch-offs and the total length of branch-offs and their length of operation. The following formula is used for the calculation of the probability of accident:

$$P = \frac{n}{m \sum_{i=1} l_i \times e_i}$$

where:

- n – number of gas pipeline branch accidents occurred,
- l – length of gas pipelines branch (km),
- e – period of operation of gas pipelines branch (years) ,
- i – gas pipelines branch,
- m – number of gas pipelines branch.

Considering that there have been no gas branch-off accidents in Estonia, at first the total probability in the Baltic States is calculated. The probability of a gas branch pipeline in the Baltic States per one branch-off kilometre per year is $P = 1.4 \times 10^{-4}$. Recalculating the probability of accident as per each country's total length of branch-offs, it is found out that the probability of a gas branch-off accident is $P = 1.9 \times 10^{-2}$ in Latvia, $P = 9.2 \times 10^{-2}$ in Lithuania and $P = 1.0 \times 10^{-2}$ in Estonia.

Both methods of calculation yield probabilities of gas pipeline branch-off accidents in the Baltic States with a similar power. This allows us to analyse each branch-off to GRS as a unique technological object, subject to external impact, as well as to calculate the probability of an accident on a branch-off based on its length in kilometres.

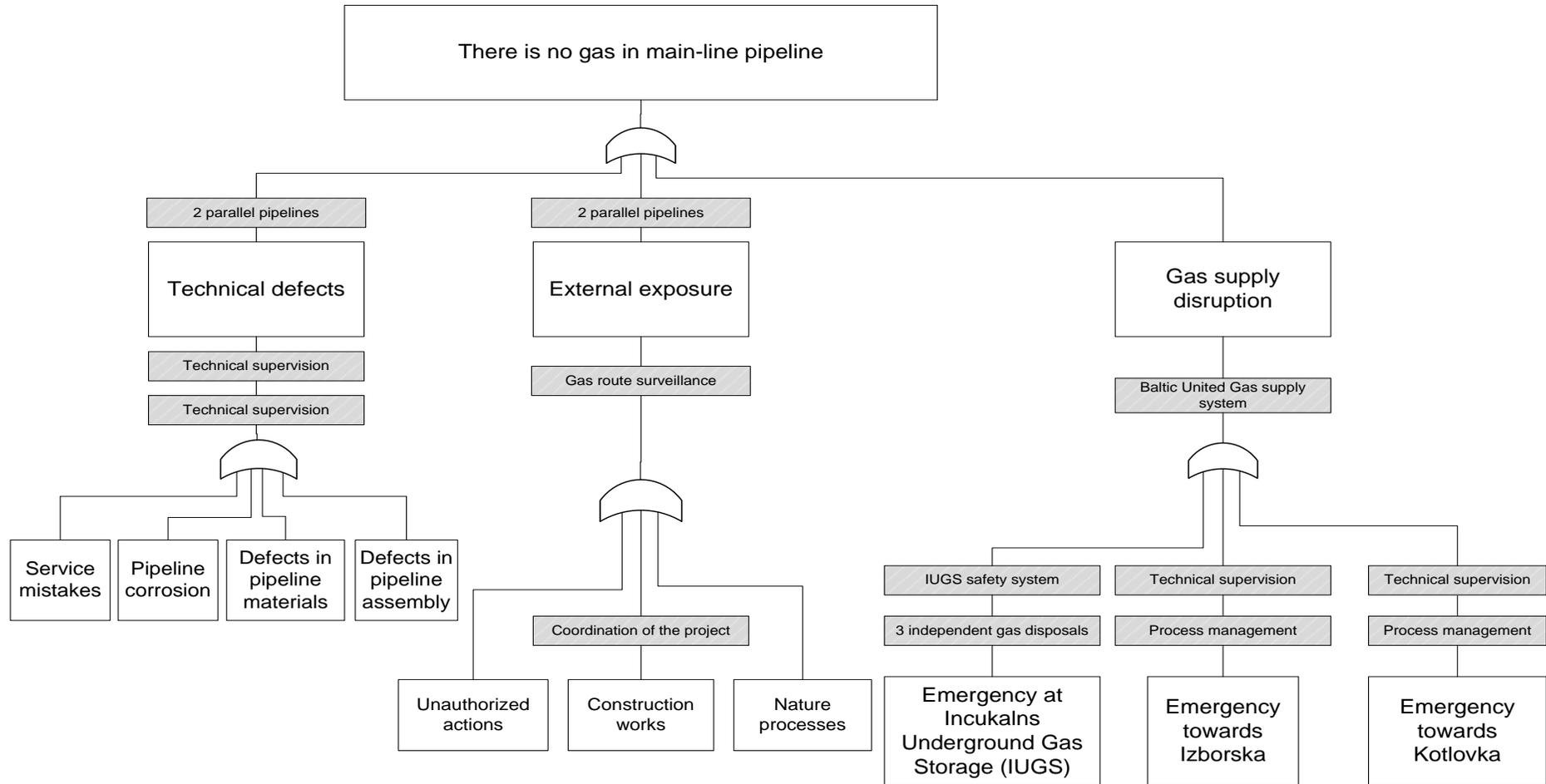
Under the risk scenario, the other group of causes that may disrupt gas supply to consumers is related to technical flaws within a GRS itself. Over the last 5 years, gas regulation stations in all Baltic States have undergone voluminous modernization programmes, hence the old GRS of the Soviet times have been dismantled and replaced with modern module-type GRS. The new gas reduction stations are equipped with an internal process management safety system. Moreover, the technical operation parameters of a GRS can be directly controlled from the gas supply dispatcher centres.

4.2.3. National - scale 15-day gas disruption causality scenario

The next group of gas supply disruptions is those, which may take 15 days to eliminate. A graphical representation of such risk causality scenario is shown in the Figure 17. Such disruptions could basically stem from gas **transmission pipeline issues** of various origins shown below in the chart of risk causality scenario. Technical damage of gas transmission pipeline may be caused, first of all, by construction problems related to insufficient quality of pipeline material and assembly.

Figure 17.

15-day Gas Supply Disruption
Risk Causality Scenario



Secondly, technical defects may arise and develop during the operation of the gas transmission pipeline due to insufficient quality of maintenance and process control.

In order to reduce the probability of technical damage of gas transmission pipelines, two safety barriers have been introduced. They serve to ensure a proper course of gas transmission processes and a systematic supervision of the technical condition of gas transmission pipelines.

In order to assess the probability of gas supply disruptions, an analysis of all accidents of gas transmission pipelines registered in the Baltic States and their causes was conducted. Over the time of operation of the gas supply system in the Baltic States, 6 notable accidents of gas transmission pipelines have taken place. Each of the Baltic States has encountered 2 gas transmission pipeline accidents.

The first gas transmission pipeline failure in Latvia dates back to the Soviet period – 1978 – and resulted in gas ignition. A defect of pipeline assembly was found to have caused it. The other gas transmission pipeline failure in Latvia occurred in 2005 on the gas transmission pipeline Vireši-Tallinn near Valmiera and resulted in one section of the pipeline being torn out and thrown 60 metres aside. In that case the leaked gas did not ignite though. Pipeline material defects were found the main cause of the accident.



Pictures from a gas transmission pipeline accident near Valmiera

Two accidents of gas transmission pipelines have taken place in Lithuania, and both were registered on the gas transmission pipeline Riga-Vilnius. The first of them also dates back to the Soviet period (1988), while the other occurred in 2009. The leaked gas ignited in both cases. The first accident in Lithuania was entailed by a material defect, whereas the second – by natural processes. Below are photos of last accident on gas transmission pipeline in Lithuania.



Pictures from a gas transmission pipeline accident in Lithuania

Two accidents have also taken place in the territory of Estonia, and both date back to 1996. The first one occurred in March on the gas transmission pipeline Izborsk-Tartu-Rakvere, while the other one followed in December on the gas transmission pipeline Vireši-Tallinn, near the Latvian border. The leaked gas did not ignite in any of the two accidents.

The number of the accidents occurred is proportional to the length of gas transmission pipelines in each of the Baltic States, which testifies to the homogeneity of the processes of construction, operation and supervision of technological equipment. Out of six accidents of gas transmission pipelines occurred in the Baltic States four were caused by technical defects, one was entailed by construction activities and one stemmed from natural processes.

With the number of accidents, the length of gas transmission pipelines in kilometres and the period of their operation in mind, it is possible to calculate the probability of gas transmission pipeline accidents in each country separately and in the whole Baltic gas supply system.

The following formula is used for the calculation of the probability of accident:

$$P = \frac{n}{m \sum_{i=1} (l_i \times e_i)}$$

where:

n – number of gas transmission pipeline accidents occurred,

l – length of gas transmission pipelines (km),

e – period of operation of gas transmission pipelines (years) ,

i – sections of gas transmission pipelines

m – number of sections of gas transmission pipelines

Based on the data of Latvia, the probability of an accident for a gas transmission pipeline of one kilometre in length equals $P = 5.7 \times 10^{-5}$. In Lithuania, the probability of an accident is $P = 2.9 \times 10^{-5}$, and in Estonia – $P = 6.9 \times 10^{-5}$, while for the Baltic States overall it is $P = 4.5 \times 10^{-5}$. This means that in the territory of Latvia an accident of gas transmission pipelines is likely to happen once in 15 years on average, in Lithuania once in 17 years on average, in Estonia once in 18 years on average, and once in 6 years on average in any Baltic state.

The calculated probabilities of gas transmission pipeline accidents are not high, which indicates that the gas supply system in the Baltic States is safe. For the sake of comparison, accident probabilities used in risk assessments in the Netherlands and the USA has been provided.

Probabilities of gas transmission pipelines in various countries

Gas pipeline accidents	Probability of accident per one kilometre over a year					
	Estonia	Latvia	Lithuania	Baltic states	Netherlands	USA
Gas transmission pipelines	$6,9 \times 10^{-5}$	$5,7 \times 10^{-5}$	$2,9 \times 10^{-5}$	$4,5 \times 10^{-5}$	$7,1 \times 10^{-5}$	$3,1 \times 10^{-4}$

From the point of view of gas supply disruption, gas transmission pipeline sections without a second parallel line are the most critical. In the territory of Latvia, it is the section from Riga to Iecava, 42 km in length, as well as the gas transmission pipelines from Riga to Liepaja (209 km) and from Riga to Daugavpils (203 km). In the territory of Lithuania, the critical sections are at Kaunas, 20 km in length, and the gas transmission pipeline from Siauliai to Palanga. No parallel gas pipelines have been built in the territory of Estonia, but the Estonian gas supply system is designed as a closed loop, which in the case of a gas transmission pipeline accident allows for provision of gas supply to the place of accident from both directions.

From the point of view of Baltic reliability of gas supply, the most critical is the Riga-Iecava section, which may break the unified Baltic gas supply system and leave 40% of consumers in Latvia, incl. 21 towns, without gas. In fact, such a situation in Latvia could be classified as an energy crisis. The probability of a pipeline accident on this section is $P = 2.1 \times 10^{-3}$. The security of the Latvian gas supply system would be substantially increased by a Latvian-Lithuanian gas pipeline interconnection between Liepaja and Palanga and between Daugavpils and Visaginas. The probability of a gas transmission pipeline accident on the branch-off to Liepaja or Daugavpils is $P = 1.1 \times 10^{-2}$.

The third reason, which might result in gas supply disruption to a large number of consumers, is disruption of gas feeding to gas transmission pipelines. In the Baltic gas supply system, gas is received through two pipelines from Russia and Belarus and in winter from the Inčukalns UGS. The possible cause of a gas feeding disruption in the Baltic gas transmission pipelines would be an accident at the Inčukalns UGS. However, as described in previous chapter (4.2.1.) probability of such accident is very low because most important technical systems of the storage can be replaced by parallel systems.

The other two reasons of possible absence of gas in the gas transmission pipelines of the Baltic gas supply system are related to gas pipeline accidents in the territory of Russia or Belarus. Over the last twenty years, 3 accidents have been registered on the gas transmission pipeline Valdai-Pskov-Riga. Two accidents occurred in 2000, whereas the third, a minor leakage, took place in 2005. In all these cases, the consumers in Russia were supplied gas from the Inčukalns UGS.

No accidents have been registered on the Belorussian gas transmission pipeline from Minsk to Kotlovka over the last 20 years. Assuming that the frequency of accidents in the territory of Belarus is equal to the Baltic States' overall and having regard of the lengths of pipelines from Kotlovka to Minsk, the probability of gas not being delivered from Belarus through Kotlovka is $P = 7.8 \times 10^{-3}$.

4.2.4. Regional-scale 15-day gas disruption causality scenario

As a sub-scenario for a 15-day gas supply disruption a risk scenario with a situation where a **gas deficit emerges in the Baltic States** will be discussed. Just as in the previously described risk scenarios, all the possible events, which may result in a shortage of gas supply in the Baltic States, are envisaged. The reasons may be technical issues or situations of economic nature with an unforeseen burst of gas consumption, as a result of which the gas reserves of the Inčukalns UGS fail to cover the demand and the volume of gas supply to the Baltic States is fully or partially affected (see Figure 18).

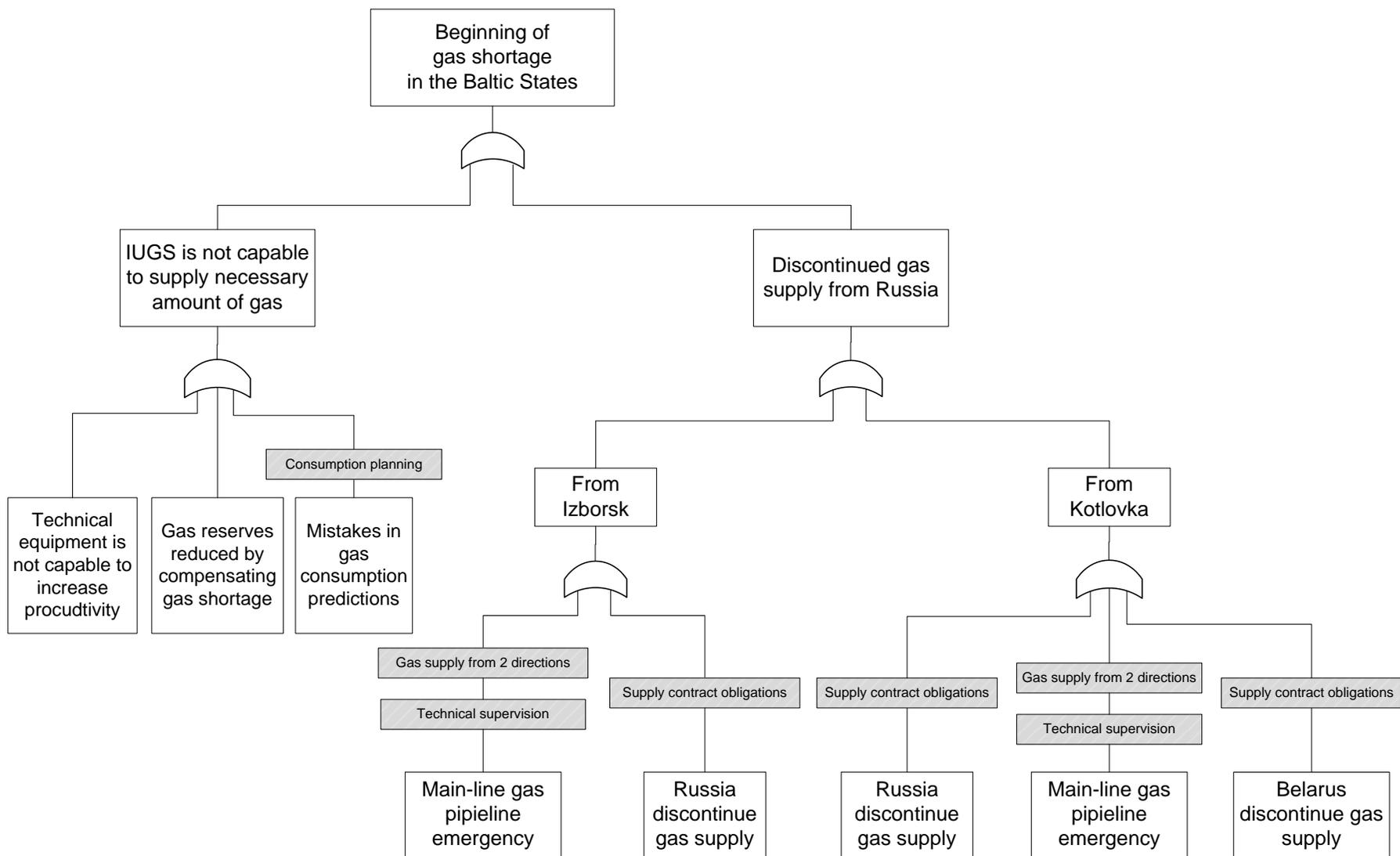
Although technical accidents on gas transmission pipelines carrying gas to the Baltic States as well as causes of gas supply disruption from Inčukalns UGS have been analysed previously (chapters 4.2.1., 4.2.2., 4.2.3.), some of events contained by the risk scenario should be given more attention to.

Based on the risk scenario, there are two possible variants that lead to the available reserves of the Inčukalns UGS becoming insufficient for a long-term compensation of a gas shortage in the Baltic States. First of all, it can be caused by unexpectedly high consumption in the case of a rigorous winter. The second option is possible if due to some reasons a gas shortage in the Baltic States is repeatedly compensated from the Inčukalns UGS gas reserves within one year. Moreover, it has been found in the risk assessment that in the case of a substantial gas deficit in the Baltic States the gas present at the Inčukalns UGS cannot be supplied to consumers in the required volume due to the limited productivity of technological equipment, thus being unable to compensate for a gas consumption deficit.

The worst risk scenario is possible on condition that the Inčukalns UGS gas reserves are practically exhausted and at that moment gas supply to the Baltic region directly from Russia and through the territory of Belarus is discontinued.

The safety barriers in this risk scenario are the gas supply agreements with the Russian Federation on gas supplies and with Belarus on gas transit to Lithuania and Kaliningrad.

Figure 18.
15-day Gas Supply Disruption
Risk Causality Sub-scenario



4.2.5. Safety barriers

In order to mitigate the risks of all kinds of external exposure, there are safety barriers in the form of pipeline route inspections and airborne monitoring of varied regularity. Furthermore, there is an additional safety barrier – all construction activities near gas infrastructure are subject to coordination.

The safety barrier designed for the avoidance of technical damage includes numerous methodical actions – from the selection of pipeline material and the verification of its conformity, the supervision of assembly and independent assembly quality control all the way to the ensuring of proper operation of the pipeline. Considering that during operation the technical condition of the pipeline may deteriorate due to corrosion or mechanical wear, there is a systematic control of the technical condition of pipeline aimed at due detection of the occurrence of technical defects and the performance of relevant repairs.

The other safety barrier serves to avoid technical defects of gas pipelines due to improper process of gas supply. The gas supply processes in each of the Baltic States are managed by specially trained dispatchers from the national gas supply dispatcher control centres. SCADA has been introduced in the gas supply systems of all Baltic States, and it transmits the key data on the parameters of gas supply process to the gas dispatcher control centre of the relevant country. In case coordinated action is needed, the Baltic States' dispatcher control centres have access to full information on the key parameters of gas supply system in all Baltic States. Thus, this safety barrier should be rated as highly efficient as well.

In order to eliminate the issues entailed by technical defects of GRS and to avoid gas supply disruptions, there are three safety barriers. Similarly to the case of pipelines, systematic technical supervision of GRS technological equipment and computer-based process management takes place. For the elimination of technical flaws of GRS, there is another safety barrier – the backup reduction system, which has proved its expedience in numerous technical failures of the basic line. Since currently all the old GRS in the Baltic States are out of service, the statistics of their disorders cannot be used to describe the operation safety of the new GRS. Assessing the above-described safety system, it can be assumed that the probability of gas supply disruption due to technical defects within a GRS does not exceed that of technical defects of pipelines.

Along with technical safety barriers the contractual are used. For the Baltic States the safety barriers for long period disruptions (such as above discussed 15-day gas disruption) are the gas supply agreements with the Russian Federation on gas supplies and with Belarus on gas transit to Lithuania and Kaliningrad.

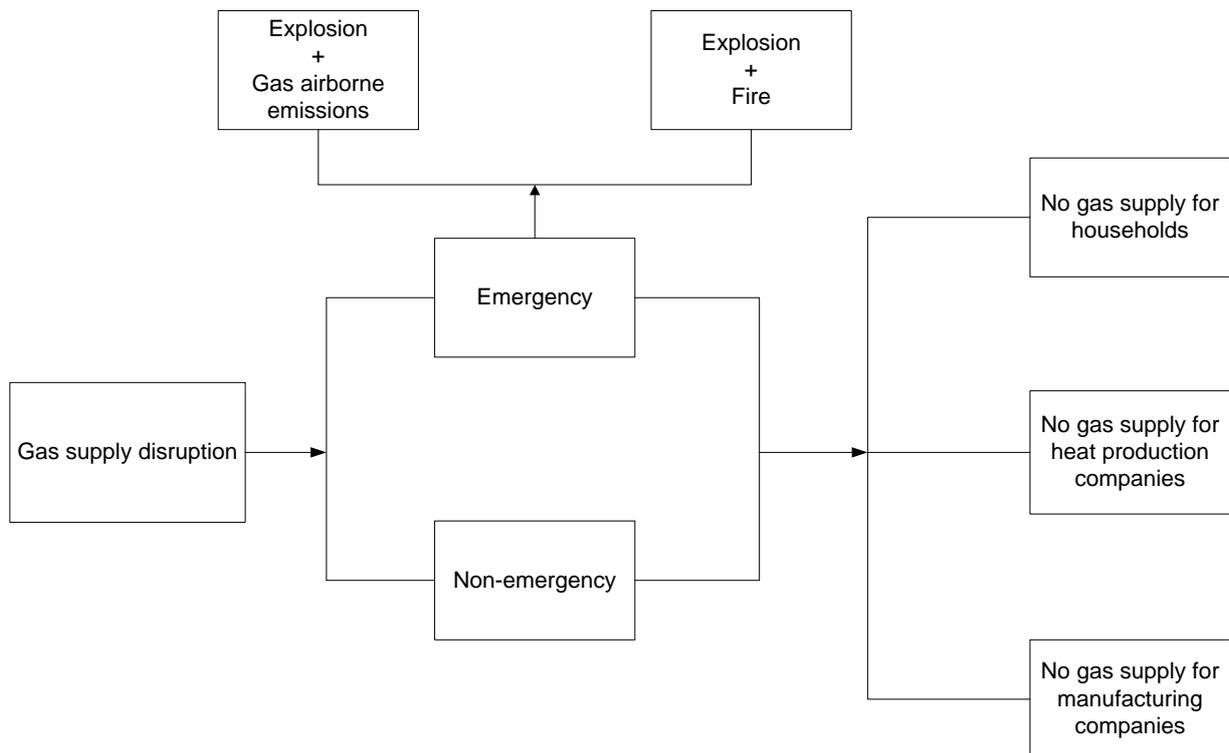
Unfortunately, the history of international relations proves that contractual liabilities cannot be considered an absolute guarantee of security. On February 18, 2004, when Russia discontinued gas supply to Belarus, Belarus, for its part, discontinued gas supply to Lithuania. It was winter, and the average hourly gas consumption in Lithuania at the time was 410 000 m³. In compliance with the mutual assistance plan, Lithuania received gas from the Inčukalns UGS, but due to the limited capacities Latvia was only able to deliver a half of the necessary gas volume. Based on this experience, it would be sensible to consider the possibility to introduce an additional safety barrier by increasing the gas reserves storable at the Inčukalns UGS, which would allow for the compensation of gas deficits having emerged in the Baltic States due to a variety of reasons.

4.3.Risk impact scenarios

The fulfilment of any of the described risk causality scenarios would be followed by consequences that would have a more or less significant impact on a certain group of consumers. As a side-effect to a gas supply disruption, the most unfavourable risk scenario where gas supply is suspended due to an accident, which can only materialize as an act of unauthorized environment pollution or a severe industrial incident is also discussed. The principal risk impact scenario is shown in Figure 19.

Figure 19.

Emergency Exposure Scenario



4.3.1. Risk impact scenario of Inčukalns UGS

The inability of the Inčukalns UGS to feed gas from the underground storage into the gas transmission pipelines in the winter time will directly influence all gas consumers in Latvia, Estonia and a small part of those in Russia. The risk impact scenario shown in Figure 20 has been compiled in accordance with the previously described risk causality scenario. As a result of a damage of any technological equipment involved in the process of gas collection, a full or partial interruption of gas supply from the Inčukalns UGS is possible. In addition to the supply interruption, some damages of technological equipment may show as more or less severe industrial incidents.

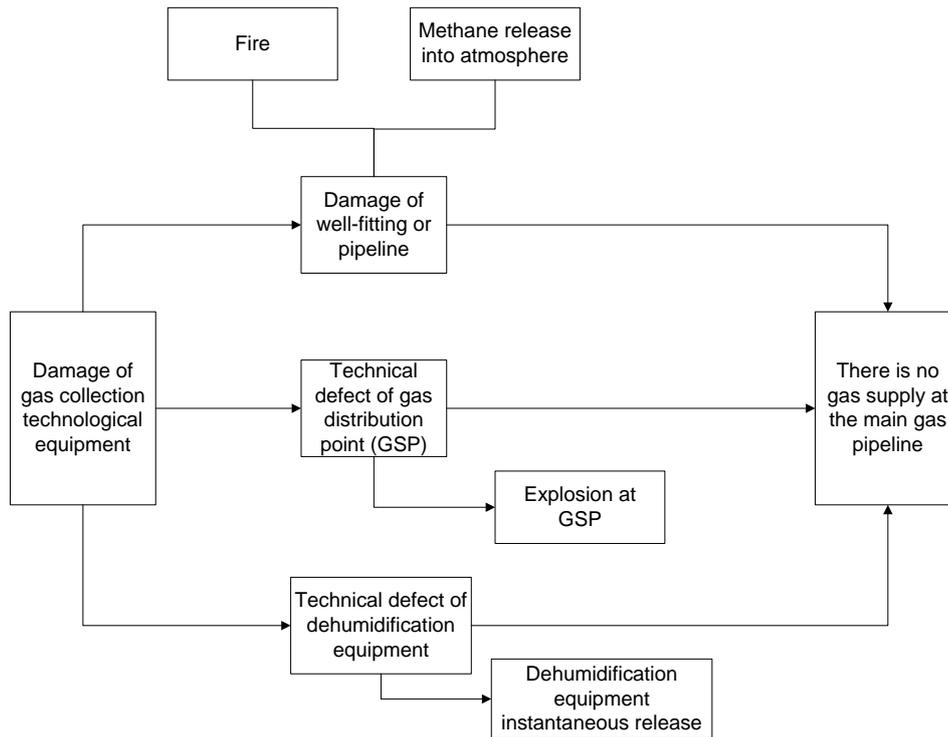


Figure 20. Risk impact scenario of Inčukalns UGS

If the well fittings are damaged, gas may escape from the well with a pressure of up to 100 bar, and under adverse circumstances its ignition is possible. Such an incident will result in a jet fire, with the flame up to 123 metres in height, and life-threatening heat radiation might spread over a radius of 168 metres around the well.

In order to avoid intense gas escape from damaged well fittings, the JSC „Latvijas Gāze” is gradually equipping the gas wells with speed valves that stop the gas flow if its intensity exceeds the permissible limits. Currently 27 wells are equipped with speed valves, and their installation on 16 more wells is due in 2012. A failure of gas pipeline might have a similar range of impact, but it could be quickly and efficiently eliminated by closing the shut-off fittings on the well, which gas is taken from.

Gas collection points are closed technological buildings of lightweight design where gas pressure reduction equipment is placed. In the event of gas escape, an explosive mixture of gas and air may emerge in the premises and explode upon adverse conditions. In order to preclude such incidents, all equipment in the GCP premises is explosion-resistant, there are gas analysers and an automated fire fighting system.

The gas drying unit is also subject to a rather high operation pressure which upon casing damage may cause the drying unit to collapse. As suggested by the results of risk assessment included in the Safety report, the overpressure shock wave and flying shivers of equipment could only endanger the staff of the Inčukalns UGS.

4.3.2. Consequences of local scale

The consequences of a brief gas disruption lasting for 3 days would be local. Only the consumers whose supply is ensured by the particular GRS, which has failed to operate properly due to technical issues or external impact, would suffer. There are 43 such GRS in the territory of Latvia. The central dispatcher service of the Latvijas Gāze AS is aware of the number of consumers, their division into three consumer groups and the average daily consumption data in summer and winter months, and its Lithuanian and Estonian counterparts also possess similar information on consumers and their breakdown into groups.

If a gas disruption is entailed by an accident on a gas pipeline branch-off from a gas transmission pipeline to a GRS, then in the worst variant based on the risk impact scenario it can materialize as ignition of the leaked gas. According to the data of the objects civil protection plan by operation unit „Gas Transport” of the Latvijas Gāze AS, life-threatening heat radiation areas can range from 25 to 280 metres around the place of accident depending on the pipeline diameter and pressure. Considering that full breakages of gas pipeline branch-offs would be quickly detected by the technical tools of SCADA system process supervision, a gas fire could be extinguished relatively fast by cutting gas supply to the relevant GRS from the central dispatcher centre.

4.3.3. Consequences of national scale

A gas supply disruption of 15 days would have much more economically significant consequences. According on the risk causality scenario, such a supply disruption may stem from technical defects of gas transmission pipelines or pipeline damages due to external exposure. Based on the calculations of the probability of the events included in the risk causality scenario, the fulfilment of this scenario would primarily result in consequences for the country where the gas transmission pipeline accident has taken place. In the aspect of gas pipeline system configuration, Latvia has the most unfavourable situation.

Considering that many gas consumers in the territory of Latvia receive gas via single-strand gas pipelines Riga-Liepāja and Riga-Daugavpils, which are not looped either, a gas pipeline accident would prevent all consumers across the place of accident from receiving gas. For instance, if an accident on the gas pipeline Iecava-Liepāja occurs near Iecava, 33 consumers of group I with the total gas consumption of 4600 m³/h, 30 consumers of group II with the total gas consumption of 700 m³/h and 63 consumers of group III with the total gas consumption of 140 m³/h are left without gas in Liepāja.

In the territory of Lithuania, around 75% of gas transmission lines are built with two parallel pipelines, which substantially improve the security of gas supply. One of critical gas pipeline sections in Lithuania is a single-line section of 20 km at Kaunas. Its damage would result in suspended gas supply to consumers serviced by the Kedainiai GRS, Vilkauskis GRS and Marijampole GRS, as well as to Kaliningrad.

The security of the Latvian and Lithuanian gas supply systems would be substantially increased by a Latvian-Lithuanian gas pipeline interconnection between Liepāja and Palanga and between Daugavpils and Visaginas. The probability of a gas transmission pipeline accident on the branch-off to Liepāja or Daugavpils is $P = 1.1 \times 10^{-2}$.

4.3.4. Consequences of regional scale

The potential consequences of the 15-day gas supply disruption are the most severe because any of the variants of gas supply disruption included in the risk scenario would result in a significant gas deficit in all Baltic States. The scope of gas deficit and the possibilities of the unified Baltic gas supply system to mitigate the harm to consumers have been assessed in the response scenarios by the Baltic States' TSOs based on considerable experience of the leading dispatchers of all three countries.

The purpose of response scenarios is to describe and reveal the capability of the system, capacity of the gas companies to act in the case of adverse events that lead to a gas supply disruption.

4.4. Response scenarios

Gas supply to Lithuania, Latvia and Estonia is ensured via several pipelines and Inčukalns UGS, and winter and summer gas flows in these countries differ. Therefore, at the first stage 9 response scenarios were analyzed with the aim to select scenarios with the most negative impact for deeper analysis. These scenarios (directions) are the following:

- Natural gas flow disruption from Russia in summer (GMS Kotlovka)
- Natural gas flow disruption from Russia in summer (CS Izborsk)- 2 cases
- Natural gas flow disruption from Inčukalns UGS in winter
- Natural gas flow disruption from Russia in winter (GMS Kotlovka)
- Natural gas flow disruption from Russia in winter (GMS Kotlovka and CS Izborsk)
- Natural gas flow disruption from Inčukalns UGS in April
- Natural gas flow disruption from GMS Kotlovka in April
- Natural gas flow disruption from GMS Kotlovka and CS Izborsk in April.

For the analysis of scenarios, upon determination of natural gas volumes supplied and not supplied, the maximum average three-day natural gas consumption volumes in each country in the relevant period of time were used. In order to perform calculations and compare the influence of individual scenarios and response capabilities, it was assumed that a supply disruption lasts for twenty four hours.

The results of this analysis are shown in an Annex 1.

Based on this preliminary analysis, comparing the adverse effects of individual scenarios, four scenarios (directions) of natural gas supply disruption in the coldest winter month of the year with a duration of **3 and 15 days** were selected for a more detailed assessment.

The directions are the following:

- **disruption of natural gas supply from the Inčukalns UGS;**
- **disruption of natural gas supply from Kotlovka;**
- **disruption of natural gas supply from Kotlovka and Izborsk;**
- **disruption of natural gas supply from the Inčukalns UGS and Kotlovka or Izborsk.**

In Estonia, the daily natural gas consumption in an emergency situation can be reduced from 6 million m³ to 4 million m³ (Annex 6). Under the effective agreements, only customers with backup fuel are applied limitations of consumption.

In Latvia upon emergency situation, one of 3 scenarios for the stabilization of gas supply takes place:

- 1) All natural gas users are divided into three groups of energy users in compliance with Article 4 of the Regulations No.312 of the Cabinet of Ministers passed on April 19, 2011,
- 2) Depending on the place of accident, it is determined who and to what extent shall be applied limitations of natural gas consumption,
- 3) Depending on the place of accident, the degree of limitation of natural gas supply by a three-level system is set (1st level: 7-12% limitation, 2nd level: 12-17% limitation, 3rd level – more than 17% limitation),
- 4) Depending on the level of limitation, the restriction of natural gas supply is communicated and enforced, and the gas supply units ensure the following consumption limitations (Annex 3, 4, 5):
 - 1st level of limitation: 1st group of energy users – no limitation,
2nd group of energy users – up to 20% limitation,
3rd group of energy users – up to 20% limitation.
 - 2nd level of limitation: 1st group of energy users – up to 20% limitation,
2nd group of energy users – up to 40% limitation,
3rd group of energy users – up to 100% limitation.
 - 3rd level of limitation: 1st group of energy users – up to 40% limitation,
2nd group of energy users – up to 80% limitation,
3rd group of energy users – up to 100% limitation.

Daily natural gas supply through GRS and units without limitations is 12 354 352 m³/h but in case of 1st level of limitation the supply drops to 11 670 632 m³/h, 2nd level of limitation to 8 910 449 m³/h and 3rd level of limitation to 5 749 067 m³/h. (Annex 2)

In Lithuania, energy companies consume up to 10 million m³ of natural gas daily, and they are applied limitations of up to 60%. Industrial customers and public utilities, which together account for 6.5 million m³ of daily consumption, are imposed limitations depending on the situation and the volume of backup fuel available.

Natural gas daily consumption in Lithuania

Consumer group	Daily consumption, %
Households	12
Heat, electricity production	54
Public utilities and commercial companies	6
Industry	28

In case of a partial interruption of gas supply when the country loses up to 20 percent of the amount of supplied gas and realistic measures to restore it are missing, gas supply to all consumers of interrupted supply shall be limited in proportion to gas consumption by them. In case of a large extent interruption of gas supply when the country loses more than 20 percent of the amount of supplied gas and realistic measures to restore it are missing TSO shall immediately (not longer than in one hour) notify the consumers whereof and after notification shall start consumer disconnection according to groups of supply limitation. According to the Catalogue of measures for safeguarding of natural gas supply security (Official gazette, 2008, No. 27-966), approved by the Government of the Republic of Lithuania, the gas supply is gradually interrupted by the following order of priority:

- Group 1 – consumers having concluded contracts on uninterrupted gas supply;
- Group 2 – industries able to use reserve fuels (enjoined by legal acts to form fuel reserves);

Group 3 – industries with no available fuel reserves;

Group 4 – industries using gas for uninterrupted technological processes and consumers producing heat and electricity able to use reserve fuels;

Group 5 – household consumers and persons securing the primary needs of consumers.

The Klaipeda district is shown as an example of limitation of natural gas consumption (Annex 7).

4.4.1. Scenario 1 - Gas supply disruption from Inčukalns UGS

During the winter season, natural gas supply to Latvia, Estonia and the western part of the Pskov Region of the Russian Federation is ensured from the Inčukalns UGS. The maximum daily natural gas withdrawal capacity is 24 million m³, half of which is allocated to consumers in Latvia, while Russia and Estonia each get 6 million m³ daily. In case gas supply from the Inčukalns UGS is lost, alternative gas supplies are available directly from Russia up to 6 million m³ per day, incl. 4 million m³ for Estonia and 2 million m³ for Latvia, as well as 5 million m³ per day in transit through Lithuania for the needs of consumers in Latvia. In this case, it would become necessary to increase the volume supplied to Lithuania from Belarus by 5 million m³ per day and fully reverse the gas flow in the pipeline Valdai-Pskov-Riga.

However, such a scenario would entail a gas shortage in the region – 5 million m³ per day in Latvia and 2 million m³ per day in Estonia (see Figure 21). This means that, corresponding to the emergency situation, it is necessary to set natural gas usage restrictions to certain natural gas users.

It may take from 12 to 24 hours from the occurrence of the emergency situation, including the exploration of its scale and the exchange of information among the adjacent countries' dispatcher centres, to rearrange the regional natural gas supply flows.

Actions in the case of disruption from Inčukalns UGS in winter

1. Limitation of gas supply to users in Latvia and Estonia

- Latvia - 3 limitation groups of users, 3 limiting stages, an appropriate limiting stage is applied depending on scale of disruption;
- Estonia - users can be limited if they have backup fuel or an agreement which allows interruption.

2. Rearrangement of gas flow system

- Stopping flow from Latvia to Russia;
- Stopping flow from Latvia to Estonia;
- Arranging flow from Russia to Estonia;
- Arranging flow from Russia to Latvia;
- Arranging flow from Lithuania to Latvia.

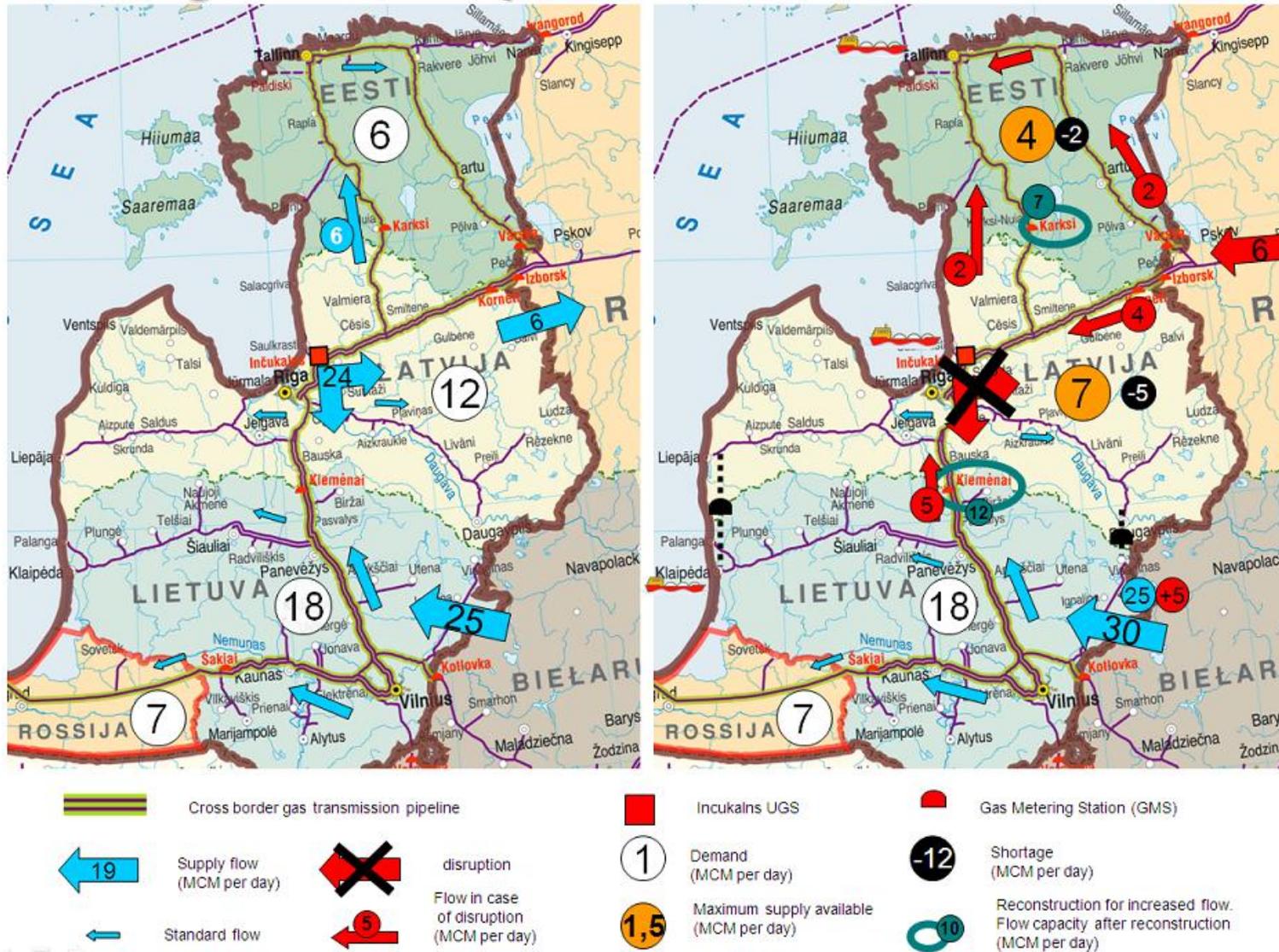
Country	Average consumption, mcm			Shortage in case of disruption, mcm			Consumption in case of disruption, mcm		
	1day	3day	15days	1day	3day	15days*	1day	3day	15days*
Lithuania	18	54	216	0	0	0	18	54	216
Latvia	12	36	144	-5	-15	-39	7	21	105
Estonia (with Nitrofert)	6	18	72	-2	-6	-12	4	12	60
Kaliningrad**	7	21	84	0	0	0	7	21	84
Total for the region	43	129	516	-7	-21	-51	36	108	465

*0.8 ratio is applied for 15 days calculation

**Region with increasing demand due development

Figure 21.

Natural gas flow disruption form Incukalns UGS in winter



4.4.2. Scenario 2 - Gas supply disruption from GMS Kotlovka

During the winter season, natural gas supply to Latvia, Estonia and the western part of the Pskov Region of the Russian Federation is ensured from the Inčukalns UGS. The maximum daily natural gas withdrawal capacity is 24 million m³, half of which is allocated to consumers in Latvia, while Russia and Estonia each get 6 million m³ per day. Lithuania is ensured natural gas supply from Russia in transit through Belarus (GMS Kotlovka), 25 million m³ per day, incl. 18 million m³ per day for consumers in Lithuania and 7 million m³ per day for the Kaliningrad Region. In case of gas supply disruption through GMS Kotlovka, alternative gas supplies to the Baltic region are available from the Inčukalns UGS along the pipeline Riga-Panevežys through GMS Kiemenai, – up to 5 million m³ per day, incl. 3.5 million m³ for Lithuania and 1.5 million m³ for Kaliningrad.

In this scenario, it would become necessary to discontinue gas supply from the Inčukalns UGS to Estonia and the Pskov Region in Russia as well as to reverse the flow in the gas pipeline Valdai-Pskov-Riga, thus ensuring gas supplies of 6 million m³ per day to Estonia and an additional volume of 4 million m³ per day for Latvia.

However, the capacity limitation of the existing cross-border connections would cause a gas shortage in the region – 14.5 million m³ per day in Lithuania and 5.5 million m³ per day in Kaliningrad (see Figure 22). This means that, corresponding to the emergency situation, it is necessary to set natural gas usage restrictions to certain natural gas users. In order to improve the situation, it is necessary to implement the measures listed above.

It may take from 18 to 24 hours from the occurrence of the emergency situation, including the exploration of its scale and the exchange of information among the adjacent countries' dispatcher centres, to rearrange the regional natural gas supply flows.

Actions in case of disruption from Russia in winter (GMS Kotlovka)

1. Limitation of gas supply to Lithuanian users

- Users are limited depending on the user type and the amount of backup fuel.

2. Rearrangement of gas flow system

- Stopping flow from Latvia to Russia;
- Stopping flow from Latvia to Estonia;
- Arranging flow from Russia to Estonia;
- Arranging flow from Russia to Latvia;
- Arranging flow from Latvia to Lithuania.

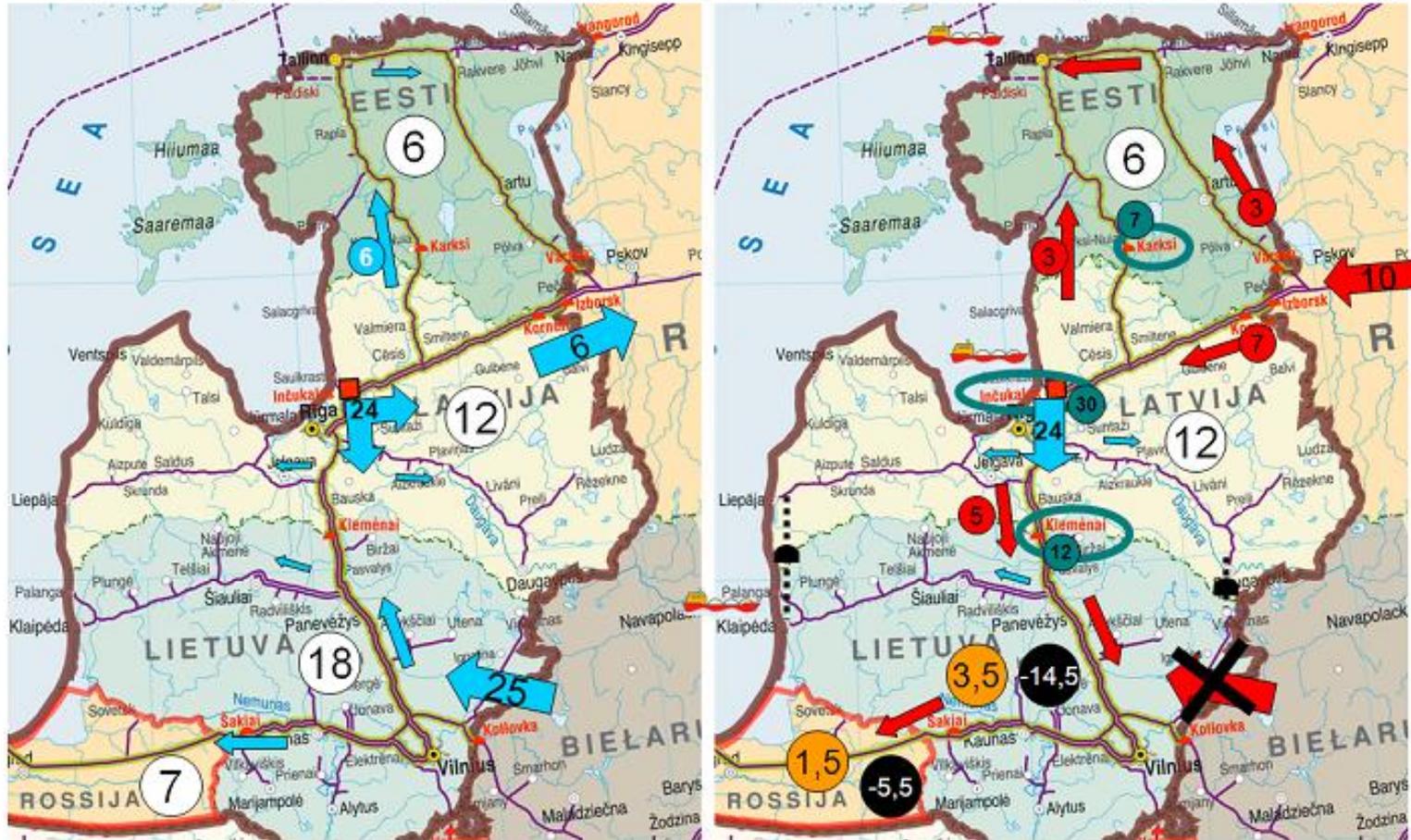
Country	Average consumption, mcm			Shortage in case of disruption, mcm			Consumption in case of disruption, mcm		
	1day	3day	15days	1day	3day	15days*	1day	3day	15days*
Lithuania	18	54	216	-14.5	-43.5	-164	3.5	10.5	52.5
Latvia	12	36	144	0	0	0	12	36	144
Estonia (with Nitrofert)	6	18	72	0	0	0	6	18	72
Kaliningrad**	7	21	84	-5.5	-16.5	-61.5	1.5	4.5	22.5
Total for the region	43	129	516	-20	-60	-225	23	69	291

*0.8 ratio is applied for 15 days calculation

**Region with increasing demand due development

Figure 22.

Natural gas flow disruption form Russia in winter (GMS Kotlovka)



4.4.3. Scenario 3 - Gas supply interruption from GMS Kotlovka and KS Izborsk

During the winter season, natural gas supply to Latvia, Estonia and the western part of the Pskov Region of the Russian Federation is ensured from the Inčukalns UGS. The maximum daily natural gas withdrawal capacity is 24 million m³, half of which is allocated to consumers in Latvia, while Russia and Estonia each get 6 million m³ per day. Lithuania is ensured natural gas supply from Russia in transit through Belarus (Kotlovka GMS), 25 million m³ per day, incl. 18 million m³ per day for consumers in Lithuania and 7 million m³ per day for the Kaliningrad Region. In case gas supply through both Izborsk GMS and Kotlovka GMS is lost at the same time, alternative gas supplies to the Baltic region are only available from the Inčukalns UGS. In this scenario, the Inčukalns UGS continues to operate with the maximum capacity of 24 million m³ per day, divided into 12 million m³ per day for the needs of Latvia, 6 million m³ per day for the needs of Estonia, and the spare capacity, which can be shifted along the pipeline Riga-Panevežys through GMS Kiemenai, – up to 5 million m³ per day, incl. 3.5 million m³ for Lithuania and 1.5 million m³ for Kaliningrad.

However, the capacity limitation of the existing cross-border connections would cause a gas shortage in the region – 14.5 million m³ per day in Lithuania and 5.5 million m³ per day in Kaliningrad (see Figure 23). This means that, corresponding to the emergency situation, it is necessary to set natural gas usage restrictions to certain natural gas users. The current withdrawal capacity of the Inčukalns UGS is also unable to fully cover the maximum gas consumption of the Baltic region in the winter season. For that matter, two gas collection points at the Inčukalns UGS should be modernized and a new one – the 4rd – should be built. A cross-border connection between Lithuania and the Inčukalns UGS, with increased capacity, the replacement of the transmission pipeline Vilnius-Riga, with its construction in the territory of Latvia from Riga to the Lithuanian border, would be welcome as well.

It may take from 8 to 20 hours from the occurrence of the emergency situation, including the exploration of its scale and the exchange of information among the adjacent countries' dispatcher centres, to rearrange the regional natural gas supply flows.

Actions in case of disruption from Russia in winter (GMS Kotlovka and CS Izborsk)

1. Limitation of gas supply to Lithuanian users

- Users are limited depending on the user type and the amount of backup fuel.

2. Rearrangement of gas flow system

- Stopping flow from Latvia to Russia;
- Arranging flow from Latvia to Lithuania.

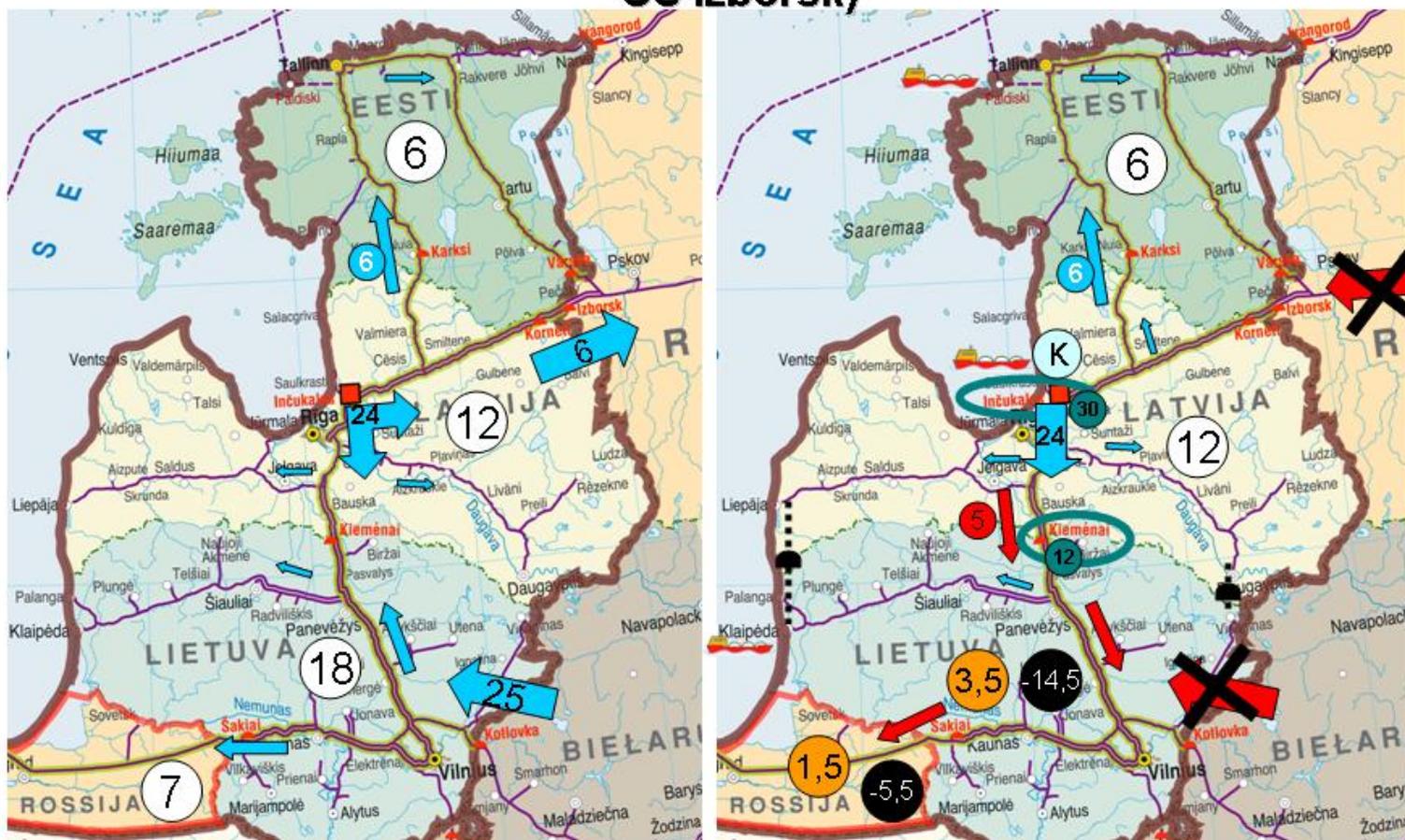
Country	Average consumption, mcm			Shortage in case of disruption, mcm			Consumption in case of disruption, mcm		
	1day	3day	15days	1day	3day	15days*	1day	3day	15days*
Lithuania	18	54	216	-14.5	-43.5	-164	3.5	10.5	52.5
Latvia	12	36	144	0	0	0	12	36	144
Estonia (with Nitrofert)	6	18	72	0	0	0	6	18	72
Kaliningrad**	7	21	84	-5.5	-16.5	-61.5	1.5	4.5	22.5
Total for the region	43	129	516	-20	-60	-225	23	69	291

*0.8 ratio is applied for 15 days calculation

**Region with increasing demand due development

Figure 23.

Natural gas flow disruption form Russia in winter (GMS Kotlovka) and CS Izborsk)



4.4.4. Scenario 4 - Gas supply interruption from Inčukalns UGS and Kotlovka or Izborsk

The most severe (but with the lowest possibility) is disruption scenario which foresees the simultaneous disruption of Inčukalns UGS and gas supply through Izborsk GMS or Kotlovka GMS. In case gas supply from Inčukalns UGS and Kotlovka GMS is lost at the same time, alternative gas supplies to the Baltic region are only available directly from Russia through Izborsk GMS and Narva LKS up to 13.5 million m³ per day, incl. 2.5 million m³ for Estonia and 7 million m³ for Latvia, as well as 4 million m³ per day in transit through Latvia for the needs of consumers in Lithuania (3 million m³) and Kaliningrad (1 million m³).

However, the capacity limitation of the existing cross-border connections would cause a gas shortage in each country of the region – 3.5 million m³ per day in Estonia, 5 million m³ per day in Latvia, 15 million m³ per day in Lithuania and 6 million m³ per day in Kaliningrad (see Figure 24). This means that, corresponding to the emergency situation, it is necessary to set natural gas usage restrictions to certain natural gas users.

It may take from 8 to 20 hours from the occurrence of the emergency situation, including the exploration of its scale and the exchange of information among the adjacent countries' dispatcher centres, to rearrange the regional natural gas supply flows.

Actions in case of disruption from Inčukalns UGS and Kotlovka GMS in winter

1. Limitation of gas supply to users in Estonia, Latvia and Lithuania

- Estonia - users can be limited if they have backup fuel or an agreement which allows interruption;
- Latvia - 3 limitation groups of users, 3 limiting stages, an appropriate limiting stage is applied depending on scale of disruption;
- Lithuania - users are limited depending on the user type and the amount of backup fuel.

2. Rearrangement of gas flow system

- Stopping flow from Latvia to Russia;
- Stopping flow from Latvia to Estonia;
- Arranging flow from Russia to Estonia;
- Arranging flow from Russia to Latvia;
- Arranging flow from Latvia to Lithuania.

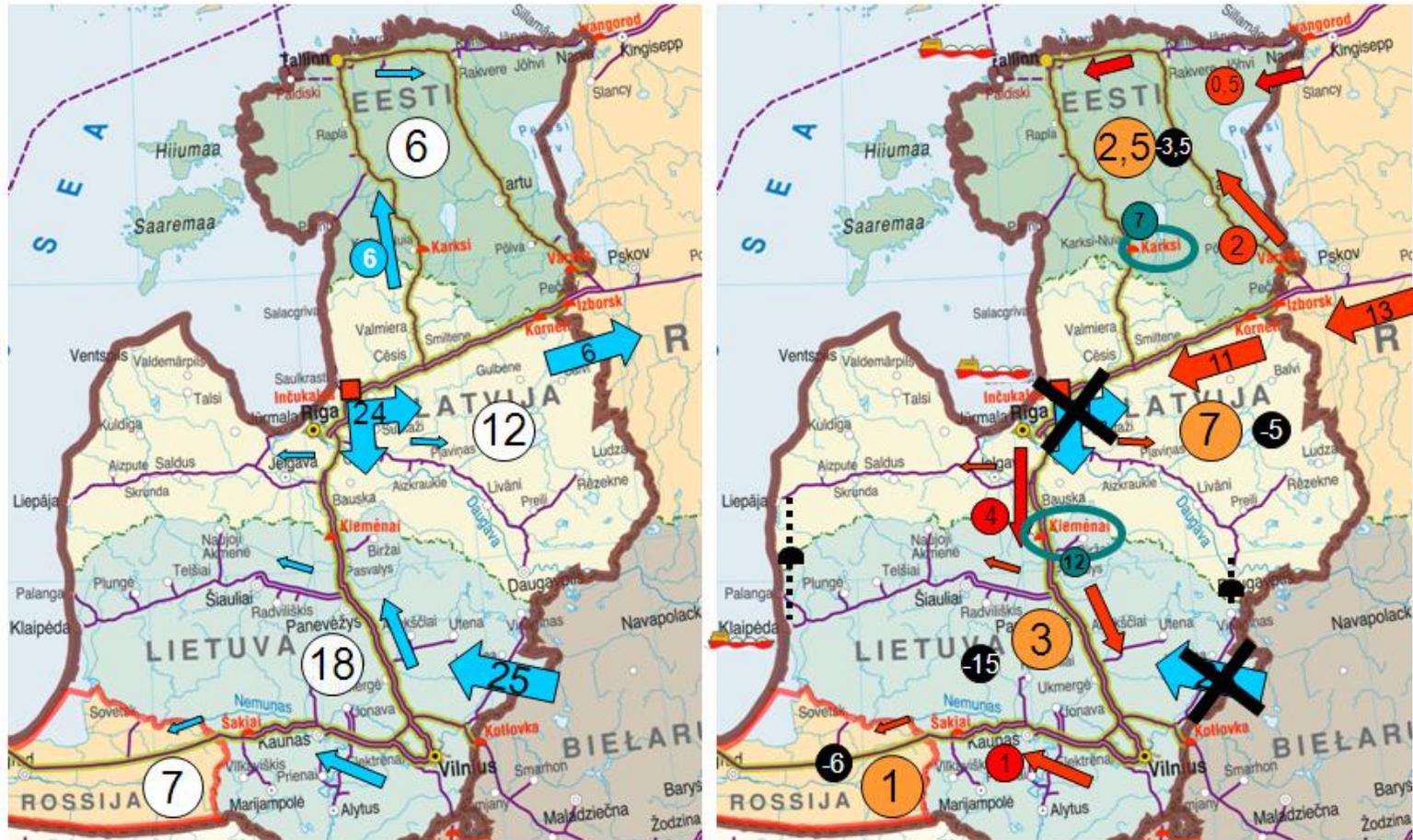
Country	Average consumption, mcm			Shortage in case of disruption, mcm			Consumption in case of disruption, mcm		
	1day	3day	15days	1day	3day	15days*	1day	3day	15days*
Lithuania	18	54	216	-15	-45	-180	3	9	36
Latvia	12	36	144	-5	-15	-60	7	21	84
Estonia (with Nitrofert)	6	18	72	-3.5	10.5	-42	2.5	7.5	30
Kaliningrad**	7	21	84	-6	-18	-72	1	3	12
Total for the region	43	129	516	-29.5	-88.5	-354	13.5	40.5	162

*0.8 ratio is applied for 15 days calculation

**Region with increasing demand due development

Figure 24.

Natural gas flow disruption from Incukalns UGS and Kotlovka in winter



In case of simultaneous gas supply disruption from Inčukalns UGS and Izborsk GMS, alternative gas supplies to the Baltic region are only available from Russia through Narva LKS up to 0.5 million m³ per day and in transit through Belarus (Kotlovka GMS) up to 30 million m³ per day, incl. 16 million m³ for Lithuania and 5 million m³ for Kaliningrad, as well as 7 million m³ per day for Latvia and 2 million m³ in transit through Latvia for the needs of consumers in Estonia.

However, the capacity limitation of the existing cross-border connections between would cause a gas shortage in each country of the region – 3.5 million m³ per day in Estonia, 5 million m³ per day in Latvia, 2 million m³ per day in Lithuania and 2 million m³ per day in Kaliningrad (see Figure 25). This means that, corresponding to the emergency situation, it is necessary to set natural gas usage restrictions to certain natural gas users.

It may take from 8 to 20 hours from the occurrence of the emergency situation, including the exploration of its scale and the exchange of information among the adjacent countries' dispatcher centres, to rearrange the regional natural gas supply flows.

Actions in case of disruption from Inčukalns UGS and Izborsk GMS in winter

1. Limitation of gas supply to users in Estonia, Latvia and Lithuania

- Estonia - users can be limited if they have backup fuel or an agreement which allows interruption;
- Latvia - 3 limitation groups of users, 3 limiting stages, an appropriate limiting stage is applied depending on scale of disruption;
- Lithuania - users are limited depending on the user type and the amount of backup fuel.

2. Rearrangement of gas flow system

- Stopping flow from Latvia to Russia;
- Arranging flow from Russia to Estonia;
- Arranging flow from Lithuania to Latvia;
- Arranging flow from Latvia to Estonia.

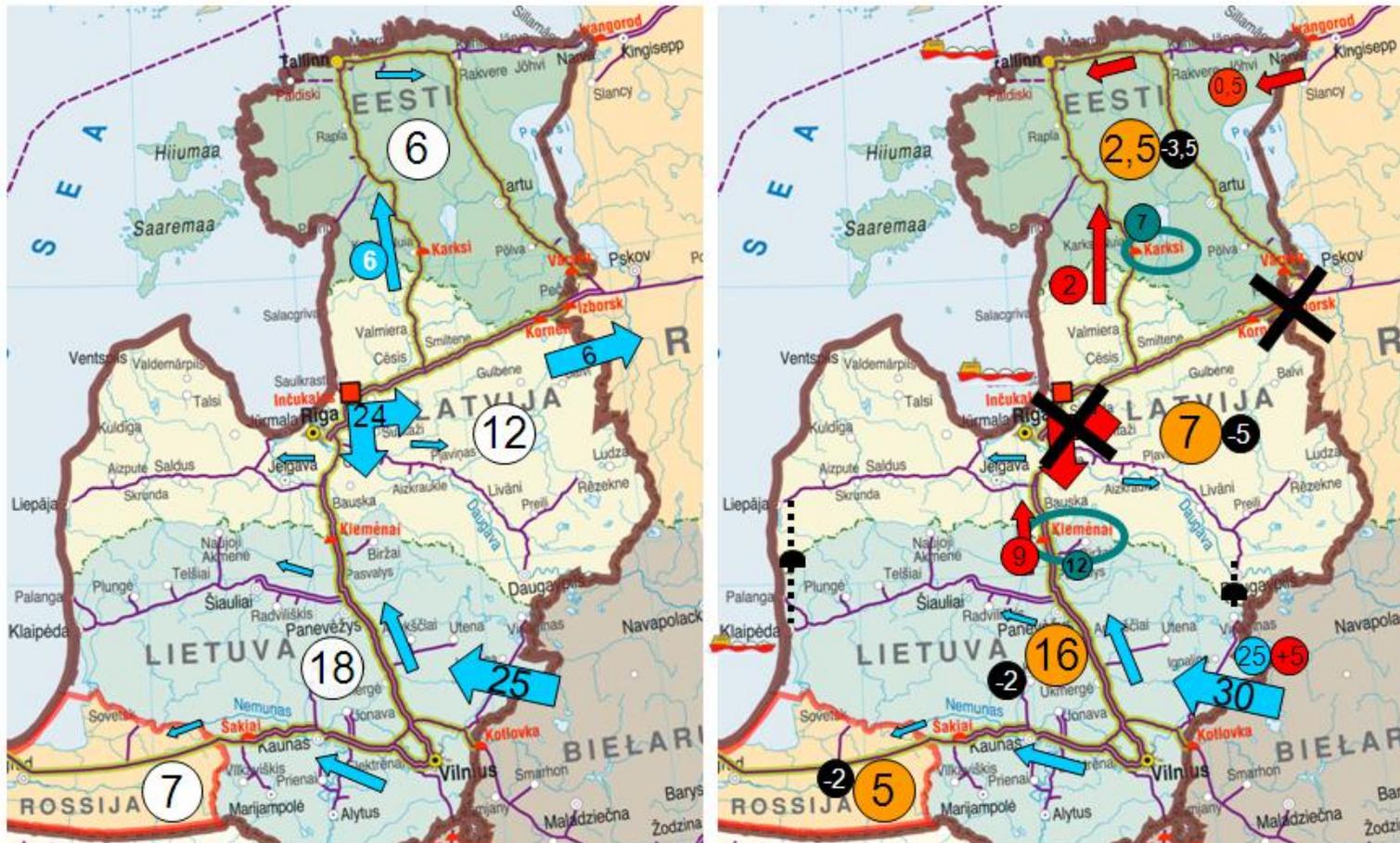
Country	Average consumption, mcm			Shortage in case of disruption, mcm			Consumption in case of disruption, mcm		
	1day	3day	15days	1day	3day	15days*	1day	3day	15days*
Lithuania	18	54	216	-2	-6	-24	16	48	192
Latvia	12	36	144	-5	-15	-60	7	21	84
Estonia (with Nitrofert)	6	18	72	-3.5	-10.5	-42	2.5	7.5	30
Kaliningrad**	7	21	84	-2	-6	-24	5	15	60
Total for the region	43	129	516	-12.5	-37.5	-150	30.5	91.5	366

*0.8 ratio is applied for 15 days calculation

**Region with increasing demand due development

Figure 25.

Natural gas flow disruption from Incukalna UGS and GMS Izborsk in winter



- | | | | | | |
|--|--|--|---|--|--|
| | Cross border gas transmission pipeline | | Incukalna UGS | | Gas Metering Station (GMS) |
| | Supply flow (MCM per day) | | Flow in case of disruption (MCM per day) | | Demand (MCM per day) |
| | Standard flow | | Shortage (MCM per day) | | Maximum supply available (MCM per day) |
| | | | Reconstruction for increased flow. Flow capacity after reconstruction (MCM per day) | | |

4.5. Risk matrix

The matrix of Baltic gas supply disruption risk provides a clear summary of all results of the Baltic States' gas supply risk assessment (see Figure 26). The scale of probabilities of the matrix has been selected based on the event probabilities obtained in the risk assessment. The scale of consequences, for its part, has been divided into four segments of assessment of severity:

- Losses to gas supplier
- Losses for gas consumers
- Harm to the environment
- Danger to human health and life

The direct material losses incurred are calculated depending on the reason and type of gas disruption. In the case of an accident, losses can be calculated in three levels. The minimum amount of losses consists of the value of gas volume lost and the value of the technological unit damaged due to the accident.

$$Z_{\min} = I_{\text{gas}} + I_{\text{unit}}$$

The actual amount of losses reflects the aggregate costs the gas supply company should reckon with in order to resume gas supply to consumers at its previous level. The costs of renovation of gas supply infrastructure should be added to the minimum amount of losses.

$$Z_{\text{real}} = I_{\text{gas}} + I_{\text{unit}} + I_{\text{renov}}$$

The maximum losses, apart from the above, also include the company's unearned profit.

$$I_{\text{renov}} + P_{\text{unearned}}$$

In the case of a gas supply disruption, the Baltic States' gas supply companies practically do not suffer direct losses as, depending on the direction of the supply disruption, changes are made in the operation of the Baltic States' gas supply systems. While gas supply issues are being solved, the continuity of gas supply in the Baltic States will be ensured by the gas reserves accumulated at the Inčukalns UGS.

The calculation of losses in the event of gas disruption should be linked to gas consumer groups. Households using gas for cooking only are practically unaffected by a brief gas disruption. Major heat supply companies should have a backup fuel, which would enable them to keep operating during gas supply disruptions. The highest losses would be those of medium production and heat supply companies without a backup fuel. The amount of losses for this group will be determined by the costs of unrecoverable materials incurred by interrupted operation.

Gas supply accidents may harm the nature and threaten human lives. There will be more harm to the nature if the accident occurs in ecologically sensitive environment or in a restricted area. Harm to the nature in all Baltic States is determined by state authorities based on the effective normative acts of the country concerned. Threat to the human health and life in gas supply accidents is rated as low if the accident has no permanent impact on the human health, medium if there is one or several victims and significant of very significant if there is a possibility of lethal outcomes.

Figure 26. Matrix of Baltic gas supply disruption risk

Probability		Negligible risk	Substantial risk	Medium risk	High risk	Very high risk
Very high	once a year and more often	<i>Repairs of gas supply infrastructure, repairs with temporary gas disconnection</i>				
High	once in 1 – 15 years		<i>Accident on a gas pipeline branch-off to any GRS in the Baltic States</i> GTP accident in the territory of Estonia	Technical accident on GTP Izborsk-Pskov GTP accident in the territory of Lithuania	Suspended gas supply from Belarus to Lithuania GTP accident in the territory of Latvia	
Medium	once in 16 – 50 years		<i>Accident at any GRS in the Baltic States</i>		Inčukalns UGS fails to supply the required gas volume	Gas supply from Russia to the Baltic States is suspended
Low	once in 51 – 100 years		Accident at any technological gas equipment of IUGS		Technical accident on GTP Kotlovka-Minsk	Accident on GTP section Riga-Iecava
Very low	once in more than 100 years				Large-scale accidents at Inčukalns UGS	Simultaneous technical accidents on GTP Izborsk-Pskov and Kotlovka-Minsk
Losses to gas supplier		10 000 to 100 000	100 000 to 1 million	1 to 10 million	10 to 100 million	More than 100 million
Losses to gas consumers		Less than 1000	1 000 to 10 000	10 000 to 100 000	100 000 to 1 million	1 to 10 million
Harm to the environment		Negligible environment pollution	Environment pollution without permanent impact	Permanent impact in one environment	Permanent impact in multiple environments	Irreversible changes in the environment
Danger to human health and life		No victims	Several victims	Up to 10 victims	1 death	Several deaths
		Negligible	Substantial	Medium	Severe	Very severe

Consequences

The scale of consequences in the risk matrix has been selected based on the impact of the possible gas disruptions in the particular segment of consequences. The degree of risk is classified according to the probability of the event and the severity of its consequences. Cells of a similar degree of risk are in the same colour. The highest degree of risk is that of the cell coloured in red and located in the top right corner of the matrix. The lowest degree of risk is that of the cell coloured in green and located in the bottom left corner of the matrix.

The brief – 3-day – disruption risks are shown italicized in the matrix, the 15-day disruption risks are in regular-faced print, and the risks of sub-scenarios of 15-day disruption are in bold.

4.6. Gas supply disruption risk mitigation measures

It follows from the results of the risk analysis conducted that both local and regional problems related to gas supply due to a variety of reasons may occur relatively often in any of the Baltic States. Gas supply to a GRS in the Baltic States may break once in 10 years on average, while gas transmission pipeline accidents can be expected once in 5-6 years on average. The risk scenarios drawn up enabled to discover the problematic and narrow places in the provision of safety of the Baltic States' gas supply system. Based on the comprehensive analysis, the following recommendations for enhancing the safety of the regional gas supply system have been prepared (see Figure 27 and table below):

- Continue modernization of Inčukalns UGS and install additional compressors at the storage to ensure both higher injection volumes and appropriate gas withdrawal.
- increase the cross-border interconnection capacities – reconstruction of the frontier GMS Karksi and Kiemenai to increase throughput, construction of a reverse unit of GMS Karksi;
- renovate the gas pipeline Riga-Vilnius;
- (probably) join the pipelines Riga-Daugavpils and Vilnius-Visaginas 40 km, Dn 400;
- (probably) join the pipelines Iecava-Liepāja and Panevežys-Klaipeda 95 km, Dn 400;
- increase the overall capacity of the Inčukalns UGS as well as the gas withdrawal capacity.

The safety of change of natural gas flow direction is affected by the reserve of natural gas in the pipelines – the more natural gas is present in the gas transmission pipeline system, with cross-border connections and reverse gas supply options ensured, the more safe and stable the gas supply system operates.

In order to schedule, calculate and ensure natural gas flow shifts, improve the safety and rational operation of regional gas supply systems, a centralized regional system of SCADA aggregating system and a stationary and dynamic software of hydraulic gas supply calculations, for instance, SIMONE, is required.



Figure 27. Measures to be implemented for enhancement of regional security of supply

1. Activities related to improvement of operation safety, increase of injection and withdrawal capacities and possible expansion of Inčukalns UGS (adjustments for transit gas compression, modernization of wells, installation of new compressor units, construction and modernization of gas collection facilities)
2. Increase of GMS Kiemēnai capacity to 12 mcm per day and construction of necessary connection. Construction of a new gas pipeline “Riga- Vilnius” (Ø500)
3. Construction of reverse connection for GMS Karksi and increase of capacity to 10 mcm per day

4. Construction of connection transmission pipelines “Iecava – Liepaja” and “Panevezys – Klaipeda”. Construction of GMS (95km, Ø400).
5. Construction of connection transmission pipelines “Riga – Daugavpils” and “Vilnius – Visaginas”. Construction of GMS (40km, Ø400).
6. Hydraulic calculation software for management and supervision (including database) for gas transmission network system
7. Construction of LNG terminal.

Estimated costs for measures to be implemented for enhancement of regional security of supply

No.	Activity	Estimated costs (MEUR)
1.	Improvement of safety of operation, increase of injection and withdrawal capacities and possible expansion of Inčukalns UGS	80*
2.	Increase of GMS Kiemenai capacity, construction of a new gas pipeline “Riga- Vilnius”	50
3.	Increase of GMS Karksi capacity and construction of reverse connection	8
4.	Construction of connection pipeline “Liepaja – Klaipeda”, 95km	48
5.	Construction of connection transmission pipelines “Riga – Daugavpils” and “Vilnius – Visaginas”, 40km	16
6.	Hydraulic calculation software for management and supervision for gas transmission network system	10
7.	Construction of LNG terminal**	350-400
	TOTAL without LNG terminal construction	212
	TOTAL with LNG terminal construction	562-612

*Without expansion

After the implementations of above mentioned measures for enhancement of regional security of supply the probability of Baltic gas supply disruption risk provides a clear summary of all results of the Baltic States’ gas supply risk assessment will be reduced significantly (see Figure 28).

Figure 28. Matrix of Baltic gas supply disruption risk after implementing the measures offered

Probability		Negligible risk	Substantial risk	Medium risk	High risk	Very high risk
Very high	once a year and more often	<i>Repairs of gas supply infrastructure repairs with temporary gas disconnection</i>				
High	once in 1 – 15 years		<i>Accident on a gas pipeline branch-off to any GRS in the Baltic States GTP accident in the Baltic States</i>	Technical accident on GTP Izborsk-Pskov.	Suspended gas supply from Belarus to Lithuania	
Medium	once in 16 – 50 years		<i>Accident at any GRS in the Baltic States</i>			Gas supply from Russia to the Baltic States is suspended
Low	once in 51 – 100 years	Accident at any technological gas equipment of Inčukalns UGS		<i>Inčukalns UGS fails to supply the required gas volume</i>	Technical accident on GTP Kotlovka-Minsk	
Very low	once in more than 100 years		Accident on GTP section Riga-Iecava		Large-scale accidents at Inčukalns UGS	Simultaneous technical accidents on GTP Izborsk-Pskov and Kotlovka-Minsk
Losses to gas supplier		10 000 to 100 000	100 000 to 1 million	1 to 10 million	10 to 100 million	More than 100 million
Losses to gas consumers		Less than 1000	1 000 to 10 000	10 000 to 100 000	100 000 to 1 million	1 to 10 million
Harm to the environment		Negligible environment pollution	Environmental pollution without permanent impact	Permanent impact in one environment	Permanent impact in multiple environments	Irreversible changes in the environment
Danger to human health and life		No victims	Several victims	Up to 10 victims	1 death	Several deaths
		Negligible	Substantial	Medium	Severe	Very severe

Consequences

Regardless of the fact that Baltic States fully comply with the N-1 standard, results of the risk assessment clearly highlight the most important components of the gas supply system in the respect of gas supply security.

In compliance with the requirements of 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 Joint Preventive Action Plan could be established. If Joint Preventive Action Plan will be established, it should contain the above-mentioned measures and other measures needed to remove or mitigate the risks identified according to the risk assessment.

Annexes