

# PREVENTIVE ACTION PLAN FOR SAFEGUARDING THE SECURITY OF NATURAL GAS SUPPLY

## 1. GENERAL PART

Article 315, paragraph 2 of the Law on Energy (hereinafter: the Law) stipulates that the Government shall adopt a Preventive Action Plan in order to ensure the security of natural gas supply, which includes risk assessment in terms of achieving security of supply, as well as measures to mitigate the identified risks that refer to the necessary transport capacity to meet the total demand for natural gas and to provide supplies to certain groups of final customers of natural gas

This plan includes a risk analysis, based on which measures and activities for the mitigation or elimination of risks have been established, in order to ensure safe, efficient and quality supply and support in the long term:

- development of the national gas pipeline system;
- development of the gas market at the national and regional level; and
- linking with the systems of neighboring countries and diversifying directions and sources of supply.

## 2. OVERVIEW OF THE NATURAL GAS MARKET IN THE REPUBLIC OF SERBIA

### 2.1. Gas Pipeline System in the Republic of Serbia

#### 2.1.1. Transport system for natural gas

The natural gas transport system consists of a network of gas pipelines of projected pressure greater than 16 bar, except for supply pipelines, as well as compressor station, block station, measuring and control station and measuring station at all delivery points from the transport system, other energy facilities, an electronic communication and information system and other infrastructure necessary for the transport of natural gas, including linepack (hereinafter: the transport system).

The total length of the transport system in the Republic of Serbia at the end of 2017 was 2,459 km. The transport system has two interconnections with other gas pipelines, one entry point at the border with Hungary (Kiskundorozsma) with a technical capacity of 15 million m<sup>3</sup>/day and one outlet point at the border with Bosnia and Herzegovina with a capacity of 1.8 million m<sup>3</sup>/day. In the system there is one compressor station Batajnica with a power of 4,4 MW and 243 outlet points. Measurement acquisition equipment for automatic data collection and processing is built on about 60% of the outlets. About 47% of the transport system is older than 30 years.

The transport and transport management system of around 95% (2,334 km) of the transport system in northern and central Serbia is carried out by the company "Transportgas Srbija" d.o.o. Novi Sad, a subsidiary company of the Public Enterprise "Srbijagas", and by the company Yugorosgaz-transport d.o.o. Niš on the other 5% (125 km), in the southeastern part of the Republic of Serbia.

About 5 million or 70% of the population of the Republic of Serbia lives in an area that has a transport network and provides the potential for further development of the gas pipeline system and the growth of natural gas consumption.

#### 2.1.2. Distribution system for natural gas

The natural gas distribution system is a natural gas distribution network consisting of a pipeline network, regulating, measuring and control stations and measuring stations at all distribution system delivery points, other energy facilities, electronic communications,

information and other infrastructure necessary for distribution of natural gas of the maximum working pressure of equal or less than 16 bar, including linepack.

The total length of the distribution system in the Republic of Serbia at the end of 2017 was 16,961 km (without connections), of which 48,9% belongs to the Public Enterprise Srbijagas. Since 2010, the distribution network's length has increased by 18.6%, the number of customers by 7% and consumption by 7%.

The number of active connections (delivery points) on distribution networks is 267,000.

The distribution and distribution system operation is performed by 34 distribution system operators.

### 2.1.3. Natural gas storage

In the Republic of Serbia there is one underground gas storage facility "Banatski Dvor" owned by Public Enterprise "Srbijagas" (49%) and GAZPROM EKSPORT LIMITED LIABILITY COMPANY (51%). The total available storage capacity of commercial gas is 450 million m<sup>3</sup> of gas. The maximum daily withdrawal capacity from the storage is 5 million m<sup>3</sup>/day and drops under 4 million m<sup>3</sup>/day when the storage is empty, while the minimum capacity is 1 million m<sup>3</sup>/day. The injecting capacity is max. 2.7 million m<sup>3</sup>/day and depends on the pressure of gas in the pipeline, where the storage is connected with the transport system, as well as the quantity of gas in the storage, while the minimum injecting capacity is 1 million m<sup>3</sup>/day. Replacement compressor capacity in case of failure of some of the compressor units does not exist. The 42,5 km long two-way pipeline Gospodinci - Banatski Dvor connects the underground gas storage with the transport system. It is connected to the gas distribution node in Elemir with two pipelines.

At the end of 2017, commercial gas stocks in the storage was 458 million m<sup>3</sup>, of which 218 million m<sup>3</sup> was available to Public Enterprise Srbijagas.

The activity of storage and management of natural gas storage is performed by the operator of the natural gas storage company PSG BANATSKI DVOR DOO NOVI SAD.

## 2.2. Natural gas consumption and supply

The Republic of Serbia's natural gas market is supplied from domestic sites and from imports. In the Republic of Serbia, natural gas is produced in 78 wells. The largest natural gas deposits are located in the Autonomous Province of Vojvodina. The only company in the Republic of Serbia that is engaged in research and production of natural gas is NIS a.d. The largest part of gas imports of the Republic of Serbia is from the Russian Federation, on the basis of a long-term contract, which guarantees a minimum natural gas quantity of 2 billion m<sup>3</sup> of natural gas per year from January 1, 2018.

The balance of natural gas in the period from 2010 to 2017 is given in Table 1.

Year:	2010	2011	2012	2013	2014	2015	2016	2017
Production	387,183	508,161	533,511	531,188	557,179	572,502	523,229	489,085
Imports	1,967,753	1,747,520	1,789,756	1,887,480	1,394,659	1,740,221	1,795,226	2,182,632
Storage, saldo	0	133,729	-216,108	-74,500	68,795	-114,511	56,850	-12,800
Foreign storages	-27,343	0	0	0	0	0	0	0
<b>Available for consumption</b>	<b>2,327,593</b>	<b>2,389,410</b>	<b>2,107,159</b>	<b>2,344,168</b>	<b>2,020,633</b>	<b>2,198,212</b>	<b>2,375,305</b>	<b>2,658,917</b>
<b>Used for producing energy by transformation</b>	<b>805,480</b>	<b>904,808</b>	<b>826,160</b>	<b>774,997</b>	<b>856,098</b>	<b>885,174</b>	<b>886884</b>	<b>920,464</b>
<i>TPP's Heating plants</i>	<i>95,173</i>	<i>153,786</i>	<i>146,795</i>	<i>70,436</i>	<i>27,391</i>	<i>20,064</i>	<i>46,582</i>	<i>94,992</i>
<i>Industrial energy plants</i>	<i>203,910</i>	<i>184,245</i>	<i>132,134</i>	<i>205,803</i>	<i>216,384</i>	<i>164,998</i>	<i>144,646</i>	<i>136587</i>
<i>Heating plants</i>	<i>506,397</i>	<i>566,777</i>	<i>547,231</i>	<i>498,758</i>	<i>480,844</i>	<i>563,451</i>	<i>566,640</i>	<i>565,657</i>
<i>Refinery</i>	-	-	-	-	<i>131,479</i>	<i>136,661</i>	<i>129,016</i>	<i>123,228</i>
<b>Own consumption in the energy sector</b>	<b>60,274</b>	<b>54,242</b>	<b>93,736</b>	<b>159,932</b>	<b>183,560</b>	<b>209,707</b>	<b>180,986</b>	<b>202,241</b>
<b>Losses</b>	<b>20,943</b>	<b>5,746</b>	<b>11,847</b>	<b>16,328</b>	<b>18,194</b>	<b>11,433</b>	<b>22,544</b>	<b>36,101</b>
<b>Final consumption</b>	<b>1,440,896</b>	<b>1,424,614</b>	<b>1,175,405</b>	<b>1,392,911</b>	<b>962,981</b>	<b>1,091,898</b>	<b>1,284,891</b>	<b>1,500,111</b>

thousand m<sup>3</sup>

<b>Non-energy purposes</b>	<b>271,435</b>	<b>283,532</b>	<b>21,496</b>	<b>13,4365</b>	<b>114,252</b>	<b>157,658</b>	<b>292,077</b>	<b>425,526</b>
<b>Energy purposes</b>	<b>1,169,461</b>	<b>1,141,082</b>	<b>1,153,909</b>	<b>1,258,546</b>	<b>848,729</b>	<b>934,240</b>	<b>992,814</b>	<b>1,074,585</b>
<i>Industry</i>	759,313	732,730	760,460	889,452	485,888	543,083	550,089	578,938
<i>Transportation</i>	12,623	14,054	4,459	9,486	8,833	11,204	6,502	5,309
<i>Households</i>	270,412	266,653	244,232	218,528	179,000	189,822	210,678	240,938
<i>Agriculture</i>	18,330	17,448	20,670	19,543	32,207	20,713	28,953	22,564
<i>Public and commercial sector</i>	108,783	110,197	124,088	121,537	142,801	169,418	196,592	226,836

Table 1: Natural gas balance in the period 2010-2017

In the total primary energy consumption in 2017, natural gas participates with 15.7%, and in the total consumption of final energy for energy purposes it is 11.3%.

Import of natural gas in 2017 was 2,183 million m<sup>3</sup>, covering 82.1% of gas in primary energy.

The domestic gas production delivered to the transport and distribution system of 377 million m<sup>3</sup> covered 15% of the consumed gas. Of that, 111 million m<sup>3</sup> was sold to other suppliers, and NIS a.d. which is the only gas producer, spent the rest for its own needs. The average daily production is 1.03 million m<sup>3</sup> and, according to NIS a.d. there is no possibility for additional production. Also, according to NIS a.d., the average daily demand for gas of the Pančevo Oil Refinery is 1.2 million m<sup>3</sup>, and the minimum daily value is 0.83 million m<sup>3</sup>. The produced natural gas is delivered to 11 points in the transport system and significantly smaller quantity (about 2% of production) is delivered to 4 points in the distribution system. Since 2012, the production has been declining and this trend is expected to continue.

In 2017, a total of 2,787 million m<sup>3</sup> was available from the import, domestic production and underground storage, of which 227 million m<sup>3</sup> were taken from the storage, and 240 million m<sup>3</sup> were deposited in the storage, 40 million m<sup>3</sup> were spent on losses in the networks, so 2.507 million m<sup>3</sup> of natural gas were delivered to consumers (Figure 1).

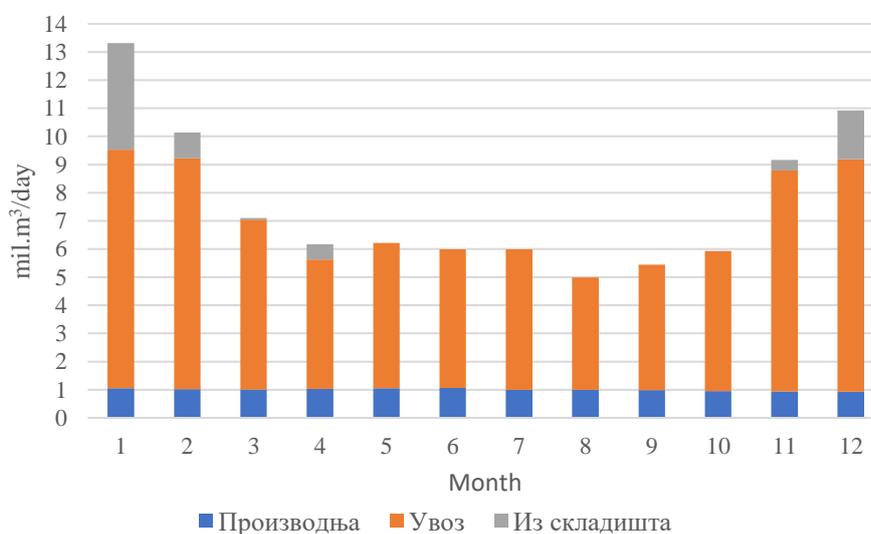


Figure 1: Acquisition of gas – average daily quantities in 2017.

The Law on Energy stipulates that from January 1, 2015 all final natural gas purchasers have the right to freely choose the supplier on the market.

Supply of natural gas is performed by 66 suppliers and 33 public suppliers.

In order to ensure the security of end-consumer supplies, it is stipulated that households and small customers whose all facilities are connected to the natural gas distribution system, if they do not choose another supplier, have the right to public supply, at regulated prices. Small customers of natural gas are end customers whose annual consumption of natural gas is up to 100,000 m<sup>3</sup> and whose all facilities are connected to a natural gas distribution system.

The end natural gas buyer has the right to spare supply, for a maximum of 60 days, which is not entitled to public supply in the event of bankruptcy or liquidation of a supplier who has supplied them until then, of termination or withdrawal of the supplier license, if they did not find a new supplier after the termination of the supply contract with the previous one, unless the termination of the contract is a consequence of buyer's failure to pay. On the basis of the conducted public tender procedure, the Government has determined the Public Enterprise "Srbijagas" for the supplier who will perform the reserve supply.

On the basis of the conducted public tender, the Government has designated the Public Enterprise "Srbijagas" for the supplier of public natural gas suppliers. The Law on Energy stipulates that until the establishment of a competitive natural gas market in the Republic of Serbia, the Government shall, on the basis of the conducted public tender procedure, determine the supplier who will supply the public natural gas suppliers, upon their request, under the same conditions and at the same prices.

More than 270,000 customers are connected to the gas pipeline system, of which 257,476 households.

In 2017, 269,010 end customers purchased gas in regulated market and 961 end customers purchased gas in free market.

The dominant supplier is Public Enterprise Srbijagas, which sells 80.1% of gas in end consumption and supplies 33.1% of end customers.

About 85% of gas is sold in the free market, and the rest to households and small customers at regulated prices.

599,045 or about 25% of the total number of households are connected to district heating. About 74% of the thermal energy in these systems is produced from gas.

The share of natural gas in electrical power production is small - less than 1% of electrical power is produced from natural gas.

Natural gas consumption in the Republic of Serbia is seasonally extremely uneven, due to the use of gas for heating, directly or indirectly through the heating plants.

A critical period in which security of supply can be significantly affected is during the winter months.

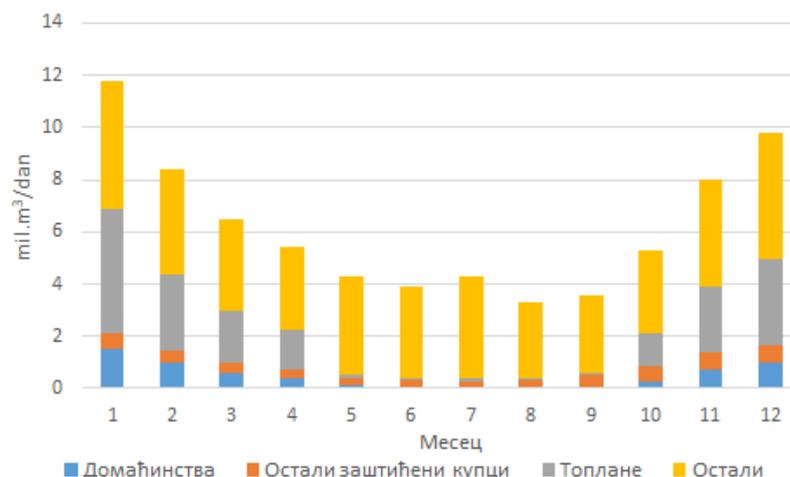


Figure 2: Structure of natural gas average daily consumption in 2017

Customers for whom a special regime of supply or protection should be provided, in cases where the security of gas supply is threatened (hereinafter referred to as: priority buyers) are: households; heat energy producers; customers who have their own consumption necessary for carrying out the activity of transport, distribution and storage of natural gas (preheating of gas at the main measuring station, compressor operation, etc.), customers who have their own consumption necessary for performing the activity of production and processing of natural gas,

oil and oil derivatives; hospitals, clinics, hospital and clinical centers, institutes, special medical institutions (emergency hospitals and other emergency health service institutions, blood transfusion centers, blood collection and processing centers and dialysis centers) and facilities and plants of manufacturers of medicines and sanitary materials; other health institutions in accordance with the Plan of the Health Institutions Network, which is adopted in accordance with the law; water supply and sewerage facilities; facilities for the production of basic food products (central bakeries, dairies and kitchens); units and institutions of the Ministry of Defense and the Army of Serbia; social welfare institutions for accommodation of users (institutions, centers, reception centers and shelters); correctional institutions, district prison, juvenile correctional centers and special prison hospitals; institutions in the field of pre-school, primary, secondary and higher education, student standard and sports; facilities in which the delivery of gas would cause permanent damage to production facilities; customers who have facilities for food production, except for central bakeries and kitchens.

Trends and factors in the consumption of natural gas that can have an impact on the conditions of supply in crisis situations are the following:

- heating plant consumption is highly dependent on winter outdoor temperatures, but without significant changes if it is reduced to average winter temperatures;
- variable consumption in households, dependent on winter outdoor temperatures and parity prices, but still lower than at the beginning of this decade;
- considerably lower consumption in industry in the last four years (with a slight growth), compared to the previous period;
- very variable non-energy consumption.

### 3. THE DEVELOPMENT OF THE GAS PIPELINE SYSTEM

The Energy Policy of the Republic of Serbia is determined by the Energy Development Strategy of the Republic of Serbia until 2025 with projections until 2030 ("Official Gazette of RS", No. 101/15) (hereinafter: Energy Strategy), and conditions, manner, dynamics and measures for the implementation of the Energy Strategy for the period 2017-2023 was determined by the Regulation on the Establishment of the Program for the Implementation of the Energy Development Strategy of the Republic of Serbia until 2025 with projections until 2030 for the period 2017-2023 ("Official Gazette of the Republic of Serbia" No. 104/17)

Based on natural gas consumption projections from the Energy Strategy, historical data and projections of users connected to the transport system, it is estimated that annual growth in natural gas consumption in the period 2017-2026 is 1.3%, with no significant changes expected in the structure of gas consumption. Also, it is assumed that peak daily consumption in the following years will be kept at the level reached in 2017, thanks in particular to measures for increasing energy efficiency.



Figure 3: Forecast for transported quantities of natural gas

Possible significant change in relation to these projections can be caused by the execution of the project for heating of Belgrade from the thermal power plant Nikola Tesla A, by the reconstruction of the thermal power plant, the construction of the Obrenovac-Belgrade heat pipeline and connecting it with the existing Belgrade heating system, which can reduce the annual consumption of heating gas by 120-150 million m<sup>3</sup> as of 2021.

Imported gas will have an increasing share in supply, as domestic production will continue to decline and it is expected that by 2026 the produced quantity sent to the gas system will be lower by about 25% than in 2017.

In order to ensure secure gas supply in the coming years, it is planned to build new capacities in the transport system, as well as to increase the gas storage capacity. New interconnective pipelines will overcome the biggest current problem - supplying gas through only one inlet gas pipeline. Some of these new interconnections are also in the function of gas transiting to other countries.

The project of expanding the capacities of the underground gas storage facility Banatski Dvor allows to increase the storage capacity from the existing 450 to 800 to 1000 million m<sup>3</sup>, the maximum technical capacity of withdrawing gas from 5 to 9.96 million m<sup>3</sup>/day and the injecting capacity from 2.7 to 5.52 million m<sup>3</sup>/day. The possible completion date is 2023. The investment value is estimated at EUR 65 million.

In the period until 2026, the following projects of interconnective pipelines are planned:

- Gas interconnection Republic of Serbia - Bulgaria, main gas pipeline MG-10 Niš - Dimitrograd (border with Bulgaria) provides natural gas supplies from the Russian Federation and other directions of supply: the so-called Southern Corridor (Republic of Azerbaijan, liquid natural gas from the terminal in the Republic of Greece, etc.). The annual capacity at the input / output point is 150 million m<sup>3</sup> in direction to Bulgaria and 1.800 million m<sup>3</sup> per year or 5.5 million m<sup>3</sup>/day in direction to the Republic of Serbia. The value of the investment in the Serbian part is EUR 85.5 million. This interconnection should be completed by 2022.

- Gas Interconnection Project Republic of Serbia - Romania, Mokrin-Arad gas pipeline (border with Romania) opens the possibility of purchasing natural gas from other sources (Romanian or gas from one of the planned trans-continental directions of supply). Also, this project significantly impacts the unloading of the main pipeline Horgos-Batajnica. The annual capacity at the inlet/outlet point is 1,600 million m<sup>3</sup> per year or 4.4 million m<sup>3</sup>/day. The value of the investment in the Serbian part is EUR 6 million. This interconnection could be completed by 2023.

- Gas Interconnection Project Republic of Serbia - Croatia, main gas pipeline MG-08 Homes (Futog) - Sotin (border with Croatia) creates the possibility of supplying natural gas

from North Africa from the Republic of Italy via the Republic of Croatia or from the proposed terminal for liquid natural gas in Republic of Croatia. The annual capacity at the inlet/outlet point is 1,500 million m<sup>3</sup> per year or 4.1 million m<sup>3</sup>/day. The value of the investment in the Serbian part is EUR 60 million. This interconnection could be completed by 2023.

- Gas Interconnection Projects Republic of Serbia - BiH and Republic of Serbia - Montenegro. The annual capacity at the inlet/outlet point towards Bosnia and Herzegovina is estimated at 1,200 million m<sup>3</sup> per year or 3,5 million m<sup>3</sup>/day. The construction cost is estimated at EUR 47 million. Completion is foreseen in 2026. Annual capacity at the inlet/outlet point towards Montenegro is estimated at 1,000 million m<sup>3</sup> per year or 2.7 million m<sup>3</sup>/day. The construction cost is estimated at EUR 60 million. Completion is foreseen in 2026.

Figure 4 shows the transport system "Transportgas Srbija" d.o.o. Novi Sad, including the aforementioned designed interconnective gas pipelines.



	Planned interconnection
	Existing gas pipeline – Transportgas Srbija
	Planned gas pipeline
	Existing gas pipeline - Yugarosgaz
	Future compressor station
	Storage Banatski Dvor

Figure 4: Transport gas pipeline system of Transportgas Srbija

#### 4. RISK ASSESSMENT OF THE HAZARDS FOR NATURAL GAS SUPPLY

The risk assessment carried out in accordance with internationally recognized standards is the starting point for determining possible preventive activities and the development of this plan in order to ensure the security of natural gas supplies to the Republic of Serbia market, that is, to priority buyers for which a special regime of supply or protection should be provided, in cases where the security of gas supply is endangered.

Analysis of the risk of occurrence of events that can significantly jeopardize the security of natural gas supply in the Republic of Serbia, scenarios that correspond to each of the observed risks (total 19 scenarios, marked 0 to 18), possible causes of occurrence of adverse events as well as possible responses to risks (ways of their reduction or elimination) are given in Table 2.

These causes of adverse events are the result of technical, political, social, information-management-communication, economic and natural factors and may arise as a result of disruptions to national infrastructure, supply or demand for natural gas.

Supply risks	Generated scenarios	Causes of risks (events and processes)	Possible response to a risk (mitigation modes)
Extreme consumption per day, week and month	0. Scenario of the highest consumption per day, week and month	Extremely cold weather combined with and without national holidays, a sudden steep rise in demand, the price of other energy products higher than the price of gas, interruption of electricity supply	Increase in withdrawal from gas storage, increased imports, transition from gas to heating oil, provision of several directions of supply, operational reserves of energy sources and strategic gas reserves
Decrease or termination of supply at the inlet in Horgos	1. Reduction of supply in Horgos by 50% during the highest consumption per day, week and month 2. Reduction of supply in Horgos by 75% during the highest consumption per day, week and month 3. Reduction of supply in Horgos by 100% during the highest consumption per day, week and month 4. Reduction of supply in Horgos by 50% during average consumption per day, week and month 5. Reduction of supply in Horgos by 75% during	Extremely cold weather in the region where the countries on the supply route take over part of the gas destined for the Republic of Serbia, sabotage on the domestic transport system in the interconnection zone or in one of the countries on the route, market disturbances, strikes in the gas sector, commercial and political disagreements among the countries on the supply route, changes in the direction of gas supply from the Russian Federation (disruption of supply through Ukraine), failure of the management system, floods, earthquakes, land shifts, greater	Increase in production from gas storage, switching from gas to heating oil, switching to supply with another supply route (in the future), securing more directions of supply, improving technical and physical security measures of the transport system (protection of the critical infrastructure), access to the free market, maintenance, advanced system design, cathodic protection, bypasses, minimum work contracts, the existence of the Computer Emergency Response Team and the identical maintenance team, operational reserves of energy sources and

	<p>average consumption per day, week and month</p> <p>6. Reduction of supply in Horgos by 100% during average consumption per day, week and month</p> <p>7. Reduction of supply in Horgos by 50% during the average consumption per winter day, week and month</p> <p>8. Reduction of supply in Horgos by 75% during the average consumption per winter day, week and month</p> <p>9. Reduction of supply at Horgos 100% during the average consumption per winter day, week and month</p>	<p>technical failure (leaks), technical obsolescence or poor maintenance</p>	<p>strategic gas reserves, redundant equipment</p>
<p>Termination of supply from gas storage</p>	<p>10. 100% disruption of supply from the storage during the highest consumption per day, week and month</p> <p>11. 100% disruption of supply from the storage during spending on the average day, week and month</p> <p>12. 100% disruption of supply from the storage during the consumption on the average winter day, week and month</p>	<p>Sabotage on the gas storage system, strike in the gas sector, failure of the management system, floods, earthquakes, land shifts, higher technical failure (cracks), technical obsolescence or poor maintenance</p>	<p>Transition from gas to heating oil, switching to supply with another supply line (in the future), providing more directions of supply, improving technical and physical security measures (protection of critical infrastructure), free market access, improved technical maintenance, improved system design, contracts on minimum work, the existence of the Computer Emergency Response Team and the identical maintenance team, operational reserves of energy products, redundant equipment</p>
<p>Decrease or termination of supply at the inlet in Horgos or termination of supply from gas storage</p>	<p>13. Reduction of supply in Horgos by 50% and termination of supply from storage by 100% on the average summer day, week and month.</p> <p>14. Reduction of supply in Horgos by 75% termination of supply from storage by 100% on the average summer day, week and month.</p> <p>15. Reduction of supply in Horgos for 100% termination of supply from storage by 100% on the average summer day, week and month.</p>	<p>Sabotage on the domestic transport system or gas storage, in the interconnection zone or in one of the countries on the route, market disturbances, strikes in the gas sector, commercial and political disagreements among the countries on the supply route, changes in the direction of gas supplies from the Russian Federation (interruption of supply through Ukraine ), failure of the management system, floods, earthquakes, land shift, greater technical failure.</p>	<p>Transition from gas to heating oil, switching to supply with another supply line (in the future), providing more directions of supply, improving technical and physical security measures (protection of critical infrastructure), free market access, improved technical maintenance, improved system design, contracts on minimum work, the existence of the Computer Emergency Response Team and the identical maintenance team, operational reserves of energy products, redundant equipment</p>
<p>Termination of supply due to compressor station defect</p>	<p>16. Termination of supply as a result of the failure of the compressor station during the highest consumption per day, week and month</p>	<p>Sabotage, strikes in the gas sector, failure of the management system, interruption in electricity supply, earthquakes, land shifts or other natural disasters, greater technical failure (leaks), technical obsolescence or poor maintenance</p>	<p>Transition from gas to heating oil, switching to supply with another supply line (in the future), providing more directions of supply, improving technical and physical security measures (protection of critical infrastructure), access to free</p>

			market, improved technical maintenance, improved system design, contracts about the minimum work, the existence of the Computer Emergency Response Team and the identical maintenance team, operational reserves of energy sources, the existence of reserve power supply, redundant equipment
Termination of supply at the point of the biggest outlet from the domestic production system	17. Termination of supply by 100% at the point of the biggest output from the domestic production system during the highest consumption per day, week and month 18. Termination of supply by 100% at the site of the largest outlet from the domestic production system during the average consumption on a winter day, week and month	Sabotage, strikes in the gas sector, failure of management systems, earthquakes, ground or other natural disasters, greater technical failure (leaks), technical obsolescence or poor maintenance	Increasing production from gas storage, construction of gas pipeline Banatski Dvor - Pančevo - Belgrade South, transfer from gas to heating oil, switching to supply with another supply route (in the future), providing more directions of supply, improving technical and physical security measures (protection of critical infrastructure ), access to the free market, advanced technical maintenance, improved system design, bypasses, minimum work contracts, the existence of the Computer Emergency Response Team and the identical maintenance team, operational reserves of energy products and strategic gas reserves, redundant equipment

Table 2: Risks for natural gas supply

Based on the risks and scenarios in Table 2, possible scenarios emerging as a combination of two events are also identified: simultaneous interruption of gas supply at the entry point in Horgos and termination of supply from the gas storage. These scenarios are numbered 13-15.

In the process of risk analysis, the present system of gas supply of the Republic of Serbia was considered, with the restriction of the analysis to its transport subsystem and its connection to the gas storage and production part, as a key to ensuring the security of supply.

Bearing in mind the context of functioning of the natural gas market (system) in the Republic of Serbia, i.e. its sensitivity to disruptions due to the existence of only one input, a gas storage facility and one compressor station, several scenarios involving similar risks are defined, but they can be distinguished by:

- the time in which they occur (the coldest days or days of maximum consumption, average winter days, average days, summer days, different volumes of working natural gas and the possibility of gas storage production),
- by intensity (capacity interruption of 50%, 75% and 100%) and
- simultaneous occurrence of two possible risks (causes).

Also, scenarios have been considered that include:

- projects for development and improvement of the gas infrastructure,
- different situations in which the market and the supply system can be found as a result of measures on the supply and demand side.

The previous was necessary for the purpose of evaluating the effects of possible preventive actions.

In accordance with the recommendation of the Joint Research Center (JRC) of the European Commission<sup>1</sup>, a 5x5 Risk matrix was adopted. In matrices, red fields have the meaning of high-risk scenarios (events), yellow fields mean medium risks, and green fields are low risk.

To quantify the likelihood and consequences of defined risk scenarios using the Closed Interval Technique, expert judgment and through possible calculations, risk ranges for the probability of the event (Table 3) and severity of consequences (Table 4) were adopted. The tables aim to enable the transition from qualitative (expert) estimates to quantitative values.

Tables were designed using the practice of EU Member States (Hungary, Republic of Greece, Republic of Poland, and Republic of Ireland) and the standard SRPS EN 16991: 2018<sup>2</sup>.

<b>Numeric value</b>	<b>Category</b>	<b>Description 1 (qualitative)</b>	<b>Description 2 (MTBE)</b>	<b>Description 3 (PoE in a year)</b>
<b>1</b>	Very possible	It will happen in near future	At least once a year	$>10^{-2}$
<b>2</b>	Possible	Similar events have been recorded in the majority of the systems in the gas sector	At least once in 1-5 years	$10^{-3}$ to $10^{-2}$
<b>3</b>	Probable	Similar events have been recorded in the gas sector	At least once in 5-25 years	$10^{-4}$ to $10^{-3}$
<b>4</b>	Little probable (not to be expected)	There are almost no examples in the gas sector	At least once in 25-100 years	$10^{-5}$ to $10^{-4}$
<b>5</b>	Rare (almost impossible)	There are no examples in the gas sector	Less than once in 100 years	$<10^{-5}$
Meaning of abbreviations: PoE – probability of an event MTBE – mean time between events				

Table 3: Scale (classification) of the probability of an event

The probability of individual scenarios is calculated according to API 581<sup>3</sup>, OGP Risk Assessment Data Directory<sup>4</sup> and Gas Pipeline Incidents Report<sup>5</sup>. Final values were adopted after expert examination and correction in accordance with SRPS EN 16991: 2018.

<b>Numeric value</b>	<b>Category</b>	<b>Description</b>
<b>5</b>	Insignificant	No special activity is required to maintain the usual (normal) state of security of supply
<b>4</b>	Moderate	The supply of all consumers can be provided with market measures. Possible minimum restrictions for non-priority customers.
<b>3</b>	Significant	Supply of priority customers can be 100% provided with market measures, with possible restrictions of up to 10 days

<sup>1</sup> Joint Research Centre Institute for Energy and Transport European Commission, JRC, „Best practices and methodological guidelines for conducting gas risk assessments”, Luxemburg, 2012

<sup>2</sup> SRPS EN 16991:2018 – Framework for control based on risk, identical to EN 16991:2018 (CEN/TC 319)

<sup>3</sup> API 581 - Risk-Based Inspection Technology

<sup>4</sup> OGP Risk Assessment data Directory, Report No. 434 – 1, 2010. International Association of Oil and Gas Producer

<sup>5</sup> Gas Pipeline Incidents Report, 9th Report of the European Gas Pipeline Incident Data Group (period 1970-2013.), Doc. Number EGIG 14.R. 0403, February 2015

		for non-priority customers. The application of the mandatory switch from gas to heating oil is possible.
<b>2</b>	Big	Supply of priority customers can be provided at the level of 90% -100% with market measures, with possible restrictions of up to 30 days for non-priority customers. The application of the mandatory switch from gas to heating oil is necessary. Additional gas imports are needed.
<b>1</b>	Disastrous	The supply of priority customers can not be ensured. All reduction measures must be applied. Additional gas imports are needed.

Table 4: Scale (classification) of the severity of consequences

The risk assessment for the gas supply system of the Republic of Serbia has the following elements:

- 1) a calculation with the N-1 formula for two cases: a) basic and b) priority customers and protected production,
- 2) real capacities of interconnections, storage and production,
- 3) the calculation of physical flows of gas by mass balance,
- 4) domestic production of gas and production of gas storage,
- 5) the role of gas in the energy mix of the Republic of Serbia,
- 6) several different high consumption scenarios and supply periods.

The above analysis was used to calculate a range of indicators that enabled the assessment of the impact of unwanted events on the supply of priority, industrial customers and electrical power supply systems. The consequences are calculated in two ways:

- 1) based on modeling and discrete simulation through the formula N-1 for priority customers and protected production, the results of which are expressed in percentages of meeting the demand of these categories and
- 2) on the basis of the total quantity of natural gas missing in the considered scenarios and at time intervals.

The values of the calculated indicators were used as the input for determining the class of consequences through Table 4.

These output indicators satisfy the condition of consistency and comparability, enabling the comparison of scenarios and possible preventive measures.

## 5. INFRASTRUCTURAL SUPPLY STANDARD

### 5.1. Infrastructural Standard

(N-1) indicator is used as a measure for assessing the security of natural gas supplies, that is, for ensuring and timely delivery of the necessary quantities of natural gas to customers. This indicator indicates the daily operational flexibility of the gas pipeline system and its ability to respond to consumption requirements under extreme conditions and is calculated as follows:

$$N - 1(\%) = \frac{Epm + Pm + Sm - Im}{Dmax} * 100$$

where:

Dmax - total daily demand for gas on the day of the highest demand for gas that statistically occurs once in 20 years [m<sup>3</sup>/day],

Epm - sum of technical capacities of all inputs from other transport systems [m<sup>3</sup>/day],

Pm - technical production capacity (total) [m<sup>3</sup>/day],

$S_m$  - the maximum technical capacity of the inlet from the underground natural gas storage [ $m^3/day$ ],

$I_m$  - the technical capacity of the largest input in the transport system [ $m^3/day$ ].

For the pipeline system, it is considered satisfactory, in terms of infrastructure from the standpoint of security of supply, if the capacities of the inlets to the transport system are such as to meet the total demand for natural gas and in case of interruption of the single largest infrastructure inlets into the transport system during the day with exceptionally large natural gas needs that are statistically occurring once in 20 years. This corresponds to the values (N-1) of the indicator greater than 100%.

The only and the largest relevant gas infrastructure in the Republic of Serbia is the cross-border connection with Hungary in the Kiskundorozsma. Of this capacity, 13 million  $m^3/day$  is available for the Republic of Serbia, and 2 million  $m^3/day$  is available for Bosnia and Herzegovina. The available (leased) interconnector capacities with Hungary for the needs of natural gas customers in the Republic of Serbia (11 million  $m^3/day$ , 90% utilization rate of the interconnector) enables annual imports of about 3.6 billion  $m^3$ , which is significantly more than 2.182 billion  $m^3$  imported in 2017, that is, 1.88 billion  $m^3$  of the average annual import in the period 2008-2016, but also more than the planned required quantities of natural gas annually until 2023. This data defines the parameter  $E_{pm}$ .

As the day of maximum consumption, which is defined as the day of exceptionally high demand, with a statistical probability of once in 20 years, for the needs of the development of this plan, was adopted on January 10, 2017, when the natural gas transport was 17.744 million  $m^3$ . The stated amount of natural gas also includes the amount of natural gas that is transported for the needs of Bosnia and Herzegovina, and after taking into account the forecasted gas consumption, for the needs of the development of this plan,  $D_{max}$  was adopted at 17.274 million  $m^3/day$ .

In accordance with the Energy Strategy, Energy Balance and data obtained from the only natural gas producer in the Republic of Serbia for the purpose of drafting this plan, it has been adopted that  $P_m$  - technical production capacity (total) is 0.745 million  $m^3/day$ . The technical production output is 1.737 million  $m^3$ , but production can not be further increased, even if it comes to crisis situations.

$S_m$  - the maximum technical capacity of the inlet from the underground natural gas storage is determined as the maximum (nominal) capacity of the gas storage facility Banatski Dvor and it amounts to 5 million  $m^3/day$ .

As the Republic of Serbia has only one point of inlet into the pipeline system, the  $I_m$  - technical capacity of the largest inlet in the transport system is equal to the volume of  $E_{pm}$ .

The results of the infrastructure standard calculation are given in Table 5. In the first three rows of the table, the calculations of the infrastructure standard for the current state of the gas pipeline system in the Republic of Serbia are presented.

In accordance with the above, the N-1 standard for the Republic of Serbia is 33.26% and is significantly under the required 100%, which clearly indicates that any and the least deviation from the normal conditions of the functioning of the gas pipeline system can cause serious consequences for the market supply.

	Development scenario 1	$E_{pm2,3}$	$P_m4$	$S_m8$	$I_m$	$E_{mnd}$	$E_{pmo5}$	$E_{pmru}$	$E_{pmh}$	$E_{pmb7}$	$D_{max6}$	N-1 (%)
1	Technical capacity	15	0.745	5	15	0	0	0	0	0	17.274	33.26
2	Possible technical capacity	13	0.745	5	13	0	0	0	0	0	17.274	33.26
3	Real capacity	11	0.745	5	11	0	0	0	0	0	17.274	33.26

4	Heat pipeline Obrenovac - Belgrade	11	0.745	5	11	0	0.75	0	0	0	17.274	37.60
5	Interconnector Niš - Dimitrovgrad	11	0.745	5	11	5.5	0	0	0	0	17.274	65.10
6	Phase II Banatski Dvor	11	0.745	10	11	0	0	0	0	0	17.274	62.20
7	Interconnector with Romania	11	0.745	5	11	0	0	3	0	0	17.274	50.63
8	Interconnector with Croatia	11	0.745	5	11	0	0	0	4.1	0	17.274	56.99
9	Interconnector with BiH or Montenegro	11	0.745	5	11	0	0	0	0	2.7	17.274	48.89
	Scenarios 4,5 and 6 cumulative	11	0.745	10	11	5.5	0.75	0	0	0	17.274	98.38
	Scenarios 4,5,6 and 7 cumulative	11	0.745	10	11	5.5	0.75	3	0	0	17.274	115.75
	Scenarios 4-9 cumulative	11	0.745	10	11	5.5	0.75	3	4.1	2.7	17.274	155.12

Table 5: Inputs and results of calculations of infrastructure standard

#### 5.1.1. Development scenarios

Possible projects (scenarios) whose construction significantly contributes to the provision and improvement of security of supply are:

- 1) Heat pipeline Obrenovac - Belgrade (in Table 5, designated as scenario 4).
- 2) Gas Interconnection Project Republic of Serbia - Bulgaria, main gas pipeline MG-10 Niš - Dimitrovgrad (border with Bulgaria) (in Table 5, designated as scenario 5).
- 3) The project for expanding the capacity of the underground gas storage facility Banatski Dvor (in Table 5, designated as scenario 6).
- 4) Gas Interconnection Project Republic of Serbia - Romania, Mokrin - Arad gas pipeline (border with Romania) In Table 5, designated as scenario 7.
- 5) Gas Interconnection Project Republic of Serbia - Croatia, main gas pipeline MG-08 Gospođinci (Futog) - Sotin (border with Croatia) In Table 5, designated as scenario 8.
- 6) Gas Interconnection Project Republic of Serbia -BiH and Republic of Serbia-Montenegro (in Table 5 designated as scenario 9), whereby a lower value was adopted for the cross-border capacity (interconnect to Montenegro).

Table 5 shows the indicator N-1 for each of the development scenarios (marked as 4 to 9) and the results show that the single largest contribution to the increase in the N-1 indicators comes from the interconnection project Niš-Dimitrovgrad with an increase of 65.10%. Following the size of the individual effects on the indicator N-1, the Phase II of Banatski Dvor project is increased to 62.20%. Other projects have a significantly smaller individual effect.

Table 5 also presents the analysis of the effects of project groups on the indicator N-1. The first group includes projects: Construction of interconnectors Niš-Dimitrovgrad, Phase II of Banatski Dvor and heat pipeline Obrenovac-Belgrade and their cumulative contribution to the indicator N-1 is 98.38%, which indicates that their implementation would not satisfy the infrastructure standard. When the interconnection project with Romania is added to this group of projects, the value of the N-1 indicator would be 115.75%, which clearly shows that the infrastructure standard can be fulfilled only with the execution of these four infrastructure projects. The execution of all these development projects would increase the value of the N-1 indicators to 155.12%.

Based on the previous, it can be concluded that safe supply of the Republic of Serbia market can only be provided by the execution of several infrastructure projects.

## 5.2. Supply standard

For the purpose of this plan, the starting point was the assumption that measures should be taken to ensure the delivery of natural gas to the priority customers in the following cases:

- 1) extreme temperatures during a seven-day peak period occurring with a statistical probability of once in 20 years;
- 2) for any period of at least 30 days of extremely high demand for gas, occurring with a statistical probability of once in 20 years;
- 3) a period of at least 30 days in case of interruption of one of the largest gas infrastructure, under average winter conditions.

For the purpose of this plan, the following relevant information was also taken into account:

- In the Republic of Serbia, extreme temperatures during the seven-day peak period coincide with the peak week of January 5-11, 2017.

- January 7, 2017 was taken as the coldest day, when 17,514 million m<sup>3</sup> of natural gas was transported, which is slightly less than the day with the highest consumption, that is January 10, 2017, when 17,744 million m<sup>3</sup> was transported (these volumes include transport for Bosnia and Herzegovina).

- For a period of at least 30 days of exceptionally high demand for gas, the period from January 1 to January 30, 2017 was taken, when the total consumption was 445,332,390 m<sup>3</sup>.

- Average winter conditions were determined on the basis of the winter months of 2017, when the consumption was 243.43 million m<sup>3</sup>.

19 different scenarios marked with numbers from 0 to 18 were considered, with the scenarios representing the detailed risk elaboration in Table 2.

To determine the probability of the occurrence of scenarios, the effect of several factors of different character was taken into account: technical, political, social, information-management-communication (including cyber), economic and natural.

Given that one of the factors that are almost everywhere appears as influential, the "technical" factor, it was taken as the basic, that is, the one that serves as a landmark in the later expert assessment of probability through Predefined interval technique. "Technical" failures are the result of primarily corrosion, erosion and cavitation occurring during the flow of fluid and the influence of the external environment. There is a limited number of data on failures on the transport system. The reason for this approach is that there are no statistics for other causes, except for the termination of supply from Ukraine, but this happened once in the 50 years of functioning of the gas pipeline system in the Republic of Serbia (the likelihood of a similar event would therefore be 1/50 years), which is a small value bearing in mind that the main gas pipeline can also fail for other reasons, including technical ones.

In order to calculate the severity of consequences of each of these scenarios, two groups of calculation were used. First, through the formula N-1 for priority customers and protected production (cumulative), for a day, a week, and a month, and the second group of calculation determining the "total quantity of natural gas missing" according to the scenarios and time intervals (day, week and month).

If the calculation through the N-1 formula for priority consumers and protected production (cumulative), for a day, a week, and a month yields a score greater than 100%, this means that within that scenario, their gas supply needs can be met and vice versa.

In terms of this plan, the production of the Oil Refinery in Pančevo is considered to be protected production, as it is not possible to produce larger quantities of heating oil which would substitute the need for natural gas without it. This is especially important in cases of serious disturbances in the market throughout the region, which would affect the increased

demand and a steep rise in prices for this energy source. The amount of gas that is minimum required for the operation of the refinery is set at 0.83 million m<sup>3</sup>/day, according to NIS (column RafP in the tables).

If, according to the calculation, the positive value of the parameters is "the total quantity of natural gas missing", the market needs are considered satisfied and vice versa.

Based on the specific combination of data on meeting the demand of protected customers and production and the overall market needs by comparison with the criteria in Table 3, the level, or the category or criticality of the consequences, is determined.

### 5.3. Group of scenarios "Market Disruption without Applying Measures"

As the starting point for the development of this plan, the calculation for the group of scenarios "Market Disruption without Applying Measures" was used, which implies the occurrence of disruptions in the natural gas market of the Republic of Serbia without the application of any measures to reduce the risk of their occurrence and was used for comparison with groups of scenarios with the application of measures.

The following applies to this scenario and to all of the following:

- The natural gas supply disruption scenario at Horgos with the simultaneous disruption of supply from the Banatski Dvor underground storage has not been considered during the winter months, since such a scenario may be considered worse than the worst case scenario and certainly belongs to a group of high-risk, but almost impossible.

- The installed capacity of pumping natural gas from Banatski Dvor is 3.6 million m<sup>3</sup>, since the worst case is assumed when the storage is empty. Higher capacities of up to 4.2 million m<sup>3</sup> do not change the character of the results, and it is important to note that in 2016 and 2017, the maximum quantities withdrawn per day were approximately 5 million m<sup>3</sup>.

- The adopted consumption of the Oil Refinery Pančevo is 0.83 million m<sup>3</sup>/day, which is its technological minimum. In the period 2015-2017, this refinery consumed 0.667 million m<sup>3</sup>/day on average.

The results of the "Market Disruption without Applying Measures" scenario group are presented in the Risk Matrix 1.

		Озбиљност последица					Вероватноћа
		Незнатне	Осетне	Значајне	Знатне	Катастрофалне	
Вероватноћа	Врло могуће	High risk	High risk	High risk	High risk	High risk	
	Могуће	High risk	High risk	High risk	High risk	High risk	
	Вероватно	Low risk (C4)	Medium risk (C5, C7)	Medium risk (C0, C16)	High risk (C8, C6)	High risk (C1, C2, C3, C9)	
	Мало вероватно	Low risk (C11, C18)	Low risk (C12)	Medium risk (C17)	Medium risk (C10)	High risk	
	Ретко	Low risk	Low risk	Low risk (C13)	Medium risk (C14)	Medium risk (C15)	
		Незнатне	Осетне	Значајне	Знатне	Катастрофалне	

■ High risk    
■ Medium risk    
■ Low risk

Risk matrix 1 - Market Disruption without Applying Measures

Six possible scenarios carry catastrophic consequences (Matrix 1, high risk fields). The supply interruptions at Horgos of 75% and 100% certainly lead to consequences when even the needs of the priority buyers cannot be satisfied. Five scenarios carry a small risk (Matrix 1, low risk fields) and are related to conditions when consumption is average. In all other scenarios, industry and other non-market customers will be subject to restrictions.

#### 5.4. Group of scenarios "Market Disruption with Applying Market Measures"

In order to ensure the supply to natural gas market, a number of market measures can be applied: a) increasing the flexibility of gas production, b) increasing import flexibility, c) increasing commercial gas reserves, d) increasing the capacity of gas infrastructure, e) diversifying sources of supply, f) interconnectors with return flow, g) short-term and long-term contracting, h) replacement of natural gas with other energy sources, especially from renewable sources, i) increase of energy efficiency, j) smart metering, k) voluntary customer disclaimer of consumption.

In the case of the Republic of Serbia, it is possible to apply the following measures:

- replacement of natural gas with heating oil;
- interruption of supply under "discontinuous supply contracts";
- increase of import flexibility;
- increase of commercial gas reserves;
- increase of the capacity of the gas infrastructure;
- diversification of sources of supply;
- interconnectors with return flow and
- long-term contracting.

Significant contributions can not yet be expected from the measures such as: increasing energy efficiency, a system of voluntary customer disclaimer of consumption or a higher share of renewable energy sources.

The supply regime, which currently applies in relations with the Russian partner, provides some benefits because it includes the maximum available daily natural gas quantities and the minimum daily natural gas quantity that must be taken, but there is a limit in transportation through Hungary.

The measure "increase in commercial gas reserves" in the Republic of Serbia can be implemented through the formation of Mandatory Natural Gas Reserves in accordance with Article 346 of the Law on Energy.

The effect of the interruption of supply under the "discontinuous supply contracts" in the Republic of Serbia in the current conditions is about 220,000 m<sup>3</sup> per day.

Measures of substitution of natural gas with heating oil in the case of the Republic of Serbia can be both market and non-market. Substituting natural gas with heating oil as a market measure is possible if the Government, in the event of a crisis, adopts measures: a) the reduction of the VAT on heating oil or otherwise determines the price of heating oil equivalent to natural gas, b) determine the price equivalent to the heating oil price in commodity reserves and place it in the market and c) take measures or determine the sources of compensation for damage that may arise for energy entities that take gas substitution measures in accordance with Article 319 of the Law on Energy.

There are 57 plants within the Serbian Heating Plant Association, of which 30 use natural gas as fuel. The district heating systems are divided into those that have the ability to switch to alternative fuels and those without this option. The estimate for October to June is based on average annual consumption. Technically, the possibility of gas substitution is estimated at 86-96.1 million m<sup>3</sup>/month. The previous refers to the substitution that can be achieved by the heating plants in changing the fuel for the production of heat energy. For the

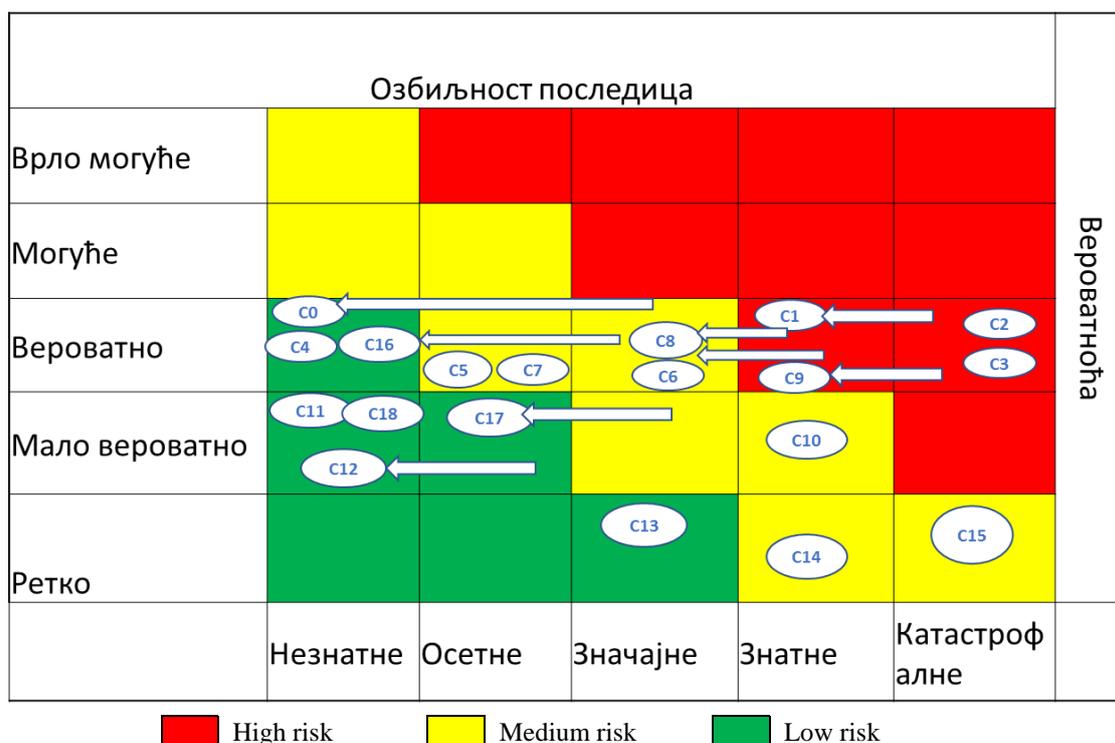
needs of the development of this plan, it was estimated that the volume of the possible substitution is 2.5 million m<sup>3</sup>/day.

Reserves of heating oil in the Republic Directorate for Commodity Reserves is equivalent to 6 to 42 million m<sup>3</sup> of natural gas or 0.2 to 1.4 million m<sup>3</sup>/day.

Article 345 of the Law on Energy stipulates that energy entities must keep operating reserves equal to 15 day consumption of derivatives, and therefore heating oil, and that heat producers are obliged to ensure operational reserves of natural gas, petroleum and/or coal derivatives in the amount that will allow at least 15 days of their average production of electrical power and/or heat in January, February and March in the previous five years.

In case of endangered supply, a substantial volume of natural gas can be substituted with heating oil in the amount up to 2.5 million m<sup>3</sup> of gas/day. This measure has been adopted as possible and necessary, although its effects on the environment are not favorable and it needs to remain in force in the event of a crisis situation until the corresponding missing gas infrastructure is built.

The results of the calculation of the scenario "Market Disruption with Applying Market Measures" with the application of measures of substituting gas with heating oil and termination of delivery under "discontinuous supply contracts" are presented in the Risk Matrix 2.



Risk matrix 2 - Market Disruption with Applying Market Measures

In this case, the eight scenarios move to lower risk categories, i.e. the application of market measures has certain effects (marked by arrows). Four scenarios (two less than a basic scenario) carry catastrophic consequences (Matrix 2, high risk fields). Supply interruptions in Horgos from 75% and 100% continue to result when even the needs of priority customers can not be met. Eight scenarios carry a small risk (Matrix 2, low risk fields) and are related to conditions in which consumption is average (one more than the baseline scenario). In all other scenarios, industry and other non-market customers will be subject to restrictions.

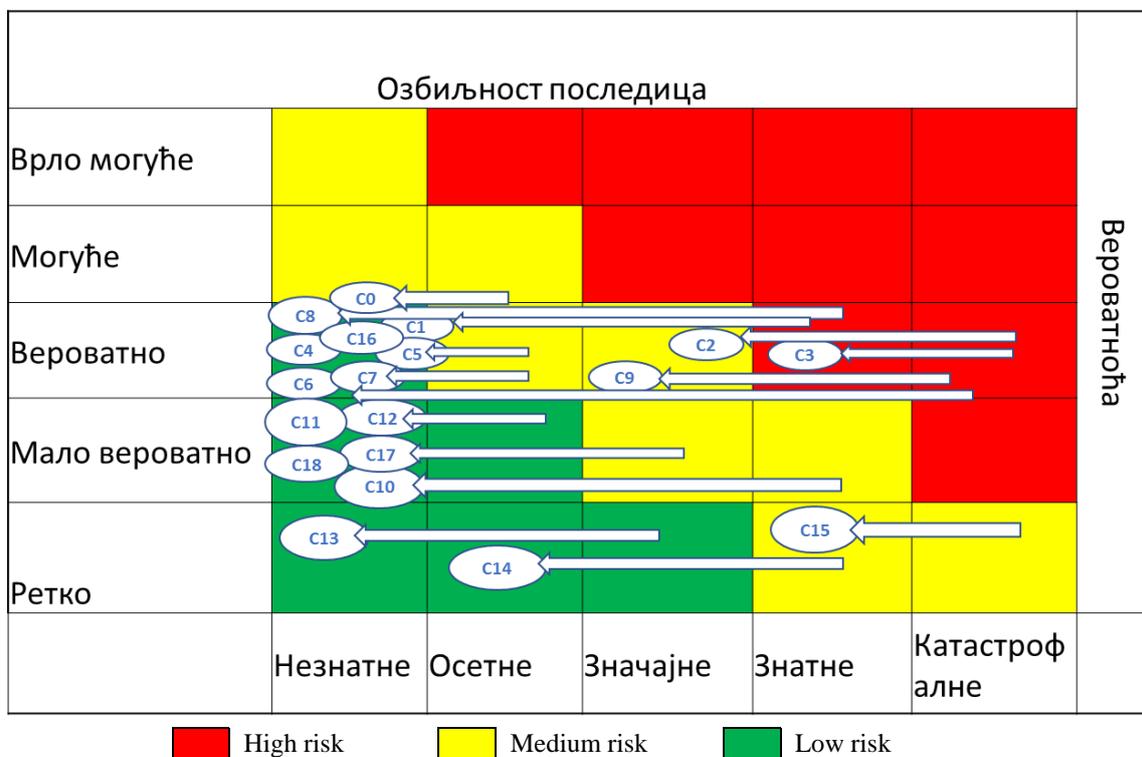
### 5.5. Non-market measures

In order to ensure the supply of natural gas to the market in the event of a crisis in the Republic of Serbia, non-market measures can be applied: the use of strategic natural gas reserves, obligatory substitution of natural gas by other energy products, obligatory withdrawal of natural gas from the storage, and various types of obligatory reductions of consumption or termination of natural gas supply.

### 5.6. Assessment of the effects of development scenarios on security of supply

#### 5.6.1. Group of scenarios "Market Disruption with the Application of Market Measures and the Construction of Interconnective Gas Pipeline Niš - Dimitrovgrad"

Results of the calculation of the group of scenarios "Market Disruption with the Application of Market Measures and the Construction of Interconnective Gas Pipeline Niš - Dimitrovgrad", which implies the event of disruptions in the market of the Republic of Serbia with the application of measures of substitution of gas with heating oil and interruption of deliveries under "discontinuous supply contracts" in case of building an interconnective gas pipeline Niš-Dimitrovgrad are presented in the Risk Matrix 3.

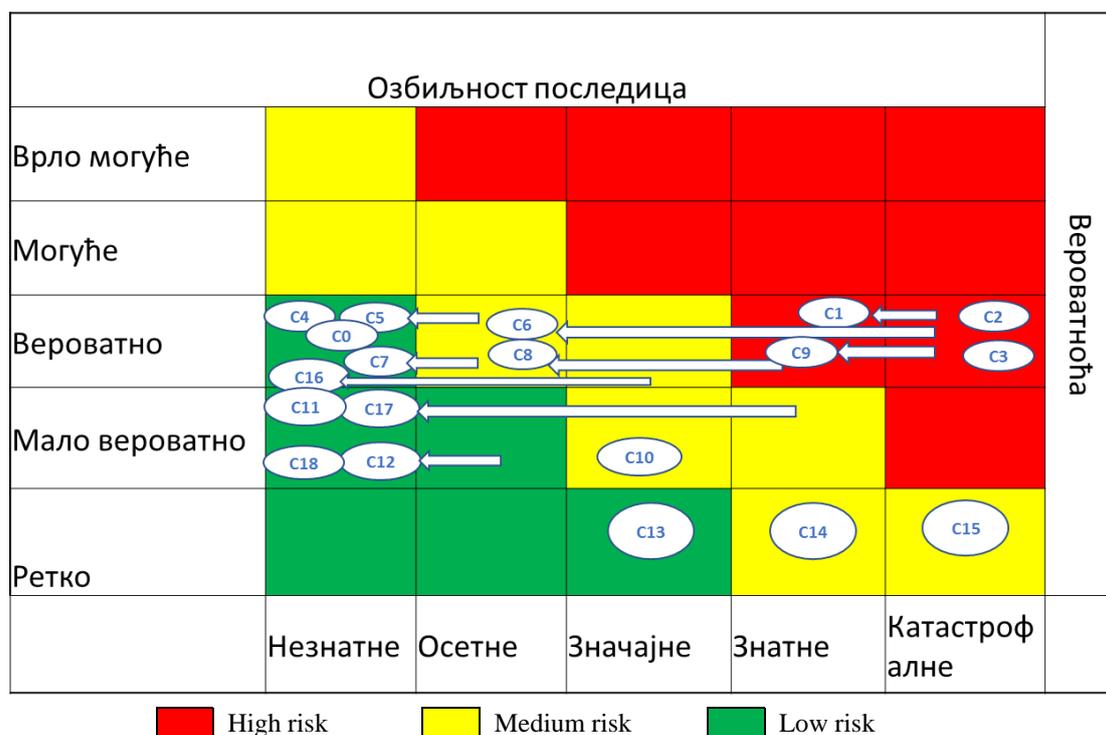


Risk matrix 3 - Market Disruption with the Application of Market Measures and the Construction of Interconnective Gas Pipeline Niš - Dimitrovgrad

In this case, 15 scenarios move to lower risk categories, i.e. the application of market measures together with building the interconnective gas pipeline Niš - Dimitrovgrad can have significant effects (marked by arrows). Only one scenario (five less than the baseline scenario) carries a serious risk (Matrix 3, high risk areas) and endangers the supply of priority customers. This is in the case of a breakdown of supply in Horgos at 100% in the period of the highest demand. Fourteen scenarios carry a small risk (Matrix 3, low risk fields) and are related to conditions where consumption does not peak. In only five scenarios, the industry and other non-market customers will be subject to restrictions (Matrix 3, low and medium risk fields).

5.6.2. Group of scenarios "Market Disruption with the Application of Market Measures with the Construction of Heat Pipeline Obrenovac - Belgrade"

Results of the calculation of the group of scenarios "Market Disruption with the Application of Market Measures with the Construction of Heat Pipeline Obrenovac - Belgrade", which implies the occurrence of disturbances in the market of the Republic of Serbia with the application of measures of substitution of gas with heating oil and interruption of deliveries under "discontinuous supply contracts" in case of building the Obrenovac - Belgrade heat pipeline are presented in the Risk Matrix 4.

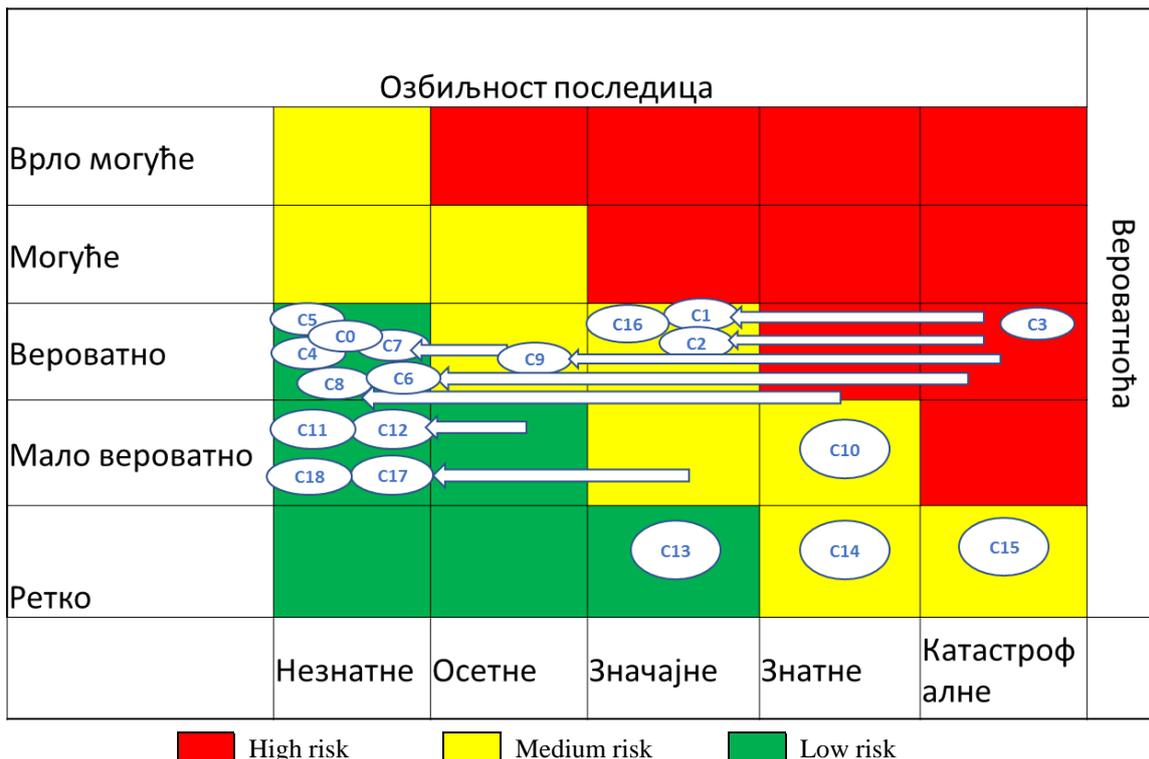


Risk matrix 4 - Market Disruption with the Application of Market Measures with the Construction of Heat Pipeline Obrenovac - Belgrade

In this case, nine scenarios move to lower risk categories, that is, the application of market measures with the construction of Obrenovac - Belgrade heat pipeline can have significant effects (marked by arrows). Four scenarios (two less than the baseline scenario) carry significant risks (Matrix 4, high risk areas) and endanger the supply to priority customers. This is in the case of supply interruption at Horgos by 50%, 75% and 100% in the period of highest demand. Ten scenarios carry a small risk (Matrix 4, low risk fields) and are related to conditions in which consumption is average (five more than the baseline scenario). In only nine scenarios, the industry and other non-market customers will be subject to restrictions (Matrix 4, high and medium risk fields).

5.6.3. Group of scenarios "Market Disruption with the Application of Market Measures with the Construction Phase II of the Gas Storage Facility Banatski Dvor"

Results of the calculation of the group of scenarios "Market Disruption with the Application of Market Measures with the Construction Phase II of the Gas Storage Facility Banatski Dvor", which implies the occurrence of disturbances in the market of the Republic of Serbia with the application of the measure of substitution of gas with heating oil and interruption of deliveries under "discontinuous supply contracts" in case the second stage of the development of gas storage Banatski Dvor are presented in the Risk Matrix 5.



Risk matrix 5 - Market Disruption with the Application of Market Measures with the construction Phase II of the gas storage facility Banatski Dvor

In this case, the eight scenarios move to the lower risk categories, and the application of market measures with the construction of Phase II of the gas storage facility Banatski Dvor can have significant effects (marked with arrows). Only one scenario (five less than the baseline scenario) carries significant risks (Matrix 5, high risk field) and endangers the supply of priority customers. This is in the case of a breakdown of supply at Horgos at 100% in the period of the highest demand. Eleven scenarios carry a small risk (Matrix 5, low risk fields) and are related to conditions where consumption is average (six more than the baseline scenario). In only eight scenarios, the industry and other non-market customers will be subject to restrictions (Matrix 5, high and medium risk fields). With this measure, it is not possible to eliminate the risks in case of interruption of delivery from the storage Banatski Dvor.

5.6.4. Group of scenarios "Market Disorder with the Application of Market Measures with the Cumulative Effect of all Projects"

Results of the calculation of the group of scenarios "Market Disorder with the Application of Market Measures with the Cumulative Effect of all Projects", which implies the occurrence of disturbances on the market of the Republic of Serbia with the application of measure of gas substitution with heating oil and interruption of deliveries under "discontinuous supply contracts" in case of executing all projects referred to in item 5.1.1. presented in the Risk Matrix 6.



Regulation on the establishment of the Program for the implementation of the Energy Development Strategy of the Republic of Serbia by 2025 with projections until 2030 for the period from 2017 to 2023;

- 2) establishment of operational reserves of energy products in accordance with Article 345 of the Law on Energy;
- 3) ensuring required natural gas reserves in accordance with Article 346 of the Law on Energy;
- 4) establishing regional cooperation in crisis situations.

The implementation of these measures also increases the security of supply of transit routes to Bosnia and Herzegovina and improves the security of supply of natural gas throughout the region.