PREVENTIVE ACTION PLAN

on measures to ensure security of gas supply in Romania

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LIST OF ACRONYMS:

ANRE	National Regulatory Authority for Energy
ANRM	National Agency for Mineral Resources
bcm/year	Billion cubic meters/year
BRUA	Bulgaria - Romania - Hungary - Austria Corridor
cm	cubic meters
CE	European Commission
EP	Entry points
ENTSO-G	European Network of Transmission System Operators for Gas
EU	European Union
INECP	Draft of the Integrated National Energy and Climate Plan
INS	National Institute of Statistics
IP	Interconnection Point
ISO	Independent System Operator
JRC	Joint Research Center
LNG	Liquefied natural gas
GMS	Gas Metering Station
mil.	Million
NTS	National Transmission System
SEN	National Electric Power System
Toe	Tons of oil equivalent
TSO	Transmission System Operator
TYNDP	10-year Network Development Plan
UGS	Underground gas storage

1. INTRODUCTION

Security of natural gas supply is a shared responsibility of natural gas undertakings, Member States and the European Commission.
In this context, Regulation (EU) 2017/1938 of the European Parliament and of the Council of 25 October 2017 concerning measures to safeguard the security of gas supply and repealing Regulation (EU) No 994/2010 (hereinafter "the Regulation") defines responsibilities and obligations for natural gas undertakings, national authorities and the European Commission and requests on the Member States to establish effective crisis management in advance and to put in place measures in the form of preventive action and emergency plans.
According to Art. 8 of the Security of Supply Regulation
Under the provisions of Article 8, paragraph (2) letter a) of the Regulation, the competent authority of each Member State, establishes „a preventive action plan containing the measures needed to remove or mitigate the risks identified, including the effects of energy efficiency and demand-side measures in the common and nationals risk assessments", elaborated in accordance with Article 9 and, after consulting the natural gas undertakings, the relevant organisations representing the interests of household and industrial gas customers, including electricity producers, electricity transmission system operators.

In accordance with Article 102 letters l) and o) of the Law no. 123/2012 of energy and natural gas, as amended and supplemented, the Ministry of Energy exercises the quality of competent authority based on the provisions of (within the meaning of) the Regulation and, in this capacity, draw up the Preventive Action Plan on measures to ensure security of gas supply, in accordance with the provisions of Regulation.
In this sense, the Preventive Action Plan was elaborated, that meets the requirements of the Regulation and was made in accordance with the provisions of Article 9, the model in Annex VI to the Regulation and the national legislation in force and includes:

- description of the natural gas system in Romania;
- the consolidated description of the regional gas system for each risk group in which Romania participates;
- the results of the relevant common and national risk assessment carried out in accordance with Article 7, including a list of the scenarios assessed and a description of the assumptions applied for each one as well as the risks identified and the main conclusions of the risk assessment;
- description of how the infrastructure standard is complied with, including the calculation of the N – 1 formula at regional and national level, the main values used for the N – 1 formula, alternative options for its compliance and the existing bidirectional capacities;
- description of the measures adopted in order to comply with the supply standard, including definition of protected customers applied, categories of customers covered and their annual gas consumption (per category, net value and percentage of the national annual final gas consumption), gas volumes needed, capacity needed and measures in place to comply with the supply standard;

- description of the preventive measures in place or to be adopted, including a description of their national or regional dimension, their economic impact, effectiveness, efficiency and their impact on customers, as well as other measures and obligations that have been imposed on natural gas undertakings, electricity undertakings, where appropriate, and other relevant bodies that may have an impact on the security of gas supply, such as obligations for the safe operation of the gas network;
- description of the future infrastructure projects, including projects of common interests;
- public service obligations related to the security of supply;
- stakeholders consultations;
- regional dimension, including calculation of the N-1 formula at the level of each risk group in which Romania participates, the mechanisms used for the cooperation among the Member States.

2. DESCRIPTION OF THE NATURAL GAS SYSTEM IN ROMANIA

2.1. Description of the functioning of the natural gas network in Romania

2.1.1. Description of the National Transmission System

The National Transmission System (NTS), shown in Figure 1, was designed as an interconnected radial-annular system and is represented by the set of main pipelines, as well as the installations, the equipment and endowments. The transport of natural gas is ensured by a network of more than 13,925 km of pipelines and natural gas supply connections with diameters between 50 mm and 1,200 mm, at pressures between 6 bar and 63 bar, through which ensures the take-over of the natural gas extracted from the production perimeters or those from imported and their transport for delivery to the domestic market participants of natural gas, export, international transport, etc.

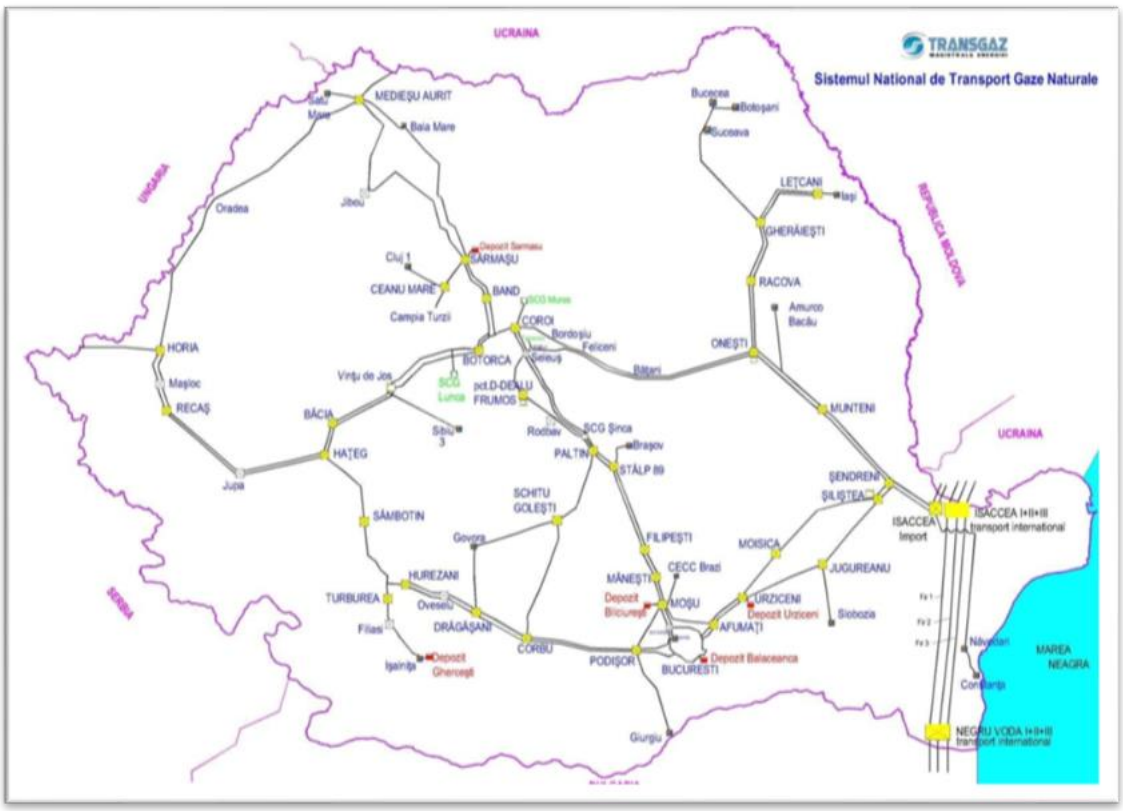

Figure 1. Map of the National Natural Gas Transmission System[1]

[1]Source: Transgaz S.A. https://www.transgaz.ro/ro/consultare-publica-planul-de-dezvoltare-sistemului-national-de-transport-gaze-naturale-pentru, page 12.

The main components of the National Natural Gas Transmission System on 31.12.2020 are presented in Table 1.

Table 1. The existing infrastructure of the NTS [2]

NTS component	Value/ UM
Total length of main transport pipelines and natural gas supply connections, including the international transport pipelines (Transit II, Transit III) and BRUA:	13.925 km, of which 369 km are transit pipelines and 479 km BRUA
The number of measuring control stations in exploitation:	1278 (1.233 measuring directions)
The number of compressor stations (GCS):	6 compressor stations (GCS Șinca, GCS Onești, GCS Siliștea, GCS Podișor, GSC Bibești and GCS Jupa)
The number of valve control stations (VCS) and/or technological nodes (NT):	58 valve control stations/ technological nodes
The number of bidirectional gas metering stations (GMS) (Giurgiu, Horia, Isaccea 1, Medieșu Aurit, (unidirectional UA-RO) - Isaccea Tranzit 1 (import), Negru Vodă Tranzit I):	6 gas metering stations for import
The number of gas	4 gas metering stations

[2]Source: site Transgaz S.A.
https://www.transgaz.ro/ro/clienti/sistemul-de-transport/infrastructura-snt
https://transgaz.ro/ro/consultare-publica-planul-de-dezvoltare-sistemului-national-de-transport-gaze-naturale-pentru, page 12.

metering stations (GMS) located on gas transit pipelines (Isaccea Tranzit II, Isaccea Tranzit III, Negru Vodă Tranzit II, Negru Vodă Tranzit III):	
The number of cathodic protection stations (CPS):	1041 cathodic protection stations
Number of gas odorization stations (GOS):	982 gas odorization stations
Pipeline diameter:	between 25 mm and 1200 mm
Operating pressure:	between 6 bar and 35 bar and 54 bar for transit
NTS interconnections with other transmission systems/ operators of adjacent systems:	
Total number of interconnection points:	11 physical interconnection points as follows: • Csanádpalota/FGSZ Ltd. (HU); • Negru Vodă I/Bulgartransgaz EAD (BG); • Negru Vodă II/Bulgartransgaz EAD (BG); • Negru Vodă III/Bulgartransgaz EAD (BG); • Medieşu Aurit/Ukrtransgaz (UA); • Isaccea I/Ukrtransgaz (UA); • Isaccea II/Ukrtransgaz (UA); • Isaccea III/Ukrtransgaz (UA); • Isaccea Import/Ukrtransgaz (UA); • Ungheni/Vestmoldtransgaz (MD); • Ruse-Giurgiu (BG-RO, RO-BG).
NTS interconnections with LNG terminals/ operators of adjacent systems:	
	Not applicable.
NTS interconnections with gas storage facilities/ operators of adjacent systems:	
Total number entry/exit points:	7 physical entry/exit points connected to storage facilities as follows: • Sărmaş/S.N.G.N. Romgaz S.A.; • Bălăceanca/S.N.G.N. Romgaz S.A.;

	• Butimanu/S.N.G.N. Romgaz S.A.; • Cetatea de Baltă/S.N.G.N. Romgaz S.A.; • Gherceşti/S.N.G.N. Romgaz S.A.; • Urziceni/S.N.G.N. Romgaz S.A.; • Tg. Mureş/Depomureş S.A..
	These physical entry/exit points are not operated by the TSO.
NTS interconnections with production facilities /producers:	
Total number entry points:	124 physical entry points as follows: • 77 entry points/S.N.G.N. Romgaz S.A.; • 29 entry points/OMV Petrom S.A.; • 13 entry points/Amromco Energy S.R..L; • 1 entry point/Raffles Energy S.R.L.; • 1 entry point/Lotus Petrol S.R.L.; • 1 entry point/Stratum Energy Romania LLC; • 1 entry point/Hunt Oil Company of Romania S.A.; • 1 entry point/Serinus Energy Romania S.A..
	These entry points are not operated by the TSO.
NTS interconnections with distribution systems/ operator of distribution systems:	
Total number exit points:	894 physical exit points/32 operators of distribution systems.
	These physical exit points are not operated by the TSO.
NTS interconnections with direct consumers / direct consumer type:	
Total number exit points:	225 physical exit points as follows: • 15 gas power plants; • 19 industrial works; • 167 commercial consumers; • 24 residential consumers.
	These physical exit points are not operated by the TSO.
Interconnections between production facilities and distribution systems:	
Total number entry/exit points:	85 physical entry/exit points for natural gas direct deliveries.
	These physical entry/exit points are operated by the TSO.

2.1.2. National Transport System Operator

The national transmission system operator (TSO) is the National Natural Gas Transmission Company “Transgaz” S.A. (hereinafter “Transgaz S.A.”), established based on the Government

Decision no. 334/ April 28th, 2000, on the reorganization of the National Natural Gas Company "Romgaz" S.A., as amended and supplemented, is the Romanian legal entity that operates as a trading joint-stock company, organized and operating in accordance with Romanian legislation and its statute.
Transgaz S.A., the technical operator of the NTS, implements the National Strategy set for the natural gas domestic and international transmission, natural gas dispatching and research-design in the field of natural gas transmission by performing, under the Romanian legislation, commercial operations proper to the object of activity approved by the Articles of Incorporation.
Transgaz S.A. operates the National Transmission System based on ISO (Independent System Operator) model, certified by operating License of the natural gas transmission system no. 1933/2013, issued by the National Regulatory Authority for Energy (ANRE).

2.1.3. The natural gas distribution systems

The national natural gas distribution system consists of natural gas distribution pipes and their related connections in total length of over 56.694[3] km, of which over 41,000 km are operated by two large distribution operators that provide for more than 100,000 users, respectively DELGAZ GRID S.A. and DISTRIGAZ SUD REȚELE S.R.L. and which feeds over 3.6 million consumers.

2.1.4. Underground natural gas storage in Romania

Underground natural gas storage plays a major role in ensuring safety in natural gas supply, facilitating the balance between consumption and gas sources (domestic production and imports).
The underground gas storage capacity is ensured in Romania through 6 underground gas storage facilities, with a total active capacity of 32.9905 TWh per storage cycle, respectively an injection capacity of 269.470 GWh/day and an extraction capacity of 344.100 GWh/day, whose technical characteristics are presented in Table 2.
Currently, two storage system operators are active on the Romanian storage market:

- The Natural Gas Storage Subsidiary DEPOGAZ Ploiești S.R.L., branch of S.N.G.N. Romgaz S.A., who holds a license for the operation of 5 underground gas storage facilities, whose cumulative active capacity is 29.836 TWh/cycle respectively 90.4% of the total storage capacity of Romania;
- DEPOMUREȘ S.A., which operates the underground gas storage warehouse of Târgu Mureș, with an active capacity of 3.1545 TWh/cycle, which represents 9.6% of the total storage capacity of Romania

[3]Source: site ANRE
Annual Report on the activity of the National Energy Regulatory Authority 2020, page 243.

Table 2. Technical characteristics of underground natural gas storage facilities[4]

STORAGE SYSTEM OPERATOR	STORAGE FACILITY	ACTIVE STORAGE CAPACITY		MAXIMUM INJECTION CAPACITY		WITHDRAWAL CAPACITY	
		mil. m^3/ciclu	TWh/ ciclu	mil. m^3/zi	GWh/ zi	mil. m^3/zi	GWh/ zi
The Natural Gas Storage Subsidiary DEPOGAZ Ploieşti S.R.L.	**Bilciureşti**	1.310.000	14.214	10.000	108.500	14.000	151.900
	Sărmăşel	900.000	9.522	6.500	68.770	7.500	79.350
	Urziceni	360.000	3.953	3.000	32.940	4.500	49.410
	Ghercești	150.000	1.602	2.000	21.360	2.000	21.360
	Bălăceanca	50.000	0.545	1.000	10.900	1.200	13.080
DEPOMUREŞ S.A.	**Târgu Mureș**	300.000	3.1545	2.600	27.000	2.800	29.000
TOTAL		**3.070.000**	**32.9905**	**25.100**	**269.470**	**32.000**	**344.100**

2.1.5. Identification of the key infrastructure relevant for the security of supply

The physical structure of the National Transmission System offers the possibility to identify and establish natural gas transport corridors in order to satisfy both the needs of ensuring the supply of natural gas to different consumption areas in the country and the needs regarding the transfer through the Romanian system of some quantities of natural gas between the systems of the neighboring countries, as a requirement imposed by the liberalization of natural gas markets and European legal framework.

Romania's National Natural Gas Transmission System consists mainly of natural gas transmission corridors and a natural gas transmission network which, although extensive and complex, was designed at a time when the emphasis was on the supply of natural gas to large industrial consumers, network, which follows a continuous development process achieved by implementing the investment projects included in the Development Plan of the National Natural Gas Transmission System for 10 years of Transgaz S.A.

In identifying the projects necessary to be developed in the natural gas NTS, the main requirements these projects have to ensure in the current dynamics of the regional natural gas market are taken into account.

The developments mentioned above are corroborated with the development of the underground storage system which has a complementary role in supporting the security, stability, optimization and flexibility of natural gas NTS.

[4] Source: site The Natural Gas Storage Subsidiary DEPOGAZ Ploiești S.R.L.
https://www.depogazploiesti.ro/en/activity/gas-storage
site DEPOMUREȘ S.A.
http://www.depomures.ro/despre_depozit.php

2.2. Natural gas consumption in Romania

Table 3. presents the main natural gas consumption figures in Romania, respectively the total annual consumption and the total annual consumption on the regulated market.

Table 3. The main figures regarding gas consumption in Romania[5]

Year	Total annual consumption [GWh]	Total annual consumption on the regulated market [GWh]
2013	132.603	50.864
2014	127.608	43.786
2015	121.726	32.322
2016	124.110	35.185
2017	129.861	33.538
2018	129.525	31.977
2019	121.054	31.750
2020	121.070	19.820*

*Starting from July 1st, 2020, the internal market for natural gas has been fully liberalized for domestic customers as well.

Table 4. presents the structure of total natural gas consumption by types of customers, provided by suppliers, in 2019 and allows the following observations:

- the registered consumption was of approximately 113 TWh, of which approximately 78.81 TWh represented the non-domestic consumption and 34.20 TWh the domestic consumption;
- the share of quantities consumed by household customers in the total final consumption is 30.26% and the number of these customers represents 94.54% of the total number of final natural gas customers;
- although the number of non-household customers represents only 5.46% of the total final natural gas customers, the share of quantities consumed by them is 69.74% of the total final consumption.

[5]Source: site ANRE
Annual Reports on the activity of the National Energy Regulatory Authority 2013-2020/ Natural Gas Market Monitoring Reports/ National reports.

Table 4. The structure of total natural gas consumption by types of final customers, in 2019[6]

Final Customers	Number of Customers (contracts)	Weight Share in Total Customers [%]	Consumption [TWh]	Weight Share in Total Consumption [%]
Household customers	3.800.245	94,54	34,20	30,26
Non-household customers	219.574	5,46	78,81	69,74
TOTAL	**4.019.819**	**100**	**113,01**	**100**

2.3. Domestic natural gas production in Romania

Due to the limited reserves of primary energy resources, in Romania the energy internal production remained practically constant at a value of about 31-36 million tons of oil equivalent (toe). Without the contribution of renewable energy sources, this value will gradually decrease over the coming years.
Table 5. presents the evolution of primary energy production, by types of energy sources, in Romania, in the period 2014-2020 (only eleven months of 2020) of which the following are highlighted:

- natural gas has a share of about 27% in total primary energy production;
- the evolution of primary energy production in Romania shows a decreasing trend, the total production in 2019 being approximately 11% lower than that recorded in 2014, the same decrease being registered in the case of natural gas;
- there is a downward trend in the production of solid fuels and crude oil and petroleum products.

Table 5. Evolution of primary energy production in Romania, by type of source[7]

Primary energy sources	2014	2015	2016	2017	2018	2019	2020*

[6]Source: ANRE
Annual Report on the activity of the National Energy Regulatory Authority 2019, page 138.
https://www.anre.ro/ro/despre-anre/rapoarte-anuale
[7]Source: site INS
http://www.insse.ro/cms/en/tags/buletin-statistic-lunar

[Thousand toe]							
Total sources of which:	**32.221,2**	**32.873,6**	**33.162**	**34.291,4**	**34.585,1**	**35.264,1**	**28.473,6**
Coal	4.903	5.235,2	4.738,5	5.164,7	4.809,9	4.330,3	2.755,8
Natural gas	9.121,2	8.722,1	8.672,6	9.282,1	9.494	10.194,9	8.124,9
Oil	10.515,7	10.333,6	11.048,8	11.175,9	11.638	12.003,3	9.104,5
Renewable sources (hydro, wind, solar)	5.106,1	5.390	5.504,7	5.203,8	5.294,4	5.295,2	5.052,4
Other conventional sources Imported petroleum products	2.110,4	2.690,2	2.691,8	2.985,8	2.905,5	2.955,3	3.073,1

*The first eleven months of the year.

The annual production of natural gas decreased from 36.2 billion cubic meters in 1986 (the year with peak production) to 10 billion cubic meters in 2019.
According to records in the National Agency for Mineral Resources (ANRM), the situation of the existing geological resources and reserves was as follows (2015):

- geological resources:703,227 billion cubic meters;
- proven reserves: 101,370 billion cubic meters.

Table 6. presents domestic natural gas production (current production and withdrawn from storage) in Romania in the period 2018-2020.

Domestic natural gas production in 2019, which went into consumption, showed a decrease compared to 2018, namely accounted for approximately 78.00% of the total consumed sources, while in 2020 there is an increase.

Table 6. Domestic natural gas production in Romania[8]

Month	Domestic	% The Total	Domestic	% The Total	Domestic	% The Total

[8] Source: site ANRE
https://www.anre.ro/ro/gaze-naturale/rapoarte/rapoarte-piata-gaze-naturale

	production [MWh]	Consumed Sources	production [MWh]	Consumed Sources	production [MWh]	Consumed Sources
	2018		**2019**		**2020**	
January	14.302.067,508	81,45	15.139.418,641	76,96	15.194.033,915	80,19
February	13.556.216,348	83,22	12.347.443,584	79,72	11.950.963,274	79,82
March	12.574.446,701	78,83	10.441.578,232	83,98	10.166.012,813	81,65
April	6.863.810,044	99,81	7.784.260,303	86,37	6.870.723,290	81,17
May	6.032.372,677	99,88	5.317.963,205	86,42	5.087.443,637	78,35
June	6.051.831,637	99,96	3.345.487,465	83,74	4.550.261,475	74,79
July	5.587.916,676	95,94	3.980.103,546	74,54	5.087.514,972	77,18
August	5.546.094,181	90,49	4.064.958,624	68,65	5.061.946,333	76,18
September	5.977.256,609	90,31	4.437.576,850	68,88	5.666.367,695	83,50
October	8.466.072,868	92,79	6.599.951,774	71,27	7.621.052,027	89,89
November	12.264.479,966	86,84	8.421.727,669	73,82	12.056.335,701	83,44
December	16.019.359,001	84,47	12.647.174,630	81,03	13.926.299,272	83,06
TOTAL	**113.241.924,216**	**90,33**	**94.527.644,523**	**77,95**	**77.256.319,431**	**80,77**

The import of natural gas (current import and withdrawn from storage) delivered for consumption in Romania during 2016-2020 and a breakdown at the level of gas import sources is presented in Table 7. and Table 8.

Table 7. Import of natural gas in Romania[9]

Month	Import (MWh)				
	2016	2017	2018	2019	2020
January	1.029.066,620	3.853.722,531	2.747.261,768	4.260.647,167	3.397.402,070
February	491.253,605	2.681.639,393	2.346.560,030	2.960.779,941	2.937.524,894
March	169.428,450	766.516,218	3.231.454,056	1.896.527,732	2.209.332,124
April	407.374,053	57.304,816	12.434,223	1.288.419,545	1.653.139,846
May	478.577,997	30.944,396	3.353,713	1.185.490,735	1.617.548,008
June	406.009,106	45.990,604	4.061,515	1.479.598,285	1.844.852,562
July	589.422,908	5.284,446	240.550,543	1.909.583,785	1.588.459,042
August	695.118,333	4.660,782	625.339,896	2.229.829,545	1.527.138,260
September	853.850,069	10.796,261	1.305.626,155	2.236.293,937	1.056.878,940
October	3.204.526,395	901.863,676	756.377,276	2.991.879,270	861.476,030
November	3.439.669,802	1.263.414,294	1.828.398,298	2.857.726,144	1.994.207,720
December	4.175.255,764	3.220.576,323	3.120.928,140	3.493.356,090	2.460.768,370
TOTAL	**15.939.553,102**	**12.842.713,740**	**16.222.345,613**	**28.790.132,176**	**23.148.727,866**

Table 8. Gas import per sources of origin[10]

Import sources	2017		2018		2019		2020	
	UE [%]	Non UE The Russian Federation [%]	UE [%]	Non UE The Russian Federation [%]	UE [%]	Non UE The Russian Federation [%]	UE [%]	Non UE The Russian Federation [%]

[9]Sourse: site ANRE
https://www.anre.ro/ro/gaze-naturale/rapoarte/rapoarte-piata-gaze-naturale
https://www.anre.ro/ro/gaze-naturale/rapoarte/rapoarte-piata-gaze-naturale/rapoarte-anuale-de-monitorizare
[10]Sourse: site ANRE
https://www.anre.ro/ro/gaze-naturale/rapoarte/rapoarte-piata-gaze-naturale
https://www.anre.ro/ro/gaze-naturale/rapoarte/rapoarte-piata-gaze-naturale/rapoarte-anuale-de-monitorizare

January	0,61	99,39	10	90	38,39	61,61	51,41%	48,59%
February	1,47	98,53	7,28	92,72	42,36	57,64	52,87%	47,13%
March	1,59	98,41	6,92	93,08	65,33	34,67	84,92%	15,08%
April	0	100	0	100	93,47	6,53	95,29%	4,71%
May	0	100	0	100	99,59	0,41	89,48%	10,52%
June	0	100	0	100	99,69	0,31	97,27%	2,73%
July	0	100	0	100	84,17	15,83	73,12	26,88
August	0	100	0	100	79,166	20,834	59,30	40,70
September	0	100	4,58	95,42	81,40	18,60	22,90	77,10
October	0	100	16,23	83,77	71,05	28,95	23,96	76,04
November	1,45	98,55	17,06	82,94	56,59	43,41	26,02	73,98
December	1,50	98,50	30,91	69,09	35,68	64,32	35,25	64,75

2.4. The role of natural gas in the electricity production

In 2019, total electricity production in Romania amounted to 57,02 TWh[11] stating a decrease compared to 2018, which was of 61.97 TWh, in meanwhile the electricity delivered by those respective producers in the network was approximately 53.63 TWh, accounting for a decrease by about 8% compared to the one delivered in the previous year.

Table 9. presents the structure of installed power, by fuel type, from which it can be seen that the percentage of the installed power of power plants using hydrocarbons (natural gas and oil) has decreased from 23,43% in 2017 to 15,65% in 2020.

Table 9. The structure of installed power by fuel type[12]

Type of Power Plant	Installed Power [MW]

[11]Source: ANRE
Annual Report on the activity of the National Energy Regulatory Authority 2019, page 84.
https://www.anre.ro/ro/despre-anre/rapoarte-anuale
[12]Source: Transelectrica S.A., page 36.
https://www.transelectrica.ro/documents/10179/11109053/Planul+de+dezvoltare+a+RET+2020_2029.pdf/5524ca56-0166-4964-8bf9-b1d2cfadeea0

	01.01.2017		01.01.2018		01.01.2019		01.01.2020	
Total of which:	24714*		24738*		24606*		20696**	
	[MW]	[%]	[MW]	[%]	[MW]	[%]	[MW]	[%]
Coal	6240	25,25	6240	25,22	6232	25,33	4787	23,13
Hydrocarbs	5792	23,43	5789	23,40	5656	22,99	3239	15,65
Nuclear	1413	5,72	1413	5,71	1413	5,74	1413	6,83
Hydro	6744	27,29	6761	27,33	6759	27,47	6704	32,40
Wind	3025	12,24	3030	12,25	3032	12,32	3024	14,61
Photovoltaic	1371	5,55	1375	5,56	1382	5,61	1392	6,72
Biomass	129	0,52	130	0,53	132	0,54	137	0,66

* Preserved groups and groups withdrawn from operation for a longer period of a year that is in rehabilitation are not included. Groups in technological trials for commissioning are also included.

** Installed power in commercial electricity generation capacities (licenses valid, in accordance with the website www.anre.ro).

Table 10. presents the structure of annual electricity production by fuel type, in GWh, in the 2015-2019 period, from which it can be seen that the percentage of electricity produced from hydrocarbons (natural gas and oil) has remained close to a value of about 16%.

Table 10. The structure of annual electricity production in 2015-2019 period[13]

Type of Power Plant	**Electricity Production [GWh]**									
	2015	[%]	2016	[%]	2017	[%]	2018	[%]	2019	[%]
Nuclear	11638	17,74	11286	17,51	11509	18,05	11377	17,67	11270	18,93
Coal	18345	27,97	16091	24,96	17154	26,91	15869	24,65	13886	23,33
Hydrocarbs[14]	9399	14,33	9960	15,45	10803	16,95	10941	17,00	9459	15,89

[13]Source: Transelectrica S.A., page 43.
https://www.transelectrica.ro/documents/10179/11109053/Planul+de+dezvoltare+a+RET+2020_2029.pdf/5524ca56-0166-4964-8bf9-b1d2cfadeea0

[14]In accordance with the Report on the activity of the National Energy Regulatory Authority 2019 natural gas represents approximatively 99% of hydrocarbons.

Hydro	16622	25,34	18272	28,34	14608	22,92	17783	27,62	15955	26,81
Wind	7062	10,76	6590	10,22	7403	11,61	6322	9,82	6773	11,38
Biomass	529	0,81	453	0,70	401	0,63	312	0,49	398	0,67
Photovoltaic	2003	3,05	1820	2,82	1870	2,93	1771	2,75	1777	2,99
TOTAL	**65598**	**100**	**64472**	**100**	**63748**	**100**	**64375**	**100**	**59518**	**100**

Table 11. presents the national production of electricity and heat cogeneration from which highlights the fact that the percentage of electricity produced in cogeneration being about 8,7% of the total national production in the period 2014-2018, given that the maximum electrical and thermal cogeneration capacities in Romania in 2018 were the following: 4135 MW gross (electricity) and 8838 MW net (heat).

Table 11. National production of electricity and heat cogeneration[15]

Anul	Total electricity produced in cogeneration units [TWh]	Electricity produced in cogeneration [TWh]	Electricity produced in cogeneration from total national production [%]	Useful thermal energy produced in cogeneration units [PJ]
2014	10,7	6,1	9,4	55,4
2015	9,2	5,6	8,5	51,0
2016	8,9	5,29	8,2	45,9
2017	8,91	5,79	9,1	47,0
2018	7,91	5,39	8,4	47,2

[15] Source: ANRE
Annual Report on the activity of the National Energy Regulatory Authority 2019, page 300.
https://www.anre.ro/ro/despre-anre/rapoarte-anuale

2.5. The role of energy efficiency measures and their effect on annual final gas consumption

By adopting in 2018 of the Directive (EU) 2018/2002 of the European Parliament and of the Council of 11 December 2018 amending Directive (EU) on energy efficiency (hereinafter "Directive (EU) 2018/2002"), the goal of improving energy efficiency has been set at European Union level, which aims to reduce primary energy consumption by at least 32.5% by 2030, in order to meet the targets set out in the 2015 Paris Agreement on Climate Change.
In order to comply with the obligations provided in Article 7 of the Directive 2018/2002, Romania has decided to develop and implement alternative measures and policies to encourage energy savings.
Consequently, to ensure that the goal of improving energy efficiency is met (and other energy and climate targets by 2030, namely to reduce domestic greenhouse gas emissions by at least 40% below 1990 levels by 2030 and to achieve a share of at least 32 % of energy from renewable sources in the Union's gross final consumption of energy by 2030) each Member State was obliged to submit to the European Commission a Draft of the Integrated National Energy and Climate Plan (PNIESC) for the period 2021-2030, which sets out national targets and contributions to achieving the European Union's objectives on climate change.
It should be noted that the new energy savings resulting from the application of energy efficiency policy measures for the years 2021-2030, as well as Romania's contribution to the European Union's energy efficiency objective will be set out in the Integrated National Energy and Climate Plan, which will be approved by Government Decision.
The policies and measures that Romania intends to adopt for the achievement of consumption targets they have a wide scope of application and require, where appropriate, a longer period of confirmation of the effects generated, the data currently available do not permit any reliable statement, regarding what energy efficiency measures will impact the natural gas market. For this reason, most of the consistent effects in terms of reducing energy consumption will be felt starting with 2025, when the trend of reductions is increasing, being influenced by the effects of investments made in the period 2020 - 2025.
In the context of the energy transition, however, we can consider that natural gas is an energy source which is already making a rapid and efficient contribution, through available and innovative technologies towards capitalizing on the potential for energy efficiency. The current potential for high-efficiency cogeneration and efficient district heating and cooling should be mentioned. While cogeneration contributes significantly to primary energy savings, this should also be taken into account in the context of industrial competitiveness, security of supply, system flexibility, sector coupling and decarbonisation, by applying it more and more to low-carbon or decarbonized energy sources.

3. DESCRIPTION OF REGIONAL GAS SYSTEM IN WHICH ROMANIA IS PART

3.1. Regional risk group Ukraine[16]

3.1.1. Description of the functioning of the gas system in the risk group Ukraine

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

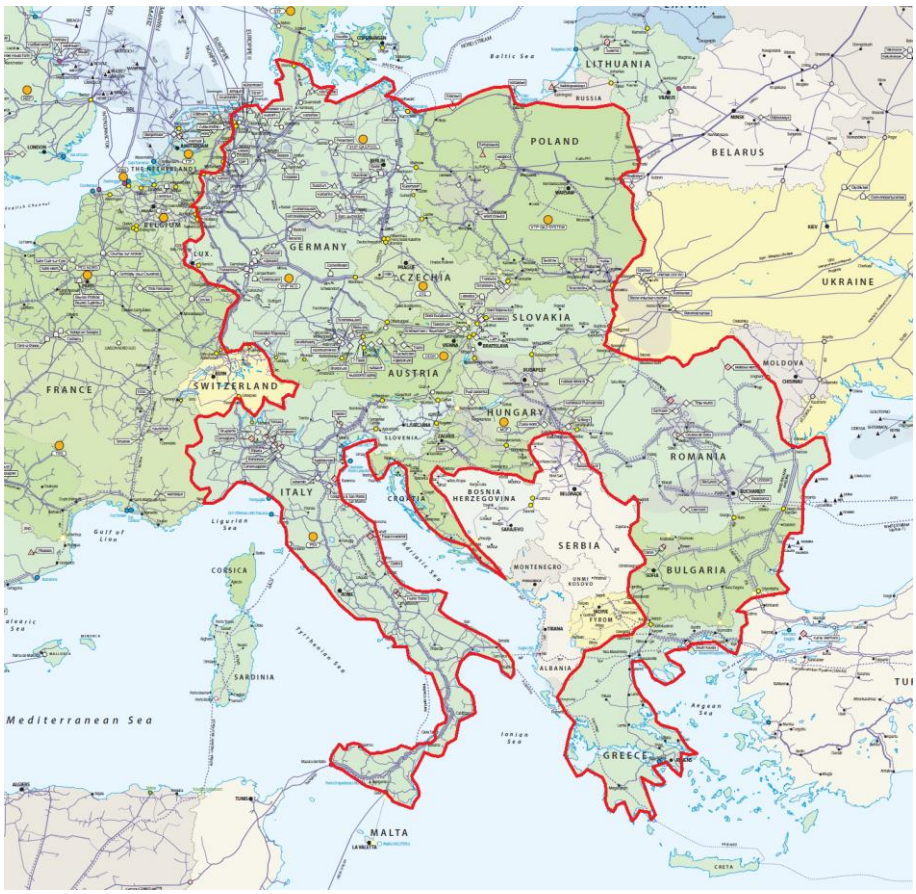

Figure 2. The countries in the risk group Ukraine

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

[16]Source: Common Risk Assessment Eastern gas supply risk group Ukraine.

Tables 12. și 13. present the main data on the natural gas systems of the Member States included in the risk group Ukraine, namely the capacity of the interconnection points between Member States and the LNG regasification terminals.

Table 12. Capacity of the interconnection points between Member States from risk group - Ukraine

(MSm³/zi)

	January 2019	**January 2021**
Bulgaria		
Strandja/Malkoclar	0	5,5
Gueshevo/Jidilovo	0	9,1
TOTAL	0	14,6
Germany		
Bocholtz	45,3	45,3
Bocholtz-Vetschau	1,3	1,3
Bunde	0,0	0,0
Dornum	68,5	68,5
Ellund	2,8	2,8
Elten/Zevenaar	46,6	46,6
Emden EPT	48,9	48,9
Eynatten/Raeren/Lichtenbusch	29,2	29,2
Greifswald NEL	64,1	64,1
Greifswald Opal	101,7	101,7
Haanrade	0,5	0,5
Medelsheim	0,0	0,0
Oude Statenzijl H Gasunie	5,6	5,6
Oude Statenzijl H OGE	6,2	6,2
Oude Statenzijl L	30,2	30,2
RC Basel	0,0	0,0
RC Thayngen-Fallentor	0,0	0,0
Vreden/Winterswijk	20,1	20,1
TOTAL	471,0	471,0
Greece		
Kipi (TR) / Kipi (GR)	4,5	4,5
Kipi (TAP)	0	31,6
TOTAL	4,5	36,1
Hungary		
Beregdaróc 1400	71,3	71,3
Beregdaróc 800	0	0

TOTAL	71,3	71,3
Italy		
Mazara del vallo	110,8	108,4
Gela	49,3	44,5
TOTAL	160,1	152,9
Luxemburg		
GDLux (BE) / Bras Petange (LU)	4,3	4,3
TOTAL	4,3	4,3
Polonia		
Tietierowka	0,7	0,7
Kondratki	104,7	104,7
Wysokoje	15,8	15,8
Drozdovichi (UA) -Drozdowicze (PL)	16,5	16,5
TOTAL	137,7	137,7
Slovakia		
Uzhgorod (UA) - Velké Kapušany (SK)	227,4	191,7
Budince	23,6	16,7
TOTAL	250,9	208,4
Romania		
Ungheni	0	0,2
Isaccea (RO) - Orlovka (UA) I	18,8	18,8
Isaccea (RO) - Orlovka (UA) II	26,9	27,4
Isaccea (RO) - Orlovka (UA) III	23,4	27,6
Medieşu Aurit - Isaccea	34,6	29,8
TOTAL	**103,7**	**103,8**

Table 13. LNG regasification terminals

MSm³/d	January 2019 & 2021
Greece	13,2
Italy	51,9
Poland	14,4

3.1.2. The role of storage facilities relevant for the risk group Ukraine, including cross-border access

The total active capacity of underground natural gas storage in 2017 in Member States forming the Ukrainian risk group amounted to 59.1 bcm (648 TWh). Among the countries of the Ukraine risk group, the largest natural gas storage capacity are in Germany, which amount to approx. 24

bcm (263 TWh), while Greece, Luxembourg and Slovenia do not have underground gas storage facilities in their gas system.
Tables 14. și 15. present data on storage facilities relevant to the risk group Ukraine, as follows:

- the storage capacity (total and working gas) and cross-border access;
- the maximum daily withdrawal capacity at different filling levels compared to peak demand, respectively 100% and 30% and the the exceptionally high gas demand (occurring with a statistical probability of once in 20 year).

Table 14. Storage capacity (total and working gas) and cross-border access

2018	Storage capacity [GSm^3]			Cross-border access
	Working gas	Strategic reserve	Total	
Austria	5.744	-	5.744	yes
Bulgaria	0.141	0.509	0.65	allowed
Croatia	0.532	-	0.532	yes
Czech republic	3.121	-	3.121	Nonavailable
Germany	25.339	-	25.339	-
Greece	-	-	-	-
Hungary	4.670	-	4.67	-
Italy	13.065	4.62	17.685	allowed
Luxemburg	-	-	-	-
Poland	3.1504	-	3.1504	-
Romania	3.075	-	3.075	Allowed
Slovakia	3.495	-	3.495	Yes
Slovenia	-	-	-	-
TOTAL	**62.332**	**5.129**	**67.461**	

Table 15. Maximum daily withdrawal capacity at different filling levels compared to peak demand

(MSm^3/ zi)

	2019			2021		
	Filling storage 100%	Filling storage 30%	Gas demand	Filling storage 100%	Filling storage 30%	Gas demand
Austria	66,4	44,4	55,3	66,4	44,4	55,3
Bulgaria	4,2	2,9	18,2	4,2	2,9	20,3

Croatia	5,8	3,2	16,6	5,8	3,2	16,6
Czech Republic	59,1	41,0	68,2	59,1	41,0	68,2
Germany	612,4	479,3	474,8	612,4	479,3	474,8
Greece	-	-	20,1	-	-	21,1
Hungary	78,6	68	77,4	78,6	69,5	89,5
Italy	263,2	171,8	443,0	291,3	190,8	438,0
Luxemburg	-	-	4,8	-	-	4,8
Poland	51,5	40,7	86,7	51,5	40,7	97
Romania	29,0	-	72,0	29,0	-	72,0
Slovakia	52,61	39,5	45,1	52,61	39,5	34,7
Slovenia	-	-	4,9	-	-	6,1
TOTAL	**1.222,81**	**890,80**	**1.387,10**	**1.250,91**	**911,3**	**1.398,40**

3.1.3. The role of domestic natural gas production of the Member States in the risk group Ukraine

The total natural gas production in the Member States forming the Ukraine risk group in 2017 amounted to 33.61 bcm (369 TWh), which is approximately 13.8% of the total natural gas consumption in this group. The largest production was recorded in Romania (11.18 bcm, i.e. 122.67 TWh), while the lowest in Greece and Slovenia (8 mcm, or 87.8 GWh).
Table 16. presents domestic natural gas production of the Member States in the risk group Ukraine for the years 2019 and 2021, which shows a slight decreasing trend.

Table 16. Domestic natural gas production of the Member States in the risk group Ukraine

Production [MSm^3/zi]	**2019**	**2021**
Austria	3,4	3,4
Bulgaria	0,6	1,1
Croatia	3,5	3,5
Czech Republic	0,5	0,4
Germany	26,2	26,2
Greece	-	-
Hungary	4,8	3,6
Italy	15,5	18,9

Luxemburg	-	-
Poland	7,2	7,2
Romania	26,0	26,5
Slovakia	0,2	0,3
Slovenia	-	-
TOTAL	**88,6**	**91,1**

3.1.4. The role of natural gas in the production of electricity in the risk group Ukraine

The total natural gas consumption in the production of electricity in 2016 in Member States forming the Ukraine risk group amounted to 65.65 bcm (720 TWh). The largest use of natural gas in power generation in 2016 occurred in Italy at 27.76 bcm (305 TWh), while the lowest in Luxembourg 92 mcm (1 009 GWh). A summary of the role of natural gas in the production of electricity of the Member States in the risk group Ukraine is presented in Table 17.

Table 17. The role of natural gas in the electricity production of the Member States in the risk group Ukraine

Grupul de Risc Ucraina (BG, CZ, DE, EL, HR, IT, LU, HU, AT, PL, RO, SI, SK)												
Gaz natural 2016, % din consumul intern brut	Energie Primară	Importuri	Inmagazinare – schimbări ale stocurilor	Exporturi	Consumul intern brut	Centrale termice	Centrale pentru încălzire - Termoficare	Consumul final de energie	Industrie	Transport	Alte sectoare	Sectorul rezidenția - casnic
AT	13,57%	165,11%	0,65%	79,33%	100,00%	23,39%	3,87%	64,40%	37,96%	3,58%	22,86%	16,79%
BG	2,85%	96,54%	0,69%	0,09%	100,00%	23,05%	7,72%	48,87%	34,24%	8,56%	6,07%	2,19%
CZ	2,57%	95,71%	1,72%	0,00%	100,00%	11,75%	8,81%	75,31%	28,72%	0,78%	45,81%	28,41%
DE	9,31%	116,04%	2,13%	27,48%	100,00%	21,63%	3,13%	74,53%	27,71%	0,63%	46,18%	14,77%
EL	0,27%	99,22%	0,51%	0,00%	100,00%	63,99%	0,00%	30,02%	15,79%	0,54%	13,68%	9,43%
HR	63,08%	48,43%	3,40%	14,91%	100,00%	20,21%	2,72%	47,48%	16,44%	0,17%	30,87%	21,46%
HU	17,80%	90,00%	3,32%	11,12%	100,00%	15,94%	6,83%	69,99%	16,42%	0,60%	52,97%	35,05%
IT	8,16%	92,06%	0,08%	0,30%	100,00%	39,15%	0,00%	57,23%	14,40%	1,90%	40,93%	29,44%
LU	0,00%	99,34%	0,00%	0,00%	100,00%	10,90%	0,42%	88,67%	39,21%	0,00%	49,46%	31,01%
PL	24,28%	83,27%	-2,66%	4,89%	100,00%	10,13%	1,39%	63,04%	23,31%	2,61%	37,12%	23,69%
RO	86,41%	13,06%	0,54%	0,01%	100,00%	27,21%	2,57%	57,77%	23,14%	0,01%	34,62%	25,40%
SI	0,61%	99,39%	0,00%	0,00%	100,00%	11,09%	3,19%	84,87%	58,93%	0,40%	25,54%	16,30%
SK	1,97%	92,85%	5,19%	0,00%	100,00%	10,46%	6,10%	65,75%	20,39%	3,64%	41,73%	27,42%
Total	14,23%	99,17%	1,04%	14,44%	100,00%	26,35%	2,45%	65,34%	22,73%	1,43%	41,17%	22,09%

3.2. Regional risk group Trans-Balkan[17]

The risk group Trans-Balkan includes: Bulgaria, **Romania** and Greece.
Romania, Bulgaria and **Greece** are considered as one **"single area"**. Essential for this risk group are the 5 Entry Points (EP) (see Figure 3.) connecting the region with countries outside the region:

- In the North: the cross-border point between Ukraine and Romania at Medieșu (EP1), the border between **Romania** and Ukraine through the interconnection at Isaccea (EP2) and the border between **Romania** and Hungary through the interconnection at Csanádpalota (EP3);
- In the South: the Entry Point (EP4) that connects Turkey with Greece, at Kipi, and the LNG terminal, at Revithoussa;
- East and West of Bulgaria, there are also two (2) Exit Points from Trans-Balkan region, EXP1 to Turkey at Strandzha/Malkoclar and EXP2 to North Macedonia at Kyustendil/ Zhidilovo.

Figure 3. Map of cross-border points in the risk group Trans-Balkan

[17]Source: Common risk assessment of the risk group Trans-Balkan.

Table 18. presents the main data on the natural gas system in the risk group Ukraine, namely the firm and interruptible capacity of the cross-border points for each Member State.

Table 18. Firm and Interruptible capacity at cross-border points in the risk group Trans-Balkan[18]

Member State	Cross-border point	Direction	Firm Capacity (Interruptible) [M(S)m^3/d]	Minimumdelivery pressure [bar-g]
Greece	Kulata (BG)/Sidirokastron (EL)	BG -> EL	11.40	47.75
		EL -> BG	4.33*	40
	Kipi	TR -> EL	4.54**	50
Romania	Orlovka (UA) – Isaccea I (RO)	UA -> RO	18.76	47
	Către Romania	UA-> dRO	23.60	35
	Orlovka (UA) – Isaccea II (RO)	UA -> RO	26.93	50
	Orlovka (UA) – Isaccea III (RO)	UA -> RO	23.43	50
	Tekovo (UA) – Medieşu Aurit - Isaccea (RO)	UA -> RO	10.98	47
	Csanádpalota (HU) – Arad (RO)	HU -> RO	4.80	40
		RO - > HU	0.24 (4.80)	(20) 40
	Ungheni (MO) – Iași (RO)	RO -> MD	0.12	9
	Ruse (BG) – Giurgiu (RO)	RO -> BG	0.15	30
		BG -> RO	3.00	30
	Negru Voda I	RO -> BG	17.44	31.5
	Negru Voda II	RO -> BG	26.93	38
	Negru Voda III	RO -> BG	23.43	38
Bulgaria	Negru Voda 1(RO)/Kardam (BG)	RO -> BG	19.92	31.5
	Negru Voda 2, 3 (RO)/Kardam (BG)	RO -> BG	57.25	38
	Kulata (BG)/Sidirokastron (GR)	BG -> EL	10.882 (0.147)	47.75
		EL - > BG	4.42 (0.59)	40
	Strandzha (BG)/Malkoclar (TR)	BG -> TR	44.35	50
	Kyustendil (BG)/Zidilovo (MK)	BG -> MK	2.53	40
	Ruse (BG)/Giurgiu (RO)	RO - > BG	0.15	30

[18]Source: Common risk assessment of the risk group Trans-Balkan; DESFA, Transgaz S.A., Bulgartransgaz, 2019.

	BG -> RO	4.47 (0.732)	30
Punct de transfer dintre NGTN și GTNTT ***	Transit -> BG	3.93 (1.96)	
	BG -> Transit	1.96 (3.93)	

***Equivalent to 4.1 M(N)m3/d.**
****Before January 2019 only 2.27 M(S)m3/day where to be considered available.**
*****Total capacity which can be used at only one of split on both interconnections in GMS Lozenets and GMS Ihtiman**

The values for natural gas consumption and national gas production of Member States included in the risk group Trans-Balkan are integrated in the description of the risk group Ukraine.

4. THE RESULTS OF THE COMMON RISK ASSESSMENT

According to the provisions of Article 7 paragraph (2) of the Regulation, the Ministry of Energy through the Competent Authority, designated on the basis of the Regulation, participated in the elaboration of common assessments, for each risk group of which Romania is part, respectively Ukraine and Trans-Balkan.

4.1. Common risk assessment for the risk group Ukraine[19]

The risk group Ukraine includes: Bulgaria, Czech Republic, Germany, Greece, Croatia, Italy, Luxembourg, Hungary Austria, Poland, Romania, Slovenia and Slovakia.
According to the provisions of Article 7 of the Regulation, the common risk assessment assesses all relevant risk factors, such as natural disasters, technological, commercial, social, political and other risks, which could lead to the materialization of the major transnational risk to security of gas supply for each Member State in the group. of risk.
The risk group Ukraine identified relevant sources of cross-border risk in each country and distributed common tables of definitions to classify the probability and impact of a risk factor.
The synthesis and analysis of all of them provided the final risk matrix.

4.1.1. The risk scenarios assessed

The common risk assessment has analyzed **8 scenarios of disruptions** in natural gas supply, which are presented in Table 19.

[19]Source: Common Risk Assessment Eastern gas supply risk group Ukraine.
Preventive Action Plan and Emergency Plan of the Eastern gas supply risk group Ukraine.

Table 19. Summary of the common risk scenarios selected for the Common risk assessment of the risk group Ukraine

Scenario	Variant	Name	Description	Duration of event (days)	Time frame	Demand	UGS level	LNG availability	Import from Norway	Import from the Russia Federation	Import from Algeria	Import from Ukraine	Transit to Balkans
S 01	a	Failure of the Ukrainian Corridor	N-1 case: failure of the cross-border point of Uzhgorod (UA) – Velke Kapusany (SK)	7	Beginning of February	1-in-20 7-day peak demand	Beginning of February	Send-out capacity 100% for 4 days and 75% for 3 days	√	√	√	!	√
	b		Failure of all cross-border points with Ukraine	14	Beginning of February	1-in-20 14 day peak demand	Beginning of February	Send-out capacity 100% for 4 days and 75% for 3 days, timing for next ship to be defined	√	√	√	X	!

	c		Failure of all cross-border points with Ukraine	30	Beginning of February	1-in-20 30-day peak demand	Beginning of February	Send-out capacity 100% for 4 days and 75% for 3 days, timing for next ship to be defined	√	√	√	X	!
S 02	a	Failure of the Ukrainian Corridor – during a cold spell event	N-1 case: failure of the cross-border point of Uzhgorod (UA) – Velke Kapusany (SK)	7	Second week of March	7-day peak demand	Second week of March	Send-out capacity 100% for 4 days and 75% for 3 days	√	√	√	!	√
	b		Failure of all cross-border points with Ukraine	14	Second week of March	14-day peak demand	Second week of March	Send-out capacity 100% for 4 days and 75% for 3 days, timing for next ship to be defined	√	√	√	X	!

S 03	a	Failure of Russian Exports to EU	Stop of flow from all Russian related supply corridors	14	Beginning of February	1-in-20 14-day peak demand	Beginning of February	Send-out capacity 100% for 4 days and 75% for 3 days, timing for next ship to be defined	√	X	√	X	!
	b			30	Beginning of February	30-day peak demand	Beginning of February	Send-out capacity 100% for 4 days and 75% for 3 days, timing for next ship to be defined	√	X	√	X	!
S 04		Failure of Baugarden	Stop of the flow in the station	7	Beginning of February	7-day peak demand	Beginning of February	Send-out capacity 100% for 4 days and 75% for 3 days, timing for next ship	√	√	√	√	√

								to be defined					
S 05		Failure of Lanzhot	Stop of the flow in the station	7	Beginning of February	7-day peak demand	Beginning of February	Send-out capacity 100% for 4 days and 75% for 3 days, timing for next ship to be defined	√	√	√	√	√
S 06		Failure of Oberkappel	Stop of the flow in the station	7	Beginning of February	7-day peak demand	Beginning of February	Send-out capacity 100% for 4 days and 75% for 3 days, timing for next ship to be defined	√	√	√	√	√
S 07		Failure of Isaccea (RO) – Orlovka (UA)	Stop of the flow in the station	7	Beginning of February	7-day peak demand	Beginning of February	Send-out capacity 100% for 4 days and 75% for 3	√	√	√	√	√

								days, timing for next ship to be defined					
S 08		Supply failure from Algeria	Stop of supply sources of Algerian origin (pipeline and LNG)	30	Beginning of February	1-in-20 30-day peak demand	Beginning of February	BAU average of past years	√	√	X	√	√

√ **Always available** **X** **Not available** **!** **With limitations**

4.1.2. Conclusions

Analyzes performed indicate that Bulgaria and Greece, as well as to a lesser extent, Romania are exposed to gas supply disruptions in Ukraine.
The Eastern gas supply risk groups from which the Ukraine Risk Group also is part (in accordance with Annex 1 to the Regulation) focused on Ukrainian gas supply, after taking into account infrastructure and supply standards, protected customers definition for each involved Member State and the results of GEMFLOW analysis of risk evaluation, concludes that:

- infrastructure and supply standards are sufficiently covered at a group level. Through the utilization of the "N-1 formula at regional level" has been demonstrated that technical capacity of gas infrastructures are sufficient to satisfy overall gas demand of the involved Member States, in the event of disruption of the single largest gas infrastructure and of the whole number of infrastructures connecting Ukraine to the group of Members States;
- GEMFLOW simulation shows that **Romania** (to a lesser extent), Bulgaria and Greece (both mainly) are very exposed to supply complications affecting the Ukrainian route: they are supposed to have unserved demand in scenarios S.01 - b, S.01 - c, S.02 - b, S.03 - a, S.03 - b and, for a higher extent, S.07. Even if there are several scenarios analysis delivering the possibility of facing difficult situations, S.01 - c is the most challenging for both demand and availability of flexibility for transmission capacity, considering failure of all the cross border point with Ukraine for a duration of 30 days, at the beginning of February. The simulation provides a stressed situation for interconnection points to and from Germany, Slovakia and Hungary (IP utilization rate from 90% to 100%) and possible unserved demand to **Romania** (-3%), Bulgaria (-78%) and Greece (-38%). Another remarkable situation comes from scenario S.03 - a where, supposing a stop of gas flow from all Russian related supply corridors, for a duration of 14 days, at the beginning of February, Bulgaria, Greece and **Romania** have huge share of unserved gas but, at the same time, several other Member States are suffering very stressed supply situations, even if the simulation don't assesses a significant percentage of unserved gas but only small marginal quantities of uncovered demand. The most difficult scenario with regards to storage gas consumption is S.03 - b, a stop of gas flow from all Russian related supply corridors for a duration of 30 days, at the beginning of February, with 13,5 GSm³. The highest values of unserved gas recorded for this scenario are 11% for Poland, 7% for Romania, 99% for Bulgaria and 47% for Greece.

4.2. Common risk assessment for the risk group Trans-Balkan[20]

The risk group Trans-Balkan includes: Bulgaria, Romania and Greece.
It should be noted that the Transcalcanic infrastructure capacity values are integrated in the description of the risk group Ukraine.

4.2.1. The risk scenarios assessed

The two scenarios analyzed in Trans-Balkan group are the following:

- 1st approach Technical capacity of gas infrastructure (EPm) comprises the total amount of gas entering the region, without taking into account that part of that gas is only for transit;
- 2nd approach from the total amount of gas entering the region, the amount of transit gas is discounted from the N-1 formula, i.e. approx. 47 M(S)m3/day.

Table 20. presents the summary of the risk scenarios selected for the Common risk assessment of the risk group Ukraine (the reference time frame for all scenarios is February 1st at 07:00 a.m.).

[20] Source: Common risk assessment of the risk group Trans-Balkan.

Table 20. Summary of the risk scenarios selected for the Common risk assessment of the risk group Trans-Balkan

Scenario	Case	Name	Description	Duration [days]	Demand (1-în-20)	LNG availability [inventory / new cargo]	Romania	Imports Ukraine	Transit N. Macedonia	Transit Turkey
S.1	a	Failure of the Ukrainian Corridor	Failure of Negru Vodă I	7	7	60% / 6 days	E*	L**	Y	Y
	b		Failure of Negru Vodă II-III (Stop of flows upstream CS Lozenets)	7	7	60% / 6 days	E	L	N	N
	c		Failure of Negru Vodă II-III (stop of flows downstream CS Lozenets)	7	7	60% / 6 days	E	L	N	Y
	d		Failure of all transit lines from Ukraine (for natural hazard or terrorism). Exit to Romania and transit to Bulgaria and Greece is compromised	30	30	60% / 6 days	E	N	N	N
S.2	a	Întrerupere export Rusia către UE	Toate punctele transfrontaliere legate de coridorul de aprovizionare din Ucraina nu sunt disponibile.	14	14	60% / 6 - 10 days	nE	N	N	N
	b			30	30	60% / 6 - 10 days	nE	N	N	N
S.3	a	Failure of the Ukrainian Corridor and unavailability of UGS Chiren	Case S1.a and UGS Chiren is not available for 7 days. Both events start at the same time.	7 (7)#	7	60% / 6 days	nE	L	Y	Y
	b		Case S1.d și USG Chiren nu este disponibil timp de 7 zile. Ambele evenimente încep în același timp.	30 (7)	30	60% / 6 days	Ne	N	N	N
S.4	a	Failure of Russian Exports to EU and	Case S2.a and UGS Chiren is not available for 7 days.	14 (7)	14	60% / 6 - 10 days		N	N	N

		unavailability of UGS Chiren	Both events start at the same time.							
	b		Case S2.b and UGS Chiren is not available for 7 days. Both events start at the same time.	30 (7)	30	60% / 6 - 10 days		N	N	N
S.5	**a.a**	Failure of the Ukrainian Corridor and problems with the LNG facility	Case S1.a and reduction of 50% in send-out capacity of the LNG facility due to technical reasons or cargo delays. LNG is affected from day 2 at 7:00 to day 5 at 7:00.	7 (3)	7	60% / 6 days		L	Y	Y
	a.b		Case S1.b and reduction of 50% in send-out capacity of the LNG facility due to technical reasons or cargo delays. LNG is affected from day 2 at 7:00 to day 5 at 7:00.	7 (3)	7	60% / 6 days		L	N	N
	a.c		Case S1.c and reduction of 50% in send-out capacity of the LNG facility due to technical reasons or cargo delays. LNG is affected from day 2 at 7:00 to day 5 at 7:00.	7 (3)	7	60% / 6 days		L	N	Y
	a.d		Case S1.d and reduction of 50% in send-out capacity of the LNG facility due to technical reasons or cargo delays. LNG is affected from day 2 at 7:00 to day 5 at 7:00.	30 (3)	30	60% / 6 days		N	N	N
S.5	**b.a**	Failure of the Ukrainian Corridor and problems with the LNG facility	Case S1.a and disruption of the pipeline Megara – Patima (a five day disruption). LNG is affected from day 2 at 7:00 to day 7 at 7:00.	7 (5)	7	60% / 6 days		L	N	N
	b.b		Case S1.b and disruption of the pipeline Megara – Patima (a five day disruption). LNG is affected from day 2 at 7:00 to day 7 at 7:00.	7 (5)	7	60% / 6 days		L	N	N
	b.c		Case S1.c and disruption of the pipeline Megara – Patima (a five day disruption). LNG is affected from day 2 at 7:00 to day 7 at 7:00.	7 (5)	7	60% / 6 days		L	N	Y

	b.d		Case S1.d and disruption of the pipeline Megara – Patima (a five day disruption). LNG is affected from day 2 at 7:00 to day 7 at 7:00.	30 (5)	30	60% / 6 days		N	N	N
	c.a		Case S1.a and unavailability of the LNG (caused by disruption of submerged connecting pipelines) for 30 days. Event starts after 12 hours.	7 (30)	30	60% / 6 days		L	Y	Y
	c.b		Case S1.b and unavailability of the LNG (caused by disruption of submerged connecting pipelines) for 30 days. Event starts after 12 hours.	7 (30)	30	60% / 6 days		L	N	N
	c.c		Case S1.c and unavailability of the LNG (caused by disruption of submerged connecting pipelines) for 30 days. Event starts after 12 hours.	7 (30)	30	60% / 6 days		L	N	Y
	c.d		Case S1.d and unavailability of the LNG (caused by disruption of submerged connecting pipelines) for 30 days. Event starts after 12 hours.	30 (30)	30	60% / 6 days		N	N	N
S.6	**a.a**	Failure of Russian Exports to EU and problems with the LNG Facility	Case 2.a and reduction of 50% in send-out capacity of the LNG facility due to technical reasons or cargo delays. LNG is affected from day 2 at 7:00 to day 5 at 7:00.	14 (3)	14	60% / 6 - 10 days		N	N	N
	a.b		Case 2.a and disruption of the pipeline Megara – Patima (a five day disruption). LNG is affected from day 2 at 7:00 to day 7 at 7:00	14 (5)	14	60% / 6 - 10 days		N	N	N
	a.c		Case 2.a and unavailability of the LNG (caused by disruption of submerged connecting pipelines) for 30 days. Event starts after 12 hours.	14 (30)	30	60% / 6 - 10 days		N	N	N
	b.a		Case 2.b and reduction of 50% in send-out capacity of the LNG facility due to technical reasons or cargo delays. LNG is affected from day 2 at 7:00 to day 5	30 (3)	30	60% / 6 days		N	N	N

			at 7:00.							
	b.b		Case 2.b and disruption of the pipeline Megara – Patima (a five day disruption). LNG is affected from day 2 at 7:00 to day 7 at 7:00	30 (5)	30	60% / 6 days		N	N	N
	b.c		Case 2.b and unavailability of the LNG (caused by disruption of submerged connecting pipelines) for 30 days. Event starts after 12 hours.	30 (30)	30	60% / 6 days		N	N	N
			*E for export at Ruse (BG) - Giurgiu (RO) and nE for no export; ** Y: yes; N: no; L: with limitations; # Length of the second event of the risk scenario.							

Risk scenarios could be reclassified based on the risk matrix (see Table 21.), which provides an overview of the risk scenarios.

Table 21. Risk matrix describing the classification of the risk scenarios based on the selected severity ad likelihood scales[21]

		Severity				
		Insignificant or Negligible	*Minor or Low*	*Moderate or Noticeable*	*Major or Severe*	*Catastrophic*
Probabilitate	*Almost Certain (very high)*					
	Probable (high)					
	Possible (average or medium)			S.1.c		S.2.a, S.2.b S.6.a.a, S.6.b.a
	Unlikely (low)		S.1.a	S.1.b, S.5.a.c		S.4.a, S.4.b S.6.a.b, S.6.b.b
	Rare (very low)		S.5.a.a, S.5.b.a, S.5.a.b	S.5.c.a		S.1.d, S.3.a, S.3.b S.5.a.d, S.5.b.b, S.5.b.c S.5.b.d, S.5.c.b, S.5.c.c S.5.c.d, S.6.a.c, S.6.b.c

4.2.2. Conclusions

Romania is directly affected in risk scenario S.1.d, S.2.a and S.2.b, along with all relevant combinations from S.3 to S.6. In risk scenario S.1.d and combinations, we assumed that Romania is providing support to Bulgaria through Ruse (BG) - Giurgiu (RO) for solidarity.
The assessment of the risk scenarios demonstrates the restricted flexibility of the regional system to the low diversification of entry points and to the low intra-regional connectivity among national transmission systems
Infrastructure projects aiming at increasing and diversifying entries to the Trans-Balkan region will substantially reduce the impact of the majority of the selected risk scenarios.

[21] Source: Joint Research Centre 2019.

4.3. National risk assessment

According to the performed analyzes, in case of major risks occurrence concerning the supply disruption of the import natural gas, there may be a shortage of gas demand coverage for a period of time, with a maximum of 17 million cubic meters (mcm)/day.

4.3.1. Risk scenarios regarding the natural gas supply in Romania

Risk scenarios regarding the natural gas supply in Romania which have been analyzed are the following:

Scenario 1: Import deficit during winter (Limitation/cease of natural gas supply from the Russian Federation to the European Union). In the situation in which natural gas acquisitions from import are limited or ceased, during winter, in periods of increased cold, natural gas deficit may reach about 10-17 mcm/day. It is necessary to define a list of interruptible consumers by whose supply limitation or suspension the deficit would be covered, ensuring the balance of the NTS.

Scenario 2: Disruption, for technical reasons (Technical failure in the NTS/storage facilities), in the cold season, of the delivery in the NTS of a maximum gas amount of approximately 13 mcm/day from the storage facilities. Part of this amount can be ensured by supplementing gas import, but it's expected that a volume of approximately 10-17 mcm/day cannot be covered in the case of limitation/cease of natural gas supply from the Russian Federation. For this scenario it is also necessary to identify certain interruptible consumers to compensate the natural gas deficit.

Scenario 3: Extreme weather conditions (Source-consumption imbalances) – very low temperatures, during the cold season, on large intervals of time, of at least 7-8 days. From the experience of the past years, in such a period countries involved in natural gas export and transit to Romania are also involved. Thus, natural gas amounts imported are substantially diminished, which leads – again – to the need to define the list of interruptible consumers to compensate the natural gas deficit, respectively amounts of approximately 10-17 mcm/day.

Scenario 4: Major imbalances on one of the main transmission directions of the NTS (Failure on transmission directions from the Russian Federation): a list with interruptible consumers associated to the system area affected will have to be defined, in this way resulting, at the level of the entire NTS, a list with interruptible consumers delimited on areas likely to be affected by the imbalance of a consumption direction.

4.3.2. Risks matrix

Risk matrix is the proper way to represent the results of a qualitative assessment. On the x axis are the probabilities classes and on the y axis are represented the consequences classes.
Table 22. presents risk matrix that describes the classification of the risk scenarios based on the selected severity and likelihood scales, based on the risks scenarios identified and analyzed in the common regional risks.

Table 22. Risk matrix

		Probability				
		Very low	**Low**	**Medium**	**High**	**Very high**
Impact	**Minor**					
	Low					
	Notable				Imbalances in the natural gas storage activity	
	Severe		Technical failure in the National Transmission System	Failure on transmission directions from the Russian Federation	Ceasing natural gas supply from the Russian Federation to the EU	
	Very Severe					

4.3.3. The main conclusions

The physical structure of the National Transmission System offers the possibility to identify and establish natural gas transport corridors that meet both the needs of ensuring the supply of natural gas to different consumption areas in the country and the needs regarding the transfer through the Romanian system of some quantities of natural gas between the systems of the neighboring countries, as a requirement imposed by the liberalization of natural gas markets and European legal framework.
By applying the investment programs, Transgaz S.A. has developed additional degree of flexibility of the national natural gas transmission network by increasing the balacing level and the functioning limits based on the Line-Pack from 40 mil. cm to 64 mil. cm, ensuring the take-

over of the natural gas extracted from the production perimeters and from imported sources in order to cover the demand of the domestic market participants.
In terms of domestic supply sources, the possible incidents that may affect the production process upstream of the National Transmission System can be remedied in good time (within 48 hours, the average time to restore the normal situation is about 8 hours) without significant impact on the supply of natural gas to the final consumers. The internal procedures of the producers provide a greater flexibility of supply, being available redirection/compensation mechanisms due to the capabilities unavailability during the intervention period.
The natural gas storage system in Romania is one of the elements that contributes to optimizing the use of natural gas transmission infrastructure and balancing the system, contributes to creating an equilibrium between consumption and domestic production and imports, and to increasing the efficiency of the NTS and significantly helps to secure gas supplies to end customers in the event of a gas supply disruption or limitation.
The risks associated with the storage activity (injection and extraction) are mainly of commercial nature, due to the development of current supply sources on competitive price that could lead to unfavorable circumstances for the storage process. Having in mind that the stored natural gas represents current consumption sources in the winter season - not only to cover consumption peaks - it is recommended that in the future the storage activity should be optimized based on multi cycle regime.
Electricity production could be affected by gas supply failures in Romania, as electricity production in hydrocarbon power plants (natural gas) accounts for about 16%[22] of total electricity production and the perspective is to increase this share through implementing the new European green policy.
Romania has the largest gas market in the region and the lowest dependence on imports, recording about 80%[23] of production in the region. Although there is a decline in domestic natural gas production, Romania still has a high potential for domestic production, with possibilities for future development once the production capacities from the Black Sea perimeters are in place.
Regarding the NTS, the technical risks cannot have a decisive effect in triggering a crisis in the supply of natural gas. The Transmission System Operator Transgaz S.A. holds all the methods and good time intervention procedures, so that the average time to restore the gas supply in the affected region is 48 hours. "Sensitivity" of the NTS is caused mainly by external factors, especially on the import directions from Russian Federation, as well as stress factors determined by meteorological events.
The obtained result for N - 1 formula, namely N - 1 = 112,4% > 100%, shows that in case of disruption of the single largest gas infrastructure, the capacity of the remaining infrastructure will be able to provide the necessary gas quantity for satisfying the gas demand of the region during a day of exceptionally high gas demand (occurring with a statistical probability of once in 20 years).
In conclusion, the fact that the value of the N - 1 formula is over 100%, indicates that the national gas infrastructures are properly sized to cover the maximum demand in Romania.

[22]Source: Transelectrica S.A., page 43
https://www.transelectrica.ro/documents/10179/11109053/Planul+de+dezvoltare+a+RET+2020_2029.pdf/5524ca56-0166-4964-8bf9-b1d2cfadeea0
[23]Source: Transgaz S.A., page 18
https://transgaz.ro/ro/consultare-publica-planul-de-dezvoltare-sistemului-national-de-transport-gaze-naturale-pentru

The NTS is carefully maintained at an appropriate level and ensures no problem of meeting the N-1 standard.
Regarding the underground storage of natural gas it is recommended that in the future the storage facilities should become exploitable under multi cycle regime.

5. INFRASTRUCTURE STANDARD

5.1. The identification of the single largest gas infrastructure

Romania's natural gas infrastructure is structured in such a way that it requires the identification of a single main gas infrastructure that represents the National Natural Gas Transmission System in its entirety.

5.2. Calculation of the N-1 formula at national level

Formula N-1 describes the technical capacity of gas infrastructure to meet the total gas demand of the area taken into account in case of affecting the main unique gas infrastructure during a day with an exceptionally high demand, determined statistically every 20 years.
Gas infrastructure includes the gas transmission network, including interconnections, as well as the production facilities, LNG facilities and storage facilities connected to the area taken into account.
Technical capacity [24] of all the other gas infrastructures available in case of damage to the main unique gas infrastructure must be at least equal to the amount of total daily gas demand for the area taken into account, during a day with an exceptionally high gas demand, determined statistically every 20 years.

The result of N-1 formula, as calculated below, must be at least equal to 100%.

The calculation method of N-1 formula:

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

Definitions of the parameters used for the calculation of the N-1 formula:

„Area taken into account": the geographical region for which the formula N-1 is calculated.

Definition regarding the demand:
„D_{max}": total daily gas demand (in million cubic meters per day) of the calculated area during a day of exceptionally high gas demand, occurring with a statistical probability of once in 20 years.

Definitions regarding the offer:

[2424]In accordance with Article 2, paragraph (1), point 18 of Regulation (EC) no. 715/2009, „technical capacity" means the maximum firm capacity that the transmission system operator can offer to the network users, taking account of system integrity and the operational requirements of the transmission network.

„EP_m": the technical capacity of entry points (in million cubic meters per day), others than than production, LNG and storage facilities, covered by Pm, Sm and LNGm, means the sum of the technical capacities of all the border entry points capable to supply gas to the calculated area;
„P_m": the maximum technical production capacity (in million cubic meters per day) means the sum of the maximum technical daily production capacities of all gas production facilities, which can be supplied to the entry points in the calculated area;
„S_m": the maximum technical storage capacity (in million cubic meters per day) means the sum of the maximum daily technical withdrawal capacities of all the storage facilities, which can be supplied to the entry points of the calculated area, taking into account their respective physical characteristics;
„LNG_m": the maximum technical capacity of LNG facilities (in million cubic meters per day) means the sum of the maximum daily technical extraction capacities of all the LNG facilities in the calculated area, taking into account the critical elements such as offloading, ancillary services, temporary storage and LNG regasification, as well as the technical extraction capacity to the system;
„I_m": means the technical capacity of the single largest gas infrastructure (in million cubic meters per day), with the largest capacity to supply the calculated area. When several gas infrastructures are connected to a common upstream or downstream gas infrastructure and cannot be separately operated, they shall be considered as one single gas infrastructure.

Calculating the N-1 formula using demand-side measures:

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

Definition regarding the demand:
„Deff": means the part (in million cubic meters per day) of Dmax which, in the event of gas supply disruption, can be sufficiently and timely covered by market-based demand-side measures, in accordance with Article 9 paragraph (1) letter (c) and Article 5 paragraph (2) of the Regulation.

The result of the N-1 formula calculated for the Romanian territory at the level of 2020 is presented below:

$$N-1[\%] = \frac{44{,}4 + 26{,}3 + 29{,}0 + 0 - 18{,}8}{72} \times 100$$
$$N-1[\%] = 112{,}4\%$$[25]
$$N-1[\%] \geq 100\%$$

Explanations of values used[26]

[25]Source: Transgaz S.A. https://transgaz.ro/ro/consultare-publica-planul-de-dezvoltare-sistemului-national-de-transport-gaze-naturale-pentru, page 39.
[26]Source: Transgaz S.A. https://transgaz.ro/ro/consultare-publica-planul-de-dezvoltare-sistemului-national-de-transport-gaze-naturale-pentru

Terms regarding the demand:

Terms regarding the demand [mil. m^3/day]		**Explanations**
D_{max}	72,0	On the gas day 08.01.2020 there was a peak winter consumption of 62,4 million Sm^3/day, lower to the consumption of a day of exceptionally high gas demand occurring with a statistical probability of once in 20 years.
D_{eff}	0	There are no contracts concluded with interruptible safety customers.

Terms regarding the offer (capacity):

Terms regarding the offer [mil. m^3/day]		**Explanations**
EP_m	44,4	Total capacity of import points (Isaccea 1, Negru Vodă 1, Csanadpalota, Ruse-Giurgiu, Ungheni).
P_m	26,3	Domestic gas production entered into the NTS (without deposit withdrawal).
S_m	29	The sum of the maximum flows withdrawn from each storage warehouse.
LNG_m	0	There are no LNG terminals.
I_m	18,8	Import capacity in Isaccea 1 Point.

For the term „P_m" was considered the potential technical capacity of production and not the technical capacity (70,4 mil. Sm^3/day). We believe that this approach provides a correct picture of the N-1 formula, that technical capacity can no longer be achieved due to the decline in domestic production.
In determining the term „S_m", the sum of the maximum flows withdrawn from each storage warehouse, updated according to the history of the last 5 years (2016-2020), was taken into account, namely:

Warehouse	**Technological capacity [mil. Sm^3/day]**	**Maximum flow [mil. Sm^3/day]**
Urziceni	4,6	4,5
Bălăceanca	1,3	1,0
Bilciurești	16,8	13,2
Sărmășel	8,5	6,1
Tg. Mureș	3,4	2,8
Ghercești	1,5	1,4
Total	36,1	29,0
Maximum daily flow	25,8	

withdrawn from all warehouses		

In determining the value of the term „EP_m", was taken into account the capacity of the Isaccea 1, Negru Vodă 1, Csanádpalota, Ruse - Giurgiu and Ungheni entry points, as follows:

Entry Points	**Capacity Point [mil. Sm^3/day]**
Entry point Isaccea 1	18,8
Entry point Negru Vodă 1	15,7
Entry point Csanádaplota	7,2
Entry point Ruse-Giurgiu	2,5
Entry point Ungheni	0,2
Total	**44,4**

Forecast of the value of the N-1 formula for 10 years for the scenario of partial interruption of natural gas supply by the Russian Federation (through Isaccea)[27]:

YEAR	**N-1**
2021	133,5
2022	123,1
2023	122,1
2024	142,9
2025	141,7
2026	140,5
2027	138,7
2028	136,9
2029	135,5
2030	132,5

It should be mentioned that, the N - 1 formula has been computed taking into account the 100% of underground storage working gas volume.
The obtained result for N - 1 formula, namely N - 1 = 112,4% > 100%, shows that in case of disruption of the single largest gas infrastructure, the capacity of the remaining infrastructure will be able to provide the necessary gas quantity for satisfying the gas demand of the region during a day of exceptionally high gas demand (occurring with a statistical probability of once in 20 years).
In conclusion, the fact that the value of the N - 1 formula is over 100%, indicates that the national gas infrastructures are properly sized to cover the maximum demand in Romania.

[27] Source: Transgaz S.A. https://transgaz.ro/ro/consultare-publica-planul-de-dezvoltare-sistemului-national-de-transport-gaze-naturale-pentru, page 41.

5.3. Bi-directional transmission capacity

Currently, Romania has interconnections with the following states:

- Hungary;
- Bulgaria;
- Republic of Moldova;
- Uckrain.

The import/export of natural gas into/from Romania is achieved through 7 cross-border interconnection points (see Table 23.).

Table 23. summarizes the maximum transport capacities available in the directions specified above.

Table 23. Characteristics of cross-border interconnection pipelines at entry points from transmission systems of neighboring countries[28]

COUNTRY	INTERCONNECTION PIPE	TECHNICAL CHARACTERISTICS	THE TOTAL TECHNICAL CAPACITY
Ukraine	Orlovka (UA) - Isaccea (RO)* LLC GAS TSO UA → Transgaz S.A.	DN 1000, Pmax = 45 bar	6.85 bcm/year at Pmin = 35 bar
	Tekovo (UA) - Medieşu Aurit (RO)* LLC GAS TSO UA → Transgaz S.A.	DN 700, Pmax = 75 bar	4.01 bcm/year at Pmin = 47 bar
	Isaccea 1 (RO) - Orlovka 1 (UA) Transgaz S.A. ↔ LLC GAS TSO UA	DN 1000, Pmax = 55 bar	6.85 bcm/year import capacity at Pmin = 46,5 bar 4.12 bcm/year export capacity** at Pmin = 35,4 bar
Hungary	Szeged (HU) - Arad (RO) - Csanádpalota (HU) FGSZ ↔Transgaz S.A.	DN 700, Pmax = 63 bar	2.63 bcm/year import capacity at Pmin = 40 bar 1.75 bcm/year export capacity at Pmin = 40 bar
Republic of Moldova	Iași (RO) - Ungheni (MO) Transgaz S.A. ↔ VestMoldtransgaz	DN 500, Pmax = 55 bar	1.88 bcm/year export capacity at Pmin = 39,5 bar 0.73 bcm/year import capacity at Pmin = 24 bar
Bulgaria	Giurgiu (RO) - Ruse	DN 1000,	1.50 bcm/year export capacity

[28] Source: Transgaz, page 15.
https://transgaz.ro/ro/consultare-publica-planul-de-dezvoltare-sistemului-national-de-transport-gaze-naturale-pentru

	(BG) Transgaz S.A. ↔ Bulgartransgaz	Pmax = 50 bar	at Pmin = 40 bar 0.92 bcm/year import capacity at Pmin = 30 bar
	Kardam (BG) - Negru Vodă 1 (RO) Transgaz S.A. ↔ Bulgartransgaz	DN 1000, Pmax = 55 bar	6.36 bcm/year export capacity*** at Pmin = 31,5 bar 5.31 bcm/year import capacity at Pmin = 45 bar

*****For these points TSO from Romania and TSO from Ukraine are in discussions for the signing of a new Interconnection Agreement.
**The capacity is offered on an interruptible commercial basis as the Annex to the Interconnection Agreement on gas quality requirments is not signed.
***Conditioned capacity by the booked capacity at Isaccea 1 entry point (EP) on the direction Ukraine-Romania.

Regarding the interconnection with Serbia, at the completion of the project "Romania-Serbia interconnection - interconnection of the national natural gas transmission system with the similar natural gas transmission system in Serbia", estimated to be implemented in 2023, the maximum transport capacity will be 1.6 bmc/year, both on the Romania-Serbia direction and on the Serbia-Romania direction.
Figure 4. presents the map with the cross-border interconnection points of the NTS with the neighboring countries.

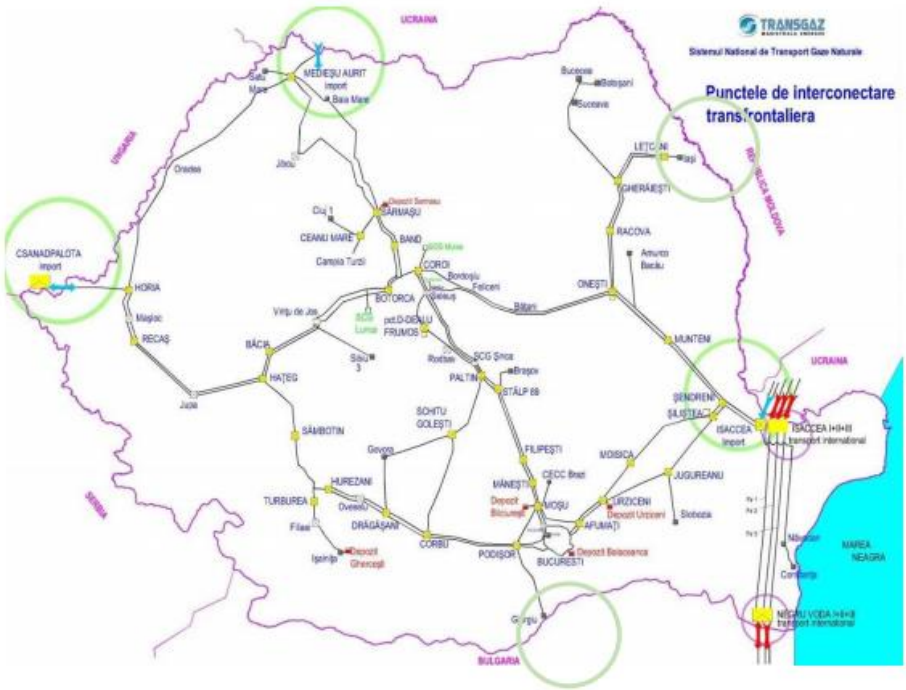

Figure 4. Map of cross-border interconnection points of the NTS

6. COMPLIANCE WITH THE SUPPLY STANDARD

6.1. Definition of protected customers

In accordance with Article 6 paragraph (1) of the Regulation, each Member State shall establish the definition of protected customers and inform the Commission thereof.
Based on this provision, the Ministry of Energy has included the definition of "protected customers" in the national legislation by adopting the Order of the Minister of Energy no. 692/2018 on the approval of the definition of the category "protected client".
In the category of "protected customer" are included: " all household customers connected to a natural gas distribution network as well as the following categories of final customers:
a) small and medium-sized enterprises, connected to the natural gas distribution networks;
b) providers of essential social services related to medical assistance, essential social assistance, emergency, security, education or public administration, connected to the distribution networks or to the National Natural Gas Transmission System;
c) heat producers, which cannot operate on fuels other than natural gas and which supply heat to household customers, small and medium-sized enterprises and/or healthcare providers, essential social assistance, emergency, security or service providers related to education or public administration."

6.2. Ensuring the supply of natural gas to protected customers

The Regulation requires, in accordance with Article 6 paragraph (1), the undertakings operating in the field of natural gas to ensure the supply of gas to the "protected customers" , as defined in national law, even in the case of particularly very high gas consumption and to take appropriate preventive action, 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.

Given the identification of customers protected by national law, gas undertakings have a particular responsibility for supplying gas to: household customers, small and medium-sized enterprises, providers of essential social services, as well as to heat producers, which cannot operate on fuels other than natural gas, to the extent that such installations deliver heating to the mentioned "protected customers".
The natural gas undertakings must be able to supply natural gas to protected customers in the three cases specified above, and are obliged to take appropriate measures to this end.

Table 24. presents the share of household customers in total natural gas consumption in Romania[29], in the period 2013 - 2020, which highlights an increase in their share by 2016, after which the value of the share remains relatively constant until 2019 and then increases in 2020.

Table 24. The share of household customers in total consumption

Year	Total consumption [MWh]	The share of household customers in total consumption [%]	Consumption of household customers [MWh]
2013	132.603.324	22,53	29.623.583
2014	127.556.673	22,34	28.738.518
2015	121.726.749	24,79	30.176.061
2016	124.110.485	28,35	35.185.323
2017	129.861.013	28,47	34.269.009
2018	129.535.366	28,48	33.939.494
2019	121.054.023	28,25	34.196.231
2020	127.070.000	30,26	38.451.382

Table 25. presents the share of protected consumers in total consumption[30], in the period 2016-2020, from which it is observed that the value of their share in the total natural gas consumption in Romania remains approximately constant.

Table 25. The share of protected consumers in total consumption*

Year	Total consumption [MWh]	The share of household customers in total consumption Consum casnici [%]	Consumption of household customers [MWh]	The share of consumption of essential services [%]	The consumption of essential services [MWh]	The share of thermal consumptifor the population [%]	Thermal consumptifor the population [MWh]
2016	124.110.485	28,35	35.185.323	6,59	8.178.881	7,54	9.357.931
2017	129.861.013	28,47	34.269.009	6,69	8.687.702	7,58	9.843.465
2018	129.535.366	28,48	33.939.494	7,01	9.080.667	8,66	11.218.333
2019	121.054.023	28,25	34.196.231	6,91	8.365.167	9,27	11.218.333

[29] Source: ANRE
Annual Reports on the activity of the National Energy Regulatory Authority 2013-2020/ Natural Gas Market Monitoring Reports 2013-2020/ National reports.
[30] Source: ANRE
Annual Reports on the activity of the National Energy Regulatory Authority 2016-2020/ Natural Gas Market Monitoring Reports 2016-2020.

2020	127.070.000	28,08	35.677.854	6,56	8.335.792	8,8	11.182.160

**Values deduced using data published in Annual Reports on the activity of the National Energy Regulatory Authority for the period 2016-2020/ Natural Gas Market Monitoring Reports for the period 2016-2020*

The share of protected consumers related to the category of small and medium-sized enterprises in total consumption, in the period 2016-2020, is the following:

Category of small and medium-sized enterprises	*Percentage*
Commercial consumers	*7,50 %*
Other industrial consumers	*2,50 %*
Other secondary consumers	*9,50 %.*

7. PREVENTIVE MEASURES

7.1. Measures to prevent the identified risks

The Regulation stipulates in Article 9 paragraph (3) that the preventive action plan is primarily based on market-based measures and shall not put an undue burden on natural gas undertakings, or negatively impact the functioning of the internal gas market.
In this respect, Table 26. presents the list of market-based demand and supply-side measures, which have been taken into account to improve the security of gas supply in case of supply disruption.

Table 26. Market-based demand and supply-side measures

Market-based demand-side measures	Market-based supply-side measures
Ensuring the availability of energy producers with the capacity to use alternative fuels and/ or renewable sources (gas-fired power plants with alternative fuels) of fuel switching	Investments in infrastructure development
	Use of interruptible supply contracts, based on market mechanisms
Commercial gas storage - non-discriminatory allocation of available storage capacity, on a multi cycle mode basis	Use of underground storage capacity to ensure continuity in natural gas supply, including increasing the flexibility of domestic production
Facilitating the integration of gases from renewable energy sources in the gas system	Supply of natural gas in energy efficiency conditions
Diversification of natural gas sources and supply routes	Increasing the share of gases from renewable energy sources in supply activities
Enhancing the relevance of bi-directional interconnections	
Synergy of NTS and National Electric Power System (SEN) dispatching activities	
Harmonized use of long-term and short-term contracts, in appropriate shares to maintain	

stability when covering natural gas demand	

7.2. Market-based demand-side measures

7.2.1. Ensuring the availability of energy producers with the capacity to use alternative fuels and/ or renewable sources (gas-fired power plants with alternative fuels) of fuel switching

Since 2016, in Romania, the energy produced by renewable sources has exceeded the energy produced by fossil fuel power plants, except for 2017 (see Table 10.).
The switching of fuel used by energy producers from natural gas to alternative fossil fuels (fuel oil) is only used in specific situations given the limitations on environmental protection. As it resulted from the national risk assessment (see Chapter 4.3.3.), the national infrastructure allows for a reliable and flexible supply of natural gas and, as a result, this measure has not been frequently used.

7.2.2. Commercial gas storage - non-discriminatory allocation of available storage capacity, on a multi cycle mode basis

Natural gas underground storage facilities are an integral part of the national gas market, with an important role in streamlining the use of natural gas transmission infrastructure and balancing the system and in ensuring the security of natural gas supply.
By implementing this measure, the premises for optimizing production and commercial activities on the gas market are created, in conditions of maximizing the stability of the NTS.

7.2.3. Facilitating the integration of gases from renewable energy sources in the gas system

This measure contains a package of actions, of a legislative / regulatory nature, as well as investment efforts aimed at the development of physical infrastructure, allowing the integration of primary energy resources, as alternatives to natural gas, in the overall consumption share. The economic viability of integrating gas from renewable sources (eg biogas) needs to be analyzed.

7.2.4. Diversification of natural gas sources and supply routes

Natural gas suppliers have multiple contracts with various producers/ suppliers and import natural gas through a variety of supply routes. The higher the diversification of sources and supply routes, the lower the impact of an incident on one supply source or route.

The diversification of natural gas supply sources and supply routes must also be taken into account by carrying out investment projects aimed at increasing the interconnection of the national natural gas transmission network to the European network and to the markets of neighboring countries, projects included in the Development Plan of the National Natural Gas Transmission System for 10 years, implemented by Transgaz S.A.
This limits the risk of serious damage to security of supply due to disruption of each supply route.

7.2.5. Enhancing the relevance of bi-directional interconnections

Romania currently has bi-directional interconnections at all borders with neighboring countries, except Serbia.
By implementing the projects from the Development Plan of the National Natural Gas Transmission System for 10 years, carried out by Transgaz S.A., aimed at creating new interconnections or increasing the interconnection capacity with neighboring countries, an increase in the number of entry routes is created which also facilitates the possibility of reverse flow with regard to the supply of the Romanian gas market, in conditions of increased flexibility

7.2.6. Synergy of NTS and National Electric Power System (SEN) dispatching activities

By synchronizing the dispatching activities of the two systems, the imbalances that the two systems could induce to each other are avoided.
Romania's objectives target the increase of dispatchable consumption in order to ensure the response to variations in demand, as well as the energy storage.
The development and use of the technical and economic potential of renewable sources in SEN depends on the development of storage capacities as well as technologies design to inject hydrogen in the form of synthesis gas from renewable energy sources and the use of hydrogen in industrial processes.

7.2.7. Harmonized use of long-term and short-term contracts, in appropriate shares to maintain stability when covering natural gas demand

This measure is necessary and aims at guiding the gas market towards the harmonized use of long-term and short-term contracts so that the supply of natural gas is not affected by trade policies aimed exclusively at maximizing economic results.

7.3. Market-based supply-side measures

7.3.1. Investments in infrastructure development

In the Development Plan of the National Natural Gas Transmission System for 10 years, Transgaz S.A. proposes major investment projects for the strategic and sustainable development of the national natural gas transmission infrastructure, which should meet the economic needs of Romania, at the same time following its compliance with the requirements of the European regulations in the field.
It should be noted that the investment projects included in the Development Plan of the National Natural Gas Transmission System for 10 years are periodically analyzed by Transgaz S.A. and are approved by ANRE, which examines, among others, whether these investments are in line with the dynamics regarding the estimated demand / consumption of natural gas in Romania.
The Development Plan of the National Natural Gas Transmission System for the period 2021-2030 (at the present moment, in public consultation) meets the requirements of European energy policy and aims:

- Ensuring security in natural gas supply;
- Increasing the degree of interconnection of the national natural gas transmission network to the European network;
- Increasing the flexibility of the national natural gas transmission network;
- Liberalization of the natural gas market;
- Integration of the natural gas market at the level of the European Union.

7.3.2. Use of interruptible supply contracts, based on market mechanisms

The suppliers have the obligation to ensure the quantities of natural gas necessary to ensure the continued gas supply to the protected customers by virtue of the European legislation provisions and the national legislation in the field.
In order to fulfill this obligation, suppliers should develop trade policies that include the conclusion of contracts with interruptibility clauses, through which to enable the improvement of the balancing activity of the NTS.

7.3.3. Use of underground storage capacity to ensure continuity in natural gas supply, including increasing the flexibility of domestic production

Romania has well-developed underground storage warehouses that allow for their rational use and encourage the growth of domestic natural gas production by stimulating the discovery and/ or rehabilitation of natural gas fields.

Underground natural gas storage has a significant role in ensuring the continuity of natural gas supply using volumes from underground storage warehouses, both in normal market conditions and in crisis situations.

7.3.4. Supply of natural gas in energy efficiency conditions

This measure aims at minimizing technological consumption and integrating renewable resources into technological consumption in the natural gas sector activities (upstream/ downstream).

7.3.5. Increasing the share of gases from renewable energy sources in supply activities

Romania aims to maintain a diversified energy mix by 2030, taking into account both the objective of decarbonising the energy system and ensuring its flexibility and adequacy.
Romania may also propose to increase the share of installed capacity using renewable energy sources. At the same time, it aims to replace coal-fired production capacities with new natural gas-fired capacities, as natural gas is a fossil fuel more environmentally friendly (its combustion resulting in the lowest carbon emissions of all fossil fuels). Moreover, power plants that use natural gas can be implemented more flexibly. The natural gas infrastructure also offers the possibility to mix renewable gases such as hydrogen, synthetic methane or biomethane and thus further reduce carbon emissions.

7.4. Other preventive measures

7.4.1. Ensuring relevant performance indicators and improving their monitoring system

In order to be able to monitor the safety and reliability of the natural gas network, a series of quality performance indicators have been developed for the natural gas transmission, distribution and supply services, as well as regarding the technical condition of the natural gas networks, that are monitored by ANRE. Performance indicators, set by performance standards for natural gas transmission, distribution and supply services, are associated with realistic specific values and minimum performance levels in order to be able to test the results obtained in relation to the objectives.

7.4.2. Maintaining a functional and reliable infrastructure

Maintaining the optimal operation characteristics and the technical condition of the natural gas networks at an appropriate level could be achieved as a result of the development of a predominantly preventive, planned, corrective and consistent maintenance system of annual development and modernization investment programs, revealed by performance indicators.

7.4.3. Natural gas supply of a last resort

The role of the supplier of last resort is decisive in ensuring the continuity of natural gas supply, having the obligation to ensure the guaranteed supply of natural gas as a last resort to final customers whose suppliers are unable to perform contractual supply tasks in relation to their own customer portfolios, according to the regulations issued by ANRE.

7.5. Non-Market-based Measures

Within the Preventive Action Plan, ensuring Romania's natural gas supply is achieved through a targeted approach aimed at adopting only market-based measures, in order to sufficiently and timely compensate a gas supply disruption.
The Preventive Action Plan focuses on this type of measures designed to prevent emergency situations.

7.6. Impact of the measures

The measures presented in the Preventive Action Plan aim to limit the economic impact on the energy market and the impact on the environment and on final customers and to optimize the efficiency and effectiveness of the national gas system and to ensure the continuous supply of natural gas to final customers.
The general obligations of the participants in the natural gas market, stipulated in Law no. 123/2012, as amended and supplemented, are used as preventive measures to ensure the level of natural gas consumption. It should be noted that in all cases these measures will not affect protected customers within the meaning of the provisions of the Regulation.
However, some residual impacts may occur when these measures are applied.
The environmental impact must be mentioned in the case of the following preventive measure: „Ensuring the availability of energy producers with the capacity to use alternative fuels and/ or renewable sources (gas-fired power plants with alternative fuels) of fuel switching", this measure, if applied, involves the use of alternative fuel oil, where CO_2 emissions are higher.

7.7. Obligations of natural gas undertakings

By Law no. 123/2012, as amended and supplemented, were stipulated general economic obligations, clearly defined for undertakings operating in the field of natural gas in Romania, which aim to supply gas to the population and, in particular, to protected customers, in order to achieve the basic objectives and to maintain good functioning of the internal gas market, especially in situations of supply disruption and crisis situations

The obligations of natural gas producers, natural gas underground storage system operators, transmission system operator, distribution system operators and natural gas suppliers, related to the safe operation of the national gas network are specified in Law no. 123/2012, as amended and supplemented (see in Table 27. a summary of the obligations of the companies operating in the field of natural gas in Romania).

Table 27. Overview of the obligations of natural gas undertakings regarding the safe operation of the national natural gas network

Undertaking	Obligation	The legal provision of Law no. 123/2012
Natural gas producers	- to hold the authorizations for the establishment of upstream supply pipelines related to the natural gas production activity and their operating license; - to ensure the operation of the upstream supply pipes related to the production of natural gas in conditions of safety, efficiency and environmental protection; - to ensure the access of third parties to the upstream supply pipes in non-discriminatory conditions, according to the specific regulations.	Article 124 paragraph (1)
Natural gas underground storage system operators	- to operate, maintain, rehabilitate and modernize surface technological installations related to underground storage warehouses, in conditions of safety, efficiency and environmental protection; - to ensure the access of third parties to underground storage warehouses, based on objective, transparent and non-discriminatory criteria, according to ANRE regulations; - to provide information to the users of the underground storage system, necessary for an efficient access to the system; - to ensure adequate means for fulfilling the obligations regarding the public service.	Article 142 paragraph (1)
Transmission system operator	- to operate the transmission system and to ensure its residual physical balance, respectively the programming, dispatching and operation of the transmission system in safe conditions; - to maintain, rehabilitate, modernize and develop the transmission system in conditions of safety, efficiency and protection of the environment; - to ensure the access of third parties to the transport system, according to specific regulations, in non-discriminatory conditions, within the limits of the transport capacities and in compliance with the technological regimes; - o exchange information with other interconnected transmission and system operators, with LNG storage and distribution operators and with other collaborators in the energy field, in compliance with ENTSO-G regulations on information exchange protocols, reports, structure and procedures access to	Article 130 paragraph (1)

	databases; - to ensure adequate means for fulfilling the obligations regarding the public service.	
Distribution system operators	- to operate, maintain, repair, modernize and develop the distribution system in conditions of safety, economic efficiency and environmental protection, the activities to be carried out on the basis of specific authorizations for the design and execution of gas distribution systems and the operation will be carried out on the basis of the distribution license; - to ensure the access of third parties to the distribution systems, in non-discriminatory conditions, within the limits of the distribution capacities, in compliance with the technological regimes, according to the specific regulations elaborated by ANRE; - to ensure the security conditions in the natural gas supply.	Article 138 paragraph (1)
Natural gas suppliers	- to conclude contracts for the purchase of natural gas, so as to ensure the coverage of consumption for its customers; - to purchase the natural gas that it offers to domestic customers, in conditions of minimizing the costs of the allocated resources, based on its own procedures, elaborated in correlation with the provisions of Article 177 paragraphs (3^15), (3^16) și (3^17), to ensure the transparency of the natural gas procurement process and, at the same time, equal and non-discriminatory treatment of persons participating in the natural gas procurement procedure as tenderers; - to allow customers, free of charge, the effective change of the natural gas supplier within 21 days from the date of the request and to send them a final liquidation statement, within a maximum of 42 days from the change of supplier; - to properly inform final customers about their actual gas consumption and the related real costs, frequently enough so that they have the opportunity to adjust their own gas consumption. This information shall be communicated at appropriate intervals, taking into account the capacity of the final customer's measuring equipment and the cost-benefit ratio of these measures, without any additional costs being charged to the final customer.	Article 143 paragraph (1)

8. INFRASTRUCTURE PROJECTS

8.1 Investment projects for the development of the NTS

The Development Plan of the National Natural Gas Transmission System presents the development directions of the Romanian natural gas transmission network and of the major projects that Transgaz S.A., as TSO, intends to implement in the next 10 years, in order to develop the transmission network of natural gas to meet market requirements.

The main investment projects (see Figure 5.) included in the Development Plan of the National Natural Gas Transmission System for the period 2021 - 2030 (under public consultation) are[31]:

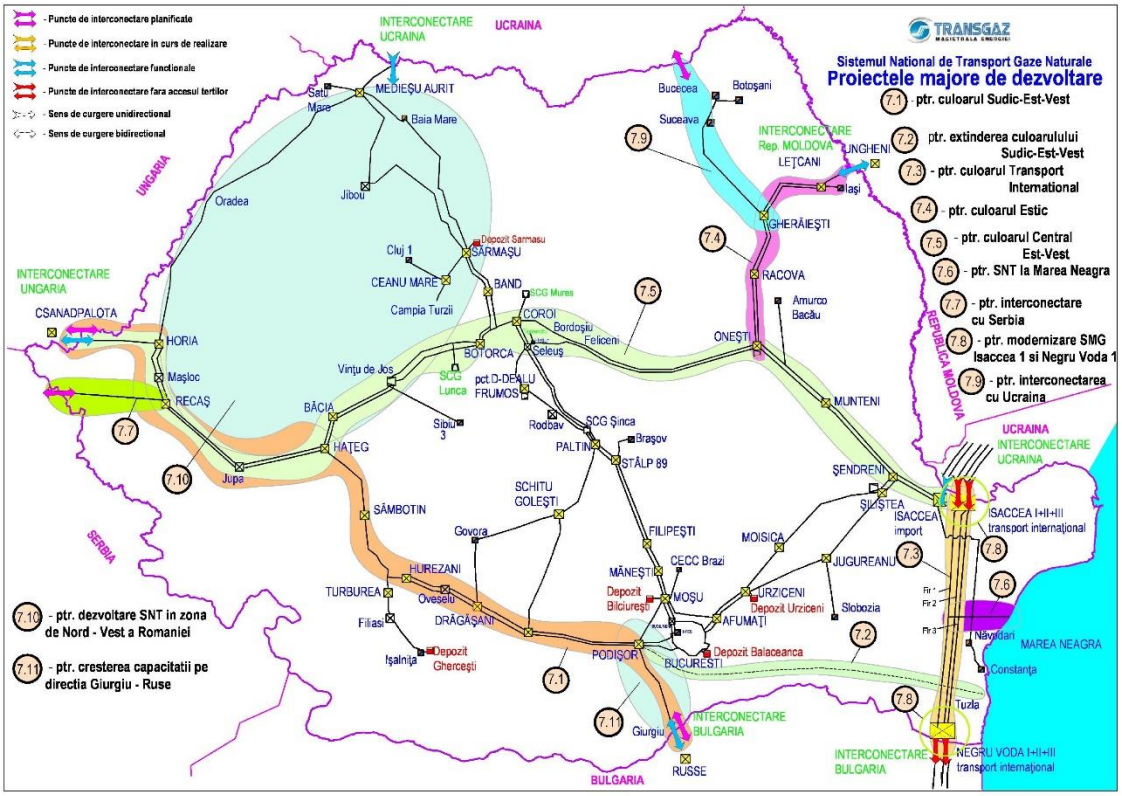

Figure 5. Map of the major projects in the NTS

8.1.1. The Project ”Development on the Romanian territory of the National Gas Transmission System on the Bulgaria - Romania - Hungary - Austria Corridor” (BRUA), involved developments in natural gas transmission capacities of interconnections between the

[31]Source: Site Transgaz S.A.
https://transgaz.ro/ro/consultare-publica-planul-de-dezvoltare-sistemului-national-de-transport-gaze-naturale-pentru

Romanian natural gas transmission system and similar systems in Bulgaria and Hungary, more precisely, it consisted in construction of a a new gas transmission pipeline that will connect the Technological Node Podișor with Horia Gas Metering Station (GMS) on the route Podișor - Corbu - Hurezani - Hațeg - Recaș - Horia, approximately 529 km long, and the construction of three compressor stations.

8.1.1.a) The Project "Development on the Romanian territory of the National Gas Transmission System on the Bulgaria - Romania - Hungary - Austria Corridor - Phase 1", which consisted in the construction of a new natural gas transmission pipeline to make the connection between the Podișor Technological Node (TN) and the Recaș TN, 32 "x 63 bar, 479 km long and in the location of three new natural gas compression stations along the route (SC Jupa, SC Bibești and SC Podișor), each gas compression station being equipped with two compression units, one in operation and one in reserve, with the possibility of ensuring bidirectional gas flow, was completed and put into operation on November 24, 2020.
At the completion of Phase 1, the physical possibility of permanent bi-directional flow between the interconnections with Bulgaria and Hungary shall be ensured, namely:

- 1.75 billion cubic meters (bcm)/year (200 thousand cm/h) transmission capacity towards Hungary, through the Horia - Csanádpalota interconnector;
- 1.5 bcm/year (171 thousand cm/h) transmission capacity towards Bulgaria through the Giurgiu - Ruse interconnector.

8.1.1.b) The Project "Development on the Romanian territory of the National Gas Transmission System on the Bulgaria - Romania - Hungary - Austria Corridor - Phase 2" consists in achieving the following objectives:
▪ gas transmission pipeline from Recaș TN to Horia GMS, approximately 50 km long;
▪ amplification of Podisor GCS, Bibești GCS and Jupa GCS, each station will be equipped with an additional compressor unit;
▪ amplification of the existing Horia GMS.
The implementation of the BRUA Project - Phase II results in ensuring the physical possibility of permanent bidirectional flow between the interconnections with Bulgaria and Hungary, ensuring the following natural gas transmission capacities:

- 4.4 bcm/year (200 thousand cm/h) transmission capacity towards Hungary, through the Horia - Csanádpalota interconnector;
- 1.5 bcm/year (171 thousand cm/h) transmission capacity towards Bulgaria.

Estimated deadline: 2023 (The completion of Phase 2 and the start of the operating period will depend on the successful completion of the Open Season procedure for the capacity booking for the Romania-Hungary interconnection point Csanádpalota).
The estimated value of the investment is 74.5 million Euros.
The BRUA project, with both its phases (Phase 1 and Phase 2) is included in the 10-year Network Development Plan (TYNDP) 2020 with identification code TRA – F – 358 (Phase 1), respectively TRA-A-1322 (Phase 2).
Both phases have also received the status of a project of common interest and are included in the fourth List of Projects of Union Interest, approved by the Commission Delegated Regulation (EU) 2020/389 of 31 October 2019 amending Regulation (EU) No 347/2013 of the European Parliament and of the Council as regards the Union list of projects of common interest

(hereinafter, "*Delegated Regulation (EU) 2020/389*"), with reference numbers 6.24.1 and, respectively, 6.24.4 -2.

8.1.2. The project "Development on the territory of Romania of the Southern Transport Corridor for the taking over of natural gas from the Black Sea shore"

Proiectul constă în construirea unei conducte telescopice de transport gaze naturale Tuzla–Podișor, în lungime de 308,3 km și DN 1200 respectiv DN 1000, care să facă legătura între resursele de gaze naturale disponibile la țărmul Mării Negre și coridorul Bulgaria–România–Ungaria–Austria, astfel asigurându-se posibilitatea transportului gazelor naturale spre Bulgaria și Ungaria prin interconectările existente Giurgiu–Ruse (cu Bulgaria) și Nădlac–Szeged (cu Ungaria) și spre piețele europene.

The project will consist of the following::

- Construction of a telescopic gas transmission pipeline, made up of two sections, as follows:
  - Section I: pipeline from the Black Sea shore to the Pig Receiving Station Amzacea, in a length of 32,4 km, will have a diameter of Ø 48" (DN1200) and a technical capacity of 12 bcm/year;
  - Section II: pipeline from the Pig Receiving Station Amzacea to the Podişor TN, in a length of 275,9 km, will have a diameter of Ø40" (DN1000) and a technical capacity of 6 bcm/year;
- Interconnection with the Transit 1 pipeline at km 37,7;
- Interconnection with the DN 500 pipeline, Podişor – Giurgiu, in the Vlaşin area;
- Inteconnection in the Podişor TN.

Estimated deadline: 2022.

The estimated value of the investment is 371.6 million Euros.

The project is included in TYNDP 2020 with identification code TRA-A-362.

The project has received the status of a project of common interest and are included in the fourth List of Projects of Union Interest, approved by the Delegated Regulation (EU) 2020/389, with reference number 6.24.4 -3.

8.1.3. The project "Interconnection of the national natural gas transmission system with the international gas transmission pipelines T1 and reverse flow Isaccea"

The completion of this project led to:

- creating a gas transmission corridor between the markets of Bulgaria, Romania and Ukraine, while the new interconnection between Greece and Bulgaria (IGB) is achieved
- ensuring reversible physical flows at Negru Vodă 1, according to the requirements of Regulation;
- creating the possibility for taking over in the Romanian transmission system of the natural gas discovered in the Black Sea, in order to the capitalization on the Romanian market and on the regional markets.

The project did not develop additional capacities at the entry/ exit point in the NTS at Negru Vodă.

8.1.4. The project "Developments of NTS in the North East of Romania in order to improve the natural gas supply of the area and to ensure transport capacities to/from the Republic of Moldova"

The project aims to ensure the necessary pressure and transport capacity of 1.5 bmc/year at the interconnection point between the NTS and the transport system of the Republic of Moldova.
The project was divided into sub-projects:
▪ construction of a new natural gas transport pipeline DN 700, Pn 55 bar, in the direction of Onești – Gherăești, in a length of 104,1 km; the route of this pipeline will be largely paralleled with the existing pipelines DN 500 Onești – Gherăești;
▪ construction of a new natural gas pipeline DN 700, Pn 55 bar, in the direction Gherăești – Lețcani, in the length of 61.05 km; this pipeline will replace the existing pipeline DN 400 Gherăești – Iași, on the Gherăești – Lețcani section;
▪ construction of a new gas compressor station at Onești, with a installed power of 9.14 MW, 2 compressors of 4.57 MW, one active and one back up;
▪ construction of a new gas compressor station at Gherăești, with a installed power of 9.14 MW, 2 compressors of 4.57 MW, one active and one back up.
Estimated deadline: 2021.
The estimated value of the investment is 174.25 million Euros.
The project is included in TYNDP 2020 with identification code TRA-F-357.

8.1.5. The project "Extension of the bidirectional gas transmission corridor Bulgaria - Romania - Hungary - Austria (BRUA Phase III)"

Assuming that the transmission capacities necessary for the exploitation of natural gas from the Black Sea on the Central-Western European markets exceed the transmission potential of the BRUA Phase 2 corridor, Transmgaz S.A. has planned the further development of the natural gas network through the development of the Central Corridor, respectively the Onești – Coroi – Haţeg – Nădlac corridor and a new interconnection with Hungary.
The development of this gas transmission corridor involves the following:
▪ rehabilitation of some existing pipelines belonging to NTS;
▪ replacement of existing pipelines belonging to NTS with new pipelines or construction new pipelines installed in parallel with existing pipelines;
▪ development of 4 or 5 new compression stations with a total installed power of approx. 66-82,5MW;
▪ increase of natural gas transmission capacities to Hungary by 4.4 bcm/ year.
Currently, Transgaz S.A. developed the pre-feasibility study on the development of this natural gas transmission corridor and this was divided into two projects, namely:

- Ensuring bi-directional flow on the Romania-Hungary Interconnection, which aims:
  - new natural gas transmission pipeline Băcia – Haţeg – Horia – Nădlac in length of about 280 km;
  - two new natural gas compressor stations along the route;
- Development of NTS between Onești and Băcia, which aims:
  - rehabilitation of some pipe sections;
  - replacement of existing pipelines with new pipeliness with larger diameter and pressure of operation;
  - two or three new natural gas compressor stations.

Estimated deadline for entire corridor: 2026.
The estimated value of the investment is 530 million Euros.
The project is included in TYNDP 2020 with identification code TRA-N-959.

8.1.6. The project "New developments of the NTS in order to take-over of gas from the Black Sea coast"

Taking into account the natural gas deposits discovered in the Black Sea, Transgaz S.A. intends to extend the NTS in order to create an additional gas collection point from the submarine offshore exploitation perimeters of the Black Sea.
The project consists in the construction of a new natural gas transmission pipeline approximately 25 km long and with a diameter of DN 500, which will connect the Black Sea coast with the existing international Transit 1 transmission pipeline, in the direction of the Black Sea coast - Corbu - Săcele - Cogealac – Grădina.
The transport capacity is 1.23 bcm/year – according to the Open - Season process.
Estimated deadline: 2021, depending on the upstream offshore project schedules.
The estimated value of the investment is 9.14 million Euros.
The project is included in TYNDP 2020 with identification code TRA-F-964.

8.1.7. The project "Romania-Serbia interconnection - interconnection of the National Natural Gas Transmission System with the similar naturale gas transmission system in Serbia"

The project aimed at the realization interconnecting the National Natural Gas Transmission System in Romania with the one in Serbia aims to strengthen the degree of interconnectivity between natural gas transmission systems in EU Member States, in order to diversify supply sources and increase energy security in the region.
The project involves the construction of a new natural gas transmission pipeline that will ensure the connection between the main natural gas transmission pipeline "BRUA" and the Mokrin TN in Serbia.
On the territory of Romania, the natural gas transmission pipeline will be connected to the BRUA Phase I pipeline (Petrovaselo locality, Timiș County) and will be 85.56 km long (the border between Romania and Serbia-Comloșu Mare locality, Timiș County).
The project consists of:
▪ construction of a new interconnection pipeline in the Recaș – Mokrin direction in length of approximately 97 km of which approximately 85 km on the Romanian territory and 12 km on the territory of Serbia with the following characteristics:

- pressure in the BRUA pipeline in the Recaș area: 50-54 bar (PN BRUA - 63 bar);
- diameter of the interconnection pipe: DN 600;
- transport capacity: max. 1,6 bmc/year (183 000 Smc/h), both in the Romania-Serbia direction and in the Serbia-Romania direction.

▪ construction of a natural gas metering station on the territory of Romania.
Natural gas export to Serbia will take place after completion of BRUA project (Phase 1).
In the event that natural gas will be taken from Serbia to Romania, it can be directed for consumption in the Timișoara - Arad area, through the DN 600 Horia – Mașloc – Recaș pipeline (25 bar), at lower pressures than in the BRUA pipeline.
Estimated deadline: 2023.

The estimated value of the investment is 56.21 million Euros.
The project is included in TYNDP 2020 with identification code TRA-A-1268.

8.1.8. The project "Modernization of GMS Isaccea 1 and GMS Negru Vodă 1"

The project "Modernization of GMS Isaccea 1 and GMS Negru Vodă 1" involves the modernization of the two measuring stations at the interconnection points, for existing capacities and offers the possibility of operating in bidirectional mode and at Isaccea, to increase energy security in the region.
The project consists of the construction of two new gas metering stations to replace the existing ones. GMS Isaccea 1 was completed in 2020.
The project " Modernization of GMS Negru Vodă 1" involves the following:

- equipping the gas metering station with separation/filtration installation and measuring installation;
- equipping with separation/filtration battery;
- the measuring installation will be composed of several parallel measurement lines (in operation and in back up) equipped with ultrasonic meters to measure the quantities of natural gas, each line being equally equipped with three/two independent measurement systems (Pay, Check and Verification). Pay and Check independent systems will use dual ultrasound meters.

Estimated deadline: 2021.
The estimated value of the investment is 12.77 million Euros.
The project is included in TYNDP 2020 with identification code TRA-F-1277.

8.1.9. The project "Interconnection of the national natural gas transmission system with the national natural gas transmission system from Ukraine, on the direction of Gherăești - Siret"

The project aims to increase the degree of interconnection of the national gas transmission network to the natural gas European network.
In this respect, in addition to the project on SNT developments in the North – East area of Romania, in order to improve the natural gas supply of the area and the insurance transport capacities to/from Ukraine, Transgaz has identified the opportunity to achieve an interconnection of the NTS with the natural gas transmission system in Ukraine, in the direction of Gherăești - Siret.
The project consists of:

- construction of a natural gas transmission pipeline of 146 km long and related facilities, in the direction of Gherăești - Siret;
- construction of a cross-border gas metering station;
- amplication of the Onești and Gherăești gas compression stations, if it is necessary.

Estimated deadline: 2026*.
The estimated value of the investment is 150 million Euros.
* It depends on setting the parameters for the interconnection point and the project implementation schedule from the territory of Ukraine.
The project is included in TYNDP 2020 with identification code TRA-N-596.

8.1.10. The project "Development/Modernization of the natural gas transport infrastructure in the North-West area of Romania"

The project involves the achievement/modernization of objectives related to the NTS, from the North-West area of Romania, in order to create new natural gas transmission capacities or increase existing capacity to ensure increasing consumption trends in the region.

According to the Prefeasibility Study, the project consists of:

- construction of a natural gas pipeline and related facilities, in the direction of Horia-Mediești Aurit;
- construction of a natural gas pipeline and related facilities, in the direction of Sărmășel-Mediești Aurit;
- construction of a natural gas pipeline and related facilities, in the direction of Huedin-Aleșd;
- construction of a gas compression station at Mediești Aurit.

Given the scale of this project, it is proposed to be implemented in three phases.

Estimated deadline: 2023 pentru for Phase 1, 2025 for Phase 2 and 2026 for Phase 3.

The estimated value of the investment is 405 million Euros.

The project is included in TYNDP 2020 with identification code TRA-N-598.

8.1.11. The project "Increasing the natural gas transmission capacity of the Romania-Bulgaria interconnection in the direction of Giurgiu-Ruse"

Having regard to the estimates of gas transmission in southern Europe in a south-north direction, following the signing the *Memorandum on cooperation for the realization of the Vertical Corridor*, by Transgaz S.A., Bulgartransgaz, DESFA SA, FGSZ Ltd. and ICGB AD, the parties agreed that in order to build the corridor it is necessary to analyze the technical needs, respectively new pipelines, interconnections or consolidations of national transmission systems

Având în vedere estimările privind transportul de gaze în zona de sud a Europei pe direcția sud-nord, în urma semnării *Memorandumului privind cooperarea pentru realizarea Coridorului Vertical*, de către Transgaz S.A., Bulgartransgaz, DESFA SA, FGSZ Ltd. și ICGB AD, părțile au convenit că pentru realizarea coridorului este necesar să analizeze necesitățile tehnice, respectiv conducte noi, interconectări sau consolidări ale sistemelor naționale de transport, to improve the natural gas supply of the area.

The project consists of:

- construction of a new natural gas pipeline and related facilities;
- building a new sub-crossing to the Danube;
- amplification of the Giurgiu GMS.

Estimated deadline: 2027.

The estimated value of the investment is 51.8 million Euros.

8.1.12. The project "Modernization of MGS Isaccea 2 and MGS Negru Vodă 2 in order to achieve bidirectional flow on the T2 pipeline"

The implementation of the project ensures bi-directional flow at the border with Ukraine and Bulgaria on the T2 transit pipeline, part of the Trans-Balkan corridor.

The project involves the following:

- equipping the gas metering station with separation/filtration installation and measuring installation;
- equipping with separation/filtration battery;

- the measuring installation will be composed of several parallel measurement lines (in operation and in back up) equipped with ultrasonic meters to measure the quantities of natural gas, each line being equally equipped with three/two independent measurement systems (Pay, Check and Verification). Pay and Check independent systems will use dual ultrasound meters.

Estimated deadline: 2024.
The estimated value of the investment is 26.65 million Euros.

8.1.13. The project "Modernization of MGS Isaccea 3 and MGS Negru Vodă 3 in order to achieve bidirectional flow on T3 pipeline"

The implementation of the project ensures bi-directional flow at the border with Ukraine and Bulgaria on the T3 transit pipeline, part of the Trans-Balkan corridor
The project involves the following:

- equipping the gas metering station with separation/filtration installation and measuring installation;
- equipping with separation/filtration battery;
- the measuring installation will be composed of several parallel measurement lines (in operation and in back up) equipped with ultrasonic meters to measure the quantities of natural gas, each line being equally equipped with three/two independent measurement systems (Pay, Check and Verification). Pay and Check independent systems will use dual ultrasound meters.

Estimated deadline: 2028.
The estimated value of the investment is 26.65 million Euros.

8.1.14. The project "The NTS Interconnection at the LNG Terminal located on the Black Sea shore"

Taking over the natural gas from the Black Sea coast through a LNG terminal involves achieving the interconectation of the NTS to the LNG terminal through construction of a natural gas transmission pipeline, about 25 km long, from the Black Sea shore to T1 and T2 pipelines.
The design capacity and pressure for this pipeline will be determined based on the quantities of natural gas available on the Black Sea coast.
Estimated deadline: 2028.
The estimated value of the investment is 19.6 million Euros.

8.1.15. Eastring-Romania

The EASTRING project, promoted by EUSTREAM, is a bidirectional flow pipeline for Central and Southeastern Europe which aims to connect gas transmission systems natural gas from Slovakia, Hungary, Romania and Bulgaria to gain access to gas reserves natural from the Caspian region and the Middle East.
EASTRING is a bidirectional flow interconnection pipeline with an annual capacity between 225,500 GWh and 451,000 GWh (approx. 20 billion cubic meters to 40 billion cubic meters), which connects Slovakia with the EU's external border through Bulgaria, Hungary and Romania.
EASTRING will provide the most cost-effective direct transport route between gas platforms from the western European Union and the Balkan region / western Turkey - an area with a lot of potential raised to provide gas from different sources.

Through the possibility of diversifying the transport routes as well as the sources of supply, security of supply will be ensured throughout region, mainly in the countries of Southeast Europe.
According to the feasibility study, the implementation of the project will be carried out in two phases, as follows:

- Phase 1 - Maximum capacity of 20 bcm/ year;
- Phase 2 - Maximum capacity of 40 bcm/ year.

Estimated deadline: 2027 for Phase 1, 2030 for Phase 2.
The estimated value of the investment is:

- Phase 1 - 1.297 million Euros for Romania;
- Phase 2 - 357 million Euros for Romania.

The project is included in TYNDP 2020 with identification code TRA-A-655.

8.2. Investment projects for the development of the natural gas storage system

Figure 6. presents the major natural gas underground storage projects operated by the The Natural Gas Storage Subsidiary DEPOGAZ Ploieşti S.R.L..

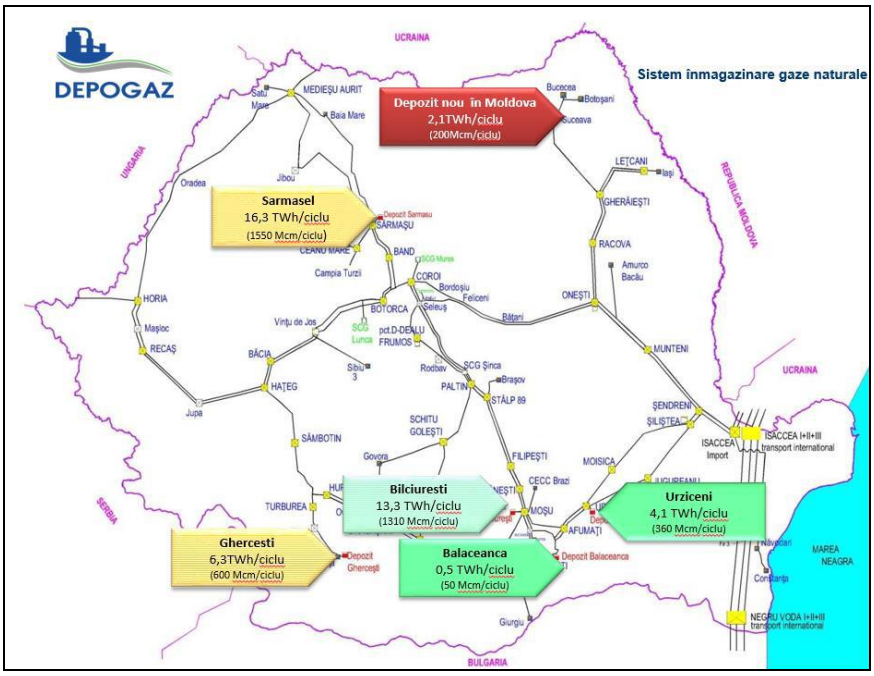

Figure 6. Map of the major natural gas underground storage projects

8.2.1. The project "Modernization of the infrastructure of the natural gas storage system - Bilciurești"

The project aims to increase the daily delivery capacity of natural gas from the Bilciurești warehouse up to a flow of 18 mcm/ day and to ensure an increased degree of safety in operation.
The project will consist of the following:

- modernization of the instalații de collection, separation, measurement and drying facilities of Bilciurești groups;
- systematization and modernization of natural gas suction/discharge piping system and modernization of Butimanu compression station cooling system;
- modernization of 39 injection/ withdrawal wells;
- drilling 4 new wells;
- new pipeline (11 km) transport of natural gas between Bilciurești warehouse and Butimanu compression station.

Estimated deadline: 2025.
The estimated value of the investment is 123 million Euros.
The project is included in TYNDP 2020 with identification code UGS – F - 311.

8.2.2. The project "Increasing the natural gas underground storage capacity of the Ghercești warehouse"

The project aims to complete the infrastructure of the natural gas storage system Ghercești to ensure the operating conditions at the capacity of 600 mil. m^3/cycle
The project will consist of the following:

- gas compression station;
- extension of drying and gas measurement facilities;
- modernization of 20 injection withdrawal wells;
- interconnection of Ghercești natural gas underground storage warehousewith NTs;
- inactive natural gas stock.

Estimated deadline: 2026.
The estimated value of the investment is 122 million Euros.
The project is included in TYNDP 2020 with identification code UGS - N - 398.

The project "New underground gas storage warehousein Fălticeni (Moldova)"

The project aims to develop a new underground storage warehouse in northeastern Romania (Moldova region), with the following technical characteristics:

- capacity of approximately 200 million m^3/cycle;
- injection capacity of approximately 1.4 million m^3/day;
- extraction capacity of approximately 2 million m^3/day.

The project will consist of the following:

- gas compression station;
- drying and natural gas measurement facilities;
- technological installations, injection/withdrawal wells;
- drilling of injection/ withdrawal wells;
- interconnection of natural gas underground storage warehousewith NTS;
- inactive natural gas stock.

Estimated deadline: 2029.
The estimated value of the investment is 80 million Euros.
The project is included in TYNDP 2020 with identification code UGS – N - 399.

8.2.4. The project "Increasing the underground gas storage capacity at the Sărmășel warehouse (Transilvania)"

The project aims to develop the existing underground storage warehouse from Sărmăşel by increasing the capacity from 900 million m^3/cycle to 1550 million m^3/cycle, increasing the injection capacity by 4 million m^3/cycle, to a total of 10 million m^3/cycle, increasing the extraction capacity by 4 million m^3/cycle, to a total of 12 million m^3/cycle, by drilling new wells, construction a modern surface infrastructure, expanding gas compression installations and modernizing and optimizing of the existing separation and fiscal measures facilities.

The project will consist in the achievement of the following investment works: 38 new wells, 48.6 km supply pipelines, 8 new technological groups, 19.2 km collecting pipelines, 3 new gas compressor units, 2 gas drying installations, separation and measure facility, renewable energy production system and connection to the NTS.

Estimated deadline: 2026.

The estimated value of the investment is 163.1 million Euros.

The project is included in TYNDP 2020 with identification code UGS-N-371.

The project has received the status of a project of common interest and are included in the fourth List of Projects of Union Interest, approved by the Delegated Regulation (EU) 2020/389, with reference number 6.20.6.

8.2.5. The project "Storage unit – Depomureș"

The project initiated by Depomureș consists in the refurbishment and development of the Târgu-Mureș underground natural gas storage warehouse, with a current capacity of 300 million cubic meters

The development project will be implemented in 2 phases:

The main objectives of this project are:

- increasing the flexibility of the warehouse by increasing the capacity of injection and withdrawal from a current average of approximely 1.7 million cubic meters/day to approximely 3.5 million cubic meters/day after the implementation of Phase 1, respectively to approximely 5 million mc/day, after the implementation of the Phase 2;
- creşterea flexibilităţii depozitului prin creşterea capacităţii zilnice de injecţie şi extractie de la o medie actuală de cca. 1,7 mil. mc/zi la cca. 3,5 mil. mc/zi după implementarea Fazei 1, respectiv la cca. 5 mil. mc/zi, după implementarea Fazei 2;
- increasing the storage capacity of the warehouse from 300 million m^3 to 400 million m^3 in Phase 1, respectively to 600 million .m^3 in Phase 2.

The project will consist of the following:

- construction of a new gas central station, comprising new gas compression units, gas drying, two-way commercial gas measuring panel, adjacent facilities;
- construction of a new underground storage collector;
- modernization of surface technological installations to increase the operating pressure;
- drilling new wells.

Estimated deadline: 2023 pentru Faza 1.

Phase 2 can only be started after the implementation of Phase 1.

The estimated value of the investment is 30 million Euros.

The project is included in TYNDP 2020 with identification code UGS – A - 233.

The project has received the status of a project of common interest and are included in the fourth List of Projects of Union Interest, approved by the Delegated Regulation (EU) 2020/389, with reference number 6.20.4.

9. PUBLIC SERVICE OBLIGATIONS RELATED TO THE SECURITY OF NATURAL GAS SUPPLY

Public service obligations (defined as *the activity of general interest in the field of natural gas, authorized, and monitored by a public authority*), related to the security of natural gas supply, as established in Law no. 123/2012, are the following:

- The holders of licenses for storage, transmission, distribution and supply of natural gas and the holder of the operating license of the LNG terminal have the obligation to carry out their activities in compliance with the obligations stipulated in the licenses, respectively the authorizations issued by ANRE, on safety, quality, continuity of supply, energy efficiency, compliance with occupational safety and health and environmental protection rules, as well as the provisions of direct contracts with customers, in accordance with Article 173 paragraph (1);
- ANRE may establish, through specific regulations, public service obligations for each activity in the natural gas sector, applicable to all licensees, or authorizations in a transparent, equidistant and non-discriminatory manner, according to Article 173 paragraph (2).

The natural gas transmission activity constitutes a public service of national interest, according to Article 125 paragraph (1), and the natural gas distribution activity, except for the one carried out through closed distribution systems, constitutes a public service of general interest, according to Article 135.

In addition, the appropriate measures for the protection of final customers guaranteeing, in particular, the adequate protection of vulnerable customers are stipulated in Law no. 123/2012, in particular those applicable to a liberalized natural gas market.

Also, Law no. 123/2012 stipulates the obligations of the supplier of last resort, both for natural gas and for electricity (defined as *the supplier designated by the competent authority to provide the supply service under specific regulated conditions*), namely:

- has the obligation to ensure the supply of natural gas to final customers, in accordance with ANRE regulations, at prices regulated by ANRE, according to Article 144 paragraph (1);
- has the obligation to supply, according to the regulations issued by ANRE, natural gas to the final customers whose supplier is in the situation of withdrawing the supply license during the activity or in any other situation identified by ANRE in which the final customers customers have not ensured the supply of natural gas from no other source, according to Article 144 paragrapf (2).

10. STAKEHOLDER CONSULTATIONS

Given the importance and implications of the Preventive Action Plan on measures to ensure security of gas supply in Romania on ensuring the safe supply of natural gas to the Romanian population and, in particular, to protected customers, the Ministry of Energy submitted the draft Preventive Action Plan to a public consultation for collection, from stakeholders, proposals, suggestions and opinions with a value of recommendation on this document.
The purpose of the consultation was to increase the transparency of the decision-making process and at the same time allowed the accumulation of useful information needed to debate public policy issues with a major impact for the period 2021-2030.
The public consultation took place after the publication by the Ministry of Energy, on the official website of the institution, of the draft Preventive Action Plan.
In addition, the draft was submitted for views/comments and proposals to natural gas companies, electricity producers and transmission and system operators: electricity and natural gas, as follows: National Regulatory Authority for Energy, Federation of Associations of Energy Utility Companies, The National Natural Gas Transmission Company Transgaz S.A., The National Natural Gas Company ROMGAZ S.A., OMV PETROM S.A., The National Electricity Transmission Company TRANSELECTRICA S.A., Electrocentrale București S.A. ELCEN, The Natural Gas Storage Subsidiary DEPOGAZ Ploiești S.R.L. and DEPOMUREȘ S.A..
The draft Preventive Action Plan was submitted to the competent authorities of Hungary and the Republic of Bulgaria for consultation.
The list of interested parties that submitted comments on the draft Preventive Action Plan in the framework of the public consultation is presented below:

- National Regulatory Authority for Energy;
- Federation of Associations of Energy Utility Companies;
- Electrocentrale București S.A. ELCEN;
- The Natural Gas Storage Subsidiary DEPOGAZ Ploiești S.R.L.;
- DEPOMUREȘ S.A.;
- OMV PETROM S.A.;
- The National Natural Gas Transmission Company Transgaz S.A..

Proposals and comments received from interested parties, either of general or detailed nature, were assessed and partially included in the text. These consisted of the following:

- Updates with regard to the investment projects;
- Additions to the proposed/ analyzed risk scenarios concerning the natural gas supply in Romania;
- Additional data regarding the calculation of N-1 formula at national level;
- Proposals to amend some of the preventive measures;
- Enhancing the importance of contracts with <interruptible clauses>.

11. REGIONAL DIMENSION[32]

11.1. Calculation of the N-1 formula at the level of the risk group Ukraina

The formula used for the calculation of the "N-1 formula at the level of the risk group" is the one provided by point 4 of Annex II to the Regulation, respectively *the N-1 formula using demand-side measures*.

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

Definitions of parameters used to calculate the N-1 formula:

EP_m	Technical capacity of entry points (in mcm/d), other than production, LNG and storage facilities covered by P_m, LNG_m and S_m, means the sum of the technical capacity of all border entry points capable of supplying gas to the calculated area.
P_m	Maximal technical production capability (in mcm/d) means the sum of the maximal technical daily production capability of all gas production facilities which can be delivered to the entry points in the calculated area.
S_m	Maximum technical deliverability of storage defined as the sum of the maximum daily withdrawal capacity of all the storage facilities that can be delivered to the entry points of the national network, taking into account their respective physical characteristics. As specified in the Regulation, the maximum capacity used in the calculation is evaluated considering all storages at the 100% and 30% of their working volumes.
LNG_m	Maximum technical capacity of the LNG plants, i.e., the maximum daily send-out of the facilities connected to the national network, taking into account the critical elements like unloading, ancillary services, temporary storage, regasification of LNG and the interconnection capacity with the transport network.
I_m	Maximum technical capacity of the major entry point (in mcm/d).
D_{max}	The demand of the entire group, determined by considering the forecast of market consumption in exceptional weather conditions evaluated with the probability of occurrence of once every 20 years.
D_{eff}	The portion of the demand that, in case the supply is interrupted, can be adequately and promptly covered using market-based demand measures.

[32]Source: Joint Research Centre - Common risk assessment of the Eastern gas supply risk group Ukraine and Common risk assessment for the risk group Trans Balkan.
Competent Authorities of Member States in risk groups - 2019.

In order to analyze the risk associated with the interruptions of natural gas supply of the Ukrainian route, in N-1 formula, was adopted as the single largest gas infrastructure: Uzhgorod-Velke Kapusany, the entry point located on the border between Slovakia and Ukraine.
The N-1 formula has been calculated for the situation of total disruption of the supply route Ukraine.
The N-1 formula has been computed taking into account the 100% of underground storage working gas volume and also taking into account the 30% of the same value. The N-1 formula has been calculated taking into account 2018/2019 scenario and 2020/2021 scenario.
A summary of the data set used to calculate the N-1 formula, in the Common risk assessment for the risk group Ukraine, is presented in the tables below, for scenario 2018/2019 (see Table 28. and Table 29.) and for scenario 2020/2021 (see Table 30. and Table 31.).
Table 32. presents the N-1 formula values, calculated for the two filling levels 30% and 100%, for scenario 2018/2019 and scenario 2020/2021.

Table 28. Capacity of the Uzhgorod interconnection point, in [MSm^3/d], for the 2018/2019 scenario

Disruption (I_m)	Capacity
Uzhgorod	***227,4***
Ukraine route	***336,5***

Table 29. The data set used to calculate the N-1 formula, in [MSm^3/d], for the 2018/2019 scenario

Member State	Ep_m	LNG_m	S_m 100%	S_m 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*
Luxemburg	*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 30. Capacity of the Uzhgorod interconnection point, in [MSm^3/d], for the 2020/2021 scenario

Disruption (I_m)	Capacity
Uzhgorod	***191,7***
Ukraine route	***294,0***

Table 31. The data set used to calculate the N-1 formula, in [MSm^3/d], for the 2020/2021 scenario

Member State	Ep_m	LNG_m	S_m 100%	S_m 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*
Luxemburg	*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 32. N - 1 formula values

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

In each case, the resulting values for the N-1 formula are far above 100%, which means that the regional gas infrastructures are properly dimensioned in order to cover the maximum demand of the involved Member States.
However, the N-1 formula does not take into account the possible existence of internal bottlenecks or problems induced by malfunctioning of the internal interconnection points or due the lack of available capacity to take up volumes of natural gas.

11.2. Calculation of the N - 1 formula for the risk group Trans-Balkan

According to point 5 of Annex II to the Regulation, for the calculation of the N-1 formula at regional level, the single largest gas infrastructure of common interest in the region that directly or indirectly contributes to the gas supply of the concerned risk group shall be used. The Orlovka - Isaccea interconnection point has been adopted as the largest single infrastructure in order to analyze the risk associated with natural gas supply disruptions within the risk group Trans-Balkan.
The capacity values of Trans-Balkan infrastructure are integrated in the risk group Ukraine description of the system.
Presentation of the values estimated in the N-1 formula for the following two situations, according to the underground capacity storage:

- 100% of the underground storage working gas volume in the area;
- 30% of the underground storage working gas volume in the area.

For the calculation of the N - 1 formula, the entire region of the three Member States is considered as one single “calculated area” and only the entry points connecting the region with countries outside the region are taken into account. Cross-border capacity points inside the region are not included. The calculation of the N - 1 formula was made for the period 2019-2022 taking into account the planned changes in infrastructure and production in the region.
As already mentioned, when considering **Romania, Bulgaria and Greece** as one region, the area has 4 entry points (EP). Mediesu (EP1) and Isaccea (EP2) are entry points to **Romania** for Russian gas transiting Ukraine. Part of the gas entering Isaccea transits **Romania** towards Bulgaria. In Bulgaria the gas enters at Negru Vodă I and Negru Vodă II & III. From Bulgaria the

gas flows towards Greece, at Sidirokastron. Csanádpalota (EP3) is the entry point to **Romania** from Hungary and Kipi (EP4) is the entry point to Greece from Turkey
Table 33. presents maximum technical capacity of entry points, in M(S)m^3/d, at the level of risk group Trans- Balkan, starting with 2019.

Table 33. Maximum technical capacity of the entry points, in M(S)m^3/d, at the level of risk group Trans-Balkan

Ukraine → Romania		**Hungary → Romania**	**Turkey → Greece**
EP1	EP2	EP3	EP4
Medieșu Aurit	Isaccea	Csanádpalota	Kipi
11	23.6	4.8	4.5
	18.8*		
	50.4*		
113.1 (total)			

Tables 34. and 35. present the parameters used to calculate N-1 formula, in the Common risk assessment for the risk group Trans-Balkan, with and without market-based demand-side measures.

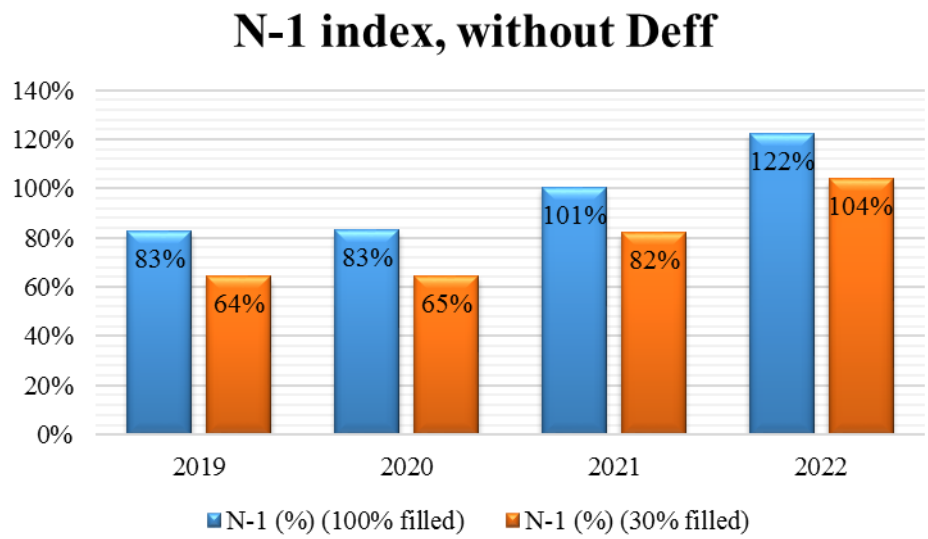

Figure 7. N-1 formula values, for the risk group Trans-Balkan, without D_{eff}

Table 34. Parameters used to calculate the N-1 formula, for the risk group Trans-Balkan, without D_{eff}

	2019	**2020**	**2021**	**2022***

	M(S)^3/d	GWh/d**	M(S)m^3/d	GWh/d	M(S)m^3/d	GWh/d	M(S)m^3/d	GWh/d
EP_m (tot)	113.10	1,195.47	113.10	1,195.47	110.50	1,167.99	137.40	1,452.32
Bulgaria	0.00	0.00	0.00	0.00	0.00	0.00	14.60	154.32
Greece	4.50	47.57	4.50	47.57	4.50	47.57	9.60	101.47
Romania	108.60	1,147.90	108.60	1,147.90	106.00	1.120.42	113.20	1,196.52
P_m (tot)	26.16	276.51	26.55	280.63	47.70	504.19	47.04	497.21
Bulgaria	0.16	1.69	0.55	5.81	1.10	11.63	1.64	17.33
Greece	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Romania	26.00	274.82	26.00	274.82	46.60	492.56	45.40	479.88
S_m (tot) (100% filled)	33.25	351.45	33.25	351.45	33.25	351.45	33.25	351.45
Bulgaria	3.75	39.64	3.75	39.64	3.75	39.64	3.75	39.64
Greece	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Romania	29.50	311.82	29.50	311.82	29.50	311.82	29.50	311.82
S_m (total) (30% filled)	10.96	115.85	10.96	115.85	10.96	115.85	10.96	115.85
Bulgaria	2.11	22.30	2.11	22.30	2.11	22.30	2.11	22.30
Greece	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Romania	8.85	93.54	8.85	93.54	8.85	93.54	8.85	93.54
LNG_m (total)	20.20	213.51	20.20	213.51	20.20	213.51	20.20	213.51
Bulgaria	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Greece	20.20	213.51	20.20	213.51	20.20	213.51	20.20	213.51
Romania	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
I_m	92.80	980.90	92.80	980.90	90.20	953.41	90.20	953.41
D_{max} (total)	115.99	1,226.01	115.99	1,226.01	115.99	1,226.01	115.99	1,226.01
D_{eff}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N-1 (%) (100% filled)	**86.14%**		**86.47%**		**104.71%**		**127.33%**	

N-1 (%) (30% filled)	**66.92%**	**67.26%**	**85.49%**	**108.11%**

Conclusions:
N-1 > 100% only for **2022 in all cases** (D_{eff}= 0, D_{eff}> 0, 30% & 100% filled)
N-1 > 100% also for **2021** only for the case of **100% filled**
Demand-side measures → N-1 formula still yields a result **lower than 100%** for the **same years** as in the case of not applying D_{eff}.

.
Taking into account demand-side measures, the resulting value from the calculation of the N-1 formula can be improved by 4% to 6% (in absolute numbers).
Results of the N-1 formula for the period 2019-2022 (see Figure 7.) show that in case of disruption of the single largest gas infrastructure (Orlovka - Isaccea interconnection point), the capacity of the remaining infrastructure will be able to provide the necessary gas quantity for satisfying the gas demand of the region during a day of exceptionally high gas demand (occurring with a statistical probability of once in 20 years) only after the year 2021 (taking into account the 100% of the underground storage working gas volume). As may be seen, for the years 2019 and 2020 the N - 1 formula yields a result lower than 100% while, in case that the underground storage working gas volume is considered equal to 30%, N-1 formula is less than 100% for the year 2022 as well.

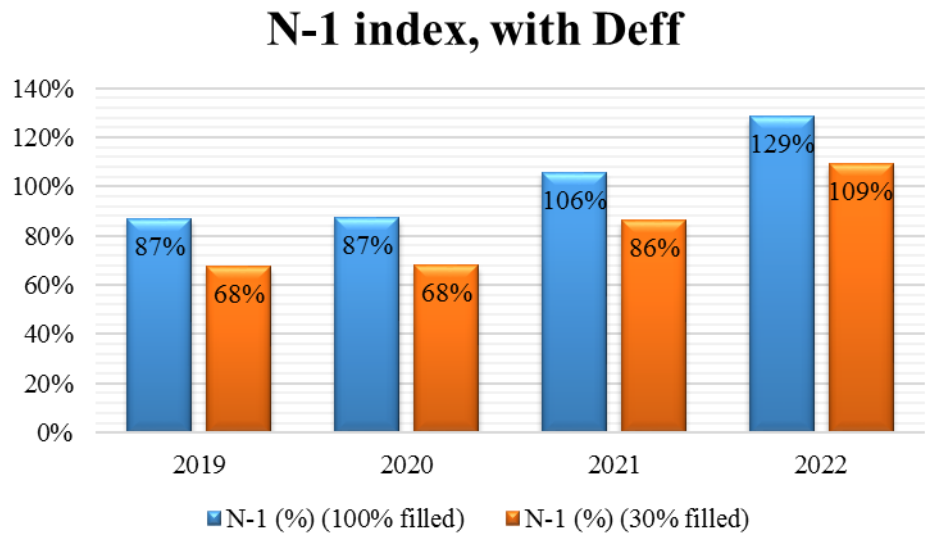

Figure 8. N-1 formula values, for the risk group Trans-Balkan, with D_{eff}

Table 35. Parameters used to calculate the N-1 formula, for the risk group Trans-Balkan, with D_{eff}

	2019	**2020**	**2021**	**2022***

	M(S)m^3 /d	GWh/d	M(S)m^3 /d	GWh/d	M(S)m^3 /d	GWh/ d	M(S)m^3 /d	GWh/d
EP_m (total)	113.10	1,195.47	113.10	1,195.47	110.50	1,167. 99	137.40	1,452.32
Bulgaria	0.00	0.00	0.00	0.00	0.00	0.00	14.60	154.32
Greece	4.50	47.57	4.50	47.57	4.50	47.57	9.60	101.47
Romania	108.60	1,147.90	108.60	1,147.90	106.00	1.120. 42	113.20	1,196.52
P_m (total)	26.16	276.51	26.55	280.63	47.70	504.19	47.04	497.21
Bulgaria	0.16	1.69	0.55	5.81	1.10	11.63	1.64	17.33
Greece	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Romania	26.00	274.82	26.00	274.82	46.60	492.56	45.40	479.88
S_m (total) (100% filled)	33.25	351.45	33.25	351.45	33.25	351.45	33.25	351.45
Bulgaria	3.75	39.64	3.75	39.64	3.75	39.64	3.75	39.64
Greece	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Romania	29.50	311.82	29.50	311.82	29.50	311.82	29.50	311.82
S_m (total) (30% filled)	10.96	115.85	10.96	115.85	10.96	115.85	10.96	115.85
Bulgaria	2.11	22.30	2.11	22.30	2.11	22.30	2.11	22.30
Greece	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Romania	8.85	93.54	8.85	93.54	8.85	93.54	8.85	93.54
LNG_m (total)	20.20	213.51	20.20	213.51	20.20	213.51	20.20	213.51
Bulgaria	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Greece	20.20	213.51	20.20	213.51	20.20	213.51	20.20	213.51
Romania	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
I_m	92.80	980.90	92.80	980.90	90.20	953.41	90.20	953.41
D_{max} (total)	115.99	1,226.01	115.99	1,226.01	115.99	1,226. 01	115.99	1,226.01
D_{eff}	5.72	60.50	5.72	60.50	5.72	60.50	5.72	60.50
N-1 (%) (100% filled)	**90.61%**		**90.96%**		**110.14%**		**133.94%**	

N-1 (%) (30% filled)	**70.39%**	**70.75%**	**89.93%**	**113.72%**

Table 36. presents the maximum technical capacity of the exit points, at the level of risk group Trans-Balkan, starting with 2019.
Taking into account these two exit points, an alternative approach to calculate the N – 1 formula can be taken by discounting transit gas from the total quantity of gas entering the region, i.e. the decrease of the value of 46.88 M (S) m³/ day in the calculation of the N-1 formula.

Table 36. Maximum technical capacity of the exit points, in M(S)m3/d, at the level of risk group Trans-Balkan

Bulgaria → Turkey	***Bulgaria → North Macedonia***
EXP1	**EXP2**
Malkoclar	**Zidilovo**
44.35	2.53
46.88 (total)	

Tables 37. and 38. presents the parameters used to calculate the N-1 formula, for the risk group Trans-Balkan, based on the application of the second approach, with and without market-based demand-side measures.
Figures 9. and 10. present the results of the N-1 formula, based on the application of the second approach, which highlights that dependence on gas transit is of a great importance for the calculation of the N-1 formula for the Balkan region, in the period 2019-2022.

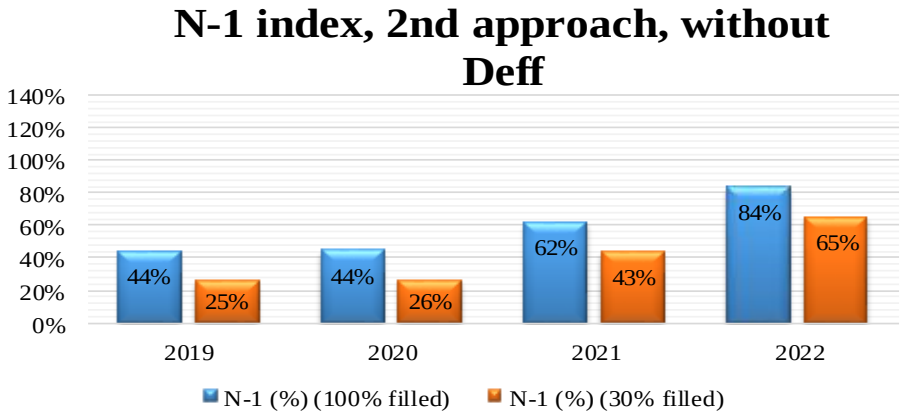

Figure 9. N-1 formula values, for the risk group Trans-Balkan, without transit gas (second approach) and without D_{eff}

Table 37. Parameters used to calculate the N-1 formula, for the risk group Trans-Balkan, without transit gas (second approach) and without D_{eff}

	2019		2020		2021		2022*	
	(S)mcm/d	GWh/d	(S)mcm/d	GWh/d	(S)mcm/d	GWh/d	(S)mcm/d	GWh/d
EP_m (total)	113.10	1,195.47	113.10	1,195.47	110.50	1,167.99	137.40	1,452.32
Bulgaria	0.00	0.00	0.00	0.00	0.00	0.00	14.60	154.32
Greece	4.50	47.57	4.50	47.57	4.50	47.57	9.60	101.47
Romania	108.60	1,147.90	108.60	1,147.90	106.00	1.120.42	113.20	1,196.52
$ExitP_m$ (total)	46.88	495.52	46.88	495.52	46.88	495.52	46.88	495.52
EXP1	44.35	468.78	44.35	468.78	44.35	468.78	44.35	468.78
EXP2	2.53	26.74	2.53	26.74	2.53	26.74	2.53	26.74
P_m (total)	26.16	276.51	26.55	280.63	47.70	504.19	47.04	497.21
Bulgaria	0.16	1.69	0.55	5.81	1.10	11.63	1.64	17.33
Greece	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Romania	26.00	274.82	26.00	274.82	46.60	492.56	45.40	479.88
S_m (total) (100% filled)	33.25	351.45	33.25	351.45	33.25	351.45	33.25	351.45
Bulgaria	3.75	39.64	3.75	39.64	3.75	39.64	3.75	39.64
Greece	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Romania	29.50	311.82	29.50	311.82	29.50	311.82	29.50	311.82
Sm (total) (30% filled)	10.96	115.85	10.96	115.85	10.96	115.85	10.96	115.85
Bulgaria	2.11	22.30	2.11	22.30	2.11	22.30	2.11	22.30
Greece	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Romania	8.85	93.54	8.85	93.54	8.85	93.54	8.85	93.54
LNG_m (tot)	20.20	213.51	20.20	213.51	20.20	213.51	20.20	213.51
Bulgaria	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Greece	20.20	213.51	20.20	213.51	20.20	213.51	20.20	213.51
Romania	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
I_m	92.80	980.90	92.80	980.90	90.20	953.41	90.20	953.41

D_{max} (total)	115.99	1,226.01	115.99	1,226.01	115.99	1,226.01	115.99	1,226.01
D_{eff}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N-1 (%) (100% filled)	**45.72%**		**46.06%**		**64.29%**		**86.91%**	
N-1 (%) (30% filled)	**26.50%**		**26.84%**		**45.07%**		**67.70%**	

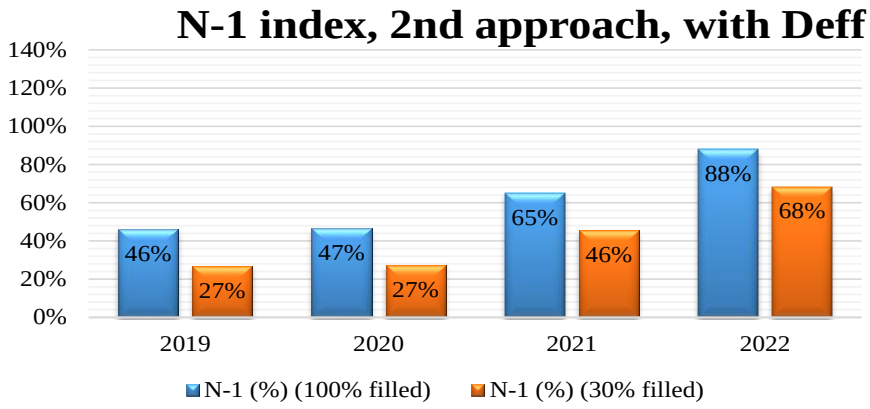

Figura 10. N-1 formula values, for the risk group Trans-Balkan, without transit gas (second approach) and with D_{eff}

Tabel 38. Parameters used to calculate the N-1 formula, for the risk group Trans-Balkan, without transit gas (second approach) and with D_{eff}

	2019		**2020**		**2021**		**2022***	
	(S)mcm/zi	**GWh/zi**	**(S)mcm/zi**	**GWh/zi**	**(S)mcm/zi**	**GWh/zi**	**(S)mcm/zi**	**GWh/zi**
EP_m (total)	113.10	1,195.47	113.10	1,195.47	110.50	1,167.99	137.40	1,452.32
Bulgaria	0.00	0.00	0.00	0.00	0.00	0.00	14.60	154.32
Greece	4.50	47.57	4.50	47.57	4.50	47.57	9.60	101.47
Romania	108.60	1,147.90	108.60	1,147.90	106.00	1.120.42	113.20	1,196.52
$ExitP_m$ (total)	46.88	495.52	46.88	495.52	46.88	495.52	46.88	495.52
EXP1	44.35	468.78	44.35	468.78	44.35	468.78	44.35	468.78

EXP2	2.53	26.74	2.53	26.74	2.53	26.74	2.53	26.74
P_m (tot)	26.16	276.51	26.55	280.63	47.70	504.19	47.04	497.21
Bulgaria	0.16	1.69	0.55	5.81	1.10	11.63	1.64	17.33
Greece	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Romania	26.00	274.82	26.00	274.82	46.60	492.56	45.40	479.88
S_m (total) (100% filled)	33.25	351.45	33.25	351.45	33.25	351.45	33.25	351.45
Bulgaria	3.75	39.64	3.75	39.64	3.75	39.64	3.75	39.64
Greece	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Romania	29.50	311.82	29.50	311.82	29.50	311.82	29.50	311.82
S_m (total) (30% filled)	10.96	115.85	10.96	115.85	10.96	115.85	10.96	115.85
Bulgaria	2.11	22.30	2.11	22.30	2.11	22.30	2.11	22.30
Greece	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Romania	8.85	93.54	8.85	93.54	8.85	93.54	8.85	93.54
LNG_m (total)	20.20	213.51	20.20	213.51	20.20	213.51	20.20	213.51
Bulgaria	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Greece	20.20	213.51	20.20	213.51	20.20	213.51	20.20	213.51
Romania	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
I_m	92.80	980.90	92.80	980.90	90.20	953.41	90.20	953.41
D_{max} (total)	115.99	1,226.01	115.99	1,226.01	115.99	1,226.01	115.99	1,226.01
D_{eff}	5.72	60.50	5.72	60.50	5.72	60.50	5.72	60.50
N-1 (%) (100% filled)	**48.09%**		**48.45%**		**67.63%**		**91.42%**	
N-1 (%) (30% filled)	**27.88%**		**28.23%**		**47.41%**		**71.21%**	

for the Balkan region, at least for the years 2021 and 2022 for which the N – 1 infrastructure standard exceeds 100 % (see also Tables 4 and 5). When gas transit flows are discounted (flows intended for neighbouring countries along the supply chain, i.e. Turkey and North Macedonia), the N – 1 calculation is below 100 % even in the scenario of demand-side measures application in the period 2019-2022.

, which highlights that dependence on gas transit is of a great importance for the calculation of the N-1 formula for the Balkan region

Conclusion: In case that transit gas flows are discounted (flows intended for neighbouring countries along the supply chain - Turkey and North Macedonia), the N-1 formula has values below 100% (N-1 <100%), ***in all cases***, even in case demand-side measures (D_{eff}) are applied, in the period 2019-2022.

11.3. Mechanisms developed for cooperation among the Member States

As provided in Article 3 paragraph (6) of the Regulation, as a means of strengthening regional cooperation is used the Regional Coordination System for Gas (ReCo System for Gas, established by ENTSO-G, which is composed of standing expert groups, for the provision of information on gas flows, as well as for the provision of technical and operational expertise between transmission and system operators in the case of emergency situations at regional or EU level.
There are three ReCo crisis management teams: the North Eastern team, the Eastern team, and the Southern team. Most Member States that are part of the risk group Ukraine are included in the ReCo East team, which was established in November 2017.
As mentioned in the Regulation, the Competent Authorities of the Member States within the Risk Groups must ensure an appropriate level of information exchange and cooperation in the event of an emergency situation at regional or EU level.
Transmission system operators cooperate and exchange information, including on gas supply flows in a crisis situation, using the Regional Coordination System for Gas and, also, in the consultations on the 10-year Network Development Plan TYNDP).

11.4. Solidarity measures necessary to implement solidarity principle

By introducing the solidarity principle, according to Article 13 of the Regulation, which requires that a directly connected Member States or through a third country to adopt solidarity obligations and to conclude technical, legal and financial agreements in order to be able to take measures to ensure the supply of natural gas to vulnerable consumers during the most severe crisis situations, the competent authorities need to have, in advance, a cooperative relationship and a common understanding regarding the management of crisis levels and the measures that should be taken, so that crisis management could be achieved.
In this regard, the Ministry of Energy has elaborated a draft Agreement on solidarity measures to safeguard the security of gas supply, which will be subject to consultation with natural gas undertakings, the natural gas transmission system operator and the National Regulatory Authority for Energy.
The draft Agreement was submitted to the competent authorities of the neighboring Member States, after which it will be subject of the Romanian Government.

12. CONCLUSIONS

The preventive action plan was established in accordance with the provisions of the Regulation.
The plan describes the tools available on the Romanian gas market, respectively only market-based measures, necessary to ensure the security of supply of final consumers and to cope with unforeseen incidents.
At the level of preventive measures, both demand-side and supply-side market-based measures are used. Non-market measures are not used in preventive measures.
Market-based measures are an essential component of the normal functioning of the market, but they can also be used in crisis situations, which are described in the Emergency Plan.
These market-based measures can be achieved mainly due to the fact that the national natural gas infrastructure is developed and that the gas supply sources are well diversified.
The physical structure of the National Transmission System offers the possibility to identify and establish natural gas transport corridors that meet both the needs of ensuring the supply of natural gas to different consumption areas in the country and the needs regarding the transfer through the Romanian system of some quantities of natural gas between the systems of the neighboring countries, as a requirement imposed by the liberalization of natural gas markets and European legal framework
In terms of domestic supply sources, the possible incidents that may affect the production process upstream of the National Transmission System can be remedied in good time (within 48 hours, the average time to restore the normal situation is about 8 hours) without significant impact on the supply of natural gas to the final consumers. The internal procedures of the producers provide a greater flexibility of supply, being available redirection/compensation mechanisms due to the capabilities unavailability during the intervention period.
The natural gas storage system in Romania is one of the elements that contributes to optimizing the use of natural gas transmission infrastructure and balancing the system, contributes to creating an equilibrium between consumption and domestic production and imports, and to increasing the efficiency of the NTS and significantly helps to secure gas supplies to end customers in the event of a gas supply disruption or limitation.
Electricity production could be affected by gas supply failures in Romania, as electricity production in hydrocarbon power plants (natural gas) accounts for about 16%[33] of total electricity production and the perspective is to increase this share through implementing the new European green policy.
Romania has the largest gas market in the region and the lowest dependence on imports, recording about 80%[34] of production in the region. Although there is a decline in domestic natural gas production, Romania still has a high potential for domestic production, with possibilities for future development once the production capacities from the Black Sea perimeters are in place.

[33]Source: Transelectrica S.A., page 43
https://www.transelectrica.ro/documents/10179/11109053/Planul+de+dezvoltare+a+RET+2020_2029.pdf/5524ca56-0166-4964-8bf9-b1d2cfadeea0
[34]Source: Transgaz S.A., page 18
https://transgaz.ro/ro/consultare-publica-planul-de-dezvoltare-sistemului-national-de-transport-gaze-naturale-pentru

The obtained result in the National Risk Assessment for formula N-1, namely N - 1 > 100% indicates that the national gas infrastructures are properly sized to cover the maximum demand in Romania.

The plan also describes the obligations of the undertakings operating in the field of natural gas, stipulated in Law no. 123/2012, which applies to the gas market in Romania, to ensure that they use the available tools to ensure the safe supply of natural gas to final consumers and especially to protected customers.

In conclusion, the Romanian natural gas system is pro-active in relation to the requirements of Regulation (EU) 2017/1938 of the European Parliament and of the Council of 25 October 2017 on measures to protect security of gas supply and repealing Regulation 994/2010.

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