

Approved

.....



MINISTER ENERGII

Preventive Action Plan

prepared on the basis of art. 8.2.a of the *Regulation No 2017/1938 of the European Parliament and of the Council of 25 October 2017 on measures to safeguard the security of gas supply and repealing Regulation (EU) No 994/2010*

Warsaw, 2019

Table of Contents

1.	SUMMARY AND CONCLUSIONS	5
2.	INTRODUCTION	7
3.	SYSTEM DESCRIPTION.....	8
3.1.	DESCRIPTION OF THE REGIONAL GAS SYSTEM.....	8
3.1.1.	Regional risk group - Belarus	8
3.1.2.	Regional risk group - Ukraine.....	9
3.2.	DESCRIPTION OF THE NATIONAL GAS SYSTEM - POLAND.....	10
3.2.1.	Domestic consumption of natural gas and the structure of natural gas sales to final customers.....	10
3.2.2.	Characteristics of the national gas system	11
3.2.3.	Gas infrastructure is key to ensuring security of natural gas supply	15
3.2.4.	Sources of natural gas imports and the structure of natural gas imports	16
3.2.5.	The natural gas storage system	17
3.2.6.	Domestic natural gas production	17
3.2.7.	The use of natural gas in electricity production	18
3.2.8.	The role of energy efficiency measures.....	19
4.	SUMMARY OF RISK ASSESSMENT	21
4.1.	COMMON RISK ASSESSMENT	21
4.1.1.	Common risk assessment for the Belarus risk group	21
4.1.2.	Common risk assessment for the Ukrainian risk group.....	22
4.2.	NATIONAL RISK ASSESSMENT	24
5.	STANDARD IN INFRASTRUCTURE	27
5.1.	N-1 FORMULA AT REGIONAL LEVEL.....	28
5.1.1.	N-1 formula for Belarusian risk group.....	28
5.1.2.	N-1 formula for the Ukrainian risk group.....	31
5.2.	N-1 FORMULA AT NATIONAL LEVEL	33
5.2.1.	N-1 formula for high-methane natural gas system	33
5.2.2.	N-1 formula for the low-calorific gas system	34
5.3.	BI-DIRECTIONAL CAPACITY.....	35
6.	COMPLIANCE WITH THE SUPPLY STANDARD	37
7.	PREVENTIVE MEASURES.....	39
7.1.	MARKET-BASED MEASURES	39
7.2.	NON-MARKET BASED MEASURES	40
8.	OTHER MEASURES AND OBLIGATIONS IN THE FIELD OF SYSTEM SECURITY	43
8.1.	THE ROLE OF OPERATORS IN ENSURING THE SECURITY OF GAS SUPPLY	43
8.2.	TASKS OF ENERGY ENTERPRISES IN ENSURING SECURITY OF GAS SUPPLY.....	44
9.	INFRASTRUCTURE PROJECTS	46
10.	OBLIGATIONS TO PROVIDE PUBLIC SERVICES RELATED TO SECURITY OF SUPPLY	51
10.1.	ENERGY LAW.....	51
10.2.	THE ACT OF STOCKS	52
11.	REGIONAL DIMENSION	54

11.1.	REGIONAL RISK GROUP - BELARUS	54
11.1.1.	N-1 formula	54
11.1.2.	Cooperation mechanism.....	54
11.1.3.	Preventive measures	55
11.1.4.	Critical gas-fired power plants	57
11.2.	REGIONAL RISK GROUP - UKRAINE.....	58
11.2.1.	N-1 formula	58
11.2.2.	Mechanisms developed for cooperation	59
11.2.3.	Preventive measures	60
11.2.4.	Critical gas-fired power plants	60

Abbreviations used in the text:

EFTA	- European Free Trade Association
GSF	- group of storage installations
EC	- European Commission
CUGS	- cavern underground gas storage
LNG	- liquefied natural gas
OGP Gaz-System SA	- Gas Transmission Operator Gaz-System SA
SSO	- storage system operator
TSO	- transmission system operator
PGNiG SA	- Polskie Górnictwo Naftowe i Gazownictwo SA
UGS	- underground gas storage
President of the ERO	- President of the Energy Regulatory Office
PSG Sp. z o.o.	- Polska Spółka Gazownictwa Sp. z o.o.
MCP	- Mutual Connection Point
Regulation 994/2010	- <i>Regulation of the European Parliament and EU Council No. 994/2010 of 20 October 2010 on measures to ensure the security of gas supply and repealing Council Directive 2004/67/EC</i>
Regulation 2017/1938	- <i>Regulation (EU) No 2017/1938 of the European Parliament and of the Council of 25 October 2017 concerning measures to safeguard security of gas supply and repealing Regulation (EU) No. 994/2010</i>
RP	- Republic of Poland
SGT	- transit gas pipeline system
SGT EuRoPol GAZ SA	- EuRoPol GAZ SA Transit Gas Pipeline System
EU	- European Union
The Act of Stocks	- the Act of 16 February 2007 on inventories of crude oil, petroleum products and natural gas, and rules of conduct in situations of threat to the fuel security of the state and disturbances on the oil market.

1. Summary and Conclusions

This Preventive Action Plan sets out measures aimed at removing or mitigating the risks and threats to natural gas supplies.

Due to the supply of the low-calorific gas system exclusively from domestic resources (gas mine) and the dispersed nature of production, the continuity of natural gas supply to customers connected to this system is much less risky than in the case of a high-methane natural gas system. In particular, some of the risks relevant to the high-methane natural gas system, due to the above-mentioned the specificity of the low-calorific gas system can not be considered as threatening this part of the market. Minor failures occurring at operating and technical facilities resulting in disruptions in gas supplies from individual facilities are compensated for by gas coming from accumulation in gas pipelines or by increasing supplies from other resources.

What is more, this plan has assessed Poland's ability to supply natural gas in accordance with the standards set out in Regulation 2017/1938 (i.e. infrastructure standard and supply standard).

The infrastructure standard, defined by the so-called formula N-1, describes the technical capacity of gas infrastructure to meet the total demand for natural gas in the analysed area, in the event of a disruption in the functioning of the largest single element of this infrastructure, on an extremely high demand day, occurring statistically once in 20 years.

The system constituting the largest, single element of infrastructure in the Polish transmission system is the System Reduction and Measurement Station in Włocławek (SSRP Włocławek). The N-1 formula calculated for Poland, assuming SSRP Włocławek failure was 118.2%. Exceeding the N-1 formula by more than 100% means that the existing gas infrastructure allows for securing supplies for the needs of customers even in the event of the failure of its largest element.

In addition, it was calculated that in Poland the quantity of gas needed to ensure compliance with the standard in the scope of supplies to natural gas recipients belonging to the group of protected customers during 30 days of extremely high demand for natural gas, with a probability of occurring once every 20 years. is approx. 1 131.2 mcm (12 296 GWh).

Due to the important role of Member States of individual risk groups in ensuring the security of natural gas supplies to Poland, this document focuses on regional cooperation. Due to the fact that an efficiently functioning internal gas market is the key to ensuring security of supply of this gas throughout the European Union, the plan includes a description of the mechanisms used for cooperation between Member States in relevant risk groups. Poland is a member of two risk groups due to gas supplies from the East:

- Belarus - Member States belonging to the risk group: Belgium, Czech Republic, Germany, Estonia, Latvia, Lithuania, Luxembourg, the Netherlands, Poland and Slovakia

- Ukraine - Member States belonging to the risk group: Bulgaria, Czech Republic, Germany, Greece, Croatia, Italy, Luxembourg, Hungary, Austria, Poland, Romania, Slovenia, Slovakia

In the opinion of the Minister of Energy, the integration of the Polish gas system with the systems of Member States of individual risk groups will allow enterprises operating on the territory of Poland to gain access to developed and diversified markets of natural gas and the flexibility of the security system in the event of implementation of crisis scenarios. In this regard, in particular, the importance of constructing interconnections as well as the construction of the Baltic Pipe gas pipeline, the expansion of the LNG terminal in Świnoujście and plans for the construction of a floating regasification terminal in the Bay of Gdańsk should be emphasized. These activities, through further integration of the Polish gas system with the systems of other EU Member States and ensuring a greater level of diversification of supply sources, will contribute to increasing the possibility of eliminating the effects of a potential disruption in supplies.

It should be noted that in addition to the implementation of the above of diversification and integration projects with EU countries, the transmission system operator conducts activities in the field of developing the national gas system, which will contribute to ensuring natural gas flows from new and expanded entry points to the national network.

In addition to the programs carried out by the transmission system operator, a distribution system operator program is being implemented in the country that will allow new customers to be connected to the gas network by building distribution networks in non-gasified areas.

Implementation of the above projects and programs constituting preventive actions will allow:

- diversification of directions and sources of supply,
- further liberalization of the natural gas market,
- development of transmission infrastructure on cross-border connections,
- increasing the degree of integration of regional natural gas markets,
- increasing the degree of security of natural gas supply.

2. Introduction

Matters regarding the country's energy security, including the country's fuel security, belong, in accordance with art. 7a paragraph 2 point 3 of the Act of 4 September 1997 on government administration departments (Journal of Laws of 2018, items 762 and 810) in connection with § 1 para. 2 point 1 of the Regulation of the Prime Minister of 13 December 2017 regarding the detailed scope of activities of the Minister of Energy (Journal of Laws item 2314) to the competence of the Minister of Energy.

In addition, the Act of 10 April 1997 - Energy Law (Journal of Laws of 2018, item 755, as amended) stipulates that the tasks of the Minister of Energy in the field of energy policy include, among others supervision over the security of gas fuel supply.

The Minister of Energy acts as the competent authority within the meaning of Regulation of the European Parliament and of the Council of the EU No. 2017/1938 of 25 October 2017 regarding measures to safeguard security of natural gas supply and repealing Regulation (EU) No 994/2010.

In accordance with art. 8 clause 2 of Regulation 2017/1938, the competent authority of each Member State shall draw up a Preventive Action Plan, including the measures necessary to eliminate or reduce the risks identified, relating to the effects of energy efficiency measures and demand-side measures in the Joint and National Risk Assessments.

3. System Description

3.1. Description of the regional gas system

3.1.1. Regional risk group - Belarus

The regional Belarus risk group, due to the supply of natural gas from the East, includes: Belgium, the Czech Republic, Germany, Estonia, Latvia, Lithuania, Luxembourg, the Netherlands, Poland and Slovakia.

The analyzes carried out indicate that the total natural gas consumption in all Member States included in the Belarusian risk group is growing. In 2016, this consumption amounted to 158 bcm (1 702.95 TWh), while in 2017, 163 bcm (1 760.94 GWh). The highest consumption of natural gas in this risk group, in 2017, was recorded in Germany (74 bcm, i.e. 802 TWh), and the smallest in Estonia (0.5 bcm, i.e. 5.36 TWh).

Natural gas can be injected into and out of the gas systems of the Belarus risk groups to and from countries outside this group through 15 one-way entry points, 7 one-way exit points and 7 two-way entry/exit points.

Total capacity of all entry points to the group's gas systems is 938.5 mcm/day (10 297 GWh/day), including the largest, located on the border between Slovakia and Ukraine: Uzhgorod-Velke Kapusany - 180.3 mcm/day (2 028 GWh/d).

Total transmission capacity of exit points from the Belarus gas system to countries outside the group is 502,6 mcm/day (5.515 GWh/d), of which the largest exit point, located on the Slovakian and Austrian border Baumgarten - 139.6 mcm/day (1 570.4 GWh/d).

The countries of the Belarus risk group are interconnected by 23 interconnection points. The largest point of entry and exit to the gas system within the group is Lanžhot on the border between the Czech Republic and Slovakia with an entry capacity of 148.8 mcm/day (1 640 GWh/day) towards the Czech Republic and an exit of 81.2 mcm/day (913.7 GWh) towards Slovakia.

LNG terminals in the Belarus risk group operate in Belgium, Lithuania, the Netherlands and Poland. The total regasification capacity of all terminals in the 2016/2017 season amounted to 105.6 mcm/day (1 151 GWh/day), and on an annual basis - 29.7 bcm (3 235.3 TWh). Levels of the utilization of regasification capacities of terminals in individual Member States, both the annual and the single day of the highest demand, were very diversified.

Table 1. Technical capacity of LNG terminals in individual Member States

Country	Belgium	Lithuania	Netherlands	Poland
Technical regasification capacity of the LNG terminal mcm/d (GWh/d)	40.80 (471.24)	10.24 (122.40)	40.84 (399)	13.68 (158)
Technical regasification capacity of the LNG terminal bcm/year (TWh/year)	9.0 (1 039.50)	3.74 (446.76)	12 (117 230)	4.99 (576.71)
The utilization rate of regasification capacities on the day of the highest demand in the 2016/2017 season	4.70%	84.0%	90.46%	30.26%
The annual utilization rate of regasification capacities	11.90 %	29.0%	6.0%	31.88%

Source: Common risk assessment of the Eastern gas supply risk group -Belarus

The total working capacity of underground gas storage in 2017 in the Member States constituting the Belarus risk group totaled 178.5 bcm (1 958 TWh). UGS facilities are available in Belgium, the Czech Republic, Germany, Latvia, the Netherlands, Poland and Slovakia. On the other hand, Estonia, Luxembourg and Lithuania do not have underground natural gas storage facilities in their gas system.

In 2017, the maximum daily withdrawal capacity of natural gas from underground gas storage facilities of the Belarus risk group at full filling amounted to 1.1 bcm/day (12 096 GWh/d), while at the end of the season - 0.85 bcm/day (9 326 GWh/day).

The total natural gas production in the Member States creating the Belarus risk group in 2017 amounted to 53 bcm (530 609 GWh), which represents about 33% of the total natural gas consumption in the member states of the group. In recent years, the highest level of extraction has been maintained in the Netherlands, while the lowest in Slovakia. In 2017, the values reached 45 bcm (442 000 GWh) and 0.09 bcm (949 GWh), respectively. In Estonia, Lithuania, Latvia, Luxembourg and Belgium, no natural gas extraction activities are carried out.

The total natural gas consumption for generating electricity in 2016 in Member States forming the Belarus risk group amounted to 44.88 bcm (492 TWh). The largest use of natural gas for energy production was recorded in Germany (20.77 bcm, i.e. 227.89 TWh), while the smallest in Luxembourg (92 mcm, i.e. 1.01 TWh).

3.1.2. Regional risk group - Ukraine

The regional Ukrainian risk group includes: Bulgaria, Czech Republic, Germany, Greece, Croatia, Italy, Luxembourg, Hungary Austria, Poland, Romania, Slovenia and Slovakia.

The regional Ukraine risk group due to supplies of natural gas from the East includes: Bulgaria, Czech Republic, Germany, Greece, Croatia, Italy, Luxembourg, Hungary Austria, Poland, Romania, Slovenia and Slovakia.

In 2017, total natural gas consumption in Member States forming the Ukrainian risk group amounted to 243.69 bcm (2 673 TWh). The highest consumption of natural gas in this group of risk was recorded in Germany (74 bcm, i.e. 802 TWh), and the smallest in Croatia (0.11 bcm, i.e. 1.15 TWh).

Among the countries of the Ukrainian risk group, liquefied natural gas terminals operate in Greece (1), Poland (1) and Italy (3). The total regasification capacity of terminals in this risk group in 2017 was 79.5 mcm/day (872 GWh/d), of which Italy had the greatest regasification capacity (15.9 bcm/year). The highest rate of utilization of regasification capacities of LNG facilities among member states of the Ukrainian risk group in 2017 was 66% and it was recorded in Italy.

The total active capacity of underground natural gas storage in 2017 in Member States forming the Ukrainian risk group amounted to 59.1 bcm (648 TWh). Among the countries of the Ukrain risk group, the largest natural gas storage capacity are in Germany, which amount to approx. 24 bcm (263 TWh), while Greece, Luxembourg and Slovenia do not have underground gas storage facilities in their gas system.

The total natural gas production in the Member States forming the Ukrain risk group in 2017 amounted to 33.61 bcm (369 TWh), which is approximately 13.8% of the total natural gas consumption in this group. The largest production was recorded in Romania (11.18 bcm, i.e. 122.67 TWh), while the lowest in Greece and Slovenia (8 mcm, or 87.8 GWh). Among the member states of the group, only natural gas production is not carried out in the area of Luxembourg.

The total natural gas consumption in the production of electricity in 2016 in Member States forming the Ukrainian risk group amounted to 65.65 bcm (720 TWh). The largest use of natural gas in power generation in 2016 occurred in Italy at 27.76 bcm (305 TWh), while the lowest in Luxembourg 92 mcm (1 009 GWh).

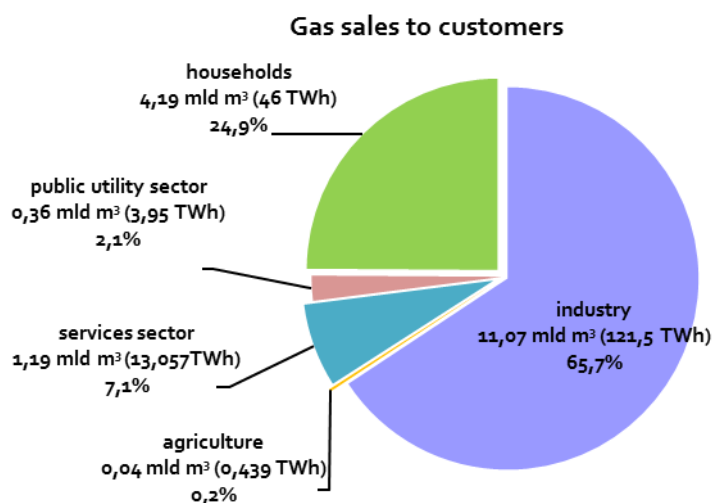
3.2. Description of the national gas system - Poland

3.2.1. Domestic consumption of natural gas and the structure of natural gas sales to final customers

In 2018, domestic consumption of natural gas amounted to 17.6 bcm (198.788 TWh) and increased by 3.89% compared to the previous year.

In 2018, energy companies sold 16.85 bcm (185 TWh) of natural gas to over 7 million end-users, which is an increase of 3.4% compared to 2017. The highest amount, i.e. 11.07 bcm (121.5 TWh) of natural gas was sold to industrial customers (65.7%), while 4.19 bcm (46 TWh) to household customers (24.9%).

Figure 1. The structure of natural gas sales (calculated as high-methane gas) to final customers by sectors



Source: Statistical surveys of the Minister of Energy.

The peak demand for natural gas consumers in 2018 was recorded on 28 February and amounted to 81 mcm/day (905,7 GWh/day), thus the maximum historical daily consumption recorded in 2012 amounting to 72.3 mcm/24 hours (793 GWh/day) was significantly exceeded.

3.2.2. Characteristics of the national gas system

3.2.2.1. National Transmission System

The national transmission system consists of transmission gas pipelines with a total length of approximately 10 743 km (as at 31 December 2018), of which:

- 10,031 km of high-methane gas network,
- 712 km of the low-calorific gas network,

and a 684 km transit gas pipeline system.

The domestic high-methane gas transmission system managed by OGP Gaz-System S.A. is powered by entry points associated with:

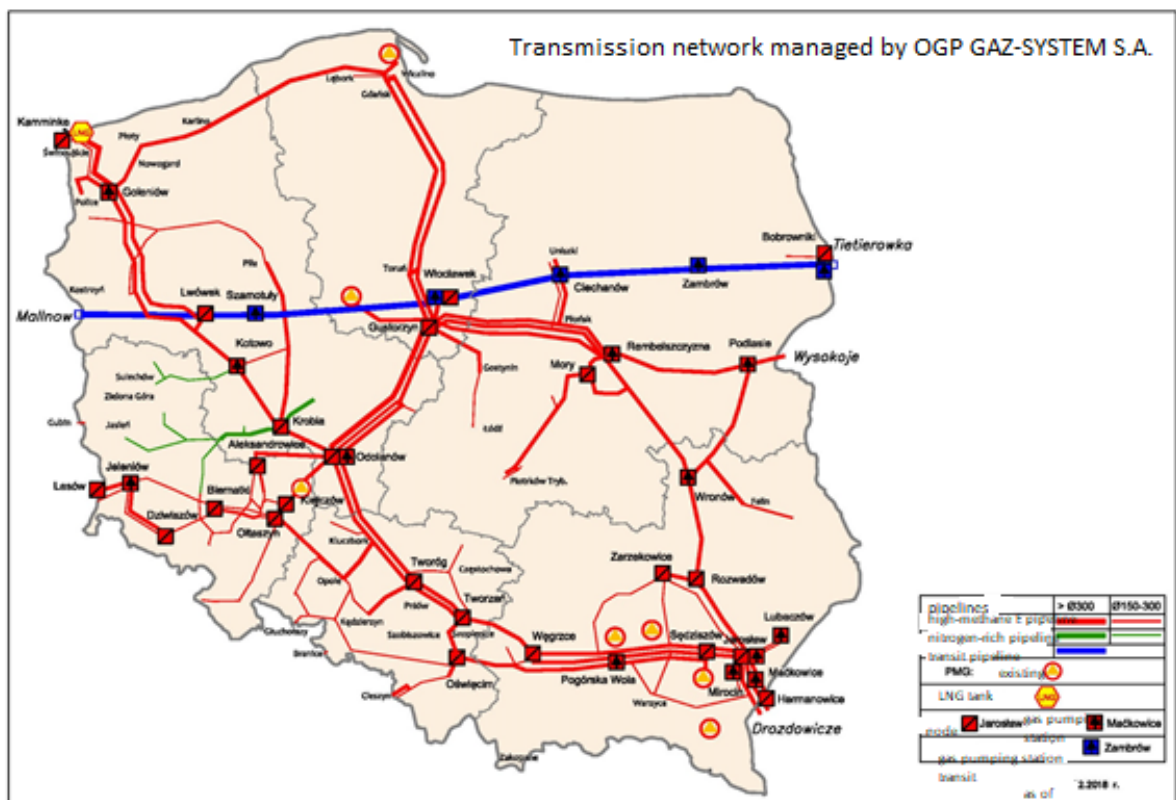
1. Import of natural gas:

- a) Drozdowicze (Polish-Ukrainian border),
- b) Wysokoje (Polish-Belarusian border),
- c) GCP Gaz-System/ONTRAS point (Lasów - Polish-German border),
- d) Cieszyn (Polish-Czech border),
- e) Transit Gas Pipeline System (Polish section of the Yamal-Europe gas pipeline):
 - Mutual Connection Point (physical entry points in Włocławek and Lwówek),
- f) local import connections:
 - Tietierowka (Polish-Belarusian border),
 - GCP Gaz-System / ONTRAS point (Gubin - Polish-German border),
 - Branice (Polish-Czech border),
- g) entry point from the LNG terminal in Świnoujście.

2. national deposits:
 - a) mines in the high-methane gas system,
 - b) KRIO Odolanów and Grodzisk denitrating plants,
 - c) mines in the low-calorific gas system.
3. UGS - 7 storage facilities in the high-methane gas system, which are the entry points to the transmission system during the gas reception process:
 - a) GFS Sanok - comprising storage facilities at UGS Husów, UGS Strachocina, UGS Swarzów and UGS Brzeźnica,
 - b) GFS Kawerna - including storage facilities of CUGS Mogilno and CUGS Kosakowo,
 - c) UGS Wierzchowice.

In 2018, 14 natural gas compressor stations cooperated with the Polish transmission system, with a total installed capacity of about 130 MW.

Figure 2. Natural gas transmission system



Source: OGP Gaz-System SA

Table 2. Technical capacity at entry points from other transmission systems and from the LNG terminal.

	Technical capacity on a continuous basis mcm/d (GWh/d)	Country	Comments
Drozdowicze	12.0(131.7)	Ukraine	
Wysokoje	15.0(164.6)	Belarus	
Tietierowka	0.6(6.6)	Belarus	local power supply
LNG terminal	13.7(150.3)		technical regasification capacity
Mutual Connection Point	24.7(271)	Poland (SGT)	deliveries to MCP can be realized from Kondratki and Mallnow Reverse from Germany
GCP GAZ-SYSTEM/ONTRAS	4.4(48.3)	German	Lasów, Gubin, Kamminke
Cieszyn	2.50.4 27.44.4	Czech Republic	October to April / May-September
TOTAL	72.9/70.8 (800/776,8)		

Source: OGP Gaz-System SA

The national transmission system is diversified in terms of technical parameters, in particular the diameters of gas pipelines and their working pressure in various parts of the country are diverse. Gas pipelines with the largest diameters are located in the East of the country. This distribution changes gradually as work progresses related to the completion of subsequent investments located mainly in the north-western, northern and central parts of the country, serving the diversification of roads and sources of supply. As a result of the investments carried out since 2009, the share of high-pressure gas pipelines (working pressure 8.4 MPa) increased from 5% to the current approx. 17% of the entire transmission system.

Figure 3. High pressure gas pipelines diameter category [mm]

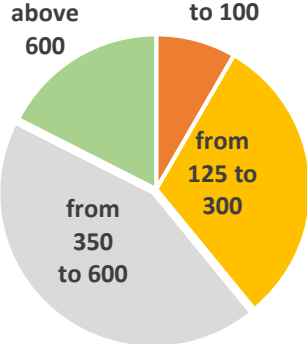
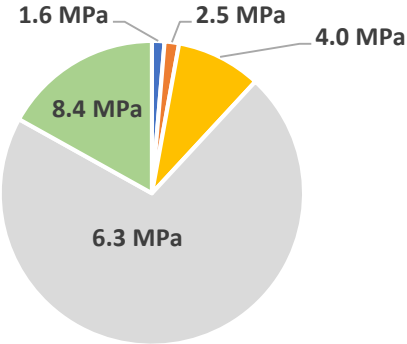


Figure 4. High pressure gas pipelines pressure categories



Source: OGP Gaz-System SA

The low-calorific natural gas transmission system covers parts of western Poland in the area of three voivodships: Lubuskie, Wielkopolskie and Dolnośląskie. The low-calorific natural gas transmission system is not directly connected to the high-methane gas transmission system. It is supplied with gas from deposits located in the Polish Lowlands by the gas mines: Kościan-Brońsko, Białcz, Radlin, Kaleje (Mchy). In addition, the low-calorific gas system is fed with gas from the Wielichowo mine, which requires the mixing of high-methane gas in the Grodzisk Wielkopolski gas mixing plant to reach the natural gas parameters of the Lw subgroup. The high-methane natural gas used in the mixing process comes from the Grodzisk Odazotownia, in which high-methane natural gas is obtained from the low-calorific natural gas in the cryogenic process. In 2018, the volume of natural gas transmitted through the network amounted to 742.3 mcm (6 763.1 GWh).

Figure 5. L gas transmission system



Source: OGP Gaz-System SA

3.2.2.2. National distribution system

The national distribution system consists of almost 195 thousand km of distribution network with active connections. The operations in the area of natural gas distribution in Poland in 2018 were conducted by 55 distribution system operators appointed by way of a decision by the President of ERO, including one subject to legal and functional separation requirements from other activities - PSG sp. z o.o. In 2018, this company managed 95.5% of the distribution network in the country. The remaining approx. 4.5% of the distribution networks were owned by 54 companies conducting local distribution activities.

The distribution Ls gas system is supplied by two gas mixing plants – mixing plant Gorzysław and mixing plant Karlino, as well as the UGS Daszewo. Ls gas being composed in those gas mixing plants is produced through the mixing of gas extracted from the local low-calorific gas fields (<Ls) with the gas from high methane group withdrawn from the high-methane distribution system. After being mixed, the gas is directed to the high pressure distribution system.

Figure 6. The natural gas distribution system managed by PSG Sp. z o.o. (Orange color)



Source: PSG Sp. z o.o.

3.2.3. Gas infrastructure is key to ensuring security of natural gas supply

From the point of view of the Polish transmission system, the facility constituting the largest single gas infrastructure is SSRP Włocławek. The remaining key gas infrastructure is part of the assessment under the Act of 18 March 2010 on special powers of the minister competent for energy and their exercise in certain capital companies or capital groups operating in the electricity, oil and gas sectors and in accordance with it is subject to entry in

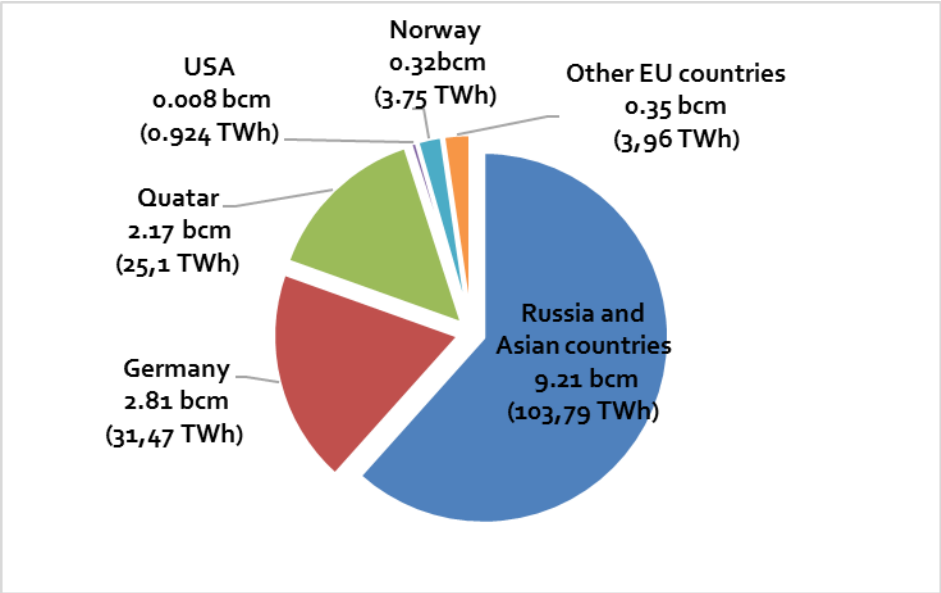
the appropriate list, which is a document protected in accordance with the Act of 5 August 2010 on the protection of classified information.

3.2.4. Sources of natural gas imports and the structure of natural gas imports

Every year, an increasing increase in the degree of diversification of sources of natural gas supply to Poland is observed. In 2018, total natural gas imports to Poland amounted to 14.95 bcm (168.99 TWh), of which:

- imports from the East (including via the Yamal-Europe gas pipeline) - 9.21 bcm (103.79 TWh), which is 61.4% of total imports;
- intra-Community acquisition - 3.16 bcm (35.43 TWh), representing 20.9% of total imports, including:
 - from Germany - 2.81 bcm (31.47 TWh), which represents 18.6% of total imports;
 - from other EU countries - 0.35 bcm (3.96 TWh), which represents 2.3% of total imports;
- LNG imports in total - 2.57 bcm (29.77 TWh), which represents 17.6% of total imports, including:
 - natural gas imports from Qatar - 2.17 bcm (25.1 TWh) after regasification, which represents 14.9% of total imports;
 - natural gas imports from the USA - 0.008 bcm (0.924 TWh), which represents 0.5% of total imports;
 - Natural gas imports from Norway - 0.32 bcm (3.75 TWh), which represents 2.2% of total imports.

Figure 7. Structure of natural gas imports to Poland in 2018.



Source: Statistical research of the Minister of Energy

3.2.5. The natural gas storage system

In Poland there are seven underground high-methane gas storage facilities cooperating with the gas transmission system: UGS Husów, UGS Wierzchowice, UGS Swarzędów, UGS Brzeźnica, UGS Strachocina, CUGS Mogilno and CUGS Kosakowo.

As at 30 June 30 2019, the active capacity of underground high-methane gas storage facilities was 3.075 bcm (34.2 TWh), the total withdrawal capacity of all UGSs with 100% filling of storage facilities was 48.69 mcm/day (534.23GWh/day), while at 30% capacity - 33.80 mcm/day (370.85 GWh/day).

Next to the above high-methane gas storage facilities, there are two low-calorific gas storage facilities managed by PGNiG SA: UGS Daszewo with a capacity of 40 mcm (320 GWh) and a maximum withdrawal capacity of 0.48 mcm/day (3,84 GWh/day) and UGS Bonikowo with a capacity of 200 mcm (1 755 GWh) and a maximum withdrawal capacity of 2.4 mcm/day (21,3 GWh/d), used to stabilize the production of low-calorific natural gas.

It should be emphasized that within the meaning of the Energy Law Act, the Bonikowo and Daszewo UGSs are not storage facilities because they do not have a dedicated storage system operator and are used only for production activities.

3.2.6. Domestic natural gas production

In 2018, domestic natural gas production amounted to 4.03 bcm (44.24 TWh), including:

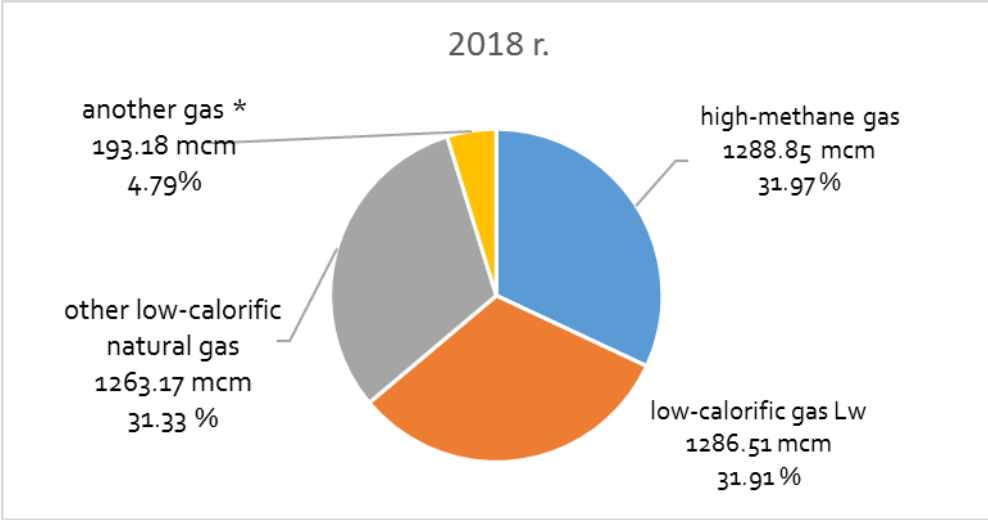
- high-methane gas - 1.28 bcm (14.14 TWh)
- low-calorific gas - 2.54 bcm (27.98 TWh)
- gas from demethanation of mines and from subsea mining - 0.19 bcm (2.12 TWh).

Part of the low-calorific gas is transferred to the low-calorific gas system and take off by customers, while part is subject to processing in denitrating plants in Odolanów (with a maximum processing capacity of 5.76 mcm/day (52,5 GWh/d) and an optimum capacity of 3.84 mcm/day (35 GWh/day) and Grodzisk Wielkopolski (with the maximum technical work capacity of 1.92 mcm/day (17,5 GWh/day) and an optimum capacity of 1.44 mcm/day (13,12 GWh/day)).

The average daily production capacity of the mines connected to the national transmission system and the denitrating plants was at the level of approx. 5.9 mcm/day (64.7 GWh/day). The maximum production capacity in 2018 amounted to 7 mcm/day (77,1 GWh/day).

In 2018, domestic natural gas production accounted for approx. 22.9% of domestic natural gas consumption.

Figure 8. Domestic natural gas production in 2018



*gas from demethanization of mines and from subsea mining
 Source: Statistical surveys of the Minister of Energy

3.2.7. The use of natural gas in electricity production

Over the past few years, the importance of natural gas in the electricity generation structure and the increase in the number of generating units based on this fuel have been observed.

In 2018, total electricity production amounted to 165.2 TWh, of which 9.59 TWh was generated from natural gas, which accounted for 5.80% of its total production. Generation of electricity from natural gas was mostly carried out in the cogeneration process.

The annual consumption of natural gas by power plants and combined heat and power plants for electricity generation was 2,547.7 mcm (27.95 TWh).

The total achievable capacity of generation sources using natural gas connected to the National Power System (NPE) is 2123 MW, which is about 4.56% of the maximum capacity of all generation sources connected to the NPE.

Table 3. Production of electricity from natural gas [GWh]

year	electricity production - total [GWh]	including gas [GWh]	%
2011	163,153	4,355	2.67%
2012	159,853	4,485	2.81%
2013	162,501	3,149	1.94%
2014	156,567	3,274	2.09%
2015	161,772	4,193	2.59%
2016	162,626	5,776	3.55%
2017	165,852	7,172	4.32%
2018	165,214	9,590	5.80%

Source: Own study based on the data of the President of ERO

In the following years, a further increase in the share of natural gas in the energy balance of Poland is forecasted. It is assumed primarily to increase the use of natural gas in generating units serving as reserve capacities for units based on renewable energy sources.

In October 2018, transmission system operators - gas and electricity (OGP Gaz-System S.A. and Polskie Sieci Elektroenergetyczne S.A) concluded an agreement on cooperation to coordinate:

- development of electricity and gas systems,
- the development of the rules for the electricity market and the natural gas market, and
- traffic management in electricity and gas systems.

3.2.8. The role of energy efficiency measures

In Poland, the legal act regulating energy efficiency issues is the Act of 20 May 2016 on energy efficiency (i.e. Journal of Laws of 2019, item 545 with later changes), on the basis of which entities are required to implement projects to increase energy efficiency. The Act covers both the private and public sectors, imposing savings obligations on all entities. It lists measures to increase the efficiency that public sector entities can use, including the solution in the form of a contract to improve efficiency. In addition, pursuant to the Act, large enterprises were obliged to conduct energy audits at four-year intervals.

The main task of the mechanisms introduced by the Act is to achieve the target set at 13.6 Mtoe in the field of energy efficiency in 2020.

The undertakings specified in the Act, which are the basis for energy efficiency improvement mechanisms, may have a dual impact on the final annual consumption of natural gas depending on their specificity. Improvements and modernizations carried out

within gas-consuming equipment and installations used in industrial processes or in energy processes, as a rule, limit its final consumption. Nevertheless, projects assuming a change in the type of fuel consumed, for example involving the use of cogeneration systems fueled with natural gas in local heat sources, in place of boilers fueled with solid fuels (e.g. hard coal) will increase the annual consumption of natural gas.

4. Summary of risk assessment

4.1. Common risk assessment

4.1.1. Common risk assessment for the Belarus risk group

According to the results of the common risk assessment of analyzes, the state of development and technical capacity of the existing infrastructure allow for disruption of the single largest element of regional infrastructure, at least at the regional level, to cover the demand for natural gas in this region. The value of the N-1 formula for the single largest natural gas infrastructure in the region (Kondratki's entry point on the Yamal-Europe gas pipeline) was set at 215% (100% filling capacity of UGS). On the other hand, for the Baltic States region, in which UGS Incukalns was adopted as the largest single infrastructure, at 173% (100% filling capacity of UGS). In both cases, the technical capacity of all other available gas infrastructure is sufficient to meet the total demand for natural gas in the analysed areas in the event of a disruption to the operation of the largest single infrastructure.

In addition, 10 disruption scenarios for natural gas supplies to the region were analysed in a common risk assessment:

1) Flow disruption on the cross-border point Kondratki (BY - PL) - suspension of natural gas transit through Poland towards Germany via the Yamal-Europe gas pipeline, 1 day of peak demand for natural gas in the region.

2) Flow disruption on the cross-border point Kondratki (BY - PL) - suspension of natural gas transit through Poland towards Germany via the Yamal-Europe gas pipeline, two weeks of high demand for natural gas in the region.

3) Disruption on all cross-border points with Belarus - two weeks of high demand for natural gas in the region.

4) Disruption on all cross-border points with Belarus and Ukraine - two weeks of high level of demand for natural gas in the region.

5) Disruption on all supply routes through Belarus and Ukraine, also to countries outside the Belarusian group, two weeks of high demand for natural gas in the region

6) Disruption on all supply routes through Belarus and Ukraine, also to countries outside the Belarusian group, no natural gas transit via Nordstream I - two weeks of high demand for natural gas in the region

7) Flow disruption on the cross-border point Kondratki (BY - PL) - suspension of natural gas transit through Poland towards Germany through the Yamal-Europe gas pipeline, month (January) of high demand for natural gas.

8) Disruption on all cross-border points with Belarus - month (January) of high demand for natural gas.

In the analyzed scenarios 1-8, countries in the region will not be exposed to a reduction in natural gas supply, mainly due to the possibility of drawing natural gas from all existing UGS within the risk group. However, the Baltic States (Lithuania, Latvia, Estonia)

will not be exposed to a reduction in supply if it is possible to receive natural gas from UGS Incukalns and LNG supplies from Klaipėda LNG FSRU will be possible.

In the absence of natural gas supplies from the LNG terminal or UGS, the Baltic States may face a reduction in supply due to current infrastructure constraints (no physical connection with neighbouring countries).

9) Disruption on all supply routes through Belarus and Ukraine, also to countries outside the Belarusian group, two weeks of high demand for natural gas in the region) - month (January) of high demand for natural gas.

10) Disruption on all supply routes through Belarus and Ukraine, also to countries outside the Belarusian group, no natural gas transit via Nordstream I - month (January) of high demand for natural gas in the region.

The analysis of variants 9-10 indicated that in the event of suspension of natural gas supplies from Belarus and Ukraine during the 1- high level of demand for natural gas in the region, the only country in the region that will be sensitive to supply restrictions is Poland. Due to the possibility of drawing natural gas from all UGS in the region, which is at a high level, as well as thanks to LNG supplies in Belgium (up to 40.80 mcm/day) and the Netherlands (up to 40.80 mcm/day), no other a country in a risk group would not be covered by this restriction. On the other hand, the Baltic States will not be exposed to the limitation of natural gas supplies if there is a possibility of withdrawal natural gas from UGS Incukalns and LNG supplies from FSRU LNG in Klaipėda will be sufficient. In the absence of natural gas supplies from the LNG terminal or UGS, the Baltic States may face a reduction in supply due to current infrastructure constraints (no physical connection with neighbouring countries).

The common risk assessment indicated a certain degree of sensitivity of the region resulting from dependence on one natural gas source. The Russian Federation was the main source of supply for the entire region in all scenarios analysed. In order to ensure security of supply in the event of disruption on major transmission routes, it was necessary to maximize transmission capacity at interconnection points in the region, with other EU members and third countries.

The simulations carried out explicitly confirmed the need to connect the Baltic States (Lithuania, Latvia, Estonia) with the rest of the region through the implemented Poland-Lithuania gas pipeline. Currently, due to infrastructure restrictions in the Baltic States region, in the event of a failure of the LNG terminal in Klaipėda or UGS Incukalns in the Baltic States, there may be a disruption in the supply of natural gas to consumers. They also confirm the desirability of diversifying sources of natural gas supplies to Poland in order to resist the disruption of supplies from the East.

4.1.2. Common risk assessment for the Ukrainian risk group

As in the case of the Belarusian group, the results of the common risk assessment for the Ukrainian group indicated that the state of development and technical capacity of the existing infrastructure allow for disrupting the single largest element of regional infrastructure, at the regional level, to cover the natural gas demand in the region. The

value of the N-1 formula for the single largest gas infrastructure in the region for which the Uzhgorod interconnection point was adopted was set at 166% at full UGS filling level and 146% at UGS filling level of 30% (season 2018/2019)

In addition, the common risk assessment analysed 8 scenarios of disruptions in natural gas supply:

1) Failure of the Ukrainian natural gas supply corridor - this scenario assumes disruption of supplies at the Uzhgorod (UA) - Velké Kapusany (SK) point for the period of:

– 7 days (from the beginning of February), according to the results, all member states will be able to face this event and will be able to completely meet the demand for natural gas

– 14 days (from the beginning of February), according to the results, in this scenario Bulgaria, Greece and Romania will face unbalanced systems.

– 30 days (from the beginning of February), according to the results, in this scenario Bulgaria, Greece and Romania will face unbalanced systems, while the demand for natural gas in the other Member States of the Ukrainian risk group will be fully met.

2) Failure of the Ukrainian natural gas supply corridor - this scenario implies a disruption of supply for a period of:

– 7 days (in the second week of March) at the point Uzhgorod (UA) - Velke Kapusany (SK), according to the results, all Member States will be able to face this event and will be able to completely meet the demand for natural gas,

– 14 days (in the second week of March), at all connection points with Ukraine, according to the results, in such a scenario Bulgaria, Greece and Romania will face unbalanced systems, while the demand for natural gas in the other Member States of the Ukrainian risk group will be fully satisfied.

3) Failure of Russian Exports to EU - this scenario assumes complete suspension of natural gas supplies from Russia during:

– 14 days (from the beginning of February), according to the results, in this scenario, Bulgaria, Greece, Poland and Romania will face unbalanced systems,

– 30 days (from the beginning of February), according to the results, in this scenario Bulgaria, Greece, Poland and Romania will face unbalanced systems.

4) Failure of Baumgarten point - this scenario describes the consequences of a sudden, total disruption of the flow through the Baumgarten point within 7 days from the beginning of February, according to the results, in this scenario Croatia, Italy and Slovenia will face unbalanced systems.

5) Failure of Lanžhot point - this scenario describes the consequences of a sudden, complete disruption of the flow through the Lanžhot point over a period of 7 days from the beginning of February, according to the results, all Member States will be able to face this event and will be able to completely meet gas demand terrestrial.

6) Failure of Oberkappel point - this scenario describes the consequences of a sudden, complete disruption of the flow through the Oberkappel point within 7 days from the

beginning of February, according to the results, all Member States will be able to face this event and will be able to completely meet gas demand terrestrial.

7) Failure of Isaccea (RO)/Orlovka (UA) point - this scenario describes the consequences of a sudden, complete disruption of the flow through the Isaccea (RO)/Orlovka (UA) point within 7 days from the beginning of February, according to the results of all member states they will be able to face this event and will be able to completely satisfy the demand for natural gas.

8) Supply failure from Algeria - within 30 days from the beginning of February, according to the results, all Member States will be able to face this event and will be able to completely meet the demand for natural gas.

The conducted analyses indicate that Bulgaria and Greece, as well as to a lesser extent Romania are exposed to disruptions in natural gas supplies from Ukraine. Analyses also indicate that it will also be impossible to fully cover the demand for natural gas in Poland in the event of complete suspension of natural gas supplies to the EU from the Russian Federation within 14 and 30 days. They confirm the desirability of diversifying sources of natural gas supply to Poland in order to resist the disruption of supplies from the East.

4.2. National Risk Assessment

The analyzes carried out for the purposes of the national risk assessment confirmed the sensitivity of the Polish system indicated in common risk assessments for the Ukrainian and Belarusian group to the complete suspension of natural gas supplies from the East in the event of an extremely high level of demand for natural gas. However, it should be emphasized that the Polish gas system will be sensitive to disruptions in gas supplies from the East until completion of the infrastructure diversifying the sources of natural gas supplies to Poland.

The maximum anticipated demand for natural gas in the winter peak of 2019/2020 included in the hydraulic analyses was estimated at about 91.5 mcm/day (1 004 GWh/day). This figure is in line with the gas consumption forecast prepared by OGP Gaz-System S.A. The analysis of customer demand for natural gas was prepared taking into account archival data on historical peak days and information on new connections to the national transmission system. The technical capacities of entry points to the transmission system are systematically growing and are at a level exceeding 130 mcm/day (1,426.36 GWh/day), assuming the maximum available reception capacities at import entry points, intra-Community supplies, LNG terminal and UGS, i.e. the offtake capacity at the beginning of the natural gas take-off cycle from storage (at the beginning of the characteristic). This value is over 30 mcm/day (329.16 GWh/day) higher than in 2014, which is associated with the development of both the transmission system and interconnections. In the analysis of scenarios, the possibility of interconnection operation to the level of their technical capabilities was assumed.

The analyses of natural gas flows were carried out for the following scenarios at the peak level of natural gas demand of consumers:

1) Ukrainian variant (no supplies through the Drozdowicze entry point) - the scenario assumes the suspension of natural gas supplies through the Drozdowicze entry point from Ukraine.

2) Belarusian variant (no supplies through the Wysokoje entry point) - the scenario assumes the suspension of natural gas supplies through the Wysokoje entry point from the direction of Belarus.

3) Eastern variant (total suspension of natural gas supplies from the Russian Federation) - the scenario assumed the total suspension of gas supplies from the eastern direction through the entry points: Drozdowicze, Wysokoje, Tietierowka and Kondratki (no gas transit to Germany via the Yamal-Europe pipeline).

4) No supplies from CUGS Mogilno - this scenario assumes the inability to receive natural gas from CUGS Mogilno.

5) LNG terminal failure - the scenario assumes suspension of natural gas supply from the LNG terminal to the national transmission system.

6) Jarosław natural gas compressor station failure

7) Failure of the Odolanów node - in the scenario regarding the failure of the Odolanów node, it was assumed that there was no possibility of natural gas flow in all directions and no supplies from Odolotownia Odolanów.

8) Failure of the Gustorzyn node - the scenario regarding the failure of the Gustorzyn node assumes the lack of natural gas flow through the node in all directions (direction Gdańsk, Łódź, Rembelszczyzna, Odolanów) and the inability to receive natural gas at the Włocławek entry point (connection with SGT) and CUGS Mogilno.

The hydraulic calculations taking into account natural gas flows in the gas system have shown that despite obtaining the N-1 formula $\geq 100\%$ in each analysed scenario, in some problems with the supply of natural gas may be due to the limited technical capacity of some gas pipelines of the national transmission system.

The results of the analysis indicated that in most of the adopted scenarios it is possible to fully cover the demand of all customers in the sample day of peak demand or short duration of disturbances. The increase in the possibility of supplying natural gas in the event of a disruption in supplies was due to a change in the flow directions in the Polish transmission system as a result of the launch of the LNG terminal in Świnoujście and the increase in the possibility of supplies by PWP.

At the same time, the analysis of the adopted scenarios allowed to highlight the potential possibility of occurrence in the system in some variants, especially in the situation of prolonged disturbances, imbalances, despite the use of all available market and non-market measures, both on the supply and demand side.

The most serious consequences for the gas system would be the suspension of supplies from the East towards all entry points. The risk of this scenario would increase if the transmission of natural gas from the Russian Federation is diverted through the territory of Belarus and Ukraine to the Nord Stream I and II gas pipelines.

The risk of transmission imbalance in some of the adopted scenarios will decrease in the case of completion of investments allowing for real diversification of natural gas supply sources and parallel reconstruction of the transmission system enabling natural gas flows on the North-South axis.

Construction of bi-directional interconnectors: Poland-Lithuania (GIPL), Poland-Slovakia, Poland-Ukraine, and Poland-Czech Republic, as well as the construction of the Baltic Pipe gas pipeline, expansion of the LNG terminal in Świnoujście and construction of the floating regasification terminal in the Bay of Gdańsk, through further integration of the Polish gas system with other systems EU member states and ensuring a greater level of diversification of supply sources will contribute to increasing the possibility of eliminating the effects of a possible disruption of supplies.

5. Standard in infrastructure

The N-1 formula describes the technical capacity of the gas infrastructure to meet the total gas demand in the area analysed in the event of disruptions in the functioning of the single largest gas infrastructure on a day of extremely high demand, statistically occurring once every 20 years.

The gas infrastructure includes the natural gas transmission network, including interconnections as well as installations used for mining operations, LNG and storage facilities connected to the transmission system within the analysed area.

The technical capacity of the entire remaining gas infrastructure in the event of disruptions in the functioning of the single largest gas infrastructure should be at least equal to the sum of the total daily gas demand in the area analysed on the day of extremely high gas demand, occurring statistically once every 20 years.

The N-1 formula is as follows:

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

where:

„ D_{max} ”- total daily gas demand of the calculated area during a day of exceptionally high gas demand, occurring statistically every 20 years.

Definitions on the supply side

„ EP_m ”- the technical capacity of entry points other than production, LNG and storage facilities covered by P_m , S_m and LNG_m apply, means the sum of the technical capacity values of all entry points capable of supplying gas to the calculated area;

„ P_m ”- maximal technical production capability means the sum of the maximal technical daily production capability of all production facilities that can be delivered to entry points in the calculated area;

„ S_m ”- maximal technical capacity to collect from storage facilities means the sum of the maximum technical daily withdrawal capacity of all storage facilities that can be delivered to entry points in the analyzed area, taking into account their respective physical characteristic;

„ LNG_m ”- maximal technical capacity of LNG facilities is the sum of the maximal technical daily send-out capacities of all LNG facilities in the calculated area, including such critical elements as offloading, auxiliary services, temporary storage and re-gasification of LNG and technical send-out capacity to the system;

„ I_m ”- technical capacity of the single largest gas infrastructure with the highest capacity to supply the calculated area [in mcm/d].

5.1. N-1 formula at regional level

5.1.1. N-1 formula for Belarusian risk group

In the Belarusian risk group, Kondratki was adopted as the largest single infrastructure in the region, being the entry point to the Polish part of the Yamal-Europe transit gas pipeline. Due to the fact that the Baltic States (Lithuania, Latvia, Estonia) remain isolated from the EU gas system (until the interconnection between Poland and Lithuania), N-1 for this region has been calculated separately, assuming that UGS Inčukalns is the largest single infrastructure .

Table 4: Demand-side figures, D_{max}/D_{eff}

	D_{max}	D_{eff}
	[GWh/d]	[GWh/d]
East-Baltic	333,7	0,0
Estonia	57,5	0
Latvia	125,19	0,0
Lithuania	151,0	0,0
Middle-west	11 872	0,0
Belgium	830,0	0,0
Czech Republic	699,5	0,0
Germany	5 142,1	0,0
Luxembourg	53,0	0,0
Netherlands	3 678,0	0,0
Poland	973,00	0,0
Slovakia	496,4	0,0

Source Common risk assessment of the Eastern gas supply risk group -Belarus

D_{eff} means that part of D_{max} which, in the event of a disruption in gas supply, can be sufficiently and timely covered by market measures on the demand side. Member States belonging to the Belarusian risk group did not specify market measures on the demand side (D_{eff}).

Table 5: Supply-side figures, EP_m

REGION	COUNTRY	EP - outside BY RG	IP	EP _m [GWh/d]
East-Baltic SUM				454,0
East-Baltic	Estonia	EP Russian	Misso Izborsk	74,0
			Narva	12,6
			Värska	42,0
	Latvia	No entry points outside BY RG	-	-
Lithuania	EP Belarus	Kotlovka	325,4	
Middle-west SUM				10 104,42
Middle-west	Belgium	EP France	Alveringem	278,0
			Blaregnies (BE)/Taisnières (H) (FR) (Segeo/Troll)	-
		EP Norway	Zeebrugge ZPT	515,28
		EP United Kingdom	Zeebrugge IZT	732,24
	Czech Republic	No entry points outside BY RG	-	-
	Germany	EP Austria	Kiefersfelden - EXIT only	0,0
			Oberkappel	159,9
			Überackern/Burghausen	230,1
		EP Denmark	Ellund	91,1
		EP France	Medelsheim/Obergaibach - EXIT Only	0,0
		EP Norway	Dornum/NETRA	721,2
		EP Russian	Greifswald	1 776,1
		EP Switzerland	Wallbach - EXIT Only	0,0
	Luxembourg	No entry points outside BY RG	-	-
	Netherlands	EP Norway	Emden (NPT)	1 376,4
		EP United Kingdom	Bacton (BBL)	319,20
	Poland	EP Belarus	Kondratki (YAMAL TGPS)	1 024,3
			Tietierowka – local supply only not taken into consideration	7,3
			Wysokoje	169,1

		EP Ukraine	Drozdowicze	135,6
	Slovakia	EP Austria	Baumgarten	247,5
		EP Hungary	Balassagyarmat (HU)/Velké Zlievce (SK)	50,8
		EP Ukraine	Budince	249,6
			Uzhgorod (UA) - Velké Kapušany (SK)	2 028,0

Source: Common risk assessment of the Eastern gas supply risk group -Belarus

Table 6: Supply-side figures, LNG_m/P_m/S_m -100%/S_m -30%

	LNG _m	P _m	S _m /LEVEL OF STORAGE AT 30 %	S _m /LEVEL OF STORAGE AT 100 %
	[GWh/d]	[GWh/d]	[GWh/d]	[GWh/d]
East-Baltic	122,4	0,0	241,6	315,6
Estonia	0,0	0,0	0,0	0,0
Latvia	0,0	0,0	241,6	315,6
Lithuania	122,4	0,0	0,0	0,0
Middle-west	1 018,0	2 513,8	8 405,3	12 916,3
Belgium	461,0	0,0	67,8	169,5
Czech Republic	0,0	6,4	253,1	842,7
Germany	0,0	272,48	4 332	7 379,0
Luxembourg	0,0	0,0	0,0	0,0
Netherlands	399,0	2 156,0	3 069,0	3 421,0
Poland	158,0	75,8	437,6	544,0
Slovakia	0,0	3,1	245,8	560,1

Source: Common risk assessment of the Eastern gas supply risk group -Belarus

Table 7 Single largest gas infrastructure of common interest for the risk group

	I_m	
	[GWh/d]	-
East-Baltic	315,6	
Estonia	Do not concern	
Latvia	315,6	UGS Inčukalns
Lithuania	Do not concern	
Middle-west	1 024,3	
Belgium	Do not concern	
Czech Republic	Do not concern	
Germany	Do not concern	
Luxembourg	Do not concern	
Netherlands	Do not concern	
Poland	1 024,3	Entry point to Yamal gas pipeline - Kondratki
Slovakia	Do not concern	

Source: Common risk assessment of the Eastern gas supply risk group -Belarus

The creation of two separate areas in the Belarusian risk group, i.e. the group of Baltic States and other countries, i.e. Central and Western, for analytical purposes, results from the fact that the Baltic States remain isolated from the EU gas system. Two levels of UGS filling were taken into account in the calculations - 100% and 30%.

Table 8 N – 1 formula

	S_m -100%	S_m -30%
	D_{max}	D_{max}
East-Baltic: Estonia, Latvia, Lithuania	173%	151%
Middle-west: Belgium, Czech Republic, Germany, Luxembourg, Netherlands, Poland, Slovakia	215%	177%

Source: Common risk assessment of the Eastern gas supply risk group -Belarus

5.1.2. N-1 formula for the Ukrainian risk group

In order to analyse the risk associated with disruptions in natural gas supplies by Ukraine in the formula for the N-1, the entry point located on the border between Slovakia and Ukraine was adopted as the largest single infrastructure: Uzhgorod-Velke Kapusany.

The N-1 formula was also calculated for the situation of total disruption of the Ukrainian supply route.

The N-1 formula was calculated taking into account 100% UGS capacity and 30% UGS filling level. The N-1 was set for two time horizons, i.e. 2018/2019 and 2020/2021.

Table 9 Parameters [GWh / d] for the 2018/2019 time horizon

Disruption (I _m)	Capacity
Uzhgorod	2 365.12
Ukrainian supply route	3,500.00

Member State	Ep _m	LNG _m	S _m 100%	S _m 30%	P _m	D _{max}
Austria	-	-	690.62	461.80	35.36	575.17
Bulgaria	-	-	43.68	30.16	6.24	189.30
Croatia	-	-	60.33	33.28	36.40	172.65
Czech Republic	-	-	614.68	426.43	5.20	709.34
Germany	4,898.78	-	6,369.47	4,985.12	272.50	4,938.32
Greece	46.80	210.10	-	-	-	209.06
Hungary	862.18	-	817.52	707.26	57.20	805.02
Italy	1,389.60	539.80	2,737.5	1,786.86	161.21	4,607.57
Luxembourg	44.72	-	-	-	-	49.92
Poland	1,432.18	149.77	535.64	423.31	74.89	901.75
Romania	1,078.55	-	301.62	-	270.42	748.86
Slovakia	2,609.58	-	547.19	410.83	2.08	469.08
Slovenia	-	-	-	-	-	50.96
TOT	12,362.48	899.67	12,174.06	9,265.07	921.51	14,427.00

Source: Common risk assessment of the Eastern gas supply risk group –Ukraine

Table 10 Parameters [GWh / d] for the time horizon 2020/2021

Disruption (I _m)	Capacity
Uzhgorod	2,103.33
Ukrainian supply route	3,057.85

Member State	Ep _m	LNG _m	S _m 100%	S _m 30%	P _m	D _{max}
Austria	-	-	690.62	461.80	35.36	575.17
Bulgaria	151.85	-	436.68	30.16	11.44	211.14
Croatia	-	-	60.33	33.28	36.40	172.65
Czech Republic	-	-	614.69	426.43	4.16	709.34
Germany	4,898.78	-	6,369.47	4,985.12	272.50	4,938.32
Greece	375.47	210.10	-	-	-	219.46
Hungary	741.58	-	817.52	722.86	37.44	930.88
Italy	1,590.29	539.80	3,029.76	1,984.48	196.58	4,555.57
Luxembourg	44.72	-	-	-	-	49.92
Poland	1432.18	149.77	535.64	423.31	74.89	1,008.88
Romania	1,078.55	-	301.61	-	275.62	748.86
Slovakia	2,124.89	-	547.19	410.83	3.12	360.91
Slovenia	-	-	-	-	-	63.45
TOT	12,481	899.67	12,463.32	9,478.28	949.6	14,418.68

Source: Common risk assessment of the Eastern gas supply risk group -Ukraine

Table 11. N-1 formula

		2018/2019	2020/2021
Uzhgorod	UGS 100%	166 %	172 %
	UGS 30%	146 %	151 %
Ukrainian supply route	UGS 100%	158 %	165 %
	UGS 30%	138 %	144 %

Source: Common risk assessment of the Eastern gas supply risk group -Ukraine

5.2. N-1 formular at national level

5.2.1. N-1 formula for high-methane natural gas system

The system constituting the largest, single element of infrastructure in the Polish transmission system is the System Reduction and Measurement Station in Włocławek (SSRP Włocławek). The calculations of the N-1 formula at the national level are presented below. Data regarding the capacity to withdraw from storage facilities at full filling and at the level of mandatory stocks come from information obtained from SSO.

Table 12. N-1 formula for high-methane natural gas system

Coefficient	Technical capacity (UGS - 100%)	Technical capacity (UGS - level of mandatory stocks 2018/2019)
EP_m	59.2	59.2
S_m	53.5	46.7
P_m	5.7	5.7
LNG_m	13.7	13.7
I_m - Włocławek	24.0	24.0
D_{max}	91.5	91.5
N-1	118.2%	110.7%

Source: Risk assessment related to the security of gas supply to Poland

5.2.2. N-1 formula for the low-calorific gas system

5.2.2.1. Lw natural gas system

To calculate the technical capacity of infrastructure to meet the demand for low-calorific natural gas Lw, the Kościan-Brońsko deposit with production capacity of 3.5 mcm/day (31 GWh/day) was adopted as the largest element of infrastructure with the largest capacity to supply the analyzed area with low-calorific gas. The sum of entry points to the Lw natural gas which is about 6.6 mcm/d (58.7 GWh/d) and technical capacity for withdrawal natural gas from UGS Bonikowo which is 2.4 mcm/day (21.3 GWh/day), were adopted as maximal technical production capability. 5.0 mcm/day (44.4 GWh/day) was adopted as the peak demand, which occurred on 7 February, 2012.

Table 13. N-1 formula result for the L_w natural gas system

Coefficient	Value mcm/day
EP_m	0
S_m	0
P_m	9
LNG_m	0
I_m	3,5
D_{max}	5,0
N-1	110%

5.2.2.2. Ls natural gas system

MG Gorzysław with technical capacity at 0.48 mcm/day (3.84 GWh/day) was adopted to calculate the technical capabilities of the infrastructure to meet the demand for Ls natural gas as the largest infrastructure element having the largest capacity to supply the analyzed area with low-calorific gas. It was assumed that the demand of customers connected to the Ls natural gas system remains stable. The maximum consumption was

assumed at 0.77 mcm/day (6.16 GWh/day). It was assumed that the maximal technical production capability is a sum of entry points which is about 0,61 mcm/day (4,88 GWh/day) and technical capacity for withdrawal natural gas from UGS Daszewo which is 0,48 mcm/day (3,84 GWh/day).

Table 14. N-1 formula result for the Ls natural gas system

Coefficient	Value mcm/day
EP _m	0
S _m	0
P _m	1,09
LNG _m	0
I _m	0,48
D _{max}	0,77
N-1	79%

5.3. Bi-directional capacity

Pursuant to art. 5 par. 4 of Regulation 2017/1938, "transmission system operators shall provide permanent physical transmission capacity in both directions (hereinafter referred to as "bi-directional flow capacity") at all intersystem interconnections between Member States.

The creation of the possibility of bi-directional natural gas flows is one of the factors affecting the security of gas supply and the possibility of regional cooperation under the solidarity mechanism in case of crisis situations. The decision to implement natural gas flow capacity in both directions at a given interconnection point should be based on an assessment of the market situation, in particular demand, forecasts for natural gas demand and supply as well as technical conditions, economic analysis of the project implementation and influence of supply security.

The obligation to ensure the possibility of bi-directional natural gas flow in relation to the connections of the Polish gas system with neighboring systems has been fully implemented in accordance with the requirements of Regulation 2017/1938 and earlier Regulation 994/2010.

The possibility of bi-directional natural gas flow (physical reverse) exists:

- on the Polish section of the Yamal gas pipeline at Mallnow - technology and measurement parameters of the Mallnow station amount to 1 240 thousand m³/h (13.6 GWh/h) and transmission capacities on a continuous basis in Mallnow in the direction of Poland amount to 700,000 m³/h (7.7 GWh/h), corresponding to 6.1 bcm/year (66.93 TWh/year)

- at the GCP GAZ-SYSTEM/ONTRAS point, i.e. points at the interconnection of Polish and German systems (Gubin, Lasów and Kamminke and Lasów Rewers) on the Polish side - allows the transmission of natural gas on a continuous basis in the direction of Germany up to 100 thousand m³ / h (1.1 GWh/h).

As part of the virtual reverse on the Yamal pipeline, it is possible to import natural gas from the west in the amount of 9 bcm/year (98.75 TWh/year).

For the current connection of transmission systems in Poland and the Czech Republic in the region of Cieszyn, it will remain in force until December 31, 2022, i.e. until the planned interconnection between Poland and the Czech Republic in the Hat area (Stork II), derogation from the obligation to implement both directions. The derogation was issued by the Minister of Economy and upheld by the Minister of Energy, after consultation with the competent authority of the Czech Republic. After commissioning the interconnector in the area of Hat (Stork II), this derogation will be valid for an indefinite period.

What is more, all current and planned investments in interconnectors operated by the Polish transmission system operator take into account the possibility of bi-directional natural gas flow:

- Baltic Pipe gas pipeline - planned transmission capacities amount to 10 bcm/year (109.72 TWh/year) towards Poland and to 3 bcm/year (32.92 TWh/year) towards Denmark,
- Poland-Slovakia interconnection - the planned transmission capacity at the interconnection is 5.7 bcm/year (62.54 TWh / year) towards Poland and 4.7 bcm/year (51.57 TWh/year) towards Slovakia.
- Poland-Lithuania interconnection - the planned transmission capacity is 2.4 bcm/year (26.33 TWh/year) towards Lithuania and 1.7 bcm/year (18.65 TWh/year) towards Poland,
- Poland-Ukraine interconnection - planned transmission capacities in both directions are expected to amount to approximately 5 bcm/year (54.86 TWh/year),
- Poland-Czech interconnection - the planned transmission capacity is up to 6.5 bcm/year (71.32 TWh/year) towards Poland and up to 5 bcm/year (54.86 TWh/year) towards the Czech Republic.

6. Compliance with the supply standard

According to art. 2 clause 5 of Regulation 2017/1938, a catalog of protected customers for the needs of the Polish natural gas market was developed and then handed over to the European Commission. The definition of protected recipient includes:

- a) a household customer who is connected to the gas distribution network;
- b) small or medium-sized enterprises, provided that they are connected to the gas distribution network and have ordered contracted capacity up to 710 kWh/h;
- c) an entity providing basic social services, provided that it is connected to the gas distribution or transmission network;
- d) installation of district heating systems, provided that it supplies heat to household customers, small or medium-sized enterprises or entities providing basic social services, provided that such an installation cannot be converted to fuels other than gas.

It should be added that small and medium-sized enterprises connected to the natural gas distribution network, as well as entities providing basic social services connected to the gas distribution or transmission network and heating systems installations may be included in the category of protected customers, provided that natural gas consumption by the abovementioned Consumer groups do not exceed 20% of final gas consumption.

Statistical data collected by the Minister of Energy indicate that gas consumption by additional groups of protected customers does not exceed 20% of the total consumption of natural gas. The total share of small and medium-sized enterprises (whose contracted capacity at the exit point from the gas system does not exceed 710 kWh / h connected to the distribution network) and entities providing basic social services is 9.98% of the final consumption of natural gas. On the other hand, the consumption of natural gas by households accounts for 26.17% of the total consumption of this raw material.

All gas companies selling natural gas to protected customers in the territory of the Republic of Poland are obliged to take measures to ensure supply to their customers in the cases specified in art. 6 clause 1 of Regulation 2017/1938. The table below presents the quantities of natural gas consumed by protected customers within the meaning of the above definition in the cases specified in art. 8 clause 1 of Regulation 2017/1938.

Table 15. Annual gas consumption by protected customers

	annual gas consumption [mcm]	annual gas consumption [GWh]	percentage share in annual gas consumption [%]
HOUSEHOLD	4,398.68	4 5912.44	26.17
SMALL AND MEDIUM COMPANIES	1,688.42	1 7508.27	9.98
ENTITIES PROVIDING BASIC PUBLIC SERVICES	431.41	4,465.77	2.55
DISTRICT HEATING INSTALLATIONS	504.24	5,263.18	3

Table 16. Standard for deliveries to protected customers

Type gas	The amount of gas needed to ensure compliance with the standard		
	Standard: extreme temperatures through 7-days peak demand for gas probability of occurrence once every 20 years [GWh]	Standard: 30 days of extremely high demand for gas probability of occurrence once every 20 years [GWh]	Standard: 30 days of disruption in the largest single gas infrastructure average winter conditions [GWh]
E	3427.4	11649	9244.9
lw	150.3	546.9	395.9
ls	39.3	100.7	95.3

Based on data obtained from natural gas suppliers in Poland, it has been calculated that in order to meet the requirements of the standard in the scope of supplies for natural gas recipients belonging to the group of protected customers, approx. 1 131.2 mcm (12 296 GWh) is needed to be completed in 30 days of extraordinary demand. The supply standard indicated above is covered by the volume of mandatory stocks, which as at 30/09/2019 amounts to approx. 1,200 mcm (13,200 GWh) and commercial inventories constituting a further approx. 1,875 mcm (20,572 GWh).

7. Preventive measures

7.1. Market-based measures

Measures to ensure security of gas supply regarding the supply side:

- Increasing production flexibility - due to the need to ensure rational management of natural gas deposits, it is not possible to significantly increase natural gas production in the event of a crisis. The maximum production capacity in 2018 was about 7 mcm/day (77.1 GWh/day).
- Increasing import flexibility - the possibility of gas supplies to the national transmission system via the Interconnection Point using the reverse flow on the Yamal-Europe gas pipeline in the amount of 23.0 mcm/day (254.4 GWh/day).
- Commercial storage of natural gas - withdraw capacity and quantity of stored natural gas - there are seven high-methane UGSs in Poland, with a total available working capacity of over 3.075 bcm (34.2 TWh), the ongoing expansion of CUGS Kosakowo will increase the working capacity of this storage to 295 mcm (3.24 TWh), which will contribute to the increase of the total active capacity to the level of approx. 3.13 mcm (34.34 TWh) in 2021.
- LNG terminal capacity and maximum shipping capacity - the LNG terminal in Świnoujście enables take off of natural gas at the level of 13.7 mcm/day (158 GWh/day), which is 5 bcm/year (54.86 TWh/year) of natural gas after regasification, the ongoing expansion of the LNG terminal will allow the expansion of the terminal regasification capacity to the level of 7.5 bcm/year (82.29 TWh/year) in 2021.
- Diversification of natural gas sources and supply routes - the cross-border interconnection between Poland and the Czech Republic (Cieszyn) allows for the supply of natural gas to the Polish gas system at the level of 2.5 mcm/day, i.e. 28.0 GWh/day in the period from October to April and 0.4 mcm/day i.e. 4.3 GWh/day in the May-September season. From 2016, points on the connection of the ONTRAS network (Germany) and Gaz-System S.A. (Poland): Gubin, Lasów as well as Kamminke and Lasów Reverse were connected into a Grid Connection Point GAZ-SYSTEM/ONTRAS (GCP GAZ-SYSTEM/ONTRAS). the point may introduce gas to the national transmission system at the level of 4.4 mcm/day (48.7 GWh/day).
- Reverse flow - if gas transmission via the Yamal-Europe gas pipeline to Germany is suspended, there is a physical possibility of receiving natural gas on a continuous basis from Germany via the Mallnow point up to 16.8 mcm/day (187.4 GWh/day).
- Use of short- and long-term contracts - both long- and medium-term contracts are concluded on the Polish market, as well as framework agreements enabling purchases of natural gas under spot transactions (Towarowa Giełda Energii offers instruments: Intra Day Market, Day Ahead Market and Commodity Derivatives Market on which weekly, monthly, quarterly, seasonal and annual products are offered)

- Infrastructure development, including ensuring flow capacity in both directions - current and planned investments in the field of interconnection by the Polish transmission system operator take into account the possibility of natural gas flow in both directions:
 - Baltic Pipe gas pipeline - planned transmission capacities amount to 10 bcm/year (109.72 TWh/year) towards Poland and up to 3 bcm (32.92 TWh/year) towards Denmark,
 - Poland-Slovakia interconnection - planned transmission capacity on the connection is 5.7 bcm/year (62.54 TWh/year) towards Poland and 4.7 bcm/year (51.57 TWh/year) towards Slovakia,
 - Poland-Lithuania interconnection - planned transmission capacity is 2.4 bcm/year (26.33 TWh/year) towards Lithuania and 1.7 bcm/year (18.65 TWh/year) towards Poland,
 - Poland-Ukraine interconnection - planned transmission capacities in both directions are to amount to approx. 5 bcm (54.86 TWh/year),
 - Poland-Czech Republic interconnection - planned transmission capacity is up to 6.5 bcm (71.32 TWh/year) towards Poland and up to 5 bcm (54.86 TWh/year) towards the Czech Republic.
- Redirecting the maximum amount of low-calorific natural gas to the denitrating plants to increase the production of high-methane natural gas.

7.2. Non-market based measures

- The mandatory stocks of natural gas constitute a non-market based measure as referred to in Annex VIII of Regulation 2017/1938. Pursuant to the Act of Stocks, mandatory stocks are maintained by energy undertakings conducting economic activity in the field of trade in natural gas abroad and entities importing natural gas. Mandatory stocks of natural gas are the assets of the above mentioned enterprises, unless they constitute, on the basis of a concluded contract, the assets of the entity accepting the order to maintain mandatory stocks (the so-called ticket service contract).

Mandatory stocks of natural gas are maintained at a level corresponding to at least a 30-day average daily import of this gas, in storage installations whose technical parameters ensure that their total quantity can be delivered to the gas system over a period of not more than 40 days.

Mandatory stocks of natural gas are at the disposal of the Minister of Energy, as the competent authority designated in accordance with Regulation 2017/1938, which, by decision at the request of the transmission system operator, may agree to their launch.

Mandatory stocks of natural gas may be maintained outside the territory of the Republic of Poland - on the territory of another Member State of the European Union or a Member State of the European Free Trade Agreement (EFTA) - parties to the agreement on the European Economic Area, in storage installations connected to the gas system. If mandatory stocks are released, the Minister of Energy shall immediately inform the European Commission about this fact, and if mandatory stocks are kept

outside the territory of the Republic of Poland, the relevant Member States of the European Union and the Member States of the European Free Trade Agreement (EFTA) - parties to the agreement on the European Economic Area.

The purpose of this measure is to ensure that objectives of general economic interest are met, i.e. security and continuity of gas supply in the event of the deepest crisis.

In addition, the non-market measure of mandatory stocks is proportionate with regard to the time constraint aspect to the extent that it is strictly necessary to achieve the objective. Mandatory stocks as one of the security of supply measures are to be ready for use in the event of a crisis (uncertain future event, no possibility of determining the moment when it would occur, or even the fact whether it will occur) when the market will not be able to respond to the crisis that is, only after exhausting market measures. Therefore, it is necessary to ensure their availability in a situation where market measures cease to be sufficient. This means that the possibility of starting mandatory stocks depends first of all on the need to create, maintain and ensure delivery.

The obligation to maintain stocks and readiness to deliver them to the system is permanent, but the non-market-based measure itself, which is the mobilization of these stocks, is time-limited.

The mandatory stocks system has been constructed in such a way that measures to ensure security of supply do not compromise the process of market liberalization, which was achieved by proportionally distributing the obligation to its participants. In accordance with the adopted solution, each participant participates in the mechanism of ensuring security of supply in proportion to its share in imports and is obliged to ensure the availability of inventory with the same specification. Therefore, the obligation to maintain mandatory stocks should be considered proportionate. In other words, the mechanism adopted is non-discriminatory and creates uniform operating principles on the natural gas market for all entities operating on it.

It should also be noted that the solutions adopted have a positive impact on the security of gas supply in neighbouring Member States in the event of a regional crisis.

It should also be noted that the solutions adopted have a positive impact on the security of gas supply in neighbouring Member States in the event of a regional crisis.

The existence of mandatory stocks and the possibility of their mobilization, in a crisis of regional range, will have a positive impact on the natural gas balance in the region. Thus, natural gas potentially needed on the Polish market will be able to be delivered to the market of neighbouring Member States affected by the crisis.

As regards the domestic natural gas market, this measure has a positive effect by strengthening the resilience of the domestic market to the effects that may be caused by a crisis resulting from a supply interruption. Guaranteeing an additional source of natural gas in the event of a crisis will minimize its effects, among others by safeguarding against interruption or disruption of the provision of services of

fundamental importance for the functioning of society, as well as securing the market against abrupt increase in natural gas prices, which is the result of market uncertainty as to the possibility of supply this raw material.

- Restrictions on natural gas consumption consist in limiting the maximum hourly and daily natural gas consumption on the territory of the Republic of Poland or its part, may be introduced for a definite period. It is a non-market measure, used when all available market measures to meet the needs of natural gas consumers have been exhausted.

Restrictions are implemented in accordance with restriction plans and do not apply to household gas consumers. The transmission system operator, distribution system operators are required to develop plans for introducing restrictions on the consumption of natural gas. These plans specify the maximum hourly and daily quantities of natural gas consumption by individual customers connected to their network, for individual supply stages. Operators inform customers about the maximum amount of natural gas consumption set for them in the plan. These quantities become an integral part of sales contracts, contracts for the provision of natural gas transmission or distribution services and comprehensive contracts.

8. Other measures and obligations in the field of system security

8.1. The role of operators in ensuring the security of gas supply

According to art. 9c paragraph 1 of the Energy Law Act, the operators of the transmission, distribution and storage system for gaseous fuels, according to the scope of activity, are responsible, among others behind:

- security of gas fuel supply by ensuring security of gas system operation and implementation of contracts with system users,
- conducting network traffic in a coordinated and effective manner,
- operation, maintenance, repairs of networks, installations and equipment,
- ensuring the long-term capacity of the gas system to meet legitimate needs in the transmission of gaseous fuels in domestic and cross-border trade, distribution of these fuels and their storage or liquefaction of natural gas, as well as in the development of the gas system and, where applicable, expansion of connections with other gas systems,
- cooperation with other gas system operators or energy enterprises in order to ensure reliable and effective functioning of gas systems and coordinate their development,
- disposing of the capacity of storage and liquefied natural gas installations;
- management of gas fuel flows and maintenance of quality parameters of these fuels,
- provision of services necessary for the proper functioning of the gas system;
- system balancing and congestion management in the gas system, which are non-marketable measure within the meaning of Regulation 2017/1938,
- providing system users and operators of other gas systems with information on the conditions for the provision of transmission or distribution services, gas fuel storage services or natural gas liquefaction services, including cooperation with connected gas systems.

In addition, in accordance with art. 58 of the Act of Stocks, gas transmission system operators, gas distribution system operators, and combined gas system operators or energy companies acting as operators, are required to develop plans to introduce restrictions. Restriction plans developed by operators specify the maximum hourly and daily quantities of natural gas consumption by individual customers connected to their network for individual supply stages. It should be noted that restrictions resulting from restriction plans do not apply to household natural gas consumers.

During the period of restrictions on natural gas consumption, the gas transmission system operator or connected system operator:

- carries out the obligations related to the introduction of restrictions, by setting and making public supply levels, in accordance with the plans for introducing restrictions,
- coordinates the activities of energy companies, other gas system operators, storage system operators, in order to ensure gas system security and implementation of restrictions,

- has full capacity and capacity of natural gas storage and liquefaction installations connected to the gas system and has mandatory stocks of natural gas.

8.2. Tasks of energy undertakings in ensuring security of gas supply

In the event of supply disruptions or unusually high demand for gas, energy companies first use market-based instruments. In the event of an emergency, market based instruments should be given priority in mitigating the effects of a supply disruption. In a situation where all relevant market measures have been applied to secure gas supplies, and gas supplies are insufficient, in particular for the needs of protected customers, it is possible to introduce additional non-market measures, which include the activation of mandatory stocks and the introduction of restrictions on natural gas consumption.

According to art. 49 of The Act of Stocks, an energy enterprise carrying out economic activity in the field of natural gas trading abroad, an entity importing natural gas and entities commissioning the provision of natural gas transmission or distribution services, are required to have procedures applicable in the case of:

- occurrence of disruptions in the supply of natural gas to the gas system,
- unforeseen increase in natural gas consumption by consumers.

Procedures should specify, in particular, how:

- starting additional supplies of natural gas from other sources or directions,
- reducing the consumption of natural gas by consumers, in accordance with the contracts concluded with them.

The procedures are agreed with the entities responsible for their implementation, including the operators of other gas systems, respectively, and then transferred to the transmission system operator.

In addition, in accordance with art. 50 paragraph 1 of the Act of Stocks, energy companies undertake actions aimed at counteracting the threat of supply disruptions, in particular the actions specified in the abovementioned procedures. Therefore, it should be stated that the abovementioned procedures do not limit companies' ability to take other market measures to counter disruptions in natural gas supply.

Whereas art. 24 of the Act of Stocks, obliges energy companies conducting business activity in the field of natural gas trading abroad and entities importing natural gas to maintain mandatory stocks of natural gas in order to ensure Poland's supply of natural gas and minimize the effects of: threat to state fuel security, occurrence of an emergency situation in the network gas, or an unexpected increase in natural gas consumption. Mandatory stocks of natural gas are maintained at a level corresponding to at least 30 days average daily imports of this gas, in storage installations whose technical parameters ensure that their total quantity can be delivered to the gas system over a period of not more than 40 days. Mandatory stocks may be maintained outside the territory of the Republic of Poland - on the territory of another Member State of the European Union or a Member State of the European Free Trade Agreement (EFTA) - parties to the agreement on the European Economic Area, in storage installations connected to the gas system that meet

the requirements set out in the Act of Stocks. In particular, the technical parameters of storage installations and gas networks to which the installations are connected should ensure the possibility of delivering within 40 days the total quantity of mandatory stocks maintained outside Poland to the national transmission or distribution network.

In addition, energy undertakings are obliged to notify to the Minister of Energy details of new gas supply contracts (or changes being made to existing contracts) with a cross-border dimension and a duration of more than one year. The information should include:

- contract duration;
- yearly contracted volumes;
- contracted maximum daily volumes in the event of an alert or emergency;
- contracted delivery points;
- minimum daily and monthly gas volumes;
- conditions for the suspension of gas deliveries;
- an indication whether the contract individually or cumulatively with its contracts with the same supplier or its affiliates is equivalent to or exceeds the threshold of 28 % of annual natural gas consumption in Poland.

9. Infrastructure projects

Table 17. Preventive actions identified

Action	Entity responsible	Term	Impact of the project on the natural gas market in the risk group
Diversification projects			
Increasing the regasification capacity of the LNG terminal in Świnoujście	Polish LNG	2021-2023	Increasing security and diversification of natural gas supplies in Poland and other countries of the Baltic Sea region as well as Central and Central and Eastern Europe. Limiting the sensitivity of the natural gas market in Poland and the region to the risk of interruptions in supplies from the east.
	OGP Gaz - System (project implementation coordinator)		
Construction of the Baltic Pipe gas pipeline	OGP Gaz - System	2022	Increasing security and diversification of natural gas supply in Denmark, Sweden, Poland and other countries of the Baltic Sea region as well as Central and Central and Eastern Europe. Limiting the susceptibility of the gas market in Poland and other countries of the region to the risk of interruptions in supplies from the east.
FSRU	OGP Gaz - System	2024-2025	Increasing security and diversification of natural gas supply in Poland and other countries of the Baltic Sea region as well as Central and Central and Eastern Europe. Limiting the sensitivity of the natural gas market in Poland and the region to the risk of interruptions in supplies from the east.

Integration projects			
Implementation of the National Ten-Year Transmission System Development Plan - for the construction of interconnectors	OGP Gaz - System	2022	Increasing security and diversification of gas supplies in Poland and other Central and East-Central European countries as well as in the Baltic States. Reduction of dependence on natural gas supplies from Central and Eastern Europe as well as the Baltic States from Russia. Impact on the construction of the regional natural gas market in the Baltic States, Central and Eastern Europe.

Domestic projects		
Action	Entity responsible	Term
Implementation of the National Ten-Year Transmission System Development Plan for the expansion of the national transmission network construction of the North-South corridor in Eastern / Western Poland and further expansion	OGP Gaz-System	2019-2029
Implementation of UGS and CUGS capacity expansion	PGNiG	2021-2030
Implementation of the Program to accelerate investment in the Polish gas network	PSG	2022
Building capacity for receiving natural gas from the Yamal-Europa gas pipeline (drying plant)	PGNiG	2019

The development of gas infrastructure, in particular interconnections, and provision of new sources of natural gas imports is one of the main elements contributing to increasing the level of security of natural gas supplies to the country and is also a tool for increasing integration with EU Member States.

Baltic Pipe project

This is a strategic infrastructure project aimed at creating a new natural gas supply corridor on the European market.

It will enable the transmission of natural gas directly from deposits located in Norway to markets in Denmark and Poland, as well as to recipients in neighbouring countries. The Baltic Pipe project will also enable natural gas supplies from Poland to the Danish and Swedish markets. Diversification of supplies by enabling access to its direct sources will significantly improve the energy security of the entire region.

Benefits of building the Baltic Pipe:

- diversifying and enabling access to new sources of natural gas supply, which is essential for strengthening national energy security. The appearance of new

participants on the natural gas market in Poland will increase its competitiveness and ensure continuity of supply,

- improving the diversification of supply sources in Denmark, Sweden and the Baltic Sea region and Central and Eastern Europe. The Danish and Swedish gas market will benefit from two new sources of supply. The investment will provide them with direct access to Norwegian natural gas and the global liquefied natural gas (LNG) market through the LNG Terminal in Świnoujście,
- launching a new, additional natural gas supply route from northern Europe, which will contribute to the strategic change of the current structure of gas flows in Central and Eastern Europe,
- increasing competitiveness on regional natural gas markets and facilitating price convergence between markets; enabling new participants to enter the market and potential increase in gas demand in the regions affected by the Project.

Poland - Lithuania project

The aim of the project is to connect the isolated natural gas markets of the Baltic States (Lithuania, Latvia and Estonia) with the European Union gas markets via a new bi-directional gas pipeline. The project will enable the integration of natural gas markets in the Baltic Sea region, as well as reducing the dependence of the Baltic States and Finland on supplies from one direction only.

Benefits of building the Poland - Lithuania connection: diversification of natural gas supply sources, reduction of dependence on one supplier, increase of energy security and energy solidarity between Member States, integration of energy markets in Europe and creation of the internal energy market,

- at the national level, the implementation of the Poland - Lithuania connection is in line with the priority actions related to security of natural gas supply, such as: extension and increase of gas transmission system capacity, construction of interconnectors and extension of connections with other gas systems,
- increase in the competitiveness of the north-eastern regions of Poland, thanks to the creation of a new transmission infrastructure enabling the collection of gaseous fuels via a distribution network or through the direct connection of large industrial customers, in addition, there will be the possibility of gasification of regions previously deprived of access to natural gas.

Poland - Czech Republic project

The Poland-Czech Republic connection is part of the European initiative related to the construction of the North-South Corridor.

Benefits of building the Poland - Czech Republic connection:

- development of transmission capacity between Poland and the Czech Republic will contribute to the integration of gas markets of the Visegrad Group countries,
- providing access to new sources of natural gas, in particular through the LNG terminal in Świnoujście and from Norwegian shelf to the Visegrad Group countries.

Poland - Slovakia project

The Poland-Slovakia connection is part of a European initiative related to the construction of the North-South Corridor. The new supply direction is in line with the strategic directions set out in Poland's energy policy until 2030. related to ensuring the country's energy security by diversifying sources and directions of natural gas supply.

Benefits of building the Poland - Slovakia connection:

- increasing the possibility of covering the demand for natural gas for domestic customers by establishing a new route of transport and a new source of this gas,
- securing natural gas supplies in crisis situations,
- natural gas supply to the south-eastern part of Poland, where there is an extensive transmission system and storage infrastructure,
- export of natural gas from Poland based on deliveries from the LNG terminal in Świnoujście, export of natural gas imported from the Norwegian continental shelf
- improving the energy security of Slovakia, Poland and the entire Central and Eastern Europe Region.

Poland - Ukraine project

The integration of the Polish and Ukrainian transmission systems is an element of the North-South Gas Corridor connecting the LNG Terminal in Świnoujście with the countries of Central and Eastern Europe through the transmission systems of individual countries and cross-border connections. The actions taken are aimed at securing natural gas supplies from Poland to Ukraine, as well as securing gas supplies from Ukraine to the European Union.

Benefits of building the Poland - Ukraine connection:

- the emergence of new transmission capacities will translate into increased energy security and diversification of natural gas supplies and sources for Ukraine,
- increasing export capacity and creating conditions for increasing the degree of utilization of the transmission system transmission capacity,
- obtaining access to storage capacity, underground gas storage facilities located on the territory of Ukraine,
- increasing the connection capacity on the Polish-Ukrainian border will allow the creation of a transport corridor supporting the integration of the regional natural gas market.

North-South Corridor Initiative

The implementation of investments related to the construction of the North-South Corridor will allow for ensuring a full and effective connection of the national transmission system with the European main gas pipeline system. It will enable the full integration of Central and Eastern European markets, which is in line with the EU energy policy.

The North-South corridor in Poland includes:

- the western thread of the North-South Corridor in Poland together with the Poland-Czech Republic interconnector, Poland-Slovakia and Poland-Ukraine interconnector,

- The eastern thread of the North-South Corridor in Poland, constituting the ideological complement to the North-South corridor and covering the Gdańsk-Gustorzyn-Wronów-Hermanowice gas main, as well as the Poland-Lithuania interconnector.

Benefits of building the North-South corridor:

- uninterrupted supply of natural gas to domestic customers in adequate quantities,
- improving the security of the operation of the national transmission network and increasing the capacity of the transmission system,
- development of the natural gas market by increasing the volume of supplies to customers from new gas pipelines;
- enabling the export and / or import of gas from neighboring countries: Slovakia, Czech Republic, Ukraine, Lithuania, Denmark,
- increasing the degree of integration of regional natural gas markets,
- increasing the security of supply,
- enabling access to new sources of supply for Central and Eastern European countries,
- creation of a new gas transport route in Europe and effective use of internal gas transmission pipelines in individual countries.

10. Obligations to provide public services related to security of supply

Public service obligations related to the security of gas supply have been set out in two legal acts: the Energy Law and the Act of Stocks.

10.1. Energy Law

According to art. 9c paragraph 1 point 1.3 of the Energy Law, the transmission and distribution system operator or combined gas system operator is responsible for the security of gas fuel supply. To this end, it is required to ensure the security of the gas system and the continuity and reliability of gas supply, while maintaining quality requirements during operation, maintenance and repair of networks, installations and equipment, together with connections to other gas systems, and ensure the implementation of contracts with users of this system.

The provision of art. 4 paragraph 1 of this Act imposes on the energy company dealing in the transmission or distribution of gaseous fuels the obligation to maintain the ability of equipment, installations and networks to provide gas supply in a continuous and reliable manner, while maintaining the applicable quality requirements.

The security of gas supply is also ensured by the way energy companies involved in the transmission or distribution of gaseous fuels plan the development of their systems. Developed by these enterprises in accordance with the provisions of art. 16 of the Energy Law Act, the development plan to meet the current and future demand for gaseous fuels for the area of its activity includes in particular:

- expected range of gas fuel supply,
- projects for the modernization, expansion or construction of the network and planned new sources of gaseous fuels,
- projects in the scope of modernization, extension or construction of connections with gas systems of other countries

The gas transmission system operator plan is drawn up for 10 years and the gas distribution system operator for 5 years. The plans also take into account the demand for new capacity in the transmission or distribution system reported by entities connected to the network or entities applying for connection to the network. The plans are prepared in close cooperation of interested entities - entities connected to the network, municipalities and in the case of a plan of energy enterprises dealing in the transmission of gaseous fuels - the local government of the voivodship in which the investment project is planned.

Based on Article. 32 section 3 of the Energy Law Act, a regulation of the Council of Ministers on the minimum level of diversification of gas supplies was issued, in which the maximum share of gas imported from one country of origin was determined in relation to the total volume of gas imported in a given year.

As an obligation to provide a public service in the field of security of natural gas supply, also Article 40 clause 1 above legal act according to which: "The President of the

Energy Regulatory Office may order an energy company, despite the expiry of the concession, to continue operating under the concession for a period not longer than 2 years, if required by the public interest." It should be noted that any losses incurred in this respect by the enterprise are covered by the State Treasury in the amount limited to justified costs of the activity specified in the concession, with due diligence.

10.2. The Act of Stocks

The Act of Stocks gathers the main public service obligations related to ensuring security of supply. However, it should be stipulated that in the event of supply disruptions or unforeseen increases in gas consumption, energy undertakings are first and foremost obliged to use market-based measures before using emergency measures. These measures may include, in particular, additional supplies of natural gas from other directions or sources and restrictions on consumption resulting from contracts with customers (commercial restrictions) and should be specified in the procedures that, in accordance with the provisions of art. 49 of the Act of Stocks, an energy enterprise that carries out economic activity in the field of natural gas trading abroad, entities importing natural gas and entities commissioning the provision of natural gas transmission or distribution services are required to own.

The procedures, after being agreed with the entities responsible for their implementation, including operators of other gas systems or consumers, as appropriate, shall be immediately transferred to the gas transmission system operator or the combined gas system operator. It should be noted that pursuant to art. 49 paragraph 3 of The Act of Stocks, the obligation to develop procedures does not apply to household gas consumers.

Article 24 para. 1.2 stipulates that an energy company conducting economic activity in the field of natural gas trading abroad and entities importing natural gas in order to ensure the supply of natural gas to the Republic of Poland and to minimize the effects of a threat to the fuel security of the state, an emergency situation in the gas network or unforeseen increase in natural gas consumption, they are required to maintain mandatory stocks of natural gas.

The provisions of the Act oblige to maintain mandatory stocks of natural gas in the amount corresponding to at least 30 days average daily import of this gas. The technical parameters of the installations in which these stocks are maintained must guarantee that all mandatory stocks will be delivered to the gas system within a period of not more than 40 days.

According to art. 25 paragraph 6 above of the Act in connection with the need to maintain mandatory stocks, an energy company carrying out economic activity in the field of natural gas trading abroad and entities importing natural gas are obliged to inform the President of the Energy Regulatory Office about the intention to start importing natural gas and provide it to the gas transmission system operator or gas combined system operator information on the place of storage of mandatory natural gas stocks to verify the technical

possibilities of delivering these stocks to the gas system at least 30 days before the date of commencement of these imports.

According to art. 28 abovementioned of the Act, mandatory natural gas stocks are the property of energy enterprises engaged in economic activity in the field of foreign gas trade and entities importing natural gas, unless they constitute, on the basis of a concluded agreement, the assets of the entity accepting the mandatory stocks order. Moreover, costs incurred by enterprises in connection with the implementation of this obligation are included in the justified costs of their activities within the meaning of Art. 3 point 21 of the Act of 10 April 1997 - Energy Law.

In addition, in accordance with art. 54 of the Act of Stocks, in the case of:

- threats to the country's fuel security,
- unforeseen increase in natural gas consumption by consumers,
- occurrence of disturbances in natural gas imports,
- failures in the networks of gas system operators,
- threats to the security of gas networks
- threats to the safety of persons,
- threat of material losses,
- the need for the Republic of Poland to fulfill international obligations,

on the territory of the Republic of Poland or parts thereof may be imposed for a limited period of time for natural gas consumption. They consist in limiting the maximum hourly and daily consumption of natural gas. This measure applies only to commercial customers. According to art. 58 paragraph 4 of the Act of Stocks, restrictions resulting from restriction plans do not apply to household gas consumers.

11. Regional dimension

11.1. Regional risk group - Belarus

11.1.1. N-1 formula

In the Belarusian risk group, Kondratki was adopted as the largest single infrastructure in the region, being the entry point to the Polish part of the Yamal-Europe transit gas pipeline. Due to the fact that the Baltic States (Lithuania, Latvia, Estonia) remain isolated from the EU gas system (until the interconnection between Poland and Lithuania), N-1 for this region has been calculated separately, assuming that UGS Inčukalns is the largest infrastructure.

Table 18. N - 1 formula results

	S_m -100%	S_m -30%
	D _{max}	D _{max}
East-Baltic: Estonia, Latvia, Lithuania	173%	151%
Middle-west: Belgium, Czech Republic, Germany, Luxembourg, Netherlands, Poland, Slovakia	215%	177%

Source Common risk assessment of the Eastern gas supply risk group -Belarus

11.1.2. Cooperation mechanism

11.1.2.1. Procedures for exchange of information

Article 11 of Regulation (EU) 2017/1938 obliges Competent Authorities to inform the Commission and the Competent Authorities of the Member States with which the member state of that Competent Authority is directly connected – immediately after declaring one of the crisis level.

Moreover, in case of an emergency the Competent Authority shall follow procedure set out in its Emergency Plan and shall provide all the pertinent information (in particular information on the action it intends to take) to the competent authorities in the risk group and competent authorities of the Member States with which is directly connected with.

As described above, in case of identification a potential risk related to disruption the gas supply in the risk group, in order to improve coordination, a Competent Authority shall inform the others of competent authorities as soon as possible.

The list of example risk situations, which may cause a disruption of gas supply, includes:

- technical problems with main transmission infrastructure that can cause disruption of the gas flow,
- short notice forecast (one or two days before) of exceptionally high demand due to extreme weather conditions in a Member State belonging to the Risk Group,
- reduction of gas flow from Russia to one or more Member States of the Risk Group.

11.1.2.2. Regional Coordination System for Gas (ReCo System)

In accordance to Article 3.6 of Regulation (EU) 2017/1938, the role of the Regional Coordination System for Gas (ReCo System for Gas), established by ENTSOG and composed of standing expert groups, for cooperation and information exchange between transmission system operators in the event of a regional or EU emergency, is considerably high.

There are three ReCo Teams: North West South and East. Most members of Belarus Risk Group belong to East Team.

The ReCo Team East was launched in November 2017 and Open Grid Europe (a German TSO) was appointed as facilitator until November 2019. As the next facilitator (until November 2021) was appointed Fluxys (a Belgian TSO). The role of the facilitator is to be the first TSO to contact in case of an emergency and to activate the communication flowchart.

The transmission system operators (TSO) shall cooperate and exchange information including gas supply flows in a crisis situation using the Regional Coordination System for Gas (ReCo System for Gas) established by ENTSOG. The main purpose of the ReCo teams is enabling exchange information between TSOs through a pre-existent channel. This action can help to approve common procedures to use in case of an emergency and to organise emergency exercises to test the resilience of the communication flowchart and explore how to improve them.

All ReCo teams operation procedures can be accounted as emergency measures but the existence of the ReCo teams can be considered as a preventive measure.

11.1.3. Preventive measures

Coordination between Member States is a key element to reduce the exposure of individual Member States to the harmful effects of disruptions of gas supply. Regional cooperation, involving both public authorities and natural gas undertakings should result in optimisation of coordinating measures and implementation of the most cost-effective measures for gas consumers in European Union. In addition, many Member States in Belarus Risk Group are currently undertaking infrastructural projects that will make a significant contribution to the security of supply in Belarus Risk Group region.

11.1.3.1. Infrastructural measures enhancing interconnections between neighboring Member States

Poland – Lithuania Interconnector (GIPL)

Klaipėda LNG Terminal and Incukalns underground gas storage have an important role in providing security of supply in East-Baltic subregion. In case of lack of gas deliveries from Klaipėda LNG Terminal or Incukalns UGS, Baltic States might face demand curtailment due to current infrastructure limitations (no physical connection with neighbouring countries). Therefore Interconnector between Poland and Lithuania (GIPL) should demonstrate how the gas supply security can be increased. The Poland-Lithuania Interconnector is perceived by the European Commission as infrastructure contributing to

the integration of the European gas system and the shaping of a liberalized gas market in the northeastern part of Europe. It is considered to be a significant element that can eliminate the barriers in the formation of a gas market in this part of Europe by eliminating the so-called "energy islands" – regions that are dependent from gas supplies from one direction. It is planned the interconnector construction will be finished in 2021 r.

Baltic Pipe

The Baltic Pipe is a strategic infrastructure project, with the goal of creating a new gas supply corridor on the European market. For the first time, it will be possible to transport gas from fields in Norway to the Danish and Polish markets, as well as to customers in neighboring countries. At the same time, the Baltic Pipe project will enable the supply of gas from Poland to the Danish and Swedish markets.

Diversification of supplies through direct access to deposits of natural gas will significantly improve energy security. The Baltic Pipe project will make a significant contribution to the creation of an eastern European energy market. The project will contribute to integration of gas markets, improved security of supplies.

The Baltic Pipe project will also further the aims of the North-South Corridor concept and the Baltic Energy Market Interconnection Plan (BEMIP), important priorities for the European Union in the area of energy infrastructure development.

The main objectives of the Baltic Pipe project:

- integration of the Danish-Swedish and Polish gas markets through supply competition and bi-directional trade to ensure increased price convergence;
- strengthening the security of supplies in the region by providing access to Norwegian natural gas deposits to Danish-Swedish and Polish markets, as well as other markets in Central and Eastern Europe;
- increasing technical reliability of gas supplies to customers by diversifying import routes;
- linking of Baltic Pipe to the LNG Terminal in Świnoujście, potentially giving Scandinavian countries access to the global liquefied natural gas (LNG) market.

It is expected the commissioning of the investment and the commencement of gas transmission will take place in October 2022 r.

Poland – Slovakia Interconnector

The main goal of the project is to create an important part of the North-South gas interconnections in Central-Eastern Europe by implementing a missing interconnection between the transmission systems in Poland and Slovakia and, thus, increase the security of gas supplies in Central-Eastern Europe through the diversification of supply sources and routes. It is planned the interconnector construction will be finished in 2022 r.

Upgrade of LNG Terminal in Świnoujście

The extension of the LNG Terminal in Świnoujście will have an impact on increasing security of supply in the Baltic Sea and CEE regions by diversifying supply routes, sources (new physical source of supply for both regions) and counterparts (access to global LNG market). It is planned the upgrade of LNG Terminal in Świnoujście will be finished in 2023 r.

Floating Storage and Regasification Unit

The FSRU Polish Baltic Sea Coast project is planned as the first floating terminal in Poland. The project will offer its regasification capacities to the gas consumers in Poland and other countries in the Baltic Sea region (supplies to be directed via Gas Interconnection Poland-Lithuania and/or LNG ships) and in Central-Eastern Europe (supplies within the North-South Gas Corridor).

There are also other interconnector projects, which have not gained FID yet. Taking into consideration further enhancement and creating a significant contribution to the security of supply in Belarus Risk Group, two other interconnectors are planned:

Poland – Czech Interconnector

The project aims at increasing the cross-border capacity between Poland and the Czech Republic by establishing a large transportation corridor that will allow for flexible transport of gas in Central-Eastern Europe within the North-South corridor. The development of the project will contribute to reinforcement of the effective operation of gas transmission systems, efficient gas exchange between the markets, as well as increase of the security of supply not only for Poland and the Czech Republic, but also for the CEE region by enabling the supply link with global LNG market via the Terminal in Świnoujście and Norwegian gas via the Baltic Pipe project.

Poland – Ukraine Interconnector

The objective of the project is to create a large transportation corridor between Poland and Ukraine. The project will contribute towards:

- establishment of a well-integrated gas market in the whole region;
- diversification of gas routes and sources for Ukraine;
- enhancement of security of gas supply for Ukraine;
- access to the gas storages in Ukraine.

11.1.4. Critical gas-fired power plants

According to art. 11 paragraph 7 of Regulation 2017/1938 during an emergency, at the request of an appropriate electricity or natural gas transmission system operator, a Member State may decide to give priority to the supply of natural gas to certain critical gas-fired power plants relative to the supply of natural gas to certain categories of protected customers. Accordingly, the following table summarizes the list of Polish critical gas-fired power plants and combined heat and power plants together with the annual consumption of natural gas by these power plants.

Table 19 Natural gas consumption by power plants and combined heat and power plants

Name of the power plant	Achievable electrical power [MW]	Annual gas consumption mcm	Fuel Type
Power plant Płock	630	750.5	High-methane natural gas
Power plant Włocławek	485	469.3	High-methane natural gas
Power and heat plant Wrotków	231	237.1	High-methane natural gas
Power and heat plant Gorzów (TG8)	54.5	n/a ¹	High-methane natural gas and low-calorific natural gas
Power and heat plant Gorzów 2	138	344.6	High-methane natural gas and low-calorific natural gas
Power and heat plant Rzeszów	101	103.4	High-methane natural gas
Power and heat plant Nowa Sarzyna	128.9	165	High-methane natural gas
Power and heat plant Toruń	100.6	121.3	High-methane natural gas
Power and heat plant Zielona Góra	188	356.5	Low-calorific natural gas

1) The TG8 unit acts as a reserve unit and is not intended for production until 2021.

11.2. Regional risk group - Ukraine

11.2.1. N-1 formula

In order to analyze the risk associated with disruptions in natural gas supplies by Ukraine in the N-1 formula, the entry point located on the border between Slovakia and Ukraine was adopted as the largest single infrastructure: Uzhgorod-Velke Kapusany.

The N-1 formula was also calculated for the situation of total disruption of the Ukrainian supply route.

The N-1 formula was calculated taking into account 100% UGS capacity and 30% UGS filling level. The formula was set for two time horizons, i.e. 2018/2019 and 2020/2021.

Table 20. N-1 formula

		2018/2019	2020/2021
Uzhgorod	UGS 100%	166 %	172 %
	UGS 30%	146 %	151 %
Ukrainian supply route	UGS 100%	158 %	165 %
	UGS 30%	138 %	144 %

Source Common risk assessment of the Eastern gas supply risk group -Ukraine

11.2.2. Mechanisms developed for cooperation

11.2.2.1. Regional Coordination System for Gas (ReCo System for Gas)

Article 3.6 of Regulation (EU) 2017/1938 highlights the role of the Regional Coordination System for Gas (ReCo System for Gas), established by ENTSOG and composed of standing expert groups, for cooperation and information exchange between transmission system operators in the event of a regional or EU emergency.

There are three ReCo teams: North West, East and South. Most members of the Ukrainian Risk Group are included within the ReCo Team East.

The main aim of the ReCo teams is to establish a pre-existent channel to exchange information between TSOs, to approve common procedures to use in case of an emergency and to organise emergency exercises to test the resilience of the communication flowchart and explore how to improve them. Consequently, the existence of the ReCo teams are a preventive measure even though all their operation procedures can be considered emergency measures.

The ReCo Team East was launched in November 2017 and Open Grid Europe (a German TSO) was appointed as facilitator until November 2019. The role of the facilitator is to be the first TSO to contact in case of an emergency and to activate the communication flowchart.

11.2.2.2. New and permanent procedure of exchange of relevant information between Competent Authorities within the Risk Group

According to the article 11 of the Regulation (EU) 2017/1938, when a Competent Authority declares one of the crisis levels, it shall immediately inform the Commission as well as the competent authorities of the Member States with which the Member State of that competent authority is directly connected.

Moreover, when the Competent Authority declares an emergency it shall follow the pre-defined action as set out in its Emergency Plan and shall immediately inform the competent authorities in the risk group as well as the competent authorities of the Member States with which is directly connected in particular of the action it intends to take.

As described above, a Competent Authority only shall inform to the rest of the Risk Group when emergency level is declared. However, in order to improve coordination, if

a Competent Authority of the Ukrainian Risk Group declares any crisis level, it shall inform the rest of members at the same time than the Commission.

Furthermore, if a Competent Authority within the Ukrainian Risk Group identifies a potential disruption affecting the gas supply from Ukraine, it shall inform the rest of Competent Authorities as soon as possible before any level of crisis.

A no fully comprehensive list of risk triggering events is the following.

- relevant reduction in gas flows from importing interconnection points with Ukraine (Drozdovychi, Uzhgorod, Beregovo, Tekovo or Orlovka);
- relevant reduction of Russian gas flows to one or more Member States of the group;
- incidents or discovery of technical problems that could end into flow restrictions involving the main transmission pipelines interconnecting Member States belonging to the risk group;
- short notice forecast (one or two days before) of exceptionally high demand due to extreme weather conditions in a Member State belonging to the risk group.

A contact list of Competent Authorities will be updated yearly by the Competent Authority acting as Risk Group Facilitator as well as by the Competent Authority that experiences any change in its contact details.

Solidarity related mechanisms are still under evaluation by Member States' Competent Authorities. As soon as one of them is signed, the involved Member States will inform the group and its existence will be made public through a special chapter (containing only non-sensitive information, i.e. date of signing and temporal extension, etc...) on the present document.

11.2.3. Preventive measures

The regulation of the interconnection agreements between adjacent TSOs is established by the Chapter II of the Commission Regulation (EU) 2015/703 of 30 April 2015 establishing a network code on interoperability and data exchange rules. The article 3 lays down the points necessarily covered by an interconnection agreement.

Generally, the contents covered in the Interconnection Agreements are as follows:

- A) General provisions;
- B) glossary: a glossary of terms used in the text, including conventions such as the schedule of the day of gas in any system;
- C) common referential:
 - units (pressure, temperature, volume, gross calorific value, energy, Wobbe index);
 - shipper codes to facilitate identification in matching processes;
- D) forecasts: monthly and weekly forecast include the quantities to be transported across the interconnection point for the next month/week. Planned maintenance plays a significant role in the interconnection management and an annual plan is approved apart from specific updates a week before the maintenance action takes place,
- E) nominations: details of nomination and re-nomination cycles are agreed;

- F) matching procedure: in order to obtain the confirmed quantities (CQ) that will be delivered at the interconnection point by each shipper avoiding any discrepancy in the nominations;
- G) allocation: once the measured quantities (MQ) are confirmed, the TSOs calculate the difference between MQ and CQ to obtain the Daily Deviations (DD). The DD will be allocated to a deviation account known as the Operational Balancing Account (OBA);
- H) exceptional Event Situation: analysed in the Emergency Plan.

These interconnection agreements deliver a unified language to exchange information and procedures to detect imbalances and invalid control variables.

11.2.4. Critical gas-fired power plants

According to art. 11 paragraph 7 of Regulation 2017/1938 during an emergency, at the request of an appropriate electricity or natural gas transmission system operator, a Member State may decide to give priority to the supply of natural gas to certain critical gas-fired power plants relative to the supply of natural gas to certain categories of protected customers. Accordingly, the following table summarizes the list of Polish critical gas-fired power plants and combined heat and power plants together with the annual consumption of natural gas by these power plants.

Table 21 Natural gas consumption by power plants and combined heat and power plants

Name of the power plant	Achievable electrical power [MW]	Annual gas consumption mcm	Fuel Type
Power plant Płock	630	750.5	High-methane natural gas
Power plant Włocławek	485	469.3	High-methane natural gas
Power and heat plant Wrotków	231	237.1	High-methane natural gas
Power and heat plant Gorzów (TG8)	54.5	n/a ¹	High-methane natural gas and low-calorific natural gas
Power and heat plant Gorzów 2	138	344.6	High-methane natural gas and low-calorific natural gas
Power and heat plant Rzeszów	101	103.4	High-methane natural gas
Power and heat plant Nowa Sarzyna	128.9	165	High-methane natural gas

Power and heat plant Toruń	100.6	121.3	High-methane natural gas
Power and heat plant Zielona Góra	188	356.5	Low-calorific natural gas

1) The TG8 unit acts as a reserve unit and is not intended for production until 2021.