REPUBLIC OF SERBIA

SECURITY OF SUPPLY STATEMENT

Year 2021

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ABBREVIATIONS

AERS	-	Energy Agency of the Republic of Serbia
APKM	-	Autonomous Province of Kosovo and Metohija
ECS	-	Excavator Conveyor Stacker System
CESEC	-	Central and South Eastern Europe Connectivity
CHP	-	combined heat and power plant
EMS JSC	-	Joint Stock Company "Електромрежа Србије" Belgrade
DSO	-	distribution system operator
ELV	-	emission limit values
EnC	-	Energy Community
EU	-	European Union
GMRS	-	main gas pressure regulating and metering station
HPP	-	hydro power plant
IEI	-	energy intensity index
JSC		joint stock company
MB	-	mine basin
MG	-	main gas pipeline
NERP	-	National Emission Reduction Plan
OHL	-	overhead line
OPGW	-	Optical Power Ground Wire
OTS	-	transport system operator
PCI	-	European Commission Projects of Common Interest
PE	-	public enterprise
PECI	-	Projects of Energy Community Interest
PMI	-	Projects of Mutual Interest
PPS	-	handover station
PS	-	petrol stations
PSP	-	pumped storage plant
PSHPP	-	pumped storage hydro power plant
RMC	-	remote, monitoring and control system
RS	-	Republic of Serbia
SBRA	-	Serbian Business Registers Agency
SCADA	-	Supervisory Control and Data Acquisition
SEEPEX	-	South-eastern European Power Exchange

SFO - natural gas storage facility operator
SS - switching station
TPP - thermal power plant
TPPNT - Thermal Power Plant Nikola Tesla
TS - transformer station
TSO - transmission system operator
UGSF - underground gas storage facility
WB6 - Western Balkan Six
WBIF - Western Balkan Investment Framework project list

1. INTRODUCTION

1.1. Legislative and Regulatory Framework of the Energy Sector

The basic legal and strategic documents which regulate the operation of the energy sector and define and implement the energy policy:

- Energy Law,
- Energy Sector Development Strategy of the Republic of Serbia,
- Program of the Energy Development Strategy of the Republic of Serbia, and
- Energy Balance of the Republic of Serbia.

These documents define the general objectives in terms of security of supply of market with energy and energy sources, and certain guidelines and frameworks for the adoption of other acts that further and closer define this issue.

Energy Law (Official Gazette of the RS, No. 145/2014, 95/2018) [1], among others, regulates:

- energy policy objectives and manner of its implementation,
- conditions for reliable, secure and high quality supply of energy and energy sources for a secure customer supply,
- energy and energy sources customer protection, conditions and manner of performing energy activities,
- conditions for the construction of new energy facilities,
- status and scope of the Energy Agency of the Republic of Serbia,
- organization and functioning of the electricity, natural gas, petroleum and petroleum products markets,
- the rights and obligations of participants in the market,
- establishment of ownership on the network operator systems,

Energy policy of the Republic of Serbia shall be diluted and implement using Energy Sector Development Strategy of the Republic of Serbia (hereinafter referred to as Stategy), Program of the Energy Development Strategy of the Republic of Serbia (hereinafter referred to as Program) and Energy Balance of the Republic of Serbia (hereinafter referred to as Energy Balance).

The Strategy is a document that outlines the energy policy and planning of energy sector development. Strategy is adopted by the National Assembly of the Republic of Serbia at the proposal of the Government of the Republic of Serbia (hereinafter referred to as Goverment) for a period of at least 15 years. The Ministry in charge of energy prepare a report every year for the Government on the realization of the Strategy.

Program defines the conditions, manner, dynamics and measures for the implementation of the Strategy. The program is adopted by the Government, for a period of up to six years on the proposal of the Ministry in charge of energy. The Ministry in charge of energy monitors the achievement of the Program and, if necessary, propose its adjustment to the actual needs at least every other year. The Government submits to the National Assembly an annual report on the Strategy and Program implementation, which comprises: the results accomplished against the objectives set by the Strategy, or the Programme for the year in which the annual report on the Strategy and Program is being submitted; estimated effects of the achieved results and their impact on the Program in the upcoming year; a proposal of measures for a more efficient Strategy and Program implementation; estimated needs for adjusting the Program and possible

Strategy adjustment to the actual needs. Government in accordance with the Strategy and Program brings national action plans that more closely define development objectives and measures for their implementation.

Energy Sector Development Strategy of the Republic of Serbia for the period 2015-2025 with projection up to 2030 was adopted in 2015 (Official Gazette of the RS, No. 101/2015) [2], and the passing of Program of the Energy Development Strategy of the Republic of Serbia until 2025 with Projections to 2030 for the period 2017 to 2023 was adopted in 2017 (Official Gazette of the RS, No. 104/2017) [3].

Energy Balance determines the annual need for energy and energy sources (expressed on a monthly basis), which is necessary to provide for the reliable, safe and quality supply of customers. It also emphasizes the rationality of energy consumption and energy optimization of resources and the required amount of energy, and energy sources, defines the required level and structure of energy stocks and spare capacity. Required contents of the Energy Balance are: balances of electricity, coal, oil, oil products and biofuels, natural gas, thermal energy and renewable energy. Government brings the Energy Balance on proposal of the Ministry in charge of energy, by the end of December of the current year for the following year. The Ministry in charge of energy monitors the implementation of the Energy balance, analyze its performance in the previous year and, if necessary, propose to the Government measures to ensure its implementation.

Ministry in charge of energy monitors the implementation of the National Action Plan For Renewable Energy and every two years submit a report about that to the Government.

The Law on Amendments to the Law on Energy[1] has been adopted during 2021, which provides additional harmonization of domestic regulations with the regulations of the European Union, as well as eliminating the shortcomings that were noticed in the application of the previous Law on Energy. The news brought by the new Law in the field of electricity, natural gas and oil and oil derivatives are presented within each sector separately.

With the Law on the Use of Renewable Energy Sources, the Republic of Serbia has harmonized its regulations with the new EU directives in this area. The aim of enacting this law is to achieve energy savings, security of energy supply, reduce the impact of the energy sector on the environment and climate change and contribute to the sustainable use of natural and other resources. The bill, among other things, envisages the establishment of the Administration for Financing and Encouraging Energy Efficiency within the Ministry of Mining and Energy instead of the current Budget Fund for Improving Energy Efficiency. The establishment of the Administration will also enable the attraction of EU grants, as well as the funds of international financial institutions in order to increase energy efficiency. It is especially important that the funds will be available to citizens.

The Law on the Use of Renewable Energy Sources introduces auctions for the award of premiums for the construction of wind and solar power plants, creates conditions for the development of the renewable energy market, and enables citizens and companies to produce electricity for their own consumption and become prosumers.

1.2. Institutional Framework Governing the Energy Sector

The institutional framework for the energy sector is determined by the Constitution, the Energy Law [1] and Law on Ministries [4].

In the energy sector of the Republic of Serbia, the jurisdiction primarily have:

[1] The Law on Amendments to the Law on Energy, Official Gazette of the RS, no. 40/2021

- The Government of the Republic of Serbia,
- Ministry in charge of energy and
- Energy Agency of the Republic of Serbia.

The Government of the Republic of Serbia prescribes conditions for delivery and supply of electricity, oil and natural gas, as well as measures to be taken in the event of an endangered security of energy and energy sources supply due to disturbances in the power system or the energy market. The Government adopts the Preventive Action and Contingency plan, in order to ensure safety of natural gas supply. Preventive Action plan contains a risk assessment in terms of achieving security of supply, as well as measures to mitigate the identified risks related to the required transportation capacity in order to meet the total demand for natural gas and to secure the supply of certain groups of final customers of natural gas. The Contingency plan determines measures, energy service companies which will be responsible for ensuring the security of the transmission system and the security of supply of certain groups of end customers, the quantity and capacity of natural gas in case of general shortage of natural gas. In case of compromised security of customer supply or energy system, due to insufficient offer in the energy market or the occurrence of other extraordinary circumstances, the Government provides measures and limits the supply of electricity or natural gas. The Government can also provide special conditions for the import or export of certain types of energy, method and conditions for determination and price control, obligation to supply only certain customers or special conditions for energy activities with minimal disruption of the energy market in the region. If the safety of the supply is endangered because of the lack of oil offer in the energy and energy source market or because of the occurrence of other extraordinary circumstances, the Government can approve amendment of the limits of certain characteristics of petroleum products quality that can be put on the market of the Republic of Serbia for a period not exceeding six months.

Ministry in charge of energy performs state administrations related to: energy, energy policy and planning of energy development in the field of electricity, natural gas, oil and oil derivatives, the energy balance of the Republic of Serbia, the oil and gas industry, strategy and policy of energy security, development of annual and medium-term programs of energy security and providing material and other conditions for the implementation of these programs, mandatory and other reserves of energy sources, safe pipe transport of gaseous and liquid hydrocarbons, manufacturing, distribution and supply of thermal energy, rational use of energy and energy efficiency, renewable energy, environmental protection and climate change in the field of energy, coordinating activities in connection with investments in the energy sector, as well as other duties specified by law.

Energy Agency of the Republic of Serbia (AERS) was established in June 2005, on the basis of the Energy Law 84/04. Position, operating mode and activities of AERS are regulated by the Energy Law (Official Gazette of the RS, No. 145/2014) [1]. AERS is the only regulatory body for energy sector and was established in order to promote and direct the development of the electricity and natural gas market on the principles of non-discrimination and effective competition, through the creation of a stable regulatory framework, as well as to perform other tasks established by the mentioned law. AERS is an independent legal entity and independent from the executive authorities in performing their duties, as well as from other state agencies and organizations, legal entities and individuals engaged in the energy industry. Members of the Council are elected by the National Assembly, thus acquiring independence in decision-making from its purview.

The Energy Law [1] regulates the tasks performed by AERS. In performing these tasks AERS take measures that, among other things, contribute to achieving the following objectives: ensuring secure supply of energy through efficient operation and sustainable development of the energy system, in accordance with the energy policy of the Republic of Serbia, including

environmental protection and the development of renewable energy sources; the development of the electricity market in the Republic of Serbia and its integration into the regional and pan-European electricity market. Also, AERS gives approval to market and technical rules, system development plans, brings the methodology for determining the price for access to the transmission or distribution of electricity, rates of access to transport, distribution and storage of natural gas, prices for guaranteed electricity supply and prices for natural gas public supply, and the cost of access to the system of oil transport pipelines and systems for the transportation of oil derivatives.

Local self-government units also have a specific role in the implementation of energy policy, which is defined through the institutional framework of the Republic of Serbia. Article 361 of the Energy Law [1] defines that local self-government units on their territory may establish an energy entity for performing the activity of thermal energy production, distribution and supply to customers, where the act on association shall determine the conditions and manner of performing each of these activities. It implies that founding act must be in accordance with the Energy Law and other acts from the institutional framework of the Republic of Serbia for energy sector.

1.3. Working Group on Security of Supply

Since 2005, the competent Ministry in charge of energy sector introduced the practice of forming Working Group to review and monitor the situation regarding security of energy and fuels supply in the Republic of Serbia. The main task of the Working Group is monitoring the situation regarding reliable and optimal supply of energy market. The working group is formed by a decision issued by the Minister in charge of energy. Meetings are held on a monthly basis during the hole year and more often, if it is necessary, depending on the situation.

Task of the Working Group is consideration and monitoring security of energy and energy sources supply, proposing appropriate measures, preparing the basis for a report on the security of electricity and natural gas supply and proposing measures in case the compromised security of customer supply or energy system operation, due to insufficient offer on the energy market or the occurrence of other extraordinary circumstances.

Working Group members are representatives of Ministry in charge of energy, "JP Elektroprivreda Srbije Beograd" (PE EPS), "Elektrodistribucija Srbije d.o.o. Beograd" (Elektrodistribucija Srbije), "Elektromreža Srbije a.d. Beograd" (EMS JSC), "JP Srbijagas Novi Sad" (PE Srbijagas), "Naftna industrija Srbije a.d. Novi Sad" (NIS JSC), Serbian Association of heating plants, Provincial Secretariat for Energy and Mineral Resources, Energy Administration of the Belgrade city, AERS and "JKP Beogradske elektrane Beograd".

Energy entities deliver Reports on activities for the Working Group meetings which contain information on the operation of the energy sector, their operating status and readiness, actual and potential problems, as well as projections for the next period (30 days).

1.4. Other Important Acts for the Functioning of the Energy Sector

1.4.1. Ordinance on Terms of Energy Supply

Ordinance on Conditions for Delivery and Supply of Electricity (Official Gazette of the RS, No. 63/2013, 91/18) [5] shall regulate more specific terms of energy supply, as well as the measures taken in case the security of energy supply has been jeopardized due to the functional disruption of the energy system or the disruption in the energy market in the Republic of Serbia, namely:

- Terms and procedure of granting approval for connection to the electric energy transmission or distribution systems,

- Measures to be undertaken in case of short-term disruptions caused by breakdowns and other unforeseen circumstances whereby safety of the energy system operation is jeopardized, as well as due to unforeseen and necessary works on maintenance of electric power facilities and required works on the expansion of the electric power system, and also other terms and measures for the purpose of supplying customers with electric energy,
- Measures to be undertaken in the case of a general electric power shortage, terms and conditions for undertaking measures and the schedule of restricting energy supply, as well as measures of energy saving and rational consumption in case of a general energy shortage,
- Terms and conditions of electricity supply suspension, as well as the rights and obligations of system operators, suppliers, or the public supplier and final customers,
- Terms and conditions for rational use of energy and energy saving,
- Method of calculation of unauthorized take-off of energy,
- Terms and conditions for the supply of electricity to customers,
- Terms and manner of fulfilling responsibilities of the supplier and public supplier.

1.4.2. Ordinance on Terms of Natural Gas Supply

Ordinance on Terms of Natural Gas Delivery and Supply (Official Gazette of the RS, No. 47/06, 3/10 and 48/10) [6] presents detailed terms of delivery and supply of natural gas, as well as measures to be taken in case of failing safety of natural gas delivery and supply to end-users due to disruptions in transmission or distribution system operation, or disturbances in the natural gas market in the Republic of Serbia, as follows:

- Conditions and procedure of granting approval for connection to the transmission or distribution system of natural gas,
- Measures to be taken in the event of short-term disruptions caused by failures and other unforeseen circumstances which threaten the safety of transportation, and natural gas distribution system, as well as the necessary maintenance of energy facilities and required works on the upgrade of the system, as well as other conditions and measures for supplying customers with natural gas;
- Measures to be taken in case of general shortage of natural gas, due to the circumstances referred to in Article 164 of the Energy Law [1],
- Conditions and methods of the suspension of natural gas supplies,
- Conditions and rational use of energy and saving natural gas,
- Terms and methods of measures and schedule constraints of natural gas supply, as well as measures for saving and rational use in case of general shortage of natural gas,
- Conditions of supplying privileged end-users' facilities to whom cannot be suspended supply due to outstanding liabilities for delivered natural gas or in other cases,
- Method of regulating relations between the supplier and the end-user to whom cannot be suspended natural gas supply,
- Method of measuring natural gas quantities,
- Calculating method for unauthorized natural gas take over,
- End-users public information.

According to the provisions of this by-law regulation, in the case of short-term disruption of natural gas supplies, caused by breakdowns in its facilities, equipment, pipelines and installations for the transport and distribution of natural gas, and other unforeseen circumstances which threaten the safety of transportation and distribution system, due to unforeseen reparation, reconstruction and maintenance of transportation and distribution systems as well as required system expansion works, the transmission or distribution system is required to measure the degree of a disruption, and take the necessary actions to bring the system in a safe and uninterrupted operation as well to determine the terms of use the remaining capacity of production, transportation or distribution systems and develop the plan for limiting the delivery of natural gas.

The plan for limiting the delivery of natural gas comprises of the following measures: replacement of natural gas with other energy sources, limit supplies of natural gas and the suspension of natural gas supplies.

This Regulation set forth the restrictive measures to be taken in case of general shortage of natural gas, conditions and terms of suspension of natural gas supplies, conditions and rational use of energy and saving natural gas, as well as objects of end-users to whom cannot be suspended natural gas supply and methodology for regulation of the relation between the supplier and the end-user to whom cannot be suspended natural gas supplies.

The transmission and distribution system operators and public suppliers are obliged in case of general shortage immediately inform the ministry about the occurrence of general shortage. The Ministry, on the basis of this notice as soon as possible submits a proposal to the Government for a decision on the implementation of measures under Article 164 of the Energy Law [1].

1.4.3. Decree on Preventive Action Plan for Safeguarding the Security of Natural Gas Supply

Within Decree on Preventive Action Plan for Safeguarding the Security of Natural Gas Supply, Official Gazette of the RS ("Official Gazette of RS", No. 102/18) [37], the Preventive Action Plan for Ensuring Security of Natural Gas Supply has been determined. This plan contains a risk assessment in terms of achieving security of supply, as well as measures to mitigate the identified risks related to the required transport capacity that would meet the overall demand for natural gas and ensure the supply of certain groups of end customers of natural gas.

1.4.4. Decree on Emergency Plan for Safegurarding of Security of Natural Gas Supply

Within Decree on Determining the Crisis Plan for Ensuring Security of Natural Gas Supply ("Official Gazette of RS", No. 102/18) [38], the Crisis Plan for Ensuring Security of Natural Gas Supply has been determined.

This plan determines the criteria for the introduction of the crisis, crisis levels, actors in case of crisis, measures taken in case of crisis, as well as the way to act in case of crisis in order to supply the market of the Republic of Serbia with natural gas.

1.4.5. Regulations of Commodity Reserves

Security of supply of oil is regulated by the Law on Commodity Reserves ("Official Gazette of RS", No. 104/2013, 145/2014 - second law and 95/2018 - second law) [44], which regulates the conditions for the formation, financing, deployment, use and renewal of required reserves of oil and oil derivatives, provision and maintenance of storage and storage space, as well as business and management of required reserves and storage space on the territory of the Republic of Serbia. In addition to the mentioned law, this area is also regulated by the Energy Law, which established the Directorate for Energy Reserves, as an administrative body within the Ministry,

and determined its competence. The Energy Law also prescribes the obligation to form and keep operational reserves of oil, coal and other energy derivatives.

Decree on Determining the Program of Measures in Case the Security of Energy and Energy Supply is Endangered - Crisis Plan Decree on Determining the Program of Measures in Case the Security of Energy and Energy Supply is Endangered - Crisis Plan ("Official Gazette of RS", No. 63/19) [45] determines the Crisis Plan when security of energy and energy supply is endangered.

This plan contains procedures and criteria for determining supply disruptions, competencies and responsibilities of public and private entities for the purpose of eliminating supply disruptions and procedures for normalization of supply in the market of the Republic of Serbia. The program also includes actions in case of an international decision on placing required reserves on the market.

1.4.6. Decree on Operational reserves of Oil, Coal and Other Energy Derivatives

Article 345 of the Energy Law defines that energy entities that perform the activity of production of oil derivatives and trade in oil, oil derivatives, biofuels and compressed natural gas are obliged to provide operational reserves of oil derivatives equal to the ten-day average amount of gasoline and gas oils, or the fifteen-day average amount of jet fuel, which they placed on the market of the Republic of Serbia in the previous year from their own production and imports.

Operational reserves of oil and coal derivatives are used in case of short-term disturbances on the market, due to accidents and other unforeseen situations due to which the safety of operation of certain parts of the energy system or the energy system as a whole is endangered.

The Decree on Operational Reserves of Oil, Coal and Other Energy Derivatives ("Official Gazette of RS", No. 79/21) prescribes the conditions and manner of gradual provision, use and renewal of operational reserves of oil, coal and other energy derivatives.

2. STRUCTURE OF ENERGY SECTOR

The energy system of the Republic of Serbia is consisted of oil, natural draft, coal, electricity sector, the sector of thermal energy and renewable energy sources. This chapter provides a brief overview of the basic data relating to the mentioned energy sectors, while a detailed description will be given in the context of specific chapters.

2.1. Crude Oil Sector

Exploitation of domestic crude oil reserves is performed within the limits of NIS JSC (in 2020 it amounted 0.861 million tonnes, which is 25% of total needs). The NIS JSC is the only company in the Republic of Serbia engaged in crude oil and natural gas exploration and production. Since 25th January, 2009 the majority stock holder (owner) in NIS JSC is the Russian company Gazprom Neft.

Production of petroleum products is carried out within Pančevo Oil Refinery which is a part of NIS JSC (in 2020 domestic production of petroleum products amounted 3.363 million tonnes).

Amendments to the Energy Law from 2021 [1] define the mixing of biofuels as the addition of biofuels to fuels of petroleum origin in the prescribed content, and the mixing of bioliquids as the addition of bioliquids to fuels of petroleum origin in the prescribed content. Also, the amendments to the Law define that motor fuels include marine fuels, liquefied natural gas and hydrogen, while marine fuels are included in the concept of oil derivatives. Hydrogen production was also introduced as a new energy activity.

The section on energy reserves defines that Energy entities engaged in the production of petroleum products and trade in petroleum products, petroleum products, biofuels, bioliquids, compressed natural gas, liquefied natural gas and hydrogen, except those that trade only in compressed natural gas and/or natural gas and/or hydrogen, are obliged to provide operational reserves of oil derivatives, which are equal to the ten-day average amount of motor gasoline and gas oils, or fifteen-day average amount of jet fuel, which they put on the market of the Republic of Serbia in the previous year.

Amendments to the Law in the part on security of supply also process the report on security of supply of oil and oil derivatives, which should contain:

1) data on production, import, export and consumption of oil and oil derivatives;
2) data related to security of supply of oil and oil derivatives;
3) technical and other requirements that must be met by liquid fuels of petroleum origin, liquefied petroleum gas and biofuels;
4) data on oil infrastructure;
5) data related to the quality and level of maintenance of oil infrastructure facilities;
6) oil infrastructure investment plan;
7) overview of the sources of supply of crude oil / oil derivatives (including the geographical origin of imported energy products defined in the European regulations on energy statistics);
8) data on capacities for import and export of crude oil and oil derivatives.

In the Republic of Serbia, the production of oil derivatives is performed in the Pančevo Refinery, while the production of liquefied petroleum gases, except in the refinery in Pančevo, is also performed in the plant of NIS JSC for stabilization, ie preparation of natural gas for transport in Elemir. Also in the plants in Odžaci where the production is performed by "Standard gas d.o.o.

Novi Sad" (propane and butane, as well as pentane-hexane fraction, ie solvent), where imported gas condensate, i.e. a wide fraction of light hydrocarbons is used as a raw material for production, and in the plants "Hipol a.d. Odžaci" (Hipol JSC) which propane is obtained as a by-product in the process of purification of refinery, i.e. petrochemical propylene to propylene of polymer purity. Energreen MTV also performs production at the same location, but in different plants. The production of propane-butane mixture and autogas, based on the mixing of components, is performed by the company Petrol LPG in the plant in Smederevo, and the company VML in the plant in Jakovo

The only provider of pipeline transport services of crude oil is "Transnafta AD Pančevo" (formerly PE Transnafta, now Transnafta JSC), which was formed on October 1, 2005, and until then this activity was performed within NIS JSC. The activity of transport of crude oil through ccrude oil pipelines and transport of oil derivatives through product pipelines are regulated activities of general interest and are performed by Transnafta JSC at regulated prices.

The activity of trade of crude oil and petroleum products including biofuels and compressed natural gas and storage is operated by a large number of economic entities. There are 26 licenses being issued for crude oil and petroleum products storage, also 55 for crude oil and petroleum products wholesale and 446 for crude oil and petroleum products retail trade. The import of crude oil is liberal and the prices are commercial. The retail trade of petroleum products on the territory of the Republic of Serbia is performed through the developed and outspread trade network of 1,500 retail facilities.

In the Republic of Serbia, the supply of transport vehicles with compressed natural gas, as a fuel, is done at 26 stations.

Total consumption of petroleum products in 2020 as final energy-generating product amounted to 3.19 Mtoe, out of which 0.562 Mtoe was spent for non-energy purposes and 2.636 Mtoe was spent for energy purposes whereby mostly in traffic sector 79.1%, then in industry and construction 13.3%, in agriculture was spent 3.7%, and in households about 1.7%, while the rest of consumers participate with 2.2%.

Directive 2009/28/EC, relating to renewable energy sources in order to reduce greenhouse gas emissions, in the part relating to the mandatory content of biofuels in motor fuels, has been implemented in domestic legislation since 2019 as adopted: Decree on the share of biofuels in the market (Official Gazette of the RS, No. 71/2019), Rulebook on technical and other requirements for biofuels and bioliquids (Official Gazette of the RS, No. 73/2019) and Regulation on the criterion of sustainability of biofuels (Official Gazette of the RS, No. 83/2019).

In 2020, the Rulebook on calculating the share of renewable energy sources (Official Gazette of the RS, No. 37/2020) was adopted, which, among other things, prescribes in more detail the energy content of fuels in transport and the method of calculating the impact of biofuels and bioliquids and their comparable fossil fuels. greenhouse gas emissions. The action plan for the construction of new capacities based on renewable energy sources undertook the obligation to reach 10% share of biofuels in motor fuels by 2020, but it is still without the share of biofuels on the market of oil derivatives in 2020.

In 2019, the Rulebook on Fixed Reservoirs (Official Gazette of the RS, No. 50/2019) came into force, which, among other things, determined the requirements and marking of these facilities, characteristics for the needs of equipment and conditions for meeting these conditions. verification of fixed tanks.

2.2. Natural Gas Sector

Natural gas sector comprises of:

- Exploration of indigenous natural gas reserves within NIS JSC (production in 2020 was 408.5 million Sm^3)[2],
- Natural gas import (2,135 million Sm^3 in 2020),
- Storage of natural gas and storage management (Underground storage Banatski Dvor - UGS Banatski Dvor, capacity of 450 million m^3 of natural gas),
- Natural gas supply,
- Natural gas transmission and transmission management ("Transportgas Srbija d.o.o. Novi Sad" and "Yugorosgaz-Transport d.o.o. Niš"),
- Natural gas distribution and distribution management is performed by 33 licensed distribution system operators. License for natural gas distribution is possessed for one additional company, but it haven't not performed this activity.

In 2020, natural gas consumption in the Republic of Serbia had the following structure:

- Transformation input 38.1%;
- Consumption in the energy sector 8.6%;
- Transmission and distribution losses 0.6%;
- Non-energy consumption 7.1%;
- Final energy consumption 45.6%.

In process of natural gas transformation in other forms of energy, highest share had district heating plants – 56.7%, followed by autoproducers with 19.3%, refineries with 14.7% and CHP with 9.3%.

The highest share within final energy consumption for energy purposes had the industry (51%) followed by households with 25.1%, commercial and public sectors with 19.9%, while the traffic sectors and agriculture had a share of 2.3% and 1.7%, respectively.

2.3. Coal Sector

The largest part of the energy reserves fossil fuels of the Republic of Serbia (about 99%) are various types of coal, whose exploitation takes place within of:

- Mining of PE Resavica (in 2020 it produced 0.379 million tonnes of coal),
- Underwater exploitation in Kovin (in 2020 it produced 0.201 million tonnes)
- Surface coal mining in two major mines in Kolubara (in 2020 domestic production was 30.024 million tonnes) and Kostolac (in 2020 production was 9.069 million tonnes of coal), which are located within PE EPS.

Of the total domestic production of coal, 98% comes from surface exploitation, and the rest of the underground and underwater exploitation. Domestic production mainly produces low-quality lignite, so the need for higher quality types of coal covered from imports and and coal-fired plants at Vreoci. That is the reason why the domestic production satisfies 97% of the total demand for coal and the rest is imported.

[2]Reduced cubic meter (Sm^3) denotes the volume of natural gas, with lower calorific value 33338.35 kJ/m^3, measured at a temperature of 15˚C and 1013,25 mbar (1 Sm^3 = 33,33835 MJ) [30].The term "standard cubic meter (Stm^3)" is used in bulletins of energy balances issued by the Statistical Office of the Republic of Serbia. This term is used for natural gas at a temperature of 15˚C and 1013,25 mbar pressure and lower calorific value Hd=33338 kJ/m^3.

Import includes import of coal shortage types of coal and coke for the needs of metallurgical complex and high-calorie coal for the industry, and the brown coal for different consumers. Total domestic coal production in 2020 amounted to 39.67 million tonnes, or 7.061 Mtoe, while the total amount of coal available for consumption is about 41.38 million tonnes or 7.741 Mtoe. Of this amount for the transformation process has been spent up to 39.845 million tonnes or 7.342 Mtoe (95%), of which 38.117 million tonnes or 6.653 Mtoe (91%) in thermal power plants, and the remaining of 1.728 million tonnes or 0.689 million tonnes (9%) in industrial power plants, heating plants, blast furnaces and coal processing.

Within the processing of coal in Vreoci, which is part of PE EPS, in 2020 was produced 214,563 tonnes of dry lignite.

Total final consumption of coal in 2020 amounted 1.863 million tonnes (0.552 Mtoe) of which in non energy purposes 0.019 million tonnes (0.005 Mtoe), and in energy purposes 1.844 million tonnes (0.547 Mtoe). In the structure of final consumption for energy purposes, the participation of industry is 39% (0.737 million tonnes or 0.212 Mtoe), 50% (0.860 million tonnes or 0.271 Mtoe) of households and other sectors with 11% (0.247 million tonnes or 0.064 Mtoe).

2.4. Energy Sector

Capacities for the production of electricity in the Republic of Serbia, for the most part are owned by PE EPS (92%), and their structure that is net production capacities, in 2020 is [25]:

- Thermal Power Plants (TPP), net output capacity of these plants is 4,079 MW
- Combined Heat and Power Plants (CHP), with net output capacity 297 MW
- Hydro Power Plants (HPP) with net output capacity 3,076 MW (including small hydro power plants)
- Wind Power Plants, with net output capacity 398 MW
- Solar Power plants, with net output capacity 12 MW
- Biogas Power plants, with net output capacity 29 MW
- Biomass Power plants, with net output capacity 2.4 MW
- Industrial power plants, with net output capacity 99.82 MW
- Gas plants, with net output capacity 3.41 MW.

Total electricity production in 2020 was 37,956 GWh (3.264 Mtoe). The largest part of production was realized in thermal power plants (70%, 26.429 million tonnes or 2.272 Mtoe) and hydro power plants (26%, 9.749 million tonnes or 0.838 Mtoe). Combined heat, wind power plants and industrial power plants in total electricity production together accounted for about 4%. Import of electricity was 5,070 GWh (0.436 Mtoe), export 5,675 GWh (0.488 Mtoe), so that net gross export amounted to 605 GWh (0.052 Mtoe) [15], [25].

Power consumption of the energy sector in the same year amounted to 11% of the total generated electricity (gross production). Losses in the transmission and distribution system amounted to 11.55% of the total electricity production (gross production) [15], [25].

Final electricity demand was 27,881 GWh (2.397 Mtoe). Electricity as final energy is consumed mostly in households (49%, 13,718 GWh or 1.180 Mtoe), then in industrial plants along with the construction sector (31%, 8,617 GWh or 0.741 Mtoe), and transport, agriculture and other consumers (21%, 5,545 GWh or 0.477 Mtoe) [15], [25].

In 2020, there were active 11 licenced electricity suppliers for open market supply. PE EPS remained dominant with 95.5 share of total energy sold in the open market and 96.9% of final consumption.

2.5. Thermal Energy Sector

Capacities for the production of thermal energy in the Republic of Serbia are installed in:

- Power Plants within the district heating system
- Thermal Power Plants (TPP)
- Combined Heat and Power Plants (CHP)
- Industrial Power Plants
- The individual boiler rooms that are not covered by energy balance.

Centralized heat supply exists in 60 towns in Serbia, with the total installed thermal capacity of boilers 7.108 GW.

Industrial power plant are used to produce thermal energy for needs of different industrial process. Except for manufacturing processes, thermal energy produced in these power plants is also used for heating of working space. In particular industrial enterprises are power plants that provide combined heat and power generation (it is estimated that in 2020 9,811 TJ of heat and 473.826 GWh of electricity was produced) [15], [25].

Production of thermal energy takes place in thermal power plants and combined heat and power plants. These are the following objects in the composition of PE EPS:

- TPP Nikola Tesla A (unit A1 and A2) for district heating of Obrenovac (steam coal units)
- TPP Kostolac A for district heating of Požarevac and Kostolac (steam units for coal)
- TPP Kolubara A for district heating of Vreoca
- CHP Novi Sad, Zrenjanin and Sremska Mitrovica for district heating and process steam (steam units for the gas and liquid fuel, new boiler in TPP Sremska Mitrovica on biomass).

Natural gas, coal, oil products and biomass are used for the production of heat in district heating plants. In 2020, in the thermal power plants was spent 570.589 million m^3 of natural gas, 174,886 tonnes of coal, 55,002 tonnes of petroleum products and 7,540 tonnes of biomass [15], [25].

The thermal energy production in 2020 amounted about 35,957 TJ or 0.859 Mtoe. The largest part of the production was achieved in industrial power plants (27%) and thermal power plants (62%) [15], [25].

Distribution losses were 3,038 TJ, or 0.073 Mtoe and consumption of the energy sector was 1,528 TJ or 0.036 Mtoe. Final energy consumption in 2020 amounted to 31,391 TJ or 0.750 Mtoe. When it comes to this amount, in industrial power plants was spent (26%) and in household (58%). Other consumers accounted for 16% of final energy [15], [25].

2.6. Renewable Energy Sector

Renewable energy sector includes:

- The production of geothermal energy,
- Use of hydropower potential, solar and wind energy,
- The production of solid, liquid and gaseous biomass,

- Import and export of biomass,
- The production of electrical and thermal energy from plants using renewable energy sources.

Electricity production from large and small watercourses was included in the balance of the total electricity production in the Republic of Serbia and was 9,749 GWh or 0.838 Mtoe. This means that in 2020 the hydropower plants produced 26% of the total gross electricity generation [15], [25].

Geothermal energy production is followed by the Statistical Office of the Republic of Serbia within their statistical surveys and in 2020 this production was 0.0051 Mtoe which is less than 1% of the total domestic production of primary energy. This data did not cover use of geothermal energy through the use of heat pumps [15], [25].

Production and consumption of solid biomass, includes, not only the production and consumption of firewood, but also the production of pellets and briquettes, for energy purposes (heating). Biomass production in 2020 in the Republic of Serbia was 1.593 Mtoe, of which the largest part of 1.356 Mtoe was consumed in households [15], [25].

2.7. Energy Resources

Energy resources and potentials of the Republic of Serbia consists of fossil, conventional (coal, oil and natural gas) and unconventional fuels (oil shale), as well as renewable energy sources.

Good quality energy reserves, such as oil and gas are symbolic and make less than 1% of geological reserves, while the remaining 99% of energy reserves are various types of coal, with the largest share of lignite from over 95% of the balance reserves. Considering the total geological reserves, among the most abundant coal reserves, the presence of still unexploited oil shale, at around 9% of the total geological reserves, is observed.

Coal reserves should, according to the projections of the consumption, meet consumption requirement until the end of this century.

Oil shale reserves are significant, but the conditions for their exploitation and technology for their use has yet to be defined, given that this is an unconventional fuel.

The volume of oil and natural gas reserves will last until 2030, and further exploitation, will depend on the translation of the off-balance reserves into balance reserves, as well as on the discovery of new deposits. Thus, the geological reserves of primary energy sources still represent a significant basis.

For the renewable energy sector, with the exception of large hydro power plants, it can be said that it is in the early stage of development. Estimated total technically available potential of renewable energy sources in Serbia is 5.65 Mtoe (65.7 TWh) per year. From this potential 1.054 tonnes (12 GWh) of oil equivalent of biomass and 909 thousand tonnes (10,5 TWh) of oil equivalent of hydropower is already used.

According to preliminary data for 2020 (and having in mind that the summary energy balance for 2020 is being prepared), the results are as follows:

Primary production includes exploitation, or use of domestic resources of coal, crude oil, natural gas and renewable energy sources (hydro potential, geothermal energy, and biomass). In the Republic of Serbia 10.9 Mtoe of primary energy was produced in 2020. This production has satisfied more than 60% of the total demand for primary energy. The structure of domestic production of primary energy is as follows: coal production amounts to 7.061 Mtoe, 65% of the total domestic production of primary energy, while the remaining part is the production of crude

oil and natural gas, hydropower and wind and solar energy, the production of firewood and geothermal energy.

Total primary energy consumption in 2020 was 16.074 Mtoe. Net import dependence of Republic of Serbia in 2020 was 32%. During 2020, mostly imported energy sources were: crude oil and petroleum products 56%, natural gas 29%, coal 8%, 7% electricity and etc.

Primary energy was used for:

- Transformation in the thermal power plants, hydro power plants, combined heat and power plants, heating plants, industrial power plants, oil refineries, coal processing, blast furnace;
- The consumption of the energy sector;
- Losses in transmission and distribution of energy and energy sources;
- Direct consumption by end users.

In the consumption structure for the transformation processes, dominates the consumption of coal 57%, then 34% of crude oil and petroleum products and natural gas 7%. Total consumption of final energy includes energy consumed in transformation processes as well as part of the total available primary energy which is not included in the processes of transformation and are directly consumed by end users.

Total final energy consumption in Serbia in 2020 was 9.67 Mtoe of which 0.75 Mtoe was consumed for non-energy purposes, while the consumption of final energy for energy purposes was 8.92 Mtoe.

By consumption sectors, final energy was most consumed in the household sector 40% (3.537 Mtoe), followed by industry 23% (2.079 Mtoe), then traffic 25% (2.204 Mtoe), while other sectors accounted for 12% (1.088 Mtoe).

On the other hand, in the final energy consumption, energy products consumption is dominated by oil with 29% (2.561 Mtoe) and electricity with 27% (2.397 Mtoe), followed by natural gas with 12% (1.067 Mtoe), coal with 6% (0.547 Mtoe), thermal energy with 8% (0.750 Mtoe), while firewood participate with 18% (1.561 Mtoe).

3. ELECTRICITY

Energy Law [1] in electricity defines the energy activities related to: electricity generation, combined generation of electricity and thermal energy, electricity transmission and electricity transmission system management, electricity distribution and electricity distribution system management, power distribution and management of the closed distribution system, electricity supply, wholesale electricity supply and organised electricity market operation. An energy-related activity can be performed by a public enterprise, business entity or other legal entity or entrepreneur having a license for performing the energy-related activity.

Energy activities of public interest, are carried out in accordance with this Law wich regulates the status of public companies (Official Gazette of the RS, No. 15/2016 and 88/2019). In the area of electricity those are: electricity transmission and transmission system management, electricity distribution and distribution system management. The other listed energy activities are performed in accordance with market principles.

To perform these energy-related activities, all domestic and foreign entities must obtain a permit, ie license issued by the AERS. The license is an administrative act on fulfilment of conditions stipulated by the Energy Law [1] and the Rulebook on Licence for Performance of Energy Activities and Certification (Official Gazette of the RS, No. 87/15 and 44/18 [7]).

License is issued for each energy activity separately. It is issued for ten years, and for the production of electricity, the combined production of electricity and thermal energy and thermal energy production for 30 years.

In the energy sector of Republic of Serbia, following energy entities have a part:

- EMS JSC which in 2016 changed the legal form from a public company to a joint stock company, performs the activities of transmission and electricity transmission system management
- PE EPS performing the following activities: electricity generation, electricity supply and wholesale electricity supply. PE EPS is the founder of the subsidiary "EPS Trgovanje d.o.o. Ljubljana" by PE EPS set up for electricity trading.
- At the end of 2020, precisely on December 29, the Government and PE EPS agreed on the transfer of shares in the distribution system operator from PE EPS to the Government, after which the Government on 31.12.2020. founded a one-member company "Elektrodistribucija Srbije d.o.o. Belgrade", which is completely independent of the vertically integrated PE EPS.
- "SEEPEX a.d. Beograd" (SEEPEX), licensed market operator on organized market/power exchange.
- Other electricity producers
- Other electricity suppliers.

The Law on Amendments to the Law on Energy[3] has been adopted during 2021, which provides additional harmonization of domestic regulations with the regulations of the European Union, as well as eliminating the shortcomings that were noticed in the application of the previous Law on Energy. Some of the novelties brought by the new Law in the field of electricity are:

[3] The Law on Amendments to the Law on Energy, Official Gazette of the RS, no. 40/2021

- obligation to develop and monitor the implementation of the Integrated National Energy and Climate Plan, in accordance with the obligations under the Energy Community Treaty, which defines national targets in the field of decarbonization in terms of greenhouse gas emissions from renewable sources, energy efficiency, energy security, internal energy market, research, innovation and competitiveness,
- arranging the merger of the organized electricity market with neighboring markets - appointment of the Nominated Electricity Market Operator,
- introduction of new participants in the electricity market: prosumer, electricity storage, and aggregator,
- extension of the authority of the AERS to issue ex officio a decision on temporary revocation of a license in cases provided by law,
- expansion of the scope of the Security of Supply Statement, which provides a complete picture of the supply of the market of the Republic of Serbia with energy and energy sources, as well as of measures taken to ensure the security of supply,
- amendment of provisions related to guaranteed and regular supply, unauthorized consumption, disconnection and suspension of electricity, protection of electric power facilities,
- more precise definition of the energy endangered electricity costumer.

Two more key laws in the energy sector have been adopted in 2021: the Law on Energy Efficiency and Rational Use of Energy[4] and the Law on the Use of Renewable Energy Sources[5]. With the mentioned laws, the Republic of Serbia has harmonized its regulations with the new EU directives in the relevant areas.

3.1. Electricity Market

By adopting the Energy Law at the end of 2014 [1], the field of energy in domestic legislation is harmonized with the provisions of the Third energy legislative package of the European Union, continued the process of introducing competition in the electricity sector in Serbia, in order to increase the efficiency of the sector through the effects of market mechanisms in the production and supply of electricity, while retaining the economic regulation of the activity of transmission and distribution of electricity as natural monopolies.

According to the Energy Law [1], from January 1, 2015 households and customers who have the status of a small customers are entitled to guaranteed supply, at prices regulated by AERS. In accordance with that, the following applies:

- end customer is a legal or natural person or entrepreneur purchasing electricity or natural gas for its own needs;
- small electricity customers are end customers (legal persons and entrepreneurs) with fewer than 50 employees and a total annual revenue of up to project €10 million in RSD counter value, whose all facilities are connected to the electricity distribution system with the voltage level lower than 1 kV, and whose electricity consumption in the previous year was not higher than 30,000 kWh;
- guaranteed supply is a public service ensuring the right of households and small customers to the supply of electricity having prescribed characteristics in the territory of

[4] The Law on Energy Efficiency and Rational Use of Energy, Official Gazette of the RS, no. 40/21

[5] The Law on the Use of Renewable Energy Sources, Official Gazette of the RS, no. 40/21

the Republic of Serbia, at reasonable, clearly comparable, transparent and non-discriminatory prices;

Households and small customers can remain under guaranteed supply and supplied in accordance with existing contracts, but they have the right and the possibility to contract supply with any licensed electricity supplier in the free market.

If a household or small customer chooses a supplier in the free market and then for any reason remains without the selected supplier, it can always return to regulated, guaranteed supply. Other customers must have a supply contract on market terms. Only one agreement on full supply may be concluded for one point of takeover and for the same period of supply. For one point of takeover, for each accounting period during the period of supply, several agreements on supply with predefined amounts of electricity may be concluded. When a supply agreement is concluded with predefined amounts of electricity, the final customer shall, prior to the commencement of supply, conclude: an agreement regulating balance responsibility for its points of takeover, and an agreement on access to the system with the operator of the system to which its facility is connected.

An end customer of electricity that is not entitled to guaranteed supply, who does not have a valid supply contract (Article 192 of the Energy Law [1]), has the right to last resort supply for a period of 60 consecutive days, in which he must find a new supplier (otherwise the system operator shall suspend electricity supply to that customer). On the basis of the conducted public tender procedure, the Government shall designate the supplier to perform last resort supply. The price at which the guaranteed supplier shall carry out last resort supply may not be lower than the average price of electricity in the organised market for the previous year (Article 193 of the Energy Law [1]).

According to the Energy Law [1], the electricity market in the Republic of Serbia includes:

- bilateral electricity market;
- balancing electricity market and
- organized electricity market.

3.1.1. Participants in the Electricity Market

Energy Law stipulates that players in the electricity market may be: an electricity producer, a supplier, a public supplier, the final customer, the electricity transmission system operator, the electricity distribution system operator, the electricity closed distribution system operatorand and market operator. The organised electricity market participants may also be other legal persons, in accordance with the rules on the organised market operation. Electricity market players are obligated to submit all necessary data to the transmission, i.e. distribution system operator pursuant to Electricity Transmission Grid Code (Official Gazette of the RS, No. 114/2017 and 60/2020) [8], Electricity Distribution Grid Code (Official Gazette of the RS, No. 71/17 and 14/19) [9] and Electricity Market Code [10].

The number of currently active licences for energy operations in electricity sector is presened in the following table.

Table 1: Active licences in electricity sector in year 2019 and 2020 [11]

Activity	Licenses in 2019	Licenses in 2020
Electricity production	26	29
Combined power and heat production	8	9
Electricity transmission and transmission system operation	1	1
Elecricity distribution and distribution system operation	1	1
Electricity distribution and closed distribution system operation	1	3
Electricity supply	51	62
Wholesale electricity supply	67	63
Ogranised electricity market operation	1	1

On the territory of the Republic of Serbia, EMS JSC is selected for performing of energy operations in the field of transmission of electricity and Elektrodistribucija Srbije in field of distribution of electricity and distribution system operation.

Energy Law 2014 [1] prescribes new obligations that those energy entities must fulfill in the process of obtaining a license, which relate to the provisions regarding the separation and certification of the electricity transmission system operator, as well as the provisions related to the separation of operators distribution system of electricity and provisions related to the compliance program and the person who monitors its implementation. By the decision of the Council of AERS, on 8 December 2017, EMS JSC is licensed for energy transmission and transmission system operation.

3.1.2. Bilateral Electricity Market

A bilateral electricity market is the market on which electricity is directly purchased and sold among the market participants on the basis of agreements on electricity supply (the Energy Law [1]).

The agreement on electricity supply particularly defines the amount of electricity, the price and the period of supply.

The amount of electricity may be:

- determined in advance for each accounting period during the period of supply,
- determined on the basis of the recorded electricity consumption at the point of takeover during the supply period, and
- determined on the basis of the recorded electricity production at the point of takeover during the supply period.

On the wholesale bilateral market the participants trade in electricity at open prices, whereas on the retail bilateral market supply is organized at open market prices and regulated prices, considering that since 2015 all customers, except for households and small customers, have been obliged to purchase electricity in the open market.

The activities of the suppliers and wholesale suppliers in the open market were mostly concerned with the field of cross-border exchange, mostly for transit through Serbia which is dominant due to the central geographic position of the power system of Serbia in the region with eight borders, as well as for the purpose of export and import for final customers.

Table 2, Table 3 and Table 4 present the relevant indicators of the electricity market in Serbia during the period 2013-2020.

Table 2: Electricity market concentration level in Serbia (2013-2015)[6] [11]

Supplier's activity	2013			2014			2015			
	Electricity quantity [GWh]	Share of three suppliers with the greatest trading scale [%]	Market concentration level	Electricity quantity [GWh]	Share of three suppliers with the greatest trading scale [%]	Market concentration level	Electricity quantity [GWh]	Share of three suppliers with the greatest trading scale [%]	Herfindahl-Hirschman Index - HHI	Market concentration level
Trade with PE EPS										
Sales to EPS	4	100	High	2,047	51	Moderately high	659	72	2,160	High
Purchase from EPS	3,297	54	Moderately high	980	39	Low	1,535	53	1,535	Moderately high
Trade between suppliers										
Sales	1,143	63	High	948	40	Low	1,349	42	852	Low
Purchase	1,298	54	Moderately high	941	26	Low	1,345	36	620	Low
Electricity import and export										
Import	486	46	Moderately high	2,925	43	Low	2,926	49	893	Low
Export	3,672	52	Moderately high	1,255	29	Low	2,306	60	536	Low
Transit										
Transit	8,328	57		12,774	41		14,092	48	815	Low

[6] Herfindahl-Hirschman index (HHI) is defined as the sum of squares of share of a single company in the market. The lower the value, the more developed is market competition. In order to rank market concentration, following boundaries are used: HHI < 1000 – not concentarted, 1001 < HHI < 2000 – moderately concentrated, HHI >2001 – highly concentrated market.

Table 3: Electricity market concentration level in Serbia (2016-2017)[7] [11], [12]

Supplier's activity	2016					2017				
	Electricity quantity [GWh]	Share of three suppliers with the greatest trading scale		Herfindahl-Hirschman Index - HHI	Market concentration level	Electricity quantity [GWh]	Share of three suppliers with the greatest trading scale		Herfindahl-Hirschman Index - HHI	Market concentration level
		[%]	[GWh]				[%]	[GWh]		
Trade on organized electricity market										
Sales	533	80	425,752	3,389	High	848	62	527	1,812	Moderately high
Purchase	533	72	423,169	1,985	Moderately high	848	59	496	1,446	Moderately high
Trade between suppliers on bilateral electricity market										
Sales	5,279	57	2,836	1,883	Moderately high	4,033	36	1,454	732	Low
Purchase	5,279	35	1,481	702	Low	4,033	50	2,018	1,148	Moderately high
Electricity sales to final costumers on open market										
Sales	11,603	98.6	11,424	9,130	High	12,637	97	12,303	8,892	High

[7] Herfindahl-Hirschman index (HHI) is defined as the sum of squares of share of a single company in the market. The lower the value, the more developed is market competition. In order to rank market concentration, following boundaries are used: HHI < 1000 – not concentarted, 1001 < HHI < 2000 – moderately concentrated, HHI >2001 – highly concentrated market.

Table 4: Electricity market concentration level in Serbia (2018-2020)[8] [11], [12]

Supplier's activity	2018					2019					2020				
	Electricity quantity [GWh]	Share of three suppliers with the greatest trading scale		Herfindahl-Hirschman Index - HHI	Market concentration level	Electricity quantity [GWh]	Share of three suppliers with the greatest trading scale		Herfindahl-Hirschman Index - HHI	Market concentration level	Electricity quantity [GWh]	Share of three suppliers with the greatest trading scale		Herfindahl-Hirschman Index - HHI	Market concentration level
		[%]	[GWh]				[%]	[GWh]				[%]	[GWh]		
Trade on organized electricity market															
Sales	2,318	64	1,473	1,760	Moderate	2,528	45	1,127	1,067	Moderate	2,816	42	1,191	938	Low
Purchase	2,318	41	954	985	Low	2,292	41	946	1,015	Moderate	2,562	42	1,083	892	Low
Trade between suppliers on bilateral electricity market															
Sales	3,951	33	1,296	659	Low	3,938	40	1,564	823	Low	5,840	45	2,645	935	Low
Purchase	3,951	35	1,372	688	Low	3,938	38	1,513	798	Low	5,838	31	1,797	647	Low
Electricity sales to final costumers on open market															
Sales	13,370	98	13,192	9,273	High	13,573	99	13,473	9,155	High	13,305	99	13,214	9,125	High

[8] Herfindahl-Hirschman index (HHI) is defined as the sum of squares of share of a single company in the market. The lower the value, the more developed is market competition. In order to rank market concentration, following boundaries are used: HHI < 1000 – not concentarted, 1001 < HHI < 2000 – moderately concentrated, HHI >2001 – highly concentrated market.

In 2020, there were 5 of among the three dominant ones in each activity. The market concentration level during the last two years remained on the same level as previuos year. Similar situation is in trade in organized market which indicates that the market is more stable in contrast to big changes in the scale of trade during the first two years of power exchange operation. The trade in bilateral market in year 2020 was by one third higher than year 2019. Retail market concentration is very high in year 2020. There is even slight decrease of concentration in comparison to 2019 which is a consequence of the dominant position of PE EPS in the retail market.

Table 14 on the page 18 presents the electricity consumption in Serbia (without APKM) during the period 2013-2020. There was a 0.19% (in year 2019) and 0.59% (in year 2020) decrease in the electricity consumption in comparison with 2018 .

The total number of metering points for customer delivery in Serbia, without APKM (withut metering points of facilities within Železnice Srbije– 42 in total), was 3,690,708 in the end of 2020. Compared to 2019, the number was increased by 0.7% (3,663,689) [11].

In 2020, only households and small customers purchased in the organized market. In 2020, 51.1% of electricity which was consumed by final customers in total were delivered in the regulated market, which is 0.7% more than in 2019 (in 2019 14,637 GWh, in 2020 14,935 GWh). Electricity quantities delivered in the regulated market for each consumption category. At the end of 2018, electricity at regulated prices was delivered at about 3.6 million metering points to final customers [11].

The valid regulated price of electricity for the guaranteed supply of end customers was approved on December 1, 2019.

Since 2015, all final customers have been able to purchase electricity in the open market where 14,032 GWh was delivered in 2020, excluding the energy delivered via supply of the last resort, which amounted to 48% of the total consumption of final customers. To customers in the open market, among which households account for 2.3 thousands (apartments owned by companies which purchase electricity in the open market), electricity was delivered to 137 thousand metering points. In the end of 2020, 11 energy entities which were licenced for electricity supply, were active in the open retail market. The dominant supplier in the free market was still PE EPS with a 95.5% (12.702 GWh) share in the total electricity quantites sold to final costumers in the open market and 96.9% (13.597 GWh) share in the final consumption [11].

Guarantee of origin [11]

Guarantees of origin are electronic documents which have an exclusive function to provide evidence to a final customer that the given share or energy quantity which was delivered by a supplier was produced from the renewable sources.

In 2017, the Decree on Guarantees of Origin entered into force and a Rulebook on Method of Calculation and Presentation of Share of All Energy Sources in Electricity Sale was adopted. In December 2017, EMS JSC adopted Rules on Issuance of Guarantees of Origin for the Republic of Serbia. On December 22, 2017, the Council of the AERS approved the Decision on Fee for Issuance, Transfer and Cease of Validity of Guarantee of Origin which created all conditions for the beginning of a new market process – Issuance and Administration of Guarantees of Origin for Electricity in Control Area of the Republic of Serbia.

In November 2020, after complying with all the conditions for full membership and following the provision of necessary insurance, EMS JSC was connected to the AIB system (AIB HUB) and, thereby, both the export of guarantees of origin from Republic of Serbia into the countries which are the Association members and the import of the guarantees of origin into Republic of Serbia were enabled. Hereby, Serbia became the first Energy Community Contracting Party which became the member of the Association of Issuing Bodies.

Thereby power producers in Serbia were given an opportunity to sell the guarantees of origin all around Europe while, on the other hand, suppliers, who are obliged to provide insight into data on the share of all types of energy sources and on the data on total electricity quantities which were sold to a final customer, can provide guarantees of origin abroad, too.

EMS AD registers participants in the system of guarantees of origin. Structure of registered participants in the Registry of Guarantees of Origin reads:

- Eligible producer, supplier and wholesale supplier – 2 (2019), 2 (2020)
- Supplier and wholesale supplier – 4 (2019), 6 (2020)
- Eligible producer – 2 (2020)

The total number of issued guarantees of origin in the period from the first issued guarantee of origin (November 2018) until January 2020 amounted to 207,509, while there were 200,087 guarantees of origin issued only in 2020. The number of imported guarantees of origin in the period since import was enabled via AIB until the end of 2020 amounted to 84,449 while there have been no exported guarantees of origin so far.

3.1.3. Balancing Electricity Market

Balancing electricity market was established on January 1, 2013 and functions pursuant to Energy Law [1], Electricity Market Code [10] and Electricity Transmission Grid Code [8]. The legal form for establishing and functioning of balancing electricity market is defined by Energy Law [1], and transmission system operator is responsible for system balancing, according to the Law, which includes the following:

- providing the balancing services in accordance with transparent, non-discriminatory and market principles which will provide adequate incentives for system users to keep balance between their delivery and takeover of electricity;
- determination of the price of electricity for the needs of system balancing, pursuant to Electricity Market Code;
- regular publication of data relating to activated balance energy and settlement price.

On the balancing electricity market, the transmission system operator purchases and sells balancing energy for the purpose of balancing between production, consumption and electricity exchange in real time and ensuring the necessary level of frequency restoration reserve and replacement reserve. Pursuant to Energy Law [1], the transmission system operator, with the prior approval of AERS, shall adopt the Rules of Operation of the electricity market. The rules on the electricity market operation shall regulate in more detail: balance responsibility of market participants, balancing electricity market, calculation of balance group deviations, calculation of financial offsets between balance responsible parties, the payment security instrument and criteria for determining the amount and the period for which it is required, calculation of electricity needed for balancing and ensuring safe system operation, the method for providing system services and other matters necessary for the electricity market functioning.

In 2019 and 2020, 62 and 60 electricity market participants had a contract on balance responsibility with EMS JSC, which is, as the transmission system operator, responsible for system balancing and providing system services within its control area. Since the beginning of the balancing market operation, EMS JSC publishes hourly values of activated balancing energy and the settlement price.

In 2019 and 2020, in line with Contract on Providing Ancillary Services and Contract on Participation in Balancing Mechanism signed with PE EPS, EMS JSC activated the balancing entities of frequency restoration and reserve replacement within its control area for the purpose of keeping balance between the total electricity production, consumption and nominated

exchange blocks and calculate the deviations of the balance groups on the basis of which a financial settlement between the EMS JSC and the balance-of-responsibility parties at the monthly level. Also, during 2019 and 2020 EMS JSC performed so called cross-border balancing for the purpose of keeping balance within its own control area. This was done by activating balancing energy pursuant to contracts on cross-border exchange of balancing energy for replacement reserve with neighbouring transmission system operators, and the engagement consisted of the activation of slow cross-border reserve (emergency electrical energy) and the activation of balancing reserve within accounting period (in accordance with Contract on Sales and Purchase of Balancing Energy for Replacement Reserve for Ensuring Safe System Operation, signed with the transmission system operator of Montenegro (CGES) and NOSBIH (B&H TSO)).

In the end of 2020, a new Contract on Operation of SMM Block was signed and harmonized with the most recent European regulations. During the whole 2019 and 2020, together with SMM members (Serbia-Montenegro-North Macedonia) control block, EMS JSC worked on the establishment of CMM GCC (Grid Control Cooperation), i.e. on the netting of unwelcome deviations of control areas within the CMM control block.

In 2020, the total engaged balancing energy was 935.4 GWh (896 GWh in 2019), for which the total weighted settlement price amounted to 35.1 €/MWh (44.3 €/MWh in 2019), or, bearing in mind the direction of activated balancing entities [16]:

- In cases where the total balance energy in the calculation interval was greater than zero: in 2019 67.106 €/MWh and in 2020 56.7 €/MWh,
- In cases where the total balance energy in the calculation interval was less than zero: in 2019 21.792 €/MWh and in 2020 12.2 €/MWh.

The transmission system operator is also responsible for providing necessary system services in order to meet the needs of transmission system customers. In order to provide necessary resources, i.e. power capacities and energy for the needs of frequency containment, frequency restoration and replacement reserve, voltage regulation, as well as system restoration after blackout. The contracted reserve of active power for the needs of frequency containment process amounted to 34 MW in 2020 in accordance with the requirements ENTSO-E. Also in 2019 and 2020, the contracted active power range for the needs of frequency restoration was 160 MW, while the contracted positive and negative replacement reserve were 300 MW and 150 MW, respectively.

During the year 2019 and 2020, after each failure of the aggregate exceeding 1,000 MW in interconnection, total response of frequency containment proceess in Serbia was tested and satisfactory results were obtained.

Required reserve of active power in frequency restoration within the EMS JSC control area is 160 MW, while on the other hand the total available frequency restoration reserve in the EMS JSC control area is 1,086 MW (out of which 926 MW in hydro power plants and 160 MW in thermal power plants), so it can be concluded that EMS JSC should not have problems in securing frequency restoration reserve in the coming period. However, the quality of frequency restoration process still is not on a satisfactory level. After December 2017, there was a sharp deterioration in quality of operation of frequency restoration process due to unauthorized takeover of electricity in part of control area of Serbia in Kosovo and Metohia, which continued in 2019 and 2020.

In 2019, the number of hours of satisfactory operation of frequency restoration was between 16% (the value in January) and 42% (the value in May). The average hourly regulation error was between -99.1 MW and 9.5 MW. The standard deviation of regulation error was between 53.4 MW and 99.8 MW.

In 2020, the number of hours of satisfactory operation of frequency restoration was between 14% (the value in March) and 55% (the value in December). The average hourly regulation error was between -114.5 MW and 4.7 MW. The standard deviation of regulation error was between 60.9 MW and 109.6 MW.

During 2019 and 2020 PE EPS satisfactorily fulfilled contractual obligations related to securing reserve replacement, while EMS JSC covered his needs for the procurement of reserve from abroad mainly by exchange of cross-border regulating energy for replacement reserve from CGEC (transmission system operator of Montenegro) and NOSBiH (transmission system operator of Bosnia and Herzegovina). In relation to emergency situation energy, cross-border tertiary regulating energy can be activated much faster (in 15 minutes), the procedure is simple, and the price of energy is usually lower. In 2019 and 2020, EMS JSC procured the total of 5,643 MWh and 950 MWh and delivered 2,331 MWh and 360 MWh of cross-border regulating energy. In 2019, EMS JSC procured a total of 1,700 MWh and delivered 2,700 MWh of emergency energy. During the 2020 EMS JSC didn't exchange emergency energy with neighboring transmission system operators.

During 2020, EMS JSC actively participated in the establishment of a single European balancing market through membership of working groups and project teams within the ENTSO-E. EMS JSC is also an active participant in two European projects:

- IGCC project - European platform for netting of unwanted deviations - Imbalance Netting - EMS JSC is a non-operational member with membership in the IGCC steering committee.
- MARI project - European platform for the market of fast tertiary regulation (mFRR) - EMS JSC has the status of an observer and actively participates in the modeling and implementation of the future EU platform.

3.1.4. Organized Electricity Market

Pursuant to Energy Law [1], organised electricity market is an institutionally regulated relationship between supply and demand of the electricity market participants with predefined standardised products and physical delivery, on a time-scale of one day in advance and within a day. The activity of organised electricity market management shall be performed by the market operator founded by the transmission system operator, in the manner prescribed by an act of the Government.

The market operator shall be responsible for establishment of the organised electricity market, administering of the organised electricity market, efficient and functional connection of the electricity market in the Republic of Serbia with neighbouring electricity markets, in cooperation with the transmission system operator in the Republic of Serbia, as well as transmission system operators and market operators of neighbouring countries, in accordance with internationally defined principles and undertaken obligations.

EMS JSC, as an energy entity that was licensed to perform energy activities in the organization of the electricity market, founded on July 14, 2015 SEEPEX - power exchange, formed on the basis of partnership with EPEX SPOT. Currenty, SEEPEX [12] manages an organizes market with standardized products on a day-ahead market.

The benefits that SEEPEX has generated in the development of the electricity market in Serbia and the region is reflected through:

- getting a new product,
- harmonization of the trade process and clearing in the organized market in accordance with the best European practice,
- transparent pricing mechanism,

- getting and publishing the reference price,
- financial security of transactions concluded on the organized market through a centralized clearing and financial settlement process and
- promotion of competition.

The power exchange[9] started operating in February 2016. On the stock exchange, 22 participants were registered in 2020, which is 3 more than in 2019. all 22 participants were active in the trade. Currently SEEPEX has two standardized products - Single Contract Orders and Block Orders. Offers for individual hours contain up to 256 price/quantity combinations for each hour of the next day. Prices must be between 0.0 €/MWh and 3,000 €/MWh. A volume (whether positive, negative or nil) must be entered in the price range. Block Orders were successfully introduced on March 22, 2017 which enabled the participants to enter orders for one or more delivery periods with a minimum one-hour delivery for the same day of delivery. Block orders are used to link several hours on an all-or-none basis, which means that either the bid is matched on all hours or it is entirely rejected. Pre-defined Block Orders exist but participants are not restricted in the determination of the Block Orders of their choice.

The total amount of electricity that was traded on SEEPEX in 2020 was 2,816 GWh, which is about 290 GWh more than in 2019 (2,528 GWh). The share of electricity which was traded on the power exchange in comparison to the electricity volume which was delivered to all final electricity customers was 8.7% in 2019 and 8.3% in 2020. Exchange share in comparison to electricity volume delivered to final customers supplied in the open market (open retail market) was in 2019 18.7% and 21.2% in 2020. On the wholesale market, the exchange share amounts to 22.7% in 2019 and 21.4% in 2020. The wholesale market in this sense implies bilateral market (electricity purchase and sale between electricity suppliers) and purchase, i.e. sale of electricity in the exchange (organized market).

In 2019, the greatest monthly scale of trade in the exchange amounted to 260,895 MWh was recorded in November, while the daily maximum was recorded on March 11 with the trade scale of 13,483 MWh. The lowest trade scale was recorded in February and it amounted to 168,968 MWh which is 1.76 times higher than last year. The highest hourly price was reached on August 29 at 9 p.m. and it amounted to 153.3 €/MWh. Average basic price on the annual level amounted to 50.5 €/MWh. In 2020, the greatest monthly scale of trade was recorded in October – 311,733 MWh. The maximum daily scale was reached on October 2 with the trade scale of 13,978 MWh. The lowest monthly trade scale was recorded in July and it amounted to 191,179 MWh which is by 13% higher than in the minimum month of the last year. The maximum hourly price was recorded on December 17, at 5 p.m. and it amounted to 165.6 €/MWh. Average base price on the annual level amounted to 38.97 €/MWh, which is 22.95% less than the average price in 2019. The cause of such a drastic drop in the wholesale price of electricity is the pandemic caused by Covid 19, which had a negative impact on business customers. In this period, the companies paid more for electricity than the offer on the market, since at the end of 2019 they signed supply contracts at prices ranging around 50 €/MWh.

3.2. Production, Transmission and Distribution Capacities

3.2.1. Production Capacities

3.2.1.1. Conventional Energy Sources

The total net installed capacity of the power plants in the Republic of Serbia in 2020 amounts to 8,029 MW: in lignite-fired thermal power plants 4,079 MW, in hydro power plants 3,076 MW,

[9] SEEPEX activities can be followed on the website www.seepex-spot.com.

in natural gas-fired or heat oil-fired thermal power plants 298 MW and in small hydro power plants 107.5 MW (Table 5). The lignite used in thermal power plants is produced in surface mines which belong to PE EPS.

In addition to the production capacities of Republic of Serbia, the renewable sources includes power plants, CHP and gas plants with a total net production capacity of 576.985 MW.

Table 5: Net production capacities from 2013 to 2020 [25]

Technology	Net production capacity [MW]							
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Thermal power plants (coal)	3,827	3,846	3,971	4,032	4,054	4,079	4079	4079
Combined heat and power plants (gas, fuel oil)	277.0	249.0	249.0	336.0	336.0	336	297	297
Hydro power plants	2,894	2,905	2,982.59	2,988.98	3,008.28	3,044.75	3060	3076
Small power plants	51.052	61.715	63.685	70.075	82.377	96.746	104.130	107.510
Other sources (renewable sources)	8.85	13.83	14.66	37.56	47.84	290.99	432.9	440.3
Wind power plants	0.5	0.5	0.5	17	25	264.28	398	398
Solar power plants	3.48	8.46	9.29	10.22	10.5	10.708	11	12
Biogass power plants	4.9	4.9	4.9	10.34	12.34	16	21.535	28.505
Biomass power plants							2.4	2.4
Other	109.84	109.84	109.84	109.84	109.84	109.84	110.15	99.82
CHP	9.6	11.9	11.9	20.50	31.84	31.836	32	37
Gas plants		1.0	1.0	3.40	3.40	3.409	3.4	3.4
Total	7,126.3	7,135.3	7,339.0	7,524.88	7,587.79	7,892.410	8,010.501	8,029.385

The share of the capacities within thermal power plants (TPP) and combined heat and power plants (CHP) amounts to 55%, while the hydro power plants (HPP) cover 38.5%. There is also one pumped-storage hydro power plant among HPPs of PE EPS with 2x307 MW capacity which is very important for system operation, apart from covering an important energy share, and about 7% of the installed capacity are other power plants.

In addition to PE EPS, the licence for power production was also held by 28 energy entities, while the licence for combined power and heat production was held by 9 energy entities (including PE EPS) with production facilities with capacity of over 1 MW.

Out of all licenced independent producers, the biggest ones include "Vetroelektrane Balkana d.o.o, Beograd" with wind farm Čibuk 1 with 158.46 MW, "ELECTRAWINDS K-WIND d.o.o." with a wind park Kovačica of 104.5 MW, "MK-FINTEL WIND AD" with wind park Košava of 68 MW, "ELICIO ALI VE d.o.o." with a wind park Alibunar of 42 MW, NIS JSC with 11.94 MW in 9 facilities, "Vetropark Kula d.o.o." (Windfarm Kula) with 9.9 MW, "Novosadska toplana" (Novi Sad District Heating Company) with combined production of 9.98 MW, "ELECTRAWINDS MALI WF d.o.o." with a wind power plant Malibunar of 8 MW, "ENERGOBALKAN d.o.o." with a wind power plant La Piccolina of 6.6 MW and "Gazprom Energoholding Serbia TETO Pančevo d.o.o." with CHP Pančevo 192MW.

The construction of new production units is needed in order to replace the existing ones, which, due to outdated technology cannot meet the requirements of environmental protection, as well as to cover the possible increase in electricity consumption.

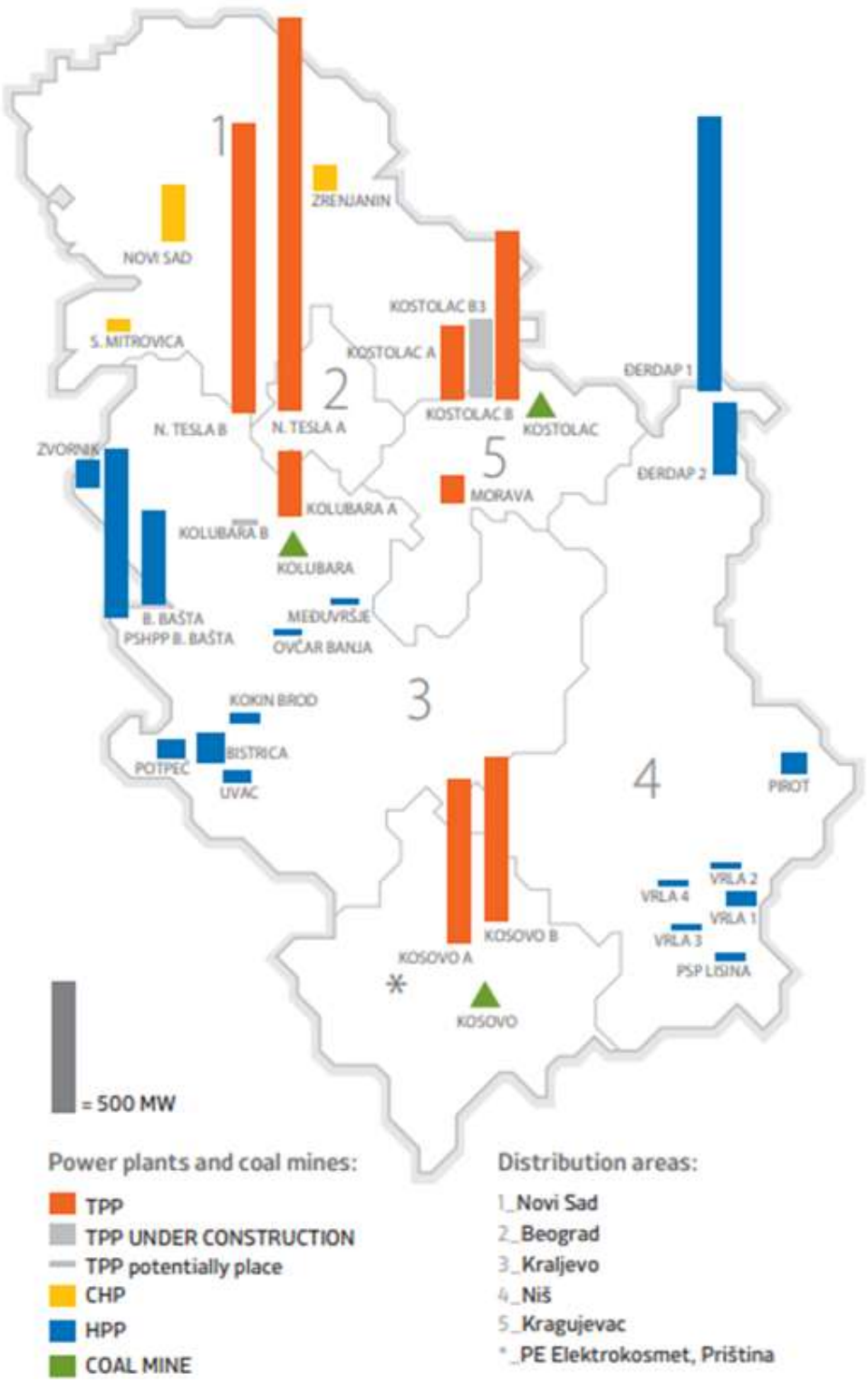

Figure 1: Production capacities PE EPS[10]

[10] As of June 1999, PE EPS does not operate its facilities on the territory of Kosovo and Metohija.

3.2.1.2. Renewable Energy Sources

Pursuant to the Article 20 of the Energy Community Treaty (Official Gazette of the RS, No. 62/06) the Republic of Serbia accepted the commitment to apply European Directives in the field of renewable energy sources - Directive 2001/77/EC for the promotion of electricity from renewable energy sources and the Directive 2003/30/EC for the promotion of biofuels or other fuels produced from renewable energy sources for transport. Since 2009 mentioned Directives were gradually replaced and in January 2012 they were repealed by a new Directive 2009/28/EC of the European Parliament and Council, dated April 23, 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.

In accordance with the Directive 2009/28/EC [13] and the Decision of the Council of Ministers of the European Community dtd. October 18, 2012 (D/2012/04/MC-EnC) a very ambitious binding target was set for the Republic of Serbia, amounting to 27% renewable energy sources in final gross energy consumption in 2020 and 10% of the energy share of produced from renewable energy sources in transport in 2020. At the same time, it was defined that the National Action Plan for renewable energy sources of the Republic of Serbia should be prepared, in compliance with the adopted template for the preparation of this document (Decision 2009/548/EC). In the meantime, Directive 2018/2001 EU (RED II) (in December 2018) came into force, starting from July 1, 2021

The Republic of Serbia in 2013 has adopted the National Renewable Energy Action Plan [14] as a framework for the promotion of energy produced from renewable sources and has set mandatory national targets for the share of energy from renewable energy sources which defined the way of achieving binding national target.

Pursuant to the abovementioned and in order to increase the use of renewable sources, Republic of Serbia joined the countries that subsidize the production of electricity from renewable sources and introduced the most widespread model - stimulated fixed redemption price (the "feed-in" tariffs) with the guaranteed electricity takeover of 12 years.

Incentive measures can be used by energy entities that have acquired the status of a privileged producer within the meaning of the Energy Law [1]. The privileged producer is entitled to incentive measures by concluding a contract on purchase of electricity with a guaranteed supplier.

In accordance with the Energy Law [1] Ministry in charge of energy monitors the implementation of the National Action Plan and submits the annual report to the Government (hereinafter: the Report). Also, in accordance with Article 15 of the Decision of the Ministerial Council of the Energy Community (D/2012/04/MC-EnC) signatories to the Treaty establishing the EnC submit report to the EnC Secretariat on progress in the promotion and use of energy from renewable sources every two years. The first report was made in 2014 and contains data for year 2012 and 2013, while the Report of the progress on implementation of the national action plan for renewable energy sources was adopted in December 2016. The second report was submitted by 31 December, 2016 and contains data for 2014 and 2015. The third report was submitted by December 31, 2018 and contains data for 2016 and 2017. The Fourth Report is submitted by December 31, 2020 and contains data for 2018 and 2019.

The quantities of electricity taken over from renewable sources from 2013 to 2020 are shown in Table 6.

Table 6: Electricity production from renewable sources from 2013 to 2020 [15], [25]

Renewable energy sources	Electricity [GWh]							
	2013	2014	2015	2016	2017	2018	2019	2020
Hydro power plants	10,853	11,617	10,783	11,520	9,752	11,393	10,198	9,749
Solar power plants	1.50	6	11.45	12.43	13.14	13.04	13.55	13.261
Wind power plants	0.55	0.37	0.42	25.91	48.45	150.42	898.21	975.63
Total	**10,855.05**	**11,623.38**	**10,794.87**	**11,558.34**	**9,813.59**	**11,556.62**	**11,110**	**10,738**

3.2.2. Transmission Capacities

Transmission system of Republic of Serbia includes 220 and 400 kV network and one part of 110 kV network in accordance with the Energy Law [1].

Transmission lines 400 kV connect the largest and most important centres of production and consumption in Serbia. Mainly over this voltage level, whole power system of Serbia is interconnected with power systems of the neighbouring countries, allowing international trade of electricity. Transmission system makes Serbia part of a Pan-European system for the transmission of electricity. Over interconnection lines Republic of Serbia is directly connected with eight countries and provides the transmission of electricity from north to south, from east to west and from the northeast to the southwest of Europe [16].

Transmission system of EMS JSC is connected with the neighbouring power systems via twenty-three 400, 220 and 110 kV interconnection lines, while 22 of them are active. In addition to transmission lines and power plants transmission system includes other supporting systems (telecommunication system, remote control system, power consumption, etc.). All of this makes transmission system one of the most complex infrastructure systems.

The electricity transmission system of the Republic of Serbia which EMS JSC is responsible for, is shown in Table 7 and Table 8.

Changes in capacity of plants connected to the transmission network were recorded due to the commissioning of 300 MVA, 400/110 kV transformers in TS Smederevo 3 and a new connection 110 kV for distribution plant Košava Wind Farm (2019). In 2020, due to the works on the reconstruction of TS 220/110 kV Srbobran, T1 220/110 kV, 150 MVA, was permanently dismantled.

During 2019 and 2020, capacity of the transmission line EMS JSC increased in total amount of 45 km (increase by 11.01 km 400 kV and 99 km 110 kV and decrease by 65.02 km 220 kV) due to the realization of the following investments.

In 2019, due to the introduction of OHL 400 kV number 401/1 TS Beograd 8 - RP Drmno in TS Smederevo 3 and the resulting transmission lines 400 kV number 401/3 TS Beograd 8 - Smederevo 3 and OHL 400 kV number 401/4 TS Smederevo 3 - RP Drmno, reconstruction of 110 kV transmission line number 107/1 TPP Kolubara - TS Tamnava - west field and 110 kV transmission line number 120/1 TPP Kolubara - TS Lazarevac, reconstruction near Vreoc, a new cable line KB 1263 TS Beograd 17 - TS Beograd was built 23 and the introduction of cable 172 TS Beograd 6 - CHP Novi Beograd in TS Beograd 45.

In 2020, due to the construction of the 110 kV OHL number 1270 TS Bela Crkva - TS Veliko Gradište, construction of the 110 kV cable line No. 1264 TS Beograd 23 - TS Beograd 45 and reconstruction of 110 kV OHL No. 106AB, construction of transmission line 2x110 kV number 1268AB TS Bor 1— TS Bor 2, construction of cable line 110 kV number 1232 TS Kruševac 1 - TS Kruševac 3, due to reconstruction of OHL 209/2 TS Sremska Mitrovica 2 - TS Srbobran from pillar No. 3 to the 110 kV portal in TS Srbobran, after which OHL 209/2 becomes OHL 110 kV No. 1272 TS Sremska Mitrovica 2 - TS Srbobran.

Table 7: EMS JSC facilities [16]

Facilities owned by EMS JSC		2013	2014	2015	2016	2017	2018	2019	2020
400/x kV	Number of facilities	16	17	18	18	18	19	20	20
	Number of transformers	23	24	29	29	29	29	30	30
220/x kV	Number of facilities	14	14	14	14	14	14	14	14
	Number of transformers	31	31	30	30	30	30	30	29
110/x kV	Number of facilities	6	6	6	6	6	7	9	9
	Number of transformers	13	13	14	14	14	14	16	16
Total	**Number of facilities**	**36**	**37**	**38**	**38**	**38**	**40**	**43**	**43**
	Number of transformers	**67**	**68**	**73**	**73**	**73**	**73**	**76**	**75**

Table 8: EMS JSC transmission lines [16]

Power lines owned by EMS JSC		2013	2014	2015	2016	2017	2018	2019	2020
400 kV	Number of OHL	32	33	34	34	36	37	38	38
	Length of OHL (km)	1,613.72	1,613.72	1,630.04	1,629.4	1,766.1	1,787.7	1,798.1	1,798.7
220 kV	Number of OHL	48	48	46	46	46	47	48	47
	Length of OHL (km)	1,884.47	1,884.47	1,845.51	1,844.59	1,844.59	1,847.68	1,847.14	1,782.66
110 kV	Number of OHL	332	341	353	359	358	367	370	374
	Length of OHL (km)	5,578.68	5,641.47	5,785.78	5,821.29	5,805.23	5,899.41	5,902.17	5,998.35
110 kV	Number of cable	-	-	-	-	9	9	11	13
	Length of cable (km)	-	-	-	-	36.58	36.58	42.72	51.15
< 110 kV*	Number of OHL	15	12	12	11	10	10	10	12
	Length of OHL (km)	245.50	235.03	231.85	220.62	220.63	220.63	220.63	230.92
Total	**Number of lines**	**427**	**434**	**445**	**450**	**459**	**470**	**477**	**484**
	Length of lines (km)	**9,322.37**	**9,374.69**	**9,493.18**	**9,515.90**	**9,673.09**	**9,791.99**	**9,811.07**	**9,861.78**

*110 kV OHL works on the 35 kV voltage.

3.2.3. Distribution Capacities

Distribution system of Republic of Serbia includes 35 kV, 20 kV and 0.4 kV network and transformer stations 110/X kV, in accordance with the Energy Law [1].

Within the Elektrodistribucija Srbije there are 35,919 transformer stations with a total installed capacity of 30,846 MVA (Table 9) and 164,481 km of power lines of all voltage levels (Table 10).

The process of handover of substations between EMS JSC and PE EPS in accordance with the Energy Law [1], which started in 2013 is fully completed in 2018 [17].

Table 9: Elektrodistribucija Srbije facilities [17]

Facilities		2013	2014	2015	2016	2017	2018	2019	2020
110/X kV	Number of facilities	177	186	183	187	188	189	196	197
	Installed capacity [MVA]	9,476	10,388	10,326	10,623	10,540	10,595	10,858	11,005
35/10 kV	Number of facilities	589	589	583	581	562	583	582	584
	Installed capacity [MVA]	6,313	6,313	6,439	6,446	6,317	6,397	6,470	6,553
20/0,4 kV	Number of facilities	8,044	8,126	11,141	8,344	8,492	11,688	8,703	8,855
	Installed capacity [MVA]	3,052	3,087	5,174	3,188	3,247	5,510	3,336	3,391
10/0.4 kV	Number of facilities	25,542	27,535	26,372	25,765	25,916	26,700	26,191	26,283
	Installed capacity [MVA]	9,435	11,209	9,913	9,770	9,749	10,113	9,791	9,897
Total	**Number of facilities**	**34,352**	**36,436**	**38,279**	**34,877**	**35,158**	**39,160**	**35,672**	**35,919**
	Installed capacity [MVA]	**28,276**	**30,997**	**31,852**	**30,027**	**29,853**	**32,615**	**30,455**	**30,846**

Table 10: Elektrodistribucija Srbije power lines [17]

Power lines (km)	2013	2014	2015	2016	2017	2018	2019	2020
110 kV	183	151	33.66	33.66	7.86	-	-	-
35 kV	6,844	6,830	6,823	6,791	6,582	6,613	6,677	6,815
20 kV	9,053	9,251	9,388	9,587	9,960	11,679	10,295	10,525
10 kV	30,530	32,349	32,701	32,929	33,153	33,637	33,448	33,669
0,4 kV	105,401	109,928	110,919	111,540	112,230	113,173	112,951	113,472
Total	**152,011**	**158,509**	**159,865**	**160,881**	**161,933**	**165,102**	**163,372**	**164,481**

3.3. Scope and Quality of the Production, Transmission and Distribution Systems Maintenance

3.3.1. Production Maintenance

The program for maintenance of electricity and heat production in 2019 and 2020 included the following activities: (planned-preventive and corrective, ie intervention maintenance), overhaul (standard, extended and capital) and investment maintenance (modernization of equipment, increase efficiency, prolonging the life of plant exploitation, increasing installed capacity, environmental programs and other).

The goals of routine maintenance in 2019 and 2020 were: determining and monitoring the state of the plant through regular preventive examinations and various methods of diagnostics, implementation of minor preventive work on plants, analysis of observed disorders and taking necessary corrective measures at a convenient time and in cases of sudden failure of the plant, organization of quickly failures repair and returning the plant to the working state.

Maintenance of TPP and CHP

Standard maintenance is an annual planned outage that usually lasts from 3 to 6 weeks. During the standard maintenance, remediation and repair of worn assemblies are performed, as well as the replacement of parts that are assumed to be unable to withstand operation, without failure, until the next overhaul.

In 2019, standard maintenance was performed on the following generating units:

- TPP Nikola Tesla A: units A1, A3, A4 and A6,
- TPP Nikola Tesla B: units B1 and B2,
- TPP Kolubara: unit A3,
- TPP Morava: unit A,
- TPP Kostolac: units A1, A2 and B1 and
- CHP Novi Sad: units A1 and A2.

In 2020, standard maintenance was performed on the following generating units:

- TPP Nikola Tesla A: units A2, A5 and A6,
- TPP Nikola Tesla B: units B1 and B2,
- TPP Kolubara: units A3 and A5,
- TPP Kostolac: units B1 and B2 and
- CHP Novi Sad: units A1 and A2.

Medium-scale maintenance is a planned outage in which, in addition to more complex preventive and corrective interventions, minor reconstructions and replacements of system parts are performed, which require a longer period of time and cannot be realized during the standard maintenance. Maintenance of this scope lasts from 6 to 11 weeks and is realized every other year.

In 2019, medium-scale maintenance was performed on the following generating units:

- TPP Nikola Tesla A: units A2 and A5 and
- TPP Kolubara: unit A5.

In 2020, medium-scale maintenance was performed on the following generating units:

- TPP Nikola Tesla A: units A3 and A4 and
- TPP Morava A.

Large-scale maintenance is a planned outage of a production facility after 35,000 to 50,000 hours of operation. This maintenance includes the replacement of parts and assemblies that are estimated to be unable to withstand without failure until the next maintenance, and the replacement of which would require a long delay with significant and extensive dismantling / assembly work. The duration of the maintenance itself is conditioned by the scope and complexity of the necessary, planned works, and the interval between each maintenance is determined based on the manufacturer's recommendation and the results of controls conducted in annual inspections.

In 2019, the large-scale maintenance was realized on unit B2 in TPP Kostolac, while in 2020 it was realized on unit A1 in TENT A, and on units A1 and A2 in TPP Kostolac A. On the units of TPP Kolubara A1 and TPP Kolubara A2, no large-scale maintenance was planned for 2019 or 2020, so the every day maintenance of the plant was intesified.

Most of the maintenance works were performed in the approximately planned duration and scope. Date and time of the maintenance were harmonized with the consumption of the power system, the maintenance of the mining plants and the realization of public procurements of goods and works. Changes in planned dates, i.e. the postponement of the maintenance beginning to a later date, mainly in 2020, occurred due to the COVID-19 pandemic.

When it comes to unplanned outages of thermoblocks, in 2019 and 2020 there was a decrease in their total number compared to 2018 (in which a relatively large increase was recorded compared to the previous year, 2017).

Data on outages for 2019 and 2020 are presented in the following table (Table 11).

Table 11: The number of outages of coal-fired thermoblocks in PE EPS in 2019 and 2020

Year		2019	2020
Boiler pipe system		77	100
Turbine facillity		23	25
Technological and electrical protection		19	13
Power facillity		2	5
Other		10	6
∑ without suppresion		131	149
Cold reserve suppression		29	20
∑ IN TOTAL		160	169
Forced outages	Number	131	149
	Forced outage rate Ki (%)	6.3	5.8
	Equivalent forced outage rate EKi (%)	21.3	19.3

As can be seen from the table shown, the total number of outages in 2019 and 2020 did not vary much. The total number of outages, not suppression, increased from 131 to 149, which is an increase of cca. 14%, but taking into account that the number in 2018 was 179 (and 136 in 2017), it is concluded that these changes are not of particular importance. What is noticeable is the relatively large increase in the number of outages due to failures in the pipe system of the boiler, from 77 to 100 (or 30%). This increase is primarily a consequence of the higher frequency of these failures in TENT A, because in the observed period the number of these outages increased from 25 in 2019 to as many as 44 in 2020. For comparison, the total number of such outages in all TPPs and TPPs in 2017 was only 48.

Although the number of outages due to turbine consumption failures has been relatively constant in the last three years, it should be noted that the number of these outages in 2017 was only 12, which is half less than in 2019 or 2020. In the period 2019-2020, the largest increase in the number of outages of this type is recorded in thermal power plants in Kostolac, where the number increased from 7 in 2019 to 13 in 2020.

In 2020, the number of repression into the cold reserve was reduced by 9 compared to the previous 2019, and the number of outages due to the action of technological and electrical protections was reduced by 6 in the same period.

In the following period, it will be necessary to plan procurements and works that will reduce the number of unplanned outages. A detailed inspection of the heating surfaces of the boiler plant and replacement of all pipes damaged by abrasion and corrosion is necessary. In this field, a lot is expected from the project of homogenization of coal quality within Kolubara Mine Complex. In TPP Kostolac B, improvements are planned in the system of collection and transport of ash and slag from growth. Equipment failures in this part of the plant have repeatedly caused delays and reduction of boiler load during emergency works in conditions without complete shutdown of the plant.

The data are taken from the official annual reports of PE EPS on the implementation of the maintenance program of PE EPS power plants for 2019 and 2020.

Hydro sector

PE EPS has 48 classical hydro-generators, two pumping plants, two reversible hydro-generators and one household aggregate (the third aggregate in HPP Međuvršje). All these aggregates were organized in a total of 16 hydropower plants and one pumping accumulation plant through branches of HPP Đerdap and HPP Drinsko Limske[11]. The most significant investments in 2019 and 2020:

- Revitalization of hydro-unit A2 in HPP Đerdap 1 has been completed (5th stage, from September 3, 2018 to November 15, 2019, lasting 14.5 months)
- At the end of 2019, preparations for the revitalization of the hydro-unit A3 in HPP Đerdap 1 (6th and last stage) began. Preparatory works continued in 2020, but the dismantling works scheduled to begin on September 1, 2020 postponed to 2021 due to delays in the delivery of parts from Russia.
- Revitalization of hydro-unit A3 in HPP Zvornik continued (started on January 11, 2018). In December 11, 2018 revitalized unit A3 was put into trial operation for 30 days, after which it began to operate in the warranty period of 12 months.
- Revitalization of hydro-unit A4 in HPP Zvornik started on February 11, 2019, with an estimated duration of 12 months. This work was successfully completed within the

[11] Mini HPPs not included.

stipulated period, after which the hydro-unit was in trial operation for 30 days, until January 20, 2020, when it started to operate in the warranty period of one year.

- In 2020, the installation of equipment for the Static Frequency Converter (SFP) in RHE Bajina Bašta was performed and preparatory works for revitalization began.
- During 2019, the production, ie production of a new 242/15.65 kV transformer, with a power of 112 MVA in HPP Bajina Bašta, was underway, and in 2020, the FAT[12] documentation was reviewed and the necessary preparatory works for installation were performed. The new unit transformer was delivered on June 12, 2020.
- Revitalizations of hydro-units in small hydro power plants were performed during 2019 and during 2020.
- In 2020, there were other investment works, such as preparatory works and the beginning of the revitalization of the (ship) lock in HPP Đerdap 1.

During 2019, major maintenance was performed on the following units: A1 in HPP Đerdap 2 (103 days), A2 in HPP Đerdap 2 (117 days), A2 in HPP Bajina Bašta (45 days) and A1 in HPP Potpeć (49 days).

During 2020, major maintenance was performed on the following units: A3 in HPP Đerdap 2 (95 days), A4 in HPP Đerdap 2 (117 days), A3 in HPP Bajina Bašta (45 days).

As for other hydro-units, a relatively large number of inspections and standard maintenance works were performed. Pump-aggregate line number 1 (electric motor M1), which was damaged in PSP Lisina in 2018, was repaired in 2020. Long duration of individual outages was also recorded in HPP Vrla 3 (64 days in 2019), due to increased vibrations in the turbine bearing of unit A1, in HPP Ovčar Banja (34 days in 2019), due to reparation of hydraulic valve NO 250 on the bypass pipeline of unit A1 and in HPP Zvornik (21 days in 2020), due to water penetration in the leading turbine bearing of the A4 unit. All these malfuncions have been successfully eliminated.

Other activities:

- During 2019 and 2020, investment-technical documentation was prepared for the upgrade of the ash and slag landfill at the location of TENT A - cassettes 4 and 5, because by the end of 2022 the projected capacities on cassettes 1 to 3 will be filled.
- In TENT A, on February 14, 2019, the construction of the flue gas desulphurization plant of units A3 to A6 began and the works continued during 2020.
- In 2019, in TPP Kostolac, the works on the construction of the river port on the tributary of the Danube in the immediate vicinity of TPP Kostolac A were completed.
- The tender for the selection of contractors for the project for condensed transport of ash, slag and gypsum for TENT A units (loan from KfW Bank) which was announced in 2020 was annulled due to incorrect offers. The retender procedure is in progress.
- During 2019, tender documentation was prepared for the procurement and installation of equipment for the purpose of reconstruction of HPP Bistrica. The repeated tender procedure for the selection of equipment suppliers and contractors is in progress.
- In 2020, a techno-economic analysis of installation options and a proposal for the selection of the optimal variant of reconstruction was performed as part of the preparation of technical documentation necessary for the start of the reconstruction of HPP Đerdap 2.

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- During 2020, after the appropriate preparations of the previous year, the Contract for the project for the construction of a flue gas desulphurization plant for units TENT B1 and B2 was signed.
- The realization of the 2nd phase of revitalization of unit TENT B1 with the replacement of the evaporator below the elevation of 72.5 meters and the implementation of the NOx system by primary measures is in progress.
- The project of the 2nd phase of revitalization of unit TENT B2 is being prepared (start of works planned for 2023).
- Regarding the maintenace within the sectors for production, processing and transportation of coal, in 2019 it is planned to start and finish maintenance on a total of 18 overburden systems, 9 systems for coal production and 4 lines for coal processing. All these maintenance works were realized, except in the case of ECS systems for overburden, where the maintenace was not done on 4 overburden systems (out of the planned 18). For 2020, it is planned to realize 19 systems of overburden, 9 systems for coal production and 4 lines for coal processing. As in the previous year, these maintenace works were carried out, except in the case of the BTO overburden system where the maintenace was not done on 4 overburden systems (out of the planned 19).

3.3.2. Transmission System Maintenance

Energy Law [1] stipulates the obligation of the system operator to ensure safe and reliable transmission of electrical energy, which therefore implies adequate maintenance.

During 2019 and 2020 the focus of works on power lines was on regular maintenance, inspections, and overhauls. On the 110 kV, 220 kV, and 400 kV transmission lines all planned overhauls were performed in 2019, while in 2020 a number of revisions/overhauls that were performed was less than planned (79%) due to the situation caused by the COVID-19. The planned overhaul and inspection of OHL 1140/2 was partially performed in 2019, including a problematic part of the route along the land security zone (minefields) with Kosovo and Metohija, which could not be realized until 2019, during which the terrain was partially demined. Continuation of demining is planned for 2021.

In 2019, a total of 8,115.91 km of transmission lines of all voltage levels were repaired, and in 2020 a total of 8,533.83 km. In addition to major works on the construction and reconstruction of lines (see page 30), works on the installation of OPGW cables on individual EMS JSC transmission lines were performed during 2019 and 2020, as follows:

<u>In 2019</u>

- OHL 110 kV No. 296 between TS Obrenovac - TPP Nikola Tesla B, in pillar range No. 17 - 23,
- OHL 110 kV No. 1113 between TS Leskovac 2 - HPP Vrla 3, repairment of OPGW cable damage in pillar range TS Leskovac 2 - pillar No. 12,
- OHL 110 kV No. 101A/3 between TS Smederevo 1 - TS Smederevo 4 , in pillar range TS Smederevo 4 - pillar No. 9z,
- OHL 110 kV No. 101A/4 between TS Smederevo 4 - TPP Kostolac A, section G,
- OHL 110 kV No. 183 between TS Zrenjanin 1 - TS Zrenjanin 2.

<u>In 2020</u>

- OHL 110 kV No. 1245 between TS Niš 2 - Prokuplje, in pillar range TS Niš 1 - pillar No. 12A and pillar No. 70 - TS Prokuplje.

The operational readiness of transformers and high-voltage equipment during 2019 and 2020 was at a high level. Good operational readiness of substations was contributed by: quality preventive and corrective maintenance of high voltage equipment, regular inspections, checks, overhauls, as well as reconstructions of substations.

In 2019, all 400/X, 220/X, and 110/X kV transformers planned for overhaul were overhauled. In 2020, only the 220/X kV transformer in TS Sremska Mitrovica 2 was not overhauled, for which disconnection permission was not obtained due to the energy situation. In addition to the planned works during 2019 and 2020, there were also significant engagements in the corrective and interventional elimination of the deficiencies.

Of the major works on high-voltage equipment and substations during 2019 and 2020, the following stand out:

- Continuation of the reconstruction of TS 220/110/35 kV Srbobran, preparations were made for the introduction of 400 kV voltage level and the transformation of 400/110 kV in the facility, reconstruction of 110 kV transmission line fields and the connecting field was performed, 400 kV transformer field was completed, and the 400/110 kV power transformer with all its equipment is positioned on the oil retention pit, and in 2021 a new transformation is expected to be commissioned.
- In 2019, the reconstruction of 110 kV and 35 kV switching stations were completed at TS 220/110/35 kV Kruševac 1. Preparatory activities were carried out for the entry of a 110 kV cable for connecting TS Kruševac 1 with distribution TS Kruševac 3.
- A new voltage level was introduced in TS Smederevo 3 in 2019, and now it is TS 400/220/110/10 kV. The projected second phase of the reconstruction was completed, which included: construction of 400 kV SS, installation of 400/110 kV transformer, reconstruction of 110 kV SS, reconstruction of TS 10 kV, and reconstruction of low voltage distribution for own consumption of the facility.
- Reconstruction continued at TS 220/110/35 kV Beograd 5. In 2019 and 2020, 35 kV cells with the corresponding busbar segments were reconstructed and new transport paths were built. The works will continue in 2021.
- A new energy transformer T4 with a transmission ratio of 110/35/10.5 kV of rated power 63 MVA was installed in TS 110/35 kV Belgrade 4 during 2019.
- In 2019, the 110 kV SS Košava was connected to the transmission system, for the connection of the wind power plant of the same name.
- In 2020, the adaptation of own consumption in TS 400/220/110 kV Sremska Mitrovica 2 began. The low voltage distribution was partially put into operation, and the completion of works is expected during 2021.
- In 2019, a new diesel-electric generator was put into operation at TS 400/110 kV Bor 2. Thus, the oldest diesel generators in EMS JSC, 51 years old, were withdrawn from the operation.
- In 2019, the construction of a new 110 kV field in TS Beograd 17 was performed for the needs of connecting the cable line (KB1263) from the direction of TS Beograd 23.
- In 2020, the construction, installation, and testing of high-voltage equipment at the new TS Bistrica were completed. The 220/110 kV power transformer with a rated power of 150 MVA was successfully transported and installed at TS Bistrica. In 2021, the facility is expected to be put into operation.
- TS Rudnik 3, TS Rudnik 4, and TS Rudnik 5 were connected to the transmission system in SS Drmno 110kV.

- In 2020, the operational readiness of transformer stations was additionally increased by purchasing two new transformers, namely the transmission ratio 220/110 kV (rated power 250 MVA) and the transmission ratio 400/110 kV (rated power 300 MVA). The 220/110 kV transformer (250 MVA) is preserved and placed in the central warehouse of EMS JSC, while the 400/110 kV transformer (300 MVA) is located in the premises of TS Niš 2.

3.3.3. Distribution System Maintenance

Reconstruction of TS 110/X kV started in 2015. In the first phase, eight transformer stations were selected for reconstruction: TS Petrovac 1, TS Šabac 1, TS Aleksinac, TS Gornji Milanovac, TS Lešnica, TS Niš 1, TS Zrenjanin 1, and TS Beograd 2. Funds for the reconstruction of the first five TS were provided through a loan from the World Bank. The reconstruction of TS Gornji Milanovac is completed in 2020, and the reconstruction of TS Beograd 2 and TS Petrovac 1 is underway, where the works are expected to be completed by the end of 2023. For TS Šabac 1, TS Aleksinac, and TS Lešnica, preparations are currently being made for the implementation of preparatory activities for the construction of facilities. A contract on connection with EMS JSC has been signed, most of the equipment has been procured and the preparation of the public invitation for the execution of works is in progress. A contract on connection with EMS JSC was signed for TS Zrenjanin 1. The preparation of technical documentation is in progress and the supplier of equipment and the contractor have been selected. Completion of works for all four substations (Šabac 1, Aleksinac, Lešnica, Zrenjanin 1) is expected during 2024.

In the second phase, the following TS 110/X kV are planned: TS Beograd 10, TS Požarevac 1, TS Kuršumlija, TS Raška, and TS Bor 1 (for TS Beograd 10 a contract on procurement and installation of equipment was concluded and a construction permit was obtained, TS Kuršumlija received a construction permit, for TS Požarevac 1 a project task was adopted and project documentation is being prepared, TS Raška and TS Bor 1 are in the initial phase of preparation of project technical documentation).

The significant investment into the distribution system automatisation at all voltage levels over the last several years has led to the considerable increase in the number of facilities and elements of the distrbution system which are included in the remote monitoring and control systems (RMC). At 110/X kV substations, as the most important elements of the distribution system, out of the total of 198 facilities from this category, 189 are included in RMC, and it is expected that the remaining 9 substation will be adjusted and included in the mentioned system. As for 35/X kV substation and switching stations, 386 out of the total 612 are included in RMC. The process of automatisation of the elements of the remaining part of the distribution system within the Elektrodistribucija Srbije is in a considerable progress as well, so that 1,777 different elements/facilities (substation 20(10)/0.4 kV, reclosers and busbar sectionings), which are distributed throught the network, are currently included in RMC. The improvement of measuring equipment and further development of the remote reading system was in progress during 2019 and 2020, but not in the planned scope.

Implemented activities related to the download of measuring devices and distribution boards in the facilities of existing customers, ie manufacturers connected to the distribution network according to the plan adopted by AERS are presented in more detail in chapter 3.7.3.

3.4. Security Assessment of Transmission and Distribution System Operation

The main guideline in the construction of the transmission and distribution network is the "n-1" criteria, according to which failure of any transmission line does not lead to a reduction in the supply of electric power to customers. Radially powered system users in which this criterion is not fulfilled are mostly in rural and mountainous areas at the distribution level.

3.4.1. Security Assessment of Transmission System Operation

Indicators of discontinuity of delivery in the transmission network which are monitored and calculated are the following:

- Power failure – undelivered power [MW] – total failed power on all measuring points where supply was interrupted,
- ENS [MWh] – total undelivered electricity which amounts to total undelivered electricity during all interruptions,
- ENS [%] – a share of undelivered electricity in total delivered electricity,
- AIT [min] – average interruption duration in minutes, a quotient of undelivered electricity and average power.

Indicators of discontinuity in delivery within the transmission network calculated in such a manner for the period 2013 – 2020 are given in Table 12.

Table 12: Indicators of discontinuity in delivery within the transmission network [11]

Interruptions		Power failure – undelivered power [MW]	ENS [MWh]	ENS [%]	AIT [min]
2013	Planned	161	618	0.002	10.43
	Unplanned	1,770	747	0.002	12.65
	Total	1,931	1,365	0.004	23.09
2014	Planned	115	110	0.0003	2.07
	Unplanned	1,905	3,496	0.0104	57.25
	Total	2,020	3,605	0.0107	59.32
2015	Planned	359	1,543	0.0046	26.57
	Unplanned	2,292	1,659	0.0049	26.35
	Total	2,351	3,202	0.0095	52.92
2016	Planned	167	547	0.0016	9.61
	Unplanned	1,693	1,317	0.0039	21.32
	Total	1,860	1,864	0.0055	30.93
2017	Planned	306	1,496	0.0044	24.76
	Unplanned	1,980	1,418	0.0042	24.04
	Total	2,286	2,914	0.0086	48.79
2018	Planned	350	1,552	0.0024	27.30
	Unplanned	1,059	826	0.0013	13.42
	Total	1,409	2,378	0.0037	40.72
2019	Planned	429	1,065	0.0032	17.93
	Unplanned	832	595	0.0017	9.25
	Total	1,261	1,660	0.0049	27.18
2020	Planned	676	1,162	0.0035	20.70
	Unplanned	2,856	978	0.0029	15.84
	Total	3,535	2,140	0.0064	36.54

In comparison to 2018, the indicators for unplanned interruptions are significantly better in 2019, both in terms of undelivered electricity as well as in terms of power failure, where indicators were lower by one third in comparison to the last year level. The indicators for planned interruptions are worse but they are on the level of last five-year average level.

The unplanned interruptions indicators considerably deteriorated in 2020, both in terms of undelivered electricity as well as of power failure where indicators were increased even three times in comparison to 2019 year level. Thecauses of this are the disruptions in the transmission system during 2020: first of all, the disruption in TS Pančevo 2 and the failure on the overhead line 106AB in February as well as the disruption in TS Smederevo 3 in July. The indicators for planned interruptions deteriorated considerably. Power failure was 3.4 times higher than previouus year. The increase in the power failure and thereby in the undelivered electricity due to planned interruptions is a consequence of planned works within the transmission system, the connection of new transmission system elements and the overhaul of existing ones.

In 2019 average duration of unplanned interruption amounted to 17.93 minutes, while planned interruption amounted to 9.25 minutes. Total average duration of supply interruption in 2019 amounted to 27.18 minutes. In 2020 average duration of unplanned interruption amounted to 20.7 minutes, while planned interruption amounted to 15.84 minutes. Total average duration of supply interruption in 2020 amounted to 36.54 minutes [16].

3.4.2. Security of Distribution System Operation

The indicators for the estimation of discontinuity of delivery in the distribution network are the following:

- SAIFI [number of interruptions/user] – average frequency of interruptions per each user, calculated as a quotient of the cumulative number of interruptions and total number of users and
- SAIDI [min/user] – average duration of interruptions in minutes per user, calculated as a quotient of cumulative duration of interruption and total number of users.

Table 13 presents indicators of continuity of supply in the distribution system for the period 2013-2020.

Table 13: Indicators of continuity of supply in the distribution system [11], [17][13]

SAIFI [number of interruptions/user]	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Total	8.78	10.53	9.25	8.11	8.38	7.99	8.14	8.2
Unplanned	6.45	8.09	6.73	6.05	6.42	6	6.29	6.61
Planned	2.34	2.44	2.52	2.06	1.97	1.99	1.85	1.6
SAIDI [min/user]	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Total	723,72	1.283	1.029	810	917	811	789	804
Unplanned	400.9	850	542	458	578	441	486	547
Planned	322.83	433	487	352	338	370	302	257

In 2019 and 2020, indicators of continuity of supply for unplanned interruptions in the distribution system in the Republic of Serbia there was a deterioration compared to the 2018. The average frequency of unplanned interruptions has reached 6.61 interruptions per user, while the average duration of unplanned interruptions was increased from 441 to 547 minutes per average user. The average frequency of planned interruptions is reduced to 1.6 interruptions per user, and the average duration of planned interruptions were also reduced by about 113 minutes, from 370 to 257 minutes.

[13] Data for 2013 are taken from AERS documentation, and for 2014-2020 from EPS Distribucija documentation.

3.5. Mechanisms of Congestion Management in Transmission and Distribution Systems

3.5.1. Mechanisms of Congestion Management in Transmission Systems

Congestion in a transmission system is the phenomenon when on the market there is a greater demand for transmission capacity than offered. It is the situation during the auction of capacities when the total value of required capacities on a border, for a given direction and for a given auction period exceeds the value of available transmission capacity [16].

Allocation of cross-border transmission capacity is a mechanism for eliminating congestion between control areas of the neighbouring transmission system operators. At the border of the control area, EMS JSC allocation of cross-border transmission capacity is performed in the form of explicit auctions (a market method through public tender for the allocation of available transmission capacity for a predefined border, direction and time period). There are two types of auctions [16]:

- Joint auctions in which the transmission system operator allocates all available cross-border transmission capacity between two control areas,
- EMS JSC as Serbian Transmission System and Market Operator organizes yearly, monthly, weekly and daily auctions for 50% of the total available cross-border transfer capacity on border with Albania. Neighbouring TSO organizes auctions for 50% of the total available cross-border transfer capacity.

EMS JSC was conducting allocation of cross-border transfer capacity on its own control area borders during 2019 and 2020 in the following manner [16]:

- From 2015 joint auctions for transmission capacity allocation are organized on Serbia - Bosnia & Herzegovina border. Annual and monthly auctions are organized by EMS JSC and daily auctions and intraday allocations are organized by NOSBIH (B&H TSO).
- From 2013 joint auctions for transmission capacity allocation are organized on Serbia - Romania border. In 2019 and 2020 daily auctions are organized by EMS JSC, annual and monthly auctions and intraday auctions are organized by Romanian TSO CNTEE Transelectrica S.A.
- From 2014 joint auctions for transmission capacity allocation are organized on Serbia - Bulgaria border. Annual, monthly and daily auctions are organized by JAO S.A. (Joint Allocation Office S.A. from Luxembourg). In 2019 and 2020 on Serbia - Bulgaria border intraday capacity allocations were not conducted due to technical problems of the Bulgarian TSO. In 2020 intraday capacity allocations are organized by EMS JSC.

  During 2017, EMS JSC became a user of the services of JAO S.A. (Joint Allocation Office S.A.) from Luxembourg, office for coordinated capacity auctions (from 2018 with the border with Croatia, and from 2019 with the border with Bulgaria).
- From 2011 joint auctions for transmission capacity allocation are organized on Serbia - Hungary border. In 2019 and 2020 annual and monthly auctions are organized by MAVIR ZRt (Hungarian TSO), while daily auctions and intraday capacity allocations are organized by EMS JSC.
- From 2014 joint auctions for transmission capacity allocation are organized on Serbia - Croatia border. Annual, monthly and daily auctions are organized by JAO S.A. (Joint Allocation Office S.A.) from Luxembourg, and intraday auctions was organized by EMS JSC.
- From 2018 on the border between Serbia and Macedonia, a joint allocation of the right to use the available transmission capacities is organized. EMS JSC was responsible for organizing daily auctions, as well as for implementing the intraday allocation of cross-

border transmission capacity. The annual and monthly auctions were organized by MEPSO (Macedonian transmission system operator).

- In 2019. години on the border between Serbia and Montenegro, EMC JSC organized yearly, monthly and weekly auctions for 50% of the total available cross-border transfer capacity. Intraday allocations are organized by EMS JSC. On Serbian-Montenegrin border since 2020, joint explicit auctions have been organised for the allocation of 100% of available capacity. Annual and monthly auctions were organized by EMS JSC and daily auctions and intraday allocations were organized by MEPSO.
- In line with the Rules for the Cross-Border Transmission Capacity Allocation, EMS JSC allocated 50% of the available capacity on the monthly and weekly level, by organizing explicit auctions on Serbian-Albanian border. The allocation of the other half of transmission capacity quantities was organised by the transmission system operator of Albania. EMS JSC also organised intraday allocation of cross-border transmission capacity on this border.

3.5.2. Mechanisms for Congestion Management in Distribution Systems

Congestion in a distribution system means that during the electricity transfer by distribution system in a given work mode, an overload of a branch distribution network occurs (of a line or transformer) or violation of voltage limitations in distribution network nodes.

Congestion management in distribution system includes the following actions to remove congestion causes:

- Change of distribution grid topology,
- Cancellation of planned and suspension of ongoing works,
- Regulation of voltage with transformers 110/X kV,
- Temporary pre-adjustment of protection, which allows increase of power line transfer capacity,
- Coordinated implementation of management actions with neighboring distribution systems operators in order to restore normal operation,
- Limitation of production of the power plants that are connected to the distribution system.

Note: The distribution system of the voltage level less than 110 kV work as a radial one. Alternative power directions are used when the need arises.

3.6. Measures for Covering Peak Demand and Insufficient Amount of Provided Electricity

In case of endangered safety of supply to end customers due to insufficient supply in the market or the occurrence of other extraordinary circumstances, the Government shall prescribe the measures for restriction of electricity supply, or special conditions for import or export of electricity, the manner and conditions for the formation and control of prices, the obligation of supply exclusively to particular users, or special conditions for performing energy-related activities with the minimum disturbance of the energy market in the region (Energy Law [1]).

In order to cover peak consumption, in the event that one or more suppliers do not provide enough electricity, the transmission system operator is obliged to provide the missing amount of electricity.

The transmission system operator shall take the following actions:

- Include the contract on system services,

- Include contracts on energy in cases of accidents,
- Draw up daily plans of PE EPS work,
- Balance the system in real time.

In order to provide system services, EMS JSC with users of the transmission system made the contract for the provision of ancillary services, which includes primary reserve, secondary reserve, the third reserve, capacity for voltage regulation and capacity for establishment of transmission system after the collapse.

The amount of reserves is regulated by the Electricity Transmission Grid Code [8], based on the technical requirements in force in the interconnection Continental Europe. Details regarding the values of frequency containment reserve, frequency restoration reserve and reserve replacemet are given in chapter 3.1.3.

By drawing up a daily work plan of electric energy system, the transmission system operator shall combine data of market players and then consider whether the suppliers have provided sufficient level of energy to supply the contractual reserve capacities based on their own demand forecasts. The transmission system operator reserves the spare capacity based on its own forecast of consumption. If this is not the case, the transmission system operator shall take the necessary measures, i.e. plan to engage the reserve capacities in the balancing mechanism or shall use the emergency power supply.

Balancing of electric energy system in real time is carried out through the activation of secondary and tertiary reserves. In this way, a balance is achieved between production, consumption and agreed cross-border exchanges in electricity. In addition to the contractual amount of spare capacities, the balancing mechanism includes all production capacities not engaged by the work plan, but which are available for production. If the country capacities are not enough to cover the consumption, the energy transmission system operator shall activate the emergency energy.

There are times when in spite of all measures, the required amount of electrical energy cannot be provided. In these cases, voltage reductions can be implemented in distribution system, by implementing voltage reductions on the low voltage side of the 110/X kV control transformers to a value of 5% less than the nominal voltage. In these cases, it can reduce the consumption by up to 200 MW. If that is not enough, the transmission system operator shall start limitation of electricity supply in accordance with the Energy Law and the Electricity Transmission Grid Code. The size of interconnection, as well as good connections with neighbouring transmission systems, make space for the national transmission system operator to be in a lower deficit for a shorter period of time.

3.7. Realization of Planned Construction of New Generation, Transmission and Distribution Facilities

3.7.1. Generation

As can be seen from the table in the chapter 3.2.1 (Table 5), during 2019 and 2020 there was no significant increase in installed production capacity. The most significant is the commissioning of 134 MW wind farms in 2019. In addition, during 2019, a new 7 MW in small hydro power plants, 6 MW in biogas power plants and 2 MW in biomass power plants were put into operation. During 2020, another 3 MW in small hydropower plants, 1 MW in solar power plants, 7 MW in biogas power plants and 5 MW in CHP plants were put into operation.

In the same period, the construction of unit No. 3 in TPP Kostolac B, with a capacity of 350 MW, whereby the construction of the VI ECS system at the Drmno surface mine, which is necessary to increase the annual coal production from 9 to 12 million tons, has been practically

completed. The realization of this project was additionally slowed down due to the harmonization of the Chinese project with domestic regulations, and due to the COVID-19 pandemic, which prevented the arrival of Chinese workers. Faster work and progress in construction can be expected in the coming period.

3.7.2. Transmission

The Energy Law defines that transmission system operator is obliged to prepare and submit to AERS a ten-year development plan of the Republic of Serbia and three-year investment plan in the transmission system for every year. During 2019 and 2020, EMS JSC prepared and submitted to AERS the Transmission System Development Plan of the Republic of Serbia for the period 2019-2028, i.e. 2020-2029, and the Plan of investments in the transmission system of the Republic of Serbia for the period 2019-2021, i.e. 2020-2022, to which the AERS Council gave its consent.

Core activity of the Investments department in 2019 and 2020 was the organisation and management of investment construction project, expansion, refurbishment and modernisation of the existing of transmission facilities (high-voltage substations and high voltage transmission lines. In 2020, despite extremely difficult extraordinary circumstances, which conditioned the organization of work on construction sites during the pandemic as well as the process of construction and reconstruction of high voltage plants and lines, works were completed, as many as fourteen facilities were put into operation and trial operation: eight high-voltage lines and six high-voltage plant facilities. Also, for the first time, a 110 kV cable was realized and put into operation outside Belgrade.

The most important final operations in this period are [16]:

- In 2019, the construction of the OHL 400 kV TS Beograd 8 - TS Drmno - TS Smederevo 3 was completed.
- In 2019, the construction of the 110 kV cable TS Beograd 17 - TS Beograd 23 was completed, which connects TS Beograd 23 to the transmission system.
- Replacement of transformer T4 in TS 110/35 kV Beograd 4. During 2019, the replacement of power transformer T4 (new transformer 110/35kV, rated power 63MVA) in TS Beograd 4 was successfully performed, with replacement of high voltage equipment in the associated transformer fields 110 kV and 35 kV. This completes the replacement of all four power transformers at TS Beograd 4 and increases the security of supply to a large number of distribution consumers from the 35 kV SS at TS Beograd 4.
- Equipping the cable field in TS Beograd 17 - direction to TS Beograd 23. In 2019, a new 110 kV cable field number S6 in TS Beograd 17 was successfully completed, tested, and put into operation, for the needs of connecting 110 kV cable No. 1263 from TS Beograd 23 "Autokomanda" to TS Beograd 17.
- Completed high-voltage line facilities in 2020:

  1. Cable 110 kV Kruševac 1 - Kruševac 3, 5.6 km
  2. Cable 110 kV Beograd 23 - Beograd 45, 2.8 km
  3. Cable 2x110 kV Bor 1 - Bor 2, 2.4 km
  4. OHL 2x110 kV Loznica - HPP Zvornik, 25 km
  5. OHL 2x110 kV No. 106AB section G, reconstruction, 3.8 km
  6. OHL 2x110 kV No. 106AB entry to TS Loznica 2, 0.3 km
  7. OHL 2x110 kV No. 101AB section I, 1.7 km

8. OHL 110 kV Bela Crkva - Veliko Gradište, 34.1 km

- Completed high voltage facilities in 2020:

  1. TS Smederevo 3 - complete reconstruction of the facility

  2. TS Sremska Mitrovica 2 - equipping the 110 kV E13 OHL field for the introduction of OHL 209/2 from the direction of TS Srbobran

  3. TS Novi Sad 3 - equipping of 110 kV E18 OHL field for introduction of OHL 217/2 from the direction of TS Srbobran

  4. TS Beograd 5 - reconstruction of 12 OHL and transformer fields in 35kV SS

  5. TS Beograd 3 - installation of high power voltage transformers for power supply of own consumption

  6. 110 kV SS Drmno - completed works on construction of OHL field for power supply of TS Rudnik 4

- The works on the reconstruction of TS 220/110/35 kV Kruševac 1 continued. As part of the reconstruction of TS Kruševac 1, during 2020, construction and electrical installation works were performed on the reconstruction of the command building and rehabilitation of roads in 110 kV SS and 220 kV SS, equipping the cable field E03 for the introduction of 110 kV cable line from the direction of TS Kruševac 3, which was completed in June. Completion of all works is planned for 2021.
- The works on the construction of TS 220/110 kV Bistrica continued during 2019 and 2020.
- Reconstruction of the 35 kV SS in TS 220/110/35 kV Beograd 5. By the end of 2020, 12 OHL and transformer fields were completed and put under voltage. There are two more fields left for reconstruction in 2021 (H06 - Bežanija 2 and H11 - Zemun C4). In 2021, it is planned to complete all works, trial operations, and activities on obtaining a use permit.
- In 2020, the works on the reconstruction and adaptation of sections on the OHL 2x110 kV TS Beograd 3 - TPP Kostolac A were completed.
- Reconstruction and adaptation work on sections of the OHL 2x110 kV Valjevo 3 - Zvornik. In 2020, the works on the section TS Loznica - RP HPP Zvornik, about 25 km, 90 pillars as well as the reconstruction of section G, about 3.8 km, were completed. With this, the OHL returns from the territory of Bosnia and Herzegovina to the territory of Serbia. The OHL entry in TS Loznica 2 in the length of about 0.3 km has been completed. There is only one section B left (out of the eight existing ones) which is located on the territory of Valjevo (pillar No. 21 to TS Valjevo 2), about 1.8 km, and is planned for realization in the second quarter of 2021, according to the annual disconnection plan.
- In 2020, work began on the construction of a new cable line, 4.6 km long, 110 kV TS Beograd 45 - CHP Beograd.
- In 2020, work began on the unbundling of 110 kV lines near TS Srbobran and the introduction of the 400 kV transmission line No. 444 in TS Srbobran. In 2021, the completion of works and technical inspection of the facility is planned.
- Works on reconstruction of the OHL No. 148/2 Bor 2 – Zaječar 2. The scope of works includes the construction of a new double circuit transmission line from TS Bor 2 to pillar No. 54, with the equipping of one circuit. The 18-pillar section has been completed and the transmission line was put back into operation during the winter of 2020. All activities planned for 2020 have been completed and the facility has been put back into

operation. The continuation of works is planned for the spring of 2021, i.e. when the weather conditions allow that.

- Activities on the unbundling of the 220 kV and 110 kV transmission lines for TS Bistrica continued during 2020.
- Works on the construction of the 110 kV cable line Novi Sad 5 - Novi Sad 7 have begun. The completion of works is planned for 2021. The construction of this cable will increase the reliability and security in the supply of electricity, and for the purpose of more stable operation of the electricity system, as well as the long-term provision of electricity supply to consumers in the area of Novi Sad.

During 2019 and 2020, significant progress was made on projects within the Trans-Balkan Corridor project [16]:

- Section 1 - Interconnection OHL 2x400 kV TS Pančevo 2 - TS Rešica - a use permit has been provided, both for the interconnection line and for the relocation of the 400 kV network in front of TS Panševo 2, which is an integral part of the project. Thus, in 2019, the investment project was completed and the legitimacy of the performed works was ensured.
- Section 2 - OHL 400 kV TS Kragujevac 2 - TS Kraljevo 3, with raising the voltage level in TS Kraljevo 3 to 400 kV - During 2020, for this project contracts were signed for the construction of OHL 400kV Kragujevac 2 - Kraljevo 3 (Lot 1) and additions and reconstructions, i.e. equipping the 400 kV transmission line field in 400/110 kV TS Kragujevac 2 and construction of 400 kV SS and transformation of 400/220 kV in TS Kraljevo 3 (Lot 2). The deadline for performing works on Lot 1 is January 17, 2022, and the deadline for performing works on Lot 2 is June 16, 2022. In the middle of the year, the works on the construction of the transmission line 2x400 kV Kragujevac 2 - Kraljevo 3 began. The length of the transmission line will be 60 km. Work on Lot 2 is expected to begin at the end of the second half of January 2021.
- Section 3 - 2x400 kV TS Obrenovac - TS Bajina Bašta, with raising the voltage level in TS Bajina Bašta to 400 kV

  Subproject of the III section of the Trans-Balkan Corridor - OHL 2x400 kV Bajina Bašta - Obrenovac. Spatial plan of the special purpose area was adopted by the Government in March 2020. Elaborations on the effects of electromagnetic and electric fields and noise levels have been made. After the inspection, the development of a solution to reduce the impact of noise was started, which caused the need to change the project task for the construction of the 2x400 kV OHL Bajina Bašta - Obrenovac. Location requirements were obtained in November 2020. The feasibility study and preliminary design were updated and at the end of the year, a request for expert control was submitted to the Audit Commission. The project for the building permit was done 80%.

  Subproject of Section III of the Trans-Balkan Corridor - Construction of 400 kV substation in TS Bajina Bašta. After the adoption of the Detailed Regulation Plan with Strategic Environmental Assessment, as well as innovation of Location Requirements for reconstruction and upgrading of TS Bajina Bašta, positive reports were received in August from the Audit Commission on the Feasibility Study and preliminary designs for connection of the access road and for the reconstruction and extension of TS Bajina Bašta. The project for the construction permit and technical control and for the reconstruction and extension of the TS Bajina Bašta, as well as for the construction of connection of the access road has been completed. In the procedure of resolving property and legal affairs, final decisions on expropriation were obtained for 90% of cadastral parcels.

- Section 4 - 2x400 kV interconnection line between Serbia, BiH, and Montenegro - The implementation of the EU donation project through the WBIF13 package has begun. The realization of this project implies the preparation of complete technical documentation for the construction of a transmission line (Building Permit Project, Executive Design Project, as well as updating the Feasibility Study for Section 3 and Section 4 of the Trans-Balkan Corridor). The system study has been completed. In 2021, the completion and delivery of the Building Permit Project and the Executive Design Project are planned.

In 2019 and 2020, the following were obtained as part of investment activities to obtain the necessary permits [16]:

Decisions on approval for performance of works on the following facilities:

- TS 400/220/110 kV Sremska Mitrovica 2 - equipping field E13
- TS 400/110 kV Kragujevac 2 - reconstruction
- TS 220/110 kV Beograd 3 - installation of high power voltage transformers for backup power supply of own consumption
- SS 110 kV Drmno - reconstruction of the switching station for the needs of connection of TS Rudnik 4
- SS 400 kV Đerdap 1 - reconstruction and extension
- TS Beograd 3 - equipping of 110 kV OHL fields for entry of OHL No. 117
- TS Niš 2 - equipping of 110 kV OHL fields for entry of mixed double line Niš 2 - Niš 6
- TS Kraljevo 3 - equipping of 110 kV OHL fields for entry of a new two-system line from the direction of Novi Pazar and reconstruction of 110 kV switching station
- TS Bor 2 - reconstruction

Usage permit for:

- TS Beograd 20 - construction
- TS Beograd 3 - reconstruction
- TS Bajina Bašta - reconstruction

These realized investment activities and investments planned for realization in 400 and 110 kV networks, as well as daily actions at the level of operational management, in 2019 and 2020 EMS JSC continued activities to reduce energy losses in the network.

3.7.3. Distribution

In line with the Energy Law [1], distribution system operator is obliged to prepare and submit to AERS an annual plan for development of distribution system for a period of at least five years, which should be harmonized with plan for development of transmission system and requirements for connection to distribution system. Development of mentioned development plan is in progress.

Energy Law [1] prescribes that the distribution system operator, in addition to the development plan, should adopt a plan for the take-over of measuring devices, measuring boxes, installations and equipment in measuring boxes, connection lines and other devices that are part of the connections in the buildings of existing buyers or producers, for each year. This obligation for year 2020 and Report on the implementation in the period 2015 - 2020 has been fulfilled by distribution system operator and delivered to AERS in May 2020. In 29th May, 2020 AERS council issued a Decision on the approval of the plan [18]. Energy Law (Article 404) [1] prescribes that all these devices should be taken over by distribution system operator by the end

of 2020 at the latest. Acquisition of measuring points by distribution system operator and technological improvement of measuring infrastructure will ensure the smooth functioning of market and a better offer in electricity market [1]. Based on the Report about the realization of the plan for the taking over measuring points for 2020, it was concluded that Elektrodistribucija Srbije did not carry out these activities in accordance with the plan, since during 2019 only 3.19% and 2020 only 1.35% of the planned measuring points were taken and none of the planned measurement points for aking over from the manufacturer.

In order to increase the security of energy supply investment investment activities as well as other activities were aiming at the completion of initiated investments and new investments in network expansion, revitalisation or replacement of existing old-fashioned equipment in the distribution network, especially transformer stations 110/X kV/kV transferred from EMS JSC as well as other measures in terms of modernisation of operations and business activities.

The following works were either completed or initiated within the distribution systems [17]:

- The most significant new elements of the distribution system put into operation in 2019 and 2020 are eight new transformer stations of primary voltage 110 kV: 110/20 kV Krnješevci with power 31.5 MVA, 110/10 kV Beograd 23 - Autokomanda with 80 MVA, 110/10 kV Beograd 45 – Amfiteatar with power 80 MVA, 110/35/10 kV Niš 15 with power 63 MVA, 110/10 kV Kruševac 3 with power 31.5 MVA, 110/35/10 kV Loznica 2 with power 31.5 MVA, 110/35 kV with power 20 MVA within Beograd 2 and 110/35 kV Sokobanja with power 31.5 MVA. Elektrodistribucija Srbije obtained four mobile transformer stations from the EU and these are used during reconstructions of existing transformer stations 110/35 kV/kV and in emergency situations in cases of extreme weather and natural disasters such as floods and fire. In 2020, all four mobile transformer stations were successfully connected to the distribution system and they are currently installed in: TS 110/35 kV Beograd 2, TS 35/10 kV Požarevac Centar, TS 35/10 kV Kruševac 4 and TS 35/10 kV Zlatibor 1. This represents the first connection of equipment of this type to the distribution system of the Republic of Serbia. In this way, the installed capacity at the 110 kV voltage level in 2019 and 2020 was increased by a total of 453 MVA.
- Construction of new transformer stations TS 35/10/kV Zlatibor 1, TS 35/10 kV Čučuge and TS 35/10 kV Loznica 5.
- Construction of 583 transformer stations on the medium-voltage level was completed, with total installed capacity of 427.2 MVA.
- Construction of 975.6 km of medium-voltage distribution network was completed.
- Construction of 967.27 km of low voltage distribution network was completed.

The primary goal of Elektrodistribucija Srbije is to improve the measurement system for users whose facilities are connected to the medium voltage network, and for users whose objects are connected to the low voltage network, those with active and reactive energy and monthly maximum power. In 2019 and 2020, the Elektrodistribucija Srbije did not submit the plan for the implementation of economically justified types of advanced metering systems to the Agency. In line with the Energy Law, the results of this plan should be an integral part of the development plan and the distribution system investment plan. Currently, the total percentage of digital meters installed at customers' facilities amounts to 1.6% (for all voltage levels), while the total percentage of digital meters installed at producers' facilities amounts to 99% (for all voltage levels). Smart grids and measurement systems will enable high reliability and quality level of delivered electricity. They will stimulate better consumption management and more dynamic electricity market, as well as considerate reduction of technical and commercial losses.

In 2020, there was an increase in losses in the distribution network which were increased by 1.79% in comparison to 2019 losses and they amount to 11.94% of electricity withdrawn into the distribution system. The activities on the reduction of losses have to be intensified in the future since it is necessary to bring losses to technically acceptable level. Regular activities on the metering devices checks in 2019, checks were made only on 4.82% of planned metering points, and in 2020 on 4.58%.

3.8. Planned Electricity Consumption and Production / Method of Providing the Missing Quantities in the next Five-Years Period

3.8.1. Realized Consumption and Production

Data for the realized electricity balance for 2019 and 2020 show differences in the structure of produced energy compared to previous years. After the increase in production at hydro power plants in 2018, there was a decrease in this production in 2019 and 2020. The reason for this difference is the extremely favorable hydrology in 2018. This is supported by the data: in 2019, hydro power plants produced 10,198 GWh, and in 2020, 9,749 GWh, in contrast to 2018, when they produced 11,393 GWh. This means that the production from HPPs in 2019 was 10.5% lower compared to 2018, and in 2020 4.4% lower compared to 2019.

In 2019, electricity production in CHPs reached 474 GWh (1.3% of total production in 2019), which is 35% more than production in 2018. However, in 2020, production in CHPs amounted to 317 GWh (0.83% of total production in 2020), which is 33.2% less than in the previous 2019.

As a positive parameter, the increased production in category "other power plants", which consists of renewable energy sources, natural gas cogeneration plants and industrial power plants. In 2019, the production of electricity in these plants amounted to 1,382 GWh (3.67% of total production in 2019), or 95.6% more than in 2018 (when production amounted to 707 GWh). In 2020, the production of electricity from other power plants amounted to 1,462 GWh (3.85% of total production in 2020), which is 5.8% more than in 2019.

Electricity production in thermal power plants in 2019 amounted to 25,546 GWh (67.94% of total production in 2019), while in 2020 it was 26,429 GWh (69.63% of total production in 2020). The realization of the balance of the TENT Branch in 2019 was 17,522.4 GWh, which is 5.5% more than in 2018. In 2020, the production of electricity in the TENT Branch was higher by 3.2% compared to 2019 and amounted to 18,088.7 GWh. In 2019, TPP Kostolac units produced 5,646.5 GWh (10.9% less than in 2018). Unlike the mentioned year, in 2020 the production in TPP Kostolac was 6,242.8 GWh, which is 10.6% more than in 2019.

A comparison of the data shows that the results of poor hydrological years in terms of energy (2019 and 2020) significantly reduced the production from HPPs. This was compensated by higher production from TPPs and the operation of new renewable sources and other power plants. According to the data for 2019, the Republic of Serbia achieved a gross production of electricity of 37,600 GWh, ie 174 GWh more than in 2018. Slightly higher electricity production (by 356 GWh than in 2019) was in 2020, i.e. 37,956 GWh.

Final consumption in 2019 compared to 2018 was slightly increased in the sectors of agriculture, industry and construction, while in the household sector and other sectors consumption was slightly lower. In 2020, final consumption in the household sector was on the rise, while in other sectors it recorded a decline compared to 2019.

In the last 3 years, there has been a decrease in total electricity imports. In 2019, total imports amounted to 5,417 GWh, which is 983 GWh less than imports in 2018, while in 2020 it amounted to 5,070 GWh (347 GWh less than imports in 2019).

Total exports in 2019 amounted to 5,341 GWh (943 GWh less than exports in 2018). In 2020, there is an increase in electricity exports by 334 GWh compared to 2019, and amounted to 5,675 GWh.

When it comes to the purchase and sale of electricity that PE EPS realizes for the needs of optimization and balancing, the situation has significantly changed for the better compared to 2018. In 2018, electricity sales amounted to a negligible 0.124 GWh, while purchases amounted to about 473 GWh. In 2019, sales increased to 1,466.5 GWh and purchases to 1,004 GWh. Realized sales in 2020 amounted to 1,604.4 GWh, while purchases were 484.1 GWh. The difference in sold and purchased electricity in 2018 was -472.8 GWh, while that difference was 462.6 GWh in 2019, and 1,120 GWh in 2020.

The recorded increase in electricity production in thermal power plants is partly a consequence of increased coal production and better realization of planned coal balances than in previous years. In 2019, the Kolubara mining basin recorded a realization of 29.7 million tons, which is 1.3 million tons more than in 2018. In 2020, there was a further increase in coal production (30 million tons), i.e. for 321.8 thousand tons more than in the previous year. Given that this mining basin predominantly supplies coal to TENT A and TENT B, this increase in coal production certainly partly affects the increase in electricity production in these power plants by 5.7% in 2019 compared to 2018, i.e. 3, 2% in 2020 compared to 2019.

In Kostolac, coal production in 2019 was 8.47 million tons, ie. slightly lower than in 2018, when it amounted to 8.6 million tons. In 2020, coal production was 592 thousand tons higher than in 2019 and amounted to about 9 million tons.

As the total coal production in 2018 amounted to 36.98 million tons, in 2019 to 38.17 million tons, and in 2020 to 39.09 million tons, a slight but constant increase in production at the level of 2-3% per year can be observed.. However, the problems that characterized the production of coal in the surface mines of PE EPS in the period 2019-2020 are similar to previous years, and they are:

- complex technological situation on coal excavation and selective operation of excavators (large amounts of interlayer tailings), which directly affects the reduction of capacitive and time utilization of equipment, and thus the decline in planned production,
- lack of spare parts,
- lack of manpower and
- delay in the implementation of procurement for current and investment maintenance of equipment.

The excavation of the overburden in the MB Kolubara Branch in 2019 amounted to 63 million m3, or 4.56% less compared to the same period previous year. It was similar in the following year, 2020, when the production of overburden was 60 million m3, ie. 4.6% less than in 2019. This result is a consequence of difficult technological conditions and frequent equipment failures. In the TE-KO Kostolac Branch in 2019, the production of overburden was 31.6 million m3, which is 4.4% less than in 2018. A significant increase in the production of overburden was in 2020 and amounted to 47 million m^3, which is 48.6% more than the previous year. This increase in production in TE-KO Kostolac is the result of the entry into operation of a new - VI ECS system, and it significantly affected the overall results in 2020 to be better - 8 million m^3 of overburden was excavated more than in 2018, ie 12, 5 million m^3 of overburden more than in 2019.

The situation at coal landfills has mostly improved compared to 2018, therefore in TENT A and TENT B at the end of 2019 there was about 303.7 thousand tons more coal compared to 2018 and about 320.3 thousand tons more in 2020 compared to 2019. In the case of TPP Kostolac B, the situation at the landfill varies. At the end of 2019, the situation at the landfills of TPP

Kostolac B was about 328.2 thousand tons more coal compared to 2018, and in 2020 there was about 350.8 thousand tons less compared to 2019. The reason for this situation is the planned maintenance of mining capacities. The condition of TPP Kolubara landfill at the end of 2019 amounted to 66,483 thousand tons, which is 30.4 thousand tons less than in 2018. In TPP Morava the situation at the landfills was far below the plan and amounted to 55,189 thousand tons (35.7 thousand tons more than in 2018). In 2020, the condition of TPP Kolubara landfill reached 91,864 thousand tons (the plan was 80 thousand), which is 25.4 thousand tons more than in 2019. In TPP Morava, the condition of the landfill at the end of 2020 was far below the plan and amounted to about 39 thousand tons (the plan was 80 thousand), i.e. 16.2 thousand tons less compared to 2019.

After the specific consumption of coal reached a maximum of 1.59 t/MWh in 2018, in the next two years there was a slight decrease in this value to 1.58 t/MWh and 1.57 t/MWh. Fuel oil consumption is also in constant decline - in 2019 by 7.4% compared to 2018, and in 2020 by 2.9% compared to 2019, so that in the observed period the total decrease is exactly 10%. The specific consumption of fuel oil records an even greater decline, as it fell from the value of 2 t/GWh in 2018 to 1.84 t/GWh in 2019, and then to 1.66 t/GWh in 2020.

Table 14 presents electricity balance in the Republic of Serbia for the period from 2013 until 2020.

Table 14: Balance of Electricity from 2013 to 2020 [15], [25]

	2013 [GWh]	2014 [GWh]	2015 [GWh]	2016 [GWh]	2017 [GWh]	2018 [GWh]	2019 [GWh]	2020 [GWh]
Gross production	**39,877**	**34,061**	**38,299**	**39,343**	**37,043**	**37,426**	**37,600**	**37,956**
Hydro power plants	10,852	11,617	10,783	11,520	9,752	11,393	10,198	9,749
Thermal power plants	28,620	22,073	27,133	27,191	26,414	24,975	25,546	26,429
Combined heat and power plants	202	75	53	140	291	351	474	317
Other power plants	202	295	330	491	585	707	1,382	1,462
Total import (including transit)	**4,077**	**7,008**	**6,303**	**5,068**	**6,549**	**6,400**	**5,417**	**5,070**
Total export (including transit)	**6,614**	**5,445**	**7,221**	**6,990**	**5,724**	**6,284**	**5,341**	**5,675**
Losses	**5,500**	**5,163**	**5,169**	**4,808**	**4,806**	**4,532**	**4,332**	**4,385**
Consumption in the energy sector	**4,937**	**4,302**	**5,138**	**5,280**	**5,270**	**3,898**	**4,252**	**4,009**
Hydro power plants	60	90	86	91	82	86	92	76
Pump	1,007	898	1,090	1,029	938			
Термоелектране	2,581	2,017	2,529	2,565	2,586	2,466	2,855	2,525
Combined heat and power plants	42	22	18	25	42	51	58	42
Industrial plants	25	32	26	33	37	42	30	39
District heating plants	170	80	97	218	193	171	163	187
Oil and gas production	234	82	93	91	87	89	93	89
Refineries		236	257	243	255	261	240	273
Coal mines	604	541	570	600	590	603	596	649
Coal transformation	214	217	282	313	366	40	38	39
Other		87	90	72	94	90	87	89
Energy available for final consumption	**26,903**	**26,158**	**27,073**	**27,333**	**27,792**	**28,047**	**27,994**	**27,881**
Final consumption	**26,903**	**26,158**	**27,073**	**27,333**	**27,792**	**28,047**	**27,994**	**27,881**
Industry+Construction	7,079	7,156	7,423	7,731	7,861	8,734	8,783	8,617
Transport	478	336	351	352	358	375	375	358
Households	14,146	13,802	14,062	13,931	14,165	13,415	13,340	13,718
Agriculture	301	298	317	314	319	341	342	331
Other users	4,899	4,566	4,920	5,005	5,089	5,183	5,154	4,856

3.8.2. Method of Providing the Missing Quantities in the next Five-Years Period

According to Strategy [2], electricity consumption growth in relation to the reference year (2010) is predicted to be around 5.7% by 2020, ie 10.5% by 2025 and 16.3% by 2030.

Ongoing activities are expected to meet future electricity needs in the medium term (see sections 3.3.1, 3.10 and 0). As in these chapters have already been analyzed in detail, it is expected that some of the oldest thermoblocks with low utilization and high emission of harmful substances will be withdrawn from use. At the same time it is shown in what ways the missing energy from these sources is expected to be replaced by other sources. According to Strategy [2] and Program [1], construction of a large number of wind and small hydropower plants has already been completed, some TPPs and HPPs have been revitalized and new CHPs have been started.

3.9. Security Supply Forecast for the Next Five to Fifteen Years

The national transmission system operator shall be obliged to guarantee, with the appropriate national institutions, the appropriate security of electricity supply. Security of supply is defined as the ability of the power system to meet consumption needs at any time.

Until 2016, ENTSO-E applied a deterministic approach to assessment of adequacy - SO&AF (Scenario Outlook and Adequacy Forecast), which gave an assessment of the adequacy of the system for several characteristic, but chronologically unrelated hours. Given the new challenges posed by the transformation of the power system with a significant share of production from intermittent renewable energy sources, there is a need for a new and improved method for analyzing the operation of the power system and assessing the adequacy

Therefore, in 2016, a new methodology for medium-term adequacy analysis at the European level was adopted - MAF (Mid Term Adequacy Forecast). The new methodology is based on a probabilistic approach of modeling and analyzing the adequacy of Europe's power system. The goal of the new method is to consider the risks related to security of supply, as well as the need for flexibility for the next ten years. With this in mind, EMS JSC has changed the methodology of analyzing the adequacy of the production system of Serbia and determining the risk of supply to consumers.

Although EMS JSC has switched to probabilistic analysis of production adequacy (it includes simulations for each hour during the year), the analysis is still performed by the deterministic method (two critical modes of power system operation are observed - winter and summer maximum). Therefore, the results of both methods will be presented below.

To assess the adequacy of the system, indicators of adequacy are used. These indicators can be defined as deterministic (capacity margin) or probabilistic (ENS, LOLE) depending on the applied methodology for adequacy assessment. The basic probabilistic indicators are:

- ENS (Energy Not Supplied) (MWh/year) – represents the level of undelivered electricity by the generation system to consumers, due to the occurrence of consumption higher than the available production and available imports in a certain period during the year.
- LOLE (Loss Of Load Expectation) (h/year) – represents the number of hours during the year when undelivered electricity occurs.

In addition to the basic LOLE indicator described above, it is common practice to monitor and calculate LOLE P50 and LOLE P95. LOLE P50 is a fifty percent (50%) indicator, ie. the median of the set of calculated LOLE indicators for all combinations. Therefore, LOLE P50 provides information on the level of risk (number of hours with undelivered energy) that can occur with a probability of 50% or once every two years. In a similar way, LOLE P95 defines the level of risk (number of hours with undelivered energy) that can occur in 5% of samples, ie. once in twenty years.

For the analysis of the adequacy of production by the probabilistic method, conducted during the development of the Transmission System Development Plan [21], two possible scenarios have been defined:

- Realistic - according to the expected development of the power system that is close to the scenario defined in the ENTSO-E MAF2018 analysis, and
- Alternative - with a deviation from the expected development of the power system in order to simulate more critical regimes (higher level of consumption and lower level of available generation capacity)

Based on the calculated probabilistic indicators of production adequacy (Table 1), it can be concluded that in 2025 there will be no problems with the adequacy of production capacities of the Republic of Serbia in both development scenarios (ENS) or hours in which interruptions of delivered energy occured (LOLE)).

Table 15: Results of adequacy analysis for realistic scenario in 2025 [21]

Scenario	ENS (MWh) P95	LOLE (h) P95	ENS (MWh) P50	LOLE (h) P50	ENS (MWh) AVG	LOLE (h) AVG
Realistic	0	0	0	0	0	0
Alternative	0	0	0	0	0	0

In the deterministic method of production adequacy, EMS JSC performs safety analysis in two characteristic cases:

- Winter maximum and
- The summer maximum.

Similarly, using two scenarios of electricity generation in order to better evaluated the extent of uncertainty in the prediction of future production capacity and evaluate the risk of security of supply in the forecasting period: scenario of realistic development of production and conservative scenario that individually prepare transmission system operators based on the plans of electricity producers who are planning connection to the transmission system.

Conservative scenario includes additional investments in production capacities, which are considered certain (already being implemented construction or in which the purchase of equipment can not fail). As for the phasing out of production capacity, most likely the plan of release will be adopted, which is not only based on the official data of individual producers, but also takes into account information about the age of some production facilities.

For the load forecasts in this scenario the best national estimate available to the transmission system operator is adopted, taking into account the maximum expected rise in consumption based on available development plans of electrical networks.

Scenario of realistic development of production, in addition to production capacity covered by conservative scenario, includes the planned investment on production capacity, which can be considered sufficiently probable according to the belief of the transmission system. Also, if there is no official information on the exit of a unit from the system, the scenario of realistic development of production consider it available in the forecasting period (at the old production capacity is calculated on the extension of life expectancy). The load is predicted in the same manner as in conservative scenario. For scenario of realistic development of production, during forecasts of new production capacity, it is necessary to take into account the national targets for the participation of renewable energy sources, as well as stimulating measures that work in this direction. However, the transmission system operator has to make a realistic forecast of future

production capacity, even if defined national goals were not met. In the context of the assessment of conformity of production and consumption of electricity gives the estimate of transmission capacity for export and import of electricity.

A conservative scenario function is to assess the lack of capacity in production at a national (and European) level in order to satisfy future consumption. Scenario of realistic development of production function is to assess whether the expected level of investment in production capacity are sufficient to meet future consumption.

Of course, in order to adequately assess the possibility of meeting the projected consumption with the planned production, need for the reserve production, expected outages and repairs of production units, capacity in which the forecasting period can not be used for various other reasons must be taken into account.

In assessing the compliance of the production capacities, tables in a format such shown in Table 16 and Table 17 (relating to the period of 2019-2029 for the Republic of Serbia) need to be filled. Based on the data presented in Table 16 and Table 17 following can be concluded:

In the Republic of Serbia, in 2029, compared to the current situation, the installed capacity connected to the transmission system will increase in the amount of:

- Scenario of realistic development of production - 1,908 MW
- Conservative scenario - 2,473 MW.

For the winter peak regime in the realistic scenario, the remaining production capacity is positive until the end of the observed period (Table 16). The lowest value is forecasted for 2020 (148 MW), while the values range up to 1,176 MW.

In the winter peak regime in the conservative scenario (Table 17), the remaining production capacity is negative only in 2020, and after that it is positive until the end of the observed period. The lowest value is forecasted for 2020 (-169 MW), while the values after 2020 range from 184 MW to 1,004 MW.

Therefore, in periods when the residual production capacity is negative, electricity will need to be imported. The value of the available import capacity is sufficient to allow undisturbed imports of electricity.

As for the summer peak regime, it is not critical in any scenario (Table 16 and Table 17). Values of the remaining production capacity range from 993 MW to 1,892 MW.

Table 16: Indicators of compliance of production and consumption of electricity in scenario of realistic development of production for the Republic of Serbia [21]

Winter maximum				
National energy data (MW)	**2019**	**2020**	**2025**	**2029**
1. Fossil Fuels (2+3+4)	4,106	4,319	4,756	4,756
2. Lignite	3,916	3,916	4,353	4,353
3. Gas	190	373	373	373
4. Waste	0	30	30	30
5. Renewable Energy Sources (Wind power plants)	374	726	2,136	2,136
6. Hydro power (7+8+9)	2,977	2,984	3,045	3,045
7. Run-of-river hydro power plant	1,991	1,998	2,035	2,035
8. Storage hydro power plant	372.1	372.1	396.6	396.6
9. Pumped storage plants	614	614	614	614
10. Total (1+5+6)	7,457	8,029	9,937	9,937
11. Unusable installed capacity	274	532	1,566	1,566
12.Ancillary services reserve	380	380	380	380
13. Overhauls	214	294	0	0
14. Forced outages	401	410	367	367
15. Unavailable Capacity (11+12+13+14)	1,269	1,616	2,313	2,313
16. Reliable Available Capacity (10-15)	6,187	6,413	7,624	7,624
17. Peak load	6,158	6,265	6,448	6,573
18. Remaining power capacity	29	148	1,176	1,051
19. Simultaneous Importable Capacity for Adequacy	3,735	4,343	4,343	5,213
20. Simultaneous Exportable Capacity for Adequacy	4,316	4,470	4,470	5,670
21. Minimum power transfer capacity	745.66	802.9	993.68	993.68
Summer maximum				
National energy data (MW)	**2019**	**2020**	**2025**	**2029**
1. Fossil Fuels (2+3+4)	4,209	4,422	4,859	4,859
2. Lignite	3,990.7	3,990.7	4,427.7	4,427.7
3. Gas	218	401	401	401
4. Waste	0	30	30	30
5. Renewable Energy Sources (Wind power plants)	374	726	2,136	2,136
6. Hydro power (7+8+9)	2,977	2,984	3,045	3,045
7. Run-of-river hydro power plant	1,990.8	1,998.2	2,034.5	2,034.5
8. Storage hydro power plant	372.1	372.1	396.6	396.6
9. Pumped storage plants	614	614	614	614
10. Total (1+5+6)	7,560	8,132	10,040	10,040
11. Unusable installed capacity	336	653	1,920	1,920
12.Ancillary services reserve	380	380	380	380
13. Overhauls	845	957	729	729
14. Forced outages	410	419	374	374
15. Unavailable Capacity (11+12+13+14)	1,972	2,409	3,403	3,403
16. Reliable Available Capacity (10-15)	5,588	5,723	6,636	6,636
17. Peak load	4,412	4,509	4,744	4,865
18. Remaining power capacity	1,176	1,214	1,892	1,771
19. Simultaneous Importable Capacity for Adequacy	3,735	4,343	4,343	5,213
20. Simultaneous Exportable Capacity for Adequacy	4,316	4,470	4,470	5,670
21. Minimum power transfer capacity	755.96	813.20	1,003.98	1,003.98

Table 17: Indicators of compliance of production and consumption of electricity in conservative scenario of production for the Republic of Serbia [21]

Winter maximum				
National energy data (MW)	**2019**	**2020**	**2025**	**2029**
1. Fossil Fuels (2+3+4)	4,106	4,319	4,756	4,756
2. Lignite	3,916	3,916	4,353	4,353
3. Gas	190	373	373	373
4. Waste	0	30	30	30
5. Renewable Energy Sources (Wind power plants)	374	726	2,136	2,136
6. Hydro power (7+8+9)	2,977	2,984	3,045	3,045
7. Run-of-river hydro power plant	1,991	1,998	2,035	2,035
8. Storage hydro power plant	372.1	372.1	396.6	396.6
9. Pumped storage plants	614	614	614	614
10. Total (1+5+6)	7,457	8,029	9,937	9,937
11. Unusable installed capacity	274	532	1,566	1,566
12.Ancillary services reserve	380	380	380	380
13. Overhauls	214	294	0	0
14. Forced outages	401	410	367	367
15. Unavailable Capacity (11+12+13+14)	1,269	1,616	2,313	2,313
16. Reliable Available Capacity (10-15)	6,187	6,413	7,624	7,624
17. Peak load	6,158	6,265	6,448	6,573
18. Remaining power capacity	29	148	1,176	1,051
19. Simultaneous Importable Capacity for Adequacy	3,735	4,343	4,343	5,213
20. Simultaneous Exportable Capacity for Adequacy	4,316	4,470	4,470	5,670
21. Minimum power transfer capacity	745.66	802.9	993.68	993.68
Summer maximum				
National energy data (MW)	**2019**	**2020**	**2025**	**2029**
1. Fossil Fuels (2+3+4)	4,209	4,422	4,859	4,859
2. Lignite	3,990.7	3,990.7	4,427.7	4,427.7
3. Gas	218	401	401	401
4. Waste	0	30	30	30
5. Renewable Energy Sources (Wind power plants)	374	726	2,136	2,136
6. Hydro power (7+8+9)	2,977	2,984	3,045	3,045
7. Run-of-river hydro power plant	1,990.8	1,998.2	2,034.5	2,034.5
8. Storage hydro power plant	372.1	372.1	396.6	396.6
9. Pumped storage plants	614	614	614	614
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11. Unusable installed capacity	336	653	1,920	1,920
12.Ancillary services reserve	380	380	380	380
13. Overhauls	845	957	729	729
14. Forced outages	410	419	374	374
15. Unavailable Capacity (11+12+13+14)	1,972	2,409	3,403	3,403
16. Reliable Available Capacity (10-15)	5,588	5,723	6,636	6,636
17. Peak load	4,412	4,509	4,744	4,865
18. Remaining power capacity	1,176	1,214	1,892	1,771
19. Simultaneous Importable Capacity for Adequacy	3,735	4,343	4,343	5,213
20. Simultaneous Exportable Capacity for Adequacy	4,316	4,470	4,470	5,670
21. Minimum power transfer capacity	755.96	813.20	1,003.98	1,003.98

3.10. Investments in Capacity for the Production of Electricity

As a signatory to the Treaty of establishment of the Energy Community, the Republic of Serbia has commited, among other things, to apply the provisions of the Directive of Large Combustion Plants 2001/80/EC in accordance with the deadlines defined by the Treaty itself, that is, until 01.01.2018.

The Directive refers to combustion plants with a power of greater than or equal to 50 MWth (all thermal power plants within PE EPS are in the category of large furnaces, that is, they have power greater than 50 MWth). The aim of the Directive is to reduce emissions of polluting substances from large combustion plants into the air.

The Ministerial Council of the Energy Community adopted two following Decisions on October 23th in 2013:

- Decision D/2013/05MC-EnC EnC for the rules of implementation of the Directive of Large Combustion Plants (Decision D/2013/05MC-EnC LCP Directive on implementing rules)
- Decision D2013/06/MC-EnC for the introduction of the Industrial Emissions Directive 2010/75/EC (Decision D/2013/06/MC-EnC on the Introduction of the Industrial Emissions Directive).

By Decision D/2013/05MC-EnC it is enabled for the contries that are signatories of the Treaty of establishing the Energy Community to use two mechanisms for the implementation of the Directive of Large Combustion Plants, which are defined within the Directive itself, as follows:

- The implementation of the National Emission Reduction Plan (NERP) in period from 01.01.2018. to 31.12.2027. The implementation of NERP has a purpose to harmonize emissions from existing combustion plants with emission's limit values - ELV defined by the Industrial Emissions Directive by the 31.12.2027.
- Implementation of the plant limited operation mechanism, so-called opt-out mechanism (20,000 hours of work between 2018 and 2023). After the expiration of the opt out period, the plant should be either shut off or must be harmonized with the ELV for new plants based on the Industrial Emissions Directive.

For the Republic of Serbia, the NERP was adopted by the Government in February 2020 [20].

According to The Strategy [2] and Program [3] from 2018 to the end of 2023, successive withdrawal from the operation of all thermo-blocks on coal smaller than 300MW is planned: TPP Kolubara A1, A2, A3 and A5 (block A4 is out of operation since 2009), TPP Morava, TPP Kostolac A1 and A2 and TENT A1 and A2. Practically all the mentioned blocks are among the oldest in the system of PE EPS (starting from 1956) and have significantly lower efficiency indicators compared to younger and larger blocks. The total power of the mentioned capacities at the top of the transmission system is 1,022 MW. Based on the Realization of the electricity portfolio of PE EPS for 2019 and 2020, it can be noticed that the mentioned capacities worked at approximately the same pace as in previous years and produced a total of 4.5-5 TWh per year. Based on the three-year business plan (3GPP) of PE EPS for the period 2021-2023, which was adopted by the Government on May 27, 2021, it can be seen that the units in TPP Kolubara and TPP Morava are planned to operate in opt-out regime by the end of 2023, which is in line with the existing strategy. However, when it comes to blocks 1 and 2 in TENT A and TPP Kostolac, there is a drastic discrepancy between official documents. Instead of shutting down, 3GPP of PE EPS envisages the revitalization of these four blocks with large financial resources. Pre-preparatory and preparatory actions for the mentioned revitalizations are in progress. Based on the prepared technical documentation and the current determination of PE EPS, the blocks at the location of TPP Kostolac A and TENT A1 and A2 will continue to operate after 2023, that is, they will be revitalized for the next 100,000 hours (approximately 15 years). This issue is

expected to be processed in the new official energy development strategy, which is being drafted.

In order to improve environmental protection in accordance with the obligations under the Energy Community Agreement, in the sector for the production of fossil fuels, it is planned that emissions of sulfur dioxide, nitrogen oxides and powdered substances are reduced to the prescribed emission limit values defined by the said regulation [22]. The issue of emission to the prescribed limit values is part of the National Emission Reduction Plan in accordance with the Decision of the Ministerial Council of the European Union E3 D/2013/05/MC-EnC and D/2013/06/MC-EnC. The implementation of the National emission reduction plan is planned in the period January 1, 2018 - December 31, 2027. However, these environmental commitments have their two downsides. Firstly, they are very expensive and involve primarily foreign technology, and secondly, they increase the consumption of electricity for their own needs, thereby reducing the available energy for the market and the available power at the transmission threshold.

On the reduction of the available power on the border of transmission will also be affected by the projects for the construction of a flue gas desulphurization plant on thermal power plants that will remain in operation after 2023. This facility for TPP Kostolac B was completed in July 2017 (the value of the project is approximately 130.5 million dollars), and for the TENT A3-A6 are in the final stage (contract for the implementation of the facility was signed in September 2017, and the completion date was 48 months). Realization of this facility is expected for TENT B. According to the available technical data, the own consumption of desulphurization facility will affect the increase in 5-6% in own consumption of the blocks that remain in, or approximately 1.1 TWh per year. This is supported by the project in the TPP Kostolac B, where for the needs of the desulphurization plant it was necessary to install two additional transformers with a power of 2x25 MVA. Also, TENT has taken measures to reduce the emission of nitrogen oxides, such as the installation of low-emission burners. Optimization of combustion process is effectively reflected in the operation of the electrostatic precipitator. The installation of a new burner changes the combustion process in the boiler furnace, which results in a significant reduction in nitrogen oxide emissions. A wastewater treatment plant was also built at the location of TPP Nikola Tesla A. A plant for temporary storage of waste was built at the TENT B location.

In addition to the above, it has been implemented through other environmental projects in order to protect the environment. Reconstruction of electrostatic precipitators in all units with a capacity of more than 100 MW was performed. TENT B is equipped with a system for collecting, transporting and disposing of ash and slag, made according to the new technology. The construction of a new ash disposal system prevented the scattering of ash from the landfill, reduced the amount of water for ash transport by 10 times, and thus permanently stopped groundwater pollution. Reconstruction, ie introduction of new technology for collection, transport and disposal of ash and slag was also performed at TPP Kostolac B and TPP Kolubara A. This solved one of the biggest environmental problems in Veliki Crljeni.

There is an intensive began of another project whose realization is closely related to reduction in power for electricity production. It is about construction of Obrenovac hot water pipeline (TENT A) - New Belgrade. This idea existed decades back, but it was practically abandoned at the beginning of the century. However, it has recently been strongly and rapidly updated. In July 2019, the City of Belgrade signed with the Power Construction Corporation of China (POWERCHINA). The estimated value is €170 million. This project aims to reduce the consumption of fuel oil and coal that Belgrade power plants use as input energy and increase the consumption of more environmentally friendly energy sources (natural gas is predominantly used - 96%). However, from the aspect of electricity, this represents a further reduction of the capacity to produce electricity by an estimated amount of 150 MW [3], but also the obligation of PE EPS to prepare all units in TENT A for the heating regime. This additional commitment alone is an amount of €20 million.

In order to implement the mentioned directive and ensure the realization of the goals defined by the Strategy [2] and the Program [3] from 2017 until year 2023, as well as the balancing of energy deficits resulting from the withdraw of blocks and own consumption of desulphurization plants, the construction and entry into operation of several larger production capacities is planed.

The construction of seven wind farms with total installed capacity up to 500 MW with an estimated annual production of 1,317 GWh (Alibunar, Malibunar, Plandište 1, Kovačica, Čibuk 1, Košava and Kostolac). The start of work on some more wind farms such as Košava 2 has been announced.

When it comes to construction the situation is as follows:

- The Alibunar wind farm 42 MW has been completed and commissioned. The contractor and also the company that participated as a financier in the volume of 25% is the Belgian company Elicio. The total investment was €80 million and the work was completed in September 2018.
- The Malibunar wind farm 8 MW has been completed and commissioned. The value of the project was €14 million and the wind farm has been in full operation since 2018. Expected production is 25 GWh per year, which roughly meets the consumption of 7,200 households.
- Completed and commissioned Košava wind farm. It was built by the Italian company MK Fintel Wind - Fintel energy, which already has two wind farms completed in Serbia - Kula and La Piccolina. Total investment value is €120 million. The installed capacity is 68 MW housed in 20 equal turbines.
- The wind farm Kovačica has been completed and put into operation. Wind farm was built by Israeli company Enlight Renwable Energy. It is a plant of 38 turbines with an installed capacity of 104.5 MW, which should provide energy to 65,000 households with total investment value of €190 million.
- Čibuk 1 wind farm was built by Vetroelektane Balkana, which is owned by companies from the US, Emirates, Finland and Germany. The investment value of the project is up to €300 million, and it is a plant with 37 turbines with an installed capacity of 158.46 MW.
- Košava 2 wind farm should also be constructed by the Italian company MK Fintel Wind - Fintel Energy. The project is a continuation of the Košava wind farm. An installed capacity of 68.4 MW is envisaged. Current status - under construction.
- Plandište 1 wind farm is designed as an energy facility with an installed capacity of 102 MW and an estimated annual production of 244.8 GWh, and will produce electricity equivalent to the consumption of about 85,000 households. It is expected that in 2021, the wind farm will be fully operational. Current status - in 2020, a new Decision on approval for connection was issued.
- Kostolac wind farm owned by PE EPS, with installed capacity 66 MW, estimated annual production 145 GWh (this project is included in the Unified list of priority infrastructure projects in the field of energy together with solar power plant Petka in Kostolac, with installed capacity 9.9 MW, estimated annual production 13 GWh). Current status - In 2020, the Contract on monitoring the construction of the connection was signed.

From 2012 to the end of 2020, a total of eight wind power plants were built in the incentive system, with a total installed capacity of 398 MW, which have the status of a privileged producer (Devreč 1 of 0.5 MW, Kula of 9.9 MW, La Piccolina of 6, 6 MW, Malibunar of 8 MW, Kovačica of 104.5 MW, Alibunar of 42 MW, Čibuk of 158.46 MW and Košava of 68 MW), and two wind power plants with a total installed capacity of 168 MW are under construction, which have the status temporary privileged producer (Plandište 1 of 102 MW and Kostolac of 66 MW).

Also, during the first quarter of 2019, it was planned to put into operation the steam-gas power plant CHP Pančevo with an installed capacity of 192 MW, as well as block B3 in the thermal power plant TPP Kostolac B with an installed capacity of 350 MW and an estimated annual production of 2,200 GWh , whose commissioning is planned for the end of 2020. Neither of the two capacities was put into operation by the end of 2020.

Production from these new capacities, including CHP Pančevo, should increase total estimated electricity production for 4,500 GWh. In this way, the production from the plant witch outage is planned, due to the end of their exploitation period, would be successfully substituted.

In addition to the steam-gas CHP Pančevo and wind farms that are especially important for meeting the goals related to renewable energy sources, the realization of the construction of the new unit B3 in thermal power plant Kostolac B will be of great importance, which will contribute to the increase of production capacities and thus to the improvement of energy stability in the Republic of Serbia, as well as ensuring a reliable and secure energy supply to the customers. The project also includes the extension of the Drmno surface mine, that is, the increase the coal production from 9 to 12 million tonnes per a year. The value of the TPP Kostolac B3 project is $545 million €The project is financed from two sources: 85% of the project value will be financed from the loan of the Chinese EKSIM Bank under preferential terms with the guarantee approved by State; the rest of projet value is provided from the funds of PE EPS (15%). The deadline for realization of the project was 58 months, but was extended to 69 months and 12 days with the concluded annexes. Completion is expected by the end of 2022. TPP Kostolac B3 unit meets all environmental protection standards prescribed by the laws of the Republic of Serbia.

In addition to the construction of new capacities during 2019 and 2020, the revitalization of hydro units continued, as well as the repairs of thermoblocks (detailed in Chapter 3.3.1).

Among other activities the following should be highlighted:

- The feasibility study and conceptual design of revitalization of blocks A1 and A2 in TENT A in December 2017 was completed and adopted by the Expert Council of PE EPS. The study predicts extension of the working life of blocks for the next 100,000 working hours, including the possibility of working in accordance with environmental regulations. The preliminary value of these revitalizations is €230 million (including the implementation of all environmental protection measures). Units A1 and A2 in TENT A were put into operation in 1970.
- The preparation of the feasibility study and the preliminary design for the revitalization of blocks A1 and A2 in TP Kostolac A was completed several years ago. Based on 3GPP PE EPS for the period 2018-2020, as well as the new one for the period 2021-2023. The harmonization of the operation of this power plant with the NERP is being considered, and in that sense the application of the "on going investments" mechanism is planned. This means that PE EPS is planning a desulphurization project at this location, and for now it has in mind only its own funds for this activity.

In the sector of electricity production, a number of environmental protection projects have been implemented, as well as projects that should ensure safe and uninterrupted supply of coal and rational management of natural resources, while reducing atmospheric pollution:

- The beginning of the realization of the project for the reconstruction of the ash removal system in TENT A, and in parallel with it the realization of the project for the construction of new ash storage cassettes, as emphasized in chapter 3.3.1.
- Wastewater treatment plant in TEKO B. This project is in progress and the planned realization is the period 2019-2022.

- DeNOx (primary + secondary measures) in TEKO B. This project is in progress and the planned realization is the period 2018-2021
- In TPP Kostolac at the beginning of 2019, the works on the construction of the port on the tributary of the Danube near TPP Kostolac A were completed. The value of the works was $15.8 million, and the purpose of the port is to accept limestone, as well as equipment for the construction of block 3 in TPP Kostolac B, and on the other hand to ship 157,000 tons of ash and 105,000 tons of gypsum per year.
- The implementation of the project for the construction of a flue gas desulphurization plant on units A3-A6 in TENT A is in progress. The work is worth €202.4 million, and is being implemented within the agreement between the Government of the Republic of Serbia and Japan. Based on that agreement, PE EPS and the Japan International Cooperation Agency (JICA) signed a loan agreement to finance the project.
- Introduction of primary and secondary measures for reduction of nitrogen oxides in TPP Kostolac, block B2 and introduction of primary measures for reduction of nitrogen oxides at TENT block B2 is in progress.
- Final activities are underway on the construction of a plant for changing the technology for collecting, transporting and disposing of ash in TPP Kostolac A.

The idea of the project "Improvement of environmental protection in the Kolubara mining basin" was to ensure safe and uninterrupted delivery of coal, as well as rational management of natural resources, while reducing atmospheric pollution. Namely, PE EPS representatives signed two loan agreements for this project: with the European Bank for Reconstruction and Development (EBRD) in July 2011, worth €80 million; and with the German Development Bank (KfW) worth €65 million with an additional donation of €9 million. This second contract was signed in October 2012. PE EPS has committed to provide €27.6 million from its own resources, so that the total value of the project is approximately €181.6 million This project envisages the procurement of new equipment that should ensure a safe supply of lignite of uniform and prescribed quality for the needs of thermal power plants and compliance with regulations in the field of environmental protection.

Project A - procurement of a new system for exploitation of overburden at the surface mine Field C (rotary excavator with a capacity of 6,600 m^3/h, conveyors with a belt width of B = 2000 mm and a depositor with a capacity of 8,800 m^3/h and electricity supply) was realized from EBRD bank loans. The work on this project was completed at the end of 2016. The original term plan meant the completion of the entire investment of the project "Improvement of environmental protection in the Kolubara basin" in the first half of 2016, but, unfortunately, the implementation of this project was marked by a long delay. For the needs of one of the previous reports on security of supply (for 2017), the expert services of PE EPS submitted information that the work is expected to be completed by the end of 2018, but that did not happen. Contractors have been identified as the reason for the delay in the implementation of the project. Finally, on December 19, 2019, the infrastructure complex from package C2 (infrastructure for the coal quality management system) was made available to PE EPS. The full capacity coal quality management project officially began in mid-2020.

From the series of mentioned projects, those that are of ecological character stand out. They are highly investment intensive and their realization is in full swing. The mentioned projects enable the retention of the existing capacities in operation and the placement of energy from PE EPS power plants on the regional market, because they provide the necessary conditions in terms of environmental protection in accordance with EU directives. One of such projects is the construction of a wastewater treatment plant at TPP Kostolac B. Contracts for equipment and works worth a total of more than €6.3 million were signed during 2018, the construction permit was obtained in April 2019, and the works began in September of the same year. The project is

part of the national program IPA 2013, and is funded by 85% from EU funds and 15% from PE EPS. The works are led by the French SADE CGTH, with the participation of three branches of the company Veloia and Energotehnika Južna Bačka.

3.11. Development Plan and Investments in Transmission System for the next Three to Fifteen Years

Development of transmission capacities includes reconstruction of existing and construction of new transmission capacities so that a balanced, sustainable and timely development of the transmission system is achieved, with the aim of connecting new conventional and renewable sources of electricity, as well as the facilities of other users of the transmission system.

Strategic and developmental importance at the national, regional and pan-European levels in the period up to 2025 and 2030, have two groups of projects in the field of electricity transmission [3].

The first group of projects includes projects of reinforcement of lines that connect transmission system of Republic of Serbia with neighbouring transmission systems and further integration of the transmission system of the Republic of Serbia in regional interconnection. These projects enable the implementation of the following strategic goals in the field of electrical energy: development of electricity market at national and regional level, increase of transmission capacity/corridors via Republic of Serbia, which have regional and pan-European significance, enabling net export of electricity and providing secure supply of electricity for domestic market.

The second group of projects includes projects for further development and reconstruction of the existing transmission network in order to ensure a secure supply of transmission system users and placement of produced electric energy. These projects enable the implementation of the following strategic goals in the field of electrical energy: providing secure supply of electricity for domestic market and development of electricity market at national and regional level.

The first group of projects includes the project "Trans-Balkan corridor", which implementation is on-going and it has predominantly regional character. The second group consists of projects of the reconstruction of existing facilities which are at the end of their life cycle, as well as the construction of new facitilies which solve the problems of unsecure, a radial supply of individual substations 110/X kV, increases the reliability of the transmission system and security of power supply to consumers, provides more efficient management of the transmission system, ensures the connection of new power plants and customers and increases the capacity of the transmission network.

The "Trans-Balkan corridor" project is included in Single Project Pipeline, Projects of Energy Community Interest (PECI), Projects of Common Interest (PCI) (section Resita - Pančevo), Western Balkan Investment Framework project list (WBIF) and list of project within investment framework of Western Balkan Six (WB6 list) (section Kragujevac 2 - Kraljevo 3 and upgrade of Kraljevo 3 substation), list of project within CESEC and it consists of two phases [3].

The "Trans-Balkan corridor - Phase 1" consists of four sections:

- Construction of double 400 kV overhead line (OHL) TS Pančevo 2 - TS Rešica - 68.3 km, €27.36 million (own funds EMS JSC);
- Construction of single 400 kV OHL TS Kragujevac 2 - TS Kraljevo 3 with increase of voltage level in TS Kraljevo 3 at 400 kV - 60 km, €29.6 million (€8 million is from own funds EMS JSC, €6.6 million is donation from WBIF, €15 million is credit from KfW);
- Construction of double 400 kV OHL TS Obrenovac - TS Bajina Bašta with increase of voltage level in TS Bajina Bašta at 400 kV - 109 km, €58.95 million (pre-accession EU funds);

- Construction of double interconnection line 2x400 kV Serbia - Bosnia and Herzegovina - Montenegro - 84 km, €40.8 million (pre-accession EU funds).

Sub-projects (sections) of Phase 1 of the "Trans-Balkan Corridor" project have been included in the EMS JSC investment plan (more detailed in chapter 0 on page 43).

The "Trans-Balkan corridor - Phase 2" includes a number of projects for construction of new 400 kV power lines. These subprojects are in the development phase, that is, in the study phase, and no decision has yet been made to enter the investment plan.

Regarding project of the reconstruction of existing 110 kV power lines, it must be considered that over 2,000 km of 110 kV OHL of transmission network was built more than 50 years ago. Although in the meantime, some of them were reconstructed, these are the replacement of worn conductors, and very rarely replacement of pillars. A large number of power lines is built on concrete pillars and passes affected routes, which results in a reduction of indicators of supply reliability. To ensure a satisfactory level of reliability of the 110 kV power transmission grid it is necessary to implement phases reconstruction of this network in the future. It is planned to reconstruct annually about 180 kilometres of 110 kV OHL by the end of 2027 [21].

3.12. Investment and Development Plan of the Distribution System for the next Three to Five Years

The main function of the planned projects in the field of electricity distribution is to increase the stability of the system and the reliability of power facilities, ensuring the quality of electricity supply to all users in accordance with the Distribution System Grid Code, increasing existing capacities (what enable connection of new consumers), reduction of technical and non-technical losses, reduction of maintenance costs by installing equipment and materials with new technological solutions, reduction of operating costs by modernization and automation, maximum utilization of available capacity during its lifetime, and improving environmental conditions by installing environmentally friendly materials and building facilities in accordance with environmental requirements.

In order to achieve stated strategic goals, projects can be divided into two groups: projects that introduce modern technologies that enable the improvement of operation and the reduction of losses in the distribution system and projects of reconstruction and reinforcement of the distribution network in order to improve the reliability of supply and reduce electricity losses in the distribution network [3].

The first group of projects includes "Smart Metering" and "Distribution network automation". The second group of projects consists of the "Project of reconstruction of TS 110/X kV at the end of their life cycle" and "Project of construction of new TS 110/X kV". The total investment value of the four projects is around €425 million.

The aim of the project " Smart Metering" is the replacement of worn-out metering infrastructure and implementation of modern systems for remote reading and load management, and information systems that allow the use of the data collected.

The application of remote reading systems for measuring devices began more than 10 years ago in all distribution areas, primarily for the system users from the consumption categories "medium voltage consumption" and "low voltage consumption". In the last two years, two projects with mixed communication technologies are being implemented on a significant number of metering devices for metering points of users from the consumption category "mass consumption". Several years after the beginning of the application of the system of remote reading of measuring devices, the need for the procurement of a unique system for reading and control of measuring devices was clearly indicated.

For that purpose, the Smart Metering Project was designed, which includes the purchase and replacement of classic measuring devices with modern electronic measuring devices that have

the ability to communicate (smart meters), as well as the purchase and implementation of systems (software and hardware) for reading, control, and data aquisition. In order to prepare for the project, the first version of the Feasibility Study and Justification of the Concept and Implementation Strategy of the AMI/MDM System was adopted in 2014. A new version of the feasibility study was prepared in 2021, which contains a techno-economic analysis and will serve as the basis for a plan for the implementation of advanced measurement systems.

The project will represent the core of the future system for remote reading of metering devices (advanced metering systems) and should include about 80% of metering devices in the category of "mass consumption" in the Republic of Serbia. It is certain that such a system would become part of a wider system of advanced grids (Smart Grid), which is a trend in the world.

The aims of project "Distribution network automation" are: improving the reliability of supply of customers, shortening the duration of interruptions, the protection of vulnerable customers (public services, hospitals, processing industry, which are sensitive to power failure), increasing the level of manipulation of medium voltage networks, improving the utilization of existing equipment through equalization of annual load diagram by remote control of load, i.e., changing the way of supply through the use of remote control in the medium voltage network. The project will be implemented through the installation of new disconnection elements in the medium-voltage network (reclosers and disconnectors) to be controlled remotely, by installing software for remote control of the existing disconnection equipment, by installing new TS X/0.4 kV with ring main unit switching equipment, by installation of ring main unit switchgear equipment in the existing TS X/0.4 kV, by installation of SCADA systems and their integration into existing dispatch control centres.

The project of reconstruction of TS 110/X kV at the end of their service life aims to increase safety of operation and security of supply and increase the efficiency of the distribution of electricity at 110 kV voltage level. In the next ten years, it is planned to complete the reconstruction of 56 TS 110/X kV and prepare projects for the reconstruction of another 59 TS 110/X kV.

The goal of the project of construction of new TS 110/X kV is to increase security of supply and increase the efficiency of electricity distribution. The process of constructing new TS 110/X kV that take over the function of an uneconomically loaded middle voltage network, solve the problem of insecure power from the existing TS 110/X kV and TS 35/X kV, high losses and low voltage conditions in the medium voltage network intensified in the previous 5-10 years, and will continue in the next ten years due to the large number of buildings whose construction is necessary. It is planned to build 23 TS 110/X kV in the next ten years and to prepare projects for the construction of another 26 TS 110/X kV.

In addition to the mentioned activities in the distribution part of the system, special attention will be paid to the continuation of implementation of environmental measures, which include the storage and shipment for processing of old transformer and motor oil, then solving problems related to the repair and replacement of transformers filled with PCB oils in accordance with legal obligations, as well as development of new technologies and solutions that prevent or minimize negative environmental impact.

3.13. Regional, National and European Goals of Sustainable Development, Including International Projects

Republic of Serbia has adopted, signed and ratified the agreement on the establishment of the Energy Community [23]. Thus, as one of its priorities, it defined the establishment of a regional electricity market and its integration into the EU energy market. Such a market should provide significant investments in this sector and contribute to the economic development and stability of country and region. Market functioning must be regulated by the legal framework of European Union in the field of electricity, as well as environmental protection, competitiveness, use of

renewable energy sources and energy efficiency. Construction of new power plants and gas interconnections will position Republic of Serbia as an important country for energy transit. Full implementation of European Union regulations in the Republic of Serbia is an obligation defined by the Energy Law [1], Strategy [2] and the Program [3].

In addition to domestic laws and strategic documents, the goals and directions of energy development in the Republic of Serbia are determined by international obligations.

Ratification of the Paris Agreement[14] is of great influence on the energy sector of the Republic of Serbia. This agreement was adopted at the 21st Conference of the Member States of the UN Framework Convention on Climate Change, held in Paris at the end of 2015. The agreement was reached "in the context of sustainable development and efforts to eradicate poverty", and aims to strengthen the global response to the dangers of climate change.

In 2019, the European Union adopted the regulatory package "Clean Energy for All Europeans" with the aim of fulfilling the obligations of the Paris Agreement - defining and achieving climate and energy goals by 2030 (reduction of GHG emissions of at least 40% compared to 1990, increasing the share of renewable energy to 32% and improving energy efficiency by 32.5%) and establishing a single energy market in the EU. Under this package, the European Union has introduced an obligation for its members to develop National Energy and Climate Plans that define national targets for reducing GHG emissions, increasing the share of renewable energy, and improving energy efficiency.

The Republic of Serbia has undertaken the obligation to develop a National Energy and Climate Plan which will define the goals of decarbonisation, increasing the share of RES, and improving energy efficiency for the period until 2030 with perspectives until 2050. The drafting of this document began in March 2021.

In 2020, the EU further corrected the decarbonisation target as part of a political initiative called the "European Green Agreement". In order for Europe to become a carbon-neutral continent by 2050, as the desired reduction of GHG emissions by 2030 a level of 55% of the GHG emissions in 1990 has been adopted. Within the framework of the "European Green Agreement", the European Union defined the "Green Agenda for the Western Balkans", with which the Republic of Serbia agreed at the regional summit in Sofia in November 2020. By signing the Sofia Declaration on the Green Agenda for the Western Balkans, the Republic of Serbia has committed itself to work with the EU to make Europe a climate-neutral continent by 2050, introducing a strict climate policy and reforming the energy and transport sectors.

In order to develop regional, national and European goals of sustainable development and integration into energy market of European Union, two groups of projects in the Republic of Serbia can be identified: projects whose realization is planned and certain in the coming mid-term period, and projects that potentially can be actual in the period after 2023.

National and regional projects whose realization is in progress or those planned in the medium term [3]:

- Project "Trans-Balkan corridor". Project, which consists of two phases in which is being implemented more subprojects of building new 400 kV power lines (in the 1st stage four sections is carried out) and connecting and switching substations, enables an increase in transmission capacity of the transmission network of Serbia, the replacement of worn-out 220 kV network, easier connection of production and storage capacities of electricity and better integration of the electricity market. The degree of realization of individual phases of the project is presented in detail in Chapter 3.7.2. The project "Trans-Balkan corridor" is included in Single Project Pipeline, Projects of Energy Community Interest (PECI),

[14] Law on confirmation of the Paris Agreement, Official Gazette of the RS - International Agreements, no. 4/2017

Projects of Common Interest (PCI) - section Resita - Pančevo, and on Western Balkan Investment Framework project list (WBIF) and list of project within investment framework of Western Balkan Six (WB6 list) - section Kragujevac 2 - Kraljevo 3 and upgrade of Kraljevo 3 substation. Estimated investment of Phase 1 is about €156.71 million.

- Project for the construction of new wind power plants at the territory of the Republic of Serbia up to 500 MW. The project implements more private investors and it is of strategic importance for the Republic of Serbia for achieving the objectives defined for the share of renewable energy in gross final energy consumption of the Republic of Serbia.
- .
- Construction of the hydropower basin Gornja Drina. The construction of three hydroelectric power plants on the Drina River is planned: HPP Buk Bijela, HPP Foča, and HPP Paunci. Power plants are of run-of-the-river type with concrete dams and chaplain turbines. The designed power of the system is between 181 MW and 211 MW, with an average annual production of 675 GWh to 705 GWh. The estimated investment is around €520 million.

Potential national and regional projects whose realization is not certain in the medium term [2]:

- The project of construction of gas CHP (Belgrade, Novi Sad, Niš, etc.) installed capacity for 860 MW. Estimated investment of project is about €1.5 billion.
- The project of construction of HPP Velika Morava installed capacity for 147.7 MW. Estimated investment of project is about €360 million.
- The project of construction of HPP Ibar installed capacity for 117 MW. This project is significant because it will enable employment of local population and improve the infrastructure (new projects), increase the use of renewable energy in accordance with the standards of European Union and increase the social standard. Estimated investment of project is about €300 million.
- The project of construction of HPP Srednja Drina installed capacity for 321 MW. Estimated investment of project is about €819 millions.
- The project of construction of PSHPP Bistrica installed capacity for 4x170 MW. New HPP will be part of the system of Lim HPPs. Estimated investment of project is about €560 million.
- The project of construction of PSHPP Đerdap 3 installed capacity for 2x300 MW. Estimated investment of project is about €400 million.
- The project of construction small hidro power plants at 191 locations with total installed capacity of 387 MW. Estimated investment of project is about €500 million.

4. NATURAL GAS

Energy Law [1] stipulates conditions whereby entities can perform energy-related activities. An energy-related activity can be performed by a public enterprise, business entity or other legal entity or entrepreneur having a license for performing the energy-related activity, unless otherwise prescribed by the Law.

Energy-related activities according to the Energy Law [1] in natural gas sector are: natural gas transmission and natural gas transmission system management, natural gas storage and natural gas storage facility management, natural gas distribution and natural gas distribution system management, natural gas supply and public natural gas supply.

Energy regulated activities are: natural gas transmission and natural gas transmission system management, natural gas storage and natural gas storage facility management, natural gas distribution and natural gas distribution system management and public supply of natural gas. Energy-related activities of natural gas supply are performed in accordance to the open market principles.

AERS is the competent body that regulates the price of natural gas for public supply, determines the price of access to the natural gas transmission and distribution system, and determines the price of access to the natural gas storage. Energy entities that perform regulated energy activities calculate regulated prices and adopt the act on prices and submit them to the AERS for approval.

The Law on Public Enterprises regulates activities of public interest in several business activities one of which is energy-related activity. The Energy Law [1] regulates activities of public interest in energy sector, as well as obligations of the public supply.

The Energy Law [1] defines energy activities of general interest in the field of natural gas, such as: transmission and natural gas transmission system management, natural gas storage and natural gas storage facility management, natural gas distribution and natural gas distribution system management, and public supply of natural gas.

The Republic of Serbia is a signatory to the Treaty establishing the Energy Community, on the basis of which it pledged to apply the Acquis Communautaire in the field of natural gas. With the adoption of the Energy Law in December 2014 [1] the third energy package of directives from the field of natural gas was transposed into the legislation of the Republic of Serbia. The Energy Law stipulates that as of January 1, 2015 all end-consumers of natural gas have the right to freely choose a supplier on the market.

During 2021, the Law on Amendments to the Energy Law (Official Gazette of the RS, No. 40/2021) was adopted, which further harmonizes domestic regulations with European Union regulations, as well as eliminates shortcomings observed in the application of the Energy Law. Some of the novelties brought by the new Law in the field of natural gas are:

- new motor fuel - liquefied natural gas;

- energy activity wholesale of natural gas;

- a new participant in the natural gas market was introduced - natural gas trade for wholesale supply;

- the vulnerable energy customer of natural gas is more precisely defined.

In order to ensure security of supply of end consumers it is stipulated that households and small customers whose all facilities/objects are connected to the natural gas distribution system, if they do not choose another supplier, are entitled to public supply at regulated prices. Small consumers of natural gas are the final customers whose annual consumption of natural gas are less than 100,000 m^3 and whose facilities/objects are all connected to the natural gas distribution system.

The right to last resort supply of maximum duration of 60 consecutive days, has the end consumer of natural gas, which is not eligible for public supply in the case of bankruptcy or liquidation of the supplier, previously supplied above mentioned consumer; after the termination or revocation of the license of the supplier who had previously supplied customer; it has not found a new supplier after the termination of the supply contract with the previous supplier, unless the contract termination is the consequence of the non-payment obligation of the buyer. The government according to the public tender procedure assigned public company PE Srbijagas Novi Sad for supplier who will perform the last resort supply.

According to the public tender the government assigned PE Srbijagas Novi Sad as a supplier for public suppliers of natural gas. The Energy Law [1] stipulates that until the establishment of acompetitive natural gas market in the Republic of Serbia the government, according to the public tender procedure, determines the supplier which will supply natural gas public suppliers, at their request, under the same conditions and at the same prices.

4.1. Natural Gas Market

In the natural gas sector, there is bilateral market functioning. Natural gas market participants include: producer (NIS JSC Novi Sad), suppliers (2019: 64 companies have been licensed, while 26 is active; 2020: 65 companies have been licensed, while 24 is active), public suppliers (2019: 32 companies; 2020: 31 companies), final customers (2019: 280,916 using regulated supply and 1,140 in the open market; 2020: 291,292 using regulated supply and 1,125 in the open market), transmission system operators “Transportgas Srbija d.o.o. Novi Sad” (Transportgas Srbija)[15], "Yugorosgaz-Transport d.o.o. Niš" (Yugorosgaz-Transport)[16], and Gastrans d.o.o. Novi Sad (Gastrans)[17], distribution system operators (2019: 33 active companies; 2020: 31 active companies, and one additional company which did not performe this activity in 2019 and 2020) and storage operator UGS Banatski Dvor.

The Transmission Network Code [30]-[34] regulates the method in line with which the transmission system operator administers transactions in the natural gas market and regulates more closely the rights and obligations of market participants who use the natural gas transmission system.

In 2020, three companies with the license for gas supply (PE Srbijagas Novi Sad, NIS JSC Novi Sad, and Cestor Veks JSC) and gas producer (NIS JSC Novi Sad) dealt with wholesale. In this market during 2019 and 2020, natural gas is purchased and sold directly among market participants based on sales contracts. During 2018, trade was functioned mutually between suppliers, and between suppliers and natural gas producer[18].

The Energy Law [1] prescribes that the Government appoints the supplier of public suppliers until a competitive market is established. According to the Energy Law the supplier of public suppliers has to offer natural gas to all public suppliers (including the one within the same legal entity as the supplier itself) under the same conditions and at the same price. In previous period, PE Srbijagas Novi Sad was the supplier of public suppliers [11].

During 2020, The largest share of natural gas quantities was sold in the open market (2019: 1,753 million m^3 or 84%; 2020: 1,853 million m^3 or 83%). The last resort supply was used by 8

[15] In November 2018, the Supervisory Board of Public Enterprise Srbijagas made the Decision on the basis of which transmission system operator Transportgas Srbija started operating on November 22, 2018.

[16] On the session of July 15, 2019, in line with the Energy Law and AERS regulations, the Council of the Energy Agency of the Republic of Serbia (AERS) has adopted a Decision on revocation of the certificate issued to the Yugorosgaz-Transport d.o.o. Niš by the Agency Decision of June 20, 2017 [11].

[17] Gastrans was certified as an independent natural gas transmission operator on February 21, 2020

[18] A significant limitation for the wholesale market is that Transmissiongas Serbia still does not apply the Rules on the operation of the transmission system which regulate access to cross-border capacities on the principles of non-discrimination and transparency, so that the allocation of capacities in accordance with the Rules on the operation of the transmission system in 2020. has not been implemented [11].

customers (2.1 million m^3) in 2019, and 35 customers in 2020 (1.2 million m^3). The share of households and small customers (with annual natural gas consumption of up to 100,000 m^3 with all their facilities connected to the natural gas distribution system) in the retail market was 20.62% [11]. Analysis of the trend of natural gas selling structure in the retail market, after market liberalization in 2015 (Table 18), shows that the ratio between selling in the open market and in the regulated market is roughly constant (85%:15%). The consumption of NIS JSC from its own production (173.6 million m^3) were not the subjects of trade on the Serbian gas market and therefore, they are not presented in Table 18.

There were no changes of suppliers on the transmission system during 2019 and 2020 [12].

On the distribution level, suppliers were switched on 17 metering points, where 3.6 million m^3 were delivered. It amounts to 1.7% of natural gas quantities delivered to final customers on the retail market [11]. Rules on Supplier Switching were adopted in 2015 and since then valid data about supplier switching exist (Table 18). This is a very significant decrease in the changes in suppliers, both in number and quantity in relation to 2019 (7.4 million m^3 at 207 metering points), and especially in relation to 2018.

Table 18: Natural gas sale in period from 2012 to 2020, in million m^3 [11]

		2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Open market	mill. m^3	324	649	804	1,514	1,712	1,917	1,881	1,751	1,853
	%	16.2	34.3	40.6	85.3	85.6	85.4	85.4	84.1	82.9
Regulated market	mill. m^3	1,680	1,243	1,178	261	289	329	321	332	382
	%	83.8	65.7	59.4	14.7	14.4	14.6	14.6	15.9	17.1
Supplier switching in transmission system	mill. m^3	-	-	-	95	-	-	148	-	-
	%	-	-	-	19.8	-	-	16.6	-	-
	Metering points	-	-	-	3	-	-	1	-	-
Supplier switching in distribution system	mill. m^3	-	-	-	4	74	21	24,8	7.4	3.6
	%	-	-	-	0.3	5.1	0.9	1.7	0.51	0.16
	Metering points				10	22	85	57	207	17

Natural gas in the Serbian market origins from indigenous production and from import. Most of natural gas quantities are provided through import from the Russian Federation based on the long-term contract, and, if necessary, from other sources under short-term contracts. Long-term contract between "Gazprom Export d.o.o." (Gazprom Export) and "Yugorosgaz a.d. Belgrade" (Yugorosgaz JSC) for natural gas supply from Russian Federation to Republic of Serbia was signed in March 2013. This contract is valid until the end of December 2021.

According to this Agreement, Yugorosgaz AD Belgrade performs deliveries of Russian natural gas to the Republic of Serbia at the parity of the station Beregovo and at the parity of the underground gas storage "Banatski Dvor"[19]. The contract guarantees the delivery of 2 billion Sm^3 of natural gas per year. The natural gas quantities over daily contracted quantities can be taken (around 6 million Sm^3) with price adjustments.

[19] During 2020, the interconnection gas pipeline from the Bulgarian-Serbian border to the Serbian-Hungarian border was mostly built and connected to the transmission system in Bulgaria and the transmission system of Transmissiongas in Serbia. Since beginning of 2021, the supply of natural gas from Russia has been operated from the direction of Bulgaria.

The contract defines the method of forming the prices of delivered natural gas (based to "oil formula") and the supply regime. The supply regime includes the takeover of nominated – available quantity of natural gas.

4.2. Transmission System

A natural gas transmission system is a network for natural gas transmission comprising a network of pipelines with design pressure exceeding 16 bar, except for supply gas pipelines, as well as compressor stations, block stations, metering and regulating stations, and metering stations at all points of delivery from the transmission system, other energy entities, electronic communications and information system and other infrastructure necessary for natural gas transmission, including line-pack (hereinafter: the natural gas transmission system).

During 2019 and 2020, the transmission network length was extended for 5 km (Table 19). Transportgas Srbija is the transmission system operator over 95% of transmission system network, while Yugorosgaz-Transport is the transmission system operator over the remaining 5%[20].

Table 19: Overview of the length of the transmission system network in Serbia in period 2011 – 2020 (km) [11]

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Length of network (km)	2,396	2,466	2,473	2,498	2,498	2,498	2,534	2,539	2,539	2,539

Basic technical characteristics of the transmission systems of Transportgas Srbija, Yugorosgaz-Transport and Gastrans are given in Table 20.

[20] With the construction of the interconnection gas pipeline from the Bulgarian-Serbian border to the Serbian-Hungarian border, the length of the transmission system was increased by an additional 15.8% in 2021. Transmissiongas Serbia operates the transmission system operator over 82% of the transmission gas pipeline network in the Republic of Serbia (2,414 km), Gastrans over 13.7% (402 km), and Yugorosgaz-Transport over the remaining 4.3% (125 km).

Table 20: Basic technical characteristics of transmission systems of Transportgas Srbija, Yugorosgaz-Transport and Gastrans [11]

Technical characteristics of the transmission system	Transportgas Srbija	Yugorosgaz-Transport	Gastrans*[21]
Capacity (mil. m^3/day)	≈ 18	≈ 2,2	34
Pressure (bar)	16–75	16–55	74
Length (km)	2.414	125	402
Nominal diameter (mm)	DN 150–DN 750	DN 168–DN 530	DN 1200
Compressor stations	1	-	1 (under construction near Velika Plana)
Compressor station, power, (MW)	4,4	-	24
Number of entries into the transmission system :	13	1	1
1.From another transmission system	4 (Horgoš, Karađorđevo brdo*, Pančevo*, Gospođinci*))	1	1 (near Zaječar)
2.From production fields – domestic gas	9	-	-
3.From the storage	1	-	-
Number of exits from the transmission system	241	6	3
Metering and regulating stations on transmission system exits	238	6	3
Overtaking stations	2	-	4
Entry into Yugorosgaz-Transport transmission system	1	-	-
Entry into Transmissiongas transmission system	-	-	3*
Interconnector towards Bosnia and Herzegovina	1	-	-
Interconnector towards Hungary	-	-	1 (under construction near Horgoš)
Natural gas storage	1	-	-

*Active from the beginning of 2021

Transmission system operators were obliged to provide automatic collection and processing of the data on natural gas flows with collecting interval of 24 hours or shorter for all delivery points from the transmission system. Such metering and data acquisition equipment is necessary for market functioning and development. So far, it has been installed in all exits on the system that is operated by Yugorosgaz-Transport and on 67% of the total number of exits from Transportgas Srbija transmission system [11]. Considering that at the end of 2017, this equipment was installed on 65% of the total number of exits from Transportgas Srbija transmission system, it can be stated that there were no significant activities in this field after that. However, adequate

[21] It is expected that all activities on the construction of this transmission system will be completed by October 1, 2021

metering and data acquisition equipment were installed on exits with larger capacities, so the share of measured natural gas is over 67%.

The main disadvantage and weakness of the transmission system is one connection with the neighboring systems that enables and provides import of necessary quantities of natural gas. This shortcoming has been overcome by building an interconnection pipeline from the Bulgarian-Serbian border to the Serbian-Hungarian border. During 2020, this gas pipeline was mostly completed, connected to the transmission system in Bulgaria and the transmission system of Transmissiongas in Serbia. The first quantities of gas for the market in Serbia from the direction of Bulgaria through this gas pipeline were delivered at the beginning of 2021.

The Republic of Serbia has four interconnections with gas pipeline systems of neighboring countries:

- Hungary - Serbia (Kishkundorozhma) - entry point and
- Serbia - Bosnia and Herzegovina (Zvornik) - exit point
- Bulgaria - Serbia (near Zaječar) - entry point[22]
- Serbia - Hungary (under contruction near Horgoš) - exit point[23]

First two interconnections are a part of Transportgas Srbija transmission system, second two are part of Gastrans transmission system, while there is no gas pipelines connected with the transmission systems of neighboring countries within the Yugorosgaz-Transport transmission system.

4.2.1. Assessment of Transmission System Reliability

The assessment of the reliability of transmission system operation is doing based on indicators of the quality of natural gas delivery and supply. Energy entities collect data on these indicators in a systematically and uniformly in accordance to the Rules on Monitoring Technical and Commercial Indicators and on Regulating Quality of Electricity and Natural Gas Delivery and Supply [36], and inform the AERS on this issue once a year.

Reliability of transmission system operation is monitored by recording number and duration of interruptions in the delivery within transmission. Interruptions are sorted out to planned, unplanned and interruptions caused by force majeure.

Interruption within the transmission system of Transportgas Srbija from 2015 to 2020 are presented in Table 21. In the same period, on the transmission system of Yugorosgaz-Transport, there were no natural gas delivery interruptions.

[22] Built in 2020, in use since the beginning of 2021

[23] In operation since October 1st 2021

Table 21: Interruptions within Transportgas Srbija transmission system by causes [11]

TSO Transportgas Srbija	Interruption causes					
	Planned interruptions		Unplanned interruptions		Vis major	
	Number	Duration (min)	Number	Duration (min)	Number	Duration (min)
2015	0	0	5	36	0	0
2016	7	2,649	0	0	0	0
2017	15	10,980	2	720	0	0
2018	7	5,460	0	0	0	0
2019	11	118	2	79	0	0
2020	3	1,890	0	0	0	0

During 2019, there were two unplanned interuptions, while in 2020, all interruptions were planned. The reasons for interruptions were being maintenance and relocation of pipelines. It is noticeable that during 2019 and 2020, the total duration of interruptions, expressed in minutes, significantly decreased compared to the previous period.

4.3. Distribution system

A natural gas distribution system is a distribution network of natural gas comprising a network of pipelines, regulation, metering and regulation, and metering stations at all points of delivery from the distribution system, other energy facilities, electronic communications, information another infrastructure necessary for distribution of natural gas with maximum operating pressure not higher than 16 bar, including line-pack.

According to the Energy Law [1], a distribution of natural gas is a regulated activity.

The length of the distribution network in Serbia has increased by more than a quarter since 2013 (25.2%). During 2019, it was increased by 864 km, and during 2020, it was increased by 597 km, or 7.9% during these two years, which created the conditions for connecting new customers [11]. The largest percentage increase in the length of the network in 2019 and 2020 was in the largest DSO, Srbijagas, where the length of the network increased by 4.69% in 2019, and then 9.72% in 2020 (partly due to the construction of the network, and partly due to the takeover of the distribution network of DSO "Heating plant Zrenjanin"). The share of PE Srbijagas Novi Sad in the total length of the distribution network in the Republic of Serbia at the end of 2020 was 57.87%. There were no changes in the length of the network in 17 DSOs during 2019, and in 14 in 2020 [11].

The length of the distribution network and the number of active connections are presented in Table 22.

Table 22: Length of the distribution network in Serbia in 2013 – 2020 [11]

Year	2013	2014	2015	2016	2017	2018	2019	2020
Length (km)	15,839	16,363	16,532	16,653	16,961	18,422	19,286	19,833
Number of delivery points	261,000	261,000	262,500	267,000	270,626	276,518	282,997	293,523

The number of connections in 2019 increased by 2.3%, and in 2020 by an additional 3.7% compared to the previous year [11].

4.3.1. Assessment of Distribution System Reliability

The assessment of the reliability of distribution system operation can be done based on indicators of the quality of natural gas delivery and supply. Energy entities collect data on these indicators in a systematic and uniform manner in accordance with the Rules on Monitoring Technical and Commercial Indicators and on Regulating Quality of Electricity and Natural Gas Delivery and Supply [36] and inform the AERS on this issue once a year. Based on the AERS Annual Report for 2019 and 2020 [11], data on continuity of delivery were not deliver by 3 DSO (Srbijagas, Heating plant Zrenjanin and Kovin-gas), while in 2020, data on continuity of delivery were collected from 295,920 delivery points, i.e. 100% of delivery points.

The reliability of distribution system operation is assessed by parameters of system reliability - number and duration of interruptions of delivery within a distribution. These parameters are monitored and registered separately as planned and unplanned interruptions in natural gas delivery. Based on these parameters, indicators of continuity of delivery from distribution systems are calculated as follows [36]:

- SAIFI [number of interruptions/user] - average frequency of interruptions per user; It is calculated as a quotient of the cumulative number of interruptions and the total number of users.
- SAIDI [min/user] - average duration of interruptions per user; It is calculated as a quotient of cumulative duration of all interruptions and the total number of users.

Summary data about reliability parameters of distribution system operation and indicators of continuity of delivery for the period 2015-2020 are presented in Table 23 and Table 24. Data are related to planned and unplanned interruptions and are sorted out in accordance with interruption causes. Maximal values of SAIFI and SAIDI indicators registered in individual distribution systems are also presented.

Table 23: Unplanned interruptions within distribution systems - Summary indicators [11]

Interruption cause	Year	Number of interruptions	SAIFI	Maximum reached SAIFI	SAIDI	Maximum reached SAIDI
			Number of interruptions/user		min/user	
Delivery reduction from upstream system	2015	0	0	0	0	0
	2016	6	0	0.12	0.10	34.14
	2017	0	0	0	0	0
	2018	0	0	0	0	0
	2019	0	0	0	0	0
	2020	1	0	0	0	0
Gas leak	2015	58	0.02	0.11	1.70	10.15
	2016	84	0.04	2.00	6.3	15.85
	2017	37	0.02	0.13	3.33	23.71
	2018	39	0.01	0.07	1.15	9.44
	2019	27	0.01	0.21	1.71	18.09
	2020	68	0.06	0.14	22.22	53.07
Third party	2015	219	0	0.15	0.09	75.88
	2016	183	0.02	0.54	3.86	710.00
	2017	259	0.03	0.04	3.80	16.44

Interruption cause	Year	Number of interruptions	SAIFI	Maximum reached SAIFI	SAIDI	Maximum reached SAIDI
	2018	230	0.06	1.00	9.37	154.62
	2019	185	0.03	2.00	6.16	360
	2020	272	0.02	0.1	5.34	11.25
Inadequate network capacity	2015	0	0	0	0	0
	2016	0	0	0	0	0
	2017	0	0	0	0	0
	2018	0	0	0	0	0
	2019	0	0	0	0	0
	2020	0	0	0	0	0
Other reasons	2015	0	0	0	0	0
	2016	0	0	0	0	0.07
	2017	3	0.01	0.3	3.79	168.14
	2018	1	0.00	0	0.02	0.18
	2019	0	0	0	0	0
	2020	4	0.01	0.2	3.89	9.57
Total	2015	277	0.02	0.15	1.79	75.88
	2016	273	0.06	2.00	10.26	710.00
	2017	299	0.06	0.3	10.92	168.14
	2018	270	0.07	1.07	10.54	164.24
	2019	212	0.04	2.21	7.87	378.09
	2020	345	0.09	0.44	31.45	73.89
Lithuania	2013	-	0.0045	-	1.53	-
Netherlands	2013	-	0.0067		1.01	

Table 24: Planned interruptions within distribution systems - Summary indicators [11]

Interruption cause	Year	Number of interruptions	SAIFI	Maximum reached SAIFI	SAIDI	Maximum reached SAIDI
			number of interruptions/user		min/user	
Cause within a system connected to it	2015	0	0	0	0	0
	2016	5	0	0.03	0.21	6.98
	2017	4	0.039	1.62	12.93	873.20
	2018	2	0.02	0.09	15.31	61.03
	2019	10	0.12	0.4	108.33	370.47
	2020	54	0.13	0.32	63.06	155.06
Administrative interruption	2015	0	0	0	0	0.16
	2016	2	0	0.55	0.04	0.65

Interruption cause	Year	Number of interruptions	SAIFI	Maximum reached SAIFI	SAIDI	Maximum reached SAIDI
			number of interruptions/user		min/user	
	2017	5	0.032	0.3	14.81	127.62
	2018	2	0.01	0.46	0	0
	2019	2	0.02	0.06	9.12	31.2
	2020	18	0.02	0.05	8.51	20.91
Operator's interruption	2015	22	0.03	1.00	4.38	540.00
	2016	27	0.11	0.31	104.85	631.92
	2017	51	0.040	1.00	14.72	360.00
	2018	62	0.06	1.00	27.36	540.00
	2019	18	0.05	1.00	20.77	540.00
	2020	91	0.09	0.34	22.36	56.64
Uncategorized interruption	2015	32	0.02	0.11	1.80	12.30
	2016	32	0.01	0.11	1.57	12.13
	2017	44	0.004	0.03	2.02	16.55
	2018	74	0.02	0.17	3.43	28.37
	2019	2	0.01	0.81	7.4	509.92
	2020	1	0	0.03	0.01	3.4
Total	2015	54	0.05	1.00	6.18	540.00
	2016	66	0.12	0.55	106.67	631.92
	2017	104	0.11	1.62	44.49	873.20
	2018	140	0.11	1.72	46.11	629.4
	2019	32	0.19	2.27	145.62	1451.59
	2020	164	0.24	0.74	93.94	236.01
Lithuania	2013.	-	0.26	-	26.97	-
Netherlands	2013.	-	0.027	-	5.10	-

To have a full understanding about the reliability of distribution systems operation in the Republic of Serbia, data about SAIFI and SAIDI indicators for two EU countries (Lithuania and the Netherlands), with the same method for indicators calculation applied, are also presented in Table 23 and Table 24 [26]. It can be noticed, for unplanned interruptions, that both indicators are significantly lower than in the case of Republic of Serbia. This means that there are significant possibilities for improvement of system operation, and that is necessary to undertake technical and organizational measures for reducing unplanned interruptions within distribution systems.

Considering "Gas leak" and "Third party" as dominant causes for unplanned interruption, it is clear that the key activities that should be undertaken are related to better maintenance of systems and better coordination with utility companies. Data for 2020 show that there were no unplanned interruptions due to inadequate network capacity, but there was one interruption due to a reduction in the upstream system with a short duration and a small number of affected sites. As in previous years, the largest number of unplanned interruptions in 2020 was due to the

actions of a third party. The total number of unplanned interruptions in 2020 (345) was the biggest in the entire six-year period 2015-2020. year, and the average values of SAIFI and SAIDI indicators have the worst values. Given that the COVID-19 pandemic started in 2020, it is possible that this fact also had an impact on such poor values of the indicators.

Considering planned interruptions, difference in relation to selected EU examples is not so significant, but it shows that it is possible to reduce duration of planned interruptions. Maximal SAIFI and SAIDI indicators are significantly higher than average values. This shows significant variation in reliability of operation of different distribution systems, and the need for some distribution systems to take adequate actions to eliminate primarily the cause of unplanned interruptions.

In Table 25, summary data about reliability indicators of distribution system operation for 2015-2020 period are presented.

Table 25: Summary continuity indicators of distribution systems

Type of interruptions	Year	Number of interruptions	SAIFI [number of interruptions/user]	SAIDI [min/user]
Planned	2015	277	0.02	1.79
	2016	66	0.12	106.67
	2017	104	0.11	44.49
	2018	140	0.11	46.11
	2019	32	0.19	145.62
	2020	164	0.24	93.94
Unplanned	2015	54	0.05	6.33
	2016	273	0.06	10.26
	2017	299	0.06	10.92
	2018	270	0.07	10.54
	2019	212	0.04	7.87
	2020	345	0.09	31.45
Total	2015	331	0.07	8.12
	2016	339	0.18	116.93
	2017	403	0.17	55.41
	2018	410	0.18	56.65
	2019	244	0.23	153.5
	2020	512	0.33	125.4

It can be observed, from Table 25, that the number of interruptions grew during the observed period - from 331 interruptions during 2015 to 512 interruptions in 2020, with a change in the trend in 2019 when the number of interruptions drops to 244, but with a very high share of unplanned interruptions (87%).

Values of continuity indicators of distribution systems (SAIFI and SAIDI) in 2019 and 2020 are worse than in the period 2016-2018[24]. These values indicate the need to undertake activities on preventive maintenance of the system, better coordination of work with other utility systems, etc.

4.4. Storage of Natural Gas

Underground gas storage (UGS) Banatski Dvor was commissioned in November 2011, and it is located on the depleted gas deposit whose capacity was amount to 3.3 billion m^3 of natural gas. Gazprom Export nad PE Srbijagas are the storage owners [40]. Total area of the storage amounts to around 54 km^2. The available capacity of the underground storage is currently 450 million $m^3$of natural gas.

The underground gas storage has 30 wells, different by purposes, equipment and period of drilling. Out of total number, 18 wells are used for natural gas injection and withdrawal; one is used for injection of reservoir water, while 11 are observation and monitoring wells. The gas injection/withdrawal line is equipped with an installation for gas processing (separators, filters), measuring and safety equipment, and equipment for gas dehydration and regeneration of glycol. Compressor station comprises of two compressor installations (gas motor, compressor, cooler). Compressors have two stages of compression; inlet pressure is 30-35 bar and outlet pressure is 150 bar. One compressor has the power of 2.5 MW and it has been in operation since 2006, while the other compressor has the power of 3.5 MW and it has been in operation since 2010.

Maximal daily withdrawal capacity is 5 million m^3/day and it is limited by the capacity of the line for gas dehydration. Maximal technical injection capacity is 2.7 million m^3/day, and it is defined by the capacity of parallel operation of both compressors. There is no backup compressor in the case of malfunction of any of compressors.

History of underground storage operation in period 2012-2020 is given in Table 26.

Table 26: Data about UGS Banatski Dvor operation in period 2012-2020 (million m^3) [11]

UGS mill. m^3	2012	2013	2014	2015	2016	2017	2018	2019	2020
Injected	389	342	284	228	197	240	273	315	299
Withdrawn	161	268	353	113	254	227	270	112	300
Own consumption	-	7	5	3	3	3	3	4.4	3.5
Delivered to transmission system	-	266	352	113	254	227	299	112	296
Cushion gas (at the end of year)	353	530	530	530	530	530	530	530	530
Commercial gas (at the end of year)	328	402	333	448	391	404	375	572	401
Maximal daily injection	2.48	2.5	2.7	2.4	2.6	2.4	2.6	2.7	2.7
Maximal daily withdrawal	3.94	4.2	4.2	2.8	4.95	5.1[25]	5.0	4.9	4.9

[24] Data in 2015 are significantly better than in the period 2016-2020. However, since data collection began in 2015, it can be objectively assumed that the results of reliability indicators in that year are rather the result of inexperience in data collection and processing, than significant additional problems in the functioning of distribution systems in the coming years.

[25] Technical capacity of underground storage is defined at a temperature of 20˚C and a pressure of 1.01325 bar, while values of maximal injected and withdrawn quantities are defined at a temperature of 15˚C and a pressure of 1.01325 bar, reduced to lower calorific value of H_d=33,338.35 kJ/m^3.

Bidirectional gas pipeline Gospođinci – Banatski Dvor enables unhindered and full connection of the underground gas storage with the transmission system. The basic data on this gas pipeline are as follows:

- length 42.5 km
- nominal diameter DN 500
- maximum working pressure: p_{max}=75 bar
- maximum gas flow:
  - withdrawal from UGS Banatski Dvor Q=415,000 m^3/h (10 million Sm^3/day) and
  - injection into UGS B.Dvor Q=230,000 m^3/h (5.5 million Sm^3/day).

Currently, Republic of Serbia should have enough natural gas for 30 days of supply interruption, while there would be a 13.7% shortfall of imported gas in order to meet needs for 90 days [27]. Of course, these results are relative, as the daily (as well as hourly) withdrawal capacity is limited, and consumption over that limit could not be satisfied (regardless to available gas in storage). Also, these results are only valid for a single season. In case of permanent interruption of supply from the direction of Hungary and without additional supply routes, Serbia would not be able to fill underground storage, which would reflect on the next year's gas supply.

The extending of a capacity of underground storage (the second phase of development) to 800 million m^3 is planned.

4.5. Security of Supply

4.5.1. Planned Production and Consumption of Natural Gas and a Way for Ensuring Gas Supply for the Upcoming Five Year Period

Natural gas is the third most used primary energy source in the Republic of Serbia, after coal and oil. Its share in the total primary energy supply in 2019 was 13.27% [25]. Gross inland consumption in 2020 amounted 2,481 million m^3, 4% lower compared to 2019 [11], [25]. Growth of consumption, noticeable for the period after 2014 (Table 27), was stopped in 2018, and the decrease in consumption has occurred, primarily because of a significant decreasing in non-energy consumption. The trend of decreasing consumption continued in 2019 and in 2020. The structure of natural gas supply and consumption in 2020 is shown in Figure 2, while the energy balance of natural gas for the period 2010-2020 is shown in Table 27.

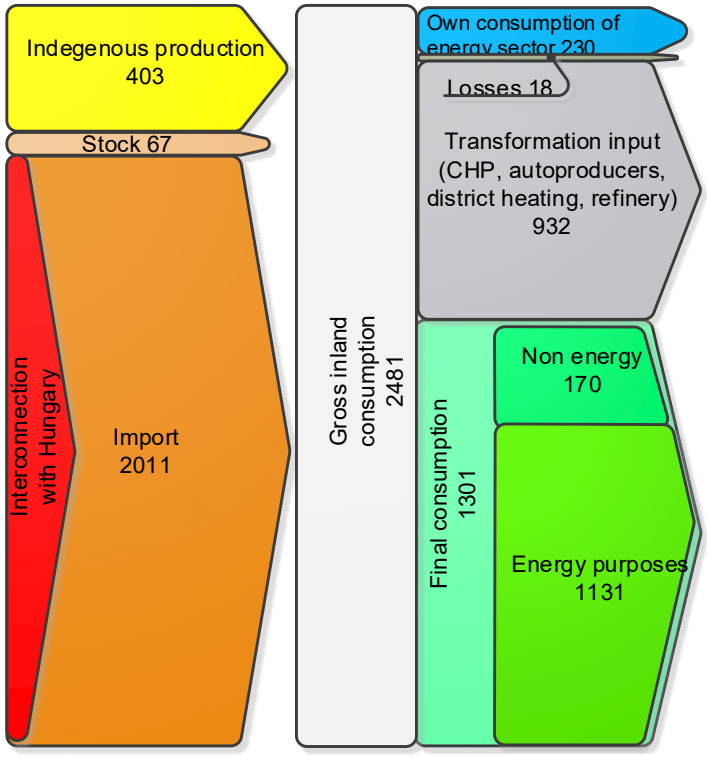


Figure 2: Supply and consumption structure of natural gas in 2020, in million Sm^3 [25] [26]

[26] https://www.stat.gov.rs/media/4782/bilans-prirodnog-gasa-2018-prethodni-podaci.pdf

Table 27: Balance of Natural Gas for the period 2010-2020, in thousands Sm^3 [15]

Year:	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Primary production	387,183	508,161	533,511	531,188	557,179	572,502	523,229	489,085	449,567	438,615	408.532
Import	1,967,753	1,747,520	1,789,756	1,887,480	1,394,659	1,740,221	1,795,226	2,182,632	2,153,385	2,262,610	2.135.585
Stock changes	0	133,729	-216,108	-74,500	68,795	-114,511	56,850	-12,800	29,458	-197,967	100.087
International bunkers	-27,343	0	0	0	0	0	0	0	0	0	0
Gross inland consumption	**2,327,593**	**2,389,410**	**2,107,159**	**2,344,168**	**2,020,633**	**2,198,212**	**2,375,305**	**2,658,917**	**2,632,410**	**2,503,258**	**2.644.204**
Transformation input	**805,480**	**904,808**	**826,160**	**774,997**	**856,098**	**885,174**	**886,884**	**920,464**	**942,349**	**953,057**	**1.006.607**
CHP	*95,173*	*153,786*	*146,795*	*70,436*	*27,391*	*20,064*	*46,582*	*94,992*	*115,978*	*149,637*	*93.990*
Autoproducers	*203,910*	*184,245*	*132,134*	*205,803*	*216,384*	*164,998*	*144,646*	*136,587*	*149,740*	*166,099*	*193.940*
District heating plants	*506,397*	*566,777*	*547,231*	*498,758*	*480,844*	*563,451*	*566,640*	*565,657*	*536,915*	*497,046*	*570.589*
Refineries	-		-	-	*131,479*	*136,661*	*129,016*	*123,228*	*139,716*	*140,275*	*148.088*
Consumption in the energy sector	**60,274**	**54,242**	**93,736**	**159,932**	**183,560**	**209,707**	**180,986**	**202,241**	**197,345**	**210,465**	**226.955**
Loses	**20,943**	**5,746**	**11,847**	**16,328**	**18,194**	**11,433**	**22,544**	**36,101**	**36,705**	**20,570**	**16.064**
Final consumption	**1,440,896**	**1,424,614**	**1,175,405**	**1,392,911**	**962,981**	**1,091,898**	**1,284,891**	**1,500,111**	**1,456,011**	**1,319,166**	**1.394.578**
Final Non-Energy consumption	**271,435**	**283,532**	**21,496**	**13,4365**	**114,252**	**157,658**	**292,077**	**425,526**	**197,386**	**169,746**	**188.194**
Final Energy consumption	**1,169,461**	**1,141,082**	**1,153,909**	**1,258,546**	**848,729**	**934,240**	**992,814**	**1,074,585**	**1,258,625**	**1,149,420**	**1.206.384**
Industry	*759,313*	*732,730*	*760,460*	*88,9452*	*485,888*	*543,083*	*550,089*	*578,938*	*720,005*	*622,175*	*614.720*
Transmission	*12,623*	*14,054*	*4,459*	*9,486*	*8,833*	*11,204*	*6,502*	*5,309*	*21,001*	*13,532*	*27.569*
Households	*270,412*	*266,653*	*244,232*	*218,528*	*179,000*	*189,822*	*210,678*	*240,938*	*243,982*	*255,165*	*302.982*
Agriculture	*18,330*	*17,448*	*20,670*	*19,543*	*32,207*	*20,713*	*28,953*	*22,564*	*23,506*	*24,488*	*20.862*
Public and commercial sector	*108,783*	*110,197*	*124,088*	*121,537*	*142,801*	*169,418*	*196,592*	*226,836*	*250,131*	*234,060*	*240.521*

Natural gas production of in the Republic of Serbia is being realized in Vojvodina area. Company for exploration, production, processing, distribution and trade of oil and oil derivatives and exploration and production of natural gas NIS JSC is the only company in Serbia dealing with the exploration and production of natural gas. Natural gas is extracted from 78 wells, while the main gas fields are as follows: Međa, Martonoš, Itebej, Torda Plitko, Miloševo[27]. After preparation process which makes produced gas applicable to final customers, produced gas is delivered via 9 points into the transmission system (96.6% of produced quantity) while the rest of produced gas is delivered via 4 points into the distribution system [11].

Indigenous production was enough to meet 16.23% of gas demand in 2020, while the rest was supplied by import from the Russian Federation in line with the long-term contract. For consumers in the Republic of Serbia, natural gas from Gazprom Moscow is acquired by Yugorosgaz JSC Belgrade. During 2019, gas was imported entirely from the Russian Federation.

[27] https://www.nis.eu/lat/o-nama/delatnosti/istrazivanje-proizvodnja

In 2020, PE Srbijagas imported gas from 4 other suppliers, and all imported quantities were taken over from the Hungarian transmission system [12]. The largest part was imported under a long-term contract, while in 2019, 441 million m^3 was imported under other contracts, and in 2020, 760 million m^3 [11].

Total indigenous production of natural gas in 2020 amounted 408.5 million m^3, which was about 7% less than in 2019 [25]. After the period from 2011 to 2015, when gas production had significant growth, production has been constantly decreased.

In the upcoming period continuation of declining trend of production is expected, since gas fields are characterized by high utilization coefficients, amounts of conventional resources and balance reserves are small, while a level of geological exploration is relatively high [2]. Projections of indigenous production up to 2024 are given in Table 28.

Table 28: Projection of indiginous production, in thousands m^3 [3]

Year	2021	2022	2023	2024
Production	365	345	317	304

In the Energy Sector Development Strategy [2] two scenarios of natural gas consumption were considered: reference scenario and scenario with implementation of energy efficiency measures. Both scenarios foresee an increase of gas consumption, both for transformation input (CHP gas facilities, increase of gas share in district heating plants and autoproducers) and for final consumption (Table 29). Besides the expected increase of total gas consumption, the Strategy also envisages an increase of the share of natural gas in primary energy mix to 16% by 2030.

Table 29: Projections of natural gas consumption, in thousand Sm^3 [3]

	Reference scenario			**Scenario with implementation of energy efficiency measures**		
	2020	**2025**	**2030**	**2020**	**2025**	**2030**
Transformation input	916,771	1,027,286	1,113,940	777,372	907,980	973,285
Final consumption	1,935,266	2,255,508	2,622,217	1,780,797	2,073,410	2,430,072
Losses	38,931	46,466	54,002	36,420	42,699	48,978
Total	**2,890,969**	**3,329,261**	**3,790,158**	**2,594,588**	**3,024,089**	**3,452,334**

Following the projections of gas consumption presented in the Strategy [2], in 2016, PE Srbijagas Novi Sad has determined the total yearly volume of natural gas to be transmissioned by the transmission system for the period from 2020 to 2029 [28]. The assessment of needed quantities was performed as the base for the Plan of the transmission system development for the period 2020-2029 [28]. Table 30 presents data for planed transmission in the next four years, i.e. up to 2025. Estimates of quantities for the DSO needs and for the needs of the final consumers connected to the transmission system were done based on historical data for the period 2014 – 2018, results of a survey conducted with DSO and end consumers connected to the transmission system, as well as the Strategy projections [2]. Data given in Table 30 are corrected in the part concerning UGS Banatski Dvor and overtaking station Pojate. Corrections were made based on the extension of milestones for UGS Banatski Dvor given in the Program [3] and based on the proposed projections of gas transmission by the Transmission Development Plan of Yugorosgaz-Transport [29].

Table 30: Estimation of natural gas quantities to be transmissed in the period 2021- 2025, in million Sm³

	2021	2022	2023	2024	2025
Overtaking station Pojate (according to Yugorosgaz-Transport)	53.7	56.4	58.7	60.4	62.8
Distributers	1,499	1,561	1,625	1,692	1,762
CHP	270	270	270	270	320
End consumers connected to the transmission system	833	851	869	887	905
UGS Banatski Dvor	300	450	600	750	750
Production on the transmission system	135.8	119.42	105.9	93.91	83.27
Own use	2.5	2.5	3	3	3
Transmission without cross border transmission	**3,094.00**	**3,310.32**	**3,531.60**	**3,756.31**	**3,886.07**
Overtaking station for cross border transmission (for Bosnia and Herzegovina)	287	287	292	298	304
Total transmission including cross border transmission (million Sm^3)	**3,381.00**	**3,597.32**	**3,823.60**	**4,054.31**	**4,190.07**

In the upcoming period consumption of natural gas will be governed by various factors related to energy sector (price of natural gas, infrastructure development, prices of other energy sources, etc.), factors related to general economic and social development (GDP growth, purchasing power of the population, implementation of environmental regulations, demographic indicators, structure of industrial production, etc.). Significant effect on natural gas consumption could have changes related to large industrial facilities, significant natural gas consumers (e.g. Azotara Pančevo, MSK Kikinda), as well as realization of projects in the energy sector (e.g. the construction of CHP Pančevo or heat supply of Belgrade from TPP "Nikola Tesla A"). However, if there is no significant change in the structure of natural gas consumption in the future, further increase of import dependency can be expected. It could rise from 81.1% in 2020 to around 90% by 2025, due to expected decline in domestic natural gas production.

The long-term contract between Gazprom export and Yugorosgaz JSC, on the supply of the Republic Serbia with natural gas from Russia, valid by the end of 2021, guarantees supply of 2 billion Sm^3 of natural gas per year. It is rational to assume that additional needs of natural gas in the period up to 2023 could be met by import from the Russian Federation. Alternative and probably more expensive options are supply from the North Stream, leasing transmission capacities in Germany, Austria and Hungary, or purchasing in the market in Hungary. After completing of the interconnection with Bulgaria the possibility of supplying from this direction (Russian Federation, Azerbaijan, LNG therminal in Greece, etc.) could be analyzed.

The available capacity of interconnector with Hungary for the needs of consumers in Serbia (11 million m^3/day, utilization rate of interconnectors of 90%) allows annual imports of about 3.6 billion m^3, which is significantly more than 2.262 billion m^3 imported in 2019, or 2.011 billion m^3 imported in 2020. The amount that can be imported on this interconnector is higher than the projected required quantities of natural gas on an annual level until 2023. The utilisation rate of the entry firm capacity on Serbian-Hungarian border of 540,000 m^3/hour was 49.7% during 2020

(52.69% in 2019). The highest daily quantity withdrawn into the transmission system on the Serbian-Hungarian border amounted to 12.59 million m^3/day in 2020 (12.56 million m^3/day in 2019), out of which 11.4 million m^3/day (12.2 million m^3/day in 2019) were intended for customers in Serbia and the rest for were intended for Bosnia and Herzegovina [11]. Natural gas consumption is uneven, depends on the season, thus capacity utilisation is considerably lower during summer.

With the construction of the interconnection gas pipeline from the Bulgarian-Serbian border to the Serbian-Hungarian border and its connection with the transmission system Transmissiongas Serbia, it is expected that in the future the main supply route in Serbia will be from Bulgaria [28]. Capacity allocation for a maximum period of 20 years on the border with Bulgaria as an entry point into the new transmission system was organized in 2019. Of the total capacity of the gas pipeline, which amounts to 12.66 billion m^3/year, slightly less than 90% has been distributed and contracted in the long term. Non-long-term contracted gas pipeline capacities will be allocated at auctions in accordance with EU Commission Regulation 2017/459, and congestion management will be in accordance with the EU Commission Decision of 24 August 2012 amending the Annex to Regulation 715/2009 [11].

4.5.2. Measures to Cover Peak Demand or Shortfalls of Suppliers

Transmission network codes [30]-[33] regulate actions regarding allocation of capacity and overload management, as well as managing actions in cases of disturbances in the transmission system.

In the case of the peak load demand when a sum of the required entry/exit capacities is greater than the total capacity, the transmission system operator determines to each applicant the capacity proportionally to the required capacity. Also, the operator of the transmission system has the right to limit or cut off interruptible capacity at entry/exit, if announced natural gas quantities for the next day are greater than the technical capacity for an entry/exit of the system. The transmission system operator limits interruptible capacity, with the minimal number of interruptions, considering the amount of the missing capacity, the frequency and the duration of interruptions in the previous period and the integrity of the transmission system.

Any case when one or more suppliers is not able to provide enough natural gas (shortfall), according to the Transmission system code, is treated as a Market Disruption, or a situation in which the security of supply of end customers is jeopardized. The shortfall can be a consequence of general shortage of natural gas or other extraordinary circumstances, which due to insufficient supply can cause a pressure drop in the transmission system and jeopardize operation of the transmission system. In the event of a general shortage of natural gas, the transmission system operator undertakes measures for limiting natural gas delivery, based on a Plan for consumption limiting, after the Government adopts a decision on the application of such measures. If a Customer[28] refuses to implement the supply limitation plan, the operator of the transmission system shall limit or cut of supply of the Customer. The transmission system is obliged to inform the Customers and the competent authorities about planned and expected interruptions in natural gas supply in advance and in time, unless it is necessary to undertake immediate measures to ensure safe and undisturbed functioning of a part or the whole transmission system.

Detailed instructions for acting in aforementioned and other situations that influence or can influence functioning of the natural market in the Republic of Serbia and affect or can affect security of supply are given in the Emergency Plan For Safegurarding Of Security Of Natural Gas Supply [38].

[28]Energy entity, gas producer, or end user that made a contract on natural gas transmission.

An experience from previous crisis (gas supply cut in 2009, sanctions of the international community in the 1990s) indicate that in such situations is necessary to require fuel switch of end-users who have such options, considering environmental effects caused by gas supply interruption of industrial users, and necessary coordination with other energy systems (primarily electric power system).

4.5.3. Quality and Maintenance of Infrastructure

Maintenance of the transmission system and other energy infrastructure under the jurisdiction of the Transportgas Srbija is carried out in accordance with the Rulebook on Technical Conditions for Undisturbed and Safe Gas Transport via Gas Pipelines of Pressure exceeding 16 bar [41] and the Transmission Network code [30]-[32], approved by the AERS. Requirements for ensuring proper maintenance to be fulfilled during the design and construction of gas stations, as well as the complete procedure related to the adoption and implementation of a Maintenance Program for the next gas year are stipulated by proper rules. A Maintenance Program should contain a list of entrances/exits that would be affected by a scheduled maintenance, an estimated period of entrance/exit capacities reduction, a level reduction for each capacity and a description of planed activities. Maintenance Program prescribes monthly, quarterly, semiannual and annual inspections of installations. Upon the inspection, proper activities should be undertaken in the identified parts of the infrastructure.

For ensuring secure supply, maintenance of the transmission system, which has been successively built (some sections had been built 50 years ago) has a crucial importance (Table 31). By analyzing results, obtained from the transmission system examination by an intelligent pig, it was determined that pipelines were in good condition and all damages with defect depths that amount 70% or more of a thickness of the pipe wall were fixed [28]. Based on the undertaken activities for repairing of pipelines damages, it was found that outer damages were mainly caused by pipe corrosion (due to damage on insulation, poor installation of insulation, etc.), while inner damages were characteristic for gas pipelines that transmissioned domestic gas.

Table 31: Age of the transmission system [28]

Age	More than 50 years	40-50	30-40	20-30	10-20	1-10	Total
Length (km)	242	729	681	244	413	30	2,339
Share (%)	10.5	31.2	28.3	10.7	17.7	1.6	100

The plan is to test gas pipelines every 10 years (the next is expected during 2021-2022) and, based on obtained results, to determine the dynamics of future investments in the transmission system.

The transmission system and other energy infrastructure under the jurisdiction of Yugorosgaz-Transport are maintained according to the Guidelines for Gas Installations Maintenance and the adopted Maintenance Program for the next gas year, in accordance with the Transmission Network code [33], approved by the AERS. A Maintenance Program prescribes monthly, quarterly, semiannual and annual inspections of installations. If needed appropriate measures should be undertaken upon the inspection. In the period 2017-2019, five inspections were carried out by the Emergency Management Sector of the Ministry of Interior, and no irregularities related to fire protection were found. It was found that the state was in accordance with provisions of the Law on Fire Protection, the Law on Flammable and Combustible Liquids and Flammable Gases and the Law on Explosive Substances, Flammable Liquids and Gases. In 2015 examination of the transmission pipeline at rivers and waterfalls crossings was performed by a PCM method (Pipeline Current Mapping). The PCM method is an indirect method for detecting outer corrosion of underground gas pipelines. The conducted testing indicated a completely

satisfactory condition of pipelines, which was expected since the transmission system was built in the past 20 years using pre-insulated pipes and a system of cathodic protection was installed.

Maintenance of distribution systems shall be performed in accordance with the Rulebook on Technical Conditions for Undisturbed and Safe Gas Distribution via Gas Pipelines of Pressure up to 16 bar and the Distribution Network codes, which each distribution system operator shall submit to the AERS[29].According to the codes, each distribution system operator adopts the Maintenance Program for the next gas year no later than 1st May, considering, as possible proposals of users and operators of related distribution systems. The maintenance program contains activities that affect reduction of distribution capacity, and include activities on connection to the distribution system, testing, repairing, replacement, re-commissioning, development and extension of the system, as well as preparatory and final works.

4.5.4. Incentives for New Investment in Exploration, Production, Transmissionation and Storage of Natural Gas

Currently, in the Republic of Serbia, there are no incentive measures for new investments in research, production, transmission and storage of natural gas

4.5.5. Plans for the Construction of Energy Facilities to Ensure the Security of Natural Gas Supply

Security of supply is related to ensuring and delivering natural gas to customers in required quantity in timely manner. Security off supply is improved by diversification of supply routes and sources and by construction of gas storages. Assessment of security of supply can be done by system availability indicator (N-1). It indicates the daily operational flexibility of natural gas infrastructure and its ability to respond to consumption requirements under extreme conditions. The indicator is calculated as follows:

$$(N-1) = \frac{E_{pm} + P_m + S_m - I_m}{D_{max}} \times 100\,[\%]$$

where:

D_{max} total daily consumption on a day with the highest gas demand with the probability of occurrence once in 20 years [Sm^3/day],

Epm sum of technical pipeline capacities, gas quantities that can be transmissioned over existing interconnections in a day [Sm^3/day],

Pm daily indigenous natural gas production [Sm^3/day],

Sm maximum daily withdrawn quantities from underground storage [Sm^3/day],

I_m maximum daily capacity of the largest gas supply infrastructure [Sm^3/day].

Transmission system, in terms of infrastructure and from the standpoint of security of supply, is considered as satisfactory if the capacities of the entrances to the system are enough to meet total demand for natural gas, in a case of interruption of the largest infrastructure that has entrance to the transmission system, during the day with exceptional high natural gas demand with the probability of occurrence once in 20 years. This corresponds to values of (N-1) indicator higher than 100%.

[29]https://www.aers.rs/Index.asp?l=1&a=94.3

For the gas network system of the Republic of Serbia values of the input parameters for calculating (N-1) indicator for 2020, are as follows:

E_{pm} = 15 million Sm^3/day (technical daily entrance capacity at Horgoš) [28], [41]

P_m = 0.745 million Sm^3/day [41],

S_m = 5.2 million Sm^3/day (UGS Banatski Dvor),

I_m = 15 million Sm^3/day (technical daily entrance capacity at Horgoš),

D_{max} = 17.744 million Sm^3/day (consumption recorded on January 19th, 2017[30]) [28].

Calculated value of (N-1) indicator for 2020 is: **(N-1) = 33.50%.**

The calculated value, significantly lower then desired 100% cannot be considered as satisfactory and clearly indicates that any deviation from the standard of operation of the gas pipeline system can cause serious consequences for the supply of the market [41][37].

However, since the gas interconnector from the Bulgarian-Serbian border to the Serbian-Hungarian border has been in operation since the beginning of 2021, and the technical capacity of this pipeline is 12.66 billion m^3, the indicator (N-1) now has a significantly higher value. (114%) and thus this infrastructure supply standard is met [11].

The key energy objects planed to be constructed for ensuring and increasing security of supply are as follows:

Gas interconnection project Serbia – Bulgaria, the main gas pipeline MG-10 Niš - Dimitrovgrad (border with Bulgaria)

Realization of this project will increase security of supply, and make possibility for supplying from Russia and other supply routes: South corridor (Azerbaijan, LNG from terminals in Greece, etc). This interconnection should be introduced by 2023.

Gas interconnection project Serbia - Croatia, main gas pipeline MG 08 Gospođinci (Futog) - Sotin (Croatian border)

Realization of this project will increase security of supply ((N-1) = 56.99%) and make possibility for opening supply routes from northern Africa, Italy via Croatia, or from foreseen LNG terminal in Croatia. According to [28] this interconnection should be introduced after until 2028.

Gas interconnection project Serbia - Romania, pipeline Mokrin - Arad (border with Romania)

Additional entrance to the system will increase security of supply ((N-1) = 58.73%), increase reliability and create possibility of gas purchasing from other sources (from Romania or from transcontinental supply routes). Also, this project will have impact on unloading the main pipeline Horgoš - Batajnica. According to [28] this interconnection should be introduced during 2022.

Project for increasing the capacity of the Underground storage Banatski Dvor

This project envisages an upgrade of the underground gas storage in Banatski Dvor from current capacity of 450 million m^3, to capacity of 800 to 1 billion m^3 with maximum technical capacity of production of 9.96 million m^3/day (415,000 m^3/h) and maximum technical capacity of injection of 5.52 million m^3/day (230,000 m^3/h). By the project realization available gas quantities will significantly increase, especially in days with the highest loads ((N-1) = 61.97%). According to [3] this project should be completed by 2022. Since the project for the UGS

[30]Data from PE Srbijagas; In the AERS Report for 2012 [11] is reported "In 2012 there was no problem with congestions, even in February when the lowest temperatures were recorded with the probability of occurrence once in twenty years ... ".

Banatski Dvor construction was done as a mining project, the extension project should be a supplement to the existing mining project.

An additional impact of the underground gas storage capacity extension on security of supply would be an increase of the system's resilience to longer, total supply cuts from other transmission systems.

In addition to the above, the construction of interconnections with Bosnia and Herzegovina, Montenegro and Northern Macedonia is also planned. According to [29], the realization of interconnection with Bosnia and Herzegovina (3.5 Sm^3/day) is planned for 2022, with Montenegro (2.7 Sm^3/day) for 2028, and with Northern Macedonia (1.04 Sm^3/day) for 2029.

In addition to the key infrastructural projects, it is necessary to continue with activities on the construction of the transmission system in order to ensure secure supply of some areas of the Republic of Serbia. The projects planned to be constructed in the upcoming period are as follows:

Main pipeline MG 01/II Itebej - Beograd Jug

Main single line pipeline of approximate length 130 km and diameter 610 mm should increase reliability of the Republic of Serbian transmission system by unloading the pipeline Kikinda-Pančevo.

Main pipeline Batajnica - Velika Plana – Niš

Main pipeline with length of 116+161 km and diameter DN 700 should increase reliability of the Republic of Serbian transmission system by connecting pipeline Niš -Dimitrovgrad and Batajnica.

Main single line pipeline RG 11-02 Leskovac - Vladičin Han - Vranje

Main pipeline of length 70.7 km, diameter 323.9 mm and maximal operation pressure of 50 bar; First section of the pipeline from PJC "Leskovac" to MMRS "Vlasotince" of 7.2 km and MMRS "Vlasotince" (5,000 m^3/h) were put into operation in 2013. Construction of 6 block stations, 2 main metering and regulating stations (MMRS "Vladičin Han/Surdulica" 5,000 m^3/h, MMRS "Vranje" 10,000 m^3/h) should be done. This project is aimed to extend the national transmission network to south part of Serbia (area of Južna Morava) to municipalities Vlasotince, Vladičin Han, Surdulica and the city of Vranje, and provide opportunities for further development of gas system toward Bujanovac and Preševo, as well as for interconnection with transmission system of the Republic of Macedonia. Activities on Project RG 11-02 have been stoped until the issue of Yugorosgaz-Transport certification, which would determine the ownership of the main gas pipelines, will be resolved.

For ensuring secure supply in the long term period, proper paining of the gas system is of the great importance. Based on the Energy Law, energy entities in charge for gas transmission and management of the transmission system are obliged to submit ten-year development plans of the transmission system to the AERS for approval. Transmissiongas Serbia and Yugorosgaz-Transport submitted ten-year plans for the development of the transmission system during 2020, and AERS approved them.

4.5.6. Preventive Action Plan and Emergency Plan for ensuring the security of natural gas supply

The Government ha adopted the Preventive Action Plan for Safeguarding the Security of Natural Gas Supply [41] and the Emergerncy Plan for Safeguarding the Security of Natural Gas Supply [38] in 2018.

The Preventive Action Plan Plan for Safeguarding the Security of Natural Gas Supply includes risk assessment in terms of achieving security of supply, as well as measures to mitigate the

identified risks that refer to the necessary transmission capacity to meet the total demand for natural gas and to provide supplies to certain groups of final customers of natural gas. The Preventive Action Plan was prepared in accordance with the Article 315 of the Law on Energy [1] and in accordance with the article 5 of Regulation (EU) no 994/2010 of the European Parliament and of the Council of 20th October 2010 concerning measures to safeguard security of gas supply and repealing the Council Directive 2004/67/EC [35]. The Preventive Action Plan included risk assessment prescribed by the article 9 of Regulation (EU) no 994/2010, preventive measures for elimination of defined risks and the responsibilities of the Competent Authorities and energy entities concerning safeguarding the security of natural gas supply.

For safeguarding secure supply, the main indentified risks are related to the natural gas supply disruption scenario at Horgoš entrance, and to disruption of supply from the Banatski Dvor underground storage.

In order to mitigate identified risks and ensure safe gas supply, the following measures and activities are detremined by the Preventive Action Plan :

- establishing interconnections with the countries in the region, construction of a new direction of natural gas supply, expansion and construction of new storage capacities, as well as realization of other projects that influence the reduction of consumption of natural gas in accordance with the Energy Strategy [2] and the 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 [3];
- establishment of operational reserves of energy products in accordance with Article 345 of the Law [1];
- ensuring required natural gas reserves in accordance with Article 346 of the Law [1];
- establishing regional cooperation in crisis situations.

The Emergerncy Plan for Safegurarding of Security of Natural Gas Supply in order to ensure the security of natural gas supply which identifies measures, energy entities that will be in charge of ensuring the security of the transmission system operation and the security of supply of certain groups of end customers, the volumes and capacity of natural gas in case of a general shortage of natural gas.

The Emergency Plan is prepared in accordance with the article 315 of the Energy Law [1] and in accordance with the article 10 of the Regulation (EU) no 994/2010 and it is based to defined three levels of crisis occurred by the natural gas shortage:

- Level 1 - Early Warning: when there is concrete, serious and reliable information that an event may occur which is likely to result in significant deterioration of the supply situation and is likely to lead to the Level 2 or Level 3 being triggered.
- Level 2 - Alert Level: when a supply disruption or exceptionally high gas demand occurs which results in significant deterioration of the supply situation, but the market is still able to manage that disruption or demand without the need to resort to non-market measures.
- Level 3 - Emergency Level: a situation of exceptionally high gas demand, significant supply disruption or other significant deterioration of supply and in the event that all relevant market measures have been implemented but the supply of gas is insufficient to meet the remaining gas demand so that non-market measures have to be additionally introduced with a view, in particular, to safeguard supplies of gas to protected customers.
- The Emegency Action Plan has defined the roles and responsabilities of energy entities in the natural gas sector, industrial consumers, as well as their interaction with relevant

authorities. Also, the competence of responsible institutions (the Government, the Ministry in charge for the energy issues, the Special Working Group established by the Ministry, Directorate for Commodity Reserves of the Republic of Serbia) and companies (Transportgas Srbija, natural gas suppliers, Public Enterprise Elektroprivreda Srbije, AD Elektromreža Srbije, major natural gas customers, natural gas transmission, i.e. distribution system operators, natural gas storage facility operator and energy entities engaged in the production of electricity and/or combined production of power and/or heat) have been detremined. This plan defined detailed procedures that should be carried out for the each level of crises, including schemes of information flows. Mechanizms for cooperation with other countries for each level of crises are determined, obligations for gas companies related to reporting for each level of crises and the list of predifined activities for securing gas supply in the event of crises are defined.

5. CRUDE OIL AND PETROLEUM PRODUCTS

Pursuant to the Energy Law [1], licensed energy activities in the petroleum and biofuel sector are:

- Production of petroleum products
- Transport of oil through pipelines
- Transport of petroleum products through petroleum product pipelines
- Trade in oil, petroleum products, biofuels and compressed natural gas
- Trade in motor and other fuels at the stations for supplying fuel into vehicles
- Storage of oil, petroleum products, biofuels and compressed natural oil
- Production of biofuels
- Production of bioliquid
- Blending of biofuels with fuels of oil origin
- Trade in fuels outside stations for the supply of means of transport

The energy activity may be performed by public company, business entity, i.e. any legal entity or entrepreneur which is in the possession of license for energy activity performance.

Transportation of crude oil through oil pipelines and petroleum products through product pipelines represent the energy activities which are defined as the activities of general interest by the Energy Law. They are carried out in accordance with this law and the law regulating the position of public companies. The rest of the above said energy activities are performed in compliance with the market principles.

Persuant to the Energy Law, no license is required for the energy activity of oil transport, oil derivatives and biofuels by other forms of transport, but the activity is important for the topic of security of supply and will be dealt with in the following text.

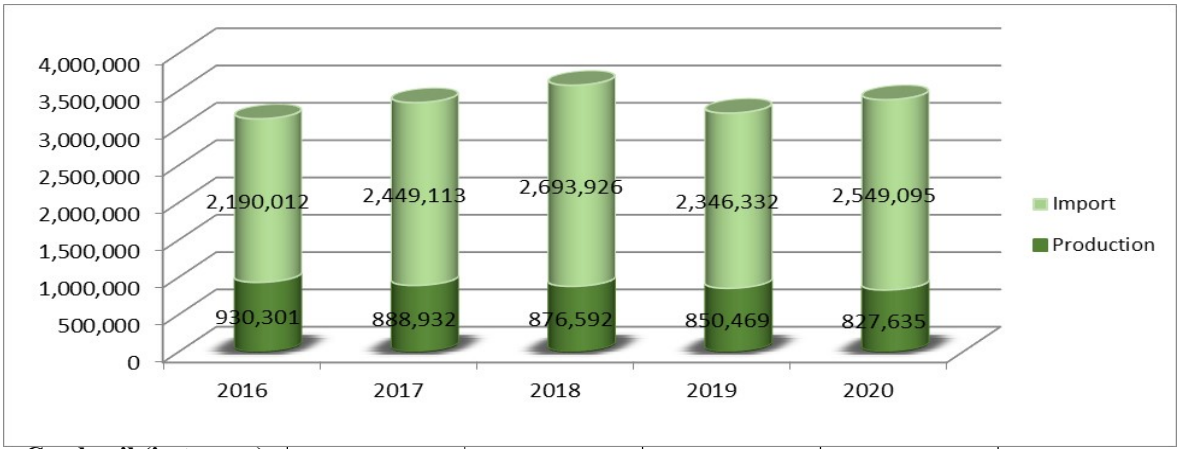
5.1. Production, Import, Export an Consumption of Crude Oil and Petroleum Products

5.1.1. Crude Oil

The necessary amount of processed crude oil is provided from import (over 70%) and a smaller part from domestic production from 63 oil fields and about 666 oil production wells. The largest number of oil fields is located in Vojvodina, in the region of Bačka (Velebit, Turija), of North Banat (Kikinda), of Central Banat (Zrenjanin) and South Banat (Jermenovci, Janošik) including oil fields in the region of Stig around Požarevac (Sirakovo, Bradarac, Maljurevac) [43].

The production and processing of crude oil in Serbia is carried out by NIS JSC and in recent years it is the only responsible for import in the Serbian market.

NIS JSC also owns the concession on a single block in Angola where is produced about 4,2 million tonnes of crude oil from 1985 to today. The oil produced in Angola (about 30,000 tonnes) is not included in the Energy Balance of the Republic of Serbia [15].



Crude oil (in tonnes)	2016	2017	2018	2019	2020
Production	930,301	888,932	876,592	850,469	827,635
Import	2,190,012	2,449,113	2,693,926	2,346,332	2,549,095
Total	3,120,313	3,338,045	3,570,518	3,196,801	3,376,730

Figure 3: Comparative review of production and import of crude oil (in tonnes) in the last five years [25]

Domestic production of crude oil is decreasing in 2019, while simultaneously deficient quantities are provided by an increase in imports, which in 2019 amounted to 2,346,332 tonnes (Figure 3). In 2020, the production retains a slight downward trend, but the import volume increases to a value of 2,549,095 tonnes. The energy balance for 2021 predicts a slight decrese (7.6%) or 765,000 tons of production [25].

All imported crude oil is mostly transported through oil pipeline of PE Transnafta that enters Republic of Serbia from Croatia near Bačko Novo Selo as a continuation of the Adriatic oil pipeline that begins in Omišalj (in the north - west of the island of Krk in Croatia), continues to Novi Sad and then to Pančevo. The other aspects of the transport of crude oil such as rail and waterways transports are not represented. In previous years a specified amount of about 200,000 tonnes was shipped via rail tankers from Romania.

The oil produced from domestic oil reservoirs is shipped from gathering stations through oil pipelines to Novi Sad Oil Refinery and further on refining to Pančevo Oil Refinery, and certain percentage (<10%) is transported by road tankers to Pančevo Oil Refinery.

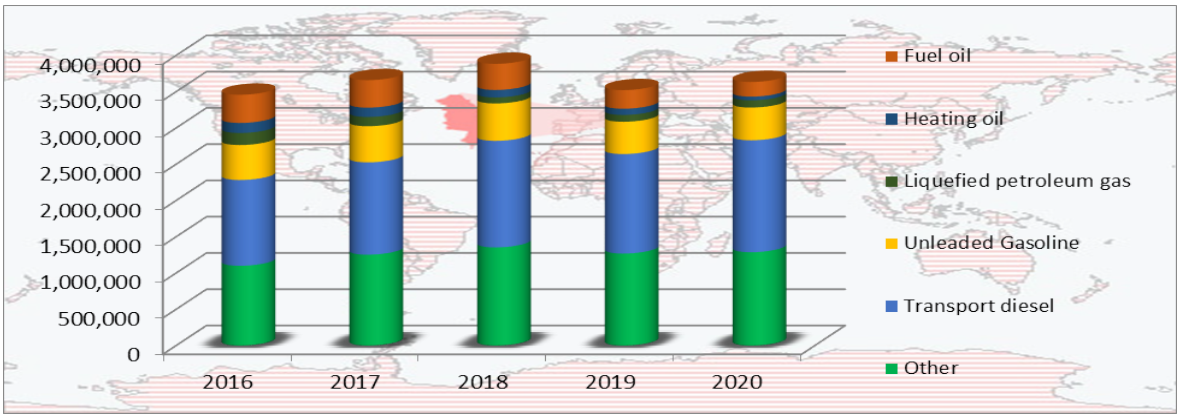
5.1.2. Derivatives of Crude Oil

The supply of petroleum products is carried out from import and from domestic processing of crude oil, obtained from the Pančevo Oil Refinery. The Pančevo Oil Refinery within NIS JSC does processing of crude oil, while the liquefied petroleum gas is produced in Gas Refinery Elemir and in the installations of former Hipol JSC now "Standard gas d.o.o. Novi Sad" (Standard gas) [11].

The quantities of produced derivatives in 2019 (Figure 4) amounted to 3,523,165 tonnes, while in 2020 they amounted to 3,653,714 tonnes, which represents an increase of 3.71%. Pančevo Oil Refinery in 2019 incresed the production of liquefied petroleum gas by 13.34% compared to 2018, while in 2020 was increase of 20.66% [25].

The derivatives produced in the Pančevo Oil Refinery are shipped by using rail tankers, watercrafts (river tankers, barges) and road tankers. The transport of petroleum products through

petroleum product pipelines does not work because there is no built petroleum product pipelines network.



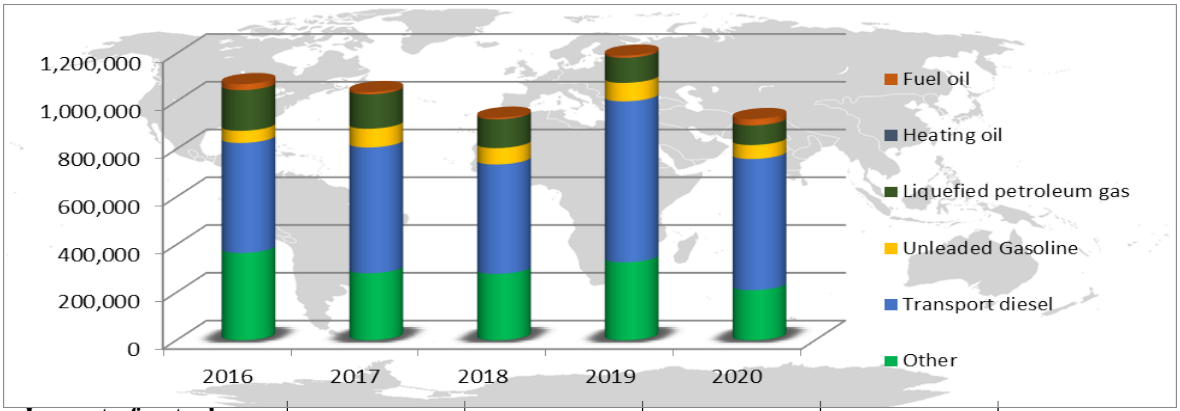
Production of petroleum products (in tonnes)	2016	2017	2018	2019	2020
Transport Diesel	1,182,882	1,273,116	1,469,062	1,372,180	1,543,221
Unleaded Gasoline	482,068	498,624	515,702	445,152	451,377
Liquide petroleum gas	165,768	127,210	82,555	93,566	99,610
Heating oil	138,514	128,275	102,948	85,988	50,736
Fuel oil	388,871	379,519	360,515	256,898	202,725
Other products	1,101,009	1,253,845	1,345,552	1,269,381	1,288,045
Total	3,459,112	3,660,589	3,885,334	3,523,165	3,635,714

Figure 4: Production of petroleum products – comparative review of 2016 to 2020

In 2019, there was an increase in imports (Figure 5), and the imported amount of derivatives was 1,192,635 tonnes, while in 2020 it is at a lower level and amounts to 926,643 tonnes. Motor fuels in 2019 registered an increase in imports of about 32,4%, while in 2020, there was an decrease of about 19.4%.

Analyzing the structure of imported derivatives it results that the highest amount of imported products is the amount of euro diesel imported mostly from Hungary, Bulgaria and Romania. The gasoline has been imported from Hungary, Austria and Romania [25].

Regarding to the supply of derivatives from import, the amounts are delivered by vessels (barges, river tankers) along the rivers of the Danube and Sava, then by rail tankers and the rest by road tankers.



Import of petroleum products (in tonnes)	2016	2017	2018	2019	2020
Transport Diesel	460,612	526,685	458,085	673,911	549,469
Unleaded Gasoline	50,924	78,457	68,462	77,250	58,416
Liquide petroleum gas	170,261	143,933	119,947	104,557	82,069
Heating oil	0	122	591	747	0
Fuel oil	24,810	9,071	6,610	8,933	26,383
Other products	366,352	281,364	278,755	327,237	210,306
Total	1,072,959	1,039,632	932,450	1,192,635	926,643

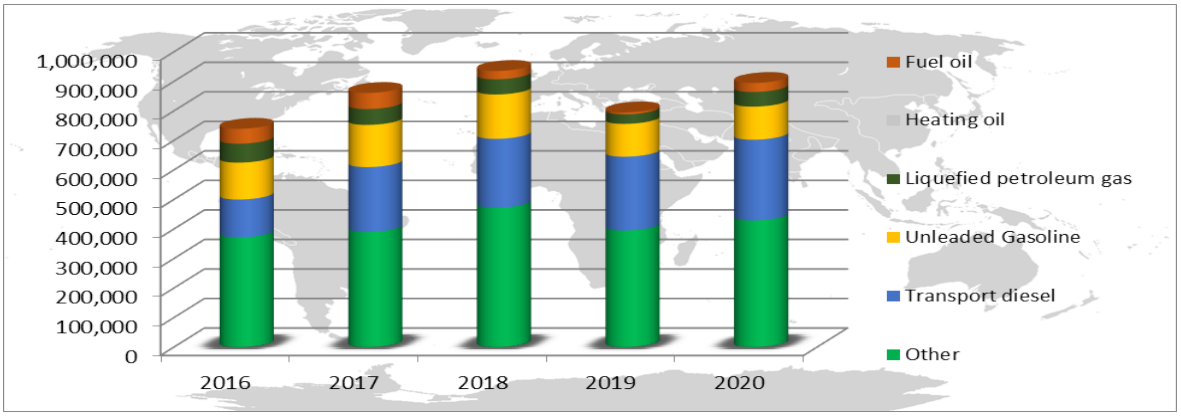
Figure 5: The import of petroleum products (in tonnes) – comparative review of 2016 to 2020

In 2019, the export of derivatives (Figure 6) decreased to an amount of 795,389 tonnes, which represents a decrease of 15%, while in 2020 it was at the level of 895,066 tonnes. The increase in motor fuel exports is especially significant in 2020 compared to 2019. In 2020, the Republic of Serbia's total export was 435,301 tonnes of motor fuels which is almost 10.7% more than in the previous year, ie at the level of 2018. The most prevalent was diesel with 273,619 tonnes, which is 9.4% more than in the previous year, followed by gasoline with 112,025 tonnes, which is 0.7% more than 2019. From other petroleum products, the bitumen export of 263,213 tonnes is significant, as well as the export of liquefied petroleum gas, which represents an increase of 55% with an amount of 49,657 tonnes compared to 32,022 tonnes [25].

The export of petroleum products is performed by placement of diesel fuel in the bunker stations at three locations along the river Danube: Novi Sad and Prahovo, and in the middle of 2015 NIS JSC has put into operation a new bunker station in Belgrade for the supply of ships in domestic and foreign transport.

In Smederevo there is also a bunker station built for supplying of only domestic vessels in the country. In 2020, 16,003 tonnes of diesel were placed on the market at the bunker stations, while 16,027 tonnes were in the previous year. Compared to 2018, when it was 16,968, there was a decrease of 5.7% [25].

In May 2018, amendments were made to the Law on Ports and Navigation on Inland Waterways, which made the area of the bunker stations for the supply of ships clearly regulated.

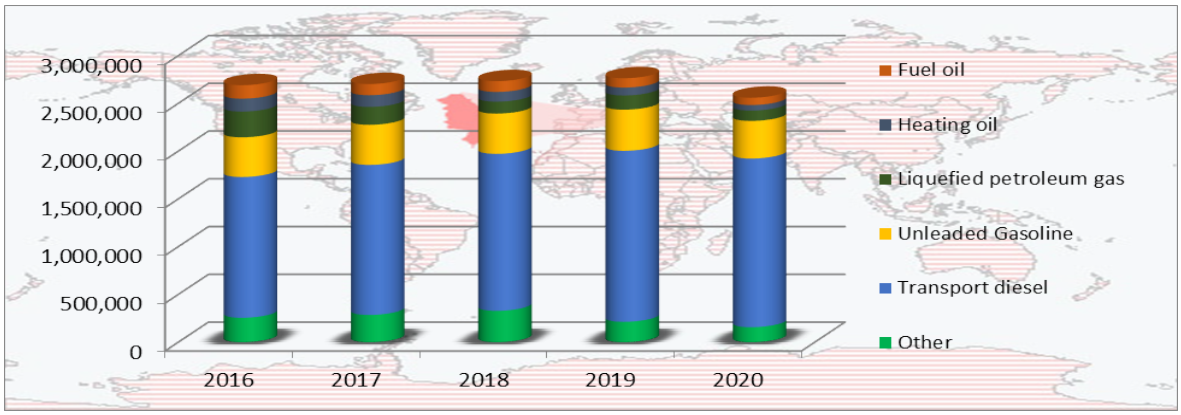


Export of petroleum products (in tonnes)	2016	2017	2018	2019	2020
Transport Diesel	128,116	219,504	233,235	250,040	273,619
Unleaded Gasoline	125,044	143,094	150,290	111,289	112,025
Liquide petroleum gas	64,010	53,573	51,387	32,022	49,657
Heating oil	1	17	1	0	0
Fuel oil	50,516	54,642	28,326	6,827	30,582
Other products	372,017	390,391	472,460	395,211	429,183
Total	739,704	861,221	935,699	795,389	895,066

Figure 6: Export of petroleum products (in tonnes) – comparative overview for the period 2016 - 2020

Final consumption for energy purposes for 2019 (Figure 7) is at the level of 2,764,525 tonnes (an increase of 1.1% compared to 2018), while in 2020, it decreased by 6.3% and amounted to 2,560,600 tonnes.

In the structure of final consumption of derivatives for 2020, the industry participates with 11%, traffic from 81%, and other sectors with 8% [25].



Consumption of petroleum products (in tonnes)	2016	2017	2018	2019	2020
Transport Diesel	1,474,142	1,571,130	1,643,371	1,790,064	1,765,554
Unleaded Gasoline	415,720	419,822	421,808	431,020	394,533
Liquide petroleum gas	269,114	187,168	124,080	148,524	107,450
Heating oil	135,238	122,571	102,514	82,804	58,437
Fuel oil	141,238	116,868	112,804	97,921	76,786
Other products	256,278	286,170	329,328	214,192	157,840
Total	2,691,730	2,703,729	2,733,905	2,764,525	2,560,600

Figure 7: Consumption of petroleum products (in tonnes) - Comparative review for the period 2016 – 2020 [25]

5.2. Security of Supply of Oil and Petroleum Products

5.2.1. Balance of Oil and Petroleum Products for Year 2021 – Plans

The balance of crude oil, petroleum products and biofuels includes production, import and export of crude oil, refining of crude oil in refineries, and production, import, export and consumption of petroleum products.

Energy Balance of the Republic of Serbia for 2021 [25] is mostly determined in accordance with the realization and assessment by the end of 2020. The exact amount of all energy products can be seen only at the end of 2021.

According to the Energy Balance [25] the supply of crude oil and semi-finished products for processing in refineries will be provided from domestic production in the amount of 0.765 million tonnes (21%), while the import will provide an additional amount of required crude oil and semi - finished products in the amount of 2,980 million tonnes (79% of total needs) [25].

The processing of domestic and imported crude oil from the stock as well as components for processing (semi - finished products) will be carried out in Pančevo Oil Refinery.

In 2021, the processing of crude oil and semi-finished products is planned in an amount of 4.137 million tonnes while the domestic production of petroleum products is planned in the amount of 4.090 million tonnes [25].

In the structure of planned oil production the largest part will belong to a production of diesel with 33.3%, then production of petrol with 14.1%, heating oil 10.4%, liquefied petroleum gas 5.3% and other products 36.9% [25].

Having in mind the overall need for petroleum products in 2021, including the planned domestic production of petroleum products, the rest of the required amount of about 0.950 million tonnes will be supply from the import [25].

In 2021 it is planned to export 0.800 million tonnes of petroleum products. The final consumption of petroleum products in 2021 is planned to be about 3.262 million tonnes, of which 0.552 million tonnes are for non - energy purposes, while 2.710 million tonnes are for energy purposes. In this structure of final consumption of petroleum products for 2021, the industry participates with 13%, the transport with 79% and other sectors with 8% [25].

In a long-term framework the consumption of petroleum products is planned in compliance with the Strategy [2].

Table 32: Projection of consumption to 2030 [2]

Consumption	Product	Unit	Period (year)		
			2020	2025	2030
Primary energy consumption	Crude oil and semi-finished products	thousands tonnes of oil equivalent	3,822	4,049	4,312
Final consumption	Petroleum products	thousands tonnes of oil equivalent	3,368.8	3,595.6	3,853.1

5.2.2. Measures to be Taken in Case the Security of Oil and Petroleum Products Supply is Threatened

Concerning the security of supply, the area of oil is regulated by the Law on Commodity Reserves [44], which regulates the conditions for the formation, financing, disposition, use and renewing of the oil and oil derivatives emergency stocks, provision and maintenance of storage, as well as the operation and management of the emergency stocks and storage facilities on the territory of the Republic of Serbia as well as the Energy Law, which created the Energy Resources Management Board, as an administrative body within the Ministry in charge of energy, for performing executive and professional tasks relating to the required reserve of oil and petroleum products and natural gas reserve requirement.

Based on the Law on Commodity Reserves, the Government of the Republic of Serbia in 2019 adopted the Decree on determining the program of measures in case the security of energy and energy supply is endangered - crisis plan (Official Gazette of the RS, No. 63/2019). The crisis plan contains procedures and criteria for determining supply disruptions, competencies and responsibilities of public and private entities for the purpose of eliminating supply disruptions and procedures for normalization of supply in the market of the Republic of Serbia. The program also includes actions in case of an international decision on placing required reserves on the market.

Long-term, medium-term and short-term programs for the formation of required reserves have been adopted [44].

The Republic Directorate for Commodity Reserves, in accordance with the Law, stores in its reservoirs the obligatory reserves of oil derivatives, manages the construction of new and reconstruction of the existing storage capacities of the Directorate financed from the budget of the Republic of Serbia [25].

In accordance with the above, the construction of 2x20,000 m^3 of reservoir for oil derivatives at the warehouse in Smederevo is in progress.

In 2018, the Energy Reserve Directorate completed the construction of a vapor recovery unit (VRU) at the warehouse of the Commodity Reserve Directorate in Požega.

Also, the Energy Resources Management Board performs annually the selection of contractors for the qualitative and quantitative analysis of derivatives as well as the selection of the insurance company for the insurance of goods in storage.

By the end of 2020, the Management Board of the Ministry in charge of energy for the purpose of forming obligatory reserves, purchased crude oil (16,000 tonnes), around 74,000 tonnes of diesel, 5,000 tonnes of heating oil – low sulfur - special NSG-S and 3,000 tonnes of motor gasoline.

At the end of 2020, mandatory reserves were formed at 21 days of average daily consumption.

In accordance with the adopted Rulebook on Establishment of the Annual Program for Formation and Maintenance of Required Reserves of Petroleum and Petroleum Products for 2021 (Official Gazette of the RS, No. 55/2021) for 2021, it is planned to increase the number of days to 25.

In the third quarter of 2021, the procedure of joint public procurement of crude oil with the Republic Directorate for Commodity Reserves will be initiated, as well as procurement of oil derivatives in accordance with the available budget and in accordance with the adopted Procurement Plan for 2021.

In the third quarter of 2021, it is planned to launch a public procurement for the second phase of construction of additional storage capacity in cooperation with the Republic Directorate for Commodity Reserves, namely the construction of two additional tanks of 20,000 m^3 (R-24 and R-26) derivatives in Smederevo.

The Energy Law [1] prescribes that in case of customers security of supply is threatened due to insufficient supply in the energy market or the occurrence of other extraordinary circumstances, the government can issue the document to approve the change of limit values of certain characteristics of the quality of oil derivatives that can be put on the market in the Republic of Serbia for the period of maximum six months. Measures may last as long as the circumstances for which they are prescribed are, or until the consequences of such circumstances are eliminated [1].

The law also defines that Energy entities that perform the activity of production of oil derivatives and trade in oil, oil derivatives, biofuels and compressed natural gas are obliged to provide operational reserves of oil derivatives equal to the ten-day average amount of motor gasoline and gas oils, or the fifteen-day average amount of jet fuel, which they put on the market of the Republic of Serbia in the previous year from their own production and imports.[1].

In May 2021, the Government of the Republic of Serbia adopted the Action Plan for the formation and maintenance of mandatory reserves of crude oil and petroleum products June 2021 - December 2026.

This Action Plan is designed to meet the required submission of an action plan to the European Union, while at the same time describing a specific plan for the formation and maintenance of required oil reserves in accordance with Directive 2009/119 / EC on minimum reserves of petroleum and petroleum products.

The action plan describes: the existing legal framework and the remaining harmonization of legislation to fully transpose the Directive, the competent authority fully responsible for the formation of Serbian mandatory oil reserves in accordance with the Directive, financing the storage of Serbian mandatory oil reserves, estimated minimum storage obligations under the

Directive, necessary data collection and reporting for the purposes of the Directive, composition of required reserves to be defined over time, specifications of quality of liquid fuels to be kept as required reserves, quantity of storage capacities required for required reserves, including quantities currently available in both public and private facilities, planned dynamics for formation of emergency reserves (procurement schedule , subsequent capacity requirements, procurement and capacity investment policy, financing), organizational structure and emergency response planning and schedule for implementation of the Action Plan.

5.3. Technical and other Requirements that Liquid Fuels of Oil Origin and Liquefied Oil Gas Must Fulfil

Pursuant to Article 337 of the Energy Law [1], petroleum products and biofuels set on the market have to complete the conditions arranged by the regulations for quality of liquid petroleum fuels and biofuels, by the regulations for protection of the environment and other regulations related to the market of petroleum products and biofuels [46], [47].

Technical and other requirements for liquid fuels of oil origin used as motor fuels for the internal combustion engines and energy fuels which are the subject of trade on the market of the Republic of Serbia as well as the method of conformity assessment of liquid fuels are regulated by the Rulebook on Technical and other Requirements for Liquid Fuels of Petroleum Origin (Official Gazette of the RS, No. 111/15, 106/2016, 60/17, 117/17, 120/17 - corection and 50/18, 101/18) [48].

Trade of leaded gasoline is forbidden on the market, the quality of unleaded motor gasoline must fulfil all requirements of SRPS EN 228 Standard and the quality of diesel fuel must fulfil all requirements of SRPS EH 590 Standard (with the exception of gas oil 0.1 for starting of tractor engines, working machines and railway vehicles, as well as the vessels with diesel engines, which contain sulphur of maximum 0.10% (m/m)).

The Energy Law [1] prescribes that in case when there is a security risk of supplying customers because of insufficient supply on the market of energy and fuels or in case of other extraordinary circumstances, the Government can approve with the amendment the modification of limits for some quality characteristics of petroleum products that could be put on the market of the Republic of Serbia for a maximum period of 6 months. The extents could last as long as the circumstances for which they are prescribed, concerning the duration of consequences.

With the modifications of the Energy Law from 2012, the legal basis for compulsory marking of petroleum products is established, with the purpose of reduction of illegal petroleum products market and since December 1, 2013 the Regulation on Marking of Petroleum Products (Official Gazette of the RS, No. 51/2015, 5/2017) is being applied [49].

The legal base for monitoring of petroleum products quality is determined by the Energy Law from 2014 [1] which is in accordance with SRPS EN 14274 Standard and since 1st December 2015 the Regulation on Monitoring of Petroleum Products and Biofuels Quality (Official Gazette of the RS, No. 97/2015, 5/17, 8/17 - correction and 119/17, 102/18) is being applied.

The monitoring of the quality of oil derivatives is carried out in accordance with the Annual Program for monitoring the quality of oil derivatives, which is an integral part of the Ordinance on the content and manner of implementation of the annual program for monitoring the quality of oil derivatives and biofuels. The said Rulebook for the current year, in accordance with the Regulation, shall be adopted by the Minister in charge of energy affairs no later than March 31 of the current year. In the period from 1 January of the current year until the adoption of the Annual Monitoring Program, the Annual Monitoring Program is adopted for the previous calendar year.

Implementation of marking and monitoring of petroleum products and biofuels quality had the significant contribution in reduction of illegal market, the income growth from excises and taxes

in the budget of the Republic of Serbia, in consumers' protection, as well as the fulfilment of internationally undertaken obligations regarding implementation of the Directives 2016/802/EC (which replaced the Directive 1999/32/EC) and 98/70/EC.

5.4. Data on Oil Infrastructure

5.4.1. The Refineries in Novi Sad and Pančevo

Crude oil refining in the Republic of Serbia is carried out in Pančevo Oil Refinery, which is belonging to NIS JSC.

The Pančevo Oil Refinery has been put into operation in 1968 by launching the first complex of plants with primary processing capacity of 1.32 MTA and with the release of other primary plants in 1978; the refinery reached the design capacity of 4.8 MTA. Engineering for this plant was prepared by company SFI/Lummus France.

It is located in Pančevo, near the Danube River at distance of about 2.5 km and at distance of about 15 km from Belgrade on the surface of about 160 hectares. The pipeline connection is connected to its own harbour on the Danube.

The crude oil can be transported to the oil refinery by pipeline, waterways, rail tankers and road tankers. Thanks to its refining capabilities, Pančevo Oil Refinery can practically process all types of crude oil and produce fuels - liquefied petrol gas, petrol, diesel fuel, jet fuel, heating oil and bitumen and petrochemical products. The capacity utilization is over 60% and storage facility has a capacity of 700,000 m^3. Since 2014, all domestic and imported crude oil is processing with a total processing of about 3.5 MTA [50].

Shipping products from the Pančevo Oil Refinery are transported by barges, road and rail tankers while the supply of HIPP is done through product pipelines.

Adjacent to Pančevo Oil Refinery there is "HIP-Petrohemija a.d. Pančevo" (Petrohemija JSC), which consists of plant for pyrolysis of primary petrol to produce ethylene, factory "Etilen".

The Refinery provides most of the raw material for this plant, so the pyrolysis petrol which returns to the Refinery is very rich in aromatic hydrocarbons, especially in benzene. The crude primary petrol from Refinery to Petrohemija JSC and the pyrolysis petrol from Petrohemija JSC to Refinery are transported through petroleum products pipelines.

In recent years the constant modernization of the Refinery has expanded its primary and secondary capacities.

Direct investments in environmental projects in the previous period exceeded the amount of €150 million, which influenced the constant trend of reducing emissions of pollutants into the air from the Refinery plant as well as the declining trend of pollutants in the ambient air of Pančevo and surroundings.

Pančevo Oil Refinery is the first energy plant in the Republic of Serbia, which in 2017, along with the submitted Action Plan and Program of measures to adjust the operation of the existing plant to the prescribed conditions, met the conditions and acquired the right to the Integrated Permit (IPPC permit), which represents a confirmation that in the future it will continue to invest in the field of environmental protection during the performance of its activities.

Novi Sad Oil Refinery presents a complex of refining and auxiliary factory plants for refining of oil and petroleum products, tank, transport - manipulative, research and laboratory facility and other accompanying facilities. It is located in the industrial zone of Novi Sad, located directly on the Danube and the navigable DTD channel. The refinery was put into operation in 1968, with designed capacity of refining 2.5 MTA.

The Novi Sad oil refinery is in the process of conservation and refining capacities have not been operating since 2013. Since March 2016 reservoir capacities are predominantly used as storage for petroleum products and crude oil.

This refinery no longer processes oil, but the entire complex has been turned into a storage terminal for crude oil and derivatives.

5.4.2. Oil Pipeline Managed by PE Transnafta

Transnafta performs the energy activity of transportation and management of transportation system. Transnafta performs the energy activity of general interest, supplying the Novi Sad and Pančevo Oil refineries with crude oil. The pipeline with a total length of 154 km stretches from the Croatian border on the Danube river through Novi Sad and Pančevo. This pipeline continues to JANAF, which departs from the port of Omišalj on the island of Krk in Croatia and across the Sisak Refinery, their last block stations Sotin and river Danube enters Serbia. The first block station is in Bačko Novo Selo, and the pipeline via terminals PE Transnafta with the Novi Sad Oil Refinery extends until the Pančevo Oil Refinery (via measuring station of Transnafta). The imported crude oil is transported through all stations along the route, and the domestic oil through local route from Novi Sad to Pančevo. The pipeline infrastructure is represented by: terminal in Novi Sad with a storage capacity of 10,000 m^3 and a pumping station, eight block stations along the pipeline, measuring station with Pančevo Oil Refinery, cathodic protection system and supervisory control system of oil pipelines.

The oil pipeline is divided into two sections:

- DN-1 (Bačko Novo Selo - Novi Sad, a length of 63.3 km in diameter of 660 mm, pressure classes ANSI 300 transportation capacity 9 MTA, 1000 m^3/h.) with 38 crossings of watercourses, 20 road crossings, 6 railway crossings, 3 dams, 2 swamps and 5 pipelines.
- DN-2 (Novi Sad - Pančevo, a length of 91 km in diameter of 457 mm, pressure classes ANSI 400, transport capacity 6 MTA) with 95 crossings of watercourses, 17 road crossings, 4 railway crossings, 6 dams and 3 pipelines

Total average volume of transport - approximately 3 million tonnes/year [51].

5.4.3. Oil Pipelines Managed by NIS JSC

For domestic transport of crude oil to the Novi Sad Oil Refinery, the oil pipelines which are managed by NIS JSC and by which the crude oil is transported from the dispatching stations are in function. It's about the oil pipeline from the delivery station "Kikinda Field" to the delivery station in Elemir in a length of 42.9 km, a pipeline from the delivery station in Elemir to Novi Sad Oil Refinery in a length of 39.5 km with a diameter of 257.4 mm, which is used for delivery of oil type "Kikinda" as well as the pipeline from the delivery station "Nadrljan" to Novi Sad Oil Refinery in a length of 86.4 km, a diameter of 203.3 mm and with a capacity of 0.5 MTA [43].

5.4.4. Petroleum Product Pipelines in the Republic of Serbia

The infrastructure for the transport of petroleum products through pipelines in the Republic of Serbia does not exist. Technically speaking, the product pipelines exist only between Petrochemical complex and Pančevo Oil Refinery for transport of semi-products and the product pipelines through which were transported ethylene and propylene to the Romanian border and further to Solventum in Romania.

The total length of the pipeline is about 65 km in the Republic of Serbia and about 50 km through Romania and it consists of two parallel product pipelines: Ethylene in a diameter of 168.3 mm and Propylene in a diameter of 114.3 mm, which is not in function at the moment.

Transnafta has initiated the project System of product pipelines through Serbia. The concept of product pipeline system means that the fully supply of the market of Serbia and partly supplying of peripheral areas of surrounding countries (Croatia, Hungary, Bulgaria) is carried out from the Pančevo Oil Refinery. Starting from Pančevo as a centre of supply of derivatives, the product pipeline system routes branch out to Novi Sad, Sombor, Belgrade and Niš, over Smederevo and Jagodina. In these cities, there would be located the terminals with appropriate storage capacities, pumping stations (secondary and main pumps) and with measuring points for commercially measurement of received and delivered quantity of motor fuel. Each of the terminals will be equipped with a plant for collection of volatile hydrocarbon and aromatic components from the storage tank.

Transnafta performed all the planning and design of technical documentation Feasibility Study and Preliminary Design and Assessment of environmental impact for the route section Pančevo - Novi Sad and Pančevo - Smederevo.

The construction project for the construction of the section Pančevo-Smederevo is in final phase of preparation.

5.4.5. The Terminals for Crude Oil

Crude oil storage tanks are located on the route of the crude oil pipeline, more precisely at terminals of Transnafta in Novi Sad and at the Terminal Novi Sad within the Novi Sad Oil Refinery and Pančevo Oil Refinery owned by NIS JSC.

Transnafta Terminal has four tanks for crude oil with a volume of 10,000 m^3 each, one of which is in the function of transport, and three are intended for storage, as well as two tanks of 20,000 m^3 for storage of mandatory reserves of crude oil.

NIS JSC at the Terminal in Novi Sad Oil Refinery has storage tanks capacity of cca 140,000 m^3 for storage of crude oil. All tanks have been reconstructed in the last three years. Also on dispatching stations Kikinda Field, Tisa and Nadrljan there are storage tanks in the function of local transport of crude oil in the capacity of over 70,000 m^3 [43].

In Pančevo Oil Refinery there are storage tanks for technological processes of total capacity of about 700,000 m^3 [43].

5.4.6. Storage of Petroleum Products

The storage capacities in the Republic of Serbia are in dispose of Republic Directorate for Commodity Reserves (approx. 180,000 m^3) Transnafta (approx. 74,000 m^3) as well as the companies performing the energy activity of crude oil, petroleum products and biofuels storage and trade of crude oil, petroleum products, biofuels and compressed natural gas.

In 2020 there were in total 26 licenses for storage of crude oil, petroleum products and biofuels.

Among the companies that are in dispose of licensed storage tanks for storage of crude oil and petroleum products, the largest capacities has NIS JSC (more than 100,000 m^3). It is followed by Transnafta, Naftachem and Mitan oil. These four entities represented in total about 80% of entirely licensed storage capacities in 2018 [52].

In 2020 there were in total 55 licenses for trade of crude oil, petroleum products, biofuels and compressed natural gas.

Among the companies that are in dispose of licensed storage tanks for trade of crude oil and petroleum products, far the largest capacities are in dispose of NIS JSC It is then followed by Transnafta, Lukoil, Naftachem, Mitan oil, EKO Dunav, Miletić Petrol, Speed d.o.o. and VML, which together with NIS JSC own approx. 90% of total licensed capacities.

Petrol LPG in Smederevo and Standard gas, Energreen MTV and Hipol JSC in Odžaci have also significant capacities for liquefied petroleum gases.

5.4.7. Stations for Motor Fuels Supply of Vehicles - Number and Locations of Petrol Stations

Motor fuels and other fuels trade at stations for supply of means of transportation is the retail trade in terms of regulations by which the trade section is regulated. Retail sale of petroleum products in the Republic of Serbia is performed by companies in ownership by domestic and foreign companies, which dependent entities are registered in Serbia.

In 2020, the number of licensed business entities which are engaged in retail sale is 446 and this is an increase of 9 compared to 2019 when this number was 437 [11].

This is due to the construction of new transportation supply stations as well as the continued leasing of NIS stations a.d. Novi Sad and Lukoil to new tenants, which increased the number of market participants.

In 2017, the Ordinance on Technical Standards for the Safety of Fire and Explosions of Fuel Supply Centers in Road Transport, Small Craft, Smaller Commercial and Sports Vehicles (Official Gazette of RS, No. 54/2017) entered into force, which prescribes technical norms for safe installation, as well as fire and explosion safety for the construction of new facilities, and the upgrading, adaptation, reconstruction and rehabilitation of existing facilities of fuel stations for transport vehicles in road traffic, less h vessels, small business and sport aircraft, as well as handling and technical standards for equipment, installation and equipment for safe storing and transferring fuel to these stations.

Based on data from the Ministry in charge of energy, at the end of 2020, the total number of active stations for the fuel supply (petrol stations PS) in Serbia was 1.565 of which 325 NIS a.d. Novi Sad (20%), Lukoil 114 (7.3%), Knez Petrol 96 (6.1%), OMV 61, EKO 56 (3.6%) and Mihajlović d.o.o. 51 [54].

The largest number of petrol stations 416 (57%) is located in the city, then in the village 140 (19%), on the main road 112 (16%), while on the highway there is only 54 (8%).

The seven companies with the largest number of petrol stations: NIS JSC, Lukoil Serbia, Knez Petrol, OMV Serbia, EKO Serbia, Mol and Mihajlović d.o.o at the end of 2020 had 699 petrol stations [54].

Other petrol stations which represent almost 50% are owned or leased by a large number of licensed entities that have from one to several stations and are not included in the analysis.

5.5. Program of Modernization and Investment of Refineries

Within the project of modernization of the Pančevo refinery, €535 million was invested, of which €463 million goes to the construction of a hydrocracking complex with a plant for hydrogen production, and the remaining amount of €72 million for projects of ecological importance.

The project was initiated by signing a contract with engineering company CBI&Lummus, in September 2009. The start of construction is planned for the June 2010 and ending in late 2012.

The investment program, which included the modernization of production capacities and technological reconstruction of the processing complex, in order to increase product quality up to the standard Euro - 5 as well as the environmental protection was implemented to the fullest

extent. Until now it has been invested into environmental projects for over €60 million, in parallel with the development of modernization of production. Thanks to the modernization, NIS JSC will fully satisfy needs of the domestic market for fuels with 10 ppm S and unleaded petrol.

The realization of the complex for mild hydrocracking and hydro (complex MHC/DHT) in Refinery Pančevo, enabled the NIS JSC to completely switch to the production of ecologically clean fuel - unleaded petrol and euro diesel with a sulphur content not exceeding 10 ppm.

With the opening of a new MHC & DHT complex with plants for mild hydrocracking and hydrotreatment, at the end of 2012, the production of the highest quality petroleum products of Euro 5 standard began. This investment successfully completed the first phase of modernization and started a new era of refinery processing, which continued in 2017 with the opening of the construction site of a delayed coking plant within the "Deep Processing" project, which introduces the Refinery to a new round of development and further modernization of refinery processing.

In accordance with the draft of Program [3] for the forthcoming period, projects are envisaged as part of the project "Deep Processing".

At the beginning of 2019, the largest capital turnaround so far was carried out in the RNP (hereinafter: the Pančevo Oil Refinery), and it encompassed almost all of the refining units. The turnaround also included a complex reconstruction of the MHC/DHT Unit as part of the planned preparation for its integrated operation with the new units. Another objective of the turnaround was to install the necessary technical and technological connections between the existing refining units and the units of the Delayed Coking Unit which are currently in construction.

The period after the capital turnaround was marked by a high refining output, and bitumen output reached an all-time peak of 59 thousand tonnes in October.

The capital turnaround of the Refinery encompasses works on the "gasoline and diesel pool" of refinery units: Platforming, Gasoline HDS, FCC complex, Alkylation, Sulfolane, Atmospheric and Vacuum Distillation Mild Hydrocracking and Hydrotreating Complex; works on the monitoring, cleaning and repair of equipment and piping and replacement of catalytic converters; as well as works in the Handling Sector, and the execution of investment projects aimed at increasing the reliability and efficiency of refining capacities.

The planned shutdown of the Refinery was also used to ensure compliance with all legal obligations concerning pressure vessels and pipelines. Additionally, the equipment was overhauled, and the problems identified in the trial run eliminated, catalytic converters replaced, etc. All these works were carried out on the group of primary and secondary processing units.

The capital turnaround included the installation of the technical and technological connections between the "old" refinery units and the units in the DCU complex, as well as the works on the reconstruction of the MHC/DHT complex for the DCU's needs.

During January 2020, the planned workover of the bitumen plant was carried out. A revision of energy consumption normatives was done. Activities for the harmonisation of training books for the DCU unit were carried out.

In February 2020, the emphasis was on cleaning the CO boiler. Activities were carried out on the development of "Job" plans for the equipment, as well as instructions for the operation and maintenance of equipment at the DCU complex. The trainings of operators by equipment manufacturers continued, such as trainings on the semi portal coke crane and trainings on OTS. The focus was also on performing pre-commissioning at the DCU.

During May 2020, activities were carried out at the DCU unit, in the part before the commissioning of Delayed Coker (S-5300) and the commissioning of acid water stripper (S-5900) / amine III regeneration (S-5950).

In June 2020, the workover of the plants for the sulphur recovery - Clauss (S-2450) was carried out and the mechanical readiness of the DCU plant was achieved.

At the end of August, the official handover-takeover of the "Certificate for trial operation of the “Bottom of the Barrel Unit" was officially performed in the Pančevo Oil Refinery.

The functional testing of the plant was performed at the DCU unit from August 24 to 28, and the first quantity of petroleum coke - high-calorie fuel – was produced. The produced coke will be shipped through an automated system that ensures efficient and safe loading of products into trucks.

During the construction of the new facility, special attention was paid to the protection of the environment, so that the plant was equipped with special collectors for collecting dust and a truck washing unit.

5.6. Overview of the Technological Security of Oil System, Quality and Maintenance of Oil and Petroleum Products

According to the Article 324 of the Energy Law [1], energy entities who realizes the energy activities of oil transport through oil pipelines, the transport of petroleum products, storage of oil, petroleum products and biofuels, the wholesale of fuels for the supply of vessels, the retail sale of fuels for the supply of vessels and biofuel production, are obliged to use and to maintain energy plants in accordance to the technical regulations and standards relating to the activity they perform, as well as the protection from fire and explosion, environmental protection determined by law and other regulations.

The conditions prescribed by this regulation are: pressure regulation and safety measures against exceeding the allowed working pressure, marking the route of the pipeline and product pipeline, the protective zone of oil and product pipelines, inhabited buildings, spaces and infrastructural objects in the protected zone of oil and product pipelines and work area, dangerous zones and corrosion protection of oil and product pipelines, conditions and mode of remote monitoring and management, conditions of design, installation and maintenance of electrical equipment and installations in dangerous areas, the requirements and testing of pipelines and product pipelines during the construction and before they are put into operation, the conditions and modes of use and handling of oil and product pipelines and their maintenance during operation, repairing and extraordinary events, conditions and modes of corrosion protection and of leaking of oil and product pipelines; examination and maintenance of security devices, conditions and method for protecting the oil and product pipelines, and protecting of their related overground devices, plants and spaces from unauthorized use or damage.

The pipeline Transnafta from the Croatian border to Pančevo has an installed SCADA system for remote control of vents on the block stations along the route of 154.3 km. It is also established a system for the detection of leaks Motorola MOSCAD by which the slightest leak is detected for a short period of time. A wireless remote control system is installed in case of a broken fiber cable that is the basic means for transmitting communication.

In the main dispatching centre in Terminal Novi Sad, a video surveillance with motion detection and alarm is installed in each block station.

Every five years the recording of status of pipeline performs by passing the intelligent inspection device (pig) on the basis of which it receives a report of the status of pipeline located on damaged places, the degree of damage and the remaining service life of pipelines, all in accordance with European standards relating to the integrity of the pipeline.

During 2018, Transnafta performed in line inspection of the section from the Terminal Novi Sad to Oil Rafinery Pančevo, and in 2019, the reconstruction of critical sites was executed according to the obtained test report. In 2021, it is planned to inspection the sections from Sotin to Novi Sad.

There have been carried out periodically inspection of riverbed of rivers Danube and Tisa in place where pipeline crosses through watercourses to ensure preventive response and to prevent accidents.

The Article 327 of the Energy Law [1] defines that the energy entity carrying out the transport through oil pipeline or transport of petroleum products through product pipelines establishes the Rules of Procedure of the system for transport through oil pipelines and the Rules of Procedure of the system for transport of petroleum products through pipelines, which include, in particular: technical conditions for the safe operation of system, procedures in case of disaster and critical situations, or interruption of transport, the rules on access to the system for transport of oil and petroleum products, requirements regarding the quality of oil and petroleum products which are given for transport, rules on measurement with defined necessary measuring devices and other transport conditions.

Transnafta applies valid document Rules of the transport system [55] which defines all activities in order to provide safe and secure transport and storage of crude oil.

On the route of the pipeline from the dispatching station in Elemir to Novi Sad Oil Refinery, the system of leak detection Krohne is implemented, and also the installation for system's measuring at the entrance to the refinery system by which all parameters of flow are received in a real time.

In 2020, the relocation of a part of the pipeline route in the highway zone and the industrial zone of Novi Sad was completed.

After connecting the new part of the pipeline route to the existing system, the inspection will be carried out by intelligent pig.

Transnafta is successively cleared the technological and storage tanks at the Terminal Novi Sad, recovering them and bringing in excellent working order.

The cleaning is performed every 10 years and in that period testing of tanks and reparation of any damage are done as well as the laser measuring with drafting of volume tables is conducted every 5 years, all in accordance with the Rulebook on Types of Criteria that is Required Verification and Intervals of their Periodic Verification (Official Gazette of the RS, No. 49/2010 and 110/2013) [56].

Transnafta in 2017 finished reconstruction of the manipulative pipelines was carried out at the Terminal Novi Sad.

The activity of the transport of products through product pipelines is not done because there are no functional product pipelines built on the territory of the Republic of Serbia.

Transnafta initiated the drafting of technical documentation in order to implement the project System of product pipeline through Republic of Serbia, which would include the construction of a pipeline from Sombor, through Novi Sad, Pančevo, Smederevo and Jagodina to Niš with a branch from Pančevo to Belgrade. Also, the project envisages the construction of the terminal at specified locations. This would achieve a safer and more secure transport with minimal impact on the environment. The total length of oil product amounted to 402 km with a capacity of 4.3 MTA.

By the end of 2020, geodetic and hydrological psamological bases have been completed. The development of the Project for the construction of the section Pančevo - Smederevo follows. The conceptual design envisages sophisticated equipment for remote control and monitoring as well as for leak detection.

At terminals and warehouses of NIS JSC and other licensed entities for petroleum products storage and wholesale the substitution of pouring of the charging system performed to avoid evaporative losses and to reduce environmental pollution. Also, the systems for the filling of petrol will be installed for condensate recovery units (VRU units) [43].

The port activity is defined by the Law on Amendments to the Law on Navigation and Ports on Inland Waters (Official Gazette of the RS, No. 73/10, 121/12, 18/15, 96/15 – other Law, 92/16, 104/16 - other Law, 113/17 - other Law and 41/18) [57]. In the Republic of Serbia there are 1.364 km of navigable rivers and channels. Transport of derivatives by waterways is done mainly on rivers Danube and Sava and the reception and dispatch of products is done at locations Bezdan, Novi Sad, Sremski Karlovci, Pančevo, Smederevo and Prahovo where modern ports are built respecting all regulations and safety measures in terms of environmental protection (protective dams, skimmers).

River fleet engaged in transport must realize the requirements in terms of security in accordance with the Regulations on the manner of transport of dangerous goods in water transport and obligations of the participants in the transport of dangerous goods by extraordinary events (Official Gazette of the RS, No. 125/2014). Water traffic in the transport of dangerous goods is done by boat which is celebrated in accordance with the European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways ADN (European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways). (Official Gazette of the RS - International Treaties, No. 8 / 2017-1 of 04 September 2017).

5.7. Capacities for Import and Export of Crude Oil and Petroleum products

According to the data from the Energy Balance for 2020 [58], the transport of petroleum products in the Republic of Serbia is carried out by rail, shipping and road transport. From Refinery to terminal plants it is mainly performed by railway and ship transport and to final customers by road transport. Currently available capacities of specified types of transport satisfy all needs for transport of products. The only provider of pipeline transport of crude oil in the Republic of Serbia is PE Transnafta. The activity of this company is oil pipeline transport through the Republic of Serbia.

5.7.1. Capacities for Import and Export of Crude Oil

The available capacities for import of crude oil are not fully used and the capacity of the oil pipeline, which manages PE Transnafta and which amounts 9 MTA is currently using less than 30%. Considering that the Novi Sad Oil Refinery is currently not operating and for which the capacity of 3 MTG has been reserved, the capacity of the direction to Pančevo from 6 MTGs is slightly above 50%. There is no possibility to export and reversible transport through existing pipelines and there are not built other pipelines that could carry out the export of manufactured domestic oil via oil pipeline transport. In 2020, it was imported 2,549,095 tonnes of crude oil [15].

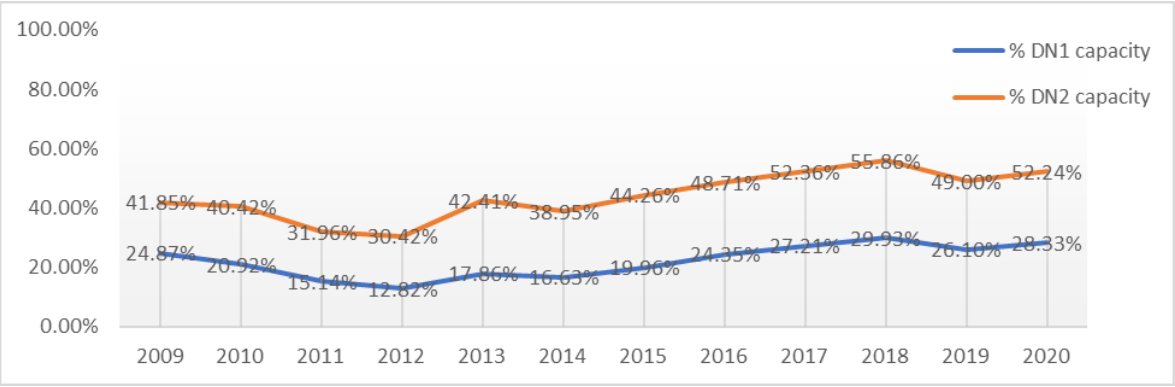


Figure 8: Percentage of oil pipeline capacity utilization for the period 2009-2020

An alternative to pipeline importing of significant quantities of crude oil represents the import by barges on the Danube from Konstanca, but there are several factors for the inefficiency of this

mode of transport. The main reason is the restriction of mobility of Danube in Đerdap hydroelectric power plants and the absence of river fleet capacity which could deliver at the optimal time the necessary amount of crude oil according to the planning needs of the processing [43].

The condition and capacity of railway tracks in Serbia represents a limiting factor for significant applications in imports of crude oil.

Domestic crude oil is transported by pipeline and tank trucks from the dispatching stations to Novi Sad Oil Refinery and shipping continues to the Pančevo Oil Refinery. Oil - type Velebit due to its bad rheological transport properties must be mixed with imported or domestic crude oil, and only by bringing to the conditions prescribed by the rules of the transmission system of Transnafta can be transported to the Pančevo Oil Refinery.

When it comes to the waterways transport of domestic crude oil there is a possibility for transport of domestic crude oil by pipelines from the dispatching station to the refinery. The biggest dispatching stations of NIS JSC Nadrljan and Elemir have the possibility of shipping of crude oil through barges but that mode of transport in the regular work of the pipeline is not implemented [43].

The transport of crude oil by tank trucks is only carried out from domestic oil fields (Turija fields of South Banat and Stig) from collecting stations that are not connected by pipelines with delivery stations previously mentioned. These are amounts that do not exceed 10% of total production. When the Novi Sad Oil Refinery stopped working, the crude oil from the oil field Turija is shipped to the Pančevo Oil Refinery by tank trucks, as due to its unfavourable rheological properties can not be transported by pipeline [43].

5.7.2. Capacities for the Import and Export of Petroleum Products

On the market a significant number of licensed entities who import derivatives by rail, car tanks, river vessels (river tankers, barges and self - propelled tanks) in its property or leasing.

The import of petroleum products by rail mostly is carried out by rail tankers in property of NIS JSC or Standard Logistic while the import by vessels, except NIS JSC (for which transportation is performed by "Jugoslovensko rečno brodarstvo a.d. Beograd" and other) is performed by several companies with their own fleet (Speed Ltd, Naftachem Ltd, Kazuk Ltd, Ladjar Kupra, Rubikon Shipping, Dunav Oil Trans, Judra Ltd, Ladjar Transport Ltd, Euro Gas Subotica, MB Gas Oil, Mario MilTrans Ltd [43].

With the modernization of Pančevo Oil Refinery and achieving of products quality on European level, NIS JSC has reduced the import while Intermol and Lukoil stayed the leaders of import.

NIS JSC mainly does the export of petroleum products by rail transport using rail tankers, by waterways using barges and by road transport using truck tanks.

5.8. Overview - Geographical Origin of Imported Fuels

Based on the available data of Ministry in charge of energy which is composed from database that is filled by entrepreneurs [59] as the data that the ministry receives from the Customs Administration, and in accordance with the classification of Section 4 of Annex B of Regulation (EC) No. 1099/2008 an overview of geographic origin and percentage of imported fuels is made.

From the table below (The naphtha is from Romania and Croatia, while the motor gasolines are mostly imported from Hungary, Slovakia, Austria and Romania and because of that we have many big international companies such as OMV, Mol, Lukoil. Hungary is also the country from which most of the energy products are imported and whose percentage 45.14% is more then 2018 (38,52%) [25].

Diesel fuels are imported from different areas opposed to gasolines: Hungary, Romania, Bulgaria Croatia and Slovakia. The paraffins, bitumens, petroleum coke and lubricants include different spectrum of products [25].

Most of the market participants is provided by euro diesel from the domestic resources, opposed to previous year when the only supply was from the import [25].

Compared to 2018 and 2019 in 2020, the number of countries from which significant quantities of derivatives are imported are reduced. Hungary, Romania, Bulgaria and are the countries from which more than 80% of the derivatives are imported.

Table 33 it is seen that oil and lubricants and LPG is a fuel which is imported from a lot of different countries and a consequence is in a large number of licensed entrepreneurs as well as the minimum of necessary technical capacities for its storage, which is not the limiting factor in the market and do not prevent competition.

In 2019, the crude oil is from Russia (Novy Port, REB) and Iraq (Kirkuk). In 2019, compared to 2018, the share of Novy Port is at the level of 33.45%, while oil is not imported from Kazakhstan (CPC Blend) and from Iran.

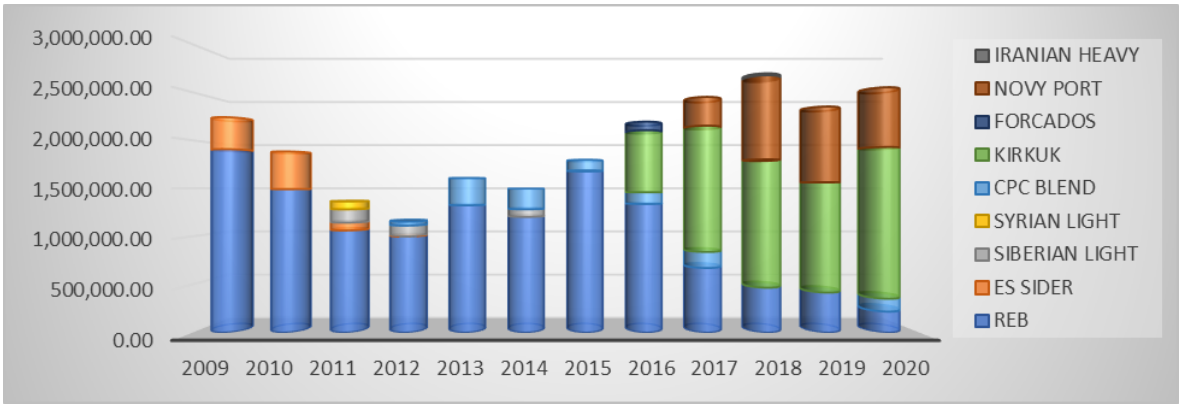


Figure 9: Structure of crude oil imports by years for the period 2009-2020

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Table 33: Table of geographic origin of imported fuels [25]

		%Crude oil	% Petroleum products	Refinery gas (not liquefied)	LPG	Naphtha	Motor gasoline	Kerosene type jet fuel	Gas/diesel oil (distillate fuel oil)	White spirit and SBP	Lubricants	Bitumen	Paraffin waxes	Petroleum coke	Other products
AL	Albania		0,54									●		●	
AT	Austria		0,63				●					●	●		●
BA	Bosnia and Herzegovina		0,82						●			●	●		
BE	Belgium		0,62								●				
BG	Bulgaria		10,21						●				●		
BY	Belarus		0,44		●										
CN	China		0,00												
CZ	Czech Republic		0,46		●										
DE	Germany		0,73							●	●		●		
ES	Spain		0,00								●				
FR	France		0,00												●
GB	Great Britain		0,00												
GR	Greece		0,88						●		●				
HR	Croatia		2,55		●	●			●				●		●
HU	Hungary		45,14		●		●		●	●	●	●	●	●	
IN	India		0,00								●				
IT	Italy		1,53							●	●		●	●	
KZ	Kazakhstan		0,00												
LT	Lithuania		0,00								●				
MD	Moldavia		0,00												
MK	Republic of Macedonia		0,26		●				●		●	●			
NL	Netherlands		0,23		●						●				
PL	Poland		0,75												●
RO	Romania		27,12		●	●	●		●	●				●	
RU	Russian Federation	51,18	1,97	●	●								●		
SE	Sweden		0,00												
SI	Slovenia		0,73								●			●	
SK	Slovakia		2,35				●		●					●	
TR	Turkey		0,21								●				
UA	Ukraine		0,58		●				●						
NG	Nigeria		0,00												
IQ	Iraq	48,82	0,00												
	Other		1,25												

6. CONCLUSION

Based on the available data from the realization of the balance in the field of electric power, it should be pointed out the continuation of the increase in production in the field of renewable energy sources, primarily from wind power plants, small HPPs, solar and biogas power plants. Compared to 2018, the largest increase in installed capacity was achieved in wind power plants (51%), followed by biogas power plants (78%), small HPPs (11%), and solar power plants (7%). In addition to the positive energy effects, these results significantly contribute to the fulfillment of international obligations undertaken by the Republic of Serbia in the field of ecology and the share of renewable energy sources in total production and consumption.

During a number of years in the previous decade, PE EPS had problems that were reflected in the decline in production in coal-fired power plants. However, looking at the results achieved in 2019 and 2020, this negative trend has stopped.

The total production of power plants owned by PE EPS in the period January - December 2019 amounted to 33,481 GWh of electricity. With the realized production, the tasks determined by the Electricity Portfolio were fulfilled with 94.6%. Total realized production in 2019 is lower by 864 GWh than realized in 2018 (34,345 GWh). This realized production is 97.5% of the realized in 2018, but it is encouraging that the coal-fired thermal power plants produced 100.9% compared to 2018, HPPs produced less by 10.6% (objective situation caused by the less favorable hydrological situation), while CHP power plants achieved 141.3% of production, compared to 2018.

In the period January - December 2020, PE EPS power plants produced 34,008.8 GWh of electricity. With the realized production, the tasks determined by the Amended Electricity Portfolio were fulfilled with 101.5%, which is 504.1 GWh more than the planned tasks (33,504.7 GWh). This realized production is higher by 1.6% than realized in the same period in 2019 or in absolute values higher by 527 GWh, primarily because coal-fired power plants achieved more by 5% or 1,162 GWh, CHP power plants were engaged at the level of 57.1% of production in the previous year, and HPPs produced 4.9% less, i.e. they achieved 491 GWh less production than in 2019.

The electricity portfolio of PE EPS for 2021 predicted realization at the level of 2019, but with coal-fired power plant production close to that of 2020, which we can consider a good expectation, having in mind the entry into the opt-out regime of several smaller blocks.

When it comes to hydropower plants, it should be noted that their availability does not represent a limitation for production and that it is dictated by hydrological circumstances in the observed year.

For a more detailed overview of future production from thermal power plants in PE EPS, it will be necessary to consider new legal frameworks with all possible influences, as well as new documents such as the National Integrated Energy and Climate Plan, Energy Development Strategy, Strategy Implementation Program, Low Carbon Development Strategy and others which are currently under development.

The problem with coal mines is as follows. When it comes to TPP Kostolac during 2019, the multi-year physical decline in coal production continued (balance decreased by 467,081 tons, i.e. 5%), and especially discoveries (balance decreased by as much as 25%, ie by 10.36 million m^3 solids). However, the production of coal increased already during 2020 compared to the previous year, due to the entry of the VI ESC system into operation. There are still no problems with the quality, thermal power, and homogeneity of coal at the Drmno mine.

Another coal mine, MB Kolubara, has been failing to supply quality coal to TPPNT for several years. Problems of low energy value of coal (lower thermal power significantly lower than guaranteed, with increased values of ash and moisture, as well as the content of the admixture -

clay and sand), very uneven quality, even on a daily basis, and significant failure in coal balance have remained. However, the reports of the competent services show that the Kolubara mines in principle meet the balances of coal production, both in tons and in total thermal power.

The current issue of disruption of electricity prices on stock exchanges in Europe and the world, as well as possible influences on Serbia, will be discussed later.

The natural gas sector is characterized by a declining trend of indigenous production since most of the gas fields are in the final stage of exploitation. In recent years, there haven't been significant discoveries of new gas deposits. This will result in a steady increase in natural gas imports in the future. Also, analysis of the energy balance of the country indicates a steady increase in the consumption of this energy source.

The main risk in natural gas supply is related to the fact that it is provided from one, predominant source of supply and by the only one supply route. However, the long-standing problem of Russian natural gas supply from only one direction is solved with the construction and commissioning of the interconnection gas pipeline from the Bulgarian-Serbian border to the Serbian-Hungarian border as well as its connection with the transmission system of the Republic of Serbia (achieved in 2021). Indirectly, this gas pipeline contributes to the diversification of supply sources, because by switching to supplying consumers in Serbia with Russian gas from Bulgaria, the technical capacity of the Horgos entrance station, according to the transmission system of the Republic of Hungary, is available for importing and taking gas from other sources.

In order to further raise the level of security of supply of the domestic natural gas market, it is necessary to ensure the expansion of the capacity of the existing underground gas storage and build interconnection with countries in the region (Bulgaria, Romania, Croatia, Northern Macedonia, Montenegro). In this way, the security of supply of the domestic market with natural gas is significantly improved, the reliability of the system operation is ensured and the possibility of purchasing natural gas under more competitive conditions is opened. There is also the possibility of reducing transit costs, as well as the possibility of supplying natural gas from other supply routes - the so-called Southern Corridor (Azerbaijan, liquefied natural gas from terminals in Greece, etc.), gas from Romania, North African gas from Italy via Croatia or through a liquefied natural gas terminal in the Republic of Croatia.

Establishing a system of mandatory reserves of the Republic of Serbia and implementing the dynamics of filling the warehouses in accordance with the adopted Action Plan will increase the security of supply when it comes to crude oil and oil derivatives.

At the same time, it is actively working on the reconstruction of existing and construction of new storage capacities at existing terminals, as well as considering the possibility of other modes of financing the construction of new storage terminals.

The Energy Reserve Directorate provides new quantities of petroleum products, as well as tickets, in accordance with the Law on Commodity Reserves and Directive 2009/119/EC. It is necessary to achieve the planned dynamics of emergency stocks forming in order to provide quantities for 90 days of net imports or 61 days of inland consumption, by January 1, 2023.

Compared to the previous period, capacities in public ownership for storage of mandatory reserves of the Republic of Serbia have been increased and the first quantities of crude oil and oil products have been stored.

Reconstruction of existing and construction of new storage facilities for the mandatory reserves on defined locations should ensure availability of products in the optimal period for the entire territory of the Republic of Serbia.

On the other hand, the constant trend of crude oil production decline in the country requires an increase in imports and a greater dependence of the Republic of Serbia on import volumes. The negative trend in crude oil production in the country can be partially stopped by investing

more significant assets in the exploration and exploitation of new oil fields, both the geographical locations and deeper layers of current landfills. In addition, in the process of production, secondary and tertiary methods can be introduced in line with the most up-to-date global trends in this field.

The constant trend of crude oil production decreasing requires import increase and a greater dependence of the Republic of Serbia on import volumes. The problem of just one direction of crude oil supplying still remains. It is a part of the pipeline infrastructure of the former Yugoslav oil pipeline operated by PE Transnafta. In the reporting period, however, there was no threat to crude oil supply of the Pančevo Oil Refinery.

Providing a new direction for crude oil import by pipeline in the coming period is essential. By establishing new interconnections, the Republic of Serbia would have significant flexibility in this regard.

Construction and implementation of Oil product pipeline network through Serbia, and connection with the neighbouring countries, will allow secure and safe transport and presence of sufficient quantity of oil products at any time. In addition to the proven cheapest, safest and fastest way of transportation, introducing this type of transport the Republic of Serbia would also unload the river transport. According to the undertaken obligations and the signing of the ADN Agreement, which regulates the transport of motor fuels by barges with double bottoms on inland waterways, the Republic of Serbia has committed to provide this type of transport for the petrol fractions by December 31, 2018. This obligation, in view of the lack of an adequate river fleet, greatly increases costs and complicates the transport of oil products from the refinery to the consumers. By introducing the pipeline transportation system, the existing oil products transport by Danube on the Pančevo - Novi Sad and Pančevo - Smederevo routes, would be reduced to a minimum.

Solving the existing problems of the railway infrastructure through the construction of new or reconstruction of existing railway tracks and increasing the axle load-carrying capacity, would enable the possibility of transporting larger oil products quantities by railway, both for import and export, which would significantly improve the security of supply of the Serbian market with these energy products.

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