I hereby approve the following.

Prof. Dr László Palkovics
Minister
Ministry of Innovation and Technology

Preventive Action Plan for the security of natural gas supply in Hungary

in accordance with the provisions of Regulation (EU) 2017/1938 of the European Parliament and of the Council concerning measures to safeguard the security of gas supply and repealing Regulation (EU) No 994/210

1 September 2020

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General information

Pursuant to *Act XL of 2008 on Natural Gas Supply* ('GA'), the minister responsible for energy policy will act as the competent authority concerning the Preventive Action Plan to be drawn up by Hungary under Regulation (EU) 2017/1938.

Pursuant to *Section 3 of Government Decree No 110/2020 of 14 April 2020 on the restriction of the off-take of natural gas, use of emergency natural gas stocks, and on other measures necessary in the event of a natural gas supply crisis situation*, the Preventive Action Plan was prepared by the Hungarian Energy and Public Utility Regulatory Authority ('MEKH') and, following its approval by the minister responsible for energy policy, submitted to the European Commission by MEKH acting upon legislative authorisation.

This Preventive Action Plan is based on the risk assessment submitted by Hungary to the European Commission in 2019 and the data series (e.g. graphs and tables) included therein rely on the same risk assessment (typically, the latest data contained therein refer to 2017 or 2018). Only such data and information are updated in this document that have considerably changed during the period following the submission of the risk assessment.

Hungary is classified in the Ukraine risk group under Regulation (EU) 2017/1938. The Ukraine risk group includes the following Member States:

- Bulgaria
- Czech Republic
- Germany
- Greece
- Croatia
- Italy
- Luxembourg
- Hungary
- Austria
- Poland
- Romania
- Slovenia
- Slovakia

The work of the Ukraine risk group was coordinated by Italy. The regional parts of this Preventive Action Plan rely on the regional working document compiled by Italy in charge of coordinating the Ukraine risk group; in particular, Chapter 10. (Regional dimension) and Appendix I (Description of the gas system per Member State in the Ukraine Risk Group) have been inserted here in adapted form in English.

1. System description

1.1. Description of the natural gas system of the Ukraine risk group

At regional level, Hungary belongs to the Ukraine risk group. The Ukraine risk group comprises of the following Member States:

- Austria
- Bulgaria
- Czech Republic
- Greece
- Croatia
- Poland
- Luxembourg
- Hungary
- Germany
- Italy
- Romania
- Slovakia
- Slovenia

1. *Figure 1: Members States of the Ukraine risk group (source: joint risk assessment performed by the Ukraine risk group)*

The following table shows group level data for the natural gas systems of the Member States included in the Ukraine risk group:

Member State	Ep_m	LNG_m	S 100%	S 30%	P_m	D_{max}
Austria	-	-	66.4	44.4	3.4	55.3
Bulgaria	-	-	4.2	2.9	0.6	18.2
Croatia	-	-	5.8	3.2	3.5	16.6
Czech Republic	-	-	59.1	41.0	0.5	68.2
Germany	471.0	-	612.4	479.3	26.2	474.8
Greece	4.5	20.2	-	-	-	20.1
Hungary	82.9	-	78.6	68	5.5	77.4
Italy	133.6	51.9	263.2	171.8	15.5	443.0
Luxembourg	4.3	-	-	-	-	4.8
Poland	137.7	14.4	51.5	40.7	7.2	86.7
Romania	103.7	-	29.0	-	26.0	72.0
Slovakia	250.9	-	52.61	39.5	0.2	45.1
Slovenia	-	-	-	-	-	4.9
Total	1 188.6	86.5	1 170.2	890.8	88.6	1 387.1

Table 1: Aggregate core data in million m^3/day for the natural gas systems of the Member States included in the Ukraine risk group, 2018/2019 (source: joint risk assessment performed by the Ukraine risk group)

- Ep_m: Maximum technical capacity of external entry points
- LNG_m: Maximum technical LNG facility capacity
- S 100%: Maximum technical withdrawal capacity (at 100% stock level)
- S 30%: Maximum technical withdrawal capacity (at 30% stock level)
- P_m: Maximum technical production capability
- D_{max}: Total daily gas demand (1/20)

As compared to typical demand in the heating season, the storage capacity is satisfactory, accounting for nearly 85% of the highest winter daily demand at 100% stock level. The maximum daily withdrawal capacity covers almost 65% of the peak day demand even at 30% stock level. Though the region's high own (domestic) daily peak production of 88.6 million m^3/day significantly contributes to supply security, it covers only 6% of the daily peak demand.

Many gas-fired (base-load) power plants are operated for electricity generation in the region, although no accurate regional information is available.

The energy efficiency obligation scheme exists only in a minority of countries in the region, yet each Member State applies policy measures in an effort to reduce the consumption of natural gas and increase energy efficiency. No detailed data is available regarding the current effect of the above measures on the consumption of natural gas.

The detailed data for the natural gas systems of each country is included in the joint risk assessment of the Ukraine risk group as follows:

- Transmission system entry and exit point capacities

- Transmission system entry and exit point utilisation rates
- List of storage facilities and their combined capacity
- Detailed natural gas production data of the countries in the region

Appendix I gives a short description of the natural gas systems of the Member States in the region (except for Hungary).

1.2. Description of the natural gas system of Hungary

1.2.1. Natural gas consumption in Hungary

In Hungary, the actual volume sold on the end-user market for natural gas increased until 2005, almost reaching 14 billion m^3, but then dropped considerably leading to a domestic consumption of less than 8 billion m^3 by 2014. The past few years have been marked with a slight rise and no decrease at all. The following graph shows how natural gas consumption by end-users has evolved in Hungary since 2005 (million m^3/year, 15°C):

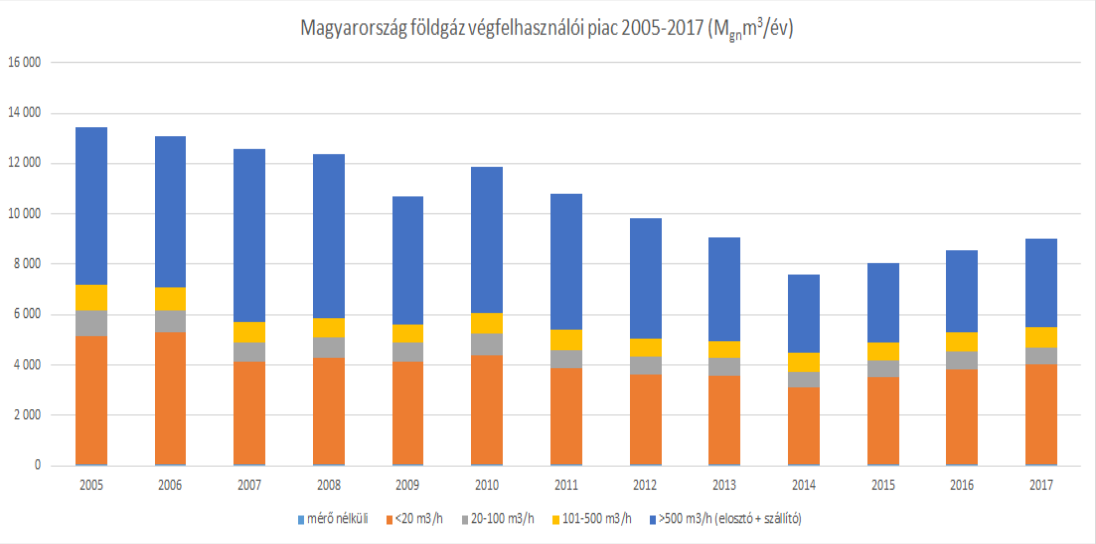


Figure 2: Natural gas consumption by end-users in Hungary (figures in million m^3/year, 15°C, source: MEKH)

The table below shows the data for various user groups for ***2014–2017***:

Hungary – actual annual natural gas end-user consumption (million m^3/year)	**2014**	**2015**	**2016**	**2017**
without meter	63	62	65	65
<20 m^3/h	3 034	3 443	3 748	3 941
20–100 m^3/h	644	696	726	706
101–500 m^3/h	729	712	777	775
>500 m^3/h (distribution + transmission)	3 138	3 133	3 224	3 547
End-users total	**7 608**	**8 046**	**8 540**	**9 034**

Table 2: Natural gas consumption by end-users in Hungary for 2014–2017 (figures in million m^3/year, 15°C, source: MEKH)

During the 4 years in the 2014–2017 period, the total natural gas consumption by end-users fluctuated between 7.6 and 9 billion m^3 in Hungary.

Adjusting the figures for temperature effects gives the following result:

Hungary – adjusted annual natural gas end-user consumption (million m^3/year)	**2014**	**2015**	**2016**	**2017**
without meter	63	62	65	65
<20 m^3/h	3 535	3 550	3 748	3 936
20–100 m^3/h	737	715	731	706
101–500 m^3/h	794	725	777	775
>500 m^3/h (distribution + transmission)	3 984	3 965	3 224	3 563
End-users total	**9 112**	**9 016**	**8 545**	**9 045**

Table 3: Adjusted natural gas consumption by end-users in Hungary for 2014–2017 (figures in million m^3/year, 15°C, source: MEKH)

In view of average temperature data, no significant fluctuation of consumption is present in the 4 years under review. When adjusted for temperature effects, the end-user market varies between 8.5 and 9.1 billion m^3. The fluctuation is caused primarily by the industrial segment and, in particular, the hectic nature of gas-fired power plants.

1.2.2. Natural gas consumption peaks

The analysis of daily consumption trends is crucial for determining the real natural gas demand of the country and, in particular, the study of peak consumption values is important for the security of supply.

The following graph represents the actual consumption peaks in Hungary:

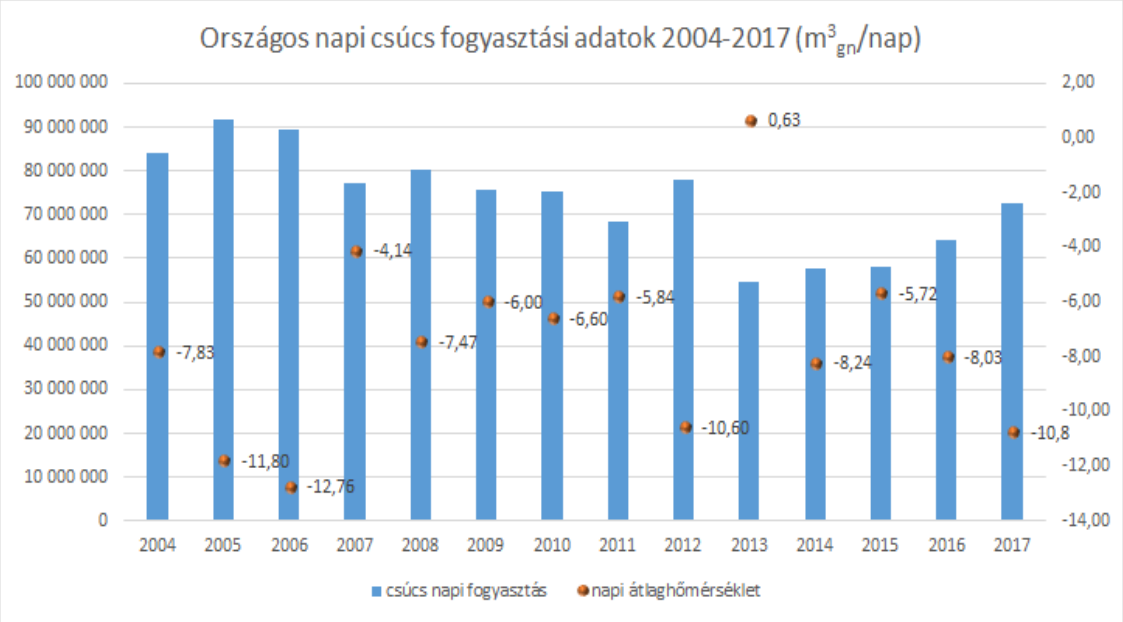


Figure 3: Daily peak natural gas consumption in Hungary for 2004–2017 (figures in million m³/year, 15°C, source: FGSZ Zrt.)

It is evident that when the Hungarian national annual consumption was higher, the daily peak consumption also showed a higher value and in 2005 it even exceeded 90 million m³/day. The shrinking of the market size was accompanied by a downturn in peaks, the extent of which was certainly influenced primarily by external temperatures as well. In Hungary, the average daily mean temperature of peak days has rarely dropped to -10 C in the past 10 years (colder weather was more frequent before). In 2017, the average daily mean temperature during peak consumption was almost -11°C, yet the peak volume barely exceeded 70 million m³/day. In 2017, the second highest national peak value was recorded on 07.01.2017, with an average daily external temperature of -12,57°C, but the daily consumption amounted only to 71.8 million m³/day.

Hungary – maximum daily peak consumption by year (thousand m³/day)	**2014**	**2015**	**2016**	**2017**
Direct transmission pipeline users	5 670	5 464	7 679	8 945
Distribution system users	49 070	50 177	54 113	60 394
Other:	2 850	2 392	2 383	3 286
Total	**57 590**	**58 033**	**64 175**	**72 626**

Table 4: Peak natural gas consumption by end-users in Hungary for 2014–2017 (figures in thousand m³/day, source: FGSZ Zrt.)

1.2.3. Operation of the natural gas system at national level

The natural gas sector has been subject to market liberalisation in Hungary since 2004. The former utility-based market model was gradually replaced by a competitive market place, the establishment of which was justified also by Hungary's accession to the European Union and the demands of natural gas consumers (customers). Every user (including the population) is free to choose among the gas traders.

The following figures show the current natural gas market model:

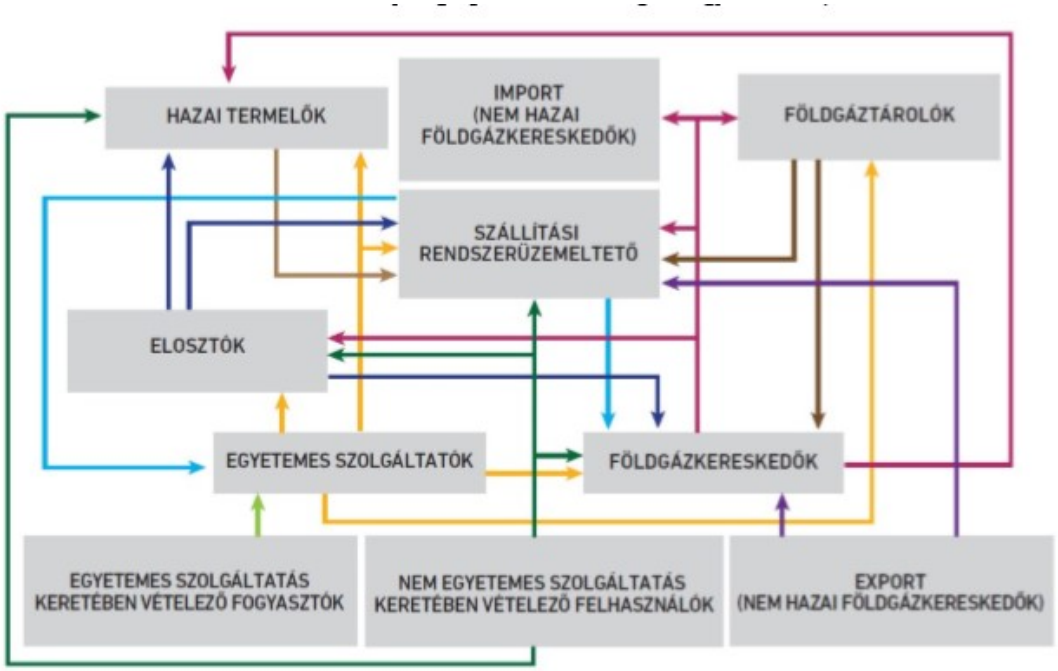


Figure 4: Natural gas market model in Hungary (source: MEKH)

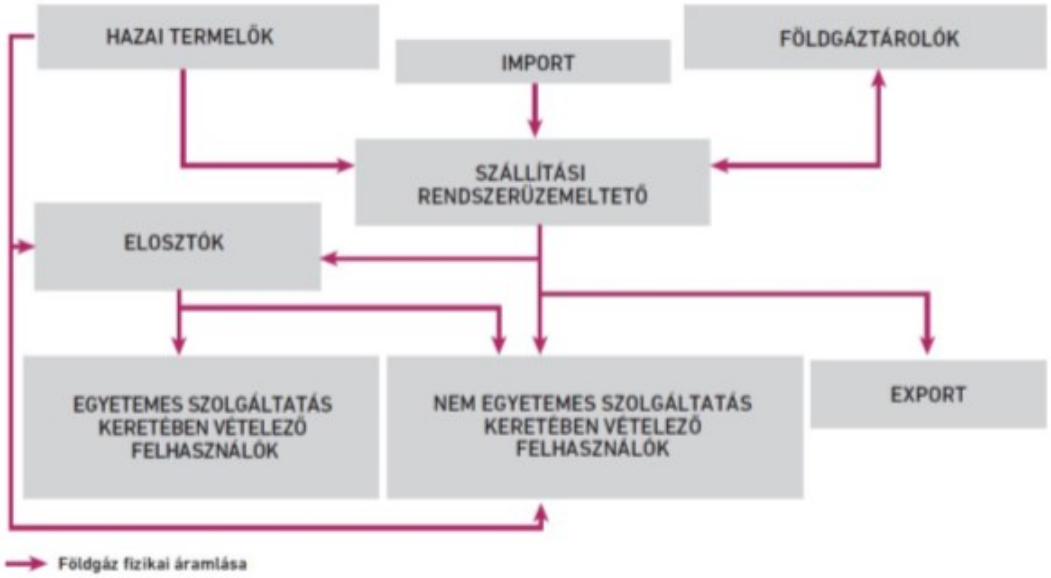


Figure 5: Physical flow of natural gas in Hungary (source: MEKH)

The natural gas produced in Hungary or imported from abroad enters the network at the entry points of the national transmission system. When produced, natural gas must first be made suitable – through technological processes – for entering the transmission systems.

A part of the natural gas is forwarded with the use of compressors at appropriate pressure along the high-pressure (25–64 bar) transmission network to the gas transfer stations (exit points) of the transmission lines, where it is made subject to deodorisation and pressure reduction before being delivered to users via the distribution networks.

Another part of the natural gas, mostly in summer, is directed to storage facilities and not to users. The reason is that the use of natural gas shows a seasonal character in Hungary i.e. consumption is much higher in winter than in summer. While daily consumption can go up to 70–80 million m^3 in winter, only 14–15 million m^3 is used on a summer day. This is due to the fact that natural gas is used mostly as a basic energy for heating during the winter period. In winter, apart from locally produced and imported natural gas, a large amount of gas is transferred to the system also from the storage facilities.

Natural gas is kept at a pressure of 30 mbar–25 bar in the distribution systems. The so-called receipt stations, operating at the boundaries of municipalities or parts thereof, control the pressure values as necessary in order to ensure that the users will always receive natural gas with the appropriate parameters. Metering is performed at the place of consumption and further pressure reduction is done before the end users.

1.2.4. Critical infrastructures for the security of gas supply

Most important infrastructures for the security of gas supply in Hungary:

- Transmission and transmission system operator infrastructure
- Storage infrastructure
- Distribution infrastructure
- Production infrastructure

Such important infrastructures include several elements, of which ***the following elements and points may be considered as particularly critical for the security of gas supply in Hungary***:

Transmission system

- ***Beregdaróc entry point:*** entry point for natural gas arriving from Ukraine.
- ***Mosonmagyaróvár entry point:*** entry point for natural gas arriving from Austria.
- ***Balassagyarmat entry point:*** entry point for natural gas arriving from Slovakia.
- ***Siófok TSO centre:*** dispatcher centre responsible for controlling the transmission system of FGSZ Zrt.
- ***Compressor stations***

The following may be considered after the risk assessment:

- ***Csanádpalota entry point:*** Hungary/Romania interconnector entry point
- ***Drávaszerdahely entry point***: Hungary/Croatia interconnector entry point

Storage system:

- ***Pusztaederics storage facility:*** it plays an important role in the gas supply of the Transdanubia region.
- ***Zsana storage facility:*** it is important for the gas supply of protected customers (mainly the population).
- ***Hajdúszoboszló storage facility:*** it is important for the gas supply of protected customers (mainly the population).
- ***Szőreg storage facility:*** it is important for the storage of back-up (strategic) gas stocks and for the gas supply of protected customers (mainly the population).

The following may be considered after the risk assessment:

- ***Kardoskút: it is important for the gas supply of protected customers (mainly the population).***

Please find below the details of each infrastructure making up the natural gas system.

1.2.5. Transmission and transmission system operator infrastructure

Currently, FGSZ Zrt. operates and supervises the transmission infrastructure in Hungary.

Figure 6: Map of Hungary's transmission system (source: MEKH, FGSZ Zrt.)

FGSZ Zrt. operates a fully integrated gas transmission system. The main elements are as follows:

- Entry points
- Compressor stations
- Pipeline nodes
- High-pressure pipeline system
- Gas transfer stations, other exit points

Natural gas is supplied to gas trade licensees, power plants and industrial consumers through the high-pressure pipeline system.

Natural gas enters the high-pressure pipeline system of FGSZ Zrt. – via the entry points – from import sources, domestic gas fields and domestic storage facilities. The system is composed of steel pipelines of a total length of almost 5 900 km, operated at an authorised pressure of

63 bar (or, in specific cases, 75 bar) and thus the actual gas pressure inside the pipelines is lower than that.

At the compressor stations there are gas turbine driven centrifugal compressors designed to increase system capacity by increasing the gas pressure, ensuring that natural gas is delivered to consumers through the pipelines. Currently, seven compressor stations are in operation. Natural gas transmission nodes are established at the connection points of the pipeline system, which serve for gas distribution and transmission towards the distribution pipelines.

The gas transmitted via the pipeline system exits at the gas transfer stations. Currently, almost 400 gas transfer stations are operated with the main task of ensuring the continuous transmission and delivery of natural gas to connected system operators and direct industrial consumers in a controlled manner. There is a continuous natural gas volume metering and quality control at all entry and exit points.

The national system's control tasks are performed by 6 regional centres of 3 regions and by the national dispatcher centre in Siófok. The odourisation of natural gas is carried out in line with legal requirements and based on contracts with system users. A cathode protection system is in place covering the entire steel transmission pipeline system and ensuring the prevention of pipeline corrosion.

Main capacity data of the natural gas transmission system (as of 2018):

Entry capacities

Capacity data	Daily firm capacity (million m^3)	Daily interruptible capacity (million m^3)
Ukraine/Hungary interconnector entry point (Beregdaróc)	56.3	15
Austria/Hungary interconnector entry point (Mosonmagyaróvár)	12.1	2.3
Hungary/Romania interconnector entry point (Csanádpalota)	0.24	4.56
Hungary/Croatia interconnector entry point (Drávaszerdahely)	0	19.2
Hungary/Slovakia interconnector entry point (Balassagyarmat)	12	
Net domestic production (14 entry points)	7.1	
Commercial underground gas storage facilities (5 entry points)	53.1	6.5
Strategic underground gas storage facility (1 entry point)	20	

Table 5: Entry points of transmission pipelines in Hungary, 2018

Exit capacities

Capacity data	Daily firm capacity (million m^3)	Daily interruptible capacity (million m^3)
Hungary/Serbia interconnector exit point (Kiskundorozsma)	13.2	
Hungary/Romania interconnector exit point (Csanádpalota)	4.8	
Hungary/Ukraine interconnector exit point (Beregdaróc)	0	16.8
Hungary/Croatia interconnector exit point (Drávaszerdahely)	7.2	12
Hungary/Slovakia interconnector exit point (Balassagyarmat)		4.8

Table 6: International exit points of transmission pipelines in Hungary, 2018

There have been two major changes with regard to entry and exit capacities since 2018:

- Thanks to a capacity enlargement, the transmission capacity towards Hungary has increased to 4.8 million m^3/day at the Romania/Hungary cross-border entry point.

Thanks to an investment project for automated flow direction change, the capacity in the direction of Slovakia along the Hungary/Slovakia interconnector has become a firm capacity. The availability of the transmission system of FGSZ Zrt. is guaranteed by a 24-hour standby service operating on the basis of standby stocks and using its own network of mechanics. The tools and stocks used by the transmission system operator licensee ensure the troubleshooting of the majority of potential technical disorders within 24 hours.

1.2.6. Natural gas storage facilities

Hungary has substantial natural gas storage capacities. In Hungary, the storage infrastructure (e.g. wells, surface technology) is developed and operated by storage licensees in line with legislative provisions and according to the standard set out in industry regulations.

Currently, the following storage licensees operate in Hungary:

- Magyar Földgáztároló Zrt. – storage facilities: Hajdúszoboszló, Zsana, Pusztaederics, Kardoskút
- MMBF Földgáztároló Zrt. – storage facility: Algyő-Szőreg

The following table summarises the main data of storage facilities in Hungary:

	Name of storage facility	Mobile capacity (million m^3/year)	Theoretical withdrawal capacity (million m^3/day)
1.	Hajdúszoboszló	1 640	19.8
2.	Zsana	2 170	28
3.	Pusztaederics	340	2.9
4.	Kardoskút	280	2.9
5.	Algyő, Szőreg *of which: security purposes*	1 900 *1 200*	25 *20*
	Total	***6 330***	***78.6***

Table 7: Maximum mobile and withdrawal capacities of natural gas storage facilities in Hungary (source: MFGT Zrt., MMBF Zrt.)

The following figure shows the geographical location of the storage facilities:

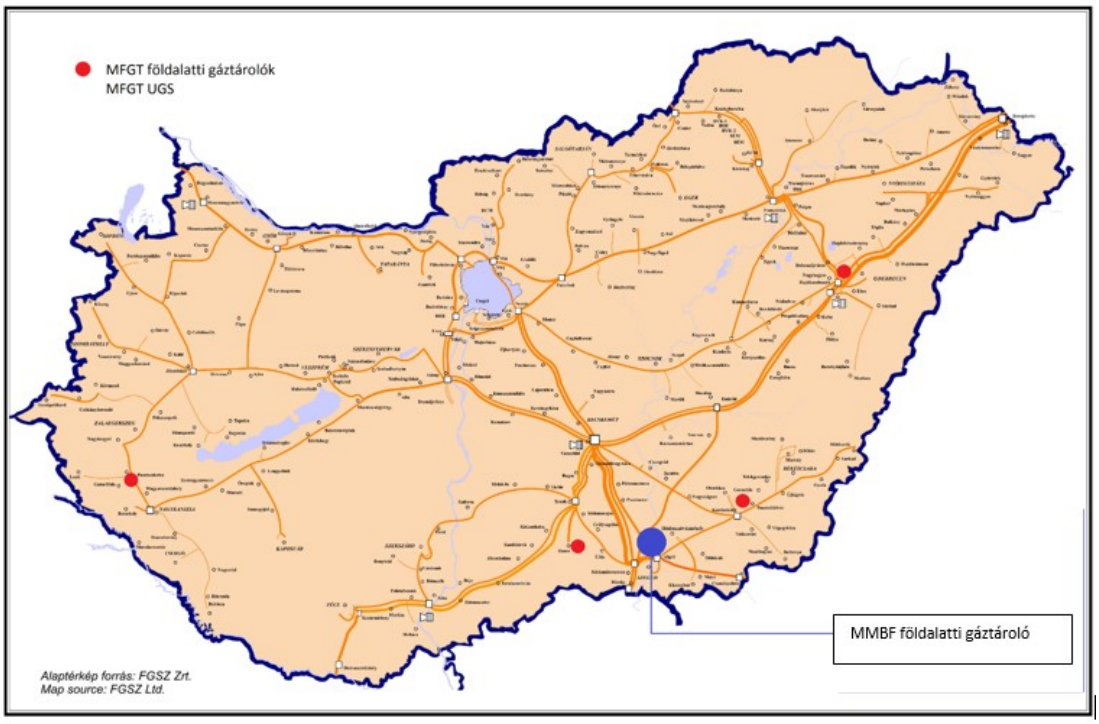


Figure 7: Geographical location of storage facilities in Hungary (source: FGSZ Zrt.)

The commercial storage facilities can hold more than 5 billion m^3 mobile gas and offer a theoretical withdrawal capacity of 58.6 million m^3/day. Furthermore, the Szőreg storage facility represents a separate mobile gas stock of 1.2 billion m^3 and offers a withdrawal capacity of 20 million m^3/day.

In Hungary, the total storage capacity amounts to 6.33 billion m^3 and offers a theoretical peak withdrawal capacity of 78.6 million m^3/day. Given that the theoretical withdrawal capacity of the storage facilities strongly depends on their actual stock levels, the real withdrawal capacity is lower than the theoretical value in a certain part of the year.

The availability of the storage infrastructure is guaranteed by a 24-hour standby service operating on the basis of standby stocks and using its own network of mechanics. The tools and stocks used by the storage licensees ensure the troubleshooting of the majority of potential technical disorders within 24 hours.

Given that up until 2018 the storage capacity in Hungary was considerably larger than domestic end user demands, the stock levels in the storage facilities at the start of the gas year failed to reach 100% until 2018 in lack of domestic market demand. This trend changed in 2019, resulting in utilisation rates of almost 100% for the storage facilities ever since.

The following table shows, at different exit levels, the aggregate withdrawal capacity values of storage facilities run by various operators:

Stock level	100 %	90%	80%	70%	60%	50%	40%	30%	20%	10%	0%
Aggregate decline curve for the 4 storage facilities operated by MFGT (withdrawal capacity million m^3/day)	53.61	53.61	53.61	53.61	52.89	51.46	50.03	44.51	38.74	27.65	21.50
Decline curve for the storage facility operated by MMBF (exit capacity million m^3/day)	25	25	25	25	25	25	25	24	22.5	21	20

Table 8: Withdrawal capacities of storage facilities in Hungary at different stock levels, 2018

The decline curves assigned to the storage facilities provide a good basis for determining the withdrawal capacity in the function of stock levels:

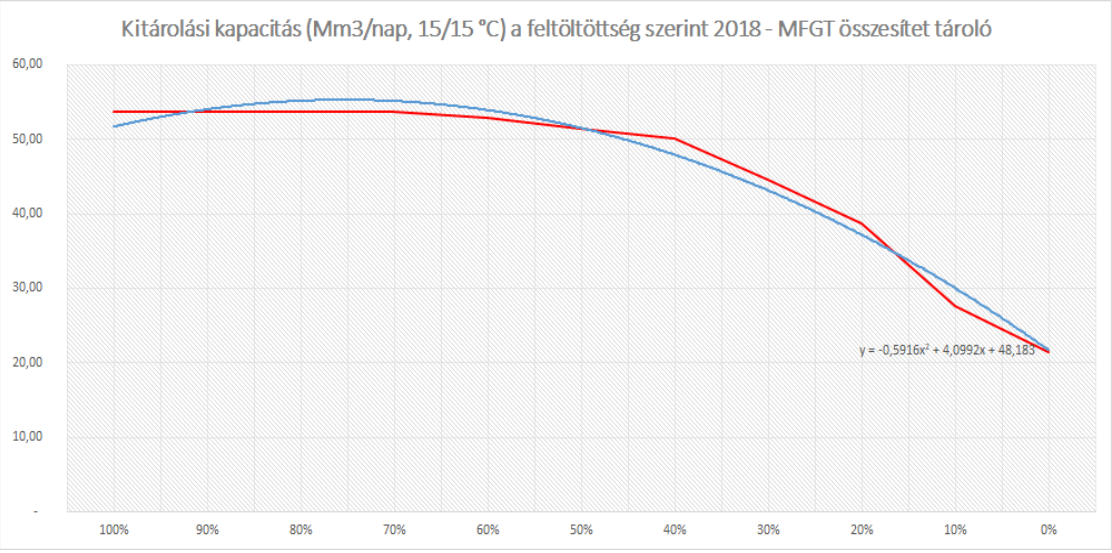


Figure 8: MFGT decline curve (source: MFGT Zrt.)

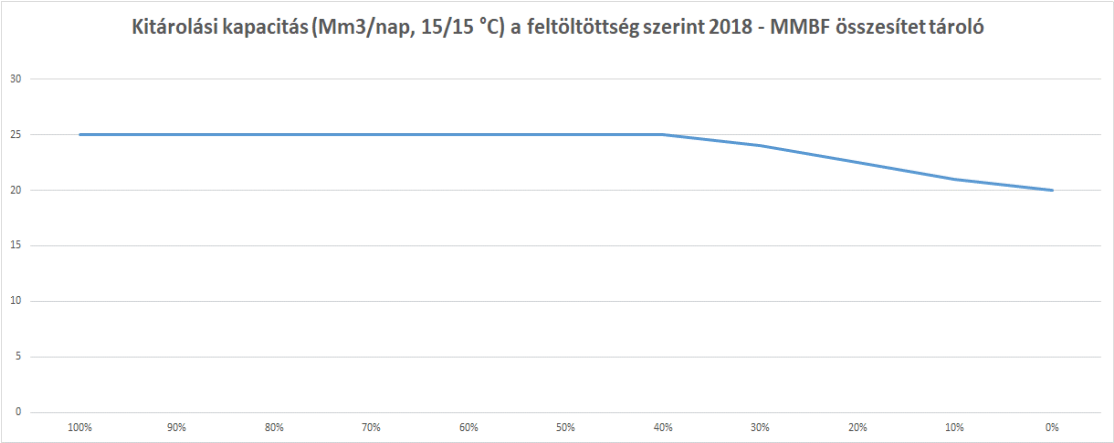


Figure 9: MMBF decline curve (source: MMBF Zrt.)

It is clear from the foregoing that at 30% stock levels the withdrawal capacity decreases from 78.6 million m^3/day to 68 million m^3/day (44 million m^3/day for MFGT Zrt. and 24 million m^3/day for MMBF Zrt.).

1.2.7. Distribution infrastructure

In Hungary, the distribution infrastructure is developed and operated by distribution licensees in line with legislative provisions and according to the standard set out in industry regulations.

In Hungary, the main distribution licensees are as follows:

- E.ON DDGÁZ Zrt.
- E.ON KÖGÁZ Zrt.
- NKM Észak-Dél Földgázhálózati Zrt.
- NKM Földgázhálózati Kft.
- TIGÁZ Földgázelosztó Zrt.

Furthermore, there is a medium-sized distribution licensee (Magyar Gázszolgáltató Kft.) and five smaller ones (Csepeli Erőmű Kft., ISD POWER Kft., NGS Kft., OERG Kft., E.GAS Gázelosztó Kft.) supplying mainly industrial areas and some municipalities in Hungary.

In Hungary, the main elements of the distribution infrastructure are as follows:

- Distribution pipelines: their starting point is the exit point of gas transfer stations and their endpoint is the site boundary of the place of consumption. The pipelines of standardised diameter are made of steel or polyethylene. According to operating pressure, the following types exist:
    - High-pressure distribution pipeline (above 25 bar)
    - High medium-pressure distribution pipeline (between 4 and 25 bar)
    - Medium-pressure distribution pipeline (between 100 mbar and 4 bar)
    - Enhanced low-pressure distribution pipeline (between 85 and 100 mbar)
    - Low-pressure distribution pipeline (between 28 and 33 mbar)

    - Pressure regulating and metering stations: equipment used for safe gas pressure reduction and, eventually, completed with gas volume metering devices.
- District pressure regulating stations: characterised mostly with entry operating pressure values between 1 and 25 bar and exit pressure values between 300 mbar and 4 bar.
- Municipality receipt stations: providing gas supplies to one or more municipalities, or parts thereof; in general, their entry pressure is between 6 and 25 bar and their exit pressure is between 1 and 12 bar.
- Industrial gas receipt station: providing gas supplies to an industrial consumer.
- Distribution dispatcher centre: central unit providing remote supervision for the distribution system.

The availability of the distribution infrastructure is guaranteed by a 24-hour standby service operating on the basis of standby stocks and using its own network of mechanics. The tools and stocks used by the system operators ensure the troubleshooting of local supply disorders within a few hours. Thus the distributors provide a solid foundation for the national security of supply and guarantee the regional security of supply for groups of smaller consumers.

1.2.8. Natural gas production

Hungary has its own natural gas production. The produced natural gas is fed into transmission pipelines or distribution pipelines or forwarded directly to customers. The following main market players feed into the transmission and distribution systems:

- MOL Nyrt.
- O&GD Central Kft.

Furthermore, several other production companies are on the market with smaller volumes:

- HHE North Kft.
- PetroHungaria Kft.
- RAG Hungary Kft.
- TÉT-3 Gázkút Kft.
- TXM Olaj- és Gázkutató Kft.
- Magyar Horizont Kft.

The following figure shows the main entry points of natural gas production:

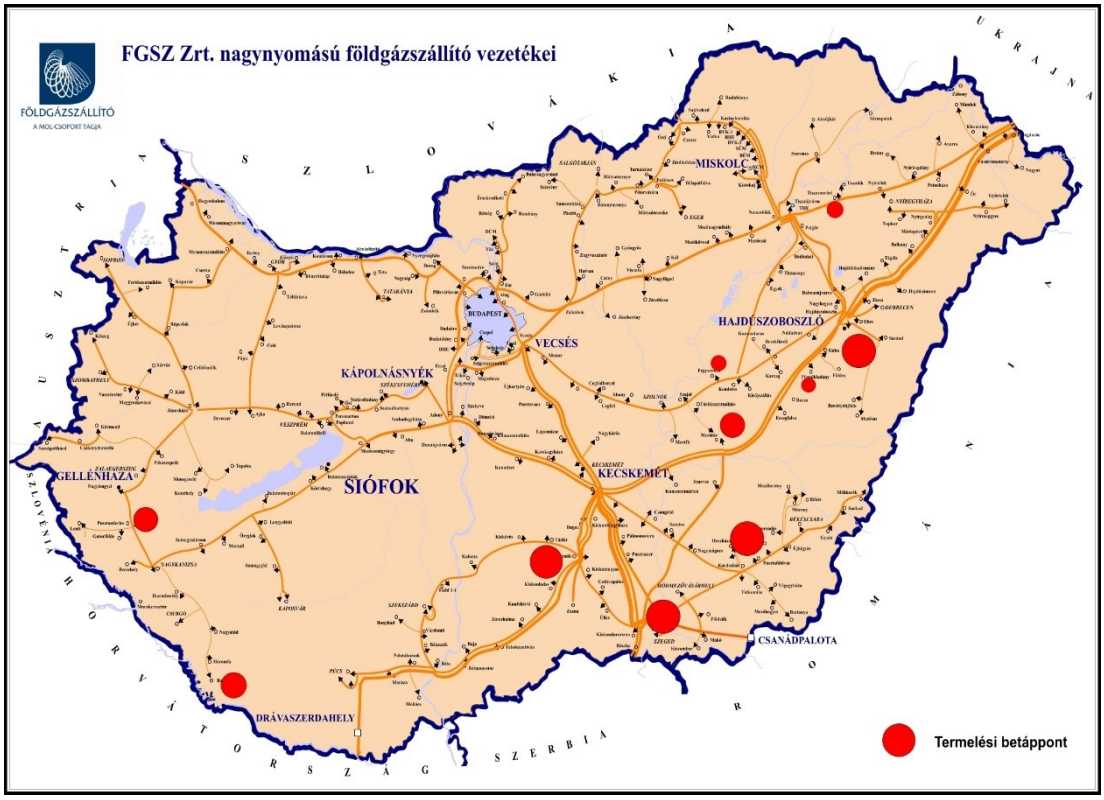


Figure 10: Main entry points of natural gas production in Hungary, 2018 (source: FGSZ Zrt.)

In Hungary, the production infrastructure (e.g. wells, compressors, preparatory plants, production pipeline system) is developed and operated by natural gas producers in line with legislative provisions and according to the standard set out in industry regulations.

The following table shows the volume of natural gas produced in Hungary between 2014 and 2017. The production volume remained unchanged also in 2018–2019.

(m^3_{gn}/year) – national	2014	2015	2016	2017
Gross	2 447 970	2 131 669	2 259 948	2 500 718
Net	1 712 440	1 547 102	1 564 201	1 734 259
Transferred for sale*	1 622 440	1 457 102	1 474 201	1 644 259

Table 9: Natural gas produced in Hungary (2014–2017) (m^3/year)

- Gross production: total gas volume deriving from hydrocarbon fields, based on the declaration of mining fees.
- Net production: total gas volume obtained less the volume of produced or separated carbon dioxide and the volume of condensates.
- Transferred for sale: net gas volume produced less own consumption (gas volume used for eventual pressure boost or in the preparation for transmission via pipelines), technical losses and gas volume reinjected for cultivation purposes

(million m^3_{gn}/year) – national	2014	2015	2016	2017
End user market in Hungary	7 608	8 046	8 540	9 034
Domestic natural gas production in Hungary	1 712	1 547	1 564	1 734
Production/market ratio	23%	19%	18%	19%

Table 10: Ratio between natural gas production and end user market in Hungary (2014–2017)

In comparison with the size of the end user market, domestic net production has accounted for an average market share of 20% in the past few years.

1.2.9. Sources of natural gas imports

As to the sources of natural gas imports, Hungary has commercial information only about the direction from which the imported natural gas reaches the country.

The following table shows this breakdown for 2014–2017:

Annual import volume	**million m^3**/year (15°C)	Mosonmagyaróvár (AT>HU)	Beregdaróc (UKR>HU)	Csanádpalota (RO>HU)	Balassagyarmat (SK>HU) connection point	**Total**
2014	million m^3/year	4 107	4 828	0	3	**8 938**
2015	million m^3/year	2 773	3 992	0	24	**6 789**
2016	million m^3/year	3 965	4 636	0	16	**8 618**
2017	million m^3/year	4 143	9 195	27	2	**13 367**

Table 11: Gas flow at the external entry points of Hungary's natural gas transmission system, 2018 (source: FGSZ Zrt., MGT Zrt.)

It is clear from the table that:

- Up until 2017, Hungary received natural gas principally from the direction of Ukraine and Austria.
- Based on the available data, the probable physical source of the natural gas received by Hungary is thought to be Russia.

The role of the Balassagyarmat entry point has increased since the date of the risk assessment and, in particular, since 2019. The low gas flow of former years has changed significantly:

- A considerable volume of natural gas is arriving from the direction of Slovakia via the Balassagyarmat entry point to Hungary since September 2019. There were some days in 2019 (11 and 12 October) when recorded imports amounted to 12 million m^3.
- In 2020, this entry point handles a daily gas flow between 6 and 12 million m^3.

Three important remarks with regard to natural gas sent to Hungary from the direction of Ukraine:

- Hungary receives, via the Beregdaróc import point, a large volume of natural gas transit to be transmitted in the direction of Serbia (approximately amounting to 1 600–2 200 million m^3/year).
- The rise in the volume of natural gas sent to Hungary via the Beregdaróc import point was caused, on the one hand, by the appearance of short-distance transits and, on the other hand, by the increased storage demands in Hungary.

The 2018–2020 period saw a rise of deliveries in the direction of Ukraine; this fact also has an impact on the extent of registered gas import, as a result of netting the gas flow, at the Beregdaróc import point.

1.2.10. The role of natural gas in electricity generation

Due to the role played by gas-fired power plants in electricity generation in Hungary, it is indispensable to examine the impacts on the electricity supply when assessing the country's security of natural gas supply.

In addition to the Paks Nuclear Power Plant, gas-fired power plants play an important role in Hungary's electricity supply; electricity generated from natural gas accounted for 22% of total electricity output in 2017. This share has been rising since 2014, given that after the low point in 2014 electricity generation by gas-fired power plants has started to increase again.

The following table shows the installed power plant production capacities in Hungary broken down by primary fuel (MW) (2014–2017):

MW	**2014**	**2015**	**2016**	**2017**
Coal	1 291.60	1 291.60	1 096.34	1 096.34
Petroleum products	1.43	1.43	1.43	1.43
Natural gas	**3 330.32**	**3 316.29**	**3 318.93**	**3 384.22**
Fissile material	2 000.00	2 000.00	2 000.00	2 000.00
Renewables, of which:	650.95	627.37	655.96	708.10
biomass	*141.30*	*141.30*	*141.30*	*141.30*
biogas, landfill gas, sewage gas	*65.16*	*77.10*	*81.16*	*84.29*
wind	*324.48*	*324.48*	*324.25*	*324.25*
hydro	*92.97*	*58.11*	*57.88*	*57.88*
geothermal	*0.00*	*0.00*	*0.00*	*3.25*
solar	*23.80*	*26.39*	*51.38*	*100.39*
Other energy sources	110.91	110.91	110.91	110.91
GRAND TOTAL:	**8 033**	**7 975**	**7 840**	**8 012**
Share of natural gas	**41%**	**42%**	**42%**	**42%**

Table 12: Installed power plant production capacities in Hungary for 2014–2017 (source: MEKH)

The following table shows the electricity generation output in Hungary broken down by primary fuel (MW) (2014–2017):

MWh/year	**2014**	**2015**	**2016**	**2017**
Coal	6 008 578	5 806 995	5 653 231	4 934 829
Petroleum products	64 840	52 273	45 763	82 973
Natural gas	**4 244 148**	**5 121 750**	**6 452 094**	**7,819,199**
Fissile material	15 648 627	15 834 395	16 053 917	16 097 599
Renewables, of which:	3 088 752	3 002 982	2 990 373	3 120 579
biomass	*1 687 903*	*1 624 756*	*1 490 977*	*1 521 268*
biogas, landfill gas, sewage gas	*292 062*	*316 183*	*353 082*	*333 388*
wind	*656 539*	*693 326*	*694 752*	*769 034*
hydro	*301 551*	*233 761*	*259 863*	*220 312*
geothermal	*0*	*0*	*0*	*226*
solar	*7 626*	*12 281*	*55 708*	*119 393*
Other energy sources	445 255	554 163	693 732	714 903
GRAND TOTAL:	**32 445 881**	**33 252 865**	**34 743 492**	**35 733 703**
Share of natural gas	**13%**	**15%**	**19%**	**22%**

Table 13: Electricity generation output in Hungary broken down by fuel for 2014–2017 (source: MEKH)

As a result of their quick regulability, Hungary's gas-fired power plants are primarily used for supplying the balancing reserves of the electricity system (mostly as secondary reserves), which is indispensable for the smooth functioning of the electricity system.

Under the current Hungarian legislation, gas-fired power plants with an installed capacity above 50 MW belong to the category of entities that may be restricted in the first round in a crisis situation regarding the security of natural gas supply i.e. they will be the first ones to be restricted when ordered so. In order to maintain the electricity system's security of supply, such power plants must keep fuel oil reserves enabling them, after the fuel switch, to generate the electricity required for the balance of the electricity system for up to a duration of 8–16 days. The required reserves are specified also with a view to ensuring sufficient time needed for replenishing the alternative fuel when the crisis situation regarding the security of natural gas supply is delayed.

Natural gas is not only used for energy generation but it also plays a major role in cogeneration in Hungary. The following table shows the combined heat and power production capacities in Hungary broken down by primary fuel (2014–2017, MW):

figures: MW	**2014**	**2015**	**2016**	**2017**
Coal	1 291.60	341.60	146.34	146.34
Petroleum products	1.43	1.43	1.43	1.43
Natural gas	**2 369.32**	**2 355.29**	**2 355.93**	**2 421.22**
Renewables, of which:	156.66	168.60	172.66	225.59
biomass	91.50	91.50	91.50	141.30
biogas, landfill gas, sewage gas	65.16	77.10	81.16	84.29
Other energy sources***	93.67	93.67	93.67	93.67
Grand total:	**4 069.34**	**3 129.18**	**2 942.69**	**3 113.83**
Share of natural gas:	**58%**	**75%**	**80%**	**78%**

Table 14: Cogeneration capacities in Hungary (2014–2017)

1.2.11. Role of energy efficiency measures

As part of the Europe 2020 Strategy aiming for smart, sustainable and inclusive growth, the European Union adopted the Energy Efficiency Directive (EED) that required Member States to achieve a 20 % energy efficiency target in the 2014–2020 period.

Article 7 of the legally binding Directive calls for the achievement of new savings each year from 1 January 2014 to 31 December 2020 of 1.5% of the annual energy sales to final customers of all energy distributors or all retail energy sales companies by volume. Such final energy efficiency savings may be achieved by implementing energy efficiency obligation schemes (EEOS), taking alternative policy measures and applying these two tools together.

In view of Article 7 of the EED, Hungary had to achieve new savings of 45.3 PJ and cumulative end-use energy savings of 167.5 PJ each year in 2014–2020 within the framework of the 4th National Energy Efficiency Action Plan. So far Hungary has used policy measures to comply with its obligations set out in Article 7.

According to a Commission analysis, during the first three years Hungary achieved – in contrast with the EU average of 24% – only 17% of the cumulated savings target set for 2020 and thus ranked 20th out of the 28 EU Member States. According to the latest (2017) annual report, the value of new and cumulated savings has increased. Almost two-thirds of the savings accounted for since 2014 originated from investment aids.

Based on the data of the Ministry of Innovation and Technology – in view of estimated lifetimes –, the energy savings achieved through policy measures amounted to 119.057 PJ between 2014 and 2018. If calculated pro rata temporis, it corresponds to 71.07% of the energy savings target set for 2014–2020, falling below the target of 89.29% calculated pro rata temporis.

Az energiaunió dimenziói	Indikátorok	EU-s szintű célszámok 2030-ra	Célok 2030-ra	Hazai helyzetkép, 2017	Főbb intézkedések
Dekarbonizáció	**ÜHG kibocsátás csökkentés 1990-hez képest**	min. -40%	**min. -40%**	-31,9 %	▪ Villamosenergia-mix klímabarát átalakítása ▪ Energiahatékonysági kötelezési rendszer ▪ Közlekedés zöldítés
	▪ A GDP ÜHG intenzitása		az ÜHG intenzitás folyamatos csökkentése	1,98 t CO_{2e}/millió Ft	
	▪ A nem-ETS kibocsátások csökkentése 2005-höz képest	min. -10%	min. -7%	-9,3%	
	A megújuló energia részaránya a bruttó végsőenergia-felhasználáson belül	min. 32%	**min. 21%**	13,33%	▪ Napelem ▪ E-mobilitás ▪ Zöld Távhő Program
Energia-hatékonyság	**Végsőenergia-felhasználás**	Indikatív 32,5%-os megtakarítás	**max. 785 PJ** A többletfelhasználás forrása csak megújuló energia lehet 2030 és 2040 között.	775 PJ	▪ Végfelhasználás csökkentése (évi 0,8% megtakarítás) ▪ Ipari energiahatékonysági beruházások ösztönzése

Figure 12: Energy efficiency targets of the European Union and Hungary (source: Ministry of Innovation and Technology, KPMG)

In addition to policy measures, a new energy efficiency obligation scheme may also contribute to the achievement of energy efficiency targets in the 2021–2030 period. Based on Hungary's National Energy and Climate Plan and the Hungarian Energy Strategy 2030 published in January 2020, the Hungarian Government has set the objective to introduce the energy efficiency obligation scheme from 2021.

Currently, no data is available for the presentation of savings with regard to natural gas.

2. Summary of risk assessment

2.1. Risk events under review

At the time of conducting the risk assessment, the individual risk events were ***identified*** and evaluated on the basis of ***extensive industry consultations***. The results are summarised in the following table:

Risk classification	Number of classified risk events
Events classified as acceptable risk	140
Events classified as moderate risk	56
Events classified as significant risk	19
Events classified as critical risk	2

Table 15: Summary table of risk events – Hungary 2018

- ***Among those under review, 2 risk events (<1%) were classified as "Critical". Both can be traced back to the same causes, rooted in Hungary's current crisis regulation, and both are linked with the applicability of the restrictive rules prevailing in domestic crisis situations.*** The two risk events are as follows:
  - A gas-fired electricity producer is unable to switch to alternative fuel (e.g. due to a technical failure or the lack of required oil stocks), thus (eventually) representing a risk for the security of supply of the natural gas system as well as the electricity system.
  - The customers concerned are not interested/not motivated or deliberately not willing to participate in the restriction, thus (eventually) representing a risk also for the security of supply of the protected customers.
- ***Among those under review, 19 risk events (<9%) were classified as "Significant".*** These risk events were divided into two groups:
  - Higher than moderate risk events related to disruptions, for various reasons and of different durations, of natural gas received via the Ukraine/Hungary and Austria/Hungary cross-border entry points.
  - Low-probability transmission or distribution pipeline capacity disruptions that have no nationwide impact but affect all customers of the area concerned, including protected customers
- ***Among those under review, 56 risk events (approx. 26%) were classified as "Moderate".*** The nature of these risk events was related to:
  - extreme weather conditions,
  - disruptions, for various reasons and of different durations, of natural gas received via the Ukraine/Hungary and Austria/Hungary cross-border entry points,
  - disruptions of low probability or no nationwide impact of certain elements of the transmission/distribution infrastructure.
- ***Among those under review, 217 risk events (approx. 64.5%) were classified as "Acceptable".***

2.2. Evaluated risk scenarios

The following three pillars were used to determine the risk scenarios for detailed evaluation to be performed at national level:

- The Union-wide security of natural gas supply simulation carried out by ENTSOG in late 2017 as stipulated in the SoS Regulation, which showed that, as far as the EU-wide scenarios are concerned, Hungary would need to take intervention measures for the security of natural gas supply only if the transit gas flow transmitted via Ukraine to Europe were to stop.
- The risk scenarios examined at regional level in the Ukraine risk group which were linked to source routes relevant to Hungary, because their in-depth examination at national level is of major importance from Hungary's point of view. These scenarios were as follows:
    - stoppage of the Russian transit gas flow transmitted via Ukraine
    - overall suspension of Russian gas deliveries to the European Union
    - stoppage of the Baumgarten hub and gas deliveries via the hub
- The results of the evaluation of the risk events identified jointly with Hungarian industry actors:
    - Among the risk events classified as "Significant" and "Moderate", we used the ones with nationwide impact. Therefore, we focused on risk events related to disruptions, for various reasons and of different durations, of natural gas received via the Ukraine/Hungary and Austria/Hungary cross-border entry points and on extreme weather conditions.
    - As the expert advice on the management of risk events classified as "Critical" had been given before the risk assessment was started, we did not examine such risk events during the process of risk assessment.
    - At the time of determining the risk scenarios, we ignored the risk events classified as "Acceptable".

In view of the foregoing, we assessed the following scenarios with the assistance of the experts at FGSZ Földgázszállítási Zrt.:

Scenario	Version	Designation	Description	Duration	Start of event
S.01	a	Supply problem of the Ukraine corridor during the January–February peak period	No source is available at the Beregdaróc and Balassagyarmat entry points	7 days	February, week 1
	b		No source is available at the Beregdaróc and Balassagyarmat entry points	14 days	February, week 1
	c		No source is available at the Beregdaróc and Balassagyarmat entry points	30 days	February, week 1
S.02	a	Supply problem of the Ukraine corridor after the winter peak period	No source is available at the Beregdaróc and Balassagyarmat entry points	7 days	March, week 2
	b		No source is available at the Beregdaróc and Balassagyarmat entry points	14 days	March, week 2
S.03		No Russian gas is sent to the EU during the January–February peak period	No source is available at the Mosonmagyaróvár, Beregdaróc and Balassagyarmat entry points	30 days	February, week 1
S.04		Supply problem in Baumgarten	No source is available at the Mosonmagyaróvár entry point	7 days	February, week 1

Table 16: Evaluated risk scenarios – Hungary 2018

The detailed evaluation of the risk scenarios is contained in the risk assessment of the security of natural gas supply in Hungary.

2.3. Main conclusions of the risk assessment

2.3.1. Results of the national risk assessment

The simulations carried out during the risk assessment of national level confirmed for each evaluated scenario that, under the conditions specified for the relevant simulation, the security of natural gas supply can be ensured for the consumers in Hungary.

However, the simulations highlighted three important aspects:

- Critical duration of crisis situations: if no natural gas arrives from Russia to the EU in the long run (over 30 days) and, as a result, no source is available at the Hungarian international entry points, gas supplies to protected customers can be maintained only with restrictions in Hungary.

- Gas supplies to Eastern Hungary: In case of the long-term disruption of the Beregdaróc entry point, gas supplies to Eastern Hungary can be ensured only through

non-standard solutions (e.g. without metering, via circuitous routes, in reverse flow directions) because the current transmission infrastructure is designed for reverse direction.

- Blending gas supplies for the entry of domestically produced natural gas: blending gas used for improving domestic production (Hajdúszoboszló and Szank) can only be supplied from the storage facility and may cause gas quality problems for certain scenarios.

In view of the above and based on the hydraulic calculations, it is established that upon the occurrence of any event influencing the security of natural gas supply, as set out in the scenarios evaluated for Hungary, all natural gas deliveries can be managed without any social, socio-economic or special impacts affecting either district heating services or electricity generation.

2.3.2. Comparison with the results of the risk assessment conducted for the Ukraine risk group

As far as Hungary is concerned, the regional risk assessment carried out simultaneously with the simulations performed at national level brought results that were similar to those of the national risk assessment.

According to the ***results of the joint N-1 analysis, neither the disruption of the single largest gas infrastructure nor the stoppage of the entire Ukraine corridor would cause any problem*** for the gas supply of the risk group (from infrastructural point of view) in the short run. However, it should be noted that the toolset of both the Ukraine risk group and the national risk assessment focuses mostly on the short-term disruption of certain infrastructural elements, while a long-term disruption of the major elements of the infrastructure may greatly deteriorate Hungary's security of supply.

No results were obtained during the examination of the 8 scenarios described under the joint risk assessment, according to which there should be a need for the restriction of gas use in Hungary.

Nevertheless, the regional assessments highlighted that, in the case of certain scenarios, the natural gas supply of Hungary (and other Member States supplied via Hungary) could be ensured, even in the short run, only by the stretched utilisation of the existing entry capacities.

Among all scenarios concerned, the most critical one (modelled also under the joint risk assessment) is S.01.c (Supply problem of the Ukraine corridor for 30 days in early February), in the case of which ***the utilisation rate of the Slovakia/Hungary interconnector may reach a critical level***.

Furthermore, according to the simultaneous examination of regional scenarios, ***several Member States of the region may face difficulties in the case of certain scenarios and such extensive restrictions may be needed which may even necessitate the implementation of individual crisis management measures (e.g. assistance between countries) in the region and also in Hungary***. One of such scenario is S.03., examined also at national level, which

assumes the disruption of Russia's entire natural gas export to the European Union for 30 days in early February.

Finally, the examination of regional scenarios also indicated that, in cases like the supply problem of the Ukraine corridor or the disruption of Russia's natural gas export to the EU, ***gas supplies from Hungary to Romania encounter capacity limits*** and that, even if there are available sources in Hungary, Romania and other Member States in Southern Europe (Bulgaria and Greece) may still be forced to implement restrictions in lack of the required transmission capacities.

3. Infrastructure standard

3.1. Infrastructure standard – Ukraine risk group

As far as the 2018/2019 and 2020/2021 scenarios are concerned, the results of regional N-1 calculations performed in the Ukraine risk group are shown in the following tables:

		2018/2019	2020/2021
Uzhgorod	100% stock level	*166%*	*172%*
	30% stock level	*146%*	*151%*
Ukraine corridor	100% stock level	*158%*	*165%*
	30% stock level	*138%*	*144%*

Table 17: Results of the joint N-1 calculations performed in the Ukraine risk group (source: joint risk assessment conducted by the Ukraine risk group)

Disruption (I_m) million m^3	**Capacity 2018/2019**	**Capacity 2020/2021**
Uzhgorod	*227.4*	*191.7*
Ukraine corridor	*336.5*	*294.0*

Table 18: Disrupted capacities considered for the joint N-1 calculations performed in the Ukraine risk group (source: joint risk assessment conducted by the Ukraine risk group)

Member State	Ep_m	LNG_m	S 100%	S 30%	P_m	D_{max}
Austria	-	-	*66.4*	*44.4*	*3.4*	*55.3*
Bulgaria	-	-	*4.2*	*2.9*	*0.6*	*18.2*
Croatia	-	-	*5.8*	*3.2*	*3.5*	*16.6*
Czech Republic	-	-	*59.1*	*41.0*	*0.5*	*68.2*
Germany	*471.0*	-	*612.4*	*479.3*	*26.2*	*474.8*
Greece	*4.5*	*20.2*	-	-	-	*20.1*
Hungary	*82.9*	-	*78.6*	*68*	*5.5*	*77.4*
Italy	*133.6*	*51.9*	*263.2*	*171.8*	*15.5*	*443.0*
Luxembourg	*4.3*	-	-	-	-	*4.8*
Poland	*137.7*	*14.4*	*51.5*	*40.7*	*7.2*	*86.7*
Romania	*103.7*	-	*29.0*	-	*26.0*	*72.0*
Slovakia	*250.9*	-	*52.61*	*39.5*	*0.2*	*45.1*
Slovenia	-	-	-	-	-	*4.9*
Total	*1 188.6*	*86.5*	*1 170.2*	*890.8*	*88.6*	*1 387.1*

Table 19: Core data considered for the joint N-1 calculations performed in the Ukraine risk group, 2018/2019 (source: joint risk assessment conducted by the Ukraine risk group)

Member State	Ep_m	LNG_m	S 100%	S 30%	P_m	D_{max}
Austria	-	-	*66.4*	*44.4*	*3.4*	*55.3*
Bulgaria	*14.6*	-	*4.2*	*2.9*	*1.1*	*20.3*
Croatia	-	-	*5.8*	*3.2*	*3.5*	*16.6*
Czech Republic	-	-	*59.1*	*41.0*	*0.4*	*68.2*
Germany	*471.0*	-	*612.4*	*479.3*	*26.2*	*474.8*
Greece	*36.1*	*20.2*	-	-	-	*21.1*
Hungary	*71.3*	-	*78.6*	*69.5*	*3.6*	*89.5*
Italy	*152.9*	*51.9*	*291.3*	*190.8*	*18.9*	*438.0*
Luxembourg	*4.3*	-	-	-	-	*4.8*
Poland	*137.7*	*14.4*	*51.5*	*40.7*	*7.2*	*97*
Romania	*103.7*	-	*29.0*	-	*26.5*	*72.0*
Slovakia	*204.3*	-	*52.61*	*39.5*	*0.3*	*34.7*
Slovenia	-	-	-	-	-	*6.1*
Total	*1 200.0*	*86.5*	*1 198.3*	*911.3*	*91.3*	*1 386.3*

Table 20: Core data considered for the joint N-1 calculations performed in the Ukraine risk group, 2020/2021 (source: joint risk assessment conducted by the Ukraine risk group)

The values of D_{max} were determined and submitted by the countries to the group at the time of conducting the risk assessment.

3.2. Infrastructure standard – Hungary

N-1 calculations

As required under Article 5(1) of Regulation (EU) 2017/1938, Hungary performed the N-1 calculations as per the formula set out in point 2 of Annex II to the Regulation. The calculation results are summarised in the following table:

Hungary N-1 calculation standard (100%)			**2018**
EPm1	***Austria/Hungary cross-border entry (Mosonmagyaróvár)***	***million m³/day***	***14.4***
EPm2	***Ukraine/Hungary cross-border entry (Beregdaróc)***	***million m³/day***	***56.3***
EPm3	***Slovakia/Hungary cross-border entry (Balassagyarmat)***	***million m³/day***	***12***
EPm4	***Romania/Hungary cross-border entry (Csanádpalota)***	***million m³/day***	***0.2***
EPm5	***Croatia/Hungary cross-border entry (Drávaszerdahely)***	***million m³/day***	***0***
EPm6	***Other (unplanned entry)***	***million m³/day***	***0***
EPm summa	**Total delivery capacity**	**million m³/day**	**82.9**
Pm	**Maximum technical production capability**	**million m³/day**	**5.5**
Sm	**Maximum technical withdrawal capacity (100%)**	**million m³/day**	**78.6**
LNGm	**Maximum technical LNG facility capacity**	**million m³/day**	**0**
Im	**Largest entry capacity (EPm2 – Beregdaróc)**	**million m³/day**	**56.3**
Dmax	**Total daily gas demand (1/20)**	**million m³/day**	**77.4**
N-1			**1.43**
N-1 (%)			**143%**

Table 21: N-1 calculations (100% stock level) – Hungary 2018

The values in the table have been determined on the basis of data submitted for 2018 and according to the risk assessment results.

Based on the calculations, Hungary has an ***N-1 value of 1.43 at 100% stock levels, which means that Hungary is in compliance with the infrastructure standard expectations laid down in the SoS Regulation***. (The N-1 value may have risen further since the submission of data for 2018, thanks to the capacity enlargement completed in the meantime at the Romania/Hungary cross-border entry point, which has increased the delivery capacity in the direction of Hungary to 4.8 million m³/days.)

The above N-1 calculations have been carried out using the maximum withdrawal capacities among the withdrawal capacities associated with 100% stock levels. In line with the provisions of the SoS Regulation, Hungary has performed the calculations also using withdrawal capacities associated with 30% stock levels. The results of such calculations are summarised in the following table:

Hungary N-1 calculation standard (30%)			
			2018
EPm1	***Austria/Hungary cross-border entry (Mosonmagyaróvár)***	***million m³/day***	***14.4***
EPm2	***Ukraine/Hungary cross-border entry (Beregdaróc)***	***million m³/day***	***56.3***
EPm3	***Slovakia/Hungary cross-border entry (Balassagyarmat)***	***million m³/day***	***12***
EPm4	***Romania/Hungary cross-border entry (Csanádpalota)***	***million m³/day***	***0.2***
EPm5	***Croatia/Hungary cross-border entry (Drávaszerdahely)***	***million m³/day***	***0***
EPm6	***Other (unplanned entry)***	***million m³/day***	***0***
EPm summa	**Total delivery capacity**	**million m³/day**	**82.9**
Pm	**Maximum technical production capability**	**million m³/day**	**5.5**
Sm	**Maximum technical withdrawal capacity (30%)**	**million m³/day**	**68.0**
LNGm	**Maximum technical LNG facility capacity**	**million m³/day**	**0**
Im	**Largest entry capacity (EPm2 – Beregdaróc)**	**million m³/day**	**56.3**
Dmax	**Total daily gas demand (1/20)**	**million m³/day**	**77.4**
N-1			**1.29**
N-1 (%)			**129%**

Table 22: N-1 calculations (30% stock level) – Hungary 2018

Based on the calculations, Hungary has an ***N-1 value of 1.29 at 30% stock levels, which means that Hungary is in compliance with the infrastructure standard expectations laid down in the SoS Regulation***.

Main details of the calculations:

- ***Im:*** Hungary's single largest gas infrastructure is the Ukraine/Hungary cross-border entry point (Beregdaróc), the disruption of which was considered for the calculations
- ***Dmax:*** the calculation of the total daily gas demand, occurring with a statistical probability of once in 20 years, has relied on two evaluations:
    - As a first step, the correlation between Hungary's natural gas consumption and the temperature was examined with linear regression using data for gas years from 2011/2012 to 2017/2018. (The examination ignored former years as – due to the changes of market structure and consumption patterns and targets – those represent a natural gas consumption structure which greatly differs from the current one.)
    - As a second step, the consumption values for extreme cold days were estimated with the methodology of generalised extreme value (GEV) distribution.

FGSZ Földgázszállító Zrt. has carried out the hydraulic simulation of the scenarios, which assumed the disruption of the Ukraine/Hungary cross-border entry point (Beregdaróc) and represented the basis for the N-1 calculations, by using withdrawal data associated with both 100% and 30% stock levels. The performed hydraulic simulations also confirmed that Hungary's natural gas supply can be ensured even in the case of the disruption of the Beregdaróc entry point.

Bi-directional transmission capacities

Currently, Hungary has interconnections with the following EU Member States:

- Austria
- Slovakia
- Romania
- Croatia

The following table summarises, from Hungary's point of view, the ***available maximum transmission capacities*** in different directions (as of 2018):

	Entry		**Exit**	
	Firm	**Interruptible**	**Firm**	**Interruptible**
Austria/Hungary	14.4	0.0	0.0	0.0
Slovakia/Hungary	12*	0.0	4.8*	0.0
Romania/Hungary	0.2	1.0	4.8	0.0
Croatia/Hungary	0.0	1.2	7.2	0.0

**Note: In 2018 it took 2 days to change the flow direction along the Slovakia/Hungary pipeline. The project for automated flow direction change has been completed since then.*

Table 23: Available maximum transmission capacities – Hungary 2018

As to the Austria/Hungary interconnector, Hungary and Austria have been granted, upon the request of Austria, an exemption of indefinite duration from the obligation to enable bi-directional capacity under Regulation (EU) No 994/2010.

4. Compliance with the gas supply standard

In Hungary, protected customers include the following (GA Section 3(68.a)):

- household customers,
- essential social services,
- district heat producers up to the extent of natural gas corresponding to the natural gas capacity demand required for heat production, only from natural gas, in order to supply heat for household customers and essential social services as defined in the Act on District Heating Services.

Hungary		
	Annual volume (million m^3)	**share, %**
Total natural gas consumption	**9 594**	**100%**
Consumption of protected customers	**4 433**	**46.2%**
of which: district heating sector (Section 5(c))	532	5.5%
of which: households	3 451	36.0%
of which: essential social services (Section 5(b))	450	4.7%

Table 24: Consumption of protected customers within the total natural gas consumption, based on year 2017 data

Pursuant to Article 6(1) of Regulation (EU) 2017/1938, the competent authority of each Member State shall require the natural gas undertakings that it identifies, to take measures to ensure the gas supply to the protected customers of the Member State in each of the following cases:

> *"(a) extreme temperatures during a 7-day peak period occurring with a statistical probability of once in 20 years;*
> *(b) any period of 30 days of exceptionally high gas demand, occurring with a statistical probability of once in 20 years;*
> *(c) for a period of 30 days in the case of disruption of the single largest gas infrastructure under average winter conditions."*

In Hungary, in addition to the system development and system operation standard, three natural gas supply-side measures warrant compliance with the supply standard:

- ***Obligations of traders responsible for the supply of protected customers*** (basically the universal service providers):
  - ***Mandatory provision of supply sources:*** On 31 March each year, universal service providers must hold natural gas supplies or supply options committed in natural gas trade contracts corresponding to the consumption of their supplied customers for the next gas year. (Section 30(2) of Government Decree No 19/2009 of 30 January 2009 implementing the provisions of Act XL of 2008 on Natural Gas Supply ('GA GD'))

    - ***Mandatory stockpiling:*** On 1 October each year, universal service providers must hold, directly or indirectly, natural gas stocks kept in domestic gas storage facilities corresponding to at least 60% of the highest winter consumption of the past one hundred and twenty months within their service area. (Section 30(2) of Government Decree No 19/2009) The volume to be stored must be published on the MEKH website by 1 March each year. (GA GD Section 30(4))
- ***Emergency natural gas stocks:*** As from 1 August 2019, the volume of emergency natural gas stocks amounts to a mobile gas reserve of 1 450 million m^3. The volume of emergency natural gas stocks was determined by taking the supply standard into consideration.

If they fail to comply, or properly comply, with their above obligations regarding the mandatory provision of supply sources and mandatory stockpiling, universal service providers will be subject to liability for damages towards their customers. (GA GD Section 30(3))

Compliance with the gas supply standard is verified by MEKH. The volume of mandatory stockpiling and emergency natural gas stocks is specified by MEKH and by the minister responsible for energy policy, respectively.

The impacts of the required measures are summarised as follows:

- The impact of legislative provisions regarding the security of supply is that the traders offering universal services will have adequate gas supplies.
- The impact of mandatory stockpiling is that, already before winter, both storage capacity and sufficient winter sources will be available for customers entitled to receive universal services.
- The impact of emergency natural gas stocks is that, even in cases of extreme weather or emergency laid down in the gas supply standard as per Article 6 of Regulation (EU) 2017/1938, adequate capacities and sources will be available for traders supplying gas to protected customers.

Impacts, efficiency and effectiveness of the measures:

- The above measures work efficiently.
- Since the adoption of the measures there has not been any such extreme weather or emergency condition which could have hindered the gas supply to protected customers.
- The acceptance of the measures is shown by the positive perception of the verification of winter preparedness.
- The measures have no higher than normal environmental impacts.
- The measures improve the security of supply for customers.

5. Preventive measures

5.1. Regulations on the development of the natural gas system

Almost all actors of Hungary's natural gas market are involved in the ***preparation, planning and implementation processes related to the development of the natural gas system***, which serve as an infrastructural basis for the security of supply. The purpose of continuous system development is to manage, basically through the 10-year development plan, the risks identified during risk assessments and related to infrastructural capacities (e.g. cross-border entry points or disruption of pipeline capacities). The related regulations are as follows:

- ***The system user*** shall, not later than by 31 August each year, inform the system operators whose system is used by the customers supplied by it about the expected 10-year capacity demands of the customers; the first 5 years broken down by year, then by 5 years. (GA GD Section 96(1))
- System operators shall perform calculation-based annual verifications of the system's technical availability on the basis of the reported demands and historical consumption data. During the verifications, it must be taken into account that the supply of protected customers has to be ensured at least in the case of the lowest temperature values occurring with a statistical probability of once in 20 years. Under Article 6(1) of Regulation (EU) 2017/1938 of the European Parliament and of the Council, the temperature values shall be specified by the Authority in line with the gas supply standard applicable to protected customers. (GA GD Section 96(2))
- Not later than by 31 December each year, the system operator shall
  a) conduct the capacity review referred to in Section 82(1) of the GA, and
  b) send the 10-year development plan to the transmission system operator
  (GA Section 82(1), GA GD Section 96(3))
- Based on the capacity review, all system operators shall submit a 10-year ***development proposal*** to the transmission system operator. (GA Section 82(2))
- Such development proposal includes a proposal for ***enhancing bi-directional capacity*** or a request for an exemption from it. (GA Section 82(3))
- All system operators shall annually ***review the development proposal*** and, if necessary, supplement it with historical performance and future affordability indicators, as well as with expected demands. (GA Section 82(4))
- The transmission system operator shall, in cooperation with other system operators, coordinate the capacity review results of transmission pipelines (including gas transfer stations), distribution systems and natural gas storage facilities and the development proposals; after that it shall make available the ***coordinated proposal*** for public technical consultation on its website and submit it to MEKH for evaluation and approval. In the development proposal the transmission system operator shall make a proposal for enhancing bi-directional capacity or submit a request for an exemption from it. In case of any disagreement, the transmission system operator shall also submit the differing opinions to MEKH. During the evaluation process, where required, MEKH shall organise a public consultation on the development proposal for system users and document the consultation outcome in a report; or in case of cross-border capacity investments it shall discuss the relevant cost-sharing and

technical/financial conditions with the authorities of the countries concerned. (GA Section 82(5))

- Under its supervisory competence, MEKH shall (together with experts if so required) ***verify the results of the capacity review submitted by the transmission system operator, and the 10-year development proposal***, checking its compliance with the previous 10-year development plan, Regulation (EU) 2017/1938 of the European Parliament and of the Council and, in particular, Article 5(1) thereof. In case the 10-year development proposal is found to be inconsistent with the security of supply objectives set forth in domestic or Community energy policies, or adversely affects the national economy, violates law or hinders efficient competition, MEKH may, by setting a deadline and stating the relevant reasons, order the transmission system operator to amend the proposal, while notifying the Government about it. (GA Section 83(1))
- MEKH will ***approve the 10-year development plan*** and define the terms of approval according to the criteria set forth in the Government Decree on the implementation of the Act on Natural Gas Supply. The MEKH decision shall include the technical information and deadlines related to different investments, the expected cost-sharing between the countries; the amendments proposed by MEKH and the impact of individual investments and their overall impact on the security of domestic supply. Furthermore, the MEKH decision shall contain the list of investments proposed for the following three years and any amendments to investments approved in the previous 10-year development plan. (GA Section 83(3))
- Prior to commencing the implementation of the relevant investments, the system operator must request an ***amendment of its operating license***. The system operator may apply only for the investments decided in the approved 10-year development plan. The relevant investments may be commenced only after the said amendment has been approved. (GA Section 83(4))
- If the system operator fails to complete on time the investments as scheduled in the approved development plan, MEKH may, in accordance with the criteria set forth in the Government Decree on the implementation of the Act on Natural Gas Supply, ***launch an invitation to tender for the completion of justified developments and for the establishment of a new natural gas storage facility***. (GA Section 83/A(1))

5.2. Regulations on supply-side security of supply

In order to maintain the supply-side security of the Hungarian natural gas market, several preventive regulations are applicable to universal suppliers and natural gas traders.

The following regulations are applicable to ***universal service provider licensees***:

- The ***criterion of universal service providing activity is that the licensee shall, at least for the next 3 gas years, dispose of a natural gas source, sourcing option or natural gas stocks*** (committed in trade contracts) that correspond to the gas consumption of the relevant gas year determined with regard to the supply security level of his customers eligible for universal service within his service area and meet the volume requirement determined in the Government Decree on the implementation of the Act on Natural Gas Supply. Universal service providers are obliged to prove the

availability of the supply sources to MEKH in accordance with the terms set forth in the Government Decree on the implementation of the Act on Natural Gas Supply. (GA Section 39)

- Universal service providers shall ensure uninterrupted gas supply for customers eligible for universal service and having concluded a contract with them within their service area, ***up to the highest day degree in the past one hundred and twenty months in winter periods within their service area, but at least up to the level of consumption that corresponds to the mean temperature stipulated by law.*** In order to guarantee the supply security level, universal service providers shall, by March 31 each year, hold natural gas supplies or supply options committed in natural gas trade contracts corresponding to the consumption of their supplied customers for the next gas year. On 1 October each year, universal service providers must hold, directly or indirectly, natural gas stocks kept in domestic gas storage facilities corresponding to at least 60% of the highest winter consumption of the past one hundred and twenty months within their service area. (Government Decree No 19/2009, Section 30)
- Universal service providers shall, by March 31 each year, submit to MEKH the ***winter preparation plan*** ensuring the supply security level for customers supplied by them and indicating the expected peak hourly demand and consumption of users within their service area for the next gas year on a monthly summary basis by consumption profile and transfer station. Along with submitting the preparation plan, they are obliged to prove that they hold, directly or indirectly, gas sources and committed storage facility capacities required for the winter supply of customers. As part of their preparation plan, universal service providers shall, by 31 August each year, prove that they hold, directly or indirectly, committed transmission and distribution capacities required for the supply of their customers. The preparation plan and its implementation is continuously monitored by MEKH. In case of insufficient preparation, MEKH will order the universal service provider to amend the preparation measures. (Government Decree No 19/2009, Section 31(1))

The following regulations are applicable to ***natural gas traders***:

- Natural gas traders are obliged to draw up a detailed source plan with regard to the supply of customers, which proves that they hold the sources that correspond to the consumption per gas year determined in view of the supply level they have contractually guaranteed to their customers. The source plan shall include the volume terms of the source contracts required in order to supply customers, and the data proving the financial viability of sources in monthly or more frequent breakdowns. MEKH is entitled to check the source plan. (GA Section 29/A)

5.3. Regulations on emergency stockpiling

In order to increase the security of natural gas supply in a preventive way, the ***Hungarian Hydrocarbon Stockpiling Association*** (MSZKSZ) is obliged to establish and maintain emergency gas stocks in accordance with Act XXVI of 2006:

- Emergency gas stocks are used mainly to ensure the security of gas supply to protected customers. (Act XXVI of 2006, Section 3(4))

- Emergency gas stocks shall be kept in emergency gas storage facilities that are able to ensure the withdrawal capacity at least for the duration specified in Article 6(1)c) of Regulation (EU) 2017/1938 of the European Parliament and of the Council. (Act XXVI of 2006, Section 4(1))
- The minister responsible for energy policy shall specify the volume of emergency gas stocks in view of the supply security risks, on the basis of the available natural gas sources and in accordance with the Preventive Action Plan and the Emergency Plan set out in Regulation (EU) 2017/1938 of the European Parliament and of the Council, taking also the proposal of the President of MEKH into account. (Act XXVI of 2006, Section 4(3))

5.4. Regulations on electricity producers

In preparation for the potential restriction of ***gas-fired power plants***, special fuel stockpiling regulations apply to gas-fired power plants:

- ***Electricity producer licensees with 50 MW and higher capacity*** shall keep normative energy carrier stocks, established by power plant or – in case they produce electricity with the use of different technologies – by power plant part, as well as emergency energy carrier stocks based on their average daily consumption of fuel heat calculated from their annual plan. Power plants with interruptible natural gas supply contract shall, in addition to the required stocks, also have in place a fuel supply contract to ensure that they are supplied with fuel for the periods during which the supply of natural gas is interrupted. (Decree No 44/2002 of the Minister for Economy and Transport on the lowest volume of energy carrier stocks at power plants with 50 MW and higher capacity and on the order of stockpiling, Section 1(1))
- The ***volume of normative energy carrier stocks means the amount of liquid hydrocarbon energy carrier*** needed for at least eight days of average electricity generation and cogeneration of heat in case of hydrocarbon-fired power plants and for at least a one day of maximum capacity operation in case of quick-start secondary auxiliary gas turbines. (Decree No 44/2002 of the Minister for Economy and Transport, Section 1(2)b))
- The ***volume of emergency energy carrier stocks means the amount of liquid hydrocarbon energy carrier*** needed for at least eight days of average electricity generation and cogeneration of heat in case of hydrocarbon-fired power plants and for at least a one day of maximum capacity operation in case of quick-start secondary auxiliary gas turbines. (Decree No 44/2002 of the Minister for Economy and Transport, Section 1(3)b))
- ***The normative energy carrier stocks shall be stored at the site where the combustion plant is operated.*** The emergency energy carrier stocks may also be stored off-site provided that the transport of stocks to the power plant does not require the use of a public railway or waterway or more than 5 km of public road, the producer is able to carry out the transport and the transport capacity exceeds the average daily energy carrier consumption. (Decree No 44/2002 of the Minister for Economy and Transport, Section 1(4)–(5))

6. Other measures and obligations – Safe operation

Pursuant to the Act on Natural Gas Supply, in order to ensure cooperation between, and access to, the transmission and distribution pipelines and storage facilities within the cooperating Hungarian natural gas system, ***all system operators*** are ***obliged to provide for the safe, effective and uninterrupted operation and maintenance of the transmission and distribution pipelines and the storage facilities operated by them, while respecting the operational safety and environmental requirements defined by MEKH.*** (GA Section 86(1))

In this regard the following regulations are applicable to ***transmission system operators***:

- Transmission system operators shall have the means and the technical, material, human and financial resources required to perform their activities related to natural gas transmission and fulfil their obligations; in particular, they shall have organisational units that ensure the continuous operation and monitoring of metering and data transmission devices and the supervision of transmission pipeline maintenance and troubleshooting, as well a non-stop technical management service that maintains contact with connecting system operators and with system users within their own organisation and provides for the completion of daily transmission tasks. (GA Section 4(2)(b)–(c))
- Transmission system operators shall operate the transmission pipeline in an economical, safe, reliable and effective manner, and maintain and develop it while taking into account security of supply and environment protection. (GA Section 5(c))

In this regard the following regulations are applicable to ***natural gas storage licensees***:

- Within their own organisation, natural gas storage licensees shall have units that ensure the continuous operation and monitoring of the storage facility and the supervision of maintenance and troubleshooting, as well as a technical management service. (GA Section 26(2))
- Natural gas storage licensees are obliged to review the technical condition of the storage facilities operated by them and determine their expected life cycle every two years. They shall send the corresponding report to MEKH by 31 March of the year that follows the year of review. (GA GD Section 18(1))

In this regard the following regulations are applicable to ***natural gas distributors***:

- Within their own organisation or within such person's organisation who performs outsourced activities approved by MEKH, natural gas distributors shall have units that ensure the continuous operation and monitoring of distribution pipelines and the supervision of maintenance and troubleshooting, as well a non-stop technical management service that maintains contact with connecting system operators and with system users within their own organisation. (GA Section 14(2))

7. Infrastructure projects

For the purpose of increasing its own security of supply, Hungary is relying on the following infrastructure projects:

Establishment of the Serbia/Hungary delivery capacity of max. 6 billion m^3/year (20°C) (in progress)
The project includes developments to ensure deliveries from the direction of Serbia, Croatia and Romania as well as in the direction of Austria and Slovakia. The following developments are required:

- Kiskundorozsma pipeline, Serbia/Hungary border
- Kiskundorozsma metering station and node connections
- Városföld pipeline connections
- Városföld node transformation

Planned date of placing in service of the infrastructure project with a capacity of 6 billion m^3/year (20°C)
1 October 2021

Development of the security of supply in North-East Hungary (plan)
As a result of the development it will be possible to transmit natural gas from the direction of Austria, Romania, Serbia, Croatia and Slovakia and from the Zsana underground storage facility to North-East Hungary and to guarantee the gas supply of the North-East Hungary region regardless of the Ukraine entry point.

Other major projects planned or to be implemented on a conditional basis (plan)
In addition to the above, Hungary plans further infrastructure projects: These are the following:

- Development of firm capacity in Hungary towards Ukraine
- Implementation of the second phase of the Romania/Hungary natural gas transmission corridor
- Increase of the Serbia/Hungary delivery capacity to 8.5 billion m^3/year (20°C)

Projects included in ENTSOG 10-year development plan

The following table summarises the infrastructure projects included in the 10-year development plan prepared by ENTSOG for 2020:

Code	Project name	State of progress	1. PCI list	3. PCI list code
TRA-A-656	**Eastring - Hungary**	Advanced	Yes	6.25.1
TRA-N-524	**Enhancement of Transmission Capacity of Slovak-Hungarian interconnector**	Less-Advanced	Yes	6.2.13
TRA-N-636	**Development of Transmission Capacity at Slovak-Hungarian interconnector**	Less-Advanced	Yes	6.2.13
TRA-F-286	**Romanian-Hungarian reverse flow Hungarian section 1st stage**	FID	Yes	6.24.1.1
TRA-A-377	**Romanian-Hungarian reverse flow Hungarian section 2nd stage**	Advanced	Yes	6.24.4.6
TRA-N-325	**Slovenian-Hungarian interconnector**	Less-Advanced	Yes	6 23
TRA-A-123	**Városföld CS**	Advanced	Yes	6.24.4.3

Table 25: Projects listed in ENTSOG 10-year development plan as directly affecting Hungary, 2020 (source: ENTSOG)

8. Public service obligations related to security of supply

The Hungarian natural gas system and natural gas market are supervised by MEKH. Pursuant to Act on Natural Gas Supply, ***the main task of MEKH is to preserve and improve the security of supply***. (GA Section 126(d))

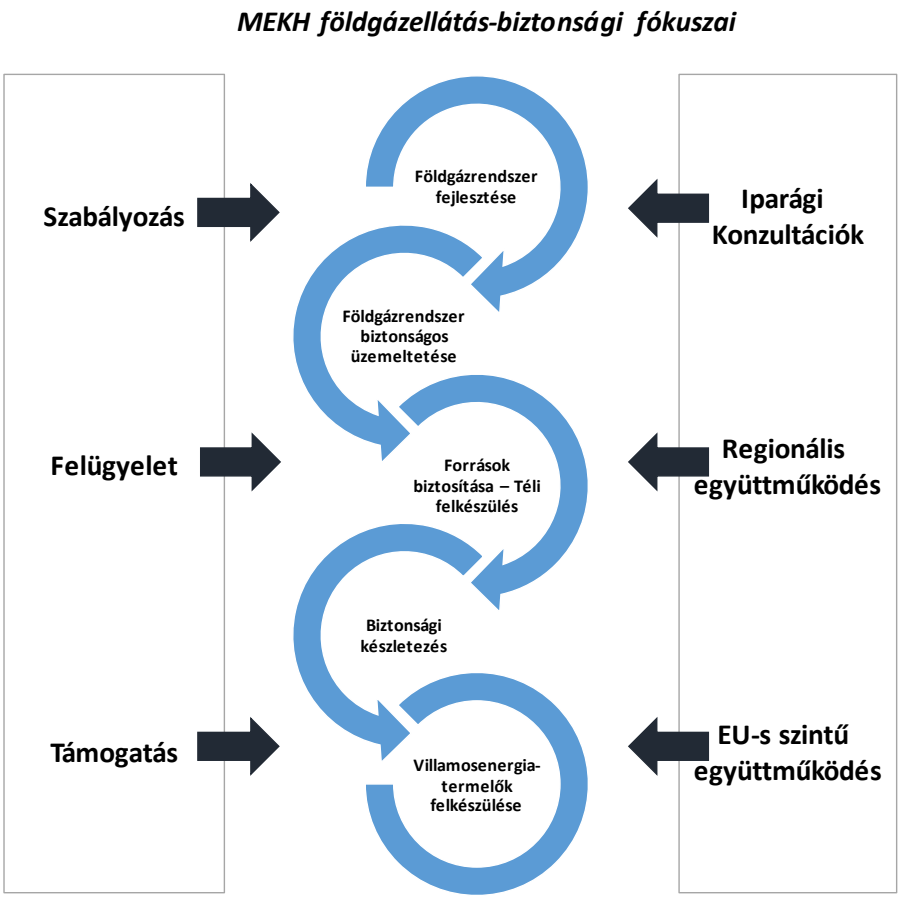


Figure 13: Main focus areas of MEKH for the security of natural gas supply

As part of its supervisory activity, ***MEKH***:

- In order to maintain the uninterrupted and secure supply of natural gas, it shall continually check (GA Section 127(o)):
  - the capacity of natural gas pipelines and natural gas storage facilities, the available gas resources of natural gas traders, the amount of stored natural gas, and the available means and gas sources that are used to balance the transmission system,
  - any change in the capacity of the cooperating natural gas system,
  - the financial stability of the natural gas trader, the existence of its financial guarantees, in order to recognise in time any economic unfeasibility,
  - the service quality and downtime indicators of licensees.

- Controls the supervision of the natural gas system capacity and the long-term proposals related to infrastructure development (submitted by the transmission system operator), checks whether it is in harmony with the Community-wide 10-year development plan, and constantly monitors the implementation of the 10-year development plan. (GA Section 127(kb)–(kc))
- Defines quality indicators for the minimum quality requirements related to licensee activities and their expected level. Quality indicators include the reliability and continuity of supply and the operational safety. (GA Section 63/C(1)-(2))
- When issuing and checking operating licenses, it controls (in accordance with GA GD Annex 5):
    - the availability and quality of the plans for natural gas supply failures, crisis situations and restrictive measures,
    - the cooperation agreements concluded with connected system operators regarding cooperation in extraordinary situations, procedures related to capacity development and practices to be followed at the time of natural gas transfer between systems under both normal and extraordinary operating conditions.

9. Consultations with stakeholders

MEKH conducts ongoing consultations with industry players in order to improve the legislative regulations on which the Preventive Action Plan and the Emergency Plan are based. As to the present Preventive Action Plan and the related Emergency Plan, an extensive industry-wide consultation was held in July 2020, where all participants were allowed to express their oral and written opinions about the regulations regarding crisis situations.

The entities involved in the consultation are summarised in the following table:

Entity	Industry role
FGSZ Földgázszállító Zrt.	Natural gas supplier and transmission system operator
MVM Nyrt. (Natural Gas Division)	Integrated natural gas market actor
Magyar Földgázkereskedő Zrt.	Natural gas trader
NKM Földgázszolgáltató Zrt.	Natural gas trader and universal supplier
MET Magyarország Zrt.	Natural gas trader
CEEGEX Közép-Kelet-Európai Szervezett Földgázpiac Zrt.	Natural gas stock exchange
Magyar Energiakereskedők Szövetsége (Hungarian Energy Traders Association)	Interest group of gas traders
Magyar Földgáztároló Zrt.	Natural gas storage
MMBF Földgáztároló Zrt.	Natural gas storage
Földgáz Elosztók Fóruma (Forum for Natural Gas Distributors)	Representative of natural gas distributors
MSZKSZ	Emergency stockpiling
MOL Nyrt. (Natural Gas Production Division)	Natural gas producer
Other natural gas producers (e.g. O&G Development Kft., Magyar Horizont Energia Kft., TDE)	Natural gas producer
MAVIR Zrt.	Electricity transmission system operator
Representatives of gas-fired power plants	Industrial consumers
Magyar Energiafogyasztók Szövetsége (Hungarian Energy Consumers Association)	Representative of industrial and small consumers
Ipari Energiafogyasztók Fóruma (Forum of Industrial Consumers)	Representative of industrial consumers
Magyar Távhőszolgáltatók Szakmai Szövetsége (Association of Hungarian District Heating Enterprises)	Representative of district heating enterprises

Table 26: Actors involved in industry consultation, 2020

The industry consultation allowed industry actors, in addition to presenting written evaluations and making proposals, to express their opinions about the adequacy of the current legislative background regarding the security of supply on a scale from 1 to 10 (1 = fully inadequate, 10 = fully adequate). The following figure summarises the results of this evaluation:

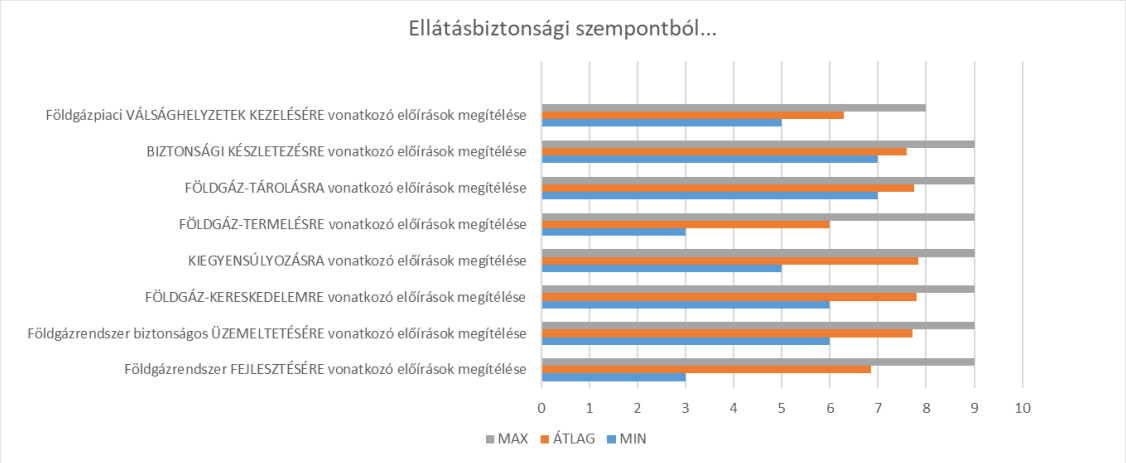


Figure 14: Summarised results of the industry consultation held on the adequacy of regulations regarding the security of supply, 2020

10. Regional dimension

This chapter was adapted from the regional chapter prepared by Italy (who coordinated the work of the Eastern gas supply risk group Ukraine).

11.1. Calculation of the N – 1 at the level of the risk group if so agreed by the competent authorities of the risk group

The following tables summarise the data set used for N-1 formula calculation in the Eastern gas supply risk group Ukraine.

Table 1: Data [MSm^3/d] for 2018/2019 scenario

Disruption (I_m)	Capacity
Uzhgorod	***227.4***
Ukraine route	***336.5***

Member State	Ep_m	LNG_m	S 100%	S 30%	P_m	D_{max}
Austria	-	-	*66.4*	*44.4*	*3.4*	*55.3*
Bulgaria	-	-	*4.2*	*2.9*	*0.6*	*18.2*
Croatia	-	-	*5.8*	*3.2*	*3.5*	*16.6*
Czech Republic	-	-	*59.1*	*41.0*	*0.5*	*68.2*
Germany	*471.0*	-	*612.4*	*479.3*	*26.2*	*474.8*
Greece	*4.5*	*20.2*	-	-	-	*20.1*
Hungary	*82.9*	-	*78.6*	*68*	*5.5*	*77.4*
Italy	*133.6*	*51.9*	*263.2*	*171.8*	*15.5*	*443.0*
Luxembourg	*4.3*	-	-	-	-	*4.8*
Poland	*137.7*	*14.4*	*51.5*	*40.7*	*7.2*	*86.7*
Romania	*103.7*	-	*29.0*	-	*26.0*	*72.0*
Slovakia	*250.9*	-	*52.61*	*39.5*	*0.2*	*45.1*
Slovenia	-	-	-	-	-	*4.9*
TOT	*1 188.6*	*86.5*	*1 170.2*	*890.8*	*88.6*	*1 387.1*

Table 2: Data [MSm^3/d] for 2020/2021 scenario

Disruption (I_m)	Capacity
Uzhgorod	***191.7***
Ukraine route	***294.0***

Member State	Ep_m	LNG_m	S 100%	S 30%	P_m	D_{max}
Austria	-	-	*66.4*	*44.4*	*3.4*	*55.3*
Bulgaria	*14.6*	-	*4.2*	*2.9*	*1.1*	*20.3*
Croatia	-	-	*5.8*	*3.2*	*3.5*	*16.6*
Czech Republic	-	-	*59.1*	*41.0*	*0.4*	*68.2*
Germany	*471.0*	-	*612.4*	*479.3*	*26.2*	*474.8*
Greece	*36.1*	*20.2*	-	-	-	*21.1*
Hungary	*71.3*	-	*78.6*	*69.5*	*3.6*	*89.5*
Italy	*152.9*	*51.9*	*291.3*	*190.8*	*18.9*	*438.0*
Luxembourg	*4.3*	-	-	-	-	*4.8*
Poland	*137.7*	*14.4*	*51.5*	*40.7*	*7.2*	*97*
Romania	*103.7*	-	*29.0*	-	*26.5*	*72.0*
Slovakia	*204.3*	-	*52.61*	*39.5*	*0.3*	*34.7*
Slovenia	-	-	-	-	-	*6.1*
TOT	*1 200.0*	*86.5*	*1 198.3*	*911.3*	*91.3*	*1 386.3*

Table 3: N-1 index values

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

11.2. Mechanisms developed for cooperation

11.2.1 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 ReCo Team East was launched in November 2017.

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.

11.2.2. 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) on the present document.

11.3. 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.

Appendix I – Description of the gas system per Member State in the Ukraine Risk Group

This chapter was adapted from the common risk assessment of Eastern gas supply risk group Ukraine submitted to the European Commission in 2019.

Austria

Austrian transmission system consists of 1.690 km of pipelines. It has six interconnections, two with Germany (Oberkappel and Überackern/Burghausen), one with Slovakia (Baumgarten), one with Hungary (Mosonmagyarovar), one with Slovenia (Murfeld/Ceršak) and one with Italy (Arnoldstein/Tarvisio). The most important entry point in terms of capacity is Baumgarten (217.42 million cubic meters per day) where Russian gas flows (roughly 80% of imports). Domestic production has decreased over the last year to about 1 GSm^3 per year. Gas storage have a total capacity (working gas volume) of 8,529 GSm^3. The capacity of those storage facilities directly connected to the AT gas system is 5,744 GSm^3. Austrian 2015 annual final gas consumption was 5,293 GSm^3 mainly related to the manufacturing sector (3,046 GSm^3).

Bulgaria

The transmission system in Bulgaria consists of 2765 km of pipelines. The transmission network has cross-border interconnections with Romania (Negru Voda / Kardam and Ruse / Giurgiu), Greece (Kulata / Sidirokastro), Former Yugoslavian Republic of Macedonia (Gueshevo / Jidilovo) and Turkey (Strandja / Malkoclar). 97% of gas demand is secured by Negru Voda entry point (Russian gas). There are also entry points from local production onshore (GMS Dolni Dabnik) and offshore (GMS Galata) and an interconnection with the Chiren storage infrastructure. Domestic production covers 2-3% of annual consumption. Chiren UGS has a technical volume of 550 million cubic meters (1300 MSm^3 of total gas volume minus 750 $MSm^3$of cushion gas). In 2016 natural gas consumption amounted to 3 GSm^3.

Croatia

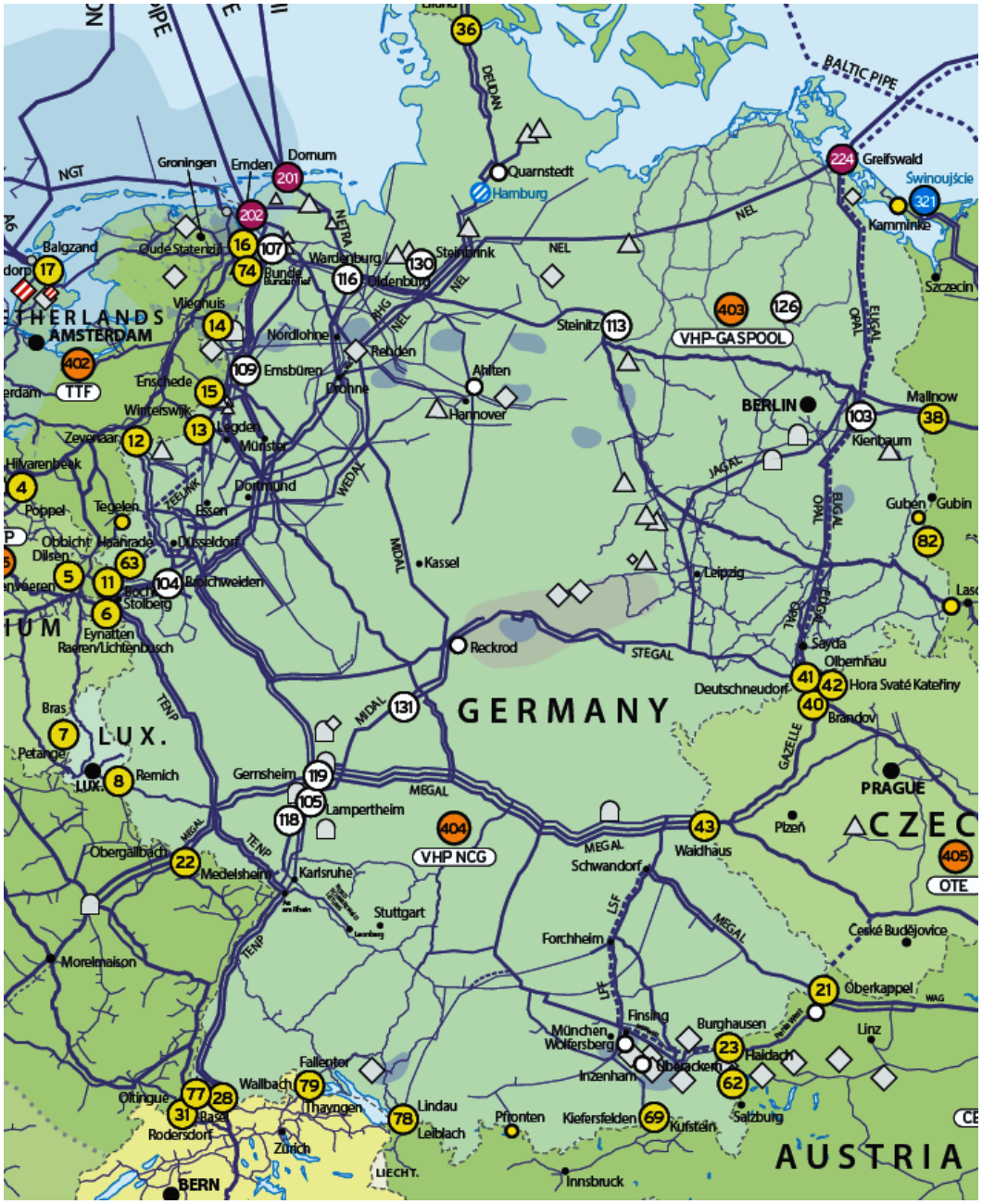
Croatian gas transmission network has a total length of 2.694 km of transportation pipelines. The natural gas transmission network has cross-border interconnections with Slovenia (Rogatec) and Hungary (Dravaszerdahely) usually utilised to import gas. There are also 7 entry points from production plants and one interconnection with the underground storage facility of Okoli. The upstream pipelines in the Adriatic sea are used to export Croatian natural gas from the production platforms to Italy. Panon gas fields are connected by upstream pipelines to the transmission network and to the underground gas storage facility at the Okoli site. The Okoli gas storage infrastructure (553 million cubic meters) is located at Okoliand and it is part of the Underground Gas Station d.o.o. Croatia is going to build an LNG terminal on the island of Krk, with a storage capacity from up to 265.000 m^3 of LNG; nominal regasification capacity of 8 billion m^3 of gas per year. In 2016 natural gas consumption amounted to 106 MSm^3.

Czech Republic

Czech gas transmission system has a total length of 2.637 km. Furthermore there is another 1.181 km of national transmission gas pipelines (the actual data for 2018). There are six cross-border interconnections, three with Germany (Hora Svaté Kateřiny, Brandov, Waidhaus), one with Poland (Cieszyn), one with Slovakia (Lanžhot) and one entry only point again from Germany (Olbernhau). Storage system is composed of eight sites (Tvrdonice, Dolní Dunajovice, Štramberk, Lobodice, Třanovice, Háje, Uhřice, Dambořice) with an overall volume of 3.177 Mm^3. In 2017 natural gas consumption was 8.527 Mm^3.

Germany

German transmission network is about 38.000 km long, and is divided in two areas, one supplied with L-Gas and the other with H-Gas. The H-Gas system is interconnected with Denmark (1 interconnection), with Norwegian and north sea gas fields (2 interconnections), with the Netherlands (2 interconnections), with Belgium (1 interconnection), with Luxemburg (1 interconnection), with France (1 interconnection), with Switzerland (1 interconnection), with Austria (4 interconnections: Überackern/Burghausen, Kiefersfelden, Oberkappel and Lindau), with Czech Republic (5 interconnections: Brandov/Stegal, Olbernhau/Hora Svaté Kateřiny, Hora Svaté Kateřiny/Deutschneudorf, Opal/Brandov and Waidhaus), with Poland (2 interconnections: Mallnow and Lasów) and with Russia (1 interconnection). L-Gas system has 4 interconnection points with The Netherlands. Storage system is composed of 37 sites with a total amount of 25,3 GSm^3 (2,1 GSm^3 for L-Gas only). Domestic production in 2016 amounted to more than 6,5 GSm^3 against a domestic consumption of approximately 84 GSm^3. There is no LNG regasification terminal in Germany.



Greece

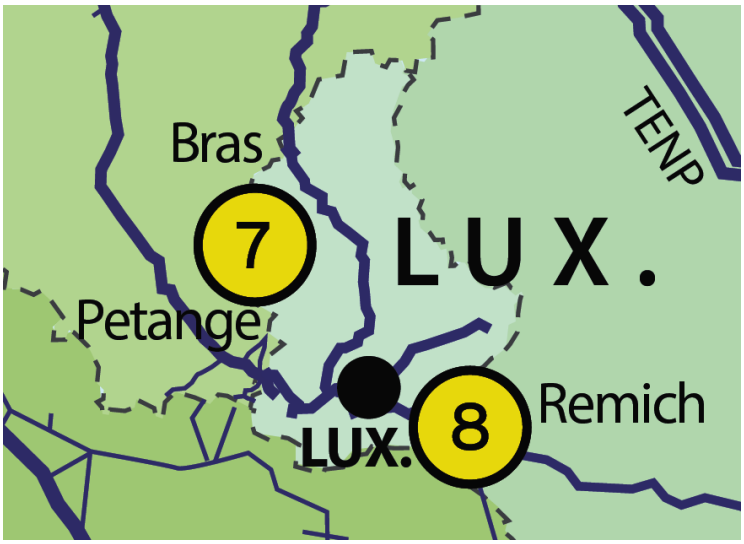
Greek gas transmission network extends for 1.456 km. The network has cross-border interconnection points with Bulgaria (Kulata/Sidirokastron) and with Turkey (Kipi). Greece is also supplied through one LNG terminal (Revythoussa) equipped of three storage tanks with an overall capacity of 225.000 m^3. In Greece there is no local production nor any underground storage. Greek network is going to be strengthen by the construction of TAP by 2020 and supposed to be further developed with other pipeline and LNG projects. In 2017, total natural gas consumption amounted to 5 GSm^3.

Italy

Italian gas transmission network extends for more than 32.000 km. The national network has cross-border interconnection points with Austria (Tarvisio/Arnoldstein), Slovenia (Gorizia/Sempeter) and with Switzerland (Griess Pass). Italy is also supplied through two off shore interconnectors: Transmed (with Tunisia and Algeria) and Greenstream (Libya). A new interconnection facility (TAP) is in progress and will be operational in 2020. There are three entry points from LNG terminals (Panigaglia, Livorno and Cavarzere) and twelve entry exit point from storage plants for an overall volume of approximately 17 GSm^3. Local production (5.6 GSm^3/y in 2016) shows a historical decreasing trend due to the decline of domestic sources, not sufficiently offset by new production developments. In 2017, total natural gas consumption amounted to 75.1 GSm^3.

Luxemburg

The natural gas transmission system of Luxembourg comprises 281,8 km of high pressure pipe line. The transmission gas infrastructure is owned and operated by Creos Luxembourg. The gas supply of Luxembourg is ensured by mainly 3 physical entry points, two from Belgium and one from Germany. A small connection with France is not in operation since 2016 anymore. The two entry points with Belgium ensure a total capacity of 180.000 Nm^3/h. The capacity at the German IP is limited to 150.000 Nm^3/h and a minimum of 90.000 Nm3/h is necessary to fulfil the N-1 obligation. The total capacity of the transmission system amounts to 330.000 Nm3/h. The transmission system transports natural gas to 59 pressure-reduction substations (distribution system and customers). No transit is currently possible due to operational constraints and gas odourisation at the German and Belgian border. No infeed or storage are connected to the transmission system. The main peak load registered in the last ten years dated from 2012 and amounts to 296,550 Nm^3/h. However due to the decommissioning in July 2016 of a CCGT gas power plant with a capacity of 375 MWel, the peak load decreased significantly to 204.780 Nm^3/h in 2016. Due to the market integration and the shutdown of the CCGT in Luxembourg, more gas volumes are currently delivered from Belgium than from Germany to Luxembourg. In 2016 70,7 % of the flows were delivered from the Belgium entry points.



Poland

At the end of 2016, the gas transmission system in Poland consisted of high pressure gas pipelines with the total length of 10,989 km. The transmission network consists of two cooperating systems covering the high- and low-calorific gas. In addition, there is the Yamal-Europe Pipeline with the length of 684 km. The Polish transmission system is historically dependent on gas supplies from the Eastern direction. There are six major physical entry points into the transmission network that are located in Drozdowicze (IP with Ukraine), Wysokoje (Belarus), Lwówek and Włocławek (on the Yamal-Europe pipeline), Lasów (Germany), Cieszyn (Czech Republic). As of June 2016, the transmission system in Poland can also be supplied via the LNG terminal in Świnoujście (5 billion cubic meters per year). Poland is currently developing investment projects along the North-South axis with the aim of improving the energy security and competitiveness of Poland and other countries in Central-Eastern Europe and the Baltic Sea region. The Polish main priorities are the expansion of the LNG Terminal in Świnoujście and the Baltic Pipe project. The terminal in Świnoujście will be upgraded in order to increase the regasification capacity and provide a wider range of LNG services. The Baltic Pipe project is underway in cooperation with Denmark to provide a direct access to Norwegian supplies. These two investments, in conjunction with the expansion of the domestic transmission infrastructure and the construction of cross-border interconnections with adjacent systems, will provide the basis for a secure and competitive gas market in the CEE and Baltic regions. Polish gas system has 7 underground Gas Storages with an overall volume of 3,150 billion cubic meters. In 2016, total natural gas consumption amounted to 16.9 GSm^3.

Romania

Romanian gas transmission network extends for more than 13.350 km. The national network has cross-border interconnection points with Moldova (Ungheni), with Ukraine (Orlovka/Isaccea and Medisul Aurit/Tekovo), with Bulgaria (Negru Voda/Kardam and Giurgiu/Ruse) and with Hungary (Csanapadlota/Nadlac). Romanian storage system has an overall working gas capacity of 3,130 GSm^3. In 2017 total domestic production was 10,7 GSm^3. In 2017, total natural gas consumption amounted to 12.1 GSm^3.

Slovakia

In 2016 the total gas transmission, for the total length of the gas transmission network of almost 2,270 km, amounted to 60.6 bcm. Due to the amount of transported gas eustream remains one of the most important TSO based on the volume of gas transported within the EU. Four compressor stations are part of the transmission network – Veľké Kapušany, Jablonov nad Turňou, Veľké Zlievce and Ivanka pri Nitre – which provide a pressure differential needed for the flow of gas with a total output of 600 MW. The total transmission capacity of the network is more than 90 bcm per year. Natural gas from the transmission network in the defined territory gets through intrastate stations into the distribution networks and is transported to the final customers. On 30 November 2011 implementing measures were completed that allow reverse flow within the transmission network in Slovakia. In this mode it is possible to transport in the west – east direction the amount of gas that is higher than the highest consumption in Slovakia in the winter months. Slovakia interconnection with neighbouring countries on the level of transmission networks currently exists with Austria [border point Baumgarten], Czech Republic [border point Lanžhot], Hungary [border point Veľké Zlievce] and Ukraine [border point Veľké Kapušany and border point Budince]. Interconnection with the Czech Republic since 2009 and with Austria since 2010 are prepared so that it will be possible in case of crisis situation (emergency level respectively) to ensure physical reverse flow of gas to Slovakia. Slovakia has in its territory several geological formations which are suitable for construction of underground gas storage facilities. Currently there are two companies active on the market, that are storage system operators - NAFTA a.s., Bratislava and POZAGAS a.s., Malacky. Total storage capacity in Slovakia is 3.35 bcm, which represents more than 65% of total consumption. The facilities are located in the southwestern part of the country near the border with Austria and the Czech Republic.

Slovenia

The Slovenian transmission network has cross-border interconnections with Austria (Murfeld/Ceršak interconnection point), with Italy (Gorizia/Šempeter) and an exit only point with Croatia (Rogatec). Slovenian gas system has no storage facilities nor any local gas production. The gas consumption figures from 2014 to 2016 has continuously grown up to 860 MSm^3.