

## ENERGY SECURITY OF THE REPUBLIC OF SERBIA

**P**rimarily task of the energy system of the Republic of Serbia is to provide safe and continuous access to energy resources at sustainable prices, respecting all the principles of a healthy environment. The impacts of climate change on the global economy and society will lead to a number of new negative consequences for society and its development resulting in the need to adapt to changing climatic conditions and reduce greenhouse gases.

The modern and accelerated development of our society is based on the ever-increasing need for energy. So far, in addition to importing, we have mostly relied on and used our own limited fossil resources.

The balance between available resources and consumption must be sustainable. Approximately 75% of energy in the Republic of Serbia comes from fossil fuels. Combustion of fossil fuels releases carbon dioxide, which is the main cause of the greenhouse effect. The use of fossil fuels, as well as their extraction from the ground, contribute to air pollution and can cause serious damage to our health and the environment.

Serbia is determined to minimize or completely eliminate these effects in the possible dynamics.

Our country understands the energy transition and green development as a new development revolution and a new growth model, which can only result in high rates of economic growth if guided through a partnership of all the members of society.

The energy crisis, which the world is currently facing, has caused a series of disruptions in the electricity, oil and gas markets and requires a more efficient operational approach in response to it, as well as responses to similar events in the future.

Respecting all relevant acts at the international level that the Republic of Serbia has accepted and ratified over the years (in 2015 - Paris Agreement, 2019 - Green Deal EC, 2019 - Podgorica, joint statement on the transition to clean energy, 2020 - Sofia Declaration on the Green Agenda of the Western Balkans) it is clear that all public policies defined today, and for the period until 2050, must contain the principles of a new growth model - green development, which entails concrete actions, introduction of carbon taxes on emissions, a gradual reduction in energy production from fossil fuels, as well as the increase in investment in healthy and renewable energy sources and energy efficiency.

It is the only way to contribute to the well-being of citizens and sustainable national and regional development.

**Our vision is energy-safe and climate-neutral economic development of the Republic of Serbia, as the regional leader in energy production.**

Greenhouse gas emissions in energy make up  $\frac{3}{4}$  of total emissions, thus making energy the focal point in combating climate change (in addition to energy, there is also transport, as well as agriculture).

Today, the world emits 51 billion tonnes of CO<sub>2</sub> per year (which is 8.5 times more than in 1950, when the annual emission was 6 billion tonnes of CO<sub>2</sub>).

The Republic of Serbia emits approximately 62 million tonnes of CO<sub>2</sub> annually, which is why the comprehensiveness of program principles in defining ways to reduce emissions, while enabling the economy to develop, is one of the most important tasks facing our generation.

## The state of energy and mining in the Republic of Serbia

### POWER ENGINEERING

When it comes to power engineering, the current electricity production is insufficient for the required level of energy security in the Republic of Serbia. For more than three decades, the Public Enterprise “Elektroprivreda Srbije” (PE EPS) has not built a single new plant for the production of electricity (the last capacity in the power industry was built in 1991). The production thermal blocks are outdated and in poor condition, leading to frequent interruptions in work caused by breakdowns, which is why the Republic of Serbia resorts to importing electricity in such situations.

The old blocks themselves are already insufficiently efficient, with additional inefficiencies resulting from the poor quality coal used in them. The homogenization of coal is delayed, even though proper conditions exist, as is the case with the unjustifiable delay of the construction of new production capacities and modernization of existing thermal and hydro power plants, as well as the construction of plants using renewable energy sources.

The total installed capacity of the TPP is 4,451 MW. The total installed capacity of power plants in Serbia is 8,606 MW, excluding those on the territory of the Autonomous Province of Kosovo and Metohija, including power plants of independent producers.

Past years have been marked by inconsistent development of production capacities with the development of the transmission and distribution system, for which there is no clear reason or justification, except for system closure and non-fulfillment of basic postulates of the strategy and action plan, thus endangering the country's energy security.

Plants for the use of renewable sources for the production of electricity (hydro, wind, solar, biomass, biogas, H<sub>2</sub>) in the private sector are underdeveloped. There is no mechanism to allocate

electricity produced in the Republic of Serbia, using the spatial and energy resources of the Republic of Serbia, as a priority for the needs of the Republic of Serbia.

There is no strategic planning of spatial and any other capacity development using renewable energy sources (RES). Coordination and harmonized development among energy entities did not exist and this requires intensive work.

The infrastructure of the transmission system is also underdeveloped, which was often developed *ad hoc*, when it was necessary to satisfy the interests of certain groups, instead of strategically developing and creating the basis for connecting the Republic of Serbia with the region.

The infrastructure of the distribution system is primarily outdated and maintained insufficiently or not at all, which is why both citizens and the economy in certain parts of the Republic of Serbia suffer from frequent power outages.

Many rural areas are barely able to receive electricity, if at all.

Losses in the distribution network are unacceptably high - over 13%, or approximately 3.5 TWh in the network whose value significantly exceeds EUR 300,000,000 per year, making the distribution sector "lose" enough money, in just a few years, which could be used to build a power plant or modernize the distribution network (depending on the price at which electricity is procured to cover losses).

In order to develop the supply of electricity, the Republic of Serbia is working intensively on the development of domestic, but also on connecting with the surrounding electricity markets. A better offer will certainly provide more favorable conditions for end-customers, and all of the regulations necessary for the basis of everything mentioned in relation to the market have already been adopted.

The two main goals are:

- a) Establishment of the national electricity market on the principles of competition, publicity and transparency, which will enable consumers to have freedom of choice in terms of electricity supply, taking into account that the price should depend on supply and demand;
- b) Establishment of the regional electricity market and its integration into the energy market of the European Union, which will enable significant investments and contribute to the economic development and stability of the economy of the country and the region.

The law enables all end customers in the Republic of Serbia to buy electricity on the free market and that the right to guaranteed supply, i.e. supply at regulated prices, can only be used by households and small users. 51.4% of end-user consumption is supplied at regulated prices, which is the consumption of households and small customers.

## NATURAL GAS

The Republic of Serbia is dependent on import for its gas needs, providing only 10% of its needs from domestic production, and everything else through import from the Russian Federation.

Increasing the level of connection with neighboring markets and countries, construction of new underground storage facilities and expansion of existing ones, which would provide natural gas reserves, as well as the development of distribution network, are the main issues and challenges when it comes to natural gas market supply in the Republic of Serbia.

Connections with neighboring markets, gas reserves and the development of the distribution network are the main issues related to natural gas energy in Serbia.

The activity of natural gas transport and transmission system management in Serbia in 2020 will be performed by two transmission system operators (TSO), “Transportgas Srbija” Ltd. Novi Sad and “Jugorosgas –transport” Ltd. Nis.

The total length of the transport system at the end of 2020 was 2,539 km (“Transportgas Srbija” Ltd. - 2,414 km (95%), “Jugorosgas-transport” Ltd. - 125 km (5%)).

The activity of distribution and distribution system management is performed by 31 distribution system operators (DSO). The length of the distribution network at the end of 2020 was 19,883 km.

At the moment, the division by final consumers is 10% population whereas 90% are large consumers, industry and plants for the production of thermal energy in district heating systems.

The activity of storage and management of the natural gas storage at the only natural gas storage is performed by the storage operator “Banatski Dvor” Ltd. (capacity - 450 million m<sup>3</sup>, maximum daily displacement capacity 5 million m<sup>3</sup>/day).

There is a possibility of expanding the storage capacity and building new storage facilities.

Until January 2021, the Republic of Serbia had only one direction of gas inflow: Russia-Ukraine-Hungary-Serbia, making it dependent on the energy-political relations between Russia and Ukraine.

As of January 1, 2021, the Republic of Serbia has diversified its natural gas supply routes and is additionally supplied from Bulgaria by the Balkan Stream gas pipeline (length of the gas pipeline through Serbia - 402 km, annual capacity - 13.88 billion m<sup>3</sup>), operated by the company “Gastrans” Ltd. Novi Sad.

On October 1, 2021, the transport of natural gas to Hungary from the direction of Bulgaria began with this gas pipeline.

Having in mind the importance of security of gas supply, the construction of several gas interconnections with the surrounding countries has been planned for decades, but it has not been realized.

After more than a decade, on February 1, 2022, the Republic of Serbia began the construction of the gas interconnector Serbia-Bulgaria (Nis-Dimitrovgrad), which will be operational in 2024.

The construction of other interconnectors would enable the natural gas market of the Republic of Serbia, which now has one supply route and two handover points (Zajecar and Horgos), to further open and allow for the presence of more suppliers, thus leading to more favorable supply conditions and higher degree of energy independence.

At the moment, the Republic of Serbia is limited to the supply of natural gas from only one supplier, namely the Russian “Gazprom”, which is why the diversification of suppliers is just as important as the diversification of routes.

Diversification of supply routes is a fundamental task in the forthcoming period in order to ensure even more stable and secure market supply, provide a favorable climate for potential investors and increase the level of gasification of Serbia, which is currently regionally uneven and insufficient. Supply security and stability would contribute to additional incentives for the development of the economy as a whole.

Diversification of routes and suppliers through interconnectors with neighboring countries and their gas pipeline systems would enable the supply of natural gas to the Serbian market from the Caspian Sea region, by connecting to the Southern Gas Corridor, delivering natural gas from the Leviathan field in the Mediterranean, and connecting to LNG terminals in Croatia and Greece.

It would also enable the delivery of natural gas from underground storage facilities in countries in the region and throughout Europe.

Connecting with the countries of the region via gas interconnectors would enable the formation of regional cooperation for the supply of markets of the Republic of Serbia and the region on the basis of cooperation in case of crisis situations.

In order to raise the level of security of natural gas supply, it is necessary to form strategic reserves of natural gas and expand the existing ones, i.e. build new storage capacities.

## **OIL AND PETROLEUM PRODUCTS**

**T**he market of oil and petroleum products is open and it has multiple participants, the dominant one being the NIS JSC. The companies “Lukoil”, “OMV”, “MOL Serbia”, “EKO Srbija Petrol” and “Knez Petrol” also have a significant share of the market.

There is one modern refinery, whose capacities meet the needs of the Serbian market.

Exploration and production of crude oil take place in 64 oil fields with 796 active boreholes in operation in Serbia. In addition to these, in 2020, an additional 38 trial pits and 3 exploratory holes were drilled.

It is estimated that the reserves of domestic oil and natural gas will be depleted in 15 years, if this exploitation rate continues.

The transport of oil through oil pipelines is performed by the Joint Stock Company for the transport of oil through oil pipelines and the transport of petroleum products through the product pipelines “Transnafta” Pancevo.

The total consumption of crude oil and semi-finished products estimated in 2021 is approximately 3.575 million tonnes, which is 0.3% more than in 2020. 0.836 million tonnes were provided from domestic production, and 2.739 million tonnes from imports. Further growth in consumption is projected.

The total estimated consumption of motor fuels in 2021 was approximately 2.39 million tonnes, which is 0.3% more than in the previous year. In the structure of this consumption of motor fuels, gasoline participated with 17%, gas oils with 78%, and LPG with 5%.

The formation of reserves of oil and petroleum products for emergency situations is the main problem when it comes to oil energy in Serbia.

Increasing the reserves of crude oil and petroleum products in the last year by 30% (from the end of 2020 to the end of 2021) has further improved security of supply in the market of the Republic of Serbia in case of any disturbances and at this moment ensures smooth operation for 25 days, with a plan to reach 61 days, measured according to average daily consumption.

Energy stability and independence in all situations are the backbone of the economy as a whole and guarantee its smooth functioning even in situations of disruption in energy supply.

By increasing its energy reserves, the Republic of Serbia has risen to the very top in the region.

## TRANSPORT

**A**ccording to publicly available data, there are a total of 35,487 registered mopeds in the Republic of Serbia, 41,535 motorcycles, 2,164,818 passenger cars, 9,900 buses, 255,954 trucks and they all use fossil fuels.

There is a growing trend of hybrid vehicles, electric vehicles, and a decline in the number of LPG vehicles, which is an alternative fuel.

According to the data for 2020, in the Republic of Serbia, the number of registered hybrid vehicles was 2,008 (petrol-electric and diesel-electric), 2,576 vehicles with combined fuel and only LPG-powered vehicles 109,198 (petrol-LPG, diesel-LPG and only LPG), the number of vehicles that use CNG as fuel (6,461) (natural gas as the only fuel or in combination with gasoline or diesel), and there is one vehicle registered for hydrogen propulsion, as well as three vehicles registered to use petrol/ethanol as fuel.

The railway is 75% electrified. In some cities, such as Belgrade, up to a third of transportation uses electricity for propulsion.

Electrification of railways, as well as incentivizing the purchase of electric vehicles, whether passenger or urban vehicles, is a future challenge.

## THERMAL ENERGY

**P**roduction, distribution and supply of thermal energy is performed in 61 heating plants, 17 power plants, 2 CPE plants and 3 thermal power plants. Out of a total of 61 heating plants, 33 heating plants use natural gas as their primary energy source, 18 heating plants use heavy fuel oil, 6 heating plants use coal, while 4 heating plants use biomass.

In the total consumption of energy products for the production of thermal energy, gas participates in heating plants with 80.6%, petroleum products with 9.2%, coal with 9.7%, biomass with less than 1%.

The observed problems in the production, distribution and supply of thermal energy are the dilapidation of plants, equipment and devices, as well as the dilapidation of the network resulting in the occurrence of large losses.

The average age of the distribution network is approximately 22 years, plants 28 years and thermal substations approximately 14 years.

The average efficiency of the production system is 89.59%, the distribution system 87.94%, and the average heat loss in the network is 12.06%.

## ENERGY EFFICIENCY

**C**ritical point of the Republic of Serbia's energy security is also the high energy intensity per unit of social product, i.e. low energy efficiency. Approximately 40% of final energy is consumed within the household sector.

It is estimated that the average consumption of thermal energy per square meter in households in Serbia is 2.5 times higher than the average consumption in the EU, and there are also households with far higher consumption than the average.

Approximately 38% of total energy consumption in households is consumed in the form of electricity, while this percentage in the EU is below 25%, which indicates that households still use electricity mainly for heating purposes, and in recent years even more for cooling purposes.

An additional problem in identifying a situation clearly and in preparation for decision-making is the lack of systematized data on energy consumption in the public sector, as well as insufficient implementation of the energy management system in the public sector. The energy management system should help to monitor energy consumption and identify opportunities to reduce it.

According to the projects implemented so far with the aim of increasing energy efficiency in the public sector, on average, savings of approximately 40% in energy are achieved, while energy savings of up to 60% can be achieved.

## RENEWABLE ENERGY SOURCES (RES)

**T**oday, the Republic of Serbia has 336 power plants using RES with a total capacity of approximately 2.91 GW, which include 13 large and medium hydropower plants (HPPs) with a total capacity of 2.35 GW, and approximately 0.56 GW are other technologies on RES.

Having in mind the high hourly efficiency of the installed power of the thermal power plant (TPP), in order to replace 4.4 GW of coal-fired TPPs in the coming decades, it is necessary to build replacement capacities that use hydro, wind and solar. It is estimated that by 2050 it will be necessary to construct a total of around 21 GW of RES capacity - hydro, wind and solar.

However, in order to achieve the goals in terms of reducing greenhouse gas emissions for 2050, it is necessary to build a total of 21-22 GW of power plants that use RES - hydro, wind and solar.

In previous years, the publicly proclaimed national targets for the use of RES have not been achieved, nor have explanations been given for this failure. In addition, these are the goals to which Serbia has committed through its program during the EU negotiating process, but they are also goals that would enable far lower greenhouse gas emissions.

The directives of the Energy Community, as well as the Ministerial Council, set a binding target for the Republic of Serbia in 2012, which is 27% of renewable energy sources in its gross final energy consumption in 2020, and Serbia reached 26.3% in 2020.

Bearing in mind the estimates that global energy consumption in the world will increase by between 50% and 100% by 2050, in addition to promoting savings and rational use of energy as national values and principles and ensuring adequate oil and natural gas reserves, it is necessary to diversify the directions and sources of energy and energy supply and engage in the construction of new electricity generation capacities that will use renewable energy sources.

An energy transition that will enable an increase in the share of renewable sources in the energy mix that will guarantee both energy security and environmental protection and increase the production of biofuels requires huge financial resources. This challenge, but also a possibility, represents a new development opportunity for the whole world, including the Republic of Serbia, and a completely new growth model that will provide healthy, clean and green economic development through new investments.

In addition, the production of energy from renewable sources has the potential to affect energy security, especially in remote areas, and to ensure supply independence in case of electricity shortages and rising prices, thus contributing to reducing dependence on electricity imports.

By completely replacing low-calorie and low-quality coal with RES capacities, the most important issue of future development is being realized, that is energy security, i.e. the secure supply and stability of the system.

Ensuring the stability of the system that uses RES is achieved through energy storage (pumped-storage hydropower plants and batteries) and renewable hydrogen, i.e. hydrogen storage facilities.

Also, it is necessary to create further opportunities for citizens to participate in the energy transition, i.e. to apply the legal concept of prosumer by installing solar panels on the roofs of households and residential communities.

The estimated surface area of roofs in the Republic of Serbia on which solar panels can be installed is 600 km<sup>2</sup>. In that sense, every building on which solar panels are installed is somewhat energy independent, achieving the ultimate goal in energy - energy security.

## MINING

In the structure of primary energy production, coal participates with 68.5%, oil with 8.0%, natural gas with 3.1%, hydro potential with 7.2%, biomass with 11.8%, while geothermal energy, solar energy, wind energy and biogas account for 1.4%.

According to the latest statistics, electricity production in the Republic of Serbia from TPPs is 68% of total electricity production, production from HPPs is 27%, while the other 5% is production from wind farms, solar power plants, biomass power plants, biogas and industrial power plants.

The Republic of Serbia has reserves of low-calorie lignite coal, with low thermal power and high percentage of ash and moisture, which is ranked as the worst type of coal, primarily in the Kolubara and Kostolac basins, which requires larger amounts of other energy-generating products during its combustion process.

Coal production exceeding 30 million tonnes during the year due to reduced coal quality and increased specific consumption of coal in thermal power plants is not enough to balance the planned electricity production due to reduced thermal capacity of coal.

High specific consumption of coal affects the increase of carbon dioxide emissions into the atmosphere, which can be a particularly aggravating fact in the coming period.

Based on the existing project documentation and the documentation that is being prepared, the Mining Basin “Kolubara” (MBK) can excavate a maximum of 31 million tonnes. Based on the current specific consumption of coal, 35 million tonnes of coal are needed for the existing units in the Thermal Power Plant “Nikola Tesla” and that amount will increase, which once again, in addition to all other parameters, shows a deficit in coal quantity and quality.

Excessive coal production, as well as the work of basic machinery on the production of overburden in irregular working conditions, leads to accelerated wear of vital assemblies on basic equipment, which in the absence of preventive and ongoing maintenance of equipment results in insufficient operational readiness of machinery, frequent unplanned and emergency equipment outages, which can certainly endanger the stability of the country's electricity system in the coming winter period, but also in the years to come.

The state-of-the-art coal quality management system, which was completed at the end of 2020, due to the desire to achieve production in quantitative terms is not used to homogenize coal and achieve the required quality of coal for TPPs, resulting in failure to achieve heat balance and planned electricity production, even with the realized excessive coal production, in quantitative terms.

The consequences are visible in an evident decline in the production of overburden, which is the main cause of the reduction of discovered coal reserves, but also a decline in coal production, which is already, in addition to the decline in coal quality, quite visible.

#### Mines in Serbia

Type of mineral raw material	Active companies that exploit mineral resources	Number of exploitation fields	Annual production	Production value (in RSD billion)
Metallic	7	13	17,000,000 t	39.1
Non-metallic	179	267	27,700,000 t	13.8
Coal	3	12	38,700,000 t	65.5
Oil and gas	2	45	868,218,820 t of oil 431,451,343 m <sup>3</sup> of gas	24.1 10.3
Total	191	337		153.2

Companies exploiting metallic mineral raw materials: “Serbia Zijin copper”, Mine “Lece”, Mine and Flotation “Rudnik”, “Bosil Metal”, “Grot”, “RMHK Trepca” and “Veliki Majdan”, “Serbia Zijin Mining” (Ex. “Rakita”).

Total balance reserves of metallic mineral raw materials in the Republic of Serbia amount to approximately 1,338,913,444 t, of which the most represented are copper reserves - about 98%, while other metallic mineral raw materials participate with 2%: lead-zinc, antimony, molybdenum, etc.

Total balance reserves of non-metallic mineral raw materials in the Republic of Serbia amount to 2,958,097,352 t, plus 8,523,954 m<sup>3</sup> (for some non-metallic minerals the reserves are shown in tonnes, and for some in m<sup>3</sup>), where the Republic of Serbia has the largest reserves in sedimentary carbonate rocks as raw materials for the production of technical-construction stone around 41%, then raw materials for the cement industry around 13%, carbonate raw materials for the processing industry around 10%, etc.

The preliminary estimated value of the confirmed reserves of mineral raw materials is EUR 150 billion, and with the included reserves of boron and lithium, as deposits of copper and gold in “Cukaru Peki”, this value exceeds EUR 250 billion.

## STRATEGIC AND LEGISLATIVE FRAMEWORK

**S**even years after the last changes in the legislative framework, in 2021, the Republic of Serbia, used all its resources in defining the basis and conditions for energy transition and establishing a new green growth model.

The pillars of energy development, energy security and environmental protection are:

1. **Energy efficiency growth** (reduction of energy intensity),
2. **Increase in the share of renewable energy sources** in the energy mix,
3. **Regional connectivity** in order to increase the security of the system, but also to diversify the supply routes and
4. **Investments in the energy and mining sectors.**

In April 2021, the Republic of Serbia **amended the complete legislative framework in the field of energy and mining**, with the aim of providing conditions for energy independence, as well as the need for further harmonization with the regulations of the Third Energy Package of the EU energy legislation and certain provisions of the EU Clean Energy Package for all Europeans.

The following laws have been adopted:

- Amendments to the Law on Energy,
- Law on Energy Efficiency and Rational Use of Energy,
- Law on the Use of Renewable Energy Sources,
- Amendments to the Law on Mining and Geological Research.

Two laws are especially important: **on renewable sources and energy efficiency** - aimed at creating conditions that enable new investments and the growth of the share of renewable energy sources in the energy mix, with a constant growth of energy savings. All this makes it possible to reduce the impact of the energy sector on the environment and contribute to the sustainable use of natural and other resources.

In addition to the stated legal framework, the **Law on Climate Change** was adopted and the low-carbon development strategy of the Republic of Serbia is expected to be adopted.

Strategic documents, which are the vision of the future energy sector of the Republic of Serbia, but also a condition without which it is impossible to start the energy transition or the

realization of the green agenda, are the national plan for energy and climate, as well as the energy development strategy.

The Republic of Serbia has begun **drafting a national plan for energy and climate**, which will define measures to reduce greenhouse gas emissions and set targets for increasing the share of RES, as well as increasing energy efficiency for 2030 with projections until 2050.

Drafting of a new **strategy for the development of the energy sector** until 2040, with projections until 2050, is underway with the accompanying program of strategy implementation, of which the hydrogen strategy is an integral part, bearing in mind that hydrogen is expected to be a significant energy source in the future.

The Republic of Serbia has not introduced a mechanism for GHG emissions trading (ETS) as is the practice in the European Union and has not yet introduced mechanisms for setting the price for CO<sub>2</sub> nor has it introduced the CO<sub>2</sub> tax.

The Ministry of Mining and Energy, in agreement with all partners, has defined a new **investment plan** with projects in energy and mining worth over EUR 35 billion, of which more than EUR 21 billion is planned for projects related to hydropower plants, solar power plants and wind farms.

The investment plan will be realized in the years and decades ahead, in accordance with all the conditions in which the capacities of the energy sector are today.

In case of realization of all projects from the investment plan, the total CO<sub>2</sub> emissions would be reduced by approximately 30 million tonnes, which is more than half of today's emissions of this pollutant.

In addition to the already planned Kostolac wind farm (66 MW), there is a possibility of public-private partnerships with companies (all together around 3,700 MW, worth over EUR 4.2 billion).

State projects of solar power plants would be realized on state land dominated by around 8,300 ha of neglected agricultural land, on which it is possible to build around 8,300 MW of solar power plants on land structures, in the total value of EUR 4.4 billion, as well as on water bodies where it is possible to build around 650 MW of photovoltaic power plants, with a total value of approximately EUR 0.4 billion.

It is possible to install around 11,000 MW of photovoltaic systems on the roof surfaces, with a total value of approximately RSD 11 billion.

Approximately 1,400 MW of solar power plants worth up to EUR 2 billion can be built on the land of PE EPS. A total of 21,350 MW in the field of solar energy, with a total value of about EUR 17.8 billion. Two reversible HPPs are planned, "Djerdap 3" and "Bistrica", with a total

capacity of approximately 2,500 MW, it is possible to build another 300 MW on the Ibar and Morava Rivers (a total of 2,800 MW, worth approximately EUR 3 billion).

The policy and goals of reducing GHG emissions are directly related to the work of the energy sector and energy security of the country, as well as the level of investments and therefore have a special significance for the energy of the Republic of Serbia.

*Potential project opportunities - investments in energy and mining of the Republic of Serbia*

<b>Potential</b>		investment (EUR billion)	private (EUR billion)	state (EUR billion)
<b>The value of projects in the field of electricity</b>		<b>7.74</b>	<b>0.00</b>	<b>7.74</b>
The value of projects in the field of solar and wind energy	Solar power plants	17.86	16.65	1.21
	Wind farms	2.52	2.41	0.11
Biogas power plants		0.32	0.32	0.00
Geothermal power plants		0.05	0.05	0.00
Construction of power plants which use waste and landfill gas		0.74	0.74	0.00
<b>Total value - renewable sources</b>		<b>21.49</b>	<b>20.17</b>	<b>1.32</b>
<b>Projects in the area of hydrogen strategy</b>		<b>0.95</b>	<b>0.25</b>	<b>0.70</b>
The value of projects in the oil and gas sector	oil	0.25	0.70	0.18
	gas	0.92	0.57	0.86
<b>Total value - oil and gas</b>		<b>1.17</b>	<b>0.13</b>	<b>1.04</b>
<b>The value of projects in the field of geology and mining</b>		<b>1.07</b>	<b>1.04</b>	<b>0.027</b>
The value of projects in the field of thermal energy and energy efficiency	thermal energy	1.07	0.00	1.07
	biomass	0.006	0.00	0.006
	energy efficiency	2,610	1.15	1.45
<b>Total - heating plants and energy efficiency</b>		<b>3.69</b>	<b>1.15</b>	<b>2.54</b>
<b>TOTAL</b>		<b>36.11</b>	<b>22.74</b>	<b>13.37</b>

The investment in mining is significant and refers especially to the renovation and expansion of the smelter in Bor, but also to the underground coal gasification project, the Public Enterprise for Underground Exploitation “Resavica” and the project of constructing a plant for producing anthracite filters in the mine “Vrska Cuka-Avramica”.

The value of required investments in the electricity sector is over EUR 7.5 billion. Of that, ongoing projects (investments in mining equipment, revitalization of TPP units, ecology, as well as the construction of the Trans-Balkan corridor, high-voltage network and transformer stations) make up 20%.

Among the planned projects, it is important to point out investments in the construction of pumped-storage hydropower plants, investments in mining equipment, further construction of high voltage network and connection with the region, remote control, new meters and network automation.

In the field of raising energy efficiency, the planned investments exceed EUR 3 billion, and they are especially related to the construction of biomass heating plants, eco-loans, energy rehabilitation of residential buildings, family houses, apartments, such as construction of CHP Kragujevac, CHP Nis, reconstruction of CHP Novi Sad, but also raising energy efficiency of the Military Medical Academy by using RES.

Investments in the field of oil and gas are especially allocated for the construction of storage capacities for gas, as well as emergency reserves of derivatives, but also gas interconnections to Bulgaria, Montenegro, Northern Macedonia, Bosnia and Herzegovina, Romania, Croatia, as well as investments in new crude-oil supply routes (Hungary-Serbia), and the construction of a product pipeline through Serbia (Pancevo-Smederevo and Pancevo-Novı Sad).

## STRATEGIC DIRECTIONS OF DEVELOPMENT

1. **Energy security** - as a basic priority of the country's development, achieving national and economic security, through maximizing independence from energy and energy imports, with sufficient quantities of energy and energy-generating products, in accordance with future energy needs.
2. **Energy security** - continuous supply in various forms and sufficient quantities, and at acceptable prices.
3. **Energy efficiency of buildings** - reduction of energy intensity per unit of gross domestic product.

4. **Just energy transition** - transition from a system in which non-renewable sources are mainly used for energy production - fossil fuels, to a system based on the use of renewable energy sources, as well as those energy resources that do not pollute the environment, which further requires major changes in production technologies, but also changes concerning the management of energy production, distribution and consumption.

5. **Decarbonisation** - carbon neutrality by 2050 and reducing net emissions to zero.

In order to solve the stated program goals, the following short-term, medium-term and long-term solutions are proposed.

➤ **Electricity**

**Short-term solutions:**

- Raising the level of success and profitability of electricity companies with the urgent launch of a new investment cycle and defining an action plan for economic and domestic functioning of state-owned companies in the field of electricity (EPS, EDS, EMS).
- Establishment of a new company “Green Energy of Serbia”, with the task of building new capacities that use renewable energy sources at the level, i.e. in the quantities, necessary to achieve energy security of the Republic of Serbia.
- As a precondition for high RES integration is the improvement of the transmission network, urgent replacement of obsolete transmission lines and substations, but also the construction of new and internal and inter-connective transmission infrastructure, not only by finding solutions by choosing a strategic partner, but also through far more efficient maintenance and the construction of the missing infrastructure. The completion of the Balkan Interconnection DV (Trans-Balkan Corridor Sec. 2 and 3...4 is conditional).
- Due to limited natural and spatial resources, but also limited access to the transmission and distribution network, it is necessary to take measures of strategic planning when it comes to using space for energy facilities, as well as finding a way to increase the state company's share in projects, particularly for large RES plants. It is necessary to, in a way, ‘reserve’ the space for RES plants.
- Modernization of the system through all segments, from the manufacturer to the end customer (user), in order to increase the quality of delivery; constant work on detecting unauthorized consumption, procurement of new meters (two-way, due to the existence of prosumers), removal of obstacles on the routes, repair of damaged poles and distribution lines in the entire territory of the Republic of Serbia and the automation of the distribution network.
- Connecting the electricity market of the Republic of Serbia with the surrounding markets will greatly improve competitiveness, i.e. supply and demand conditions; it will also be the basis for the development of interconnections, thus ensuring the stable functioning of the electricity systems of countries whose markets are connected. The precondition for the

mentioned connection is the adoption of the decree on the coupling of organized day-ahead and intra-day electricity markets.

### **Long-term solutions:**

- Construction of plants for the production of electricity from renewable energy sources, pumped-storage hydropower plants, as well as storage for electrical energy, but also gas power plants as a transitional solution, primarily for plants that will be 100% or majority owned by the Republic of Serbia, in order to achieve energy security (synchronize them with the plan to withdraw obsolete thermal capacity from use), with the popularization of individual (prosumer, i.e. installation of photovoltaic panels in households and industry).
- After the construction of sufficient capacities for the production of electricity from RES, the withdrawal of obsolete TPPs will begin. In accordance with the dynamics of building new capacities (other than thermal capacities), reduce production from TPPs to technological minimums or preserve them in the form of ‘cold reserves’, while providing coal reserves that would be used in accordance with the situation.
- Ensuring the balancing of RES and peak needs will ensure both the production and control of production from TPPs, together with pumped-storage HPPs and HPPs.
- Plan the replacement of old high-voltage components (power transformer stations PTS and transmission lines TL). Replacement of transmission lines with a larger cable cross-section in order to control technical losses on the network, harmonize the development plans of the transmission system with the needs and plans for the construction of new plants for the production of electricity.
- Periodically harmonize the prices of guaranteed supply with the market to an extent acceptable and appropriate to the standard of the citizens of the Republic of Serbia.

### **➤ Decarbonization**

#### ***Energy transition:***

- Increase the production of electricity and heat, especially from RES, for greater application in wide consumption in industry and transport.
- Intensified greening of areas in the Republic of Serbia and the development of planned plantations of forests and energy crops.
- Build new air cleaning plants (desulphurization, denitrification and prevention of particulate matter emissions).
- Develop new technologies for the removal of harmful gases from the atmosphere – CO<sub>2</sub> ‘capture’ and its storage in plants that use fossil fuels (hermetically sealed abandoned mines of underground exploitation, emptied gas deposits, etc.).

### ***Withdrawal of TPP - long-term***

- To determine the precise dynamics of complete closure of small, obsolete and inefficient TPP units, with a plan to keep several units in the function of experimental research plants in order to be able to use new energy sources (biomass, H<sub>2</sub> etc.).
- To determine the dynamics of phasing in of facilities into operation at the technological minimum or their introduction into the ‘cold reserve’ regime, i.e. complete closure by 2050.
- Until the complete decarbonization and cessation of the use of energy from fossil fuels for electricity production, the operation of thermal power plants only makes sense if coal of the required quality is burned, which will provide the same or higher calorific value with smaller amounts of coal than the large quantities we are currently using resulting in huge carbon dioxide emissions.

### ➤ **Natural gas**

#### **Medium-term/long-term solution:**

- In order to achieve stability and security of natural gas market supply, urgently initiate the expansion of Banatski Dvor gas storage to the maximum capacity, one billion m<sup>3</sup> of storage capacity, which would provide sufficient natural gas reserves for its needs in winter (through the use of natural gas from Underground Gas Storage “Banatski Dvor” only would provide uninterrupted supply for 40 days based on current consumption).
- Construction of a storage facility (Itebej) for storing gas reserves of neighboring countries and supporting the establishment of a regional gas exchange.
- Acceleration of gasification of the entire territory of the Republic of Serbia, construction of a gas distribution network in all settlements and substitution of solid fuels with natural gas by large consumers.
- Establishing strategic gas reserves in the amount necessary to meet the needs of 30 days of supply in the coldest winter period, which would be used as strategic reserves only in emergency situations. Strategic reserves ensure energy security and security of supply in cases of disruption and interruption of natural gas supply.
- Improving regional cooperation in the field of natural gas supply and mutual response in emergency situations in the supply of this energy source.
- Construction of new interconnectors with neighboring countries (Bulgaria, Hungary, Romania, Croatia, Bosnia and Herzegovina, Macedonia and Montenegro), as well as connection with the Autonomous Province of Kosovo and Metohija.
- Relying on long-term contracts with the most stable elements based on which the prices are formed in order to achieve the goal of ensuring the stability of natural gas supply in the

Republic of Serbia, it is necessary to further diversify supply routes through interconnectors with neighboring countries and fully open the natural gas market in the Republic of Serbia, which would result in the natural gas supply stability to the market of the Republic of Serbia, lead to more favorable conditions, and the Republic of Serbia becoming a gas hub.

- Construction of gas CHP plants as a transitional solution for the production of electricity and heat, with installed gas turbines that can use hydrogen as fuel in the future.

### ➤ **Oil and petroleum products**

#### **Short-term solutions:**

- Establishing emergency oil reserves, crude oil reserves and petroleum products that ensure uninterrupted functioning for a period of 61 days.
- Establishing operational reserves in accordance with the adopted plans.
- Construction of oil and product pipelines.

### ➤ **Transport**

#### **Medium-term/long-term solutions:**

- Reduce import dependence on oil and derivatives and reduce CO<sub>2</sub> emissions with incentives of domestic production and economy.
- The necessity to provide additional incentives (increase the budget) for the transition to electric cars.
- Prohibition of the purchase of vehicles that do not have some kind of electric drive no later than 2040. (The EU will have this ban in 2035).
- Develop a system of measures for the transition of public transport to electricity, hydrogen, biofuels and natural gas.

## ➤ **Thermal energy production**

### **Short-term solutions:**

- Intensify the replacement of boiler plants with high-efficiency boiler plants, with the possibility of all new boilers being adapted to use hydrogen as an alternative fuel in public utility companies for heat production and distribution network reconstruction.
- Transition to a new system of charging for thermal energy according to consumption by applying the Decree on the formation of the price of heating and as a final result have economically sustainable positive business.
- Replacement of the distribution network with the reconstruction and modernization of boiler rooms.

### **Long-term solutions:**

- Develop a system of incentive measures municipalities and cities provide for the use of RES in heat production.
- Intensify the use of RES in district heating systems in Serbia - enable greater participation of solar energy in district heating systems in Serbia, as well as further development and use of biomass.
- Define a clear plan for the development of district heating systems in the local self-government units which is fully harmonized with the development of the gas distribution network.

## ➤ **Energy Efficiency**

### **Short-term solutions:**

- Providing incentives for improving energy efficiency in households for energy rehabilitation of buildings, family houses and apartments in order to increase the energy efficiency of these facilities and reduce excess energy consumption by at least 50%, depending on the level of development of the municipality/city.
- Provide funds from the budget of the Republic of Serbia, donors and international financial institutions for energy rehabilitation programs in buildings, whereby energy efficiency will be achieved through the rehabilitation of residential buildings, apartments and family houses, as well as through the activation of renewable energy resources.
- Improving the Directorate for Financing and Encouraging Energy Efficiency at full capacity, which in the long run should grow into an independent fund for energy efficiency similar to those which already exist in the region.
- Introduction of energy management system in the public sector in accordance with the Law on Energy Efficiency and Rational Use of Energy and implementation of the Incentive

Program for energy rehabilitation of public buildings at the local level with a reduction of energy consumption of approximately 40%.

### **Long-term solutions:**

- Rehabilitation of existing heating systems and transition to more energy efficient energy sources that will contribute primarily to the reduction of CO<sub>2</sub>, uninterrupted supply to users, as well as cleaner air and environmental protection.
- Through the energy management system, improve energy management at the local level, energy rehabilitation and the energy efficiency of public buildings, which will reduce electricity consumption by 988 MWh/year and reduce CO<sub>2</sub> emissions by 357 t/year. Expanding the control of electricity management is also planned, which will have multiple effects of up to 500% when compared with the stated short-term goals.
- Long-term provision of incentives for improving energy efficiency in households for energy rehabilitation of family houses, apartments and residential buildings and for the use of renewable energy sources for household needs. In the period from 2021 to 2050 approximately 100 million m<sup>2</sup> of living space must be rehabilitated.  
At the same time, the annual electricity savings will amount to 500,000 MWh, while CO<sub>2</sub> emissions for the entire period will be reduced by 37% compared to the emissions from 2020.

## ➤ **Green energy**

### **Medium-term solution:**

- Achieving the goal of a minimum of 49.6% share of renewable energy sources in gross final energy consumption by 2040.
- Organizing an auction for the allocation of market premium for plants over 500 kW, or over 3 MW for wind power plants, but also solar energy.
- Allocation of feed-in tariffs for small plants below 500 kW, i.e. 3 MW for wind power plants and demonstration projects (non-commercial innovation projects) in the auction process.
- Selection of a strategic partner for the construction of RES power plants.
- Enabling citizens, the economy and the public sector to install solar panels on their facilities in order to produce electricity from RES for their own needs, as well as to place the surplus in the network through the legal concept of prosumer.
- Allocation of incentives for thermal energy for heat pumps, biomass, solar energy, geothermal energy.
- Granting incentives in traffic for the production of advanced biofuels.

- Creating conditions to encourage innovative technologies in early development that use new renewable sources, such as renewable hydrogen.

### **Long-term solution:**

- Achieving the goal of a decarbonized economy in 2050.
- Continuous and up-to-date adjustment of regulations to current measures in the field of green energy and harmonization with the energy policy of the European Union in order to achieve the desired goals.
- Support for ensuring the stability of the electricity system for the integration of a larger share of RES, i.e. the construction of hybrid power plants with electricity storage and increasing the use of renewable hydrogen.
- Improving strategic planning in order to increase the integration of the share of RES by 2050.

### **➤ New technologies - innovations**

- Develop a plan for the transition of the Morava Thermal Power Plant into an innovative-experimental center for energy development (application of hydrogen and other innovations in the field of energy).
- Through interstate agreements/contracts/memoranda/cooperation, ensure the participation of Serbian scientific community in projects related to hydrogen, nuclear energy, batteries and the like.
- Strengthening scientific and technological capacities and **the establishment of a fund for stimulating research in energy and mining.**
- Developing regional connections on the development of innovations, with special emphasis on hydrogen, CO<sub>2</sub> savings and other innovative technologies.
- Greater involvement in EU research funds in energy, especially in areas that may be suitable for the development of equipment production and IT in Serbia.

### **Concluding remarks**

**T**he world, and Serbia too, is approaching a turning point that will determine whether our civilization has a future. Depending on what we do, how we plan, and above all whether we are or will be aware of the seriousness of the impact of climate change, and at the same time our need for further development, we will determine our own

destinies - from total collapse to complete and sustainable, green economic, societal and social development.

The Government of Serbia and the Ministry of Mining and Energy are committed to sustainable and green development and to the creation of conditions for all generations to come, in the decades ahead. Changes have always taken place and the world has changed in the physical, technological, but also in the social and economic sense.

Today, when energy transition is a condition of a new paradigm of development, we meet change head-on because we want to be an active part of the energy revolution, which not only brings changes in energy infrastructure, but also a completely new way of resource management, a new growth model, and thus contributes to standards and survival of the country. Energy and environmental security is the final goal of everything we are doing.

Our vision implies a high degree of energy independence, which will enable Serbia to be a minimally import-dependent country. Serbia can, and will, work on that in the coming years, to be completely discretionary in the production of the necessary amount of electricity from its own resources. In addition, Serbia will accelerate the establishment of strategic reserves of all necessary energy sources.

We will work on encouraging the substitution of energy sources that are not produced in Serbia with those that are produced in Serbia, and through the transformation into green energy sources, we will provide a way to maintain the supply security.

Our goal is for all consumers in Serbia to have a secure and continuous supply of energy and energy-generating products at favorable and acceptable prices. Therefore, all energy entities will have to adjust their production, transmission and distribution, respecting all environmental standards.

Developing, improving and encouraging the application of new technologies and digitization will enable a higher degree of integration of our energy system, better quality of service and a high degree of energy security.

**The changes** cannot be stopped, they can be postponed, but the price that society and the economy would pay by postponing changes in the energy system would be far higher than if we set out on the path of change.

*This document was prepared by all employees of the Ministry of Mining and Energy, who are aware that they have the privilege of living in a time of change and thus the opportunity to do good for the future of their country; through their committed work*

*they are responsible not only for the development of the legislative framework and investment plan, but also for the selfless commitment to a new modern, developed and green energy-safe Serbia.*