

REPUBLIC OF SERBIA
SECURITY OF SUPPLY STATEMENT

Year 2017

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ABBREVIATIONS

AERS	- Energy Agency of the Republic of Serbia
APKM	- Autonomous Province of Kosovo and Metohija
CESEC	- List of Projects for Gas Connection of Middle Eastern and South Eastern Europe
CHP	- combined heat and power plant
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
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
PSHPP	- pumped storage hydro power plant
RMC	- remote, monitoring and control system
RS	- Republic of Serbia
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, adopted in December 2014 (Official Gazette of the RS, no. 145/2014) [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,
- use of renewable energy sources,
- 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,
- field of heat energy as the energy industry, and its production, distribution and supply, etc.

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 Strategy), 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 Government) 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 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) [2].

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.

1.2. Institutional Framework Governing the Energy Sector

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

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

- 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), "Operator distributivnog sistema EPS Distribucija d.o.o. Beograd" (EPS Distribucija), "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) [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. Regulations of Commodity Reserves

In the part of security of supply, the area of oil is regulated by the Law on commodity reserves which regulates the conditions for the formation, financing, deployment, use and restoration of the obligatory reserves of oil and petroleum products, provision and maintenance of space for storage, as well as the operation and management of the compulsory reserves and storage facilities on the territory of the Republic of Serbia.

2. STRUCTURE OF ENERGY SECTOR

The energy system of the Republic of Serbia is consisted of oil, natural draft, coal, power engineering 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 2015 it amounted 0.930 million tonnes, which is 30% of total needs). The "Naftna industrija Srbije a.d. Novi Sad" (NIS JSC) is the only company in 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 2016 domestic production of petroleum products amounted 3.459 million tonnes, which is 90.6% of total needs for petroleum products).

By the new Energy Law [1] some of the existing energy activities, for which a license has been provided in this area, have gained new meanings. Thus, the activity of producing oil products includes not only the processes of obtaining oil products by crude oil refining, degasoliation or separating light liquid hydrocarbons, but also all the technological processes that give standardized products of the prescribed quality.

In Republic of Serbia, the production of oil products, more precisely liquefied petroleum gases, is performed, except in the refinery in Pančevo, at the NIS JSC plant for stabilization, i.e preparation of natural gas for transportation in Elemir (propane, as well as gas condensate); in plants in Odzaci by Standard gas (propane and butane as well as pentane-hexane fraction, or solvent), where imported gas condensate i.e wide fraction of light hydrocarbons is used as the raw material for production; and in the "Hipol a.d. Odžaci" (Hipol JSC), where the propane receives as a by-product in the process of purification of petrochemical propylene to propylene polymeric purity. At Hipol JSC location, but in other plants, the Energreen MTV is also produces the same products. The production of propane-butane mixture and autogas, based on the mixing of components, is carried out by Petrol LPG in Smederevo and VML at the plant in Jakovo.

The only service provider - operator is "JP Transnafta Pančevo" (PE Transnafta), which is founded on October 1, 2005 until when the service was carried out within NIS JSC company. The business activities of transportation of crude oil through crude oil pipelines and petroleum products through product pipelines are the regulated business activity of general interest and is carried out by PE Transnafta by 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 20 licenses being issued for crude oil and petroleum products storage, also 39 for crude oil and petroleum products wholesale and 470 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 1450 retail facilities.

In Republic of Serbia, the supply of transport vehicles with compressed natural gas, as a fuel, is done at 20 stations.

In addition to the traditional trade in motor and other fuels at the stations for the supply of transport vehicles, the new Energy Law provides a license for fuel trade out of the fuel station. In

this way, the supply of sports airplanes by jet fuel and direct supply of end users with energy and heating products, such as fuel oils, biofuels, propane, propane-butane mixture and other, are regulated. For this activity, for now, the license have two energy entities.

Total consumption of petroleum products as final energy-generating product amounted 3.359 Mtoe, out of which 0.611 Mtoe was spent for non-energy purposes and 2.748 Mtoe was spent for energy purposes whereby mostly in traffic sector 77.63%, then in industry 12.24%, in agriculture was spent 4.96%, and in households about 2.38%, while the rest of consumers participate with 2.79%.

Directive 2009/28/EC, which refers to the required content of biofuels in motor fuels, in order to reduce the greenhouse gas emissions, has not been implemented in domestic legislation yet. By the Action plan for building new capacities on the basis of renewable energy sources is assumed obligation to reach 10% of the share of biofuels in motor fuels by 2020, but the share of biofuels in the oil products in 2016 was still negligible. So far, the license for production of biofuels and bioliquids has been given to a single entity, whereas for the mixing biofuels with petroleum fuels the license have two energy entities.

2.2. Natural Gas Sector

Natural gas sector comprises of:

- Exploitation of domestic natural gas reserves within NIS JSC (production in 2016 has been 523.229 million m³),
- Natural gas processing within gas refinery,
- Natural gas import (one direction from Russia via Ukraine and Hungary, total amount of 1,795.226 million m³ in 2016),
- Storage of natural gas and storage management (underground storage facility Banatski Dvor (UGSF Banatski Dvor), capacity of 450 million m³ of natural gas),
- Natural gas supply,
- Natural gas transport and transport management ("JP Srbijagas Novi Sad" and "Yugorosgaz a.d. Beograd"),
- Natural gas distribution and distribution management (34 companies).

In 2016, natural gas consumption in Republic of Serbia had following structure:

- Systems of energy transformation – 37.3%;
- Energy sector – 7.6%;
- Transport and distribution losses <1%;
- Non-energy consumption – 12.3%;
- Sectors of final energy consumption – 41.8%.

In process of natural gas transformation in other forms of energy, highest share had district heating plants - 64%, followed by refineries with 15% and thermal power plants with 5%.

The highest share within final energy consumption for energy purpose had industry (55%) followed by households with 21%, agriculture and traffic with 4% and other consumers with approximately 20% share.

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 2016 it produced 0.536 million tonnes of coal)
- Underwater exploitation in Kovin (in 2016 it produced 0.252 million tonnes)
- Surface coal mining in two major mines in Kolubara (in 2016 domestic production was 28.54 million tonnes) and Kostolac (in 2016 production was 9.11 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. That is the reason why the domestic production satisfies 97% of the total demand for coal and the rest is imported.

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 2016 amounted to 38,440 million tonnes, or 7.32 Mtoe, while the total amount of coal available for consumption is about 8 Mtoe. Of this amount for the transformation process has been spent up to 7.349 Mtoe, of which 6.622 Mtoe (90%) in thermal power plants, and the remaining of 10% 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 2016 was produced 434,372 tonnes of dry lignite.

Final consumption of coal in 2016 amounted 0.844 Mtoe of which in non energy purposes 0.006 Mtoe, and in energy purposes 0.837 Mtoe. In the structure of final consumption for energy purposes, the participation of industry is 43%, 42% of households and other sectors with 15%.

2.4. Energy Sector

Capacities for the production of electricity in the Republic of Serbia, for the most part are owned by PE EPS (99%), and their structure in 2016 is:

- Thermal Power Plants (TPP), net output capacity of these plants is 4,032 MW
- Combined Heat and Power Plants (CHP), with net output capacity 336 MW
- Hydro Power Plants (HPP) with net output capacity 3,016.975 MW (including small hydro power plants)
- Wind Power Plants, with net output capacity 17 MW
- Solar Power plants, with net output capacity 10.22 MW
- Biogas Power plants, with net output capacity 10.34 MW
- Industrial power plants, with net output capacity 20.53 MW.

In about twenty industrial enterprises there are power stations that enable production of electric and thermal energy, capacity of 100 MW, of which the largest number was not operational.

Total electricity production in 2016 was 39,343 GWh (3.383 Mtoe). The largest part of production was realized in thermal power plants (69%) and hydro power plants (29%). Combined heat and power plants and industrial power plants in total electricity production together accounted for about 1.2%. Import of electricity was 5,068 GWh (0.436 Mtoe), export 6,990 GWh (0.601 Mtoe), so that net gross export amounted to 1,922 GWh (0.165 Mtoe).

Power consumption of the energy sector in the same year amounted to 13% of the total generated electricity (gross production). Losses in the transmission and distribution system amounted to 12% of the total electricity production (gross production).

Final electricity demand was 27,466 GWh (2.362 Mtoe). Electricity as final energy is consumed mostly in households (51%), then in industrial plants along with the construction sector (29%), and transport, agriculture and other consumers (20%).

In 2016, there were 60 licenced electricity suppliers for open market supply (only 14 were active). PE EPS remained dominant with 97% share of total energy sold in the open market and 97% 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 57 towns in Serbia, with the total installed thermal capacity of boilers 6.587 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 2016 10,211 TJ of heat and 344 GWh of electricity was produced).

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 Lazarevac
- CHP Novi Sad, Zrenjanin and Sremska Mitrovica for district heating and process steam (steam units for the gas and liquid fuel).

Natural gas, coal, oil products and biomass are used for the production of heat in district heating plants. In 2016, in the thermal power plants was spent 566,640 million m³ of natural gas, 183,01 tonnes of coal, 86,049 tonnes of petroleum products and 7,927 tonnes of biomass.

The thermal energy production in 2016 amounted about 36,097 TJ or 0.862 Mtoe. The largest part of the production was achieved in industrial power plants (28%) and thermal power plants (63%).

Distribution losses were 3,406 TJ, or 0.081 Mtoe and consumption of the energy sector was 2,141 TJ or 0.051 Mtoe. Final energy consumption in 2016 amounted to 30,550 TJ or 0.730 Mtoe. When it comes to this amount, in industrial power plants was spent (34%) and in household (55%). Other consumers accounted for 11% of final energy.

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.

Balance of renewable energy for 2016, included the production and consumption of electricity from large and small watercourses, geothermal energy, solid biomass (firewood, pellets, briquettes), biogas, solar energy and wind energy. In 2016, renewable energy accounted for 18.8% of the domestic production of primary energy.

Electricity production from large and small watercourses was included in the balance of the total electricity production in the Republic of Serbia and was 11,520 GWh or 0.991 Mtoe. This means that in 2016 the hydropower plants produced 29% of the total gross electricity generation.

Geothermal energy production is followed by the Statistical Office of the Republic of Serbia within their statistical surveys and in 2016 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.

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 2016 in the Republic of Serbia was 1.103 Mtoe, of which the largest part of 0.897 Mtoe was consumed in households.

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 per year. From this potential 1.054 tonnes of oil equivalent of biomass and 909 thousand tonnes of oil equivalent of hydropower is already used.

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 Republic of Serbia 10,836 Mtoe of primary energy was produced in 2016. This production has satisfied more than 70% of the total demand for primary energy. The structure of domestic production of primary energy is as follows: coal production amounts to 7,318 Mtoe 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 2016 was 15,728 Mtoe. Net import dependence of Republic of Serbia in 2015 was 30.3%. During 2016, mostly imported energy sources were: crude oil and petroleum products 57%, natural gas 26%, coal 10% 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 56%, then 28% of crude oil, petroleum products 3%, natural gas 6% and 7% of the hydropower potential. 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 2016 was 9.616 Mtoe of which 0.875 Mtoe was consumed for non-energy purposes, while the consumption of final energy for energy purposes was 8.680 Mtoe.

By consumption sectors, final energy was most consumed in the household sector 36%, followed by industry 27%, then traffic 25%, while other sectors accounted for 12%.

On the other hand, in the final energy consumption, energy products consumption is dominated by oil with 32% and electricity with 27%, followed by natural gas with 10%, coal with 10%, thermal energy with 8%, while renewable energy (firewood) participate with 13%.

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 which regulates the status of public companies (Official Gazette of the RS, no. 15/2016). 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 [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.

The basic structure of the electricity sector was established in 2005 upon the adoption of the Energy Law in 2004 (Official Gazette of the RS, no. 84/2004) by unbundling and internal reorganisation of a common vertically integrated "JP Elektroprivreda Srbije Beograd" and establishment of "JP Elektromreža Srbije Beograd".

EMS JSC and PE EPS were established on July 1, 2005 by the decision of the Government and both of them are 100% owned by the Republic of Serbia.

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 Distribucija consisting of previous companies "Elektrovojvodina", "Elektrodistribucija Beograd", "Elektrosrbija", "Jugoistok" and "Centar", for the performance of the activity of electricity distribution and distribution system management and subsidiary "EPS Trgovanje d.o.o. Ljubljana" by PE EPS set up for electricity trading.
- SEEPEX a.d. Beograd (SEEPEX), licensed market operator on organized market/power exchange.
- Other electricity producers
- Other electricity suppliers.

3.1. Electricity Market

By adopting the new 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, which 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 new Energy Law [1], the conditions for obtaining the right to guaranteed electricity supply have been changed. Accordingly, from January 1, 2015 households and customers who have the status of a small customer 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 10 million € in dinar 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 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 (but not the obligation) 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.

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 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 operator and the 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 RS", no. 91/2015) [8],

Electricity Distribution Grid Code (Official Gazette of the RS, no. 71/17) [9] and Electricity Market Code [10].

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

Table 1: Active licences in electricity sector in year 2016 [11]

Activity	Active licenses
Electricity production	15
Combined power and heat production	6
Electricity transmission and transmission system operation	1
Electricity distribution and distribution system operation	/
Electricity supply	63
Wholesale electricity supply	40
Ogranised electricity market operation	1

On the territory of the Republic of Serbia, EMS JSC and EPS Distribucija are selected for performing of energy operations in the field of transmission and distribution of electricity, as noted in the introduction to this chapter.

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.

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. Households and small customers have an option to select a supplier in the open market, but they can always switch back to the guaranteed supplier.

In 2016, the wholesale electricity market was based on trade between suppliers since there were no large independent electricity producers. The activities of the 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. In 2016, electricity export was higher than the import meant to cover the demand of customers in Serbia, due to favourable meteorological and hydrological situation and continual operations of thermal power plants during the major part of the year.

Table 2 and Table 3 present the relevant indicators of the electricity market in Serbia during the period 2013-2016.

Table 2: Electricity market concentration level in Serbia (2013-2014) [12], [13]

Supplier's activity	2013			2014		
	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
Trade with PE EPS						
Sales to EPS	4	100	High	2,047	51	Moderately high
Purchase from EPS	3,297	54	Moderately high	980	39	Low
Trade between suppliers						
Sales	1,143	63	High	948	40	Low
Purchase	1,298	54	Moderately high	941	26	Low
Electricity import and export						
Import	486	46	Moderately high	2,925	43	Low
Export	3,672	52	Moderately high	1,255	29	Low
Transit						
Transit	8,328	57		12,774	41	

Table 3: Electricity market concentration level in Serbia (2015-2016) ¹ [14], [15]

Supplier's activity	2015				Supplier's activity	2016				
	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	
Trade with PE EPS					Trade on organized electricity market					
Sales	659	72	2,160	High	Sales	533	80	425,752	3,389	High
Purchase	1,535	53	1,535	Moderately high	Purchase	533	72	423,169	1,985	Moderately high
Trade between suppliers					Trade between suppliers on bilateral electricity market					
Sales	1,349	42	852	Low	Sales	5,279	57	5,279	1,883	Moderately high
Purchase	1,345	36	620	Low	Purchase	5,279	35	1,481	702	Low
Electricity import and export					Electricity sales to final costumers on open market					
Import	2,926	49	893	Low	Sales	11,603	98	14,474	9,130	High
Export	2,306	60	536	Low						
Transit										
Transit	14,092	48	815	Low						

In 2015, out of 41 active suppliers, there were 6 of them among the three dominant ones in each activity. The level of market concentration remained on the 2014 level. Market concentration for the energy purchased from PE EPS significantly increased in comparison to 2014, which is a consequence of the fact that 2014 was untypical in terms of energy. Namely, in 2014, due to unavailability of mines and lack of coal and reduced production from thermal power plants,

¹ 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 concentrated

1001 < HHI < 2000 – moderately concentrated

HHI > 2001 – highly concentrated market

PE EPS purchased larger quantities of electricity in the market, whereas in 2015 the production was normalized and the electricity was sold to other suppliers to a great extent.

During 2016, 52 suppliers were active, and five out of them were among the three dominant ones in each activity. The level of market concentration remained on the 2015 level. The trade in the organized market, which has existed since the month of February 2016, ranged from moderately high to highly concentrated, which is a consequence of the beginning of the market operation and the low number of market participants. The trade in the bilateral market was on the trade level from the previous year with a tendency for the reduction in the market concentration. Also, high bilateral market concentration level in the field of sales is noticeable, as PE EPS still remained the dominant seller of electricity in the bilateral market in this year. The retail market concentration was very high, but still there was an insignificant downward trend in the market concentration in comparison with 2015.

Table 12 on the page 39 presents the electricity consumption in Serbia (without APKM) during the period 2013-2016. There was a 1.5% increase in the electricity consumption in 2016 in comparison with 2015, while the highest rise was experienced in the category of households and other customers.

The total number of metering points for customer delivery in Serbia, without APKM (without metering points of facilities within Železnice Srbije– 22 in total), was 3,624,625 in the end of 2016. Compared to 2015, the number was increased by 0.2% (3,617,781) [15].

In 2016, only households and small customers (besides having to meet the conditions related to annual income and number of employees, they are restricted to 30,000 kWh consumption in the previous year and all their facilities must be connected to the grid voltage lower than 1 kV) purchased in the organized market. Newly enforced legal restriction had a dominant impact on the reduction of supply in the regulated market from 17,221 GWh in 2015 to 16,138 GWh in 2016, which is a 6.3% decline. At the end of 2016, electricity at regulated prices was delivered on the total of 3,517,989 metering points to final customers.

Regulated electricity prices for final customers, pursuant to Energy Law from 2014, were firstly applied on January 1, 2008, after positive opinion of AERS on the PE EPS proposal and the approval given by the Government of the Republic of Serbia. The current electricity price for regulated guaranteed supply of final customers was approved on October 1, 2016. The average increase in the prices for all customers entitled to regulated price is 3.8%. In 2016, the Council of AERS adopted the amendment of the Methodology for Setting Electricity Price for Guaranteed Supply.

Since 2015, all final customers have been able to purchase electricity in the open market where 12,474 GWh was delivered in 2016, which amounted to 43.3% of the total consumption of final customers. The customers in the open market, which included a small number of households, had their electricity delivered to over 85,000 metering points (it amounts to 102,000 along with public lighting). Out of 60 companies licenced for electricity supply in 2016, there were 14 of them active in the open retail market. The dominant supplier in the free market was still PE EPS with a 95% share in the total electricity quantities sold to final customers in the open market and 97% share in the final consumption.

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 2015, 46 electricity market participants had a contract on balance responsibility with EMS JSC (then PE EMS), 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 April 2015, EMS JSC signed an agreement on the use of common regulation reserve within control block with the transmission system operator in Montenegro, which is extremely important for the stability of system operation.

During 2016, the number of balance responsible parties fluctuated, so in the end of 2016 the total of 55 electricity market participants had a signed Contract on Balance Responsibility with the transmission system operator.

In 2016, 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. Also, during 2016 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)).

In 2015, the total engaged balancing energy was 941,683.3 MWh, for which the total weighted settlement price amounted to 53.697 €/MWh, or, bearing in mind the direction of activated balancing entities:

- In cases where the total balance energy in the calculation interval was greater than zero: 64.098 €/MWh,
- In cases where the total balance energy in the calculation interval was less than zero: 18.073 €/MWh.

In 2016, the total engaged balancing energy was 939,664.50 MWh. The total weighted settlement price amounted to 36.632 €/MWh, or, bearing in mind the direction of activated balancing entities:

- In cases where the total balance energy in the calculation interval was greater than zero: 47.252 €/MWh,
- In cases where the total balance energy in the calculation interval was less than zero: 11.071 €/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 45 MW in 2015 and 34 MW in 2016. In 2015 and 2016, 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.

In this moment, the needs for frequency containment reserve in the following years cannot be precisely estimated, but it can be said, with a great certainty, that frequency containment reserve will not exceed the amount of 45 MW. Therefore, it can be concluded that EMS JSC should not have difficulties in securing frequency containment reserve in the coming period, considering that the currently available frequency containment reserve amounts to 474 MW.

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 976 MW (out of which 816 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, even though the quality of frequency restoration process has had a slight upward trend for a while, it should be mentioned that it is still not on a satisfactory level because of the absence of frequency restoration on the territory of Autonomous Province of Kosovo and Metohija.

In 2015, the number of hours of satisfactory operation of frequency restoration was between 35% (the value in June) and 65% (the value in October). The average hourly regulation error was between -37.6 MW and 36.6 MW, and the standard deviation of regulation error was between 39.5 MW and 118.5 MW. When it comes to 2016, the number of hours of satisfactory operation of frequency restoration was between 35% (the value in June), and 53% (the value in October). The average hourly regulation error was between -17.1 MW and 34.7 MW, and the deviation of regulation error was between 44.2 MW and 82.1 MW.

EMS JSC is taking measures in order to additionally improve the quality of operation of frequency restoration. In this respect, EMS JSC, together with the transmission system operators of Macedonia (MEPSO) and Montenegro (CGES) with whom it forms a control block within a synchronised area Continental Europe, began redefining the operating mode of frequency restoration in the way which would enable the exchange of frequency restoration energy in real time, in accordance with European grid codes.

During 2016 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). In 2016, EMS JSC procured the total of 1,165 MWh and delivered 1,945 MWh of cross-border regulating energy for replacement reserve and 400 MWh of emergency energy. It should be noted that the integration of balancing market into a unique European market is ongoing at European level, while regional cooperations

represent one of the steps in the process of establishing the unique European balancing electricity market. In this regards, the goal of the regional cooperation of EMS JSC with CGEC and MEPSO is the regulation costs reduction and improvement of operational security of the electric power system. In accordance with it, the following agreements have already been signed:

- new Agreement on the operation of SMM control block with CGES and MEPSO, which provided common dimensioning of regulating reserve,
- Contract on cross-border exchange of balancing energy for replacement reserve with CGES. MEPSO will probably join in this agreement in the second half of 2017, after removing the shortcomings in the national regulatory framework.

In this way the obligatory replacement reserve for each member of the block was reduced, and consequently the costs of its procurement decreased. The other positive effect is the creating of the opportunity for Serbian producers to sell regulating energy to neighbouring countries as well. The final goal of the development of the model for common replacement reserve within our control block is a unique Merit order list (ranking of available energy sources based on the price ascending order) for all three transmission system operators. In July 2016, so called WB6 agreement was signed on the political level, in which it was agreed that the operators of the Western Balkan region who are still not part of the European Union would begin the cooperation in the field of system balancing and frequency regulation. Therefore, it is expected that the further development of cooperation will go in this direction. EMS JSC is, besides participating in regional initiatives, an active member in the projects of the European Union and project teams of ENTSO-E that are working on the establishment of the unique European balancing electricity market, whose implementation is expected to be by the end of 2025.

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 a.d. Belgrade - power exchange, formed on the basis of partnership with EPEX SPOT. At the beginning, SEEPEX [16] decided to manage an organized 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 exchange² started operating in February 2016, and during the year 13 participants were registered, while 11 of them actively traded. 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. The 254 prices are not necessarily the same for each hour. 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 2016 was 533,270 MWh. The highest monthly trading volume of 93,625 MWh was realized in September, and highest daily trading volume of 7.177 MWh on September 6, 2016. The lowest monthly trading volume was in June and accounted for 31,161 MWh. The highest hourly rate reached on December 19, at 6 p.m. and amounted to 93.63 €/MWh. The average annual price was 34.75 €/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 Republic of Serbia amounts to 7,826 MW. Within PE EPS, in lignite-fired thermal power plants, the installed capacity amounts to 4,386 MW, in hydro power plants 2,936 MW, in natural gas- fired or heat oil-fired thermal power plants 347 MW and in 13 small hydro power plants – 27.7 MW (Table 4). The lignite used in thermal power plants is produced in open pits which belong to PE EPS.

In addition to the production capacities of PE EPS, the distribution network includes 216 small power plants with a total installed capacity of 129.5 MW, owned by other entity.

Table 4: Electricity generation capacities from 2013 to 2016³ [11]

Technology	Installed capacity [MW]			
	2013	2014	2015	2016
Hydro power plants	2,835	2,835	2,835	2,936
Thermal power plants (coal)	3,905	3,905	3,905	4,386
Combined heat and power plants (gas, fuel oil)	356	353	353	347
Other sources (renewable sources) – small PE EPS power plants	20	20	22	28
Small power plants – independent producers	61	77	77	129
Total installed capacity	7,177	7,190	7,192	7,826

² SEEPEX activities can be followed on the website www.seepex-spot.com.

³ Small hydropower plants - installed capacity up to 10 MW.

The share of the capacities within thermal power plants (TPP) and combined heat and power plants (CHP) amounts to 60.4%, while the hydro power plants (HPP), including small HPP cover 37.5%. 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.

Until the reorganization of PE EPS from July 1, 2015, production capacities were organised in five daughter companies of PE EPS which hold the license for electricity generation: HPP Đerdap, Drinsko-Limske HPP, Panonske CHPs, TPP Nikola Tesla and TPP and pits Kostolac.

After a reorganization of PE EPS, starting from the second half of 2015 and during 2016, production capacities are organized within the PE EPS. Also, until mid-2015, small distribution HPPs PE EPS were within daughter companies for electricity distribution Elektrosrbija, llc and Jugoistok, llc and since July 1, 2015, production in these facilities is performed by PE EPS, based on the contract on facility lease. Within the PE EPS reorganisation there was a change of status, i.e. production capacities in small distribution HPPs were transferred to PE EPS as a parent company with status change on January 4, 2016.

Apart from production capacities of PE EPS, 216 small power plants with total installed capacity of 89.48 MW owned by other legal and natural persons were also connected to the power distribution grid.

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.

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 [17] 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. 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).

The Republic of Serbia has adopted the National Renewable Energy Action Plan [18] 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.

The Government, at the proposal of the Ministry in charge of energy, adopts regulations that detail the conditions and procedure of acquisition, duration and termination of the status of privileged producer of electricity from renewable energy sources, the maximum capacity of all power plants using wind and solar energy that will get status of privileged producer, content and other elements of the contract on purchase of electricity. 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 (Official Gazette of the RS, no. 8/15) and contains data for year 2012 and 2013. The share of renewable energy in gross final energy consumption in 2013 was 19.10% and in 2014 20.1%.

The quantities of electricity taken over from renewable sources from 2013 to 2016 are shown in Table 5.

Table 5: Electricity production from renewable sources from 2013 to 2016 [19], [20], [21]

Renewable energy sources	Electricity [GWh]			
	2013	2014	2015	2016
Hydro power plants	10,853	11,617	10,783	11,520
Biomass power plants	18.70	20.65		
Solar power plants	1.50	6	11.45	12.43
Wind power plants	0.55	0.37	0.42	25.91
Biogas power plants	18.70	22	23	34
Total	10,892.44	11,666.03	10,817.87	11,592.34

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 [23].

Transmission system of EMS JSC is connected with the neighbouring power systems via twenty-four 400, 220 and 110 kV interconnection lines, while 22 of them are active [23]. 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 a.d. is responsible for, is shown in Table 6 and Table 7.

In comparison to 2014, there has been considerable increase of EMS JSC facility capacities since the newly-constructed transformer station Beograd 20 was commissioned and since there was an increase in some of existing transformer stations. A slight change in installed capacities of the EMS JSC plants in 2016 compared to 2015 was due to the replacement of the transformer at TS Smederevo 3. Transformer 150 MVA has been replaced with a new 250 MVA. The handover of 52 of 53 transformer stations 110/X kV/kV was completed in 2015. There is an ongoing procedure for the handover of the remaining transformer station since there are unsettled ownership issues.

The change in the capacity of 110 kV transmission lines in 2016 compared to 2015, was due to the completion of works on the introduction of power line in TS Niš 2, OHL 1245 TS Niš 2 – TS Prokuplje, 1246/1 TS Niš 2 – TS Niš 8 and 1246/2 TS Niš 1 – TS Niš 8, as well as reconstruction of OHL 115/2 TS Čačak 3 – TS Čačak 2. Minimal reduction in the installed capacity of the 220 kV and 400 kV transmission lines, compared to 2015, came after the correction of data in the database, and after receiving the technical permit for the OHL 458 and 459 SS Đerdap 1 - HPP Đerdap 1. In line with the Energy Law [1], the handover of overhead lines and cables 110 kV between EMS JSC and PE EPS which started in 2013 is still ongoing. There is one overhead line left to be handed over and all cable lines 110 kV which are still owned by EPS Distribucija.

Table 6: EMS JSC facilities [24]

Facilities owned by EMS JSC		2013	2014	2015	2016
400/x kV	Number of facilities	16	17	18	18
	Number of transformers	23	24	29	29
220/x kV	Number of facilities	14	14	14	14
	Number of transformers	31	31	30	30
110/x kV	Number of facilities	6	6	6	6
	Number of transformers	13	13	14	14
Total	Number of facilities	36	37	38	38
	Number of transformers	67	68	73	73

Table 7: EMS JSC transmission lines [24]

Power lines owned by EMS JSC		2013	2014	2015	2016
400 kV	Number of OHL	32	33	34	34
	Length of OHL (km)	1,613.72	1,613.72	1,630.04	1,629.4
220 kV	Number of OHL	48	48	46	46
	Length of OHL (km)	1,884.47	1,884.47	1,845.51	1,844.59
110 kV	Number of OHL	332	341	353	359
	Length of OHL (km)	5,578.68	5,641.47	5,785.78	5,821.29
< 110 kV*	Number of OHL	15	12	12	11
	Length of OHL (km)	245.50	235.03	231.85	220.62
Total	Number of lines	427	434	445	450
	Length of lines (km)	9,322.37	9,374.69	9,493.18	9,515.90

*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 EPS Distribucija there are 34,877 transformer stations with a total installed capacity of 30,027 MVA and 160,881 km of power lines of all voltage levels. The process of taking ownership of the transformer station 110/X kV/kV from EMS JSC ended in 2015, for 52 of the 53 stations for which the takeover process was initiated. EPS Distribucija is now committed to maintain these facilities.

Most of the 110 kV overhead lines has been transferred into the ownership of EMS JSC during the establishment of this enterprise in 2005. In accordance with the Energy Law [1] all underground cables are submitted to EMS JSC and this process is ongoing [24].

Table 8: EPS Distribucija facilities [25], [26]

Facilities owned by EPS Distribucija		2013	2014	2015	2016
110/X kV	Number of facilities	177	186	183	187
	Installed capacity [MVA]	9,476	10,388	10,326	10,623
35/10 kV	Number of facilities	589	589	583	581
	Installed capacity [MVA]	6,313	6,313	6,439	6,446
20/0,4 kV	Number of facilities	8,044	8,126	11,141	8,344
	Installed capacity [MVA]	3,052	3,087	5,174.0	3,188
10/0.4 kV	Number of facilities	25,542	27,535	26,372	25,765
	Installed capacity [MVA]	9,435	11,209	9,913	9,770
Total	Number of facilities	34,352	36,436	38,279	34,877
	Installed capacity [MVA]	28,276	30,997	31,852	30,027

Table 9: EPS Distribucija power lines [25], [26]

Power lines owned by EPS Distribucija (km)	2013	2014	2015	2016
110 kV	183	151	33.66	33.66
35 kV	6,844	6,830	6,823	6,791
20 kV	9,053	9,251	9,388	9,587
10 kV	30,530	32,349	32,701	32,929
0.4 kV	105,401	109,928	110,919	111,540
Total	152,011	158,509	159,865	160,881

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

3.3.1. Production Maintenance

Determining the required scope and dynamics of the maintenance, starts from the overview of overall state of the plant, analysis and assessment of the degree of realization of the repair and renovation program from the previous period, as well as routine maintenance, the possibilities of providing financial resources and the time required for the preparation and implementation of planned activities, as well as the necessity to satisfy as much as possible electricity demand for the supply and sale purpose from its own capacities.

Besides reconstruction aftermath of the floods from 2014, during 2015 and 2016 is was continued with revitalization and modernization of power system capacities. Maintenance program of electricity and heat production plant included operational maintenance (planned-

preventive and corrective or emergency maintenance) and overhaul (standard, extended and capital).

Through regular operational maintenance, cyclic maintenance with a larger scope of work in the so-called "Capital overhaul", as well as the corresponding investment activities in the existing equipment (the "additional investments") satisfactory level of availability of equipment and facilities is achieved.

In the year of 2015 standard overhauls have been carried out on 13 TPP units, 4 CHP units, and 45 HPP units.

Capital overhaul of TPPs included following activities. At the beginning of 2015 capital overhaul of unit TPPNT A3 has been completed. The unit capacity was increased by 23 MW. Two-thirds of equipment has been replaced. In the same year capital overhaul of unit TPPNT A2 and unit TPP Kostolac A2 has been completed (without increasing capacity). During 2015 and 2016 activities on the construction of unit TPP Kostolac B3 was continued. In the area of hydropower, revitalization of unit no. 5 in HPP Djerdap 1 was completed at the beginning of 2015 (lasting for sixteen and a half months). The unit capacity was increased by 15 MW. Also, during 2015 and 2016 revitalization of unit no. 1 in HPP Djerdap 1 was carried out. In TPP Morava, during five months overhaul in the year of 2015, besides standard activities, large investing activities in the turbo-generating facility were conducted. The most significant event in the area of hydropower is the revitalization of HPP Zvornik, begun in 2015. Works at each of four units are going to last 12 months and will be completed within four years. The value of revitalization is 70 million €, financed by the loan of German development bank KfW. After revitalization total capacity of units will be 125.6 MW, what represents 30% more compared to the actual total capacity of 96 MW. The first unit that will be revitalized is unit no. 1.

In the year of 2016, standard overhauls, overhauls of medium scope and capital overhauls were done. In the thermal sector, standard overhauls have been carried out on 13 coal-fired TPP units and on three CHP units. Medium scope overhauls were carried out in unit TPPNT A1 and unit TPP Kostolac B1. Capital overhauls were conducted in TPP Morava (without increasing capacity) and unit TPPNT B2. Capital overhaul with a capacity increase by 29 MW was carried out on unit TPPNT B2, in the period from 7th May until 11th November, 2016 (188 days). This overhaul included extensive works on boiler and turbine facility, installation of new metering and control system, generator stator and rotor replacement with an installation of new technology for generator temperature measurement, works on substations of voltage level 6.6 kV and 0.4 kV, etc. Works on TPP Morava was done in the period from 28th February until 25th August, 2016 (184 days in total). Major works were conducted on boiler and turbine facility. It is necessary to emphasize the construction of brand new electrofilter with particle emission below mg/Nm³.

Considering the hydro sector, the most significant works during 2016 were following activities: continuation of works on the fourth stage of revitalization in HPP Djerdap 1 (unit A1), completion of the first stage of revitalization in HPP Zvornik (unit A1 finished 24.12.2016 – the unit capacity was increased by 7 MW), commencement of the second stage of revitalization in HPP Zvornik (unit A2 started revitalization process at 27.12.2016 – with expected increasing capacity by 7 MW), capital overhaul of unit no. 6 in HPP Djerdap 1 (lasting for 38 days – without increasing capacity), capital overhauls on units no. 9 and no. 10 in HPP Djerdap 2 (lasting for 103, and 162 days respectively – without increasing capacity). On remaining units (in PE EPS exists 50 HPP units and two pumped storage plants Lisina) standard overhaul works were done. There is a delay in the fourth stage of revitalization in HPP Djerdap 1 due to delay in delivery of turbine equipment from the side of a contractor. Planned completion of revitalization of this unit is 30th September 2017. Revitalization is completed, the unit is in operation and next

step is measuring and proving new, increased power, which will be followed, in the documentation declare, a new power unit.

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.

As in previous years, during 2015 and 2016 the focus of works on power lines was regular maintenance, inspections, and overhauls. On power lines of voltage level 100, 220 and 400 kV in 2015 were conducted almost all planned overhauls (approximately 99% of a planned number). Also, inspections and overhauls of OHL 155/2 and OHL 1800 were carried out, which represents problematic part of the route along administrative line with APKM (difficult access to the power line due to minefields). Of all power lines planned for overhaul in 2015 only two were not overhauled (OHL 263AB due to impossibility of getting permission for switching off and OHL 102 AB/2 that has been reconstructed).

In 2015 it was overhauled about 8,080 km of power lines of all voltage levels. From all major works on power lines in 2015 there is a need to stand out construction of OHL 1241 TS Majdanpek 2 - TS Mosna and reconstruction OHL 114/1 and OHL 191/2 on section TS Kruševac 1 - pillar 24, as well and works on dissolution and introduction of power lines in TS Vranje 4 (OHL 168AB) and TS Beograd 20 (OHL 451/1 and 451/2, 129AB, 1239A+1203/1, 1239B+1234, 1240AB).

In 2016 almost all planned overhauls on power lines of voltage level 110 kV and above were conducted (99.95% from planned number). It were carried out all planned power line inspections and overhauls except OHL 1140/2, problematic part of the route along ground safety zone (difficult access to the power line due to minefields), due to impossibility of getting consent for work.

In 2016 it was overhauled 7,725 km of power lines in total. Of major works on power lines in 2016 works were conducted on dissolution and introduction of power lines in TS Niš 2 (OHL 1245 TS Niš 2 - TS Prokuplje, OHL 1246/1 TS Niš 2 - TS Niš 8 and OHL 1246/2 TS Niš 1 - TS Niš 8), as well and works on reconstruction of OHL 115/2 TS Čačak 3 - TS Čačak 2).

Besides aforementioned major works during 2015 and 2016 it has been realized several specific works:

- adaptation of 110 kV OHL 133/1 TS Srbobran – TS Bačka Topola and OHL 117/2 TS Beograd 35 (Sremčica) – TPP Kolubara,
- reconstruction of concrete pillars on OHL 106AB, section D and F,
- several adjustments of power lines of voltage level 400 kV, 220 kV and 110 kV with planned highway E-763 and construction of IKEA department store.

Although years 2015 and 2016 from the operation and maintenance point of view were far better comparing to previous 2014, certain different climatic conditions (landslides, storm winds and simultaneous occurrence of snow, ice, and wind) led to damages and accidents on power lines. From the long list of reconstructed power lines aftermath natural disasters, it stands out:

- In January 2015 repairs on OHL 1116 TS Krupanj – TS Osečina and OHL 1176 TS Krupanj – TS Ljubovija were performed.
- During the year of 2015 repairs on OHL 150 TS Bor 1 – TS Majdanpek 1, OHL 177 TS Bor 2 – TS Majdanpek 2 and OHL 128/3 TS Majdanpek 3 – TS Neresnica in the area of Majdanpek and Bor were performed.

- In November 2015 permanent repairs on OHL 110 kV no. 106A/3 TS Loznica – HPP Zvornik and no. 106B/3 TS Osečina – HPP Zvornik were performed.
- In August 2016 a repair on OHL 100 kV no. 1012/1 TS Bajmok – TS Sombor 3 was performed.
- In October 2016 a permanent repair on OHL 110 kV no. 128/4 TS Neresnica – TS Petrovac was performed.
- In February 2016 a repair on OHL 150 TS Bor 1 – TS Majdnapek was finally performed after a severe damage in the month of December 2014.

Operational readiness of transformers and high-voltage equipment was at a high level during 2015 and 2016. Apart from standard regular operations, during 2015 the reconstruction of TS 220/110/35 kV Beograd 5 was continued, while a new transformer with the power capacity of 400 MVA was installed and two new transformer bays were equipped in TS 400/220 kV Obrenovac. In 2015 the installation of the second 400/110 kV transformer in TS Leskovac 2 was completed and a new 400 kV transformer bay was equipped. The second transformer was installed and commissioned in TS Jagodina 4. The most important event in this field is the commission of newly constructed transformer station TS 400 kV Beograd 20, which has significantly improved the security of the transmission system and the reliability of supply in the region of Belgrade.

In 2016 the reconstruction of a series of transformer stations from the previous period was continued and the reconstruction of several new SS and TS began as well. During this period, the planned and emergency replacements (two planned and two emergency replacements) of transformers were conducted.

3.3.3. *Distribution System Maintenance*

During 2015, the technical documentation for rehabilitation of eight TS, selected as the most critical ones, was done. For five out of these eight TS 110/X kV TS (Petrovac 1, Šabac 1, Aleksinac, Gornji Milanovac and Lešnica), funds for rehabilitation were provided through the World Bank loan. The rehabilitation of the aforementioned TS is ongoing and expected to be completed in the first half of 2017. The rehabilitation of the remaining three TS (Niš 1, Zrenjanin 1 and Beograd 2), which is planned to be financed from the own funds of PE EPS, has not begun yet.

During 2016, the process of rehabilitation of the next group TS 110/X kV, which were taken over from EMS JSC in 2013, was continued by announcing of public procurements for the development of investment-technical documentation and feasibility studies for the following TS 110/X kV: Raška, Bor 1, Kuršumlja, Požarevac 1 and Beograd 10.

Apart from aforementioned rehabilitations, a series of other significant operations and activities was conducted during 2015 and 2016, as well. The regular overhauls on TS and power lines of all voltage levels were carried out. Apart from regular overhauls of electrical facilities, the network capacity was expanded through the reconstruction of existing and the construction of new facilities [25], [26].

During 2015, the installed capacity of the 110 kV network was increased by 74.5 MVA by increasing the capacity of existing transformer stations (the installation of new and replacement of existing transformers). At the medium voltage level, the construction of 323 new transformer stations increased the installed power capacity of the facilities of this category by 131.18 MVA. Also, in 2015 the length of the medium voltage distribution network was increased by 329.55 km, while the low voltage network was increased by 455.34 km during the same period.

Among the most important new elements of the distribution system that were commissioned in 2015 are next transformers: 110/20 kV with the power capacity of 31.5 MVA in the transformer bay T-102 in TS 110/20 kV Pećinci, transformer 110/20 kV with the power capacity of 31.5 MVA in the transformer bay T-101 in TS 110/20 kV Rimski Šančevi, transformer 110/35 kV with the power capacity of 31.5 MVA in the transformer bay T-101 in TS 110/35 kV Čačak 1 and transformer 110/35 kV with the power capacity of 20 MVA in the transformer bay T-102 in TS 110/35 kV Krupanj.

During 2016, four new transformer stations at the 110 kV voltage level were constructed, which increased the installed capacity of this part of the system by 163 MVA. At the medium voltage level, 238 new transformer stations, with the total installed capacity of 106.88 MVA, were constructed. The total length of the medium voltage distribution network constructed in 2016 was 217.46 km, while the low voltage network was increased by 180.93 km during the same period.

The most significant new elements of the distribution system that were commissioned in 2016 are four new transformer stations, namely TS 110/35 kV Mosna with the power capacity of 20 MVA, TS 110/35/20 kV Ljig with the power capacity of 31.5 MVA, TS 110/20/35 kV Vladimirci with the power capacity of 31.5 MVA and TS 110/10 kV Beograd 41 with two transformers of the total power capacity of 80 MVA, each transformer with the power capacity of 40 MVA.

The significant investment into the distribution system automation at all voltage levels over the last several years has led to the considerable increase in the number of facilities and elements of the distribution system included in the remote monitoring and control systems (RMC). At TS 110/X kV, as the most important elements of the distribution system, out of the total of 187 facilities from this category, 175 are included in RMC, and it is expected that the remaining 12 TS will have been adjusted and included in the aforementioned system by the end of 2017. As for TS 35/X kV and switching stations, 304 out of the total 577 are included in RMC. The process of automation of the elements of the remaining part of the distribution system within the EPS Distribucija is in a considerable progress as well, so that 966 different elements/facilities (TS 20(10)/0.4 kV, reclosers and busbar sectionings), which are distributed through the network, are currently included in RMC.

The activities related to the taking over of the metering devices and switchboards in the facilities of the existing customers or producers connected to the distribution network, are ongoing and described in detail in Chapter 3.7.3.

3.4. Security Assessment of Transmission and Distribution System Operation

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 [14]:

- 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.

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. Customers "antenna" type in which this criterion is not fulfilled are mostly in rural and mountainous areas at the distribution level.

Indicators of discontinuity in delivery within the transmission network calculated in such a manner for the period 2013 - 2016 are given in Table 10.

Table 10: Indicators of discontinuity in delivery within the transmission network in the period 2013 – 2016 [14], [15]

Interruptions		Power failure – undelivered power [MW]	ENS [MWh]	ENS [%]
2013	Planned	161	618	0.002
	Unplanned	1,770	747	0.002
	Total	1,931	1,365	0.004
2014	Planned	115	110	0.0003
	Unplanned	1,905	3,496	0.0104
	Total	2,020	3,605	0.0107
2015	Planned	359	1,543	0.0046
	Unplanned	2,292	1,659	0.0049
	Total	2,351	3,202	0.0095
2016	Planned	167	547	0.0016
	Unplanned	1,693	1,317	0.0039
	Total	1,860	1,864	0.0055

The value of undelivered electricity during 2015 was significantly greater compared to several previous years. The main cause is primarily a great disturbance in TS Beograd 5 (September 2015), when during the construction, the outage of the whole substation occurred. Also, some other significant reasons are disorders caused by extreme storms in western Serbia during the month of March (snow, ice rain, wind) as well as long-term interruption of TS Ljubovija due to the failure of radial on radial OHL 1176 (March 2015).

In 2016 the value of undelivered electricity are significantly lower compared to 2015, for both planned and unplanned interruptions of supply. The most significant is the reduction of power outages, which lead to the reduction of undelivered electricity caused by planned outages due to planned works on the transmission system, new element connection and overhaul of existing transmission system elements.

In 2015 average duration of unplanned interruption amounted to 25.77 minutes, while planned interruption amounted to 23.97 minutes. Total average duration of supply interruption in 2015 amounted to 49.74 minutes. In 2016 there was a great decrease of average duration of planned interruption, from 23.97 minutes to 8.55 minutes, which represents a reduction of 2.8 times. The average duration of unplanned supply interruption is on the previous year level i.e. amounted to 20.6 minutes. Total average duration of supply interruption in 2016 amounted to 29.15 minutes.

3.4.2. Security of Distribution System Operation

The indicators for the estimation of discontinuity of delivery in the distribution network are the following [14]:

- 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 11 presents indicators of continuity of supply in the distribution system for the period 2013-2016.

Table 11: Indicators of continuity of supply in the distribution system [11], [26]⁴

SAIFI	2013	2014	2015	2016
Total	8.78	10.53	9.25	8.11
Unplanned	6.45	80.09	6.73	6.05
Planned	2.34	2.44	2.52	2.06
SAIDI	2013	2014	2015	2016
Total	723.72	1.283	1.029	810
Unplanned	400.90	850	542	458
Planned	322.83	433	487	352

With indicators of continuity of supply in the distribution system in 2016 in Serbia is achieved better results compared with 2015. The average frequency of unplanned interruptions was decreased (from 6.73 to 6.05 interruptions per average customer), while the average duration of unplanned interruptions was decreased from 543.6 minutes to 416.3 minutes per average customer. The average frequency of planned interruptions was also decreased from 2.52 to 2.06 interruptions per customer), while the average duration of planned interruptions was decreased by 135 minutes per average customer (from 487 to 352 minutes).

In 2016, the share of certain interruption causes within the number and duration of unplanned interruptions was on the level from 2015. The percentage rate of causes is mainly unchanged, but the share of "unknown causes" and "other" continued to decrease, so in 2016 was less than in previous years. This shows that identification of interruption causes is better than before, what allows adequate measures to eliminate the cause of the interruption and reduction of their number and duration.

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 [23].

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, PE EMS 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

⁴ Data for 2013 are taken from AERS documentation [11], and for 2014-2016 from EPS Distribucija documentation [26]. The previous report on security of supply contained data for 2013-2015 that was taken from AERS documentation, so for years shown in both reports (2014 and 2015) the data may vary.

transmission capacity for a predefined border, direction and time period). There are two types of auctions [23]:

- 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 and weekly auctions for 50% of the total available cross-border transfer capacity on borders with Albania, Montenegro and Macedonia. 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 2015 and 2016 in the following manner [27], [24]:

- 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 2015 and 2016 annual and monthly auctions are organized by EMS JSC, and daily 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 and monthly auctions are organized by ESO (Bulgarian TSO) and daily auctions are organized by EMS JSC On Serbia - Bulgaria border intraday capacity allocations were not conducted due to technical problems of the Bulgarian TSO.
- From 2011 joint auctions for transmission capacity allocation are organized on Serbia - Hungary border. In 2015 annual and monthly auctions are organized by EMS JSC, daily auctions by MAVIR ZRt (Hungarian TSO), while intraday capacity allocations are organized by EMS JSC In 2016 EMS JSC was responsible for the organization of explicit daily auctions as well as allocations of intraday cross-border transmission capacity, while MAVIR ZRt was responsible for the organization of annual and monthly explicit auctions.
- From 2014 joint auctions for transmission capacity allocation are organized on Serbia - Croatia border. Annual and monthly auctions are organized by HOPS (Croatian TSO) and daily and intraday auctions are organized by EMS JSC

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.

Activities related to the automation and modernization of distribution network are described in detail in chapter 3.3.3.

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 0.

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, which 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 [1] and the Electricity Transmission Grid Code [8]. 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

In the period from 2015 to 2016, 76 small power plants with a total installed capacity of 50 MW were connected to the distribution network. When it comes to the major projects, the preparations for the unit no. 3 in thermal power plant Kostolac B, 350 MW, were carried out.

3.7.2. Transmission

The Energy Law defines that transmission system operator is obliged to prepare and submit to AERS a ten-year plan for the development of the transmission system of the Republic of Serbia for every year. During 2016, EMS JSC prepared and submitted to AERS the Development Plan of the Republic of Serbia transmission system for the period 2017-2026 which is currently in the phase of adoption.

Core activity of the Investments department in 2015-2016 was the organisation and management of investment construction of new transmission facilities and refurbishment of the existing ones (high-voltage substations and high voltage transmission lines), and/ or other subsystems in EMS JSC as well as expansion, refurbishment and modernisation of the existing subsystems [27], [24].

The most important final operations in this period are:

- Finished TS 400/110 kV Beograd 20.
- OHL 400 kV no. 451 TS Beograd 8 – TS Pančevo 2, introduction into TS Beograd 20.
- Installation of a new transformer in TS Jagodina 4 was completed (300 MVA).
- Reconstruction of 220 kV and 110 kV overhead line on TS Belgrade 5 and TS Belgrade 3 were completed.
- Reconstruction of the range at the Danube crossing on OHL 220 kV no. 253/1 TS Београд 8 – НИП Раћево was completed
- OHL 110 kV Majdanpek – Mosna.
- Installation of a new transformer T3 (400 MVA) in TS Obrenovac was completed as well as a complete reconstruction of SS 400 kV.
- Reconstruction of the 110 kV plant in TS 400/110kV Leskovac 2 was completed with installation of transformer (300 MVA).
- Works on installation of protection and control systems at the TS 220/35 kV Bajina Bašta were completed.

- Works on construction and commissioning of the new section of the double transmission line OHL 110 kV no. 114/1 Kruševac – Dedina were completed.
- Damage repairs of OHL 110 kV no. 150 Bor 1 – Majdanpek 1.
- Complete construction works of 110 kV transmission line for TS Vranje 4 were completed.
- Replacement work of transformer at TS Kraljevo 3 (150 MVA) was completed.
- Replacement work of transformer at TS Beograd 4 (63 MVA) was completed.
- Replacement work of entire high-voltage equipment for three transformer bay in SS Đerdap 1 was finished.
- A new oil pit was built at TS 220/110 kV Beograd 17.
- New 110 kV bay of TS Belgrade 5 for cable line to TS Belgrade 41 was put into operation.
- Reconstruction of all 220 kV long-distance fields at TS 220/110 kV Kruševac 1 was completed.
- Use permit for reconstruction and extension of TS 400/220/110kV Leskovac 2 was obtained.
- Reconstruction of OHL 110 kV no. 154/1 Niš 1 – Niš 2 was finished.
- Replacement of damaged conductors at the crossing of the Sava River on OHL 110 kV no. 104/2 Belgrade 5 - Belgrade 32. The modern solutions and conductor of the improved characteristics were applied.
- Reconstruction, rehabilitation and adaptation of 55 km of overhead lines 2x110 kV no. 106AB Valjevo 3 - Zvornik. Section from TS Loznica to TS Osečina and TS Valjevo 3 has been revitalized.
- Connection of distribution transformer station TS Niš 15 (Doljevac) has been realized, with a degree of completion of 90% in 2016, and it is expected that the project will be completed by the end of 2017.
- Reconstruction of overhead line 2x110 kV Čačak 1 - Čačak 3 was carried out on 70% of the route. Complete completion of reconstruction of OHL 115/3 will be in 2017.
- Complete preparation of documentation for construction of OHL 2x110 kV Bor 1 - Bor 2 and complete connection line for TS Kraljevo 6 (Ribnica) was completed.

Among other investment projects that are in progress, the most important investment and strategic projects for EMS JSC [27], [24] that are stand out are:

- Construction of the first phase of the Trans-Balkan corridor - OHL 2x400 kV Pančevo 2 - Rešica was started.
- Preparatory activities for equipping and reconstruction of OHL 400 kV at TS Pančevo 2 (for the introduction of OHL 400 kV Pančevo 2 - the border of Romania).
- Works on adaptation of TS 400/220 kV Obrenovac, which will continue in 2017.
- Works on reconstruction and extension of TS 220/110 kV Smederevo 3 to TS 400/220/110 kV Smederevo 3.
- Preparatory activities for construction of OHL 400 kV Kragujevac 2 - Kraljevo 3 with equipping of OHL bays to TS Kragujevac 2 and TS Kraljevo 3.

- Preparatory activities for upgrading and reconstruction of TS 400/220/110 kV Kraljevo 3 and TS 400/220/35 kV Bajina Bašta.
- Preparatory activities for upgrading and reconstruction of SS 400 kV Đerdap 1 and reconstruction of TS 400/110 kV Bor 2.
- Preparatory actions on construction of OHL 2x400 kV - connection BiH, CG and RS.
- Preparatory activities and commencement of works on upgrade and reconstruction of TS 220/110/35kV Srbobran in TS 400/110 kV Srbobran.
- Preparatory activities for construction of 110 kV outage and introduction of a 400 kV overhead line in TS Srbobran and introduction of a 400 kV overhead line in TS Smederevo.
- Preparatory activities for construction or reconstruction of OHL 101AB Belgrade 3 - Kostolac, OHL 110 kV no. 148/2 Bor 2 - Zajecar 2, OHL 110 kV Ada - Kikinda 2, OHL 2x110 kV no. 104/5 Indija - Stara Pazova, introduction to TS Krnješevci, OHL 110 kV no. 1127 introduction to TS Kraljevo 6, OHL 2x110 kV Niš 2 - Niš 6.
- Preparatory activities for construction of cable lines for supplying Belgrade waterfront.
- The Government adopted regulations on adoption of spatial plans for special purpose area for OHL 2x110 kV Kraljevo 3 - Novi Pazar 1 and OHL 2x110 kV no. 113/X Niš 1 - Vrla III.

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, EMS JSC from 2015 to 2016 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, and delay is partly due to the reorganization of PE EPS and creation of distribution system operator that was implemented in mid-2015.

Energy Law [1] determines 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 has been fulfilled by distribution system operator and delivered to AERS in 2016. In 2017, AERS council issued a Decision on the approval of the plan [28]. Energy Law (Article 404) [1] defines that all these devices should be owned 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 [3].

In order to increase the security of energy supply 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 [25], [26]:

- Completed construction and commissioning of new TS 110/35 kV Mosna (20 MVA).
- Completed construction and commissioning of new TS 110/35/20 kV Ljig (31.5 MVA).
- Completed construction and commissioning of new TS 110/20/35 kV Vladimirci (31.5 MVA).
- Completed construction and commissioning of new TS 110/10 kV Beograd 41 (80 MVA).
- Works on revitalization of five TS 110/X kV taken from EMS JSC (Petrovac 1, Šabac 1, Aleksinac, Gornji Milanovac and Lešnica).
- Installation of new power transformer in TS 110/20 kV Rimski Šančevi (31.5 MVA) was completed.
- TS 110/35/10 kV, 31.5 MVA Kopaonik was constructed with the upgrade of 110 kV hybrid bay in TS 110 kV Raška. Waiting for connection.
- Completed works on TS 110/10 kV, 20 MVA Ribnica were finished. Waiting for connection.
- TS 110/35 kV Niš 15 Doljevac, 2x31.5 MW on 110 kV side was reconstructed.
- Installation of new transformer in TS 110/20 kV Pećinci (31.5 MVA) was completed.
- Replacement of 20 MVA transformer was completed with a new unit of 31.5 MVA in TS 110/35 kV Čačak.
- Construction of 561 transformer stations on the medium-voltage level was completed, with total installed capacity of 238.06 MVA.
- Construction of 547.01 km of medium-voltage distribution network was completed.
- Construction of 636.27 km of low voltage distribution network was completed.

The replacement of meters in the distribution companies with more modern models is planned. PE EPS is preparing a project on the modernisation of the system for electricity distribution and supply so as to provide monitoring, protection and automates optimisation of the work of all system parts and installations between system users, power plants, network and connected facilities. However, there is great delay in project realization.

After the creation of a distribution system operator, the primary goal 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. 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.

With the investment activities in 2015 and 2016 (increased grid capacity, replacement of invalid meters, dislocation of metering points), better control over electricity theft and increasing of the collection rate, the distribution system operators initiated the trend of reduction of energy loss in grids. However, that activities was not sufficient and they did not match the level of losses and the need to cut the losses to an acceptable level in technical terms.

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

In 2015 total gross electricity production reached the value of 38.3 TWh (71% from TPP and 28% from HPP). In 2016 is produced 39.3 TWh of electricity, while production from HPPs was increased for 0.737 TWh, and production from TPPs approximately on the level from 2015. CHP plants, as a rule, were in operation in accordance with heating need in winter period and they produced almost triple more electricity compared to the value from 2015.

Production from small power plants connected to a distribution network is relatively small, but due to a connection of new capacities, regardless of hydrological conditions variation, production increases from year to year. Production from these power plants in 2016 amounted to 492 GWh, what is about 49% more comparing to value from 2015 (330 GWh).

Due to the electricity market opening, the participation of more suppliers in the market is more active, so that the volume of cross-border trade in electricity is also increased. In 2016 in Serbia was imported 5,068 GWh (with transit), and exported 6,990 GWh (with transit).

End customer electricity consumption in 2016 reached the value of 27,466 GWh, what is 393 GWh more than in 2015 (27,073 GWh).

Table 12 presents electricity balance in the Republic of Serbia for the period from 2013 until 2016.

Table 12: Balance of Electricity from 2013 to 2016 [19], [20], [21], [22]

	2013 [GWh]	2014 [GWh]	2015 [GWh]	2016 [GWh]
Gross production	39,877	34,061	38,299	39,343
Hydro power plants	10,852	11,617	10,783	11,520
Thermal power plants	28,620	22,073	27,133	27,191
Combined heat and power plants	202	75	53	140
Other power plants	202	295	330	492
Total import (including transit)	4,077	7,008	6,303	5,068
Total export (including transit)	6,614	5,445	7,221	6,990
Losses	5,500	5,163	5,169	4,808
Consumption in the energy sector including own use of TPP and HPP	4,937	4,302	5,138	5,146
Hydro power plants	60	90	86	91
Pump	1,007	898	1,090	1,029
Термоелектране	2,581	2,017	2,529	2,565
Combined heat and power plants	42	22	18	25
Industrial plants	25	32	26	33
District heating plants	170	80	97	84
Oil and gas production	234	82	93	91
Refineries		236	257	243
Coal mines	604	541	570	600
Coal transformation	214	217	282	313
Other		87	90	72
Energy available for final consumption	26,903	26,158	27,073	27,466
Final consumption	26,903	26,158	27,073	27,466
Industry+Construction	7,079	7,156	7,423	7,864
Transport	478	336	351	352
Households	14,146	13,802	14,062	13,931
Agriculture	301	298	317	313
Other users	4,899	4,566	4,920	5,005

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.

As it will be analyzed in more detail later, some of the oldest thermal power plants with low efficiency and significant emission of hazardous gases will be withdrawn.

According to Strategy [2] and Program [3], it is foreseen construction of larger number of wind power plants, hydro power plants, and combined heat and power plants. From the other side, increased construction of renewable energy sources can help to certain extent in satisfaction of future electricity needs.

Modernization and revitalization of existing hydro and thermal plants will enable greater flexibility of their work and increase of electricity production.

The aforementioned activities are expected to provide for the fulfillment of future electricity needs in the medium term (see sections 3.3.1, 3.10 and 3.13).

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. For assessment of

production adequacy in the Republic of Serbia EMS JSC has so far used the modified methodology of the ENTSO-E (for making the long-term reports of adequacy) [29].

Regulation (EC) no. 714/2009 [30] defines, among other things, the obligation to create an SO&AF (Scenario of Outlook and Adequacy Forecast) of the report every two years, but due to practical needs, this report is made every year. It is a follower of previous reports: UCTE System Adequacy Forecast (UCTE System Adequacy Forecast) and ETSO Adequacy (ETSO Power System Adequacy). In the second half of 2016 there was a change and SO&AF reports were replaced by MAF (Mid-term Adequacy Forecast) reports. The Mid-term Adequacy Forecast (MAF) is a Pan-European assessment of the risks to security of supply and the need for flexibility over the next decade. The methodology used by ENTSO-E takes into account transformation of the power system with increasing variable generation from renewable energy sources. It emerged in 2013 as a result of the recommendation of the Electricity Coordination Group (ECG) for ENTSO-E to update their adequacy methodology and assessments to better account for the risks to security of supply and the need for flexibility as the Pan-European power system moves towards higher levels of renewable energy sources (RES). These improved assessments should also help highlighting the contribution of electricity interconnectors to national adequacy at times of potential scarcity.

The MAF presents the first Pan-European probabilistic assessment of adequacy. While market-based probabilistic modelling approaches have already been adopted in some national generation adequacy studies and regional adequacy assessments, this is the first time such studies have been conducted at the Pan-European level. This is a significant analytical achievement and it is based on extensive cooperation between representatives of TSOs covering the entire Pan-European region under the coordination of ENTSO-E.

MAF 2016 represents an important milestone in the development of probabilistic market modeling for adequacy assessments and there are many improvements, such as:

- The study involves the whole Pan-European perimeter including Turkey.
- The results are compared by calibration of four different analytical tools, which also take into account regional differences in power systems across Europe. This increases the consistency and robustness of the complex analytical results presented in the report, and helps to improve the links between the MAF and the regional/national adequacy studies.
- Significant technical development is also important, which enabled the adjustment of the analysis to the specific requirements of different regions in Europe. This includes:
 - an advanced temperature-sensitive load model;
 - harmonised probabilistic hydrological analysis with data sets for extended dry and wet hydro conditions;
 - forced outage rates (FOR) for thermal units as well as on HVDC links.

ENTSO-E has developed consistent bottom-up scenarios for European energy systems in 2020 and 2025. The scenarios are designed to assess adequacy, based on key metrics such as energy not-served (ENS) and loss of load expectation (LOLE), and considering the role of interconnection as well as cross-border exchanges. The analysis has been carried out on data collected from all transmission system operators within the Pan-European perimeter based on the principles established by ENTSO-E.

Probabilistic simulations are needed to explain all possible combinations of uncertainties which the electric power system will face in the future. It is also important that these combinations account not only for the average conditions of the system but, even more importantly, also for the most extreme conditions which typically will push the power system to a stressed situation

(e.g. situations of scarcity). With increased shares of variable RES in the system, the most critical situations may occur in the future at times other than peaks in demand. Also seasonality/climate factors should be properly considered in different combinations, namely: low temperatures leading to high demand in winter (or high temperatures leading to high demand in summer) combined with dry years, low precipitation, leading to scarcity of water in hydro reservoir, etc. Probabilistic methods use climate databases to assess the variability of RES production as well as the seasonality of demand, hydro production and thermal production availability. A simulation of a given hour of the interconnected Pan-European power system is performed by combining load \times RES \times hydro \times thermal \times cross border capacity factors.

For each future scenario of installed capacities of the Pan-European power system (2020 and 2025 scenarios) a systematic combination of all uncertainties is performed to setup the hourly simulations of the interconnected Pan-European system. A number N of simulation runs for each scenario 2020 or 2025 is performed by considering combinations of: 14 wind – photovoltaic (PV) – temperature climatic year situations \times between 3 and 6 hydrological yearly situations depending on the region \times 200 \div 300 situations for random outages samples of thermal units and HVDC links. This means that for each scenario 2020 or 2025 and each of the N simulation above, hourly simulations of the whole interconnected Pan-EU perimeter are performed, which result in 8760 hours – variables calculated for each simulation run. For each hour of these simulations, a value of ENS is calculated. This value can be either zero or different than zero, which indicates a problem. Each value that arises is counted and stored. This number divided by the total number of simulations gives an indication of the probability occurrence of this value of ENS. Bookkeeping of the number of counts of ENS allows us to construct the so-called Probability Distribution (PD) function. Most of the time, the value of ENS will be zero, meaning the system is adequate. However due to the large number of possibilities considered, different sets of hours with different values of ENS are found. A very large value of ENS appears in a small number of hours, and these are situations where the system can face severe power shortages.

Since a large set of data is concerned, it is also necessary to "extract" the most important values. Therefore, the following values are calculated:

- Average (mean) value – This is the average value of ENS calculated as $ENS = \sum ENS / \sum simulations$.
- Median value (P50) – This is the value of ENS for which there are equal number of simulations reporting $ENS > P50$ or $ENS < P50$ ($ENS < P50\%$ or $ENS > P50\%$ 50% of the times).
- "1-in-20 years" (P95): This is the value of ENS for which 95% of the values found are lower than P95 ($ENS < P95\%$ 95% of the times). Only 5% of values found are higher than this value. P95% gives a measure of high values of ENS which are likely to occur with very low but still finite probability of occurrence. P95 gives a measure of the 'low probability – high impact: worst case 1-in-20 years' situation observed.

Three simulations runs have been defined in MAF 2016:

- Base case: Day-ahead adequacy. Operational reserves do not contribute to adequacy.
- Sensitivity Case I: Day-ahead adequacy + operational reserves contributing to adequacy ~ "real time" adequacy
- Sensitivity Case II: Sensitivity Case I + HVDC forced outages.

The report [31] provides a tabular overview of the values for Energy Non-Served (ENS) and Loss of Load Expectation (LOLE) found for several countries within the Pan-European perimeter and within the different simulations performed for year 2020. Republic of Serbia,

along with some other countries, is not included in this overview, since the simulations showed that no adequacy problems are observed for such country and then values ENS and LOLE should be understood as being zero/negligible.

For the Republic of Serbia, the report [31] stated the following conclusions:

- Load and annual demand forecast provided for 2020 and 2025
In the period 2016-2020 an increase of electricity demand is estimated with an average annual rate of 1.23 %, corresponding to consumption of 41,7 TWh in year 2020. Forecast of the annual demand increase is around 1.1 % for the period 2020-2025 and amount to consumption of 44,1 TWh in 2025.
- Net generating capacity forecast provided for 2020 and 2025
The increase of the capacity from renewable sources is expected to come primarily from wind power, reaching around 1000 MW until 2025. The net generating capacity of TPP on fossil fuel is expected to decrease, mainly because of the Industrial Emissions Directive and Large Combustion Plant Directive of EU.
- National view on Generation and System Adequacy forecast for 2020 and 2025 and its relation to the MAF results
- National adequacy analysis, shows that no problems are expected in the period till year 2025. This results can be proven by the results of particular MAF probabilistic simulations, and confirmed by adequacy indicators (ENS and LOLE).

The additional tables in the report include the expected production capacities in the Republic of Serbia for 2020 and 2025 (Table 13).

Table 13: Net generating capacity [31]

Expected Progress 2020 [MW]									
Nuclear	Lignite	Hard coal	Gas	Oil	Other non renewable	Wind	Solar	Other renewable except for hydro	All hydro
0.0	5,567.0	0.0	593.0	0.0	0.0	530.0	20.0	0.0	3,142.0
Expected Progress 2025 [MW]									
Nuclear	Lignite	Hard coal	Gas	Oil	Other non renewable	Wind	Solar	Other renewable except for hydro	All hydro
0.0	4,645.0	0.0	631.0	0.0	0.0	1,060.0	95.0	0.0	3,086.0

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 committed, 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 countries 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.

In order to implement the mentioned directive and ensure the realization of the goals defined by the Strategy [2] and the Program [3] in the period 2017-2023 the construction and entry into operation of several larger production capacities is planned. Outage of thermal power plants that are at the end of the exploitation period, as well as the installation of desulphurization facilities, flue gas denitrification and high efficiency electrofilter in existing thermal power plants is also planned.

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, Kosava and Kostolac), the CHP Pančevo (installed capacity of 140 MW and an annual production of 910 GWh) and unit B3 in the TPP Kostolac B with installed capacity of 350 MW and an estimated annual production of 2,200 GWh is planned in the period from 2017 until 2020. Production from these new capacities should increase total estimated electricity production for 4,427 GWh. In this way, the production from the plant with 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. The project also includes the extension of the Drmno surface mine, that is, the increase the coal production from 9 to 12 million tons per a year. The value of the TPP Kostolac B3 project is 715.6 million \$ (about 81,100 million of RSD). 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 project value is provided from the funds of PE EPS (15%). The deadline for realization of the project is 58 months. TPP Kostolac B3 unit meets all environmental protection standards prescribed by the laws of the Republic of Serbia. The realization of these construction is of great importance for the development of the energy sector of the Republic of Serbia due to the reliable and secure supply of energy products and energy as well as the establishment of conditions for reliable and safe operation and sustainable development of the energy sector in general. All that directly affects the competitiveness and export ability of the Serbian economy.

In addition to the construction of new capacities, the continuation of the hydro power plants revitalization with the increase of the power delivered to the transmission system is planned: the aggregates G1, G2 and G3 in HPP Đerdap 1 with new installed power of 3x205 MW, aggregates G2, G3 and G4 in HPP Zvornik with new installed power of 3x31.4 MW and G1, G2 and G3 aggregates in HPP Potpeć with a new installed power of 3x19 MW with the installation of a new G4 power unit of 13 MW. In addition, it is planned to revitalize aggregate A4 in the TPP Nikola Tesla A with the increase of the installed capacity from 308.5 MW to 335.3 MW, the A1 and A2 generators in HPP Bistrica with the new installed power of 2x57 MW and the aggregates in the HPP Vlasina with a new installed capacity of 137 MW (the total installed capacity increase of 8 MW).

It is planned that reconstructed and new production units should be realized using modern technologies that provide optimal level of energy efficiency in the electricity generation sector. They would replace the old, energy-inefficient thermal units that are getting out of operation.

The outage of eight thermo-units of total balance power of 622 MW and production of about 1,717 GWh is planned by the end of 2023 (for Kostolac A1 additional analyzes will be done on the cost-effectiveness of outage/reconstruction). This means that by the end of 2023 additional electrical energy in the amount of about 2.71 TWh would be provided from domestic sources, with the production from new TPP and CHP completely replacing production from outaged TPP and CHP, thereby it would be possible to fulfill two strategic goals of the Republic of Serbia in the field of electricity: ensuring the safe supply of electrical energy to the domestic market and creating opportunities for net electrical energy export.

The outage of the eight mentioned thermo units is consequence, in addition to their age (valid for units A1 and A2 in TPP Kolubara A which will be operational only by the end of 2017), and the need to meet the requirements of the Regulation on limit values for emissions of air pollutants from combustion plant (Official Gazette of the RS, no. 6/16) [32], that is, the implementation of the power plant limited operation mechanism (20,000 hours in the period 2018-2023). In order to improve protection of environment in the fossil fuel production sector, it is planned that emissions of sulfur dioxide, nitrogen oxides and powdered substances are reduced to the prescribed emission limit values defined by the mentioned regulation [32]. Emissions reduction to the prescribed limit values is part of the National Plan for the reduction of emissions, which is the result of the aforementioned Decision of the Ministerial Council of the European Union D/2013/05/MC-EnC and D/2013/06/MC-EnC. The implementation of the National Emission Reduction Plan is foreseen in the period 1st January, 2018 – 31st December, 2027.

The implementation of the projects for the construction of the flue gas desulphurization plant on units A3-A6 at TENT A, preparatory activities for reduction of nitrogen oxides to TENT A4, and construction of plants for waste water treatment in TENT A and B are in progress. Emission reduction facilities will, due to their own consumption, cause a reduction in the available power at the transmission threshold by a maximum of 2% in relation to the available power. Although these plants have an impact on the reduction of available energy for placement in the transmission system, this impact is not crucial for the balance of electricity, as in the case of capital remotes in the period to the end of 2023.

The program [3] predicts the realization of thirteen projects with aim to reduce the emission of toxic gases SO₂ and NO_x, reducing them to the permitted limits and solving the problem of ash handling, waste storage and wastewater treatment at the locations of individual production capacities in PE EPS. The mentioned projects should contribute to ensuring the security of electricity supply (because it allows the maintenance of the existing production capacities in the operation) and the development of the energy market (since it enables the placement of energy from PE EPS's power plants to the regional market, while the necessary conditions in terms of environmental protection is provided).

The total estimated value of the projects is 535.7 millions € and includes the reduction of SO₂ and NO_x emissions in the TPP Nikola Tesla A (unit A1, A2 and A6), TPP Kostolac A (units A1 and A2), TPP Nikola Tesla B (units B1 and B2), TPP Kostolac B (unit B2), new ash handling system in TPP Nikola Tesla A, adaptation of landfill in accordance with the EU Directive for landfill in TPP Nikola Tesla A, TPP Nikola Tesla B, TPP Kolubara A and TPP Morava and the construction of the waste water treatment plant in TPP Kostolac A, HPP Đerdap (eight locations) and HPP Drinsko-Limske (eight locations).

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

Development of transmission capacities includes revitalization 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.

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 110 kV network in order to ensure a secure supply of transmission system users. 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 110 kV power lines which are at the end of their life cycle, as well as the construction of new lines which solve the problems of unsecure, a radial supply of individual substations 110/X kV.

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) 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 Resita - 65 km, 25.6 millions € (own funds EMS JSC);
- Construction of single 400 kV OHL TS Kragujevac 2 - TS Kraljevo 3 - 60 km, 29.6 millions € (eight millions € own funds EMS JSC, 6.6 millions € donations from WBIF, 15 millions € credit from KfW);
- Construction of double 400 kV OHL TS Obrenovac - TS Bajina Bašta - 111 km, 66.75 millions € (pre-accession EU funds);

- Construction of regional 400 kV interconnection Serbia - Bosnia and Herzegovina - Montenegro through construction of double 400 kV OHL TS Bajina Bašta - TPP Pljevlja - HPP Višegrad with possible prospective connection of RHPP Bistrica - 84 km, 41.8 millions € (pre-accession EU funds).

The "Trans-Balkan corridor - Phase 2" includes a number of projects for construction of new 400 kV power lines. Only after the completion of the first phase, based on the completed planning and technical documentation, decision will be made on the priorities of projects under Phase 2.

It is planned that the construction of sections 1 and 2 of Phase 1 of the project will be completed by the end of 2023, and construction of sections 3 and 4 of the same phase, subject to provision from sources of funding for these two sections.

For one section of phase 2 of the project, the preparation of prefeasibility study is on-going, therefore there are still no available data on the final technical characteristics and effects of power line construction.

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 40 kilometres of 110 kV OHL by the end of 2023, that is, a total of 280 kilometres during Program implementation [3].

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

Basic function of the planned projects in the field of electricity distribution is to increase the level of reliability of power supply of electricity customers, reduce the losses of electricity and optimize the use of the distribution network [3].

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 "Improving metering infrastructure" 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 277 million €.

The aim of the project "Improvement of metering infrastructure" 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 project is being implemented in phases, through the replacement of electric meters and implementing the system in areas where advance preparation and screening of the existing situation is carried out. Currently, documentation has been prepared and made available for replacing indirect, semi-indirect and direct metering groups in the area of a complete distribution network and the replacement of the meters for a total of about 50,000 households and 25,343 indirect metering group that will be incorporated into the TS X/0.4 kV. Also, the documentation was prepared for

the implementation of an information system that will allow remote reading, load management and use of data obtained in this way.

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. By the end of 2023, the reconstruction of 28 TS 110/X kV is planned to be completed, the reconstruction of three TS 110/X kV (Paraćin 3, Čićevac and Kuršumljija) is planned to be underway and necessary spatial planning and technical documentation for three TS 110/X kV (Ristovac, Pirot 2 and Vlasotince) is planned to be prepared. The reconstruction of other mentioned TS (older than 40 years), which is necessary in order to increase safety of operation and security of supply and increase the efficiency of the distribution of electricity at 110 kV voltage level, will start after 2023.

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 that the construction of 32 TS 110/X kV will be completed and that the required spatial planning and technical documentation will be prepared by the end of 2023. It is also planned that the licenses for three TS 110 / X kV (Boljevac, Leskovac 5 and Stara planina) will be provided by the end of 2023.

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 [33]. 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 and actions 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 actions in the Republic of Serbia is an obligation defined by the Energy Law [1], Strategy [2] and the Program [3].

All national goals, activities and measures in the energy sector are fully in line with the objectives of regional energy strategy and European Union strategy, which implies creating a competitive and integrated energy market, attracting investment in the energy sector and

ensuring safe and sustainable energy supply. If we want to highlight the key elements of sustainable development in Republic of Serbian energy market, these are: energy efficiency, renewable energy sources and environmental protection and reduction of impacts on climate change.

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. Some sections of the project are currently being built, with some in process of preparation of spatial planning and technical documentation, and for some this development has yet to begin, which facilitates the possibility of financing and realization of project itself. The project "Trans-Balkan corridor" is included in Single Project Pipeline, Projects of Energy Community Interest (PECI), 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 163.75 millions €.
- The project of construction of new thermo-unit in TPP Kostolac B3 (installed capacity of 350 MW), with expansion of existing mine, according to all EU standards for environmental protection. Power placement of new B3 unit into transmission system of electrical energy will be carried out through the existing 400 kV switching station located in immediate vicinity of new unit. The value of the project TPP Kostolac B3 is 715.6 million \$ and completion period is 58 months. The project is financed from two sources: 85% of the project will be funded by a loan from the Chinese EKSIM bank under preferential conditions approved by the government guarantee, and the residue is provided from the PE EPS (15%). Preparation of project documentation is on-going [34].
- 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. For most subprojects technical documentation is prepared, or in the final stages, and for all power plants awarded with the temporary status of privileged producers construction permission was issued. Construction of the first wind farms is expected to begin during 2017. Estimated investment of project is about 706 millions €.
- The project of environmental protection in the sector of the electricity production from EPS's power plants. The project includes thirteen subprojects intended for reduction in emissions of harmful gases SO₂ and NO_x, their reduction in permissible limits, resolving the problem of ash handling, waste storage and treatment of waste water in locations of particular generating capacity in EPS. For some sub-projects planning and technical documentation is prepared, while for some is in the preparation phase. Estimated investment of project is about 535.7 millions €.

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

- The project of construction of TPPNT B3 installed capacity for 750 MW. Main objective of this project is the response to the increase in electricity demand in Serbia and region. Estimated investment of project is about 1.6 billions €.
- The project of construction of TPP Kolubara B installed capacity for 2x375 MW. It is expected that in the coming years the existing lignite TPP will be reconstructed before the end of its technical life. Together with renewable energy sources, lignite thermal power plants can achieve the goals of European Union in order to preserve the environment, with security and competitiveness. Estimated investment of project is about 1.5 billions €.
- The project of construction of TPP Novi Kovin installed capacity for 2x350 MW. Estimated investment of project is about 1.33 billions €.
- The project of construction of TPP Štavalj installed capacity for 300 MW. Estimated investment of project is about 700 millions €.
- The project of construction of new thermo-unit in CHP Novi Sad installed capacity for 340 MW. The new Thermo-unit is part of the existing TPP Novi Sad for the production of electricity and heat. Estimated investment of project is about 400 millions €.
- 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 billions €.
- The project of construction of HPP Velika Morava installed capacity for 147.7 MW. Estimated investment of project is about 360 millions €.
- 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 millions €.
- 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 millions €.
- The project of construction of PSHPP Đerdap 3 installed capacity for 2x300 MW. Estimated investment of project is about 400 millions €.
- 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 millions €.

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 this Law.

Energy-related activities according to the Energy Law [1] in natural gas sector are: natural gas transport and natural gas transport 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 transport and natural gas transport 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 activity of natural gas supply are in accordance to the open market principles.

Energy Agency of the Republic of Serbia (AERS) is the competent body that regulates the price of natural gas for public supply, determines the price of access to the natural gas transport 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: transport and natural gas transport 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.

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 m³ and whose facilities/objects are all connected to the natural gas distribution system. In addition to PE Srbijagas another 32 energy entities have a license to perform activities of public service.

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 for supplier who will perform the last resort supply.

According to the public tender the government assigned PE Srbijagas as a supplier for public suppliers of natural gas. The Energy Law [1] stipulates that until the establishment of a competitive 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

Natural gas buying and selling takes place in the market, and it is based on the contract on the sale of natural gas between market participants. The contract on the sale of natural gas determines the amount of natural gas (can be in advance agreed for each accounting period during the supply period or determined on the basis of actual consumption by the consumer at the delivery point during the supply period, in the case of full supply sale) price and supply period.

Natural gas market participants at the end of 2016 are:

- natural gas producer (1);
- natural gas suppliers (65) of which is active 30 suppliers;
- public natural gas supplier (33);
- supplier of public suppliers (1);
- end customer (265.271 on regulated supply and 923 on free market);
- transport system operator (2);
- distribution system operator (34) of which one operator is not active and
- natural gas storage facility operator (1).

The Republic of Serbia uses natural gas from domestic sources as well as imported gas. The largest deposits of natural gas are located in Vojvodina (Elemir, Kikinda, Mokrin, Velebit-gas dome, Ada, Čantavir, Martonoš, Međa, Itebej, etc.). The capacity of these sites are sufficient to meet between 20 and 25% of the current needs of the Republic of Serbia for natural gas. The only company in Serbia engaged in the exploration and production of natural gas is the "Naftna industrija Srbije a.d. Novi Sad" (NIS JSC). As a part of NIS JSC there is gas refinery in Elemir, whose main activity is processing of domestic natural gas for safe transportation and production of liquefied petroleum gas and light gasoline fraction (C5+). The rest of needs for natural gas Republic of Serbia imports from Russia on the basis of long-term contracts as well as from other sources under other agreements.

The natural gas end-users have the right to choose a supplier on the market, with the right of the households to realize them from January 1, 2015. The supply of end-customers with natural gas can be performed by an energy entity that has a license to perform a supply or public supply activity in accordance with the Energy Law [1]. Supply of end-customers with natural gas can also be performed by an energy entity that carries out the activity of distribution of natural gas if it fulfills the condition that less than 100,000 m³ end-customers are connected to its system. The public supplier is designated by the Government of the Republic of Serbia.

The activity of natural gas transmission and natural gas transmission system management performs the natural gas transmission system operator (TSO). TSO also perform the activities of organizing and administering the natural gas market and perform business operations in accordance with the principles of objectivity, transparency and non-discrimination, observing

conditions prescribed by Energy Law [1] and its by-law regulations. TSO may not purchase or sale natural gas, except in the case of providing necessary natural gas quantities for the first system filling, own natural gas consumption, system balancing and compensation of losses in the transmission system.

TSO is responsible for: safe and reliable operation of the transmission system and quality of natural gas delivery; safe operation of the natural gas transmission system; transmission system management in the manner that will ensure safety of natural gas delivery; development that will ensure long-term capability of the transmission system to fulfil rational requirements for natural gas transmission; coordinated operation of the transmission system with other transmission, i.e. distribution systems and natural gas storage facility; system balancing; non-discriminatory access to the transmission system; accuracy and reliability of natural gas measurement at the points of takeover, into and from the transmission system; arranging and administering the natural gas market.

TSO is obliged to: maintain and develop the transmission system; pass rules on the transmission system operation; adopt a transmission system development plan every year for a period of at least ten years and harmonise it with the plan of development of connected systems and with requests for the connection of storage facilities, producers and customers; adopt the program of measures and prepare the annual report (submit it to the AERS for approval); procure natural gas for the purpose of ensuring safe operation of the system and for the compensation of losses in the transmission system, based on the principles of minimum costs, transparency and nondiscrimination; purchase and sell natural gas for the purpose of system balancing, i.e. balancing of the amount of natural gas taken over, for the needs of users, by the transmission system at the point of entry and delivered from the transmission system at the output point, based on the principles of minimum costs, transparency and non-discrimination; use line-pack for the purpose of system balancing, ensuring system operation safety and compensation of losses in the transmission system; balance the system based on the principles of minimum costs, transparency and non-discrimination; take the prescribed safety measures when using the transmission system and other capacities in the function of the transmission system; decide on the price of access to the transmission system pursuant to this Law; determine the price of natural gas for the needs of system balancing in accordance with regulations on the transmission system operation; not discriminate any transmission system users or groups of users, and particularly not favour energy entities associated with it; provide information to transmission system users for the efficient system access based on the principles of transparency and non-discrimination; ensure confidentiality of commercially sensitive information obtained during performing the activity and publish information that may ensure advantage in the market in a non-discriminatory manner; collect and publish data and information necessary for the fulfilment of prescribed obligations in terms of transparency and supervision of the natural gas market, in accordance with the rules on the natural gas transmission system operation; submit to the end customer or its supplier, upon a request of the end customer, the data on natural gas consumption in the facilities of that customer, in the form and according to the procedure on operation of TSO; determine technical and technological conditions for connecting facilities, devices and plants into a single system; supervise the safety of delivery and supply and submit data for a report on safety of supply to the Ministry in charge of energy; take measures for an increase in energy efficiency and environmental protection; exchange information necessary for the safe and secure system functioning with other system operators; cooperate with other system operators and other relevant stakeholders, aiming at establishment of the regional natural gas market and market liberalization; submit to the AERS the data and documents on prices of non-standard services to which the AERS shall give its consent and which shall be published on the system operator's website, and regulate other matters necessary for the transmission system operation and natural gas market functioning.

The transmission system operator should keep records of transactions in the natural gas market, in a manner and according to the procedure stipulated by the rules on the natural gas transmission system operation.

The activity of natural gas distribution and natural gas distribution system management performs the natural gas distribution system operator (DSO), with rights and obligations stipulated by Energy Law [1].

DSO performs business operations in accordance with the principles of objectivity, transparency and non-discrimination, observing conditions prescribed by Energy Law and its by-law regulations.

DSO is responsible for: safe and reliable operation of the distribution system and quality of natural gas delivery; safe operation of the natural gas distribution system; development ensuring long-term capability of the distribution system to fulfil the needs for natural gas distribution in an economically justified manner; construction of connection to the distribution system; providing information to energy entities and distribution system users that is necessary for the efficient access to the distributions system, based on principles of transparency and non-discrimination; non-discriminatory access to the distribution system; distribution system management in the manner that will ensure safety of natural gas delivery; accuracy and reliability of delivered natural gas measurement.

DSO is obliged to: maintain and develop the distribution system; pass the rules on the distribution system operation; adopt a distribution system development plan every year for a period of at least five years, harmonized with the development plan of connected systems and requests for connection; adopt the program of measures and prepare the annual report (submit it to the AERS for approval); submit the data for the report on safety of supply to the Ministry in charge of energy; issue a decision on the price of access to the distribution system pursuant to Energy Law; publish the prices of connection in accordance with the methodology prescribed by AERS; adopt the plan for reduction of losses in the system if the losses exceed the technically justifiable level; procure natural gas for the compensation of losses in the distribution network, based on the principles of minimum costs, transparency and non-discrimination; not discriminate any distribution system users or groups of users, and particularly not favor energy entities associated with it; provide information to distribution system users for the efficient access to the system, based on the principles of transparency and non-discrimination; ensure confidentiality of commercially sensitive information obtained during performing the activity and publish information that may ensure advantage in the market in a non-discriminatory manner; verify and submit to the transmission system operator the data necessary for administering of the natural gas market, in accordance with the rules on transmission system operation; take prescribed safety measures while using the distribution system; exchange information necessary for the safe and secure system functioning with other system operators; submit to the AERS the data and documents concerning rules of natural gas distribution system operation; take measures for an increase in energy efficiency and environmental protection; and deal with other matters necessary for the distribution system operation and market functioning.

The natural gas distribution system operator may neither purchase nor sell natural gas, except for the purpose of ensuring its own natural gas consumption and for losses in the distribution system.

The activity of natural gas storage and natural gas storage facility management performs the natural gas storage facility operator (SFO). SFO performs business operations in accordance with the principles of objectivity, transparency and non-discrimination, observing conditions prescribed by the Energy Law [1] and by-law regulations.

SFO is responsible for safety and reliability of natural gas injection and extrusion; safe operation of the natural gas storage facility; non-discriminatory access to the storage facility; storage facility management.

SFO is obliged to: maintain and develop the storage facility; take the prescribed safety measures; pass the rules on the storage facility operation; adopt a natural gas storage facility development plan every year for a period of at least ten years and harmonize it with the plan of development of connected systems and with requests for the connection of storage facilities and facilities of producers and customers; adopt the non-discriminatory behavior Program, designate the person responsible for supervision of implementation of this program, and prepare the annual report and submit it to the AERS for approval; manage the facility operation; submit the data for the report on safety of supply to the Ministry in charge of energy; publish the data on available capacities; purchase natural gas for its own consumption and the compensation of losses, based on the principles of minimum costs, transparency and non-discrimination; decide on the price of access to the storage facility pursuant to Energy Law; not discriminate any storage facility users or groups of users, and particularly not favor energy entities associated with it; provide information to storage facility users for the efficient access to the storage facility, based on the principles of transparency and non-discrimination; harmonize the operation and exchange data necessary for the safe and reliable storage facility operation with the transmission system operator; submit to the AERS the data concerning rules of natural gas storage facility system operation; provide the transmission system operator with the data of significance for the natural gas market functioning; ensure confidentiality of commercially sensitive information obtained during performing the activity and publish information that may ensure advantage in the market in a non-discriminatory manner; take measures for an increase in energy efficiency and environmental protection; regulate other matters necessary for the storage facility operation.

The natural gas storage facility operator may neither purchase nor sell natural gas, except for the purpose of ensuring its own natural gas consumption and for compensation of losses in the natural gas storage facility.

The largest economic impact on the natural gas market has a quarterly movement in the purchase price as well as the USD exchange rate. The price of gas has a significant impact on the price of transit through Hungary, which is higher than the current price for domestic users in Hungary, as well as users from Croatia and Romania.

Natural gas market participants regulate their balance responsibility by concluding an agreement on transmission, thus regulating the financial responsibility for the difference between the quantity of natural gas delivered at input points of the transmission system and the quantity taken over at output points of the transmission, i.e. distribution system, for the accounting period. TSO is responsible for the establishment and implementation of balance responsibility of market participants and for keeping the registry of balance responsibility, in accordance with regulations on the transmission system operation and rules on a change of supplier. The supplier is balance responsible for the points of takeover of the end customer that purchases natural gas pursuant to the agreement on sale with the full supply. The data needed for keeping the registry of balance responsibility for the points of takeover in the distribution system is provided by DSO, which should submit them to the TSO. TSO has to provide natural gas for balancing and maintenance of safe system operation, from market participants, by the use of natural gas from the storage facility, as well as from the line-pack.

The activity of natural gas transmission and management of transmission system in Serbia is performed by two TSO, PE Srbijagas and "Yugorosgaz-Transport d.o.o. Niš" (Yugorosgaz-Transport).

At the end of 2014, the Government adopted the Conclusion on the basis for restructuring of PE Srbijagas, which stipulated that the transport and distribution system operators are legally

separate entities from PE Srbijagas. The plan was also harmonized with the Energy Community (EnC), which responded to the invitation of the Ministerial Council of EnC to Serbia in September 2014 to fulfill the obligations from the Agreement on the establishment of EnC related to the separation of the transport system operator.

On June 22, 2015, the Supervisory Board of PE Srbijagas made a decision on the establishment of "Transportgas Srbija d.o.o. Novi Sad" (Transportgas Srbija), as well as the decision on the establishment of "Distribucijagas Srbija d.o.o. Novi Sad" (Distribucijagas Srbija). The Government, at its session held on June 27, 2015, gave its consent to that decision. These companies were established on August 22, 2015 and registered in the register of economic entities as active, but did not start their work. With the Conclusion of November 19, 2015, the Government enabled Transportgas Srbija and Distribucijagas Srbija, to perform activities of general interest transport and management of the transport system and distribution and management of the distribution system under the license of PE Srbijagas until its validity period and recommended that all necessary activities should be undertaken in order to obtain the appropriate licenses as soon as it is possible. Also, with its Conclusion of December 23, 2016, the Government enabled PE Srbijagas to continue independently or through the company Transportgas Srbija to perform activities of general interest in transport and management of the transport system until obtaining a license for the performance of this activity and recommended that to undertake all necessary activities in order to obtain for Transportgas Srbija this license as soon as possible.

Yugorosgaz-Transport is legally separated from "Yugorosgaz a.d. Beograd" (Yugorosgaz JSC) Belgrade, which owned it prior to the adoption of the Energy Law, and was granted a license for performing natural gas transmission and transmission system operation in September 2013, according to the then applicable law. The Energy Law of 2014, in accordance with EU regulations, established three models of organization or separation of the transmission system operator, namely: the transmission system operator according to the ownership split model, the independent system operator and the independent transport operator. Acting in the legal deadline, Yugorosgaz-Transport submitted in August 2016 to AERS a request for certification according to the model of an independent system operator, which, considering the ownership structure of this and parent company, was treated as a requirement for certification of the transport system operator in relation to third countries, in accordance with the Law.

By its decision of December 2016, AERS has conditionally certified Yugorosgaz-Transport as an independent system operator, with the obligation to harmonize organization and business within a year in a way that meets the requirements for the independence of the system operator to the required model, which implies the prior alignment of the confirmed international agreements concluded with the Russian Federation and the EU, or the countries of South-Eastern Europe. Also, the system operator was ordered to submit a ten-year plan for the development of the transport system, a program for ensuring non-discriminatory behavior and an act signed with the owner of the transport system providing guarantees that will enable the financing of the development of the transport system within the same deadline.

In Table 14 is presented natural gas balance for the period 2013-2016.

Table 14: Natural gas balance for the period 2013 – 2016 [21]

Year	2013	2014	2015	2016
(million m ³)				
Total primary production	531.188	557.179	572.502	532.229
Total imported	1,887.422	1,394.574	1,740.221	1,795.226
Stock balance	-72.6	68.8	-114.470	56.85
Energy sector consumption	773.846	856.098	885.174	886.884
Energy sector own use	159.937	183.560	209.707	180.986
Total loss (transmission and distribution)	16.356	18.344	11.433	22.544
Energy for final consumption	1,395.871	962.552	1,091.898	1,284.891

The origin of imported natural gas in 2015 and 2016 were from the Russian Federation, according to longterm agreement. For buyers in Republic of Serbia, natural gas is purchased from Gazprom Moskva by company Yugorosgaz JSC (share holders are Gazprom Moskva 50%, PE Srbijagas 25%, and Central ME Energy and Gas, Vienna 25%).

The only natural gas producer is the NIS JSC. The produced natural gas, after preparation that allows it to be used by end customers, delivers to 13 places in the transport system and much less (up to 6% of production) in four places in the distribution system. The total annual production, which was delivered to the transport and distribution system, amounted to 399 million m³ in 2016, which is less by 7.6% of the production in the previous year.

Table 15 shows quantities of natural gas within the transmission and distribution system from own production for the period 2013 – 2016.

Table 15: Quantities of natural gas within the transmission and distribution system from own production for the period 2013 – 2016 [15]

Year	2013	2014	2015	2016
Delivered into transmission system	451	453	422	388
Delivered into distribution system	17	14	10	11
Total production	468	467	432	399

Of the total quantities delivered in the transport and distribution system in 2016, 175.1 million m³ (44%) of natural gas was sold to other suppliers, while most of the natural gas is NIS JSC spent for its own needs, mostly in the Pančevo Oil Refinery.

In the transport system PE Srbijagas 2,696 million m³ of natural gas was acquired during 2016. These quantities were transported for the needs of: buyers, transit for Bosnia and Herzegovina, storage, for compensation of natural gas losses in transport and distribution systems and for the consumption of compressors. Transport was carried out reliably and safely, with remote control and control of the parameters of the transport system condition from dispatching centers located in Belgrade and Novi Sad.

Table 16 shows taken quantities of natural gas into transmission system in the period 2013 – 2016.

Table 16: Taken quantities of natural gas into transmission system in the period 2013 – 2016 [15]

(million m ³)	2013	2014	2015	2016
Domestic production taken into transmission system	451	453	422	388
Taken from Hungary for Serbia	1,823	1,468	1,740	1,795
Taken from Hungary for BiH	194	185	223	232
Total taken	2,468	2,106	2,386	2,415
From storage	266	353	113	254
Transported	2,734	2,459	2,499	2,669

Natural gas is taken over into distribution systems mostly from the natural gas transport system. Some distribution systems take over natural gas from another distribution system. Only a small amount of natural gas is taken from the production of natural gas connected to the distribution system. In 2016 only PE Srbijagas took gas directly from production.

Table 17 gives quantities of taken within systems for distribution for the period 2013-2016.

Table 17: Quantities of taken within systems for distribution for the period 2013-2016 [15]

(million m ³)	2013	2014	2015	2016
Total distributed	1,362.79	1,288.43	1,405	1,474
Taken from transmission system	1,258.1	1,197.85	1,310	1,371
From distribution system	87.4	76.71	85	92
Directly from natural gas production	17.162	13.6	10	11
Losses	13.29 (1%)	12.42 (1%)	8 (0.57%)	14 (0.95%)

The warehouse operator performs the activity of storage and management of natural gas storage. There is only one, underground gas storage facility Banatski Dvor (UGSF Banatski Dvor) whose founders and owners are PE Srbijagas (49%) and Gazprom Germania (51%), based on the Agreement between the Government of the Republic of Serbia and the Russian Federation on cooperation in the field of oil and gas (Law on Ratification of the Agreement between the Government of the Republic of Serbia and the Government of the Russian Federation on Cooperation in the field of oil and gas "Official Gazette of the Republic of Serbia - International Agreements" no. 83/08) concluded in January 2008. Agreement on the implementation of a joint project It was signed in October 2009.

During 2016, more gas was withdrawn from the warehouse than it was delivered to the warehouse. At the beginning of 2016, there were 448 million m³ of commercial gas. From the transport system, 200 million m³ were handed over to the warehouse, of which 3 million m³ were spent on own consumption of the warehouse, and the remaining 197 million m³ of gas was imprinted for commercial purposes. The users withdrew 254 million m³ from the warehouse, as they were handed over to the transport system. At the end of 2016, the warehouse had 391 million m³ of commercial gas.

During 2016, the maximum technical capacity of the imprint was 2.7 million m³/day, while the maximum technical withdrawal capacity from the warehouse was five million m³/day. Maximum daily pressed quantities in 2016 amounted to 2.6 million m³/day, while the maximum daily withdrawn quantities amounted to 4.95 million m³/day.

The amount of luggage gas in the warehouse did not change in 2016 and amounted to 530 million m³.

Table 18 shows natural gas consumption per sector of final energy consumption for the period 2013 – 2016.

Table 18: Natural gas consumption per sector of final energy consumption for the period 2013 – 2016

Final energy consumption sector	2013	2014	2015	2016
Households	219.086	179.000	189.822	210.678
Industry and building (for energy purpose)	865.884	485.459	543.083	550.089
Traffic	4.674	8.833	11.204	6.502
Public and commercial	139.815	142.801	169.418	196.592
Agriculture	32.047	32.207	20.713	28.953

In the natural gas balance in the final consumption sectors for 2016, household consumption accounted for 21%, while the industrial sector consumed 55% of the available quantities for energy purposes, while other sectors (transport, public and commercial and agriculture) spent the remaining amount of natural gas (24%). The heaters have taken a total of 566.640 million m³ of natural gas, representing 24% of the available gross natural gas quantity in 2016.

In 2016, natural gas consumption in the household sector increased by 11%, in heating plants remained at the same level, while in the industrial sector, natural gas consumption increased by 1.1% compared to 2015.

4.2. Transport 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).

At the end of 2016, the length of the transmission system of PE Srbijagas was 2,298 km in northern and central Serbia, and the transmission system of company Yugorosgaz-Transport was 125 km in the south-eastern part of Serbia (Table 19). PE Srbijagas owns 95% of the transport gas pipeline network, and Yugorosgaz-Transport over the remaining 5%.

Table 19: Overview of the length of the gas pipeline transmission system in Serbia in period 2013 – 2016 (km)

Year	2013	2014	2015	2016
Length of network (km)	2,398	2,423	2,423	2,423

Approximately 5 million or 70% of Serbia's population lives in an area that has an existing natural gas transmission network, which provides potential for further development of the natural gas distribution system and the rise in natural gas consumption.

Basic technical characteristics of transmission systems PE Srbijagas and Yugorosgaz-Transport are given in Table 20.

Transport system operators were obliged to provide automatic collection and processing of natural gas flow data by 2011, with a 24-hour or shorter interval for all delivery points from the transport system. Such measurement and acquisition equipment is necessary for the functioning and development of the market. So far it has been installed at all delivery points on the system

operated by Yugorosgaz-Transport and 35% of the total number of exits from the transport system PE Srbijagas.

The main disadvantage and weakness of the transport system is one connection from other systems that enables and provides import of necessary quantities of natural gas. The connection or transfer point is located in Kishkumdorozmi (Republic of Hungary), and the gas is imported via the Hungarian transport system from the Russian Federation under a long-term contract with Gazeksport.

The Republic of Serbia has two interconnections with other gas pipelines (one inlet and one outlet), which are gas pipelines:

- Hungary - Serbia (Kishkumdorozhma) - entry point
- Serbia - BiH (Zvornik) - exit point

Both interconnections are part of transport system of Transportgas Srbija, while Yugorosgaz-Transport does not have pipelines connected with transport systems of neighboring countries.

Table 20: Basic technical characteristics of transmission systems PE Srbijagas and Yugorosgaz-Transport ad [15]

Technical description of transmission system	PE Srbijagas	Yugorosgaz-Transport
Capacity (M. m ³ /day)	≈ 18	≈ 2,2
Pressure (bar)	16–75	16–55
Length (km)	2,298	125
Nominal Diameter (mm)	DN 150–DN 750	DN 168–DN 530
Average age of the transmission system	25	10
Compressor Stations	1	-
Power rate of compressor stations (MW)	4.4	-
The total number of connection entries into the transmission system :	15	1
1 Other transmission system	1 (Horgoš)	1
2. Domestic production fields	13	-
3. Underground storage	1	-
Number of connections in transmission system	242	5
Stations for measurement and regulation (at exit of the transmission system)	239	5
Delivery station	2	-
Exit to the transmission system of Yugorosgaz	1	-
Interconnection to the BiH	1	-
Connection to the underground storage facility	1	-

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 and other infrastructure necessary for distribution of natural gas with maximum operating pressure that is equal or lower than 16 bar, including line-pack.

According to the Energy Law is a regulated activity.

In the period between 2013 and 2016 the length of the distribution network increased by 5.1% - 16,363 km (without connections), thereby creating the conditions for connection of new customers. However, comparing to 2015, distribution network increased only for 121 km (0,7%). Positive trend of investment into distribution network development has been kept. The largest part of the increase in the length of the network in 2016 was within PE Srbijagas distribution

system. PE Srbijagas now owns about 47.6% of the total distribution network. Table 21 shows the change in length of the distribution network for the period 2013 to 2016.

Table 21: Length of the distribution network for the period 2013 to 2016

Year	2013	2014	2015	2016
Network length (km)	15,839	16,363	16,532	16,653

The number of active connections (delivery points) in distribution networks is approximately 267 thousand, and comparing to 2015 there is 4,600 more delivery points (1.75%) [15].

4.4. Storage of Natural Gas

The underground gas storage facility Banatski Dvor is very important for ensuring safe natural gas supply in Serbia. It is located in the area of exhausted gas storage capacity of 3.3 billion m³ of natural gas. The total area of the warehouse is about 54 km².

The Banatski Dvor warehouse was put into operation in November 2011. The two-way gas pipeline Gospođinci - Banatski Dvor has enabled the undisturbed and complete connection of the underground gas storage with the transport system of PE Srbijagas.

The basic technical characteristics of the underground gas storage Banatski Dvor are given in the Table 22.

Table 22: Basic technical characteristics of the underground gas storage

Operating volume of gas storage	450 M m ³
Stored gas in gas pillow	530 M m ³
Maximum inlet capacity of the storage	2.8 M m ³ /day
Maximal production capacity of gas storage	4.5 M m ³ /day
Length of pipe connection	42.5 km
Nominal diameter of pipeline	DN 500
Maximal operating pressure of gas pipeline	75 bar

After the second phase of development, about 800 million m³ of gas will be stored in the warehouse. The underground warehouse is connected with two pipelines to the gas distribution junction in Elemir.

4.5. Security of Supply

4.5.1. Planned Production and Consumption of Natural Gas and Security of Supply the Missing Amount for the Period 2020–2030

By the energy balance of the Republic of Serbia for 2016, the primary production amounted to 523.229 million m³, which is 8.6% less than the production in 2015. According to the projections shown in the Strategy [2], a trend of permanent reduction of primary production is foreseen, with the primary production expected to be 200.936 million m³ of natural gas in 2030. The total amount of natural gas from imports in 2016 amounted to 1,795.226 million m³, which is by 3.2% more than in 2015. According to the document [2], taking into account the reference scenario, the amount of natural gas from imports will be steadily increasing (according to projections for 2030 it is predicted that the amount of natural gas to be imported is 3,589.222 million m³).

In Table 14 is given a natural gas balance for the period 2013-2016, while the structure of the final consumption of natural gas is given in the Table 18.

In Table 23 is a projection of natural gas by 2030 according to the reference scenario from the Strategy [2].

Table 23: Projection of natural gas by 2030 [2]

(Million m ³)	2020	2025	2030
Projection of primary energy consumption	2,890.969	3,329.261	3,790.158
Primary energy production	401.872	300.148	200.936
Import	2,489.092	3,029.113	3,589.222
Final energy consumption in energy purpose	1,601.21	1,863.683	2,163.831

At the entry point Hungary-Serbia (Kishkundozhma), the capacities were used by: PE Srbijagas, Gazprom eksport and BH-Gas d.o.o. Sarajevo, and the output capacity at the interconnector to Bosnia and Herzegovina BH-Gas and Gazprom Export.

In 2015, the incoming uninterrupted capacity at the border with Hungary of 540,000 m³/hour (13 million m³/day) was used on average 41.4% (in 2014 it was 36.5%), and should be taken into account and that natural gas consumption is seasonally remarkably uneven and that capacity utilization is considerably lower in summer months. The largest daily amount taken into the transport system at the border with Hungary was 10.72 million m³/day, of which 9.24 million m³/day was for customers in Serbia, and 1.48 million m³/day for the needs of Bosnia and Herzegovina.

In 2016, there were no problems with capacities. During the winter months, there were enough free capacities on the interconnectors. In 2016, the incoming uninterrupted capacity at the border with Hungary was used on average 42.6%. The largest daily amount taken into the transport system at the border with Hungary was 10.43 million m³/day, of which 8.94 million m³/day was for customers in Serbia, and 1.49 million m³/day for the needs of Bosnia and Herzegovina. With the available capacity of interconnectors for the needs of natural gas customers in the Republic of Serbia of 11 million m³/day and the utilization rate of interconnectors of 90%, annual import of about 3.6 billion m³ is possible, which is significantly more than 1.795 billion m³ imported in In 2016, or 1.864 billion m³ of the average annual import in the last ten-year period (2007-2016).

4.5.2. *Incentives for New Investment in Exploration, Production, Transportation and Storage of Natural Gas*

New infrastructural facilities of the gas pipeline system, i.e. interconnectors or natural gas storage facilities may, upon a request, be exempted from the application of the principle of transparency and non-discrimination, under the following conditions:

- That investments in the new infrastructural facility increase competitiveness in the market and safety of supply;
- That the risk of investments in new infrastructural facilities is such that the investments will not occur unless the exemption is approved;
- That the new infrastructural facilities are owned by a natural or legal person that performs business operations within another legal person separated from the system operator within which the new infrastructural facilities will be constructed;
- That users of the new infrastructural facility bear the expenses of the facility exploitation;
- That the exemption does not prevent competition, efficient functioning of the internal natural gas market and efficient operation of the regulated system to which the new infrastructural facilities are connected.

The act of exemption can be also applied in the case of a considerable increase of the capacity of existing infrastructural facilities and modification of this infrastructure ensuring development of new sources of natural gas supply.

In case of interconnections, act of exemption could be applied after exchange of opinion with other countries that are included within interconnection commissioning.

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

The security of supply has been significantly increased by activating the work of the underground warehouse Banatski Dvor, with projected displacement capacity of 5 million m³/day.

Preparations are under way for the construction of interconnectors with Bulgaria on the basis of the agreement on the construction of the Niš-Dimitrovgrad-Sofia gas pipeline, which would significantly contribute to increasing supply security. The agreement was signed in 2012, and the Memorandum of Understanding between the Government of the Republic of Serbia and the Republic of Bulgaria was prepared for signature (and signed in January 2017). The length of this pipeline should be about 150 km and the capacity is 1.8 billion m³ per year.

Also, in order to increase security of supply, there may be significant interconnection with the gas systems of other neighboring countries, primarily those countries that have a more developed gas infrastructure and additional gas security options, such as Romania and Croatia.

Project of gas interconnection Serbia - Bulgaria, main gas pipeline MG-10 Niš - Dimitrovgrad (border with Bulgaria) [3]:

The Interconnection Project Serbia - Bulgaria is on the Single List of Infrastructure Projects in the Energy Sector, the Priority List of Infrastructure Energy Projects (PECI Lists), List of Projects of Common Interest (PCI Lists) and Lists of Central and South Eastern Europe Gas Connection Projects (CESEC lists).

The project envisages the construction of a single-entry gas pipeline, 109 km long, with a diameter of DN 700, with a technical capacity of 1.8 billion m³/year, with a maximum operating pressure of 55 bar.

This project represents the infrastructure basis for the establishment of gas interconnection with the Republic of Bulgaria. Primary technical elements of the pipeline are pipelines, facilities and associated infrastructure. An integral part of the pipeline consists of:

- 2 handover and cleaning stations (PPS) - at a location near the state border and within the existing GRC "Niš 2"
- 6 block cells
- 2 cleaning stations within the PPS
- 4 main measuring stations (GMRS): GMRS "Niš 2" with capacity of 30,000 m³/h, GMRS "Bela palanka 2" with capacity of 3,000 m³/h, GMRS "Pirot" capacity of 35,000 m³/h, GMRS "Dimitrovgrad" capacity 7,000 m³/h
- Cathode protection devices for the line of the gas pipeline
- Devices and equipment for the needs of remote control and plant management

This project significantly improves the security of domestic gas supply supply by introducing a new supply line, opening up the possibility of supplying natural gas from Russia and other directions of supply, Southern Corridor (Azerbaijan, natural gas from the terminal in Greece,

etc.). The realization of this project influences the improvement of the domestic (increase in the number of participants in the market) and the establishment of a regional natural gas market, the transit costs are reduced and the possibility of more intensive gasification of the territories of eastern and southern Serbia opens.

Realization of the gas interconnection project Serbia - Bulgaria, the main gas pipeline MG-10 Niš - Dimitrovgrad (the border with Bulgaria) is planned for the period 2017-2021.

Gas Interconnection Project Serbia-Croatia, main gas pipeline MG-08 Gospodinci (Futog) - Sotin (border with Croatia) [3]:

The project of gas interconnection Serbia - Croatia is on the Single List of Infrastructure Projects in the Energy Sector, the Priority List of Infrastructure Energy Projects (PMI Lists), List of Projects of Common Interest (PCI Lists) and Lists of Central and South Eastern Europe Gas Connection Projects (CESEC lists) .

The project envisages the construction of a single-pass single-pipe gas pipeline in the length of 95 km, diameter DN 600, capacity 1.5 billion m³/year, projected pressure of 75 bar.

Main gas pipeline MG-08 Homeless people (Futog) - Sotin is the infrastructure basis for the establishment of gas interconnection with the Republic of Croatia. Primary technical elements of the pipeline are pipelines, structures that are an integral part of the pipeline and the accompanying infrastructure. The following components and installations are the components of the pipeline:

- 1 transfer and cleaning station at a location near the state border
- Block station
- Cathode protection devices for the line of the gas pipeline
- Devices and equipment for the needs of remote control and plant management

This project significantly improves the security of supplying the domestic natural gas market by opening up the possibility of purchasing natural gas from other sources. This project positively influences the development of the domestic market (increasing the number of participants in the market), the development of the regional market, opens the possibility of reducing transit costs. The realization of this project influences the diversification of sources and directions of natural gas supply; the possibility of obtaining an alternative source and direction of supply with Algerian gas from the Republic of Italy via the Republic of Croatia or through the future terminal for natural gas in the Republic of Croatia opens up (planned capacity of 5-6 billion m³).

Provision of safe supply of domestic natural gas market - Significant Implementation of gas interconnection project Serbia-Croatia, main gas pipeline MG-08 Homeless (Futog) - Sotin (border with Croatia) is planned for the period 2021-2023.

Gas Interconnection Project Serbia - Romania, Mokrin-Arad gas pipeline (border with Romania) [3]:

Gas Interconnection Project Serbia - Romania is on the Single List of Infrastructure Projects in the Field of Energy.

This project envisages the construction of a single-pass single-pipe gas pipeline with a length of 6 km, a diameter of DN 600, a technical capacity of 1.6 billion m³/year, a maximum working pressure of 50 bar.

The main gas pipeline Mokrin - Arad is the infrastructure basis for the establishment of a gas interconnection with Romania. Primary technical elements of the pipeline are pipelines, structures that are an integral part of the pipeline and the accompanying infrastructure. The following components and installations are the components of the pipeline:

- one transceiver and two cleaning stations
- Block station
- Cathode protection devices for the line of the gas pipeline
- Devices and equipment for the needs of remote control and plant management

This project significantly improves the security of supplying the domestic natural gas market by opening up the possibility of purchasing natural gas from other sources, significantly reducing the basic main route Horgos - Batajnica. This project positively influences the development of the domestic market (increasing the number of participants in the market), the development of the regional market, and also opens up the possibility of including existing and future gas storage in the regional natural gas market. The project has a positive impact on the improvement of the diversification of sources and directions of natural gas supply, especially in the case of the implementation of trans-continental natural gas supply projects via Romania.

Implementation of the gas interconnection project Serbia – Romania, the Mokrin-Arad gas pipeline (the border with Romania) is planned for the period 2022-2023.

Project for the expansion of the capacity of the underground gas storage Banatski Dvor [3]:

The project envisages the expansion of the technical capacity of the warehouse to 800-1,000 million m³ with the capacity of daily withdrawal of up to 10 million m³ of natural gas

The expansion of the underground natural gas storage in Banatski Dvor implies expansion from the current capacity of 450 million m³ to capacity from 800 million to one billion m³ with a maximum technical capacity of 9.96 million m³/day (415,000 m³/h) and maximum technical capacity of printing from 5.52 million m³/day (230,000 m³/h). This will double the available quantities of natural gas that are available from the warehouse (from 5 million m³/day to 10 million m³/day).

Like the aforementioned projects and the project of expanding the capacity of the underground gas storage, Banatski Dvor has a positive impact on the security of supplying the domestic natural gas market. With this project, the available quantities of natural gas are significantly increased in the periods of maximum daily natural gas consumption. Additional storage capacities, together with anticipated interconnections, open the possibility of their use in the regional natural gas market.

Realization of the project for expanding the capacity of the underground gas storage facility Banatski Dvor is foreseen for the period 2020-2023.

Table 24: Construction of main, distribution and distribution pipelines [3]

Project	Description	Effects according to available documentation
Mainline gas pipeline PG 11-02	Mainline single-pipe gas line RG 11-02 Leskovac-Vladicin Han-Vranje, 70.7 km long, 323.9 mm in diameter, maximum working pressure up to 50 bar, six block stations, three main measuring stations (GMRS "Vlasotince" 5,000 m ³ /h, GMRS "Vladichin Han/Surdulica" 5,000 m ³ /h, GMRS "Vranje" 10,000 m ³ /h)	Expansion of the transport network of the Republic of Serbia in South Pomoravlje, in the municipalities of Vlasotince, Vladicin Han, Surdulica and the city of Vranje, creating opportunities for further development of the gas pipeline system towards Bujanovac and Presevo, as well as the possibility of connecting with the gas pipeline system in the Republic of Macedonia.
Mainline gas pipeline MG 01/II Itebej – Beograd jug	The main one-pipe gas line is about 130 km long and 610 mm in diameter	Increasing the safety of the functioning of the transport system of the Republic of Serbia; Reducing the gas pipeline Kikinda - Pančevo; Creating opportunities for easier functioning of the domestic natural gas market
Mainline gas pipeline Batajnica – Velika Plana – Niš	Mainline gas pipeline 116 + 161 km long diameter DN 700	Increasing the safety of the functioning of the transport system of the Republic of Serbia; Connection of gas pipeline Niš - Dimitrovgrad with Batajnica; Creating opportunities for easier functioning of the domestic and regional natural gas market.
Distribution gas pipeline PG 09-04/2 Aleksandrovac – Tutin	Distribution gas pipeline operating pressure up to 50 bar length of about 121 km and diameter 323.9 mm	Development of the transport network of the Republic of Serbia and the gasification of municipalities (Brus-Kopaonik, Raška, Novi Pazar, Tutin) on the route of the gas pipeline.
Distribution gas pipeline – UGSF Banatski Dvor	Distribution gas pipeline operating pressure up to 50 bar length 50 km and diameter DN 600	Connecting UGSF Banatski Dvor with a pipeline from Romania; Creating opportunities for easier functioning of the domestic and regional natural gas market.
Distribution gas pipeline (2015: Lenght 16,532 km, No of active connestion 262,506)	Maximum operating pressure of distribution pipelines 16 bar and 4 bar, pipelines of steel and polyethylene pipes of different diameter	Reducing the consumption of electricity in households, substitution of liquid fuels (fuel oil, fuel oil) in heating plants and industry; Increasing the efficiency of primary energy using more efficient technologies (cogeneration, condensing boilers, etc.).

Realizing the projects shown in Table 24 the security of supply of domestic natural gas market is significantly improved, with the construction of the Itebej-Belgrade gas pipeline south the security of supply of Belgrade and central Serbia. Infrastructure prerequisites (transport system)

for the use of natural gas in the south, southwestern and central Serbia are being achieved. New gases are being developed and existing gas distribution networks are being developed, allowing for increased use and development of the domestic natural gas market.

Realization of projects for construction of main, distribution and distribution pipelines, which are shown in Table 24 is envisaged in the period 2017-2023.

Table 25 to the Table 28 present the on-going investments as well as planned for the future development of transmission and distribution systems, systems for storage of natural gas, as well as planned investments in interconnection projects.

Overview of other strategic projects proposed by PE Srbijagas, and estimate of investment into natural gas sector is presented in Table 29.

Table 25: Natural gas transmission system development – On-going investments

Item	Investment
1	High pressure distribution pipeline Osipaonica – Požarevac
2	High pressure distribution pipeline Aleksandrovac – Brus – Kopaonik – Raška – Novi Pazar – Tutin
3	Main gas pressure regulating and metering station Brus
4	Main gas pressure regulating and metering station Kopaonik
5	Main gas pressure regulating and metering station Raška
6	Main gas pressure regulating and metering station Novi Pazar
7	Main gas pressure regulating and metering station Tutin
8	High pressure distribution pipeline Bačka Palanka – Obrovac – Bač
9	Main gas pressure regulating and metering station Obrovac
10	Main gas pressure regulating and metering station Bač
11	High pressure distribution pipeline RG 08-17 Paljevsko polje – Kosjerić
12	Main gas pressure regulating and metering station Kosjerić
13	High pressure distribution pipeline RG 08-18 Požega - Arilje
14	Main gas pressure regulating and metering station Arilje
15	High pressure distribution pipeline Šid
16	Main gas pressure regulating and metering station Šid
17	Main gas pressure regulating and metering station Kukujevci
18	High pressure distribution pipeline Titel
19	Main gas pressure regulating and metering station Vilovo
20	High pressure distribution pipeline Kljajićevo
21	Main gas pressure regulating and metering station Kljajićevo
22	High pressure distribution pipeline Belu Crkvu
23	Main gas pressure regulating and metering station Bela Crkva
24	Main gas pressure regulating and metering station Dobanovci

Table 26: Natural gas transmission system development – Planned investments

Item	Investment	Technical characteristics
1	High pressure distribution pipeline PSG Itebej – Pančevo – Beograd Jug	DN 600; L= 130 km
2	Main gas pressure regulating and metering station Kovačica	Capacity Q = 35,700 Sm ³ /h
3	Main gas pressure regulating and metering station Beograd jug	Capacity Q = 23,000 Sm ³ /h
4	Pipeline Mokrin-UGSF Banatski Dvor	DN 600 L= 50 km
5	PPS Loznica	Capacity Q = 100,000 Sm ³ /h
6	Suply of Company MSK Kikinda with domestic natural gas from Elemira	DN 300 L= 40 km
7	High pressure distribution pipeline RG 05-06 Beograd - Valjevo	DN 400 – DN 150 L= 86 km
8	Main gas pressure regulating and metering station Obrenovac	Capacity Q = 17,000 Sm ³ /h
9	Main gas pressure regulating and metering station Ub	Capacity Q = 5,000 Sm ³ /h
10	Main gas pressure regulating and metering station Lajkovac	Capacity Q = 17,000 Sm ³ /h
11	Main gas pressure regulating and metering station Mionica	Capacity Q = 7,500 Sm ³ /h
12	Main gas pressure regulating and metering station Valjevo	Capacity Q = 35,000 Sm ³ /h
13	Main gas pressure regulating and metering station Surčin	Capacity Q = 20,000 Sm ³ /h
14	Main gas pressure regulating and metering station Zuce	Capacity Q = 60,000 Sm ³ /h
15	High pressure distribution pipeline RG 05-02/1	DN 450, L= 8 km
16	Main gas pressure regulating and metering station Bežanija 2	Capacity Q = 100,000 Sm ³ /h
17	High pressure distribution pipeline Smederevo Osipaonica	DN 300, L= 16 km

When it comes to the development of the distribution system it should be noted that the realization of 27 investments in municipalities and cities across Serbia (Beograd, Pančevo, Požarevac, Kragujevac, Kruševac, Čačak, Smederevo, itd.) is in progress.

Table 27: Interconnection projects – Planned investments

Item	Investment	Technical characteristics
1	Interconnection with Bulgaria	DN 700; L = 109 km
2	Connection with Romania	DN 600; L = 17.5 km

Table 28: Natural gas underground storage – Planned investments

Item	Investment	Technical characteristics
1	Capacity upgrade in natural gas storage in B.Dvor ^{*1}	capacity 1,000,000,000 m ³
2	Building new natural gas storage in Itebe	capacity 1,000,000,000 m ³

^{*1} Underground gas storage Banatski Dvor – current capacity of gas storage is 450 million m³ (under standard conditions). Current number of wells is 18. According to signed Memorandum, there are plans for increasing gas storage capacity up to 1 billion m³ (under standard conditions). The Study on capacity increasing of underground gas storage Banatski Dvor will give the answers regarding the necessary number of gas wells for supplying the newly defined gas storage capacity

Table 29: Other strategic projects

Item	Investment	Technical characteristics
1	LNG terminal in Pančevo port	
2	Introduction of CHP plants	Novi Sad (450 MWe + 300 MWt), Beograd (400 MWe + 200 MWt), Pančevo (200 MWe + 100 MWt), i Niš (400 MWe + 200 MWt)

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.

Pursuant 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.

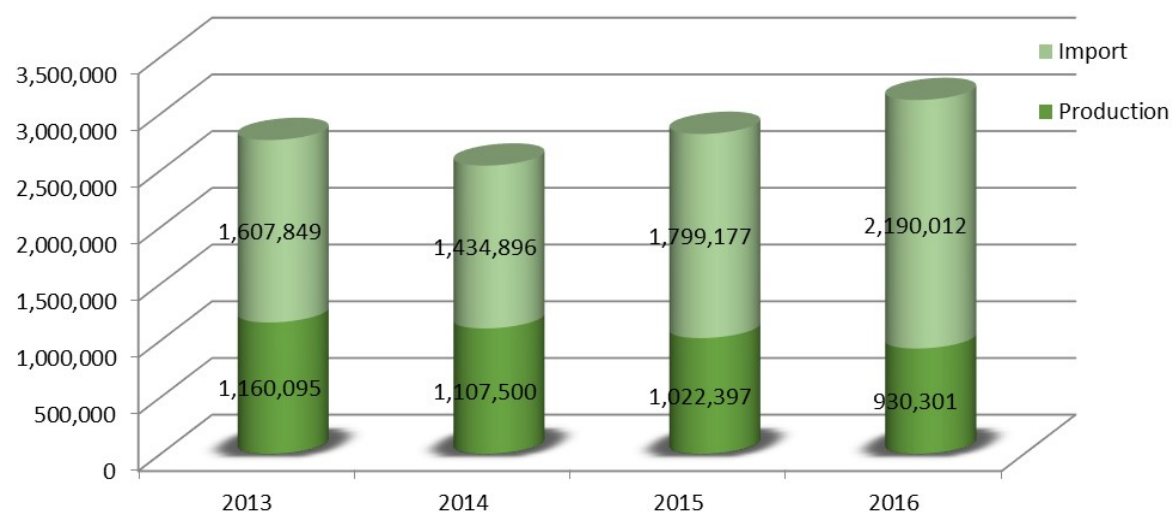
5.1. Production, Import, Export and Consumption of Crude Oil and Petroleum Products

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) [35].

The production and processing of crude oil in Serbia is carried out by "Naftna industrija Srbije a.d. Novi Sad" (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 52,000 tonnes) is not included in the Energy Balance of the Republic of Serbia [19].



Crude oil (in tonnes)	2013	2014	2015	2016
Production	1,160,095	1,107,500	1,022,397	930,301
Import	1,607,849	1,434,896	1,799,177	2,190,012

Figure 1: Comparative review of production and import of crude oil (in tonnes) in the last four years [36]

Domestic production of crude oil is decreasing in 2015, while simultaneously deficient quantities are provided by an increase in imports, which in 2015 amounted to 1,799,177 tonnes. In 2016, the production retains a slight downward trend, but the import volume increases to a value of 2,191,513. The energy balance for 2017 predicts approximately the same level of production.

All imported crude oil is only 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.

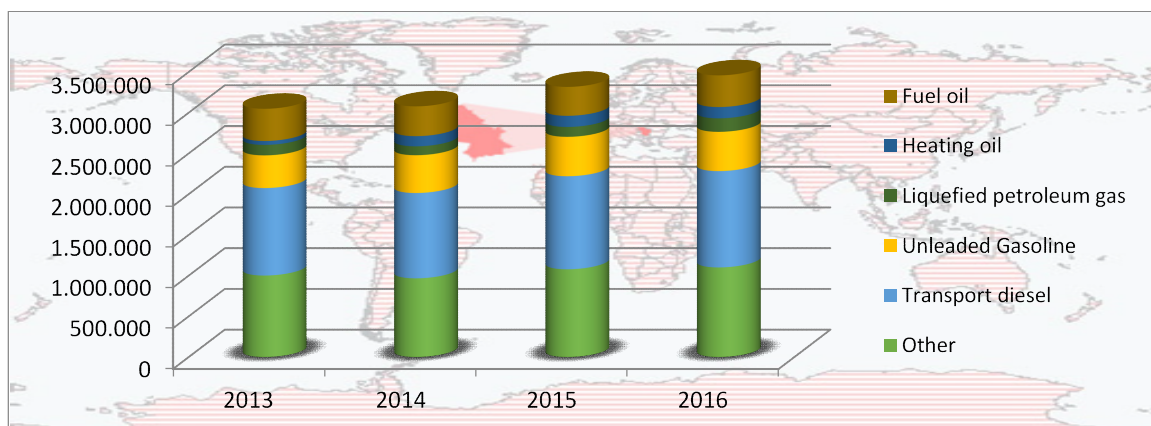
The oil produced from domestic oil reservoirs is shipped from gathering stations through oil pipelines to Novi Sad Oil Refinery and further on refining to Pančevo Oil Refinery, and certain percentage (<10%) is transported by road tankers to Pančevo Oil Refinery.

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 the installations of former Hipol JSC now "Standard gas d.o.o. Novi Sad" (Standard gas) [11].

The quantities of produced derivatives in 2015 (Figure 2) amounted to 3,317,721 tonnes, while in 2016 they amounted to 3,459,112 tonnes, which represents an increase of 4.3%. Pančevo Oil Refinery in 2014 increased the production of liquefied petroleum gas by 11% in 2015, while in 2016 this increase was 36.8% [36].

The derivatives produced in the Pančevo Oil Refinery are shipped by using rail tankers, watercrafts (river tankers, barges, hovercrafts) and road tankers. The transport of petroleum products through petroleum product pipelines does not work because there is no built petroleum product pipelines network.



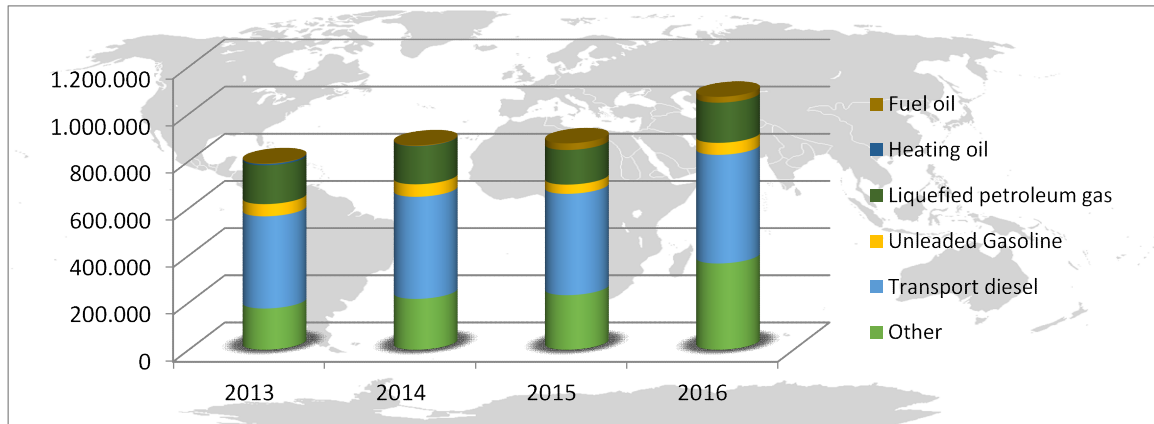
Production of petroleum products (in tonnes)	2013	2014	2015	2016
Transport Diesel	1,073,903	1,047,495	1,142,290	1,182,882
Unleaded Gasoline	401,469	464,115	484,090	482,068
Liquide petroleum gas	128,571	108,986	121,117	165,768
Heating oil	47,928	124,999	136,723	138,514
Fuel oil	395,446	365,944	355,142	388,871
Other products	1,001,619	967,266	1,078,359	1,101,009

Figure 2: Production of petroleum products – comparative review of 2013 to 2016

In 2015, the mild trend of import growth continued, and the imported amount of derivatives was 875,724 tonnes, while in 2016 it is at a higher level and amounts to 1,072,959 tonnes. Motor fuels in 2015 registered a slight decline in imports as a result of the supply of wholesale traders by NIS JSC while in 2016 it was again registered a growth of about 10%.

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 [36].

Regarding to the supply of derivatives from import, all 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)	2013	2014	2015	2016
Transport Diesel	390,898	432,832	429,627	460,612
Unleaded Gasoline	51,775	53,084	39,168	50,924
Liquide petroleum gas	164,401	160,635	146,665	170,261
Heating oil	6,079	1,260	36	0
Fuel oil	2,406	3,156	28,191	24,810
Other products	175,427	216,261	232,037	366,352

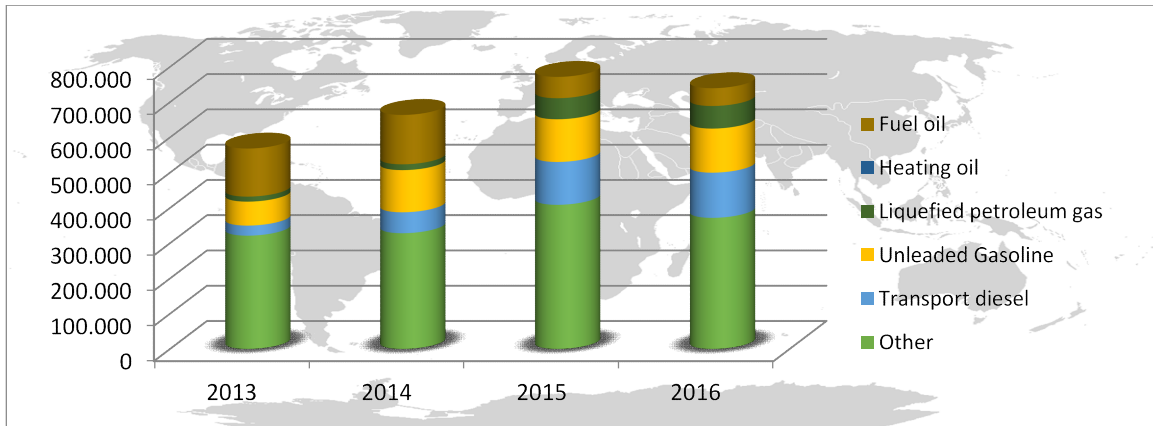
Figure 3: The import of petroleum products (in tonnes) – comparative review of 2013 to 2016

In 2015, the trend of increased export of derivatives continued in the amount of 771,756 tonnes, while in 2016 it was at the level of 739,704 tonnes. The increase of motor fuels export is particularly significant. In 2015, the Republic of Serbia's total export was 302,249 tonnes of motor fuels which is almost 55% more than in the previous year. The most prevalent was diesel with 121,464 tonnes, which is 105% more than in the previous year, followed by gasoline with 121,328 tonnes, which is approximately at the same level. From other petroleum products, the bitumen export of 219,502 tonnes is significant, as well as the export of liquefied petroleum gas, which represents an increase of 263% with an amount of 59,647 tonnes compared to 16,393 tonnes [36]. In 2016, the trend of export growth was noticed, but at the level of up to 5%.

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 2015, 23,883 tonnes of diesel were placed on the market at the bunker stations, while 15,336 tonnes were in the previous year, which is an increase of 56% [36].

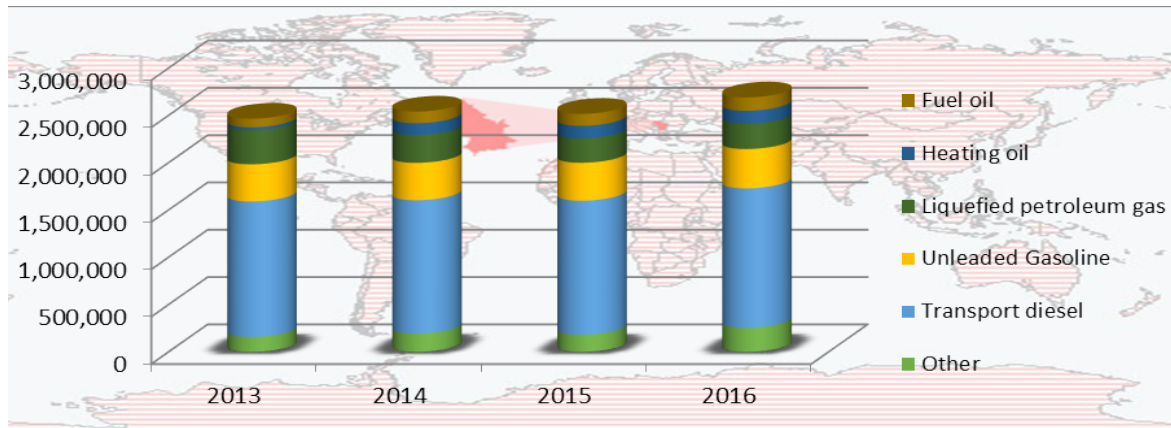
So far, no license has been issued for the performance of this activity due to the lack of harmonization of the regulations governing this field. Amendments to the Law on Ports and Inland Waterways are expected by the end of 2017.



Export of petroleum products (in tonnes)	2013	2014	2015	2016
Transport Diesel	28,575	59,328	121,464	128,116
Unleaded Gasoline	67,976	119,607	121,138	125,044
Liquide petroleum gas	14,167	16,393	59,647	64,010
Heating oil	0	0	2	1
Fuel oil	136,388	140,132	60,493	50,516
Other products	321,495	328,452	409,012	372,017

Figure 4: Export of petroleum products (in tonnes) –comparative overview for the period 2013 - 2016

Final consumption for energy purposes for 2015 (Figure 5) does not deviate significantly from consumption in 2014 and is at the level of 2,518,280 tonnes, while in 2016 it grew by 7% and amounted to 2,691,730 tonnes. In the structure of final consumption of derivatives for 2016, the industry participates with 13%, traffic from 76%, and other sectors with 11%.



Consumption of petroleum products (in tonnes)	2013	2014	2015	2016
Transport Diesel	1,432,122	1,408,752	1,416,856	1,474,142
Unleaded Gasoline	393,136	395,298	401,172	415,720
Liquide petroleum gas	362,102	295,413	259,989	269,114
Heating oil	28,550	123,634	130,287	135,238
Fuel oil	91,702	122,784	126,962	141,238
Other products	159,607	196,154	183,014	256,278

Figure 5: Consumption of petroleum products (in tonnes) - Comparative review for the period 2013 - 2016 [36]

5.2. Security of Supply of Oil and Petroleum Products

5.2.1. Balance of Oil and Petroleum Products for Year 2017 – 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 2017 [21] is mostly determined in accordance with the realization and assessment by the end of 2106. The exact amount of all energy products can be seen only at the end of 2017.

According to the Energy Balance [21], the supply of crude oil and semi-finished products for processing in refineries will be provided from domestic production in the amount of 0.854 million tonnes (24%), while the import will provide an additional amount of required crude oil and semi - finished products in the amount of 2.660 million tonnes (76% of total needs) [21].

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 2017, the processing of crude oil and semi-finished products is planned in an amount of 3.719 million tonnes while the domestic production of petroleum products is planned in the amount of 3.657 million tonnes [21].

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% [36].

Having in mind the overall need for petroleum products in 2017, including the planned domestic production of petroleum products, the rest of the required amount of about 0.9 million tonnes will be supplied from the import [21].

In 2017 it is planned to export 0.8 million tonnes of petroleum products. The final consumption of petroleum products in 2017 is planned to be about 3,073 million tonnes, of which 0.461 million tonnes are for non-energy purposes, while 2.611 million tonnes are for energy purposes. In this structure of final consumption of petroleum products for 2017, the industry participates with 14%, the transport with 76% and other sectors with 10% [21].

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

Table 30: Projection of consumption to 2030 [2]

Consumption	Product	unit	Period (year)		
			2020	2025	2030
Primary energy Consumption	Crude oil and semi-finished products	thousands tons of oil equivalent	3,822	4,049	4,312
Final Consumption	Petroleum products	thousands tons 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 [37], 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.

Long-term, medium-term and short-term programs for the formation of required reserves have been adopted [37].

By the end of 2016, the Management Board of the Ministry in charge of energy for the purpose of forming obligatory reserves, purchased crude oil (16,000 tonnes), around 21,000 tonnes of diesel, 5,000 tonnes of heating oil – low sulfur - special NSG-S and 3,000 tonnes of motor gasoline. Also, in 2016, the procurement of about 14,000 tonnes of euro diesel was made [36].

The Republican Directorate for Commodity Reserves, in accordance with the Law, holds in its reservoirs required reserves of oil derivatives, manages the construction of new and reconstruction of the existing warehousing capacities of the Directorate financed from the budget of the Republic of Serbia.

In 2015, the Energy Resources Management Board implemented contracts on the rights to optionally purchase of oil derivatives in accordance with the Law on Commodity Reserves and Directive 2009/119/EC [38].

In 2016, the Energy Reserves Agency selected by a public tender, a public private partnership advisor for the construction of a warehouse for required reserves. A tender was conducted and the contractor for the construction of a system for the recovery of steam (VRU) was selected at the warehouse of the Directorate for Commodity Reserves 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.

During 2017, the Energy Resources Management Board has procured 9,000 tonnes of euro diesel.

Having in mind that concluded optional contracts have expired due to the obligation of budget users to conclude contracts for a period not exceeding two years, and that the Republic Commission for the Protection of the Rights of the Bid has annulled the public procurement for option contracts in 2016 in the appeal procedure, the estimated number of obligatory reserves currently required is around 10. If the new procurement of option contracts is realized in accordance with the existing financial plan and public procurement plan, the number of days in 2017 can be doubled.

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 until the circumstances for which they were prescribed continue, or until the consequences of such circumstances are last for [1].

The law determines that the Energy entities performing the activity of oil derivatives production and oil, oil derivatives, biofuels and compressed natural gas trade are obliged to provide the operational reserves of oil derivatives that are equal at least to 15 days of its average selling in the previous year. The operational reserves of oil derivatives and coal used in the case of short-term disruptions in the market, caused by breakdowns and other unforeseen circumstances that endanger the safety of operation of individual parts of the energy system or the energy system in whole [1].

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

Persuant 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 [39], [40], [41].

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) [42].

Since enacting of the Rulebook on Technical and other Requirements for Liquid Fuels of Petroleum Origin in 2012 the significant progress in conformity of the quality of fuels with the European requirements has been achieved. 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 590/1 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. 46/2013) is being applied [43].

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) is being applied.

An annual program for monitoring the quality of petroleum and biofuel products for 2016 was established.

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 fulfillment of internationally undertaken obligations regarding implementation of the Directives 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 two refineries, which are belonging to NIS JSC.

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 3 MTA.

In recent years, the refinery mostly processed the domestic oil of Velebit type using production capacity of only 0.5 MTA.

The refinery is scheduled for reconstruction in order to move to production of base oils with annual production of 180,000 tonnes of base oils, designed by Chevron Lummus Global. As a raw material it would be used naphthenic domestic oil of Velebit type and hydrocracking heavy residues from processing in the Pančevo Oil Refinery. Reservoir capacities have been reoriented and now they are a warehouse crude oil terminal.

Crude oil refining in the Republic of Serbia is carried out only 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 secondary plants in 1969; the refinery reached the design capacity of 4.8 MTA. Engineering for this plant was prepared by company SFI/Lummus France.

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 harbor 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 - petrol, diesel fuel, jet fuel and heating oil. The capacity utilization is over 60% and storage facility has a capacity of 700,000 m³. Since 2014, all domestic and imported crude oil is processed with a total processing of about 3 MTA [44].

Shipping products from the Pančevo Oil Refinery are transported by barges, road and rail tankers.

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.

The location of Pančevo Oil Refinery is very good, from the standpoint of the market and traffic capabilities; however, on the grounds of environmental protection in Pančevo and the environment, the key drawback is the wind rose, which greatly contributes to the increase of pollutants and unpleasant effects on the population of the Town of Pančevo and surrounding villages.

5.4.2. Oil Pipeline Managed by PE Transnafta

PE Transnafta performs the energy activity of transportation and management of transportation system. PE 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 PE 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 2x10,000 m³ 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 m³/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 [45].

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 [35].

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.

PE 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 center 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.

PE 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, and for 2017 the development of the execution project for the section Pančevo - Novi Sad will start.

The construction of this section gives the possibility to transport products from Pančevo to Novi Sad, and covers the market with terminals in Novi Sad because the Novi Sad Oil Refinery is not operational.

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 PE Transnafta in Novi Sad and at the Terminal Novi Sad within the Novi Sad Oil Refinery and Pančevo Oil Refinery owned by NIS JSC.

PE Transnafta Terminal has four tanks for crude oil, in volume of 10,000 m³ each, out of which two are in the function of transport and two are intended for storage.

"Naftna industrija Srbije a.d. Novi Sad" (NIS JSC) at the Terminal in Novi Sad Oil Refinery has storage tanks capacity of cca 140,000 m³ for storage of crude oil. All tanks has 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 m³ [35].

In Pančevo Oil Refinery there are storage tanks for technological processes of total capacity of about 700,000 m³ [35].

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 m³) PE Transnafta (approx. 37.000 m³) 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 2016 there were in total 18 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 (100.000 m³). It is followed by Lukoil, PE EPS and PE Transnafta. These four entities represented in total about 80% of entirely licensed storage capacities in 2016 [46].

In 2016 there were in total 40 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 PE Transnafta, Lukoil, Naftachem, Mitan oil, Petrobart, 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 Republic of Serbia is performed by companies in ownership by domestic and foreign companies, which dependent entities are registered in Serbia.

In 2016, the number of licensed business entities which are engaged in retail sale is 470 [11].

There was an increase in the number of licensed business entities compared to the previous period. At the same time, there has been a decrease in the number of stations for fuel supply of vehicles (petrol stations PS).

Based on data from the Ministry in charge of energy, at the end of 2015, the total number of stations for the fuel supply (petrol stations PS) in Serbia was 1.481 of which the active stations were 1372, inactive 48, closed 31, while 30 had no status mark. In 2016, the total number of petrol stations is in decline and amounts to 1450.

The largest number of petrol stations 325 belongs to NIS JSC which accounts for 24% of the total, then Lukoil with 111 petrol stations, which makes 8%, followed by Knez petrol with 5% and OMV and Eko Serbia with 4% of the total number of petrol stations

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

The five companies with the largest number of petrol stations: NIS JSC, Lukoil Serbia, EKO Serbia, Serbia OMV, MOL Serbia and Knez Petrol, at the end of 2015 had 615 petrol stations [48].

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

The program of modernization of Pančevo Oil Refinery envisaged the total price of the project in the amount of 547 million euros, of which 396 million goes to construction of hydrocracking complex, the rest of 151 million euros is foreseen for the projects of ecological significance - the construction of plants for the production of hydrogen in Pančevo Oil Refinery, as well as the modernization and construction of industrial infrastructure of Refinery [35].

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 about 60 millions €, 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 sulfur content not exceeding 10 ppm.

During 2015, reconstructions were carried out at the C-2200 Vacuum Distillation Plant, which included the reconstruction of 16 pumps in order to increase reliability in operation. Also, the project LDAR (leak detection and repair) was implemented. A closed sampling system was also implemented, which is a significant contribution to the preservation of the environment. The overhaul at the FCC plant and the SARU plant has been successfully completed. A conceptual study and a basic project of deep processing were developed by the CB&I.

In 2016, the realization of Deep Processing project ("Coking") continued which is the second phase of modernization of the refining complex, with the aim of completing the desulphurisation process in refinery capacities.

Also, the capital overhaul at the Pančevo Oil Refinery was successfully carried out. During the capital overhaul, a hydrocracking catalyst was replaced in order to increase the yield of medium distillates.

The contract for the implementation of the project „Deep Processing” was signed, a new heat exchanger Packinox was put into operation, a gas line installation project was completed. New types of oil "Kirkuk" and "Forcados" have been started.

The deconservation and start of the plant "Small" atmospheric distillation and Mercox kerosine were performed in order to increase the volume of processing and production efficiency.

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

The project also includes the implementation of delayed coking technology as the second phase of modernization of processing capacities of the oil refinery in Pančevo.

This project will allow the increasing of depth of processing (to 92%) and increasing of production of white derivatives (to 85.8%), while simultaneously it will improve and increase the efficiency of the processing process, the availability of the plant and the maximization of level of optimization of energy costs.

The realization of the project, along with other measures that will also be implemented in the Pančevo Oil Refinery, the Energy Intensity Index (IEI, determined based on the Solomon methodology) will be 107. The IEI is measured in relation to the refineries whose index is 100. So, the Pančevo Oil Refinery will be almost equated with world refineries whose IEI is positioned as a benchmark index [3].

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 PE 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 center 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 2016, PE Transnafta performed in line inspection of the section from the border with Croatia to Novi Sad, and for the year 2017, the remediation of critical sites was planned according to the obtained test report.

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.

PE Transnafta applies valid document Rules of the transport system [49] 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.

PE Transnafta elected the contractor in 2016 and in 2017 the reconstruction of manipulative pipelines at Terminal Novi Sad will be carried out.

PE 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) [50].

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.

PE 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 2016, the geodetic and hydrological psychiatric substrates have been completed, while in 2017 the Project for the execution of the section Pančevo – Smederevo will be completed.

The preliminary design includes sophisticated equipment for remote control and monitoring and 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) [35].

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. 92/2016) [51].

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 a 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).

5.7. Capacities for Import and Export of Crude Oil and Petroleum products

According to the data from the Energy Balance for 2014 [52], 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 2016, was imported 2,190,012 tonnes of crude oil [19].

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 Djerdap 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 [35].

The condition and capacity of railway tracks in Serbia represents a limiting factor for significant applications in imports of crude oil [35].

Domestic crude oil is transported by pipeline from the dispatching stations to Novi Sad Oil Refinery and depending of needs, the 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 PE 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 [35].

The transport of crude oil by tanks 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 unfavorable rheological properties can not be transported by pipeline [35].

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 and "Jugoslovensko rečno brodarstvo a.d. Beograd" 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. [35].

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 [53] 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 (Table 31) it is seen that 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 2016, the crude oil is from Russia, Kazakstan, Iraq and Nigeria, while the refinery gas is from Russia.

The primary petrol is from Croatia, while the motor gasolines are mostly imported from Hungary, Austria and Romania and because of that we have many big international companies such as OMV, Mol, Lukoil. We imports from Hungary the largest amounts of fuels [36].

Diesel fuels are imported from different areas opposed to gasolines: Hungary, Romania, Bulgaria and Slovakia. The paraffins, bitumens, petroleum coke and lubricants include different spectrum of products [36].

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 [36].

Compared to 2013 and 2014 in 2015 and 2016, the number of countries from which significant quantities of derivatives are imported are reduced.

Table 31: Table of geographic origin of imported fuels [36]

		%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		0,87									•		•	
AT	Austria		0,50				•			•		•	•		•
BA	Bosnia and Hercegovina		3,20									•	•		
BE	Belgium		0,41								•				
BG	Bulgaria		8,70						•				•		
BY	Belarus		1,24		•										
CN	China		0,00										•		
CZ	Czech Republik		2,78		•										
DE	Germany		0,94								•		•		
ES	Spain		0,01								•				
FR	France		0,03												•
GB	Great Britain		0,04									•	•		
GR	Greece		0,53								•		•		
HR	Croatia		5,50		•	•								•	•
HU	Hungary		30,14		•		•		•	•	•	•	•	•	
IN	India		0,05								•				
IT	Italy		2,43							•	•		•	•	
KZ	Kazakhstan	5,57	0,03		•										
LT	Lithuania		0,04								•				
MD	Moldavia		0,50						•						
MK	Republic of Macedonia		0,11		•						•				
NL	Netherlands		0,40		•						•				
PL	Poland		2,70		•										•
RO	Romania		28,17		•		•		•	•				•	
RU	Russian Federation	59,98	3,70	•	•								•		
SE	Sweden		0,01										•		
SI	Slovenia		0,50								•			•	
SK	Slovakia		4,70				•		•					•	
TR	Turkey		0,60								•				
UA	Ukraine		1,13		•				•						
NG	Nigeria	4,01													
IQ	Iraq	30,44													
	Other		0,04												

6. CONCLUSION

In period of previous two years there were no emergency situations relating to natural disasters or significant disturbances on energy product market. However, based on gained experience from 2014 and major floods with significant consequences, determination of guidelines and formation of the long-term measures for responding was continued. Such measures include regular updating and appending of plans for protection against sudden heavy rains and floods. In addition, the occurrence of stormy winds, as well as mini tornadoes, results with the collapse of the pillars of power lines, mostly in the distribution and rarely in the transmission power system. In the medium term, the measure is timely planning and inventory management for the needs of ongoing investment activities, as well as for cases of unforeseen situations. In the long-term measures, one can consider changing the type of pillars on a some route and relocation and re-designing the route.

In addition, problems is also ice rain in combination with low temperatures, which creates major problems for the overhead electricity network, especially at low voltage network and in mountainous areas. Therefore, interventions in these cases are very difficult and can take a few days.

In accordance with the above, continuous measures for reducing the risks in the supply of electricity are maintenance of the transmission and distribution power network, in accordance with the planned of competent energy entities, as well as the planning and development of the transmission and distribution power network.

Regarding electricity, Serbia is generally in large manner energy safe and independent. Production capacities continue to meet the needs of demand, and in the total amount and exceed. Electricity import is realized during winter in order to meet demand picks, while produced electricity surplus is exporting during rest of a year. Thereby, in the last ten years, export exceeds import. Short-term disturbances in production cannot substantially change this good condition. In the case of exceptionally strong winters, the Republic of Serbia has the potential to import electricity from different directions of supply, due to its good connection with neighbors over interconnection transmission lines. In fact, very good interconnection network represents only the realization of previous decisions that had the character of long-term measures to reduce the risk of electricity shortages.

When it comes to natural gas, there is a downward trend in production in the country, since most of the gas fields are in the final stage of exploitation. In recent years, there has been no significant discovery of new sites, which will result in a steady increase in imports of natural gas. On the other hand, looking at the energy balance of the country, there is a steady increase in consumption of this energy in all sectors of consumption. The underlying risk when supplying natural gas is that gas is predominantly provided from one end source and one line of supply. In the previous period, there was a situation where, without the influence of the Republic of Serbia, there was a significant reduction in the delivered daily quantities of imported natural gas into the system. Short-term measures are the withdrawal of stored quantities from the Banatski Dvor underground storage and interventional gas supply from countries in the region, as well as the substitution of this energy source by other energy sources (to the maximum extent possible). Medium-term measures include the expansion of capacity and the construction of new underground gas storage facilities and their closure (on which results have been observed in recent years as can be seen from the report itself). Also, the medium-term plan should also contain a strategy for a significant investment of funds in the exploration of potential geological locations in order to discover and bring about the production of new gas fields in the country. Long-term measures include the inclusion in international projects for new directions of supply as well as the provision of contracts for the supply of natural gas from new sources. In this way,

the security of supplying the domestic natural gas market is significantly improved, reliability of the system is ensured, and the possibility of purchasing natural gas under more competitive conditions is opened up. The possibility of reducing the transit costs, as well as the possibility of supplying natural gas from Russia and other directions of supply, is opening up. South Corridor (Azerbaijan, liquid natural gas from the terminal in Greece, etc.), construction of interconnectors with the Republic of Romania, as a direction of supplying Algerian gas from the Republic of Italy through the Republic of Croatia or through the future terminal for liquid natural gas in the Republic of Croatia (envisaged capacity 5- 6 billion m³). Preparations are under way for the construction of interconnectors with the Republic of Bulgaria on the basis of the Agreement on the construction of the Niš-Dimitrovgrad-Sofia gas pipeline, which would significantly contribute to increasing the security of supply. The agreement was signed in 2012.

Significant progress in security of supply increasing, in terms of crude oil and oil products, was achieved through the establishment of a system of mandatory reserves of the Republic of Serbia and the implementation of the storage filling dynamics in accordance with the adopted Action Plan. 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 (public private partnership).

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. 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.

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, 2015 and by December 31, 2018. for diesel fractions. 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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