REPUBLIC OF SERBIA
MINISTRY OF ENERGY, DEVELOPMENT AND ENVIRONMENTAL PROTECTION

REPORT ON STRATEGIC ENVIRONMENTAL ASSESSMENT FOR THE ENERGY SECTOR DEVELOPMENT STRATEGY OF THE REPUBLIC OF SERBIA BY 2025 WITH PROJECTIONS UNTIL 2030

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C O N T E N T S

INTRODUCTORY NOTES

Strategic Environmental Assessment (SEA) is an assessment of the possible impacts that a proposed project and program may have on the environment, and the specification of measures for prevention, minimization, mitigation, remediation or compensation of adverse effects on the environment and human health. The SEA implementation in planning gives the scope for considering the changes occurring in space, also taking into account the needs of the subject environment. Within the SEA, all activities envisaged in the plan are critically considered from environmental aspects, after which a decision is made on whether to implement the plan and under which conditions, or whether to abandon the planned activities.

Planning implies development, while a strategy for sustainable development requires environmental protection. In this context, the strategic environmental assessment is an unavoidable instrument for achieving the sustainable development objectives.

The SEA integrates socio–economic components with components of biophysical environment, links, analyzes and assesses the activities in different spheres of interest, as well as directs policy, plans or programs towards solutions which are primarily of environmental interest. It is an instrument which helps in integrating the objectives with principles of sustainable development when making decisions about spatial planning, thereby taking into account the need to avoid or limit negative environmental effects on health and socio-economic status of population. The significance of the SEA lies in the fact that it:

- Includes the aspect of sustainable development in addressing the causes of environmental problems in their source;
- Addresses the issues and impacts of wider significance, which do not deal with individual projects;
- Helps in checking the suitability of different alternative development concepts;
- Avoids limitations occurring in carrying out an environmental impact assessment for proposed projects;
- Ensures location compatibility of planned solutions from environmental aspects;
- Establishes a context for impact analysis of specific projects, including prior identification of problems and impacts for which more detailed analysis is needed, etc.

In domestic planning practice, the SEA is covered by the Law on Environmental Protection ("Official Gazette of the Republic of Serbia", Nos. 135/2004, 36/09 and 72/09 – 43/11 – The Constitutional Court, Art.34 and 35). Pursuant to Art.35 of this Law, "*Strategic environmental assessment shall be carried out for plans, programs and principles in the domain of spatial and urban planning or land use, **energy**, industry, transport, waste management, water resources management and other fields and shall be an integral part of the plan, program or principle*".

The SEA must be harmonized with other environmental impact assessments (EIA), as well as with plans and programs for environmental protection. It has to be undertaken in accordance with the procedure prescribed by the Law on Strategic Environmental Impact Assessment ("Official Gazette of the Republic of Serbia", Nos. 135/2004 and 88/10).

The SEA is undertaken with the aim to ensure environmental protection and enhance sustainable development through integrating the basic principles of environmental protection

into procedures for the implementation and adoption of plans. The SEA implies the "preparation of the report on the status of the environment, implementation of consultation procedure, taking into account the report and results of the consultations in decision making procedure and procedure of enactment or adoption of certain plans and programs, as well as providing of information and data relating to the adopted decisions" (Law on SEA).

Pursuant to Art.6 of the Law, criteria for identification of possible significant impacts of plans on the environment and for making decisions on undertaking the SEA are shown in Annex I. These criteria are based on: (1) Characteristics of the plan; and (2) Characteristics of environmental impact. The identification of environmental protection problems in the planning area and possible impacts of the plan on basic environmental factors are of special importance in making decision on undertaking and coverage of the SEA together with the implementation of other criteria.

The Report on Strategic Environmental Assessment has been prepared based on the decision of the Ministry of Energy, Development and Environmental Protection (No.: 312-01-00731/2013-04 of 11.06.2013) on undertaking a strategic environmental assessment for the **Energy Sector Development Strategy of the Republic of Serbia by 2025 with projections until 2030 (hereinafter referred to as the "Strategy").**

Considering the need to undertake the subject SEA, in the procedure for low-value public procurement No.15/2013, the Ministry of Energy, Development and Environmental Protection of the Republic of Serbia, as a promoter of the SEA, has commissioned the Institute of Architecture and Urban & Spatial Planning of Serbia to undertake the SEA, with which the Ministry signed the Agreement on Undertaking the Strategic Environmental Assessment Report No.: 404-02-44/2013-01 of August 16, 2013 (Ministry) and No.: 1355 of August 16, 2013 (Institute) respectively.

In accordance with the Agreement, the obligation of the strategic assessment developer is to carry out a good quality strategic environmental assessment in specified time periods, and pursuant to relevant legislation and Terms of Reference as specified by the Ministry.

1. STARTING POINTS FOR STRATEGIC ENVIRONMENTAL ASSESSMENT

Pursuant to Art.13 of the Law on Strategic Environmental Impact Assessment, the starting points for the SEA include:

- Brief overview of contents and objectives of the Strategy and relationship of the Strategy to other plans and programs;
- Overview of environmental quality and the current state of the environment in the area encompassed by the Report;
- Characteristics of the environment in the areas in which it can be exposed to significant impacts;
- Consideration of environmental protection problems in the plan and explanation of reasons why certain issues have been left out from the assessment process;
- Overview of alternative solutions relating to the environmental protection the plan and program, including the alternative solution for non-implementation of the plan, as well as the most favorable solution from the aspect of environmental protection;
- Results of consultations with authorities and organizations concerned which are important from the aspect of SEA objectives and possible environmental impacts.

This Chapter encompasses all abovementioned points, except for the overview and evaluation of alternative solutions which are given in Chapter 3 of the SEA Report.

1.1 Overview of the subject, contents and objectives of the strategy and relationship to other documents

1.1.1 Subject of the Strategy

As stated in the introductory part of the Strategy, since the beginning of the second decade of the 21st century, the Republic of Serbia has been profoundly affected by a crisis in terms of its general economic and social development. In times of prolonged economic recession, the Republic of Serbia is facing the challenge to pave a long-term desirable path to energy sector development and to define strategic commitments on which it would base its development in the forthcoming medium-term period, i.e. by 2030. The strategic re-examination and positioning of national energy sector should enable this sector and country's economy to come out of current crisis at lower costs, as well as enable the future economic growth and sustainable economic development to take better starting position. In the context of the mentioned themes, the objective of the Energy Sector Development Strategy of the Republic of Serbia by 2030 is to offer the path to market restructuring and technological modernization of energy sector of the Republic of Serbia, so that it could better prepare itself for the period of growth in general demand for goods and services.

Strategic planning of the energy sector implies that processes in economy and country, as well as in lives of people, should take place at lower economic costs along with higher level of social and ecological sustainability, thereby higher standard of living along with pollution reduction and better nature protection. In this sense, adequate energy, economic, environmental and social policies should derive from the implementation of the Energy Law and Energy Sector Development Strategy of the Republic of Serbia, which would, together with appropriate legislation and rule of law, lead to sustainable energy system, more efficient

economy and better social wellbeing, along with sustainable balance of natural resources and the lowest possible levels of pollution.

An integrated and continual planning approach has been applied in developing the Strategy and undertaking the subject SEA with an emphasis placed on seeking sustainable measures through integrating the realistic objectives with potentials in the field of energy, on the one hand, and objectives with the need for protecting the environment, quality of life of people and socio-economic development, on the other.

The use of renewable energy sources (RES), as well as the use of clean technologies, that gives special importance to the Strategy, stands out as an important potential for development.

1.1.2 Contents of the Strategy

The Strategy is developed according to the Terms of Reference and an overall consideration of energy system of the Republic of Serbia.

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The relationship between energy and sustainable development is one of the essential factors of the strategic development of the energy sector. It is seen in the use of relatively clean energy available from different sources, relying more on renewable energy sources, green energy production and consumption, as well as in the fact that energy turnover and prices must have a market character.

The strategic priorities of energy sector development in the Republic of Serbia by 2030 are the following:

- *Energy Security*. Energy import dependence in 2010 was 33.5 %, and as such it was not high. Due to delay in the construction of electric power plants, the Republic of Serbia may become a significant importer of electricity in forthcoming years. Therefore, in addition to energy saving, it is also necessary to provide adequate reserves of crude oil and natural gas, as well as to initiate construction of new electric power plants.

- *Development of energy market*. The Republic of Serbia has accepted, signed and ratified the Treaty Establishing the Energy Community and thus it has become integrated into the EU internal energy market. This should enable to win significant investments, as well as contribute to economic development and stability of the country. Furthermore, for the functioning of internal and regional markets, it is also necessary to work on further development and modernization of electricity and natural gas infrastructures.

- *Transition towards sustainable energy system.* The implementation of energy efficiency measures, use of renewable energy sources, environmental protection and reducing the impact of climate change are the key elements of transition towards sustainable energy system of the Republic of Serbia. The available renewable energy sources and clean oil technology will be used, whereby the standards related to environmental protection will be tightened.

The energy sector development includes:

- *Electric power system:*
  - ✓ Successive withdrawal of blocks with generating capacity of 300MW (thermal power plants "Nikola Tesla" A1 and A2, Kostolac A1 and A2, Morava and Kolubara thermal power plants, Panonnian combined heat and power plants) in the period from 2018 to 2024;
  - ✓ Construction of new coal-fired thermal power plants of total generating capacity of 700MW by 2025 (350MW by 2020);

- ✓ Construction of combined heat and power plants with gas engines of total capacity of 450 MW by 2020;
- ✓ Construction of reversible hydropower plants with capacity of 600MW by 2020;
- ✓ Construction of 400kV transmission lines in northeast-southwest and east-west directions;
- ✓ Reinforcement of 110kV transmission network;
- ✓ Development of distribution network.

- *District heating systems* – Considering that heating sources, substations and distribution network are over 25 years old, a need for their revitalization imposes itself, but also a need for institutional linkage. In the structure of energy sources, the accent is placed on an increased use of renewable energy sources. One of the possibilities is also to transform cogeneration plants into combined heat and power plants using gas engines, whereby their market prices could repay the investments in these capacities.

- *Renewable energy sources* – With the ratification of the Treaty Establishing the Energy Community, the Republic of Serbia has also undertaken obligations from the Directive 2009/28/ EC on the promotion of the use of energy from renewable sources. The National Action Plan for RES has set a national goal to increase the share of energy from renewable energy sources in final energy consumption to 27 %.

- *Coal* – In order to maintain the existing and predict new coal capacities for coal-fired power plants, it is necessary to open new open-pit mines. As for underground coal mines, it is of strategic importance to link reserves of these mines to the capacities of coal-fired power plants.

- *Crude oil* – The Republic of Serbia is a highly import-dependent country with low share of its own crude oil production. In the forthcoming period, the activities will be directed towards the mitigation of such situation.

- *Natural gas* – It is mainly imported, while the natural gas transportation system (pipeline) is of limited capacity. Thus, it is necessary to provide natural gas infrastructure in all parts of the country, as well as interconnections with neighboring countries. To this end, the "South Stream" Project is of great importance in terms of transmission charges, as well as the use of natural gas cogeneration. Besides, is it also important to expand capacity of the Banatski Dvor underground gas storage, as well as to develop a gas storage system in Vojvodina and central part of the country.

- *Efficient energy use* – The Law on Efficient Use of Energy provides a basis for support to all activities. The Law on Planning and Construction and related regulations will be consistently applied to the construction of high-rise energy facilities. Provision of information to and environmental education of the public is an essential step towards a rational energy use and selection of energy sources, where the major precondition includes the creation of an adequate pricing policy.

Institutional and socio-economic frameworks for energy sector development of the Republic of Serbia are the following:

- *Development of institutional framework* – Rising the importance of the Ministry responsible for energy in that it would meet the needs of energy sector development and support it. It is also necessary to improve educational, professional and scientific research potential of the country (establish an energy institute of Serbia). It is also necessary to improve energy statistics system in the Statistical Office of the Republic of Serbia. In addition to all the abovementioned, the professional associations, chambers of commerce and other chambers are also important.
- *Legal and market framework for sub-fields of (law) energy sector* –Rules for the internal market in electricity and natural gas are harmonizes with the EU Second Energy Market Package and partially with the EU Third Energy Market Package. The harmonization with the Third Energy Market Package will be finalized within the prescribed deadlines. In the field of crude oil, EU directives on the storage of crude oil and crude oil products compulsory reserves by 2023 will be implemented and a crude oil product quality monitoring system will be established in accordance with the EU regulations. The status of heat production as an energy activity will be regulated by the law.
- *Socio-economic and social aspects of envisaged development* – The Strategy envisages that energy sector development should contribute to economic development. The budget of the Republic of Serbia and public companies should disburden themselves of costs of maintaining low energy prices. Improvement of labor market mobility will mitigate negative effects of structural changes on workers with low qualifications, as well as on vulnerable groups and certain geographical areas.
- *Energy sector and energy-related fields - the necessity of horizontal harmonization* – National environmental laws have a strong influence over energy sector. Legal standards and principles for environmental protection have become an integral part of national energy legislation. It is also important to apply provisions of the Aarhus Convention through the national legal system.

1.1.3 Objectives for environmental protection, development and planning in the Strategy

All analyses of key economic and technological changes in the 21st century reveal that, over the last two and half centuries, energy was and remains the driving force and key factor for economic changes, as well as a backbone of economic growth. Changes at the global level require a professional consideration of future long-term energy trends at the national level and, therefore, also an appropriate energy management.

The beginning of modern era of modern technologies is related to the key discovery of energy conversion and its concentration at the place of its consumption. Today, energy has lost none of its importance in the society and the knowledge economy in spite of predictions that importance of natural resources will be reduced, and even the importance of potentials of energy available for technologically most sophisticated economy.

Today, strategic positioning of countries, nations and companies around the world is carried out to provide access to remaining natural resources, especially mineral resources such as crude oil and natural gas. But, there is also a technological competition in energy efficiency and commercial use of RES. In the 20th century, the world population increased by 3.7 times, while final energy demand increased by more than 30 times. This means that, along with intensive exponential growth in world's population especially pronounced in the second half of the 20th century, there was a marked increase in energy consumption per capita. Although exponential

trend in population growth was mitigated at the end of the 20th century, the trend towards increase in energy consumption per capita is further growing. Over the last three decades, at the very end of the 20th century, an increase in total primary energy consumption was 2.1 % per year, the world population was growing at an annual rate of 1.6%, while world GDP was growing at an annual rate of 3%. This is supported by the fact that, regardless of reduction in energy intensity, the rate of total primary energy consumption is still growing faster than world population. Even in the countries with the fastest technological progress and the greatest income per unit of energy consumed, thus becoming more energy efficient, the energy production and total consumption per capita is increasing. According to estimates of the International Energy Agency (IEA), the primary energy consumption is expected to increase by 40 % in the period between 2005 and 2025. This indicates a need for strategic planning for energy sector development, as well as a need for a detailed analysis from all aspects, both from development, technological and economic aspects and from social, ecological and other aspects.

Today, it is certain that, in economy, the energy sector is the one which has the greatest negative effects on the environment, and its dependence on predominantly conventional energy sources poses a real threat to sustainable trends of economic activity. Namely, the fact that the most profitable and readily available energy comes from non-renewable resources (coal, crude oil and natural gas) are essential characteristics of world energy which affect the sustainable future, i.e. have influence on the possibility of the present generation to achieve economic growth and development without denying future generations this possibility.

No doubt that energy was and remains a field of special importance for overall economy and society. Should the energy sector be made more stable, modern and well organized, this would certainly be of great benefit to overall country's economy. And vice versa, should not a sufficient attention be dedicated to energy sector in terms of strategic planning, the economy as a whole would have a bad position and poor prospects.

The most likely scenario of global development includes economy based on efficient use of relatively "clean" energy that would be available from different sources. According to all scenarios of development, the task of energy sector will be to provide significant amount of energy and energy-generating products to meet the needs of economy and society for a relatively long period of time, but with tendency of reducing the energy intensity, i.e. energy consumption per unit of GDP.

The second requirement placed before energy sector is that energy should be "cleaner", i.e. that energy sector should, to the greatest possible extent, rely on renewable energy sources while, to the least possible extent, on exhaustible energy sources.

The third requirement which will be predominant in the future is that production and consumption of "green" energy should have the least possible adverse effects on the environment, water, air, soil and, indirectly, on the whole food chain, biodiversity and human health.

The fourth requirement that is placed on energy sector relates to economic efficiency and energy market. Energy is a commodity, thus its turnover and prices must have a market character. Energy demand and supply essentially affect its prices, conditions of energy supply and world energy flows. Given that energy sector has extremely high external effects (costs for or benefits to indirect participants who must not be direct consumers, or suppliers), it is necessary for this market to have corrective mechanisms for internalizing the externality (application of the "polluter pays principle"). This means that the environmental and other external costs must be included in retail

prices – through charges, fees, taxes, fines or other economic and financial instruments. In future energy options, external costs included in prices of certain energy-generating products must also include the costs of transition, i.e. substitution and technological adaptation to the use of other, as a rule, more expensive energy sources once the nonrenewable conventional energy sources will be exhausted.

It is not possible to meet such requirements without an adequate legal framework, institutions and authorities responsible for the implementation of this concept. Behavior-based energy efficiency and environmentally-friendly behavior require a non-selective implementation of the existing laws, as well as non-discriminatory practice. Finally, energy-ecological culture is of essential importance, but also a change in behavior of consumers and producers of energy, which derives from dispersion of knowledge as a key factor of economic development today.

Energy sector development should also be socially bearable, i.e. possible abrupt changes in energy market must not have too severe social consequences for majority of the population. The possibilities of a dynamic energy sector development in terms of rational redistribution of costs and benefits at the national level should be used. The key positive social effects of such energy sector development include growth in energy sector employment, higher standard of living and improvement in the human rights situation, as well as opportunity to enjoy the public goods. New technological solutions, based on market simulations, should be a guarantee that **more efficient**, "**cleaner"** and, to a greater extent, **renewable energy**, will also be **socially sustainable**.

Main goals of energy sector development in the Republic of Serbia include energy security, establishment of energy market and functioning of energy sector under the principle of sustainable development, while legal and institutional frameworks, as well as potential directions of their development in light of activities of the Energy Community and EU-accession process, should enable the realization of these goals.

Strategic objectives for each energy sector are the following:

Electric Power System

- Ensuring security of electricity supply in the domestic market;
- Developing electricity market at national and regional levels;
- Expanding electric transmission capacities/corridors through the Republic of Serbia which are of regional and pan-European importance;
- Reducing losses in distribution network;
- Creating possibilities for net electricity export.

District Heating System

- Ensuring security of heat supply for wide and industrial consumption along with strict observance of environmental protection rules;
- Increasing energy efficiency in production, transportation, distribution and consumption of heat;
- Increasing the use of renewable energy sources;
- Sustainable operations of heat producers.

Renewable energy sources

- Increasing the share of power produced from renewable energy in order to reduce dependence on energy imports and improve energy security.

Coal

- Ensuring security and reliability of coal supply for thermal power plants;
- Securing the necessary amount of coal for final consumption and heat production.

Oil

- Ensuring security of supply of oil derivatives that would meet the highest EU quality standards on domestic market;
- Reducing import dependence;
- Ensuring new directions for crude oil path.

Natural gas

- Ensuring security of natural gas supply on domestic market;
- Creating domestic and regional natural gas markets.

Efficient energy use

- Improving energy efficiency in all end-use sectors.

1.1.4 Relationship to other documents - strategies, plans and programs

Spatial Plan of the Republic of Serbia from 2010 to 2020

The strategic priorities of energy sector development regarding renewable energy sources in the Strategy of Energy Sector Development are harmonized with the main objective of the Spatial Plan of the Republic of Serbia in relation to the share of renewable energy sources in the total energy balance of the Republic of Serbia. Energy production will be directed to the use of locally available renewable energy sources, thereby reducing negative effects on the environment. Furthermore, this will also provide greater possibility to employ domestic capital, spur the development of small-size enterprises in the field of renewable energy technologies, as well as to spur greater employment. The Energy Sector Development Strategy envisages the construction of renewable energy power plants with total capacity of 1,112 MW by 2020, i.e. 1,413 MW by 2015. In the district heating systems, the target share of renewable energy sources in electricity generation is 11,2% in 2020, and 12,1% in 2025 (the share of RES is currently neglectable). The RES usage (except for biomass) is envisaged to be between 270 and 307 thousand toe (tone of oil equivalent) in the total energy consumption by 2025 (currently, 5 thousand toe is used).

The operational objective of the Spatial Plan of the Republic of Serbia aimed at climate protection is neutral to priorities set out in the Energy Sector Development Strategy. The operational objective is defined in the Spatial Plan of Republic of Serbia in terms of introducing the environmentally friendly technologies in energy sector implying greater use of available renewable energy sources, along with active involvement of local self-governments, while in the Energy Sector Development Strategy, it is defined as an activity that includes greater use of RES, whereby the promotion of RES should be included into energy plans for cities and local communities as a part of local energy strategies.

For the purpose of achieving the progress in environmental protection, one of the priorities is to reduce pollution originating from energy industry. This implies making of a polluter cadastre with emission balances, as well as construction of desulfurization and denitrification

systems of thermal power plants ("TPP Kostolac" and "TPP Nikola Tesla B" and deashing system of the "TPP Nikola Tesla A"), as well as ash and slag handling systems. There is a good correlation between these priorities and priorities of the Strategy which also refer to a reduction in greenhouse gas emissions associated with electricity generation.

The main objective in the Spatial Plan of Republic of Serbia is to improve energy efficiency in sectors of building industry, industry, transportation and public utility, which is of economic interest for the Republic of Serbia, as well as of importance for environmental protection, and all in the context of sustainable use and preservation of natural resources. In the Strategy, it is defined in the context of sustainable energy sector development, as the creation of conditions for improving energy efficiency. Taking into account the priorities set in strategic documents regarding the thermal power plants in the Republic of Serbia, the Spatial Plan of the Republic of Serbia envisages the following: to complete the construction of blocks of "TPP Kolubara B" with presumed installed capacity of 700 MW (2x350 MW); the construction of a new modern block "TPP Nikola Tesla B 3" with presumed installed capacity of about 700 MW with ultra-supercritical parameters; reconstruction/construction of a new gas-fired power plant of presumed installed capacity up to 450 MW - combined heat and power plant in Novi Sad, construction of "TPP Kostolac B3" with presumed installed capacity of 700 MW; construction of a separate circulating fluidized bed (CFB) power plant of installed capacity of about 200 MW in the Kolubara Mining Basin. These plans are uncertain to a significant extent as they are conditioned by overall development in the country, thus also energy sector development. This fact has been confirmed in the process of the Spatial Plan implementation so far.

In the field of hydropower, the following is envisaged: increasing the installed capacity for several existing hydroelectric power plants; preparation of the investment and technical documentation and realization of projects by "Elektroprivreda Srbija" at the existing reservoirs and energy facilities, and preparation of investment and technical documentation and realization of projects by "Elektroprivreda Srbije" and "Vodoprivreda Srbije " at the existing multi-purpose reservoirs for water resources management; construction of new hydroelectric power plants with the aim to use potentials of cross-border watersheds; construction of reversible hydropower plants "Bistrica" and "Djerdap 3" and other hydroelectric power plants on larger rivers; as well as the construction of small and medium hydroelectric power plants.

In the field of renewable energy sources, it is envisaged to construct plants for distributed energy generation based on renewable energy: district heating plants and cogeneration power plants fired by biomass, industrial and municipal waste; wind farms; solar power plants; small hydroelectric power plants.

National Sustainable Development Strategy

Strategic priorities for energy sector development are harmonized with main sectoral objectives of the National Energy Sector Development Strategy related to reduction of air pollution originating from the energy industry, improvement of fuel quality and gradual abolishment of the use of leaded gasoline and diesel with high levels of sulfur, improvement of the air pollution monitoring system in cities and capacities of air quality test laboratories, as well as improvement of public access to information on air quality and raising public awareness.

The objectives of sectors in the National Energy Sector Development Strategy for renewable energy sources are: to intensify the exploration of renewable energy sources for their verification and more realistic balancing; identify technologies for which it is justifiable to introduce incentive measure; perform comparative analysis of possible incentive mechanisms; adopt regulations for stimulating the use of renewable energy sources (tax relief, incentive prices of electricity generated by RES, etc.); increase the use of renewable energy sources; environmental education and public awareness-raising in order to stimulate greater use of renewable energy sources. All abovementioned is harmonized with principles of the Strategy to create economic and financial conditions for increasing the share of energy from renewable sources. Concerning the climate change and ozone layer protection, the Strategy sets out the priority of adaptation of economic entities in the energy, housing and public utility sectors to the climate change policy, as well as fulfillment of international obligations. It is neutral to the strategic priority of careful analysis of climate change impact on the energy sector in the Republic of Serbia and adoption of adequate adaptation plans.

Effects of International Obligations Undertaken by Serbia

Membership in the Energy Community and the process of joining the EU are of special importance. The Treaty Establishing the Energy Community is the first agreement between the Republic of Serbia and EU by which the Republic of Serbia has undertaken the obligation to implement regulations of the EU. It entered into force in 2006.

The importance of the Treaty Establishing the Energy Community was confirmed by ratification of the Stabilization and Accession Agreement in 2008. The Agreement underlines the need for cooperation between the Republic of Serbia and EU in integrating achievements of the Energy Community and integrating the Republic of Serbia into the European energy market.

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 Sector from 2008 essentially determined the direction of the development of oil and gas sector because, on the basis of this Agreement, the agreements on sale and purchase of majority package of NIS shares and on construction of the part of the South Stream pipeline through the territory of the Republic of Serbia and Banatski Dvor underground natural gas storage were signed. This Agreement provided a more secure supply of natural gas and, to a considerable extent, a secure supply of oil derivatives, but at the same time a foreign partner has been introduced in this process.

In the field of hydroelectric capacity use and the use of electric transmission capacities, the Protocol with Government of the Republic of Italy from 2011 on cooperation in the field of energy sector was ratified at the end of 2012 which regulates the cooperation between the two countries.

1.2 Overview of environmental quality and the current state of the environment[1]

1.2.1 Quality of basic environmental factors

The characteristics of the current state of the environment are a basis for investigating and evaluating environmental problems in an area. Environmental quality is considered one of he

[1] The following data were used for the analysis and presentation of data on environmental quality: data obtained from the Serbian Environmental Protection Agency (also including the data submitted by the Republic Hydrometeorological Service); documentation basis of the Spatial Plan of the Republic of Serbia; other available documentation from spatial plans and studies dealing with areas containing the most significant energy facilities and activities.

basic criteria for a balanced and sustainable development in the Republic of Serbia. For the needs of this investigation, basic characteristics of the current status are defined based upon the existing strategic documents, environment reports, environmental studies, as well as other available professional and scientific literature.

Different factors determine the state of the environment in Serbia, out of which the most important include: urban and coal-mining areas where there is heavy traffic and high concentrations of population and industry, which exerts pressure on the environment posing a threat to environmental quality, on the one hand, and to the survival of rural and protected areas with depopulation trend in which the environment is preserved to a greater or smaller extent, on the other hand.

Ambient Air Quality

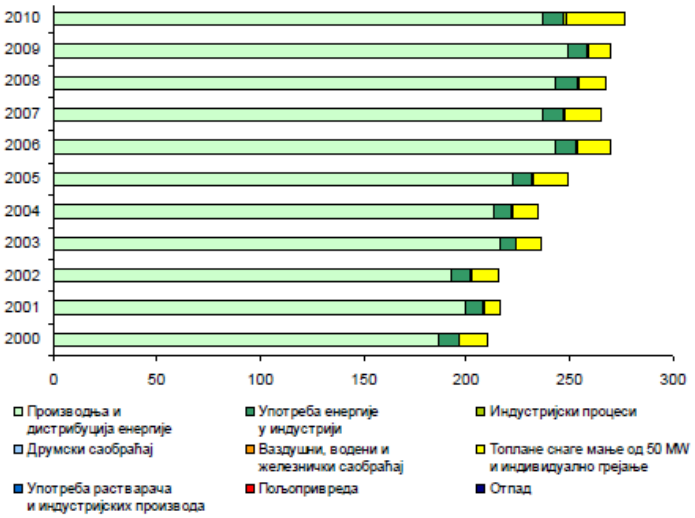
Ambient air quality is certain areas and cities is dependent on emissions of SO_2, NOx, SO, soot, fine particulate matter and other pollutants generated by different facilities and processes. Major causes of ambient air pollution include: obsolete technologies; lack of flue gas purification devices or poor efficiency of filtration devices; irrational use of raw materials and energy resources; poor maintenance; etc. A considerable pollution comes from inappropriate storage and disposal of by-products, such as fly ash from thermal power plants and mine waste rock from open-pit mines. Levels of traffic-generated pollution are raising, including high emissions of benzene, lead and soot, particularly in large cities.

Major sources of air pollution include thermal power plants in Kolubara and Kostolac lignite basin and the RTB Bor Mining and Smelting Complex. Lignite has a low caloric value and high moisture content, while large quantities of fly ash, sulfur and nitrogen oxides are emitted from lignite combustion. The most important industrial ambient air polluters include: oil refineries in Pančevo and Novi Sad; cement plants in Beočin, Kosjerić and Popovac; chemical plants in Pančevo, Šabac and Kruševac; and Smederevo steelworks. The highest levels of pollution come from combustion processes of low quality lignite (thermal power plants in Obrenovac, Lazarevac and Kostolac) and motor fuels (Belgrade, Niš, Užice, Čačak, etc.). The ambient air pollution also comes from the use of solid fuels (wood and coal) in households, boiler rooms in buildings and solid fuel burners.

Certain economic sectors which contribute to emission of SO_x, NO_x and PM_{10} classified according to the NFR nomenclature (CLRTAP) are shown in figures for each pollutant separately. The most significant amounts of **sulfur dioxide** emissions come from thermal power plants, metals production and processing plants, refineries, and chemical industry. The data reveal that the following plants are the greatest sources of emissions of this pollutant:

1. Thermal Power Plant “Nikola Tesla A“;
2. Thermal Power Plant and Open-pit Mines „Kostolac B1“;
3. Thermal Power Plant “Nikola Tesla B”;
4. Thermal Power Plant and Open-pit Mines “Kostolac A1”;
5. RTB Bor, Bor Copper Smelting Plant and Copper Refining;
6. Thermal Power Plant “Nikola Tesla”, TPP „Kolubara“;
7. Thermal Power Plant “Nikola Tesla”, TPP “Morava“;
8. NIS, Pančevo Oil Refinery;
9. Kolubara Mining Basin, the Processing Unit;
10. RTB Bor, Cooper Smelting Plant and Copper refining, the Sulfuric Acid Factory.

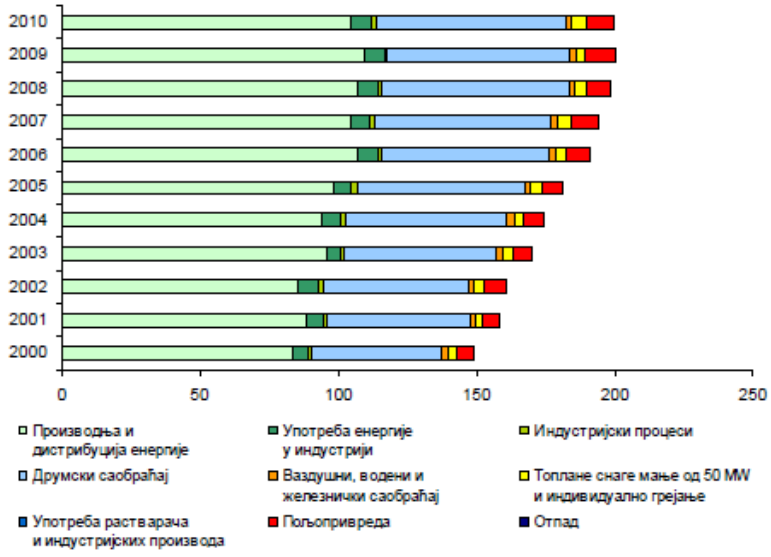
Graph 1.1. SO_x emissions by source sectors in the period 2000-2010 (Gg/year)



The results of the data analysis have revealed that the greatest amounts of **nitrogen oxide** emissions come from thermal power plants, chemical and mineral processing industry, metals production and processing plants, as well as refineries:

1. Thermal Power Plant "Nikola Tesla A";
2. Thermal Power Plant "Nikola Tesla B";
3. Thermal Power Plant and Open-pit Mines „Kostolac B1";
4. "HIP Azotara" nitrogen plant;
5. Thermal Power Plant and Open-pit Mines "Kostolac A1";
6. Thermal Power Plant "Nikola Tesla", TPP „Kolubara";
7. Lafarge Cement Plant;
8. „U.S. Steel", Company for the production and processing of steel;
9. PD Pannonian TE-TO (Combined Heat and Power Plant), TE-TO Novi Sad;
10. NIS, Pančevo Oil Refinery.

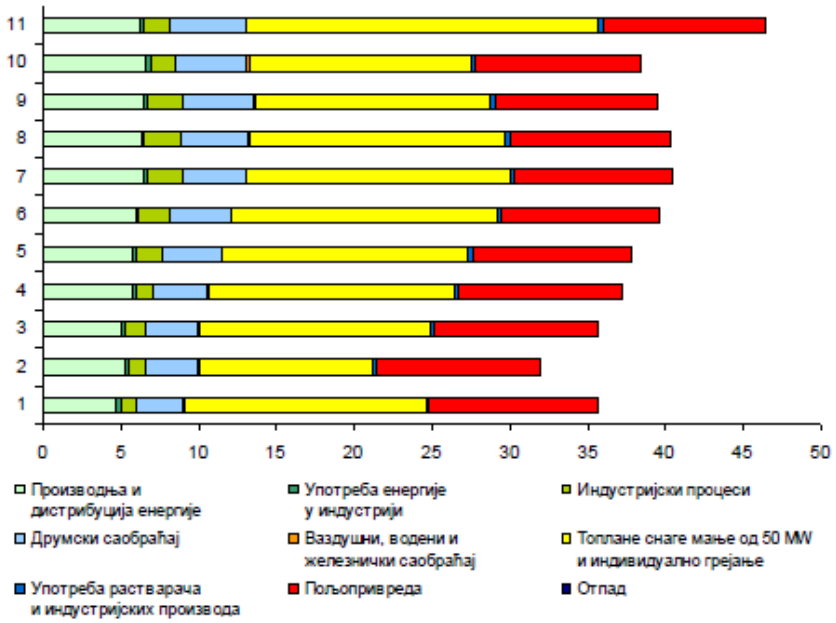
Graph 1.2. NO_x emissions by source sectors in the period 2000-2010 (Gg/year)



The most significant point sources of **fine particulate matter** in the Republic of Serbia include thermal power plants, metals production and processing plants, refineries, as well as chemical industry. The most significant sources include:

1. Thermal Power Plant "Nikola Tesla A";
2. Thermal Power Plant and Open-pit Mines "Kostolac B1";
3. Thermal Power Plant "Nikola Tesla", TPP „Morava";
4. Thermal Power Plant „Nikola Tesla B";
5. Thermal Power Plant „Nikola Tesla" , TPP „Kolubara";
6. Thermal Power Plant and Open-pit Mines „Kostolac A1";
7. RTB Bor, Bor Cooper Smelting Plant and Copper Refining, the Smelting Plant;
8. NIS, Pančevo Oil Refinery;
9. „HIP Azotara" nitrogen plant;
10. Kolubara Mining Basin, the Processing Unit.

Graph 1.3. RM_{10} emissions by source sectors in the period 2000-2010 (Gg/year)



In 2012, the ambient air in agglomerations of Belgrade, Bor, Kosjerić and Pančevo was excessively polluted (3rd category). Compared to the previous year, the ambient air quality did not change. In 2012, the ambient air in Valjevo was also excessively polluted (3rd category).

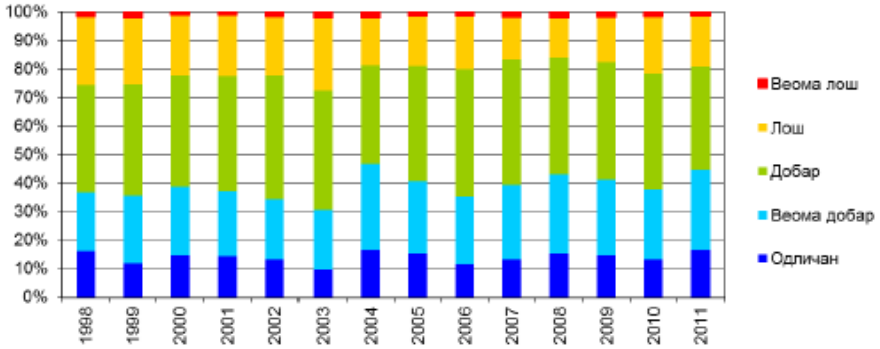
In 2012, in agglomerations of Niš and Užice, the ambient air was moderately polluted (2nd category). In agglomeration of Niš, the ambient air quality was better then in 2011. The ambient air quality was assessed based upon annual values of a smaller number of ambient air pollutants than in 2011.

In 2012, in agglomerations of Novi Sad and Smederevo, according to available data, the ambient air was slightly polluted (1st category). In both agglomerations, the ambient air quality was assessed based upon annual values of a smaller number of ambient air pollutants than in 2011.

Water quality

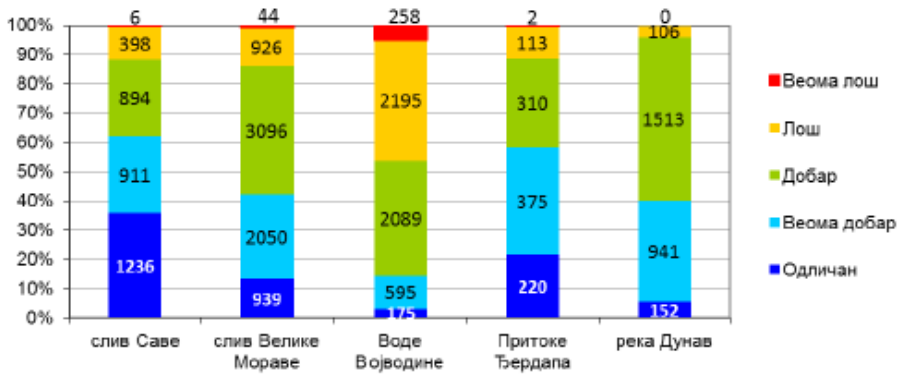
The quality of surface water is mainly contingent on industrial plants, agricultural production, as well as long dry periods both in the territory of the Republic of Serbia and in neighboring countries and transboundary river basins. Major sources of surface water pollution in Serbia include: industrial and municipal wastewater; agricultural drainage water; drainage and seepage water from landfills; water pollution caused by pollutants that are spread through rivers; as well as floods and waste materials originating from thermal power plants. The Republican Statistical Office data reveal that only about 35% of households is connected to sewerage network. Out of the total amount of municipal wastewater, approximately 87% is released into water recipients without purification. In the major cities in the country, Belgrade, Novi Sad and Niš, wastewater is released into water recipients without purification. Some of the water purification plants are neglected, while a great number of them provide only primary (mechanical) water purification, but most of them do not operate continuously. Defuse sources of pollution account for more than 50% of the total water pollution. The analysis of surface water quality indicators (*SWQI*-Serbian Water Quality Index) was based on 19,727 water samples taken from 145 measuring points for surface water quality monitoring which was carried out once a month in average in the period of 1998-2011 (Graphs 1.4. and 1.5.)

Graph 1.4. Assessment of quality of all water samples by year



Expressed in *SWQI*, the water in canals and rivers in Vojvodina has been of the poorest quality over the last fourteen years. Compared to the total number of samples taken from all river basins, even 83% of water samples taken from the territory of Vojvodina falls into the category of *very poor water quality*. Poor water quality in river basins in this region is also supported by the data that even 46% of water samples falls into the category of *very poor* and *poor* water quality. The current program of systematic surface water monitoring for biological parameters does not meet the criterion of high degree of reliability.

Graph 1.5. Quality of water samples in percentage by watersheds for the period



Industrial facilities located in urban zones mainly release water into urban sewerage systems and most frequently without prior pretreatment. Larger industrial facilities located outside settlements, usually on river banks or in their immediate vicinity, also release their wastewater directly into watercourses without prior pretreatment. Threat of surface water pollution which comes from biodegradable organic matter is particularly pronounced nearby cities and food processing industries (sugar factories, fruit and vegetable processing plants, big farms, slaughter plants, etc.). This problem is particularly pronounced in periods of year characterized by low water levels and high temperatures. Large industrial plants, owning to their water purification systems, decompose themselves significant amounts of organic matter and thus maintain a satisfactory water quality. Contrary to them, in periods when factories operate at full capacity, the small watercourses are threatened by pollution resulting from oxygen deficit and anaerobic decomposition of organic matter, whereby toxic matters and gases (hydrogen sulfides, methane and ammonia) are released, thus threatening flora and fauna of all watercourses. Based upon data of the Republic Hydrometeorological Service, water quality in Serbia is generally poor. The examples of clean water (1st and 1st/2nd class quality) are very rare and can be found in mountain regions, for example, in the Djetina, Rzav, Studenica, Moravica and Mlava rivers in Central Serbia. The most polluted watercourses include the Stari (Old) and navigable Begej rivers, the Vrbas–Bečej canal, and the Toplica, Veliki Lug, Lugomir, Crni Timok and Borska rivers. The water quality in watercourses nearby large cities (Belgrade, Novi Sad, etc.) is particularly threatened by nutrients and organic and inorganic pollutants (coming from released untreated agricultural waste and drainage water). Declining water quality may be partly associated with transboundary pollution in rivers flowing into Serbia. The Tisa river enters the territory of Serbia as a river whose water belongs to 3rd quality, while the Begej river enters Serbia as a river whose water belongs 4th quality. Transboundary rivers are polluted by nutrients, crude oil, heavy metals and organic matter.

Soil Quality

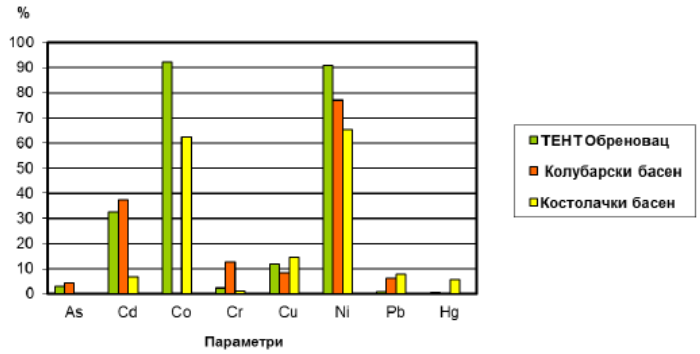
The soil quality, i.e. degree of soil degradation, in Serbia is affected by numerous natural processes (erosion, landslides, surface runoff). However, anthropogenic phenomena and processes have significant effect on the soil quality, amongst which the most significant include: soil pollution caused by chemical substances (mineral fertilizers, pesticides) and organic fertilizers (solid and liquid manure) used for agricultural purposes; industrial processes; mining works; inappropriate waste disposal, existence of septic tanks that receive non-sanitary wastes (form households, livestock farms); pollution of soil along the roads due to unsolved water drainage; changes in land use (illegal construction); etc. Soil pollution is also affected by inappropriate agricultural practices, including uncontrolled and improper use of artificial fertilizers and pesticides, as well as absence of irrigation water quality control. Sporadic presence of heavy metals in soil is a result of untreated drainage waters from landfills, as well as from mining facilities and power plants. Soil is polluted in areas of intensive industrial activities, inappropriate waste disposal sites, mining areas, as well in places where different accidents occur.

The greatest sources of soil pollution causing high degree of soil degradation include exploitation of mineral raw materials, particularly in Kolubara-Kostolac and in Bor-Majdanpek mining basins, as well as the uncontrolled and inappropriate disposal of industrial waste, particularly nearby large industrial centers (Bor, Pančevo, Novi Sad, Smederevo, Belgrade, Kragujevac). Additional sources of soil pollution include deposition of air pollutants contained in the exhaust gases from vehicles along roads, in particular along main

roads. Based upon analyses carried out by the Agency for Environmental Protection, 332 locations were identified at which soil pollution was confirmed by the results of laboratory tests of soil and underground water in immediate vicinity of localized sources of pollution, where soil pollutants have been present over a longer period of time.

Agricultural soil analysis was carried out near the three most significant coal mining and electric power industrial complexes: Kostolac basin, TPP „Nikola Tesla“ Obrenovac, and Kolubara mining basin, where lignite is extracted and burned. The total number of 344 soil samples have been taken from the three mentioned locations. The soil test results of samples taken in surrounding area of mining and thermal power plants revealed that limit values of certain parameters, out of which Cd, Co, Cu and Ni stand out, were exceeded.

Graph 1.6. Value percentage in excess of allowable concentrations of heavy metals in soil in surrounding areas of significant coal mine industrial complexes



The land in the Kostolac Mining Basin is mechanically damaged and degraded by open-pit mines and mine rock waste, coal waste and ash dumps. The open-pit mine together with waste rock dumps covers an area of 2,085 ha and extends up to three separate locations. The village of Ćirikovac together with the Mlava-Mogila waste dump which is outside the area of the village covers an area of 525ha, the village of Klenovnik together with the waste dump covers an area of 380ha, open-pit mines in the area of the village of Drmna cover an area of 170ha, while the total area is 1,010 ha together with waste dumps within the areas of villages. In addition to open-pit mines, there are also two thermal power plants (A and B) with total installed capacity of 310MW. Fly ash and slag produced by burning lignite in boilers of thermal power plants is transported by hydraulic removal systems and disposed of in three cassettes of the total area of 264ha. Effects of TPP „Kostolac“ and borrow pit for coal mining, as well as effects of mine waste rock dumps, on soil properties have been monitored in an area of about 49,000ha, where 90 surface soil samples were taken. Fly ash from dumps, gases and particulates from TPP chimneys and coal dust from open-pit mines are principal sources of ambient air and soil pollution.

Thermal power plants „Nikola Tesla“ A and B are located in the Sava River valley near Obrenovac. The fly ash dump covers an area of 407.94 ha. The total area of ash dump of the TPP „Nikola Tesla B“ is 727.68 ha. Effects of pollution originating from TPPs and dumps have been monitored in an area of approximately 46,000 ha, where 206 surface soil samples have been tested.

The Kolubara basin covers an area of approximately 48,000 ha, within which the coal exploitation is envisaged at an area of 13,400ha, out of which 7,038 ha has already been reserved for surface coal mining. Chemically damaged soil has been monitored at an area of 51,000 ha, in a wider area of coal overburden layers, dumps and recultivated areas, where 48 soil samples were taken.

Areas most threatened by pollution

Areas in which the environment is polluted and degraded (locations where concentrations of pollutants exceed limit values, urban areas, areas of lignite open-pit mines, waste rock dumps, fly ash and slag dumps, thermal power plants, expressway corridors, watercourses whose water was classified into the fourth class and "below" class of quality, have negative effects on people, flora and fauna and quality of life of people. For this category, it is necessary to provide such solutions which would prevent further degradation and mitigate effects that limit the development. For the purpose of achieving better environmental quality, it is also necessary to carry out the restoration of threatened ecosystems, as well as the remediation of consequences of pollution. The most threatened areas belonging to this category include: Pančevo, Bor, Majdanpek, Obrenovac, Smederevo, Belgrade, Novi Sad, Subotica, Loznica, Kostolac, Čačak, Lučani, Kruševac, Šabac, Kikinda, Prahovo, settlements in Kolubara mining basin, expressway corridors Belgrade-Novi Sad, Belgrade-Šid and Belgrade-Niš-Leskovac. The greatest emissions of SO_2, NO_x and suspended particles are found in the area of the City of Belgrade, then in Braničevo district, Bor and South Banat districts. Big dumps for fly ash produced during coal combustion in thermal power plants are located in Obrenovac, Lazarevac and Kostolac. Urban areas in this category include: Zrenjanin, Ruma, Valjevo, Kosjerić, Novi Popovac, Kraljevo, Niš, Vranje, Zaječar, Majdanpek, Vrbas, Mladenovac, Smederevska Palanka, Požarevac, Sremska Mitrovica, Kragujevac, Gornji Milanovac, Užice, Priboj, Trstenik, Prokuplje, Pirot, Novi Pazar, Leskovac, Jagodina, Paraćin; as well as watercourses whose water was classified into the fourth class and "below" class of quality.

The hotspots in the Republic of Serbia include Bor (RTB - smelting and mining complex, flotation tailing dump in Veliki Krivelj), Pančevo (chemical and petrochemical industry, refinery), Obrenovac (thermal power plant "Nikola Tesla", fly ash dump), Lazarevac (open-pit mines, thermal power plant, fly ash and slag dump, Vreoci), Kostolac (thermal power plant, open-pit mines, fly ash and slag dump), Šabac (industry, sludge dump), Belgrade (industry, traffic, landfill sites), Kruševac (chemical industry, landfills), Smederevo (steelworks, raw mineral dump), Loznica (industry, Zajača), Novi Sad (oil refinery, unremedied consequences of the NATO bombardment), and the Great Bačka canal (on the Crvenka-Kula-Vrbas section).

Based upon the Preliminary IPPC List for plants for which an integrated permit is issued in the Republic of Serbia, there are 156 of such plants, out of which 29 in the energy sector, 26 in metal production and processing industry, 36 in the mineral industry, 19 in the chemical industry, 4 waste management plants, and 68 plants in other fields of industry. The environmental issue is also important in the context of achieving regional cooperation and cooperation in the Danube and the Sava River basins, as well as in establishing an integrated regional energy market and regional transport network, the Black Sea economic cooperation, transboundary cooperation of regions, etc.

Transboundary impacts

Concerning transboundary impacts, the most pronounced water pollution comes from watercourses entering Serbia from Romania, where water quality of the Begej, the Tamiš, the Zlatica, the Karaš and the Nera rivers is below required class. Accidents of cyanide spill into the Tisa river from the gold mine in the Northern Romania, as well as dumping of mine waste rock into the river, have caused ecological disaster and produced long-term consequences for ecosystem in the Republic of Serbia. It is of utmost importance to monitor potential sources of

radiation which could spread to the Republic of Serbia from its immediate surrounding areas (nuclear plants near Baja in Hungary and Kozloduy in Bulgaria). A joint control is of great importance, as well as a permanent exchange of information. The Republic of Serbia cooperates with countries in the region on issues of water quality control and transboundary water pollution. International cooperation primarily refers to water quality of the Danube, Sava, Tisa, Tamiš and Drina rivers. The Danube river water is of particular interest for the Republic of Serbia primarily because of public water supply, i.e. the protection of groundwater in the South Bačka and the South Banat against the pollution. The pollution of the Danube river water also affects water quality of the Djerdap Lake. Furthermore, developing the regional cooperation in the field of water resources management is also of great importance. To this end, the sustainable water management, regulation of the use and protection of water and aquatic ecosystem, as well as protection of water against negative impacts, have been carried out based on the ratification of the Convention on Co-operation for the Protection and Sustainable Use of the River Danube and signing of the Framework Agreement on the Sava River Basin. Potential transboundary water pollution in countries downstream from the Danube (Romania and Bulgaria) can come from Bor and Majdanpek basins (mines, mills, smelting plant and refinery) through the Borska, Pek, Timok, Kriveljska and Danube rivers. Transboundary pollution in the countries downstream from the Danube is possible through the Sava river (Šabac, Barič), and transboundary pollution in Bosnia and Herzegovina through the Drina river (Ljubovija, Zajača, Krupanj).

1.2.2 Elements of the environment that are exposed to impacts

1.2.2.1. Coal mines

Large area occupied by open-pit mines, ecosystem degradation and out-migration of population, i.e. changes in settlements network, are amongst the most significant aspects of structural changes caused by open-pit coal mining. In addition, high levels of harmful emissions from energy-generating complexes cause pollution (air, water, soil and flora). Coal deposits and zones in which raw minerals are extracted are numerous. From the aspect of land use and degradation, the surface deposits and open-pit mines are of special importance. The greatest areas of surface mining include Kolubara Mining Basin, Kostolac-Kovin coal basin and Bor-Majdanpek mining basin.

Kolubara Mining Basin

Coal in the Kolubara surface mining basin is extracted from four the the Coal Field „B", Coal Field „D", „Tamnava – Western Coal Field" and from „Veliki Crljeni". These four coal fields covering an area of approximately 80 square kilometers which are located in Lazarevac, Lajkovac and Ub municipalities make up a technological and production whole. Approximately 30 million tons of coal per year is produced in the „Kolubara" Mining Basin.

Location: 50 km southwest of Belgrade. The Kolubara basin extends along the lower course of the Kolubara river from Lajkovac to its confluence with the Sava river. It encompasses an area of almost 600 square kilometers. The seat of the „Kolubara" Mining Basin is in Lazarevac.

Climate: Moderate-continental climate. Special attention should be paid to winds, because direction in which they blow is an important factor of potential pollution and environmental endangerment in this area. The climate is favorable for agricultural production.

Relief: The area is composed of a lowland to the northwest and a hilly-mountain terrain to the southeast. The Kolubara, as the strongest river in the area, has cut a large valley. The surface mining has completely changed the relief of this area. The broken hilly terrain subsidence in the eastern part of the basin has been caused by coal mining, while a flat terrain surface has been formed by deposited substrates.

Geological properties: Paleozoic crystalline schist, Triassic chalk and limestone, sandstone and marl, mass of extrusive igneous rocks of andesitic and dacitic composition. The economically most important raw mineral in this area include coal, lignite, infusorial earth, quartz-sandstone, etc.

Soil: According to the represented land categories, the most part of the area within the Kolubara mining basin falls into the category of arable land, considering that over 80 % of arable land falls into I-IV bonitet class.

Hydrological characteristics: Several larger and smaller rivers, such as the Kolubara, Onjeg, Ljig, Peštan, Turija, Beljanica, and Lukavica rivers, are in immediate surrounding area.

Ambient air quality: Zones of open-pit mines are sources of high level of dust emissions, but the emissions originating from mining equipment and transport means containing harmful gases such as nitrogen oxides, carbon monoxide, sulfur dioxide and volatile organic matters, are not negligible. There are also emissions of suspended particulate matter and suspended solids from dust fall-out. Volatile and settleable particle emissions also cause problems. Measurements of emissions have shown that in a great number of cases the emission limit values (GVI) were exceeded. It was found that suspended particles and settleable particles contained heavy metals: nickel, chromium, cadmium, manganese, lead, etc. Occasionally, nickel, cadmium and manganese emissions exceed MDK. Measurements are carried out at four measurement stations: „Vodovod“ Vreoci, wastewater purification plant, cableway switch yard and Medoševac water supply network. The control of the following parameters was carried out: SO_2, NO_2, soot and suspended particulate matter.

Water quality: The surface and groundwater are exposed to intense pollution originating from high amount of pollutants emitted from thermoelectric power plants and mining complexes, as well as from defuse sources including smaller discharge of used wastewater into the recipient, improperly built septic tanks, pollutants emitted from agricultural complexes, etc. The water quality of the Kolubara river has been monitored at Slovac, Beli Brod and Draževac profiles. Water quality at Slovenac profile belongs to 2nd/3rd class, while water quality at the other two profiles belongs to the 3rd class. The measured contents of dissolved oxygen and organic load in river water at all three profiles belongs to the required 2nd class. During high-level water periods, the content of suspended particulate matter transforms into fibrous state, whereby electrical conductivity of water is reduced. Occasionally, higher concentrations of mercury, phenols, mineral oils and other harmful matters occur at the Beli Brod and Draževac profiles. Wastewater from the ”Kolubara-Prerada“ (Kolubara branch “Processing”) accumulates in canals of wastewater purification plants (WPP). After undergoing purification process, the water is discharged into the Crne vode canal (or the Beličanski Creek) and transported to the Kolubara river. After passing through chambers for sediment collection and oil separation, wastewater is discharged into the Peštan (Zeoke) river and the Guševac Stream which flow into the Peštan river (Rudovci) and the Kladnica river (Kalenić).

Noise: Noise sources in the "Kolubara-Prerada" include: District Heating Plant, Drier Facility, Dry Separation Facility, Wet Separation Facility, as well as the noise originating from industrial railway traffic, heavy vehicle traffic and cableway. Noise is generated both by processing plants and by transportation of processed coal and coal from open-pit mines. The "Kolubara-Prerada" plants are sources of noise generating different noise levels. Measurements in "Kolubara-Prerada" plants and reload stations in Baroševac have shown that noise exceeds the permitted level. In Vreoci, noise is generated by intensive heavy vehicle traffic. The thermal power plant in Veliki Crnjeni The is also one of the noise sources.

Soil quality: The degradation of humic soils is caused by surface mining technology used in the Kolubara open-pit mines. The soil degradation typical for this area is a result of intensive coal excavations which have led to the formation of soil of lower bonitet class, as well as formation of deosole and techogenic soils. These are anthropogenic soils derived from disposal of mine waste rock and fly ash, as well as from open-pit mines at which coal is excavated. Higher levels of arsenic (above the permitted 20 mg/kg) have been detected in a greater number of soil samples taken from the most threatened villages (Vreoci, V.Crljeni), while the content of other metals (Cu, Zn, Cr, Pb, Ni, Hg) has shown only an increasing tendency. According to values of parameters tested in soil samples, the most polluted location is the one situated within the area of the Coal Upgrading Facility. In 2012, three soil samples taken from this location contained arsenic levels above intervention level (55mg/kg), while pH ranged from 3.51 to 5.7. On other locations, the values in soil samples have shown that intervention measures are not needed, in accordance with the Regulation.

Other impacts: landscape devastation, degradation of natural cover, degradation of agricultural land cover, erosion, mining equipment noise, change in land use, impacts on biodiversity, habitat loss for certain flora and fauna species, adverse human health impacts.

Kostolac-Kovin mining basin

Over the past four decades, the effects of surface coal mining in the Kostolac basin on all elements of the environment have been numerous. Lignite surface mining in „Drmno", „Ćirikovac" and „Klenovnik" mines has caused a degradation of geomorphologic and pedologic structure of the terrain and entire ecosystem, negative effects on water natural regime, function of settlements, infrastructure systems, etc.

Location: The Kostolac coal mining basin is located about 90 km east of Belgrade, in a western part of the territory of the town of Požarevac. Other potential deposits of energy resources – zone of oil and gas exploration, are located in the western part of the Veliko Gradište municipality and northern and western parts of the town of Požarevac.

Climate: Moderate-continental climate in which effects of steppe climate of neighboring Banat are noticeable. A relative vicinity of the entrance into the Djerdap Gorge, as well as exit from the Gorge, affects the speed of *košava* (southeast wind) which blows at over 90km/h and thus significantly affects this region. The entire region is under the influence of this wind about hundred days a year. Characteristics of the climate include dry winters with small amount of snow falls.

Landscape (type of landscape): natural and rural landscape – pastures and meadows with smaller anthropogenic impacts.

Hydrological characteristics: The Danube and its tributaries, the Great Morava and Mlava rivers, with a backwater called "Dunavac" and the Canal make up specific hydrographic features of the region.

Vegetation: Vegetation in areas surrounding open-pit mines is degraded - dust clumps onto the leaves and reduce the effectiveness of photosynthesis, thus affecting the plant's growth rate.

Noise: Excessive noise levels are possible in all phases of lignite surface mining. Noise sources include: machines for lignite excavation and transportation, as well as ancillary machinery, with the following noise emissions: rotor dredges (92-94 dB), dradgline excavators (82dB), disposal machines (85-89 dB), conveyor belt transporters (96-102 dB), bulldozers (115 dB), and diesel trucks (110 dB).

Ambient air quality: Excavation, transport and reloading of coal, as well as waste rock, generate the highest level of pollutants in open-pit mines. Waste rock dumps are the largest sources of ambient air pollution considering that they contain large amounts of sand or other loose material, which is particularly pronounced when strong winds blow. Dust emissions form surface mining operations and coal and overburden transported by conveyor belts, as well as harmful vehicle exhaust and diesel emissions from mining equipment (carbon monoxide CO, carbon dioxide CO_2, nitrogen oxides NOx, sulfur oxides SO_2, methane (CH_4) and volatile organic compounds /VOC/, etc.) occur in all phases of technological process in lignite surface mining. Primary pollutants include: point sources (dredgers, loaders), line sources (roads in open-pit mines, conveyor belt transporters for coal and overburden) and surface sources of pollution (active surfaces in open-pit mines and dumps). Occasionally, secondary pollutants are emitted due to greater wind speed causing the dust to rise and disperse within the air.

Water quality: The required water quality of the Danube river is 2nd class quality. In 2009, the results of water quality measurements for the Danube at the closest measurement stations of the RHMS show that actual water quality falls into 2nd/3rd class at Smederevo and Veliko Gradište profiles, while into 3rd class at the Banatska Palanka profile. The prescribed water quality of the Great Morava river at the Ljubičevo profile is 2ndA class. The water quality of the Great Morava river upstream from the Ljubičevo profile has been classified into 3rd/4th class, while after the inflow of wastewater from Požarevac, the water quality has fallen into 4th class (while when dissolved oxygen levels and concentration of cooper are higher, the water quality falls bellow class). The required water quality of the Mlava river is 2ndA class quality, but results of measurements carried out in the period 2006-2009 at the Petrovac profile (about 30 km downstream from open-pit mine) revealed that its actual quality belonged to 3rd class, while due to occasionally higher values of nitrate-nitrogen (NO_2-N) and suspended particles, the water quality was below class. Higher values of iron (Fe) and manganese (Mn) were also registered at certain profiles. Physical-chemical analyses of drain overflow of water from „Drmno" open-pit mine have shown that mineral oils, phenols and biological oxygen consumption are the main parameters which do not satisfy the water quality in the Mlava river.

Soil quality: The pollution is highest in the immediate vicinity of soil pollution sources (open-pit mines, thermal power plants, fly ash and slag dumps, municipal solid waste, etc.) due to direct contamination with harmful particles, wastewater and harmful gases. Test results have shown that arsenic, lead and cadmium are also present in soil. The concentration of

nickel often exceeds the limit value. The test results for a smaller number of soil samples have also shown the values of other metals (cooper, zinc and lead) and organic pollutants (index of hydrocarbon, PAC, DDT and PCBs) are higher. High concentration of zinc at the Prugovo-Poljana location „Crepana" requires intervention. Within the zone of source water protection, the results of test for a great number of soil samples have shown that content of nickel and index of hydrocarbon and cooper are higher in places.

Other impact: higher level of noise and vibrations, accident risk, agricultural land degradation, threat to construction and housing, negative effects on human health, irrational land use, negative effects of pollution on agricultural crops, erosion, landslides, negative effects on natural resources.

Bor-Majdanpek mining basin

In the area of the Bor-Majdanpek mining basin, the exploitation and processing of mainly metallic mineral raw materials (cooper, gold, silver) are carried out.

Location: Located in the Eastern Serbia, in the Timok region, close to Bulgarian and Romanian borders.

Relief: Valley mountain area, surrounded by southern slopes of Carpathians, with the Veliki Krš mountain to the north, the Crni Vrh to the northeast and Deli Jovan mountains to the west.

Geological features: Coal deposits are located in the western part of the Carpathian Arch. These are mainly deposits of porphyric type within the Upper Timok eruptive area. The undeveloped coal deposits of „Borska reka" located within the „Jam" mine is a very important potential of mineral resources.

Hydrological characteristics: The Danube, Timok, Borska, Kriveljska and Pek rivers, and the Bor Lake.

Climate: Openness towards the Vlaška valley determines the climate of this region. The continental climate determines climatic conditions, to a great extent. In connection with this, weather conditions in this region are sometimes different from weather conditions in neighboring regions.

Ambient air quality: Dust emissions dominate in zones of surface mining. Locally, harmful emissions from mining equipment and transportation means are important as they contain harmful gases like nitrogen oxides, carbon monoxide, sulfur peroxide and volatile organic matter. Flotation tailing dumps are a significant dust emission source which poses a threat to surrounding villages and agricultural land, whereby limiting the agricultural production and damaging the health of people. Significant amount of dust emissions result from technologies used for building the dams at flotation tailing dumps, non-implementation of measures for dam recultivation, and absence of sanitary protection of the zones. Copper Smelting Plant emits large amounts of sulfur dioxide and arsenic. Air quality is monitored using inappropriate and obsolete equipment, which does not allow for momentary interventions in case of ecological accidents.

Water quality: Great amounts of wastewater from flotation tailing dumps, water drained from open-pit mines, as well as wastewater from industrial mines containing different pollutants, are discharged into the Borska, Kriveljska, Brestovačka, Ravna, and Pek rivers, and in the Šaški Stream, etc., thus polluting the surface and groundwater. Great amounts of sulphates, arsenic and heavy metals that are carried into rivers poses a threat to settlements situated on the banks of contaminated rivers in Serbia and Bulgaria and affect the water quality of the Danube river.

Soil quality: Mining works over a long period of time have resulted in the expansion of mines into agricultural areas and construction land, while agricultural land has been completely degraded in some places due to degradation of pedological layer. Significant emissions of sulfur dioxide from metallurgical processes have caused soil acidification, damage to vegetation, and erosion.

Noise: Principal sources of noise include blasting at open-pit mines, industrial plants of RTB Bor, and quarries. Measurements carried out in 2011 in the City of Bor showed that noise levels exceeded the permitted limit values in a great number of measuring points.

Other impacts: Almost all plants use dangerous chemicals which can cause chemical accidents and environmental pollution. Industrial zones of the RTB Bor group are located in immediate vicinity of Bor residential area, thus increasing the threat of noise pollution for residents of the city of Bor, i.e. posing a threat to human health.

1.2.2.2. Thermal power plants (TPP) and combined heat and power plants (TE-TO)

Thermal power plants “Nikola Tesla” (in Serbian: TENT) include:

- TPP “Nikola Tesla A” (with the total of 6 blocks);
- TPP “Nikola Tesla B” (with the total of 2 blocks);
- TPP „Kolubara“ (with the total of 5 blocks);
- TPP „Morava“ (with one block).

„Kostolac" thermal power plants and open-pit mines include:

- TPP „Kostolac A“ (with the total number of 2 blocks);
- TPP „Kostolac B“ (with the total number of 2 blocks.

„Pannonian” Combined Heat and Power Plant (TE-TO) includes:

- TE-TO Novi Sad.
- TE-TO Zrenjanin.
- TE-TO Sremska Mitrovica.

Thermal power plant "“Nikola Tesla A"

TPP "“Nikola Tesla A" (Serbian: TENT A) uses approximately 56,000 tons of Kolubara lignite per day, while its blocks are combined heat and power plants.

Location: on the right bank of the Sava river, about 40 km upstream of Belgrade between settlements of Krtinska and Urovci, about 3 km west of Obrenovac.

Relief: Most of the region is a noticeable low-lying area, while some parts are low mountain and hilly area. The Bukvik mountain top dominates in a low mountain part of the area.

Geological features: Paleozoic crystalline schist, Triassic chalk and limestone, sandstone and marl, mass of extrusive igneous rocks of andesitic and dacitic composition. The economically most important raw mineral in this area include coal, lignite, infusorial earth, quartz-sandstone, etc.

Hydrological characteristics: The Sava and Kolubara rivers, as well as the Tamnava river which is the third-largest river in this area, actually a canal which remained from the previous course of the river.

Soil: The following types of soil are found in the area: euthric combisols, black soil, strongly acidic euthric combisols, alluvium, sandy soils.

Climate: The area is in the center of moderate-warm belt. The low moderate-warm belt, high relative humidity, fog and atmospheric temperature inversion result in smaller dispersion of flue gases both in vertical and horizontal directions, so that pollutants stay near the ground, near sources of pollution.

Climate change: Although high technologies must be applied in compliance with EU law, coal-fired thermal power plants are a significant source of CO_2 emissions.

Ambient air quality: Fly ash dumps of TENT A contribute to cumulative air pollution. Occasionally, concentrations of SO_2, NO_2, suspended particles, soot and heavy metals in the atmosphere exceed limit value. The air quality control near TENT A includes the total settleable particles and sulfur oxide (SO_2). Emissions of the total settleable particles are monitored at 18 measuring points, while SO_2 emissions at 4 measuring points at different distances from TENT A and TENT B. The analysis of results obtained in 2009 showed the following percentages of data exceeding the GVI for average monthly values:

- 8,33% within the tailing dump of the TENT A;
- 2,78% close to the TENT A (Local Ecological Action Plan of the City Municipality of Obrenovac).

High, and occasionally exceed, levels of ambient air pollution result from technologies currently used in power plants, boiler operation outside their prescribed operating regimes, as well as insufficient efficiency and irregularities of eclectic filter operation. Other local sources of pollution, such as traffic, household use of solid fuels, industrial plants, coal excavation, dust rising from the dumps, etc., significantly contribute to ambient air pollution, etc.

Water quality: In 2011, water quality of the Sava river in half of the total number of tested samples fell into 2nd class, while river water in other half of the tested samples was of lower quality, whereby in 42% cases due to physical-chemical contamination of water, while in 17% cases due to bacteriological contamination. In the Kolubara river, the water quality in only 8% of samples fell into 2nd class, in 83% of samples the water was physically and chemically contaminated, while water of half of the total number of tested samples was bacteriologically contaminated (City Institute for Public health Belgrade). The water from the Sava river is used for cooling the condensers. Upon completion of the condenser cooling process, the water is discharged into the Sava river through recirculating cooling

water channel. This is a thermally loaded water. Water temperature in the cooling water channel increases by about 7ºC, while an increase in water temperature downstream the Sava river does not exceed 4ºC relative to the water temperature at the upstream profile. Wastewater from machine hall contains mineral oils. Occasionally, the content of mineral oils in water exceeds the maximum permitted value for 2nd class quality of 0,05mg/l, noting that the content of mineral oils is often greater in the Sava river upstream from the TENT B and TENT A, thus also in catchment. Wastewater that drain over the ash dumps in the TENT A is directly discharged into the Sava. Results of groundwater quality tests show the presence of dangerous and harmful matters and high level of pollution in the zone of the existing ash dump. The test results also show the presence of sulphates, suspended particles, arsenic, as well as changes in pH value.

Fly ash disposal: The cassette 1 of the ash dump of the TENT A in Obrenovac is covered with earth. The cassette 2 is active and the ash dumped into this cassette is mixed with water, while the cassette 3 is passive and recultivated, with planted grass.

Noise: At most of measuring points, the noise levels exceed the permissible ambient noise levels.

Other impacts: accident risk, negative effects on health of people, problem in waste management, negative effects of pollution on agricultural crops, degradation of agricultural land, greenhouse gas emissions, negative effects on natural resources.

Thermal power plant ""Nikola Tesla B"

Location: on the right bank of the Sava river, 50 km upstream from Belgrade, between settlements of Skela and Ušće, in the area called Vorbis.

Relief: The most of the region is a noticeable low-lying area, while some parts are low mountain and hilly areas.

Geological features: Paleozoic crystalline schist, Triassic chalk and limestone, sandstone and marl, d mass of extrusive igneous rocks of andesitic and dacitic composition. The economically most important raw mineral in this area include coal, lignite, infusorial earth, quartz-sandstone, etc.

Hydrological characteristics: the Kolubara, Sava and Tamnava rivers.

Climate: In the center of moderate-warm belt. The low moderate-warm belt, high relative humidity, fog and atmospheric temperature inversion result in smaller dispersion of flue gases both in vertical and horizontal directions, so that pollutants stay near the ground, near sources of pollution.

Climate change: Although high technologies must be applied in compliance with EU law, coal-fired thermal power plants are a significant source of CO_2 emissions.

Ambient air quality: Flue gases from boiler furnaces, after delivering a portion of their heat to pre-heaters and intermediate pre-heaters, move through air heaters where they heat fresh air, and then move through electric filter where fly ash particles are separated, and further through fans for flue gases where they are pushed up the chimney into the atmosphere. Flue

gases contain pollutants, out of which SO2, NOx, CO,CO2 and fine particulate matter (fly ash) are the most significant ones. The air quality control in the surrounding area of the TENT B includes measurements of the total emission of settleable particle and sulfur dioxide (SO_2). The total settleable particle emission is monitored at 18 measuring points, while SO_2 emissions are monitored at 4 measuring points, at different distances from TENT A and B. The results of the analysis carried out in 2009 showed the following data which exceed the GVI for average monthly values:

- 6,25% within the dump of the TENT B, and
- 1,69% near TENT B (Local Ecological Action Plan of the City Municipality of Obrenovac)

Water quality: In 2011, water quality of the Sava river in half of the total number of tested samples fell into 2nd class quality, while river water quality in other half of the samples was lower, whereby in 42% cases due to physical-chemical contamination of water, while in 17% cases due to bacteriological contamination. In the Kolubara river, the quality in only 8% of water samples fell into 2nd class quality, in 83% of samples the water was physically and chemically contaminated, while water of half of the total number of tested samples was bacteriologically contaminated (City Institute for Public health Belgrade). The water from the Sava river is used for cooling the condensers. Upon completion of the condenser cooling process, the water is discharged into the Sava river through recirculating cooling water channel. This is a thermally loaded water. Water temperature in the cooling water channel increases by about 7ºC, while an increase in water temperature downstream the Sava river does not exceed 4ºC relative to the water temperature at the upstream profile. Wastewater from machine hall contains mineral oils. Occasionally, the content of mineral oils in water exceeds the maximum permitted value for 2nd class quality of 0,05mg/l, noting that the content of mineral oils is often greater in the Sava river upstream from the TENT B and TENT A, thus also in the catchment. Wastewater that drain over the ash dumps in the TENT B are indirectly discharged into the Sava through the Vukićevac Canal. Results of groundwater quality analyses show the presence of dangerous and harmful matters and high level of pollution in the zone of the existing ash dump. The test results also show the presence of sulphates, suspended particles and arsenic, as well as changes in pH values.

Fly ash disposal: New technology for reducing the ash dispersion level is used by mixing fly ash with water in the ratio 1:1 (previously, this ratio was 1:10).

Noise: At most of measuring points, the noise levels exceeded the permissible ambient noise levels.

Other impacts: landscape degradation, degradation of agricultural land cover, change in land use, impacts on biodiversity, habitat loss for certain flora and fauna species, adverse human heath impacts.

„Kolubara" Thermal power plant

Location: "Kolubara" thermal power plant is located at the edge of the Kolubara mining basin, in Veliki Crljeni, 15km north of the center of Lazarevac.

Climate: Moderate-continental climate. North, southeast and west winds are most frequent winds in this region. Wind speed ranges from 0.1 to 6.5 m/s.

Relief: The terrain is inclined towards the Kolubara river which forms a western boundary of the region. The northwestern part of the region is a low-lying land, while the southeastern part is a hilly area.

Vegetation: This is a forest-rich region. Oaks trees grow in the low-lying area, while elms trees grow in the hilly part of the area. Climatic and soil conditions are very favorable for growing all main agricultural crops: maize, vegetable, fruit, beet, sunflower, etc.

Geological features: The region is composed of different rocks, both in terms of their geological age and way of their formation, as well as in terms of their petrographic and chemical properties. The geologically oldest rocks include Paleozoic crystalline schist, Triassic chalk and limestone, sandstone and marl. The lower, hilly part of the terrain and low-lying terrain is composed of Tertiary and Quaternary sediments composed of sand, clay, sandstone, limestone, loam, gravel, infusorial earth, and coal. A large mass of extrusive igneous rocks of andesitic and dacitic composition bears witness of turbulent geological past of this region.

Hydrological characteristics: The Kolubara, Beljanica, Turija, Peštan, Ljig, Lukavica, Grabovica, and Onjeg rivers.

Ambient air quality: Sources of air pollution in the TPP "Kolubara" include: two chimneys (105m and 130m high), ash and slag dump – coal dump, coal transportation system. Principal air pollutants emitted from the TPP "Kolubara" include: sulfur, nitrogen and carbon oxide, solid particles of fly ash and slag, and coal particles. The results of analysis of harmful emission measurements revealed that:

- Measured values of solid particle measurements most frequently exceeded the GVI values;
- Measured values of nitrogen oxide concentration were most frequently within the GVI values;
- Measured values of sulfur oxide concentrations frequently exceeded the GVI values for such boiler furnaces.

Considering the content of sulfur in the fuel (0.5% in average), as well as the fact that de-sulfuring plant has not been built, such values are expected. The results of the analysis of harmful emission measurements revealed that:

- Measured values of median daily SO_2 concentration were bellow the prescribed GVI values;
- Measured values of median daily soot concentration were season depended.

In the summer, they are within the permitted limit value, while in the winter they exceed the permitted limit value. However, due to simultaneous effects of local household solid-burning stoves, the overall results cannot be fully accepted as they refer only to operation of thermal power plant. The analysis of the obtained results of harmful emissions revealed that direct effects of thermal power plant are felt in the northwestern – southeastern zone due to circulation of winds. This zone along the mentioned longitudinal axis extends from northwest of the Ibar's main road (Serbian: Ibarska magistrala) to southeast of Sokolovo junction (Local Ecological Action Plan of the City Municipality of Lazarevac). The problem of ambient air pollution originating from fly ash dump has been solved through recultivation of passive

cassettes and maintenance of water body in the active cassette, i.e. through a careful monitoring of activities at ash and slag dumps. It is necessary to change transportation system for fly ash having the lower water content (water-fly ash ration 1:1), as well as substitute the existing inappropriate system which causes problems.

Water quality: Water from the Kolubara river is used for technological processes within the thermal power plants. Approximately 3.700.000m3/year of water is used from catchment. Different types of muddy, oily, saline and wastewater come from technological processes after the chemical preparation of water. Hydraulic transport is used to carry all wastewater with ash and slag to the dump. Greater part of the water is returned to production process, while only a smaller part is discharged into canal through which it flows into the Kolubara river through the Turija river. The ash dump affects the quality of groundwater and causes a rise in groundwater levels. The presence of sulfates and suspended particles, as well as changes in pH values, cause change in wastewater quality.

Noise: Thermal power plant is a source of noise of different strengths and frequencies. Specific technological operations and large-scale mining equipment can generate high noise levels. Noise suppressors are installed in 5 boilers of the TPP "Kolubara". Occasionally, the level of noise originating from the TPP "Kolubara" exceeds the permitted values.

Soil quality: The highest soil pollution levels occur near sources of soil pollution. Secondary contamination occurs under the influence of unfavorable weather conditions when gases and fly-ash particles settle down on the ground. Soil acidity varies, which can be associated with different acid-gas sediments at different distances from their sources. Occasionally, higher concentrations of lead and cadmium in settleable particulate matters are detected.

Other impacts: landscape devastation, degradation of forest and agricultural land cover, problems with waste disposal, adverse human heath impacts, impacts on biodiversity.

Thermal power plant "Morava"

Location: on the right bank of the Great Morava river, 2,8km from Svilajnac. This location has been selected because of its position which is the most favorable for waste coal transportation from surrounding mines, as well as vicinity of the river whose water is used for cooling systems.

Climate: Moderate-continental climate. Vicinity of high mountain massive to the east of the area, wide openness towards the west, towards the Great Morava river valley, affects microclimates. The southeast wind known as "košava" prevails in periods of cool weather, while northwest wind is typical for the periods of warm weather.

Relief: Low-lying land of the Great Morava river valley.

Geological feature: The area is composed of sedimentary rocks, neogenic lake sediments in the hilly part of the area, and alluvial plain in the valley formed by the Great Morava river depositing the sediments on its flood plain. Neogenic sediments are mainly composed of sand and clay, while Tertiary limestone is also found in places.

Hydrological characteristics: The Great Morava and Resava rivers.

Air quality: Flue gases containing sulfur dioxide, nitrogen oxide, carbon dioxide and fine particulate matter are discharged through the 105m high chimney after the purification and separation of fine particulate matters in electro-fillers. The analysis of results of measurements of specific target air pollutants which was carried out in 2011 revealed that values for SO2 and fine particulate matter exceeded GVI, while NOx (NO2) emission values were within the GVI.

Water quality: Drain wastewater that overflows during ash and slag hydraulic transport is directly or indirectly discharged into the water recipient due to obsolete hydraulic transport of „rare″ ash-water suspension (1:10). Wastewater originating from washing the steep-angle conveyors is directly discharged into river after the mechanical sedimentation of coal particles in sedimentation chambers. Sanitary wastewater is directly or indirectly discharged into river after the mechanical and biological purification in aerobic conditions in purification devices.

Water which contains oil and/or mazut, after undergoing the process of separation of oil or mazut through absorbing membranes, is indirectly discharged into the water recipient through rain drain pipes or through recirculating cooling water tunnel. The analysis of data obtained in recipients which was carried out in 2011 revealed that there was no significant change in water quality in the Great Morava river downstream from the TPP „Morava“. It was found that the water temperature in the Great Morava river increased by 3°C in its lower course.

Noise: Noise occasionally exceeds the permitted level. In 2011, measurements were not carried out due to unplanned prolongation of overhaul works for objectively valid reasons.

Other impact: adverse human health impact, impact on flora and fauna, problems in waste management.

Thermal power plant "Kostolac"

The "TPP - KO Kostolac" uses lignite from "Ćirikovac" and "Drmno" open-pit mines to generate electricity.

Location: in the peri-Pannonian part of the northeastern Serbia, nearby the town of Kostolac and archeological site of Viminacium.

Relief: The relief of the Kostolac basin terrain is characterized by sediment accumulation and soil erosion. Morphologically, the area covered by the Plan is characterized by two ridges (Požarevačka greda and Boževačka greda ridges), with Stig valley in-between. Ridges extend from north to south and are almost parallel. Topographically, the tertian of the Pannonian region slopes downward towards large rivers.

Climate: Moderate-continental climate. The effects of the steppe climate of neighboring Banat are noticeable. The region is highly affected by "košava", strong southeast wind.

Hydrological characteristics: The Danube and its tributaries, the Great Morava and the Mlava, with a backwater called "Dunavac" and the Canal make up a specific hydrographic features of the region.

Type of land use: Most of the land is arable land, due to which the interest in preserving agricultural land is significant. Mostly arable land is used primarily for the production of

wheat, vegetable and stone fruit, while soil fertility can be improved by deep plowing, the use of fertilizers and erosion protection in inclined terrains.

Vegetation: Conditions for vegetation to grow are very favorable, both in low-lying areas and valley and hilly areas. Vegetation types include forest and steppe vegetation in low-lying areas, while hilly areas in the east were once covered by sweet oak and bitter oak trees. Due to high soil moisture, the areas around watercourses (marshy land, marsh vegetation) are natural forest complexes (poplar, willow, common oak, hornbeam, alder, ash-tree etc.), which are autochthonous plant species. So far, insufficient attention has been given to the vegetation preservation so that many habitats have been degraded.

Ambient air quality: Thermal power plants "Kostolac A" and "Kostolac B" emit different harmful pollutants that cause ambient air pollution. Harmful pollutants emitted by thermal power plants in the atmosphere include SO_2, NO_x, CO_2, CO and fly ash particles. The closer and wider surrounding areas are directly polluted during the transportation and storage of fuel (lignite). The sulfur dioxide which, together with nitrogen oxide, causes acid rains, has the greatest negative effects on human health, flora and fauna, as well as on materials (accelerated corrosion). In addition, a certain amount of particles are emitted from coal dumps, as well as from ash and slag dumps. While ambient air pollution occurs in the immediate vicinity, the ash discharged from chimneys can be dispersed over long distances in dependence of chimney height and weather conditions. The "Middle Kostolac Island" ash and slag dump is a secondary source of pollution because strong winds often disperse the fly ash particles causing excessive ambient air and soil pollution in the vicinity. Based upon comparison of results of emission measurements with the maximum values of the emission (GVI) prescribed by domestic law and EU regulations, in can be concluded that emissions of SO_2, Nox, CO and fine particulate matter occasionally exceed the permitted levels.

Water quality: the used cooling water from the TPP „Kostolac B" is discharged into the Mlava and Danube rivers, but they do not cause significant temperature rise. Hydraulic transport of fly ash and slag provides a necessary level of surface and groundwater protection: overflowing water that leaves the dumps reaches surface water which infiltrates into groundwater. Groundwater in the surrounding area of fly ash dumps is characterized by increased mineralization (increased water hardness, higher content of sulphates, etc.) and higher content of solid substances, lubricants, oil or β radioactive emitters. Wastewater from dumps increases concentration of SO_4, calcium, magnesium, iron, zinc, mineral oils and arsenic in groundwater. Bacteriologically, aerobic mesophilic bacteria, as well as coliform bacteria, have been detected in groundwater, but their number meets the prescribed norms.

Soil quality: The content of natural radionuclide in coal combustion fly ash and slag is increased relative to its content in a common soil, but does not lead to a significant increase in internal and external radiation exposure.

Location of ash: The "Middle Kostolac Island" ash and slag dump is used for disposal of fly ash and slag from TPP "Kostolac A" and TPP "Kostolac B".

Noise: The results of noise measurements revealed that in all measurement points the noise levels exceeded the permitted outdoor ambient noise level for both daytime and nighttime period.

Other impacts: greenhouse gas emission, adverse human health impacts, impacts on biodiversity, landscape devastation, change in land use, degradation of forest and agricultural cover, problems with waste disposal.

Combined Heat and Power Plant Novi Sad

Location: in northern, industrial area, on the river bank of the Danube, only 5 km from the city of Novi Sad. Combined Heat and Power Plant Novi Sad is the largest of the three Pannonian combined heat and power plants.

Relief: The city of Novi Sad lies on the river banks of the Danube. The lowland area is located on the left river bank of the Danube (Bačka), while on the right river bank, the hilly part of the area lies on the Fruška gora slopes (Srem). Elevation from the Bačka side ranges from 72 meters to 80 meters above the sea level, while from the Srem side, the elevation ranges from 250 meters to 350 meters above the sea level.

Climate: Climate of the area transforms from moderate-continental to continental. The dominant wind is „košava" - southeast wind.

Hydrological characteristics: The Mali Bački canal flows into the Danube near Novi Sad. It is a part of the Danube-Tisa-Danube canal and smaller irrigation canal.

Geological feature: The area is characterized by two different geomorphologic entities: Fruška Gora, an isolated, narrow mountain, and the flat aluvian plain of the Pannonian basin. The southernmost part of the alluvial plain of the Pannonian basin which has a uniform geological composition and slightly emphasized relief belongs to the surrounding area of Novi Sad. The dominating fluvial erosion limited by meander cutting into the Danube river bed, as well as aeolian and fluvial sediment accumulation, is a factor of relief pollution.

Ambient air quality: Flue gases containing sulfur dioxide, nitrogen oxide and fine particulate matter are discharged through 160m high chimney into the atmosphere. The analysis of measurements of specific target air pollutants revealed that emissions of fine particulate matter and SO2 were below GVI, while emissions of NOx (NO2) were above GVI. Emissions of pollutants in atmosphere in 2011 were: 4.76 t/year of fine particulate matter; 107.8 t/year of SO_2; 1 305.7 t/year of NOx - (NO_2); 25,3253 t/year of CO_2. (Environmental Protection Report in the Public Enterprise „JP EPS" for 2011).

Water quality: The largest amount of water in the TE-TO Novi Sad is used for the water cooled surface condensers and recirculating cooling water system, while water is supplied from the Danube river. The return cooling water, as well as all other wastewaters, after the purification are discharged into the Danube. The Danube river is classified as 2nd class watercourse. The analysis of data on the wastewater recipient carried out in 2011 revealed that the Danube river, upstream and downstream, did not meet the MDK for the 2nd watercourses, as well as that concentrations of ammonia, inorganic nitrogen and suspended particulate matter in sewage water exceeded the MDK. (Environmental Protection report in the Public Enterprise „JP EPS" for 2011)

Noise: Noise was measured in the surrounding area of the Combined Heat and Power Plant Novi Sad, near the "Šangaj" settlement. Measured noise levels were within the permitted outdoor ambient noise level in the residential area for both daytime and nighttime period. Measurements were carried out in 2009.

Other impacts: waste disposal, adverse human health impacts.

Combined Heat and Power Plant Zrenjanin

Location: The Combined Heat and Power Plant (TE-TO) Zrenjanin is located in the industrial zone of Zrenjanin, 4 km far from the city center.

Climate: the steppe climate. Košava is prevailing wind in the area. The southwest wind is the second-largest wind in this area. This wind always brings snow or rain, as well as sufficient humidity. A cold and rather strong northerly wind is the third-large wind in this area.

Relief: Geomorphologically, the relief of the terrain in the area of Zrenjanin is a noticeable lowland area which elevation ranges from 73 meters to 82 meters above sea level. The area lies in an alluvial plain between the Tisa and the Begej rivers.

Geological features: The oldest rocks found in a wider area of Zrenjanin include Precambrian crystalline schist. Crystalline schist of this complex are of very heterogeneous composition and lie at the depths ranging from 2 000 meters to 4 000 meters. They abruptly rise to the southeast and in the area of Vršac mountains (Vršačke planine), they appear on the surface of the terrain.

Hydrological characteristics: The area is the densest river and canal hub in Europe where many rivers flow: the Begej, Tamiš, Tisa, Danube rivers, and the Danube-Tisa-Danube canal, within the are of 30km.

Ambient air quality: Flues gases containing sulfur dioxide, nitrogen oxide and fine particulate matter are discharged from the 160m high chimney into the atmosphere. The analysis of measurements of specific target air pollutants carried out in 2011 revealed that emissions of fine particulate matter and SO_2 were below the GVI, while NOx (NO_2 emissions) were above GVI. Emissions of ambient air pollutants in 2011 were: 0,05 t/year of fine particulate matter; 85,26 t/year of NOx - (NO_2); 53617 t/year of CO2 (Environmental Protection Report in the Public Enterprise „JP EPS“ for 2011).

Water quality: Wastewater (originating from chemical cleaning of boiler plant, washing and passivization of water system, and oily water) are discharged through the Aleksandrovac canal into the Begej river after the purification. The Aleksandrovac canal belongs to the 4th class watercourse, and the Begej river to the 2nd class watercourse. The acidic–alkaline water from the demineralization process is neutralized and discharged into the Aleksandrovac canal. Oily wastewater is also processed (through anthracite coal filters) and then discharged into the Aleksandrovac canal. The discharges lead to a significant increase in the content of nitric oxide, nitrate, dissolved oxygen, ammonia and COC in the Aleksandrovac canal.

Noise: Noise measurements were carried out in the surrounding area of the TE-TO Zrenjanin. All equipment generating noise is a stationary equipment. Measurements were carried out at 5 measuring points in the industrial zone and within the TE-TO Zrenjanin at different distances from noise sources (fans for pushing fresh air into boiler). The measured noise levels exceeded the permitted outdoor ambient noise level for both daytime and nighttime period (2009).

Other impacts: adverse human health impacts.

The Combined Heat and Power Plant (TE-TO) Sremska Mitrovica

Location: It is located on the left bank of the Sava river, four kilometers downstream in the eastern, industrial zone of the city.

Climate: Climate is moderate-continental with micro-location characteristics of a mountain area. Transitional seasons are characterized by changes in weather. Autumn is warmer than Spring. Summers are stable with occasional short heavy rains and precipitation of local character. Winters are cold with snowfall. The east wind prevails in this area.

Relief: The relief consist of three natural entities in the south-east direction. The first, northernmost entity encompasses mountain area – area of the central part of Fruška Gora mountain which elevation ranges from 200 meters to 540 meters above sea level. The second entity encompasses the area of southern foot of the Fruška Gora mountain which elevation ranges from 120m to 200m above seal level. The third entity encompasses the Srem lowland which elevation ranges from 80m to 120 m above sea level. The southernmost entity encompasses the area of northern Mačva, a lowland and marshy area.

Geological features: River deposits (sand and sludge) prevail in the Sava riparian area. Older sediments (lake and marine deposits) lie in deeper parts of Srem beneath the Quaternary cover.

Hydrological characteristics: The Sava and Bosut rivers are two main watercourses. Other watercourses include mountain streams of Fruška Gora and lowland canals of lesser importance. In addition to rivers, there are also several small artificial lakes near villages of Čalma and Bešenovački Prnjavor.

Ambient air quality: Flue gases containing sulfur dioxide, nitrogen oxide and fine particulate matter are discharged through 105m high chimney into the atmoshpere. The analysis of measurements of specific target air pollutants carried out in 2011 revealed that emissions of fine particulate matter and SO_2 were below GVI. Emissions of NOx (NO_2) in January-April period exceeded GVI. After the adjustment of burner during the overhaul period, emission values were reduced to GVI. Air pollution emissions in 2011 were: 0,030t/year of fine particulate matter; 10,531 t/year of NOx - (NO_2); 7875t/year of CO_2 (Environmental Protection Report in the Public Enterprise „JP EPS“ for 2011).

Water quality: TE-TO Sremska Mitrovica has a recirculating cooling water system, using water from the Sava river. The return cooling water is discharged into the Sava. The Sava river belongs to the 2nd class watercourse. The analysis of data on the wastewater recipient carried out in 2011 revealed that the Sava river, both downstream and upstream, did not meet MDK for the 2nd watercourses for ammonia and nitric oxide, nitrate and suspended particulate matter.

Noise: Noise measurements were carried out in the surrounding area of the TE-TO Sremska Mitrovica. All equipment generating noise is a stationary equipment. Fans for pushing fresh air into boiler are principal noise source. Based upon measured noise levels, it can be concluded that TE-TO have no effects on buildings in the residential zone.

Other impacts: adverse human health impacts.

1.2.2.3. Hydroelectric power plants

Hydroelectric power plants (HEPS) inevitably cause environmental impacts. This primarily includes changes in aquatic ecosystem of reservoirs and riparian ecosystem. These changes are of permanent character and require continuous monitoring and protection measures. Different processes take place in HEPS accumulation reservoirs causing a significant water quality degradation due to organic matters and waste which are brought in the accumulation reservoirs.

Hydroelectric power plants (HPPs) within the HPP „Djerdap" include: HPP „Djerdap 1", HPP „Djerdap 2", HPP „Pirot" and „Vlasinske" HPPs

Hydroelectric power plant "Djerdap 1"

Location: It is located 10km downstream from Kladovo, 943 kilometers from the Danube mouth at the Black Sea. The hydropower and navigation system "Djerdap 1" is a complex multi-purpose facility. It is currently the largest hydroelectric facility on the Danube. It is completely symmetrical and designed so that each country (Serbia and Romania) has equal parts of the main facility available, which they maintain and use according to the agreement and conventions on construction and exploitation.
It is a run-of-the river hydropower station.

Relief: Relief of the terrain is complex and very diverse, composed of tectonic forms (mountains and valleys) formed through exogenic processes – paleo-abrasion relief, fluvial-denudation plateau, karsts both on the surface and beneath surface, aeolian forms.

Geological features: Almost all rocks were formed during all geologic periods: Paleozoic crystalline schist, Permian red sandstones, Mesozoic sandstones and dolomites, Paleocene-Neogene sediments, Quaternary deposits of marl and quicksand and plutonic and volcanic rocks.

Morphological aspects: Main morphological elements include the Djerdap Gorge and lower and medium-high mountains with valleys between them. The gorge is 100 km long and connects the Pannonian basin with the Pontic basin, intersecting the Carpathian mountains.

Climate: A climate boundary zone between steppe climate of Pannonian plain, moderate-continental climate of south edge of Panonnian basin (Šumadija) and continental climate of lowland of Vlaška.

Hydrological characteristics: The Danube river, identified as the Pan European Transport Corridor 7 is a vital connection between the Western Europe and countries of the Central and Eastern Europe. The Djerdap Lake was formed after the construction of a 54 m high and 760 m wide dam. The Lake is 140 km long and 130m deep. It extends between Sip and Ram.

Soil and groundwater: The Danube slow-down caused by building the hydroelectric power plant resulted in changes in groundwater regime in the riparian area. Groundwater level is higher, but oscillations in groundwater levels have been mitigated. Drainage systems have been built to protect land from ground water discharges.

Water quality: According to basic physical-chemical and biological water quality indicators, the water quality in the accumulation reservoirs meets the prescribed quality for the 2nd class watercourses. Out of hazardous matters, the higher concentrations of phenol matters and mineral oil in water have been occasionally registered, which can be associated with the fact that the Danube is one of the largest transportation routes. The content of other hazardous substances and materials in water is within the permitted limit for the 2nd class watercourses (heavy metals, polychlorinated biphenyls, polynuclear aromatic hydrocarbons, radionuclide).

Floating debris: The existing level of urbanization and the development of industry and utility infrastructure resulted in occurrence of a great number of different concentrated and dispersed pollutants upstream from the hydroelectric power plant. Solid wastes from a great number of illegal dumps located at banks of accumulation reservoir, as well as non-purified wastes and used water ,generate a large amounts of floating solid waste upstream from the hydropower plant causing problems in its operation, as well as in operation of its ancillary facilities.

Noise: So far, noise measurements have not been carried out in the surrounding area of "HPPs Djerdap" (Power Plants Djerdap Limited Liability Company) because hydroelectric power plants are dislocated from settlements and, as such, they are not factors of environmental risk from this aspect.

Waste: Municipal solid and floating wastes collected from water surface and waste trap grilles in front of hydro-aggregates at the entrance of facilities of hydroelectric power plants is transported to the landfill built near Davidovac on regular basis. The landfill was built in accordance with current regulations.

Wastewater: Approximately 100 million m^3 of technical water and 20.000 m^3 of wastewater is discharged from HPP „Djerdap 1" per year. Technical water mostly includes a cooling water used for turbine cooling and, as such, it is discharged in the Danube. The cooling water contains small amounts of oil.

Hazardous matters: In the HPP „Djerdap 1", there are 12 transformers filled with transformer oil which contains PCBs. Other hazardous matters include turbine and hydraulic oils which are stored in central storage facility. The oil service unit contains 16 reservoirs per 30m^3 of oil. The HPP „Djerdap 1" uses a relatively small number of chemicals which may be considered dangerous.

Other impacts: geological stability, impact on flora and fauna due to changes in water level, impact of locally higher relative humidity of the air, impacts on water quality (depending on how long harmful substances stay in water, as well as on their quantity), erosion downstream along river banks due to fluctuations in river water level.

Hydroelectric power plant "Djerdap 2"

Location: A developed area which extends 80 kilometers downstream from HPP "Djerdap 1". The HPP "Djerdap 2" is the second joint venture between Serbia and Romania on the Danube. It was built at river km 863 upstream from the Danube river mouth at the Black Sea, at Kusjak-Ostrovul Mare profile. This system is a complex and multipurpose hydro-technical facility. It consists of a main hydroelectric power plant, two additional hydroelectric power plants, two spillway dams, two water locks, and two switchgears. One of each two mentioned

hydropower plants belongs to Serbia and Romania respectively. Considering that Serbian-Romanian border is between the two hydroelectric power plants, each side maintains and exploits its part of the system without being disturbed. These are run-of-the river hydroelectric power plants.

Relief: The relief is complex and very diverse, represented by tectonic forms (mountains and valleys). The relief was formed through exogenic processes - paleo-abrasion relief, fluvial-denudation plateau, karsts found both on the surface and beneath it, aeolian forms.

Geological features: Almost all rocks were formed during all geologic periods: Paleozoic crystalline schist, Permian red sandstones, Mesozoic sandstones and dolomites, Paleocene-Neogene sediments, Quaternary deposits of marl and quicksand and plutonic and volcanic rocks.

Morphological relief forms: The main morphological elements of the relief include the Djerdap Gorge and low and medium-high mountains with valleys between them. The gorge connects Panonnian basin with the Pontic basin, intersecting the Carpathian mountains.

Climate: A climate boundary zone between steppe climate of Panonnian plain, moderate continental climate of south edge of Panonnian basin (Šumadija region) and continental climate of lowland of Vlaška.

Hydrological characteristics: The Danube river as Pan European Transport Corridor 7 is a vital connection between Western Europe and countries of Central and Eastern Europe. The Djerdap Lake was formed after the construction of a dam 54 m high and 760 m wide. The Lake is 140 km long and 130 m deep. It extends between Sip and Ram.

Suspended debris: At all measured profiles, the content of suspended particulate matters in the accumulation reservoir of the HPP "Djerdap 2" was less than 10 mg/l. A decrease in concentrations of suspended particulate matters was recorded along the watercourse during April, while values measured in June and September were low and uniform along the entire watercourse.

Floating debris: Problem of floating debris is particularly pronounced in the period of high water levels when a great amount of wood waste, plastic package waste, and other floating wastes originating from different sources of pollution upstream of hydroelectric power plant accumulate on water trap grilles in front of aggregates. These wastes are collected by special lifting equipment – the so-called "sweepers", and transported to industrial landfill of the HPP "Djerdap 2".

Water quality: According to all basic physical-chemical and biological indicators of water quality, water in the accumulation reservoir of the HPP „Djerdap 2" belongs to prescribed water quality for the 2nd class. The water quality in the accumulation reservoir is a direct result of the quality of water which inflows in the reservoir.

Wastewater: Sources of wastewater from the main hydroelectric power plant and HPP „Djerdap 2" include water from sanitary blocks and cooling systems of aggregates and block-transformers. The quality of wastewater from HPP "Djerdap 2" is monitored on quarterly basis. All prescribed water quality indicators are monitored according the Regulation of

Water Classification. Considering that all technical and sanitary waters are discharged into the Danube in the same place, cumulative impact of wastewater and technical water is monitored.

Hazardous matters: In the HPP „Djerdap 2“, hydraulic and technical oils are used for auxiliary technological equipment of aggregates, while spare amounts of these oils, as well as transformer oil, are stored in the central storage facility. Oils used in the HPP „Djerdap 2“ are PCB free.

Waste: Wastes are collected in places at which they are generated and then transported to the plateau in front of the central storage facility in Kursjak, which is located within the HPP „Djerdap 2“. Hazardous waste is stored in the storage facility for hazardous waste matters in Kusjak. The storage facility and its surrounding area is arranged in accordance with current regulations. In the "HPPs Djerdap", there is an ongoing process of introducing the waste management (sorting, classification in places of waste generation and processing for further treatment). Oil purification is carried out in purification facility within the main hydroelectric power plant. The purified oil is reused so long as it has satisfactory characteristics, while oil sludge is collected and disposed of in storage facility for hazardous waste from which it is delivered to institutions which are authorized for further waste treatment.

Noise: So far, noise measurements in surrounding areas of electric power plants within the „HPPs Djerdap“ have not been carried because hydroelectric power plants are dislocated from settlements and, as such they are not factors of environmental risk.

Other impacts:

- Microclimate change in the accumulation reservoir area within the HPP „Djerdap 2“ due to large amount of water;
- Difficult recreational use of reservoir banks due to water-level fluctuations of reservoir;
- Disturbed regimes of surface waters;
- Groundwater level rise in the entire stretch;
- Potential landslides;
- Great daily water-level oscillations of the Danube river;
- Fish migration.

Hydroelectric power plant "Pirot"

Location: It is located in the territory of southeastern Serbia, between the town of Pirot and Serbian-Bulgarian border. The hydroelectric power plant uses water from the Visočka river at the profile of the "Zavoj" dam.
It is a hydroelectric power plant with accumulation reservoir.

Relief: The mountains were formed during the Alpine orogeny. They constitute the western part of the Balkanides directed parallel to the Earth’s axis confronting the Meridian Carpathians and create an arch-shape mountain belt. The mountains include the Suva Planina mountain, Svrljiške Planine mountains, and mountains of Ozren, Devica,Tupižnica, Tresibaba, and Belava. The Pirot valley is a part of a composite valley of the Nišava river.

Geological features: Mesozoic rocks. The type of rocks include different colors sandstones and conglomerate. Limestone and Dolomite limestone cover a very large area, while alevrolites and sandstone shale are imbedded in carbonate rocks. The belt close to the river is

composed of eluvial-delluvial materials. Concerning the geological rock formation, the terrain is composed of almost always mixed rocks, so that they often form a flysch.

Climate: Climate of valleys and mountain climate, more continental than moderate-continental climate. Small amounts of precipitation.

Hydrological characteristics: Due to scarce precipitation, mountains are often dry, without water sources and streams of greater importance. The Nišava, Timok, Moravica, and Visočica river are major rivers in the region in which there is also the „Zavoj“ artificial lake. Water sources and powerful water sources (Čitlučko vrelo Moravice – powerful water source of the Moravica) are found at foothills (a water source just below the Vražja glava peak of the Stara Planina mountain).

Vegetation: Considering that it is a mountain area, forest cover is insufficient from the aspect of soil protection against erosion. A great part of the land area is covered by forests which are degraded and with underbush which do not offer sufficient soil protection against erosion.

Waste: In the HPP "Pirot", according to amounts of waste, only some types of waste are separated in an organized way, while other types of waste, non-hazardous waste, are disposed of on municipal solid waste landfill. The waste is, depending on its type, collected at three locations. Waste oils and liquids are collected and stored in the storage facility for oil and mazut before being delivered to companies which are authorized for waste treatment.

Wastewater: The HPP „Pirot“ discharges approximately 200 m³ of sanitary wastewater per year into the Pirot sewerage system. Depending on duration of hydro-aggregate operation, an average of approximately 330,000 m³ of technical water is discharged per year. Technical water mostly includes a cooling water which is used for cooling the generators and hydro-aggregate bearings and, as such, it is discharged into a drainage canal. Due to higher pressure in the cooling water system, it is not very likely that more significant amounts of oil will get into water. Smaller amounts of technical water, approximately 10,000 m³, is actually a drainage water which is collected on the hydroelectric power plant and pumped into the drainage canal.

Hazardous matters: There are 2 larger transformers (45 MVA) and 6 smaller ones (100 – 1000 kVA) in the hydropower plant. Transformer oil is PCB free. Other hazardous matters include hydraulic and turbine oils which are stored in the storage facility. The oil is tested on regular basis, while the turbine oil is dried and filtered every year during the overhaul of the hydropower plant.

Other impacts:

- Changes in flow regime (reduction) of the Visočica and Temštica rivers in the section downstream from the dam to the confluence with the Nišava river;
- Changes in flow regime (increase) of the Nišava river in the section downstream from the location where wastewater from drainage canal of hydropower plant is discharged into the river;
- Micro-climate change in the zone of “Zavoj” accumulation reservoir;
- Difficult recreational use of reservoir banks due to water-level fluctuations of reservoir.

Hydroelectric power plant “Vlasina”

Location: Four accumulation hydroelectric power plants are gradually positioned from the Vasina river to the town of Vladičin Han. The system includes HPP "Vrla 1", "Vrla 2", "Vrla 3", "Vrla 4" and PAP "Lisina" (Pump Accumulation Plant). Water from the Vlasina Lake which was created as a result of building an earth dam on the Vlasina river, as well as water from the Bitvrđe village watershed and the Romanovska and the Masuričkа river basin flows through tunnels to these hydroelectric power plants. Within the Vlasina HPPs system, consisting of mountain rivers of the Božica and Lisina, a large pump accumulation plant (PAP) "Lisina" was built to pump, when necessary, the water from the Lisin Lake into the Vlasina Lake (which is a main accumulation reservoir for the "Vlasina HPPs" system). It belongs to the type of hydroelectric power plants with accumulation reservoir.

Relief: The relief is composed of deep narrow valleys with steep sides and old mountain rocks with erosion surfaces. The relief is also made up of numerous low and medium-high mountains.

Geological features: The old rocks (gneiss, granite), extrusive igneous rocks (andesite) are frequently found, while limestone is rarely found in the area.

Climate: Climate is of sub-mountain type with cool summers and cold winters. In spite of the great height of the area, precipitation amounts are low.

Hydrological characteristics: The Vlasina Lake, the Vlasina, Vrla and Lužnica rivers are in the north, while the Pčinja and Božićka reka rivers are in the south.

Waste: Temporary, partially arranged waste dump is near the central workshop on the HPP „Vrlo 3“. Hazardous waste and transformer and turbine oils are stored in the storage unit which meets legal requirements.

Waste water: An average amount of 6.5x106 m^3 of wastewater originating from cooling systems, as well as approximately $60x10^3$ m^3 of sanitary wastewater per year is discharged from the „Vlasina HPPs“. This wastewater is discharged from hydroelectric power plants without prior treatment.

Waste matters: In the „Vlasina HPPs“, there are 18 transformers containing 7–25 t of transformer oil each and 15 smaller transformers containing 0,4 – 0,8 t of transformer oil each. In the HPP “Vrlo 3”, there is a central storage facility where all types of oil used in the system are stored. Within all HPPs, there are auxiliary storage units for storing certain amounts of technical oil. Technical oil regeneration is carried out occasionally, while a certain amount of waste oil is later sold to authorized companies.

Groundwater: Six accumulation reservoirs are conceived so as to prevent adverse environmental impact of groundwater occurring under the influence of reservoirs, except in case of landslides which occur on accumulation reservoirs of Lisina and HPP „Vrlo 2“.

Other impacts: The very concept of the Vlasina system, implying the use of water from natural waterways, redistribution of water from river basins and, above all else, the building of 6 accumulation reservoirs, 4 hydroelectric power plants and 1 pumping plant with all

associated infrastructure in an area of 520 km², involes significant effects of the system on the environment.

Hydroelectric power plant on the Drina river

Location of the HPP "Bajna Bašta": The „Bajna Bašta" run-of-the-river hydroelectric power plant in Perućac is the larges hydropower plant built on the Drina river. A concrete dam 90 meters high and 460 meters long was built across the Drina river. The lake (reservoir) extends to a length of 52 kilometers towards the town of Višegrad.

Location RHPP "Bajna Bašta": The reversible hydropower plant RHPP "Bajina Bašta" is a hydropower plant with accumulation reservoir. The upper part of the reservoir is located in the valley of the Beli Rzav river, while the lower part of the reservoir includes a lake of the existing HPP "Bajina Bašta". It is a reversible hydropower plant.

Location HPP Zvornik: It was built at river km 93 from confluence of the rivers Drina and Sava. It is a run-off-the-river hydropower plant.

Relief: The relief is composed of narrow valleys with steep sides and old mountain rocks with erosion surfaces, as well as numerous low and medium-high mountains. Almost all genetic relief types (except for aeolian) are represented: tectonic, fluvio-denudation, paleo-abrasive, paleo-vulcanic, karsts, rarely glacial type. Mountainous relief dominates.

Geological features: slate, serpentinites, limestone, igneous rocks (more extrusive than intrusive rocks), lake sediments. Impermeable rocks dominate, but there is also limestone.

Climate: Moderate-continental climate, with higher relative humidity of the air after the creation of artificial lakes in Perućac and Zaovina.

Hydrological characteristics: The Drina river with tributaries, the small Pilica river, the Rača, and the Rogačič rivers. An artificial reservoir, the Perućac Lake, was built on the Drina river.

Other impacts: geological stability, impacts on flora and fauna due to changes in water level, local air temperature rise, impacts on water quality, downstream changes in bank erosion rates due to fluctuations in water level.

Hydroelectric power plants on the Lim river

Location of the HPP "Bistrica": Located on the Lim river between the towns of Prijepolje and Priboj. It is a hydroelectric power plant with accumulation reservoir.

Location of HPP "Potpeć": it is located on the Lim river near Pribojska Banja spa. It is a run-of-the-river hydroelectric power plant.

Location of the HPP "Kokin Brod": The dam and hydroelectric power plant "Kokin Brod" were built on the Uvac river. After the construction of the dam, the 28 km long Zlatar Lake was created containing 250 million cubic meters of water. It is a hydroelectric power plant with accumulation reservoir.

Location the HPP "Uvac": The Uvac river was dammed for the needs of building a hydroelectric power plant, thus creating the Uvac (Sjenica) Lake. It is a hydroelectric power plant with accumulation reservoir.

Relief: The relief is dissected by narrow valleys with steep sides, as well as by gorges. Medium-high and high mountain area with valleys. All genetic relief types, except for Aeolian, are found in the region:

- tectonic reflief – mountains (Tara, Zlatibor, Golija and Rogozna), valleys (Novopazar and Sjenica valleys and secondary valleys: Ivanjica, Arilje, Tutin, Priboj and Prijepolje valleys);
- fluvial-denudation – composite valleys of the Lim and the Golijska Moravica, as well as narrow valleys with steep sides of the rivers Mileševica and Uvac;
- karsts – Pešter Field, Koštam Field, Ušac glacial system, the Tubić's Potpećka and Stopić's caves;
- glacial relief – on the Golija mountain.

Geological features: The terrain is of different composition, from Paleozoic shale to lake and Quaternary sediments. There are slate, limestone, serpentine minerals, igneous rocks and sediments.

Climate: More sub-alpine than moderate-continental (in the north) climate.

Hydrological characteristics: The Lim river is the most water-rich tributary of the Drina river. The Lim formed a composite valley. Upstream of the Lim, there is an artificial lake (Potpeć Lake) 10km far from the town of Priboj. The valley of the Uvac river was dammed, thus creating the Zlatar Lake. The Uvac river is the greatest tributary of the Lim flowing from the eastern part of the Drina river basin. Many mountain streams that flow down the southeastern slopes of the Ozren mountain join and form the Lim river. The total area to the Uvac river basin is 1,344km^2, while median elevation is 1,300 meters above seal level. The river is 115 km long with height difference of 657 meters. The Uvac river has a large hydropower potential. The most significant hydrographic objects in the region also include: river Raška (60km), Golijska Moravica and Rzav.

Other impacts: disturbed natural regime of surface water, potential landslides, geological stability, impacts on flora and fauna due to changes in water level, local increase in relative humidity of the air, impacts on water quality (depending on how long the harmful substances stay in water and on their quantity), fish migration.

Hydroelectric power plant "Elektromorava"

Location of HPP "Ovčar": Located on the West Morava river at the entrance to the Ovčar-Kablar Gorge near Ovčar Banja spa.
It is a of run-of-the-river hydroelectric power plant.

Location of HPP "Međuvršje": Located at the Ovčarsko-Kablar Gorge exit.
It is a of run-of-the-river hydroelectric power plant.

Relief: Noticeable missives of Ovčar and Kablar mountains. The West Morava river that flows between these two mountains has cut a huge gorge.

Geological features: The Kablar mountain is composed of serpentine minerals, limestone, diabase and hornstone, while Neogene sediments are found in valleys.

Hydrological characteristics: The Morava together with the West Morava river is the largest river in Serbia. The Great Morava river is 185 km long, while together with the West Morava, it is 493 km long. The Great Morava river flows through the most fertile agricultural and most densely populated region of Central Serbia called Pomoravlje (the Morava River Valley). The West Morava flows in direction parallel to the Earth's axis from the west to the east, separating Šumadija region from southern parts of the country. The first Serbian hydroelectric power plants - "Međuvršje" and "Ovčar banja", were built in one of the most beautiful parts of Central Serbia where the river that flows between Ovčar and Kablar mountains has cut a huge gorge.

Climate: Moderate-continental climate. There are great microclimate differences between towns and surrounding mountains, while moving west, the climate becomes colder.

Other impacts: impacts on infrastructure, disturbed natural regime of surface water, potential landslides, geological stability, impacts on flora and fauna, local increase in relative humidity of the air, impacts on water quality, fish migration.

1.2.2.4. Oil and gas deposits

Large oil and gas deposits have been discovered in the territory of Autonomous Province of Vojvodina within the Panonnian basin. Altogether 222 hydrocarbon deposits in 88 fields were found at the depths ranging from 300 to 3600 meters. The larger deposits are found in Banat region: Mokrin, Kikinda, Elemir, Boka, Janošik, Jermenovci, and Lokve, while in Bačka region, in Kelebija, Velebit, and Palić.

Underground natural gas deposits include: Mokrin, Kikinda, Elemir, Torda, Međa, Begejci, Plandište, Velika Greda, Tilva (Banat), and Srbobran (Bačka) deposits.

Potential oil and natural gas deposits have been located in the West Morava river valley between the towns of Čačak and Kraljevo, then in the Kosovo valley and, in the east, in the surrounding area of the Timok river (Vlaška-Pontic basin), in the Getska depression. According to the volume of technically recoverable oil and on the basis of the world classification of reserves, the greatest number of discovered deposits belong to the group of marginal deposits, while there is also a smaller number of small and medium deposits. According to available data from 2009, the total geological oil and natural gas reserves in AP Vojvodina, expressed in 106 toe, at 31st December 2009, were 186.36, out of which 40.54 x106 toe (tones of oil equivalent) belongs to reserve balances.

The most significant environmental impacts of exploitation of oil and natural gas resources are associated with oil drilling (drilling fluid from oil and gas drilling operations), crude oil storage and transportation. The issue of bentonite drilling fluid has not been so far regulated by any of the legal acts, but addressed within the waste matter.

Water pollution: The formation water occupies a dominant position in the process of exploration and production of oil and natural gas by its quantity, as a waste which always accompanies oil and natural gas production processes. Based on, for example, data from 2004, 1,473,000 m^3 of formation water in the oil and natural gas production was produced.

The produced formation water is reinjected through 55 boreholes into the formations from which it was withdrawn. The water in refineries is used for steam generation, cooling systems, fire protection systems, etc. The water taken out of watercourses is used and processed in water treatment plants where untreated water is chemically treated. All atmospheric wastewater in Pančevo refinery passes though primary treatment units and, as such, it is discharged into the water recipient, while oily water, after primary treatment, is transported to secondary water processing unit for chemical and biological treatment in the HIP "Petrohemija" and then discharged into the water recipient.

Concentration of hydrocarbon in hit water bearing layers: During the exploration and borehole drilling, casting (steels pipes) is inserted into boreholes to provide their technical safety and prevent communication between the hit layers. In this way, the contamination of water bearing layers saturated with oil or hydrocarbons is prevented.

Concentration of hydrocarbons in hit surface water basins: The groundwater is protected by technically equipping a borehole. Considering that operations to extract oil and natural gas involve drilling boreholes, as well as the collecting systems, the accident situations causing the pollution of surface water may occur. Over the past fifty years of oil and gas production in AP Vojvodina, there has been sporadic water pollution cases, but the effects on the environment have not been great.

Drilling waste management: Temporary disposal techniques are currently used for disposing of drilling wastes (fluids and solid cuttings), but technical documentation is under preparation which will ensure that drilling waste, in accordance with principles of waste management, will be permanently disposed of by injecting the drilling waste deep underground into a geological formation. So far, the amount of disposed drilling wastes, i.e. temporarily disposed drilling wastes, is estimated at approximately 600000 m3, with a prediction that, in future, another extra 7000 m3 of drilling wastes will be disposed of per year. Refineries are also generators of waste. Waste comes from technological processes used in the production, as well as from other activities carried out within refineries. In Pančevo refinery, a certain amount of waste matters, both the secondary materials and hazardous waste, are temporarily stored in boxes that are classified according to the type of waste matter which is stored in them. Hazardous waste which is sorted and designated is stored in a separate box. Oil-based mud from api mud separators, tanks and pipelines, is disposed of in two sedimentation basins (old and new one) in the refinery and continually processed until the state of inertia is reached using the method of sodification by authorized organization. The flare stack system in the refinery is, in normal conditions of plant operation, intended to maintain operating pressure in processing equipment by letting hydrocarbon gases through pressure regulators, while under accident conditions, its role is to protect pressure vessels and columns against too high pressures through safety valves and provide safe removal of hydrocarbon gases. Furthermore, the flare stack system also serves for occasional draining of processing equipment for the purpose of repairing the equipment under pressure and for partially or completely stopping the operation. All gas which gets into this unit is burned with flare stacks. After the gas recovery unit in which gases are compressed and washed out is put in operation, the recovered gasses return into fuel gas system, thus providing the minimum amount of gas burned on flare stack. Waste flow from the flare stack system include combustion byproducts: CO, SOx, NOx; unburned hydrocarbons, and solid particles.

The total amount of the generated and disposed wastes (drilling fluid wastes in particular): Approximately 7000 m^3 of drilling fluids are used per year. Drilling fluids are temporarily stored in fluid tanks for temporary use.

Loss of agricultural/forest land: Exploration and production of oil and natural gas are for the most part carried out in AP Vojvodini which is a lowland agricultural land, so that in the phase of exploration and drilling the exploration boreholes, three hectares of agricultural land are occupied. If the results are negative, the borehole is liquidated and land prepared for crops. If results are positive, the area of min. 10 m x 10 m is used for drilling the boreholes. Considering that exploration is carried out in AP Vojvodina where forests do not occupy significant area, forests are not endangered in the phase of exploration and drilling of exploration boreholes. Concerning canals and watercourses, which are plenty in AP Vojvodina, locations for boreholes and collection systems are dislocated to prevent water pollution.

Impacts on protected areas and flora species: Explorations for oil and natural gas have been carried out in a part of Deliblatska peščara (Deliblato Sands), which is a protected area. The exploration for natural gas, which is about to be completed, is carried out in the Tilva field where there are still two boreholes, while other boreholes have been preserved. In the protection of strictly protected areas and species, a great problem lies in the existence of reserve pits in vicinity of oil well boreholes. In most cases, the works on borehole construction and exploitation occur prior to the remediation of sites (temporary drilling-fluid and solid waste disposal sites) after the completion of exploitation of the existing boreholes. Scattered drilling fluids remain in depressions nearby arable fields posing a threat to people and animals (wild animals in such areas suffer the most). The groundwater and soil quality of surrounding land is threatened the most, which directly contaminates the existing vegetations. Example: „Melenci Duboko" gas-condensate deposit which lies in the vicinity of the Banja Rusanda spa**.**

1.2.3. Considered issues and problems of the nature and environmental protection in the Plan and reasons for omitting certain issues from the SEA

Criteria for the identification of possible significant effects of plans and programs on the environment are contained in Annex I of the Law on Strategic Environmental Impact Assessment. These criteria are based on: characteristics of the plan/program and characteristics of environmental impact.

In this specific case, in addition to the mentioned criteria, the identification of problems in environmental protection in the area under direct influence of energy facilities and activities is of special importance, as well as the analysis of possible effects of the mentioned activities on environmental quality, and in particular on:

- Quality of basic environmental factors: air, water, soil;
- Natural values (particularly the protected natural resources);
- Cultural and historic heritage;
- Waste generation and treatment;
- Human health;
- Social development;
- Economic development;
- Natural resources.

Based on the analysis of the Draft Strategy, the possible environmental implications of mining sector, thermal power plants and hydroelectric power plants have been considered because the mentioned activities imply dominant environmental impact of energy sector. Although the focus will be placed on these activities and facilities, all strategic guidelines set forth in the Strategy have been analyzed from environmental and socio-economic aspects, also including (positive and adverse) impacts of the so-called "green" or renewable energy (wind farms, small hydropower plants, etc.).

The Strategic Environmental Assessment Report can explain why certain issues related to environmental protection have not been appropriate for consideration. In this specific case, this refers to the absence of a more detailed environmental impact assessment for individual facilities and activities in energy sector at the level of technical and technological analysis, taking into account that an appropriate level of detail of such analysis has not been reached in the Strategy. However, it will be possible to reach the required level of detail in developing the Strategy at the level of the Energy Strategy Implementation Program, as well as in the making the planning, project and technical documentation for each planned energy facility. In this context, the SEA will be predominantly based on the assessment trends in the environment resulting from individual activities in the field of energy or from interactions with several activities in the field of energy (cumulative and synergistic impacts).

1.2.4 Prior consultations with authorities and organizations concerned

In the preparatory phase for the Decision on Undertaking a Strategic Environmental Assessment for the Energy Sector Development Strategy of the Republic of Serbia by 2025 with projections until 2030, consultations were conducted with relevant institutions. The Request for an opinion on the Draft Decision on Undertaking SEA was sent on March 28, 2013 to the following institutions:

1. Republic Hydrometeorological Service
2. Environmental Protection Agency
3. Ministry of Internal Affairs
4. Republic Agency for Spatial Planning
5. Institute of Nature Conservation of Serbia
6. Provincial Secretariat for Urban Planning, Construction and Environmental Protection
7. Republic Legislative Secretariat
8. Ministry of Regional Development and Local Self-Government
9. Ministry of Finance and Economy
10. Ministry of Health
11. Ministry of Natural Resources, Mining and Spatial Planning
12. Ministry of Labor, Employment and Social Policy
13. Ministry of Education, Science and Technological Development
14. Ministry of Agriculture, Forestry and Water Management
15. Ministry of Defense
16. Ministry of Foreign Affairs

The cooperation with the mentioned institutions has resulted in the final text of the Decision on Undertaking a Strategic Environmental Assessment on the basis of which the process of carrying out the SEA began.

2. GENERAL AND SPECIAL OBJECTIVES OF THE STRATEGIC ENVIRONMENTAL ASSESSMENT AND SELECTION OF INDICATORS

Pursuant to Art.14 of the Law on Strategic Environmental Impact Assessment, general and specific objectives of the strategic environmental assessment have been set based on requirements and objectives related to environmental protection in other plans and programs, environmental protection objectives set at national and international levels, collected data on the state of the environment and significant issues, problems and proposals related to environmental protection in plans or programs. The appropriate indicators that will be used in the strategic assessment process will be then selected based on defined objectives.

2.1. General SEA objectives

The general SEA objectives have been set based on requirements and objectives related to environmental protection in other plans and programs, environmental protection objectives set at the national level and objectives of relevant sectoral documents related to environmental protection. Based on requirements and objectives related to environmental protection set in plans and strategies, the general SEA objectives have been set, and they predominantly relate to the following fields of the environment: protection of basic environmental factors and sustainable use of natural resources, as well as improvement in waste management and rational use of mineral and energy resources aimed at reducing the pollution and pressure caused by human activities in threatened areas, then biodiversity conservation, landscape enhancement and protection of cultural and historic heritage, as well as population, human health and socio-economic development and strengthening of institutional capacities for environmental protection.

2.2. Special SEA objectives

Special SEA objectives have been set in certain fields of environmental protection in order to achieve general objectives. Special SEA objectives are concrete, partially qualified statements in form of guidelines and actions (measures, works, activities) for the implementation of these changes. Specific SEA objectives are primarily a methodological measure through which the effects of plans/programs on the environment are identified and checked. They have to provide a clear picture on important effects of plans/programs on the environment to decision-making authorities, on the basis of which it is possible to make decisions which associated with environmental protection and achievement of basic objectives of sustainable development.

2.3. Selection of indicators

Strategic planning is a key link in an environmental change management system, while the creation of a database (information base) to identify the subject environment is an initial and the most important stage in a planning process. On the basis of identified state of the environment, it is possible to define adequate measures in the planning process for the purpose of achieving an efficient environmental protection. Environmental indicators are an integral part of information system. Environmental management indicators are very important segment in planning process, as well as a level within a complex spatial information system. The purpose of using them is to direct the strategic solutions towards achievement of set objectives.

Environmental indicators are very suitable for measuring and evaluating the planning solutions from the aspect of possible environmental damages, as well as for identifying unfavorable effects which are to be mitigated or eliminated. Environmental indicators are also tools for systematic identification, assessment and tracking of environmental conditions and as well as for considering future consequences. Furthermore, they are tolls for tracking certain changeable values both in the past and in the present, and are also required as input data for each planning (strategic, spatial, urban planning, etc.).

In Serbia, there is a permanent shortage of environmental data, so that it is very difficult to perform a high-quality analysis of the state of the environment. Information system should enable an efficient provision of information and data which will be processed and analyzed in accordance with international and European methodologies. Environmental information system maintained by Environmental Protection Agency still does not provide all necessary data. The Environmental Protection Agency collects data on air emissions, emissions to water and the waste management. In addition, environmental indicator systems appropriate to the needs of planning, as well as to the methodology for making and implementing the planning documents, have not been elaborated in details.

In the field of planning, there is no a specific environmental indicator system, but certain spatial and environmental indicators can be found within systems of indicators for other purposes. Such situation results, to a great extent, in an inefficient environmental management and inefficient planning in general. Neither is an environmental indicator system which would also be applicable (measurable) to planning standardized in the current legislation.

Sustainable development indicators are needed to identify trends of moving towards or away from sustainability, as well as to set goals for improving general well-being. However, it is not possible to discuss sustainability indicators and criteria without previously defining the sustainable development, as well as basic principles of sustainable development. In 2008, the Republic of Serbia adopted the National Energy Sector Development Strategy ("Official Gazette of the Republic of Serbia", No. 57/08) which contain principles and priorities in sustainable development, as well as 76 indicators for tracking the progress of Serbia towards sustainable development. These indicators have been selected from the set of UN indicators, but not all of indicators are used in Serbia. The indicators are specified in the Law on Spatial Plan of the Republic of Serbia ("Official Gazette of the Republic of Serbia", No. 88/10). The Regulation on the National List of Environmental Indicators ("Official Gazette of the Republic of Serbia", No. 37/2011) prescribes the list of environmental indicators, which have been used herein.

The SEA indicators have been selected in accordance with the above mentioned SEA objectives, as well as on the basis of indicators of the Spatial Plan of the Republic of Serbia and the National Sustainable Development Strategy of the Republic of Serbia. They are in accordance with the "CSD Indicators for Sustainable Development". This set of indicators is based on the concept of cause-effect-response. Indicators of cause denote human activities, processes and relationships affecting the environment, the indicators of effect denote the state of the environment, while indicators of response define strategic options and other responses aimed at changing "consequences" for the environment.

Table 2.1. Selection of general and specific SEA objectives and selection of relevant indicators for environmental receptors

SEA	General and specific SEA objectives	Specific SEA objectives	Indicators
AIR	**Reducing air pollution levels**	- Reducing air pollutant emissions to prescribed emission levels	- Particle emissions, and SO_2 and NOx emissions - Frequency of exceeding the daily limit values for soot, SO_2 and NO_2 - Changes in greenhouse gas emissions, primarily in CO_2 (%) - Increase of RES share in energy balance (%)
WATER	**Protection and conservation of surface and groundwater quality**	- Reducing surface and groundwater pollution to the level that will not affect their quality - Mitigating negative effects of energy facilities on hydrological regimes	- BOC and COC in watercourses affected by energy facilities and activities - Temperature changes in watercourses - Changes in water regimes - Changes in water quality class (%) - Reused and recycled water as a result of energy sector activities (m3)
SOIL	**Protection and sustainable use of forest and agricultural land**	- Protection of agricultural and forestry land - Reducing soil degradation and erosion	- Changes in forest cover (%) - Changes in agricultural land area (%) - Share of degraded areas as a result of activities in the field of energy (%) - Land area threatened by soil erosion processes (ha)
NATURAL VALUES	**Landscape, natural values and biodiversity protection, conservation and enhancements**	- Landscape protection - Protection of natural values and areas - Biodiversity conservation – avoid irreversible losses	- Share of re-cultivated areas in the overall area of degraded regions (%) - Number of energy facilities that may cause landscape changes - The area of all protected natural areas that may be affected by energy sector activities - Number of endangered flora and fauna species that may be affected by energy sector activities
CULTURAL AND HISTORIC HERITAGE	**Preservation of protected cultural heritage**	- Cultural properties protection, preservation of historic properties and archeological sites	- Number and importance of protected immoveable cultural properties that may be affected by energy sector development activities

SEA	General and specific SEA objectives	Specific SEA objectives	Indicators
WASTE	**Sustainable waste management**	- Improving waste utilization, treatment and disposal	- Total annual amount of waste generated in energy sector (t) - % of total amount of waste subject to re-use, recycling and treatment
POPULATION HEALTH	**Population health improvement**	- Reducing negative effects of energy industry on human health	- Frequency of respiratory diseases (%) close to energy facilities (thermal power plants and open-pit mines) - Frequency of diseases which can be associated with activities in the field of energy - Number of people affected by noise generated by energy facilities
SOCIAL DEVELOPMENT	**Social cohesion and strengthening of institutional capacity for environmental protection**	- Better quality of life - Preservation of population density in rural areas - Improve environmental protection service and monitoring and control service	- Improvement of energy efficiency in residential buildings (%) - Number of households displaced as a result of activities on the energy sector - Number of measuring points in monitoring system
ECONOMIC DEVELOPMENT	**Encouraging economic development**	- Encouraging economic development - Promote local employment - Reducing dependency on sources of imported energy - Reducing transboundary negative environmental impacts caused by energy facilities	- % of people employed in the energy sector with salary above the average salary in the Republic of Serbia - Reduction in number of unemployed people as a result of growth in the energy sector employment (%) - Number of environmental protection programs for energy sector development - % of assets allocated for environmental protection out of the total investments in the energy sector
NATURAL RESOURCES	**Rational use of nonrenewable resources**	- Rational use of nonrenewable energy sources and increasing the use of renewable energy sources - Improving energy efficiency - Introducing cleaner technologies	- Final energy consumption per capita - Share of renewable energy sources in total energy use - Improvements in energy efficiency (% of reduction in energy use)

Table 2.2. Designation of SEA special objectives

No.	SEA Objectives
1	Reducing harmful air emissions to prescribed values
2	Reducing surface and groundwater pollution to the level that will not effect their quality
3	Mitigating negative effects of energy facilities on hydrological regime
4	Protection of forest and agricultural land
5	Reducing soil degradation and erosion
6	Landscape protection
7	Protection of natural vales and areas
8	Biodiversity conservation – avoid irreversible losses
9	Cultural heritage protection, preservation of historic properties and archeological sites
10	Improving waste utilization, treatment and disposal
11	Reducing negative effects of energy industry on human health
12	Better quality of life of people
13	Preservation of population density in rural areas
14	Improvements in environmental protection service and monitoring and control service
15	Encouraging economic development
16	Promoting local employment
17	Reducing dependency on sources of imported energy
18	Reducing transboundary negative environmental impacts caused by energy facilities
19	Rational use of nonrenewable energy sources and increasing the use of renewable energy sources
20	Improving energy efficiency
21	Introducing cleaner technologies

The evaluation will be carried out for each individual sector of the Strategy (in evaluating alternative solutions), i.e. for each strategic commitment in each sector of the Strategy (in multi-criteria evaluation and identification of strategically significant impacts) in relation to specific SEA objectives shown in Table 2.2.

3. ENVIRONMENTAL IMPACT ASSESSMENT

The aspect of environmental protection is today one of the prime social tasks. Negative effects that are present today are mainly the result of wrong planning for settlements and transportation system, uncontrolled and inadequate use of energy, as well as the lack of basic knowledge in the field of environmental protection. From the abovementioned pint of view, the changes, which are a consequence of adaptation of nature to the needs of the man, can be such as he expected, but also, and often, quite unfavorable for him. The set of different changes entails very complex consequences which, in principle, have a feedback effect on initiators of changes, thus leading to new environmental conditions and new consequences.

The purpose of strategic environmental assessment for the subject Strategy is to consider possible negative effects on the environment and to give guidelines for their mitigation, i.e. to mitigate them to acceptable levels without creating conflicts, also taking into account environmental carrying capacity of the subject area.

The Strategy will be a framework for energy system development in the Republic of Serbia with all possible (positive and negative) implications for environmental quality. Bearing this in mind, the focus in the strategic environmental assessment has been placed not only on an analysis of strategic commitments which may imply negative impacts and trends, but also on strategic commitments which contribute to environmental protection and better quality of life of people. In this context, the SEA will provide an analysis of possible effects of planned activities on the environment which will be evaluated in relation to defined objectives and indicators.

Pursuant to Art.15 of the Law on Strategic Environmental Impact Assessment, the assessment of possible effects of plans and programs on the environment shall contain the following elements:

- Overview of the assessed impacts of alternative solutions of plans and programs that are favorable from the aspect of environmental protection, with the description of measures aimed at preventing and limiting the adverse effects or increasing the positive effects on the environment;
- The comparison of alternative solutions and an overview of reasons for selection of the most favorable alternative solution;
- The overview of the assessed impacts of plans and programs on the environment with the description of measures aimed at preventing and limiting the adverse or increasing the positive effects on the environment;
- The way in which the environmental factors have been taken into consideration in the environmental impact assessment, including the data on: air; water; soil; climate; ionizing and non-ionizing radiation; noise and vibrations; flora and fauna; habitats and biodiversity; protected natural resources; population; human health; cities and other settlements; cultural and historic heritage; infrastructure, industrial and other structures; or other man-made values;
- The ways in which the following impact characteristics have been taken into account: probability, intensity, complexity/reversibility, time dimension (duration, frequency, reversibility), spatial dimension (location, geographical area, size of the exposed population, transboundary nature of impact), as well as cumulative and synergistic nature of impact.

3.1. Assessment of alternative solutions

The Law on Strategic Environmental Impact Assessment does not prescribe what are alternative solutions of the plan/program which will be subject to strategic environmental assessment. However, in practice, the following two alternatives are considered:

1) The alternative according to which the plan and program should not be implemented;
2) The alternative suitable for the adoption and implementation of the plan and program.

Alternative solutions of the subject Strategy represent different rational ways, instruments and measures for the realization of Strategy objectives though considering the possibility of using the natural resource for special purposes and activities.

The overall effects of the plan, thus also its effects on the environment, may be identified only by comparing the current status with objectives and solutions of the Strategy.

The adoption or non-adoption of strategic document is not the subject of the analysis, neither is the implementation of the adopted document, considering that the subject Strategy will be adopted in accordance with regulations governing its adoption, while the Strategy will have a form of a law. Consequently, without limitation to positive and negative effects which the adoption or non-adoption of the Strategy might have, the strategic environmental assessment will not elaborate either the alternative of adopting or the alternative of non-adopting the Strategy but continue to follow the current trend in the energy sector development.

For the above mentioned reasons, the strategic environmental assessment will deal only with alternatives envisaged by the Strategy:

- Alternative A – reference scenario ("business as usual" – hereinafter referred to as the "BaU")
- Alternative B – scenario with the implementation of energy-efficiency measures (hereinafter referred to as the "EE")

Here, it should be noted that non-adoption or non-implementation of the Strategy and continue to follow the current trend is, by no means, the BaU scenario of the Strategy itself, but a process which is, besides being contrary to the previous Strategy, also contrary to the regulations in the field of environmental protection and international obligations which Serbia has undertaken, and thus untenable.

The matrix method is used in exploring the fields for the needs of the SEA, or more precisely, for the assessment of effects of alternative solutions on the environment. Effects of strategic determinants on the state of the environmental areas covered by the Strategy have also been considered in this way. Taking into account the fact that the SEA is undertaken for the long-term Strategy, which, in turn, results in uncertainty in its realization, the used method for developing scenarios of development allows for the assessment of positive and negative impacts of selected alternatives. In matrices, the scenarios of development per sectors of the Strategy are intersected with objectives of the SEA and related indicators.

Environmental protection implies resolving of potential conflicts in space in the context of national interest for energy sector development, on the one hand, and interests of local communities, on the other. In this context, the most important task of strategic assessment is to recognize signs of potential conflicts, as well as to prevent or minimize the importance and intensity of these conflicts through adequate guidelines.

Table 3.1. Assessment of impacts of the Strategy in relation to the SEA objectives per alternative solutions

SEA objectives

1. Reducing the amount of particulate matter emissions in the air to the prescribed level
2. Reducing the amount of surface and groundwater pollution to the level which will not produce negative effects on water quality
3. Mitigating the negative effects of energy facilities on hydrological regimes
4. Protection of forest and agricultural lands
5. Reducing soil degradation and erosion
6. Landscape protection
7. Protection of natural values and areas
8. Biodiversity protection – avoiding irreversible losses
9. Protection of cultural properties, preservation of cultural heritage and archeological sites
10. Improving waste usage, treatment and disposal
11. Reducing effects of energy sector on human health
12. Better quality of life of people
13. Preservation of population density in rural areas
14. Improving environmental protection service and monitoring and control service
15. Encouraging economic development
16. Promoting local employment
17. Reducing dependence on energy import
18. Reducing transboundary environmental impacts of energy facilities
19. Rational use of non-renewable energy sources and expand the use of renewable energy sources
20. Improving energy efficiency
21. Introducing clean technologies

Field of development	Alternative solutions	Scenarios of development	SEA objectives																				
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Electric power system	A	Further increase in the electricity consumption, which is untenable, will lead to an increase in the use of fossil fuels, increase in specific emissions in the air, and risk associated with higher dependence on imports of energy-generating products and electricity	-	-	-	-	+	0	+	-	-	+	+	+	0	+	+	+	-	-	-	-	+
	B	Reduction in electricity consumption, especially in public and housing sectors, which is directly reflected in a reduction of negative environmental impacts, reduction in coal's share of electricity generation, i.e. reduction in import dependency	+	+	-	+	+	+	+	-	+	+	+	+	0	+	+	+	+	0	+	+	+
District heating system	A	The use of fossil fuels in forthcoming period without increasing the share of RES, high energy consumption, significant air emissions.	-	+	-	0	0	0	0	0	0	+	-	-	0	+	0	+	-	+	0	-	0
	B	Significant reduction in energy use, especially in the building sector, and district heating transmission sector, and greater use of renewable energy will reduce environmental impact.	+	+	+	+	0	0	0	0	0	+	+	+	+	+	+	+	+	+	+	+	+
Renewable energy sources	A	Slow increase in the share of renewable energy in total energy consumption, especially in the transportation sector.	-	0	0	0	0	0	0	-	0	+	+	-	0	0	0	0	0	0	0	0	0
	B	Increase in electricity production from RES, especially in the biofuel sector, will lead to positive effects (decrease in dependence on energy imports, reduction in environmental pollution, greater participation of local population in the energy sector)	+	0	-	0	0	0	0	-	0	+	+	+	+	+	+	+	+	0	+	+	+

Field of development	Alternative solutions	Scenarios of development	SEA objectives																				
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Coal	A	Slower improvements in coal mining systems, which will lead to lower efficiency in coal mines, increase in environmental pollution load, closure of certain underground mines, etc.	0	-	-	0	-	-	-	-	-	0	-	0	-	+	+	+	+	0	-	0	0
	B	Secure and reliable coal delivery to electric power system, population and industry, along with reduced environmental impact and higher efficiency of the system	0	+	+	0	+	-	-	-	-	+	+	+	+	+	+	+	+	0	+	+	+
Crude oil	A	Continuation in the trend of high imports dependency, great impact on basic environmental factors	-	0	-	-	0	0	0	0	+	+	0	0	0	+	+	0	-	0	-	+	+
	B	Reduced dependence on oil imports, the production of higher quality fuels thus reducing environmental impact, the modernization of petrol stations and oil exploitation techniques and methods of refining crude oil	+	+	0	+	0	0	0	+	+	+	0	0	0	+	+	0	+	+	0	+	+
Natural gas	A	Continuation of the current practice will lead to an increase in the use of natural gas in district heating systems because of inappropriate gas delivery system, as well as to rise in prices thus reducing the households natural gas consumption and putting in jeopardy the establishment of home and regional markets for natural gas.	+	0	0	0	0	0	0	0	0	0	+	+	0	+	+	0	-	0	-	+	+
	B	More efficient use of natural gas as substitution for electricity for the needs of heating will lead to a reduction in coal consumption, reduction in air pollution, and will strengthen connections in the region, etc.	+	+	+	0	0	0	+	0	0	+	+	+	0	+	+	0	-	0	0	+	+
Efficient energy use	A	Continuation of high energy consumption per unit of GDP in all economic sectors will lead to weaker competitiveness on the market, as well as higher levels of environmental load	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	-	-	-
	B	Greater energy efficiency implementation will make products more competitive because the energy costs will make up a smaller share of the total costs of a given product; also, this scenario will provide faster introduction of energy management, thus also the growth in employment of highly educated professionals at all levels and all parts of the country..	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

Field of development	Alternative solutions	Scenarios of development	SEA objectives																				
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Legislative framework	**A**	Harmonization of domestic legislation with the EU acquis in the field of energy will lead to significant improvements in energy sector management, energy monitoring system and energy statistics; the harmonization of regulations in the field of energy with the regulations related to environmental protection, thermal power sector, fuel quality, as well as an increase in the use of renewable energy sources, is of special importance	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	-	-	-
	B	There are no differences in relation to the previous scenario, except that greater support and greater legal obligations will lead to a decrease in dependence on energy imports.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Institutional development	**A**	Optimum development of the energy sector requires significant improvements in professional and scientific potential; all this will lead to enhancement of capacity building of the staff of the competent authorities and government institutions at all levels, which will have a significant positive effects on the country's economic growth.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	-	-	-
	B	Greater insistence on energy efficiency leads to more rational non-renewable energy use and greater use of renewable energy along with higher energy efficiency and introduction of clean technologies in the energy sector.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Socio-economic development	**A**	Both scenarios imply a marked-based approach to energy sector development, whereby in this scenario the real costs will not be acceptable on the market due to insufficiently efficient production, which will have significant consequences for economic development and quality of life of people.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	-	-	-
	B	Insistence on energy-efficiency measures has a multiple effects: it directly contributes to a more efficient energy sector, thus also to more efficient industry and transportation sectors, as well as the building sector, through improvements in construction and building material industries, etc.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

Meaning of symbols: + overall positive effect; - overall negative effect; **0** no direct effect or vague effect;
A – reference scenario; **B** – scenario with the implementation of energy-efficiency measures.

Summarizing the assessment of effects of alternatives in relation to the SEA, the following can be concluded:

- Alternative A – reference scenario ("business as usual" – BaU) is based upon the continuation of the current practice in energy consumption, which also implies an increased need for energy resources, i.e. an increased production for the same amount of required energy. This leads to more serious implications for basic environmental factors, but also for socio-economic development in the Republic of Serbia. The alternative does not exclude the realization of sectoral priorities (significant projects) which have significant positive effects on environmental quality, but certainly diminishes their importance, which directly affects dynamics of positive trends in the area, the environment and socio-economic aspect of development in the Republic of Serbia;

- Alternative B – scenario with the implementation of energy-efficiency measures has been corrected in relation to the alternative A, because it implies the implementation of a series of measures aimed at reducing the final energy consumption in accordance with obligations under the Treaty Establishing the Energy Community and in accordance with the Directive 2006/32/EC on energy end-use efficiency and energy services. These measures will inevitably lead to a reduction in electricity consumption and positive effects on environmental quality and socio-economic development in the Republic of Serbia.

Based on the above, it can be easily concluded that alternative B of the Strategy is much more favorable than the alternative B from the aspect of sustainability.

3.2. Evaluation of characteristics and significance of effects of strategic commitments

In continuation of the SEA, an evaluation of significance, spatial extent and probability of impact of planning solutions on the environment has been carried out. The impact significance is assessed in relation to impact magnitude (intensity) and spatial extent of potential impact. Impacts, i.e. effects of planning solutions, are evaluated according to the magnitude of change by assigning scores from -3 to +3, where minus sign is used to denote a negative change, while sign plus to denote a positive change. This evaluation system is used both for individual impact indicators and for related categories through summary indicators.

Table 3.2. Criteria for evaluating the impact magnitude

Impact magnitude	Designation	Description
Critical	**- 3**	Significant environmental overload
Greater	**- 2**	Environmental disturbance of great extent
Smaller	**- 1**	Environmental disturbance of smaller extent
No impact	**0**	No direct and/or unclear environmental impact
Positive	**+1**	Smaller positive environmental changes
Favorable	**+2**	Favorable environmental changes
Very favorable	**+3**	Changes that significantly improve the quality of life

Criteria for evaluating the spatial extent of impacts are shown in Table 3.3.

Table 3.3. Criteria for evaluating the spatial extent of impacts

Impact significance	Designation	Description
International	**I**	Possible transboundary impact
National	**N**	Possible impact at the national level
Regional	**R**	Possible impact at the regional level
Local	**L**	Possible impact of local character

Criteria for assessing the probability of impact occurrence are shown in Table 3.4

Table 3.4. Scale for assessing the impact probability

Probability	Designation	Description
100%	**S**	Impact will definitely occur
More than 50%	**L**	Likely impact
Less then 50%	**P**	Possible impact
Less then 1%	**N**	Impact is not likely to occur

Additional criteria can be derived according to impact duration, i.e. duration of consequences. In this context, temporary/occasional (PO) and long-term (LT) impacts can also be defined. Based upon all abovementioned criteria, the importance of identified impacts for the realization of SEA objectives has been evaluated.

<u>It is adopted that</u>: Impacts of importance for the subject Strategy are those which have strong or greater (positive or negative) effects on the entire territory of the Republic of Serbia or at the regional level, or which imply transboundary impacts, according to criteria shown in Table 3.5.

Table 3.5. Criteria for evaluating strategically important impacts

Level	Impact magnitude		Designation of significant impacts
International level: I	Strong positive impact	+3	I+3
	Greater positive impact	+2	I+2
	Strong negative impact	- 3	I-3
	Greater negative impact	- 2	I-2
National level: N	Strong positive impact	+3	N+3
	Greater positive impact	+2	N+2
	Strong negative impact	- 3	N-3
	Greater negative impact	- 2	N-2
Regional level: R	Strong positive impact	+3	R+3
	Greater positive impact	+2	R+2
	Strong negative impact	- 3	R-3
	Greater negative impact	- 2	R-2

Table 3.6. Priory activities in the Strategy encompassed by SEA

Sector of the Strategy	Priority activities
Electric power system	1. Reconstruction and withdrawal of thermal power plants[2] pursuant to Large Combustion Plants Directive
	2. Construction of coal-fired power plants of capacity of 700MW by 2025 (350MW by 2020)
	3. Construction of the "Bistrica" reversible hydropower plant and/or "Djerdap 3" reversible hydropower plant
	4. Construction of combined heat and power plants of capacity of approx. 450 MW by 2020
	5. Development and strengthening of transmission and distribution infrastructure
District heating system	6. Reduction in distribution network losses
	7. Introduction of measurement of space heating energy consumption of end-users and payment per quantity of delivered energy
Renewable energy sources	8. Increase in the share of power produced from renewable energy
	9. Realization of Action Plan for RES by 2020
Coal	10. Opening of new open-pit mines in the Kolubara basin
	11. Expansion of the "Drmno" open-pit coal mine
Crude oil	12. Reconstruction of the existing and construction of new storage facilities
	13. Increasing the depth of processing
Natural gas	14. Construction of the "South Stream" gas pipeline
	15. Providing at least two interconnections by 2020
	16. Completion of gasification system in Serbia
Efficient energy use	17. Energy efficiency reconstruction of existing buildings
	18. Introduction of energy management system in the public sector
Legislative framework	19. Development of legal norms in the field of energy in accordance with international and EU regulations
Institutional development	20. Improvement of institutional framework for implementation of EU legal norms
	21. Improving the educational, professional and scientific research potential of the country
	22. Improving the energy statistics system in accordance with the EUROSTAT/IEA system for collection and presentation of national energy data and energy indicators compiled on the basis of the data collected
Socio-economic development	23. Energy development as a contributor to economic growth
	24. Harmonization of energy, energy products and electricity pricing with energy policy and principles of market economy
	25. Development of domestic industry and commercial scientific research sector for transfer of the cutting edge technologies in the field of energy
	26.Insistence on measures for energy efficiency in final consumption
	27. Environmentally friendly use of coal and/or RES in insufficiently developed areas in the Southern and Eastern Serbia and part of the Western Serbia
	28. Establish a social dialogue in the energy sector
	29. Measures aiming at enhancing labor market mobility, training and requalification in accordance with structural changes in energy sector.

[2] The withdrawal of all thermal power plants with generating capacity less than 300MW (TENT A1 and A2, Kostolac A1 and A2, Morava and Kolubara thermal power plants, Panonnian combined heat and power plants) is planned to be carried out in the period from 2018 to 2024.

Table 3.7. Assessment of scope of effects of strategic priorities on the environment and elements of sustainable development

SEA objectives

1. Reducing the amount of particulate matter emissions in the air to the prescribed level
2. Reducing the amount of surface and groundwater pollution to the level which will not produce negative effects on water quality
3. Mitigating the negative effects of energy facilities on hydrological regimes
4. Protection of forest and agricultural lands
5. Reducing soil degradation and erosion
6. Landscape protection
7. Protection of natural values and areas
8. Biodiversity protection – avoiding irreversible losses
9. Protection of cultural properties, preservation of cultural heritage and archeological sites
10. Improving waste usage, treatment and disposal
11. Reducing effects of energy sector on human health
12. Better quality of life of people
13. Preservation of population density in rural areas
14. Improving environmental protection service and monitoring and control service
15. Encouraging economic development
16. Promoting local employment
17. Reducing dependence on energy import
18. Reducing transboundary environmental impacts of energy facilities
19. Rational use of non-renewable energy sources and expand the use of renewable energy sources
20. Improving energy efficiency
21. Introducing clean technologies

Strategic priorities	SEA objectives																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Reconstruction of thermal power pursuant to the Large Combustion Plants Directive	+3	+3	0	+2	0	0	0	+1	0	+1	+1	+1	+1	0	+1	0	0	+1	-1	+1	+3
Development of new coal-fired thermal power plants of capacity of 700MW by 2025 (350MW by 2020)	0	0	0	-1	0	-2	0	-1	0	+1	0	+1	-1	0	+2	+2	+2	0	-1	0	+2
Construction of the "Bistrica" reversible hydropower plant and/or "Djerdap 3" reversible hydropower plant	0	0	-3	-2	-1	-2	-1	-2	0	0	0	+1	-1	0	+2	+2	+3	-2	+3	0	+3
Development of combined heat and power plants using gas engines of capacity of approx. 450 MW by 2020	+1	0	0	0	0	-1	0	0	0	0	0	+1	0	0	+2	+1	0	0	+2	0	+1
Development and strengthening of transmission and distribution infrastructure	0	0	0	-1	0	-1	0	0	0	0	0	+1	+1	0	+2	+1	+1	0	0	0	0
Reduction in distribution network losses	0	0	0	0	0	0	0	0	0	0	0	+1	0	0	+2	0	+1	0	0	+1	0
Introduction of measurement of space heating energy consumption of end-users and payment per quantity of delivered energy	0	0	0	0	0	0	0	0	0	0	0	+1	0	0	0	0	+1	0	+1	0	0
Increase in the share of power produced from renewable energy	+3	0	-2	-1	0	-1	-1	-2	0	+2	+1	+1	0	0	+1	+1	+1	-1	+3	0	+2
Realization of the Action Plan for RES by 2020	+3	0	-2	-1	0	-1	-1	-2	0	+2	+1	+1	0	0	+1	+1	+1	-1	+3	0	+2
Opening of new open-pit mines in the Kolubara basin	-2	-3	-2	-3	-3	-3	0	-2	0	-1	-1	-1	-2	0	+2	+2	+2	0	-2	0	-2
Expansion of the "Drmno" open-pit coal mine	-2	-3	-2	-3	-3	-3	0	-2	-3	-1	-1	-1	-1	0	+2	+2	+2	0	-2	0	-2
Reconstruction of the existing and construction of new storage facilities	0	-1	0	0	-1	-1	0	0	0	0	0	+1	0	0	+1	+1	0	0	0	0	0

Strategic priorities	SEA objectives																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Increasing the depth of processing	-1	-1	0	0	0	0	0	0	0	0	0	+1	0	0	0	+1	+1	0	0	0	-1
Construction of the "South Stream" gas pipeline	+2	0	0	-1	-1	-1	-1	-1	0	0	0	+1	0	0	+3	+2	0	-1	+1	0	0
Providing at least two regional interconnections by 2020	0	0	0	-1	0	-1	-1	-1	0	0	0	+1	0	0	+2	+1	0	-1	0	0	0
Completion of gasification system in Serbia	+2	0	0	0	0	0	0	0	0	0	+1	+1	0	0	+1	+1	0	0	+1	0	0
Energy efficiency reconstruction in the building sector	+3	0	0	0	0	0	0	0	0	0	+1	+1	0	0	0	+1	+1	0	+1	+2	0
Introduction of energy management system in the public sector	0	0	0	0	0	0	0	0	0	0	0	0	0	+1	+1	+1	+1	0	+1	+2	0
Development of legal norms in the field of energy in accordance with international obligations and EU regulations	+3	+3	0	0	0	0	0	0	0	+2	+1	+1	0	+2	+1	0	0	0	0	+1	0
Improvement of institutional framework for implementation of legal norms based on EU law	+3	+3	0	0	0	0	0	0	0	+2	+1	+1	0	+2	+1	0	0	0	0	+1	0
Improving the educational, professional scientific research potential of the country	0	0	0	0	0	0	0	0	0	0	0	+1	0	+1	+1	0	0	0	+1	+1	0
Improving the energy statistics system in accordance with the EUROSTAT/IEA system for the collection and presentation of national energy data and energy indicators compiled on the basis of the data collected	0	0	0	0	0	0	0	0	0	0	0	0	0	+2	+1	0	0	0	0	0	0
Energy development as a contributor to economic growth	0	0	0	0	0	0	0	0	0	0	0	+1	0	0	+3	0	-1	0	+1	0	+1
Harmonization of energy, energy products and electricity pricing with energy policy and principles of market economy	0	0	0	0	0	0	0	0	0	0	0	-1	0	0	+2	0	+1	0	+1	0	0
Development of domestic industry and commercial scientific research sector for transfer of cutting edge technologies in the field of energy	0	0	0	0	0	0	0	0	0	+1	+1	+1	0	0	+3	0	+1	0	0	0	+2
Insistence on energy-efficiency measures in final energy consumption	+1	0	0	0	0	0	0	0	0	0	0	+1	0	+1	+2	0	+1	0	+1	+3	0
Environmentally friendly use of coal and/or RES for insufficiently developed areas in the Southern and Eastern Serbia and part of the Western Serbia	-1	0	-1	-1	-1	-1	-1	-1	0	+1	0	+1	0	0	+1	+1	+1	0	+1	0	+1
Establish a social dialogue in the energy sector	0	0	0	0	0	0	0	0	0	0	0	+1	+1	0	0	0	0	0	0	0	0
Measures aiming at enhancing labor market mobility, training and requalification in accordance with structural changes in energy sector.	0	0	0	0	0	0	0	0	0	0	0	+1	+1	0	+2	+2	0	0	0	0	0

* - criteria according to Table 3.2.

Table 3.8. Assessment of spatial extent of effects of strategic priorities on the environment and elements of sustainable development

SEA objectives

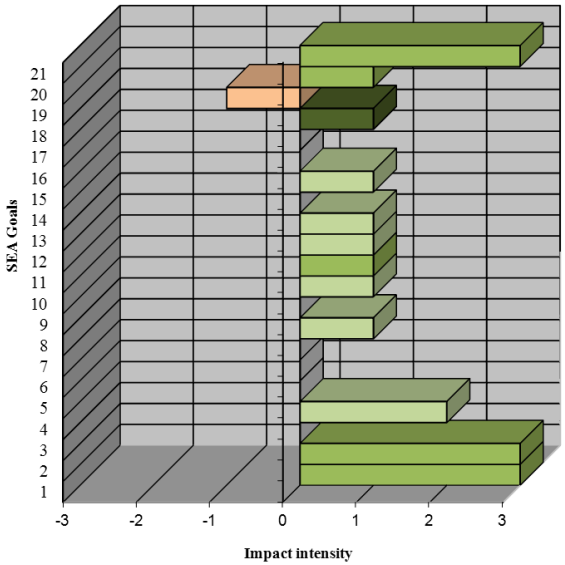
1. Reducing the amount of particulate matter emissions in the air to the prescribed level
2. Reducing the amount of surface and groundwater pollution to the level which will not produce negative effects on water quality
3. Mitigating the negative effects of energy facilities on hydrological regimes
4. Protection of forest and agricultural lands
5. Reducing soil degradation and erosion
6. Landscape protection
7. Protection of natural values and areas
8. Biodiversity protection – avoiding irreversible losses
9. Protection of cultural properties, preservation of cultural heritage and archeological sites
10. Improving waste usage, treatment and disposal
11. Reducing effects of energy sector on human health
12. Better quality of life of people
13. Preservation of population density in rural areas
14. Improving environmental protection service and monitoring and control service
15. Encouraging economic development
16. Promoting local employment
17. Reducing dependence on energy import
18. Reducing transboundary environmental impacts of energy facilities
19. Rational use of non-renewable energy sources and expand the use of renewable energy sources
20. Improving energy efficiency
21. Introducing clean technologies

Strategic priorities	SEA objectives																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Reconstruction of thermal power pursuant to the Large Combustion Plants Directive	R	R		L				L		L	R	L	L		L			I	L	R	R
Development of new coal-fired thermal power plants of capacity of 700MW by 2025 (350MW by 2020)				L		L		L		L		R	L		N	L	N		N		R
Construction of the "Bistrica" reversible hydropower plant and/or "Djerdap 3" reversible hydropower plant			I	I	I	I	I	N				I	L		N	L	N	I	N		N
Development of combined heat and power plant using gas engines of capacity of approx. 450 MW by 2020	L					L						L			L	L			L		L
Development and strengthening of transmission and distribution infrastructure				N		L						N	L		N	L	N				
Reduction in distribution network losses												N			N		N			N	
Introduction of measurement of space heating energy consumption of end-users and payment per quantity of delivered energy												N					N		N		
Increase in the share of power produced from renewable energy	N		I	L		L	L	I		L	L	N			N	N	N	I	N		N
Realization of the Action Plan for RES by 2020	N		I	L		L	L	I		L	L	N			N	N	N	I	N		N
Opening of new open-pit mines in the Kolubara basin	L	R	R	L	L	L		L		L	L	L	L		L	L	N		N		N
Expansion of the "Drmno" open-pit coal mine	L	R	R	L	L	L		L	N	L	L	L	L		L	L	N		N		N
Reconstruction of the existing and construction of new storage facilities		L			L	L						L			N	L					

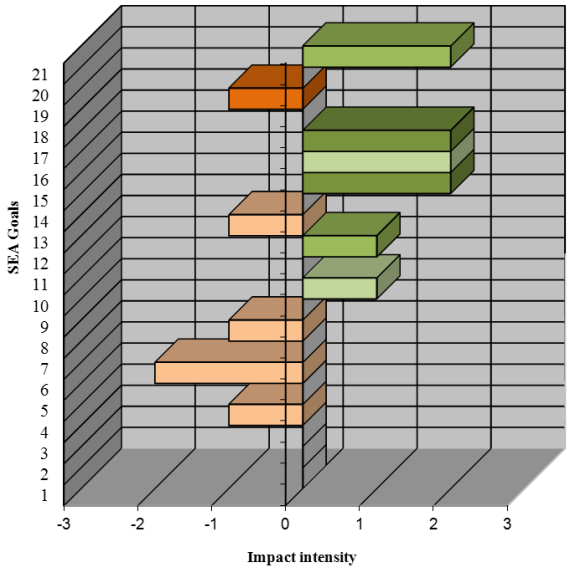
Strategic priorities	SEA objectives																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Increasing the depth of processing	L	L										N				L	N				N
Construction of the "South Stream" gas pipeline	N			L	L	L	L	L				N			N	N		I	N		
Providing at least two regional interconnections by 2020				L		L	L	L				R			R	L		I			
Completion of gasification system in Serbia	N										L	L			L	L			N		
Energy efficiency reconstruction in the building sector	N										L	L				L	L		L	N	
Introduction of energy management system in the public sector														L	L	L	L		L	N	
Development of legal norms in the field of energy in accordance with international obligations and EU regulations	N	N								N	N	N		N	N					N	
Improvement of institutional framework for implementation of legal norms based on EU law	N	N								N	N	N		N	N					N	
Improving the educational, professional scientific research potential of the country												N		N	N				N	N	
Improving the energy statistics system in accordance with the EUROSTAT/IEA system for the collection and presentation of national energy data and energy indicators compiled on the basis of the data collected														N	N						
Energy development as a contributor to economic growth												N			N		N		N		N
Harmonization of energy, energy products and electricity pricing with energy policy and principles of market economy												N			N		N		N		
Development of domestic industry and commercial scientific research sector for transfer of cutting edge technologies in the field of energy										N	N	N			N		N				N
Insistence on energy-efficiency measures in final energy consumption	N											N		N	N		N		N	N	
Environmentally friendly use of coal and/or RES for insufficiently developed areas in the Southern and Eastern Serbia and part of the Western Serbia	L		R	L	L	L	L	I		L		R			R	L	N		R		R
Establish a social dialogue in the energy sector												N	N								
Measures aiming at enhancing labor market mobility, training and requalification in accordance with structural changes in energy sector.												N	N		N	L					

* - criteria according to Table 3.3.

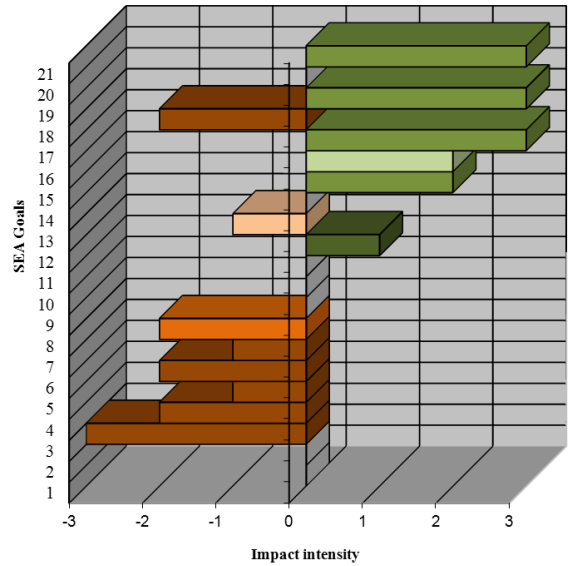
Reconstruction of thermal power plants pursuant to Directive on large combustion plants



Building the new coal-fired power plants with an installed generation capacity of 700MW by 2025 (350MW by 2020)



Building the Reversible Hydroelectric Power Plant "Bistrica" and/or Reversible Hydroelectric Power Plant "Djerdap III"



Designation (negative)	Impact significance	Designation (pozitive)
I	Transboundary	I
N	National	N
R	Regional	R
L	Local	L

SEA objectives

1. Reducing the amount of particulate matter emissions in the air to the prescribed level
2. Reducing the amount of surface and groundwater pollution to the level which will not produce negative effects on water quality
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4. Protection of forest and agricultural lands
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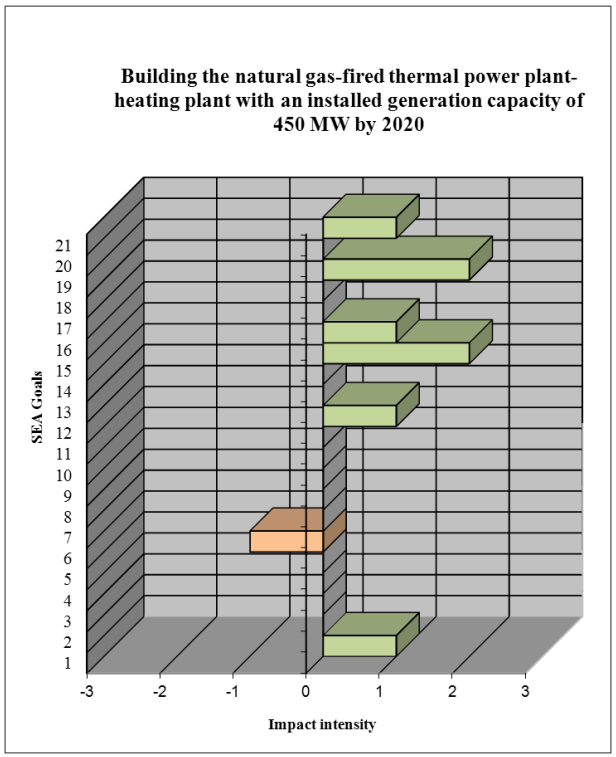
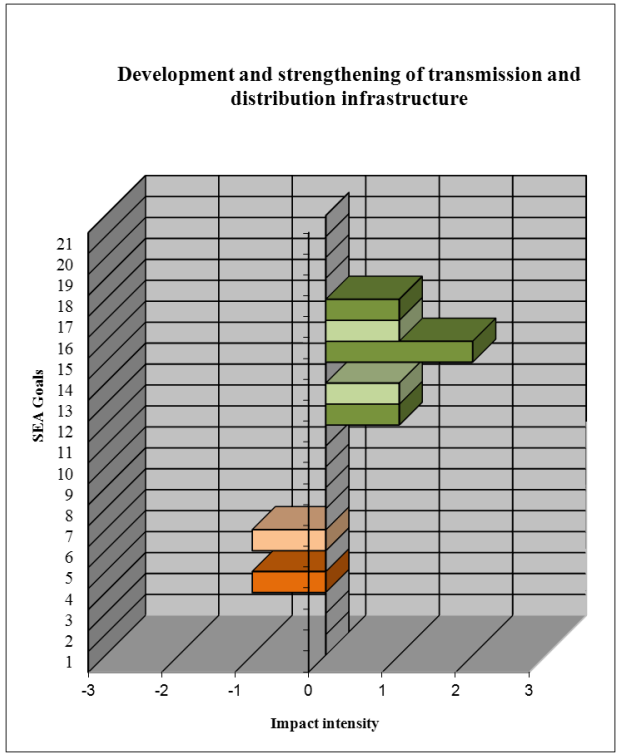
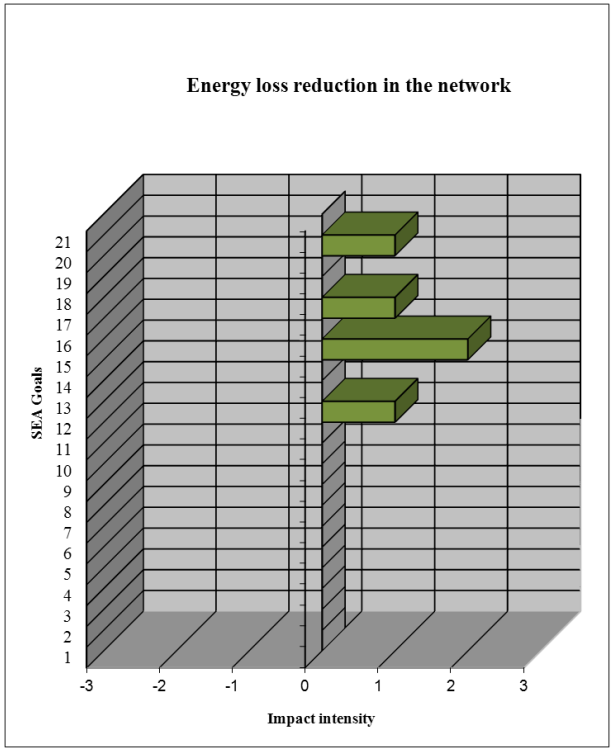
18. Reducing transboundary environmental impacts of energy facilities
19. Rational use of non-renewable energy sources and expand the use of renewable energy sources
20. Improving energy efficiency
21. Introducing clean technologies







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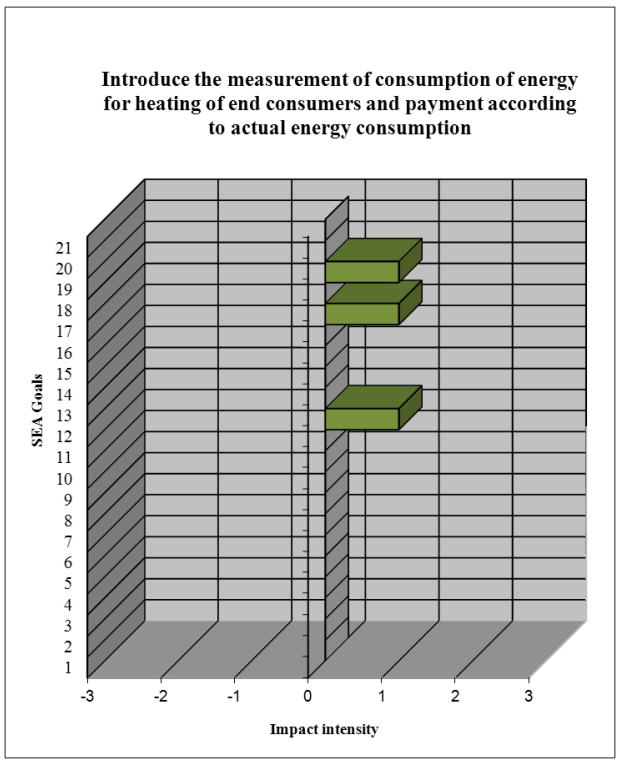

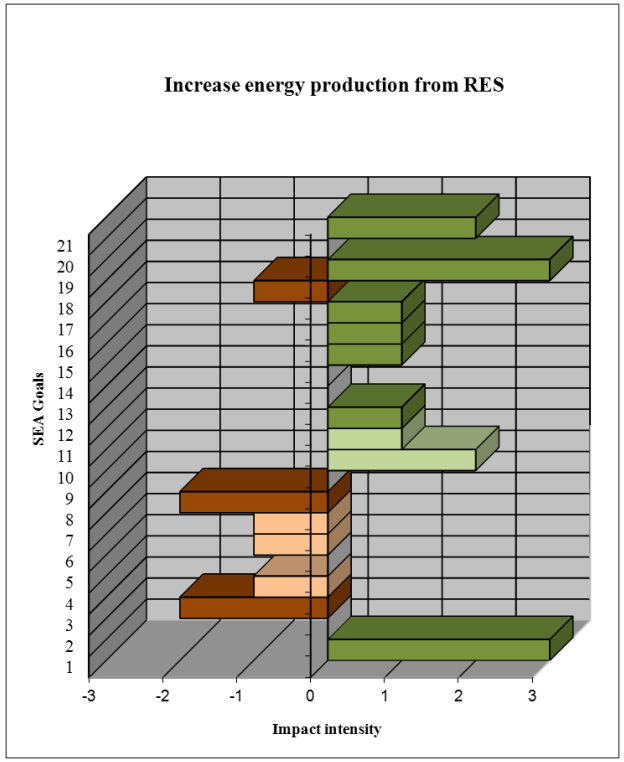

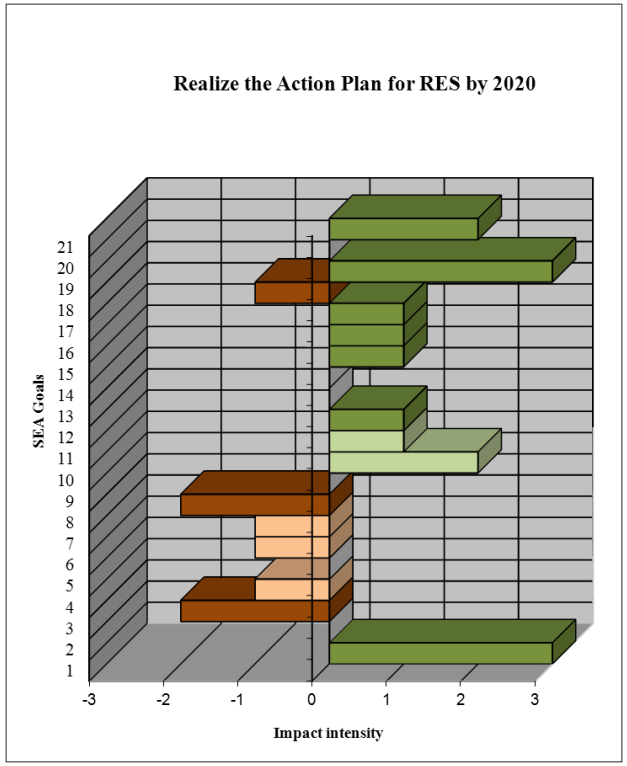

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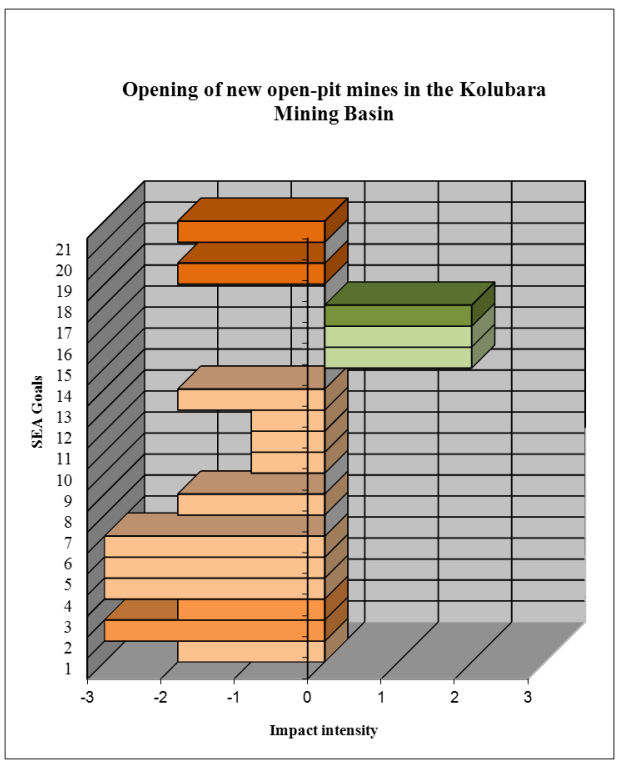

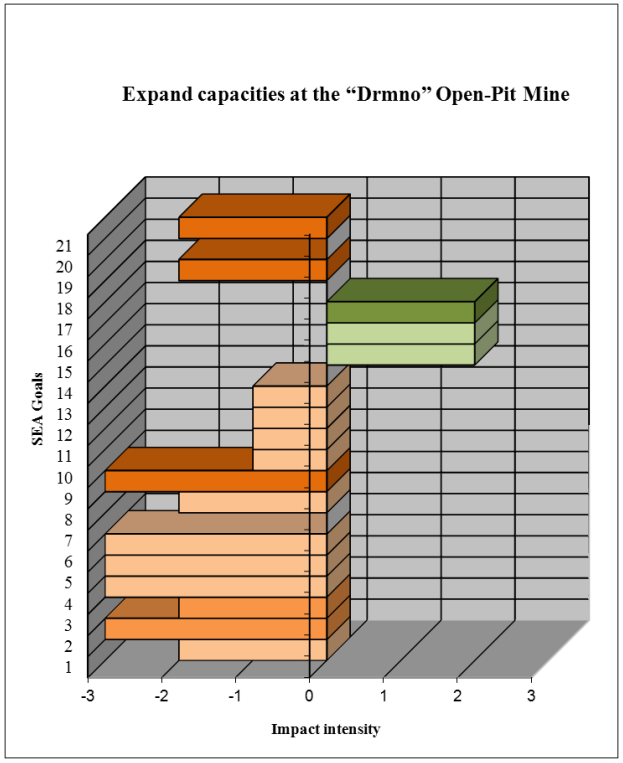

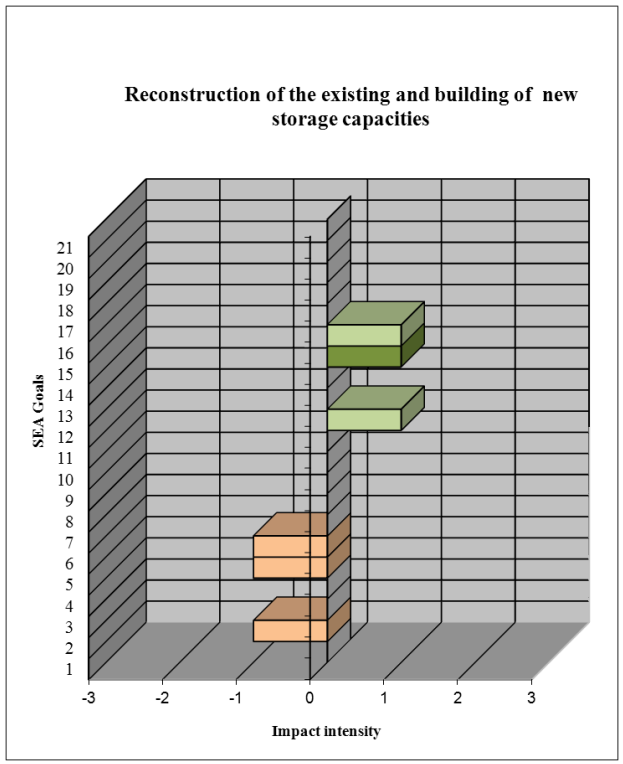

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9. Protection of cultural properties, preservation of cultural heritage and archeological sites
10. Improving waste usage, treatment and disposal
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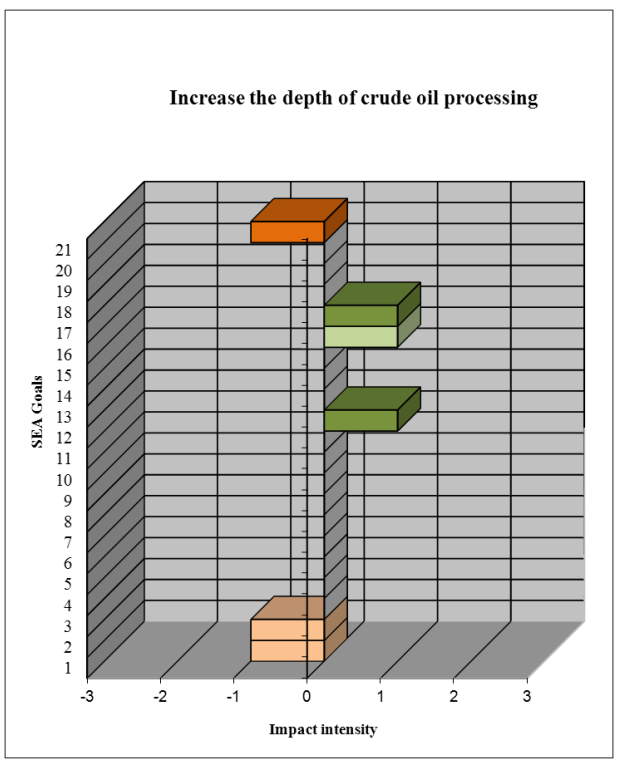

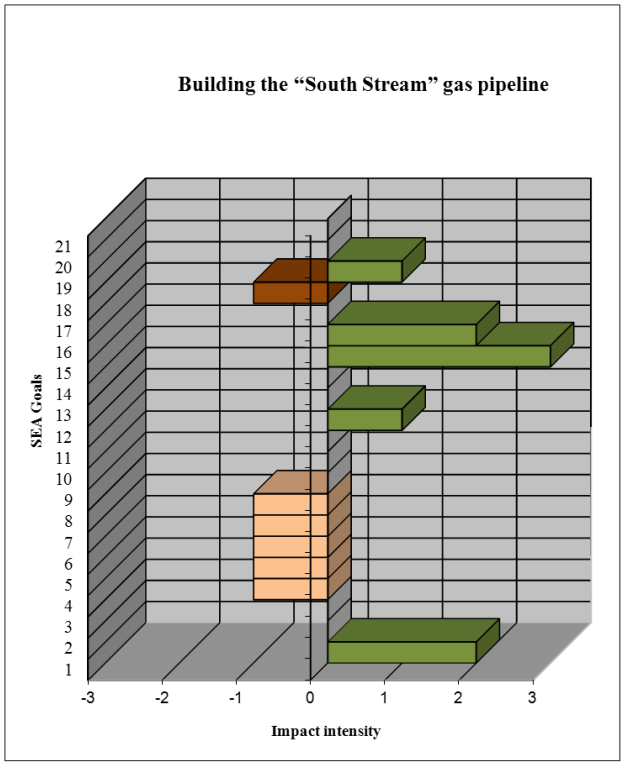

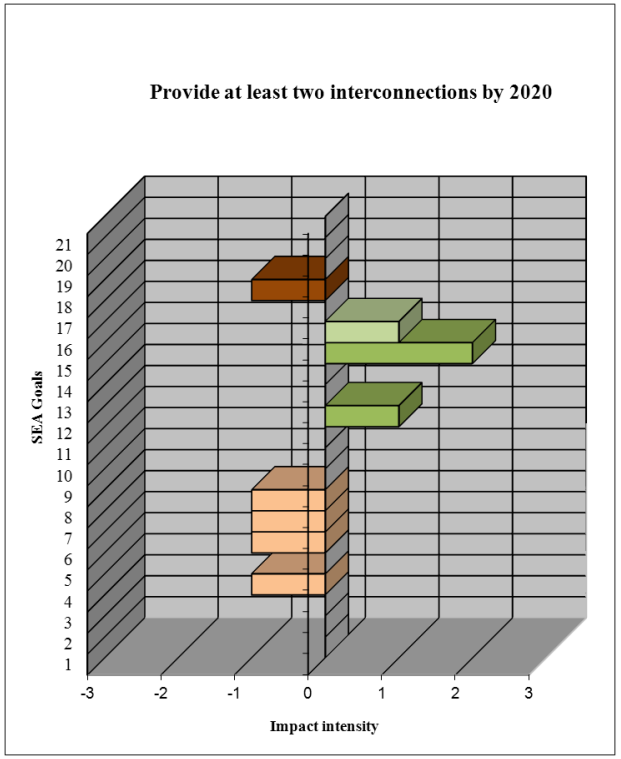

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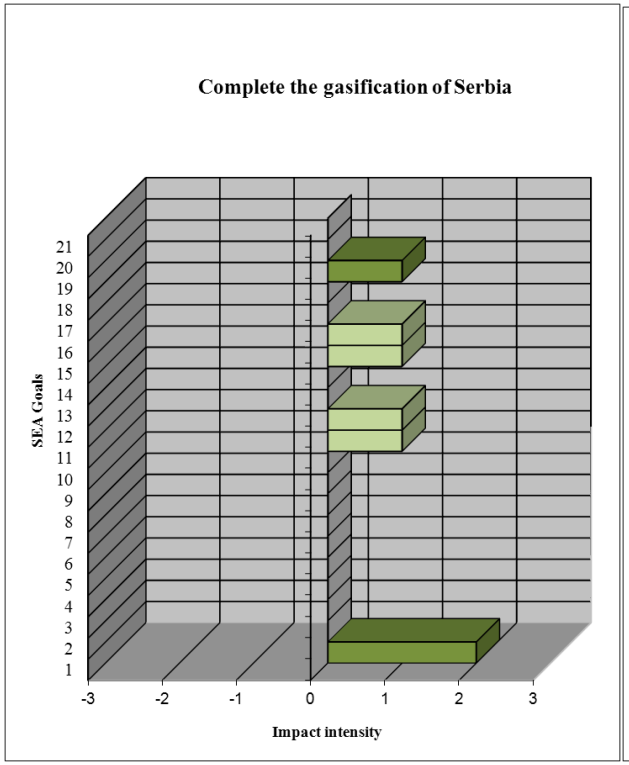

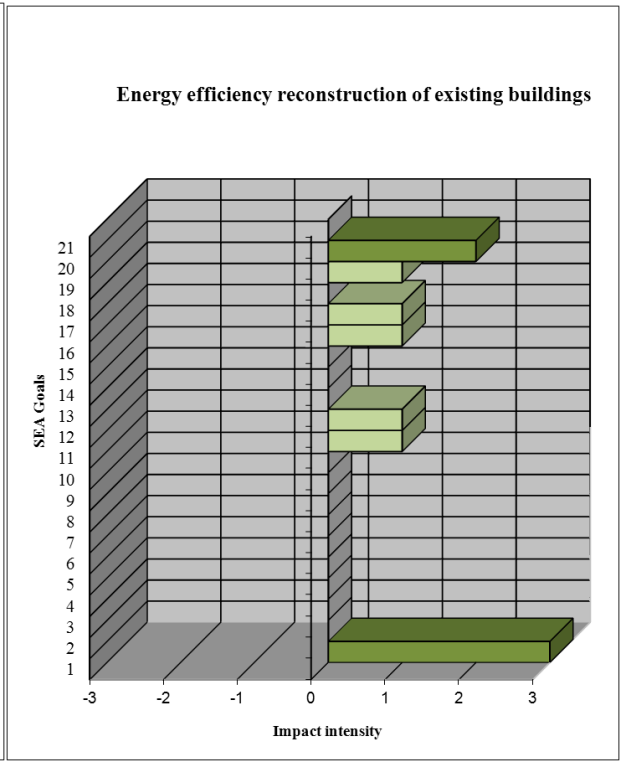

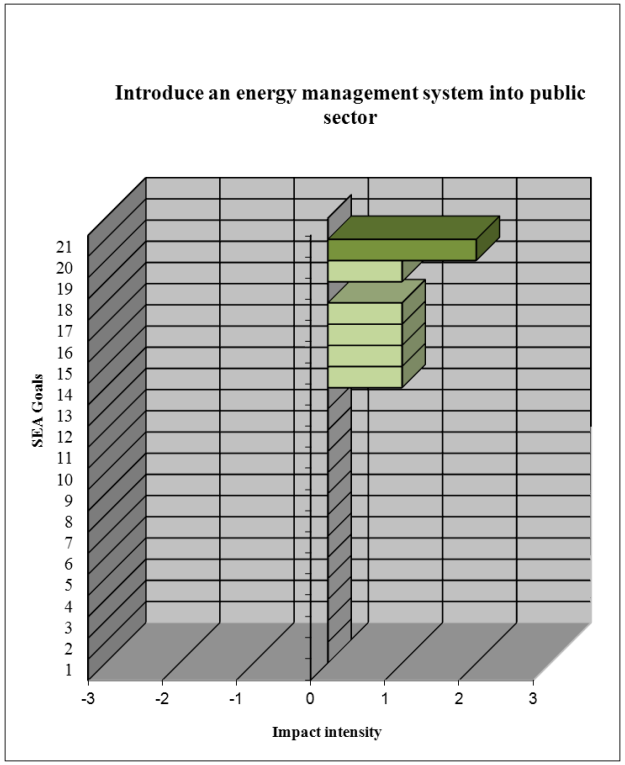

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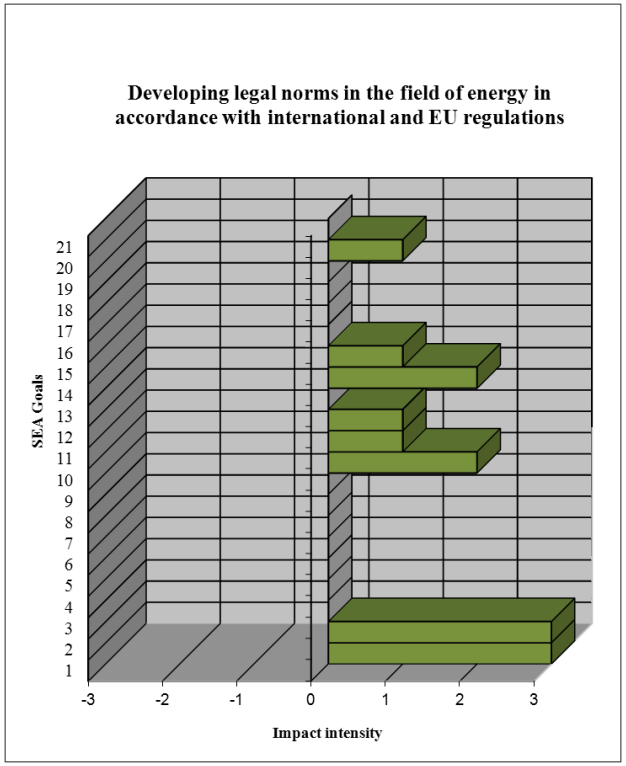

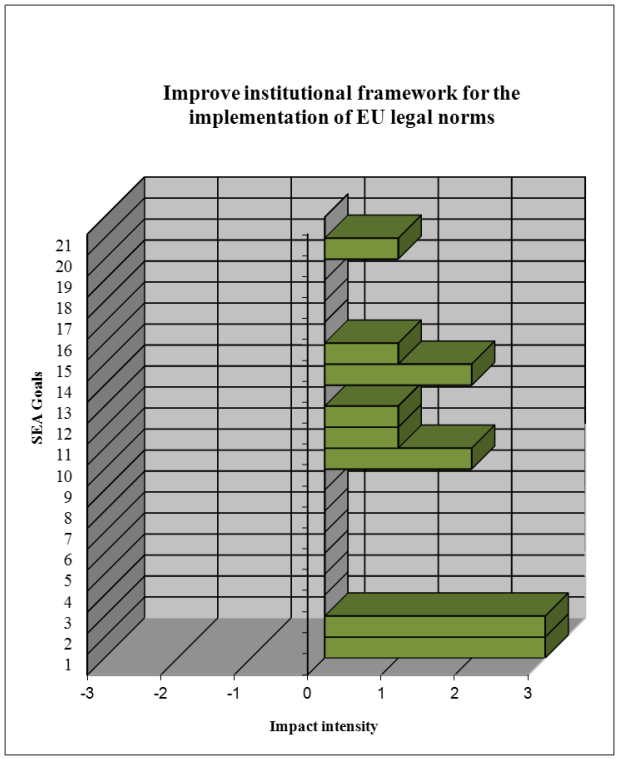

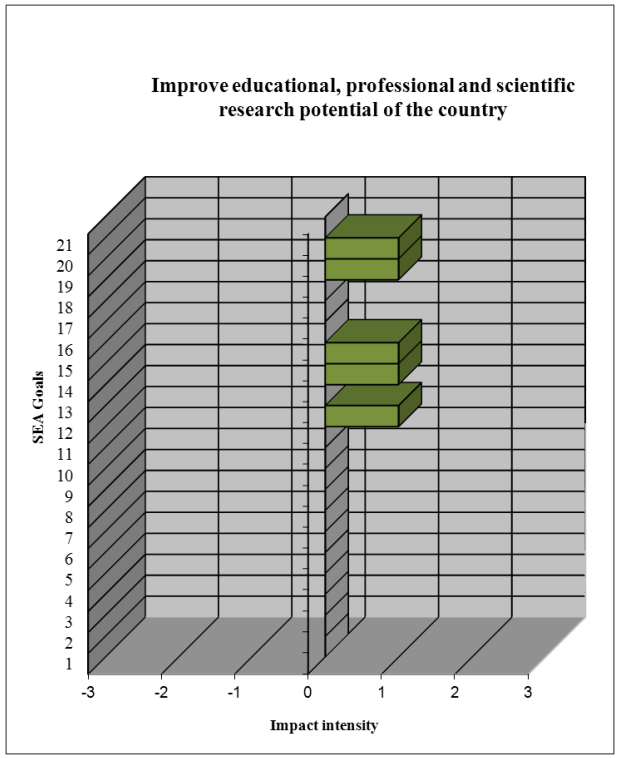

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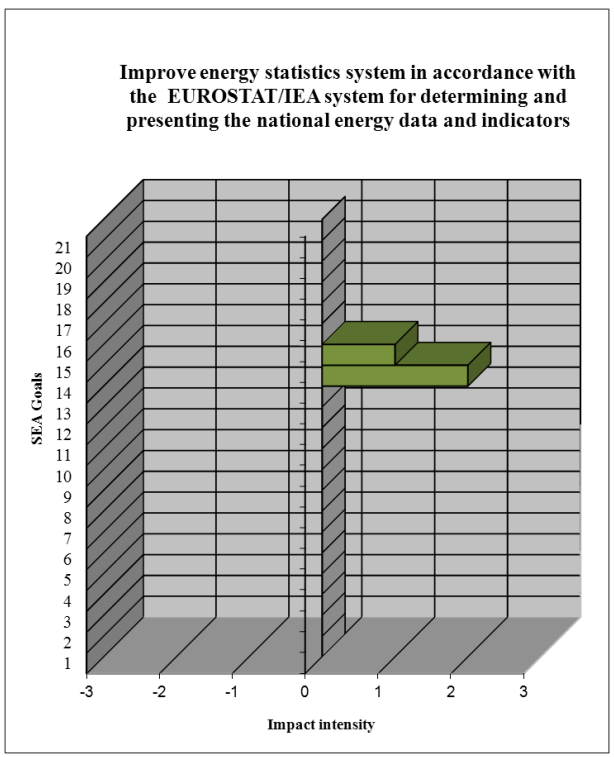

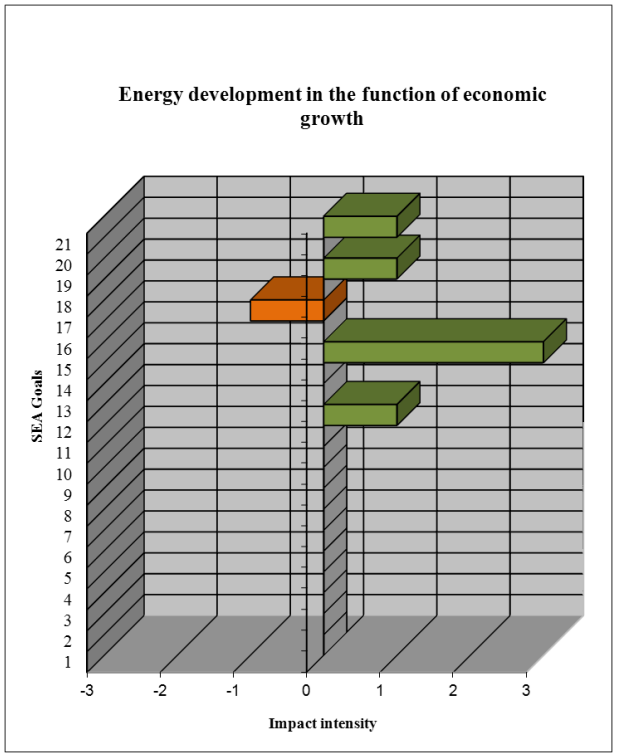

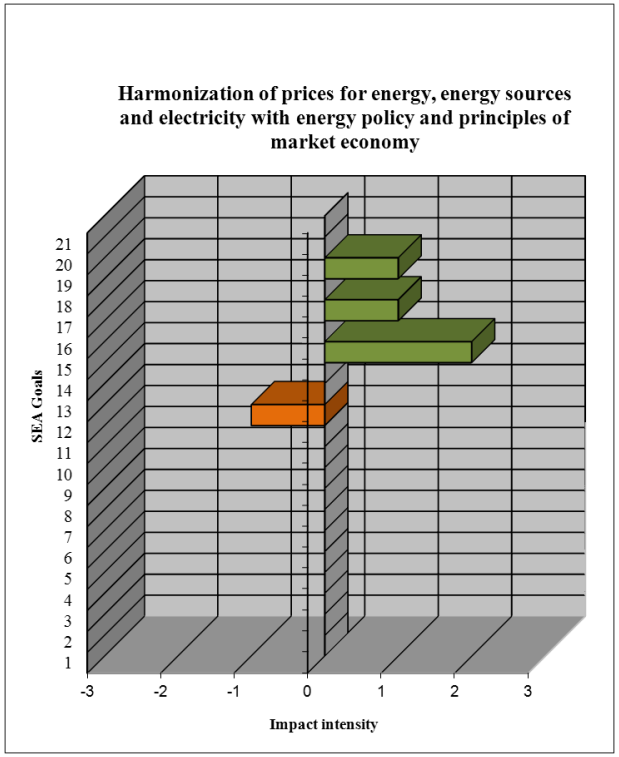

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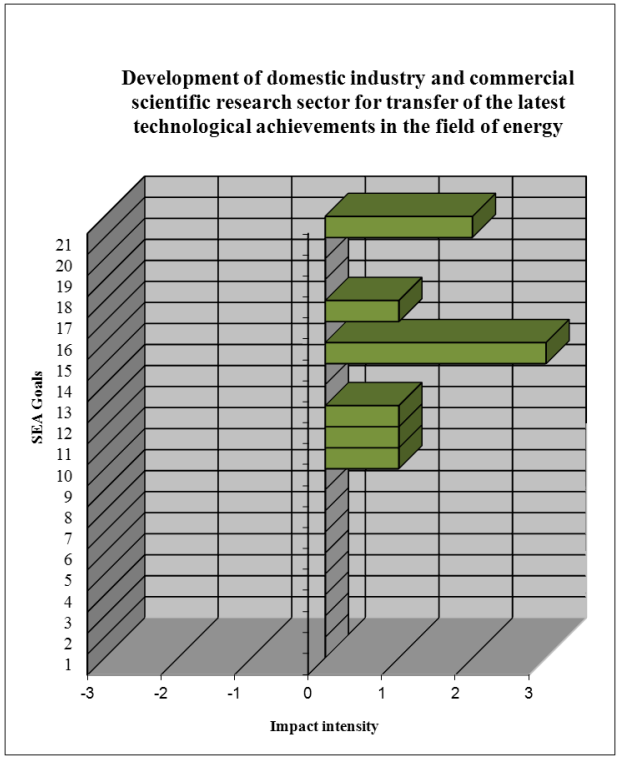

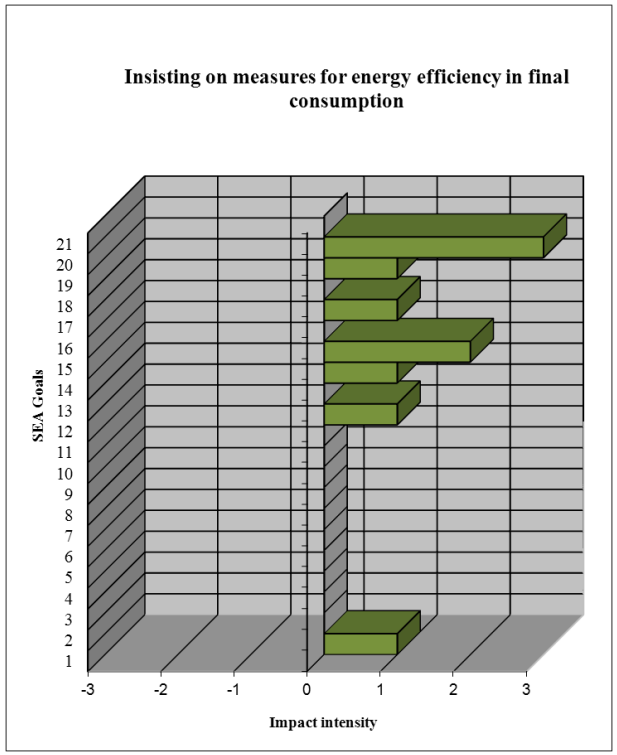

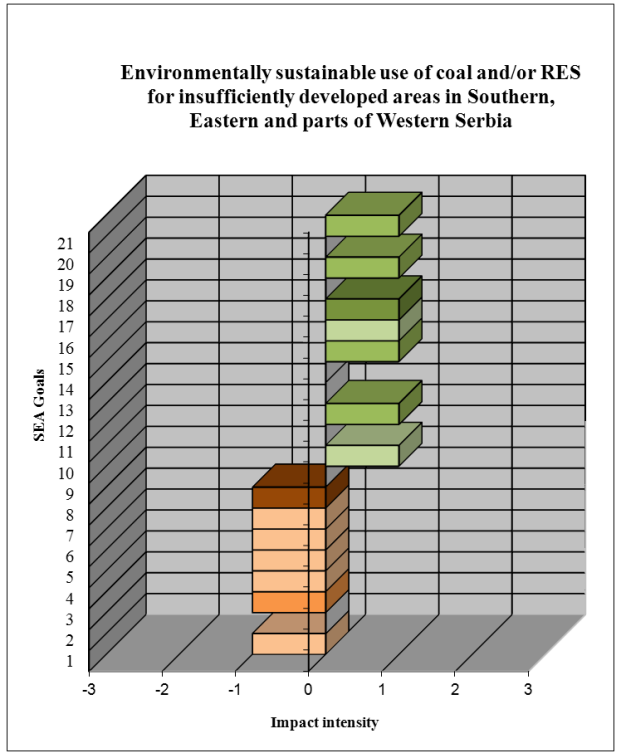

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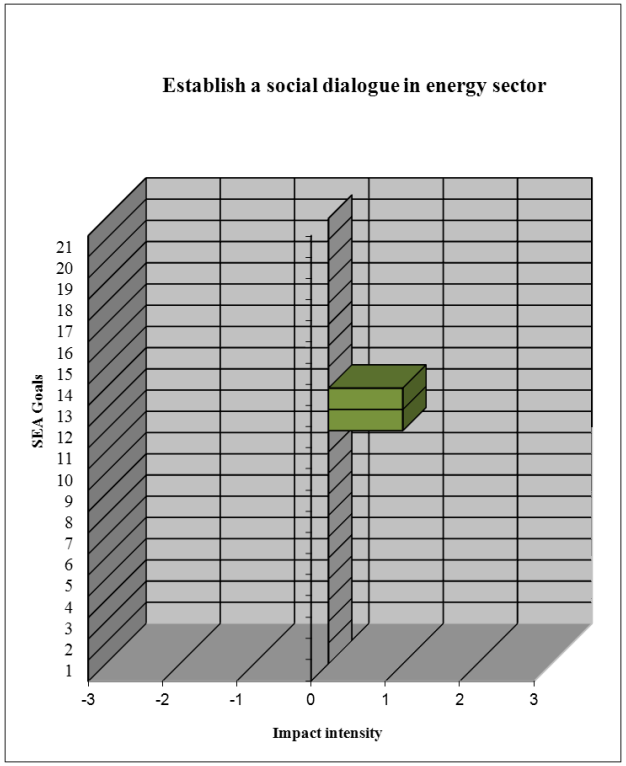

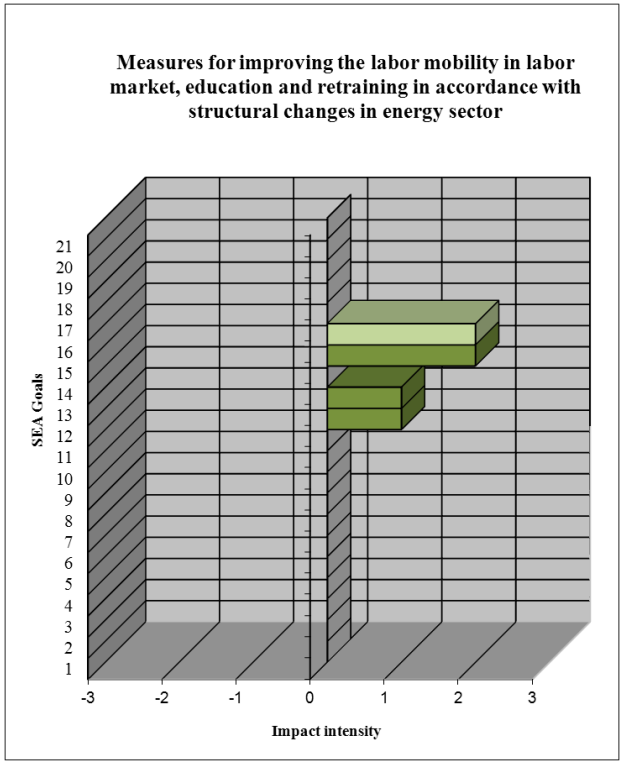

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Table 3.9. Identification and evaluation of strategically significant impacts of priority activities

Strategic priorities	Identification and evaluation of significant impacts		Reasons explanation
	SEA objective	Rank	
ENERGY SYSTEM			
Reconstruction of thermal power plants pursuant to the Large Combustion Plants Directive	**1**	**R+3 / S**	It is expected that people's quality of life will be significantly improved at the regional level by reducing emissions of ambient air pollutants and reducing negative impacts on water quality. The introduction of cutting edge technologies in thermal power plants will contribute to this.
	2	**R+3 / L**	
	21	**R+3 / S**	
Development of new coal-fired thermal power plants of capacity of 700MW by 2025 (350MW by 2020)	**15**	**N+3 / P**	Significant positive effects are expected, which will spur economic growth and reduce dependence on energy imports by using new technologies in production processes.
	17	**N+2 / S**	
	21	**R+2 / S**	
Construction of the "Bistrica" reversible hydropower plant and/or "Djerdap 3" reversible hydropower plant	**3**	**I-3 / S**	There will definitely be negative transboundary impacts on hydrological regime of watercourses on which hydropower plant will be built, which may also cause the loss of forest and agricultural lands upstream of water intake (dam). Construction of the hydropower plant could have visual impact on landscape quality, but also impact on biodiversity. Positive impacts relate to spurring economic growth, reduction in dependence on energy imports, increase in the share of power produced from renewable energy, and introduction of clean technologies in electricity production.
	4	**I-2 / L**	
	6	**I-2 / S**	
	8	**N-2 / P**	
	15	**N+2 / P**	
	17	**N+3 / S**	
	18	**I-2 / S**	
	19	**N+3 / S**	
	21	**N+3 / S**	
DISTRICT HEATING SYSTEMS			
Reduction in distribution network losses	**15**	**N+2 / P**	Improvements implied by economic growth and development are expected.
RENEWABLE ENERGY SOURCES			
Increase in the share of power produced from renewable energy	**1**	**N+3 / L**	The expected positive effects will contribute to reducing harmful air pollution by increasing renewable energy use, i.e. by introducing clean technologies in electricity production processes. Certain projects can have negative effects on certain natural resources (effects of small hydropower plants on water resources) and biodiversity (effects of wind farms on ornithological fauna and chiropters).
	3	**I-2 / L**	
	8	**I-2 / P**	
	19	**N+3 / S**	
	21	**N+2 / S**	
Realization of Action Plan for RES by 2020	**1**	**N+3 / L**	The expected positive effects will contribute to reducing harmful air pollution by increasing renewable energy use, i.e. by introducing clean technologies in electricity production processes. Certain projects can have negative effects on certain natural resources (effects of small hydropower plants on water resources) and biodiversity (effects of wind farms on rnithological fauna and chiropters).
	3	**I-2 / L**	
	8	**I-2 / P**	
	19	**N+3 / S**	
	21	**N+2 / S**	

Strategic priorities	Identification and evaluation of significant impacts		Reasons explanation
	SEA objective	Rank	
C O A L			
Opening of new open-pit mines in the Kolubara basin	**2**	**R-3 / P**	The use of the same amount of non-renewable resources or increase in their the use may cause negative effects on water quality (underground water pollution and possible surface water diversion). On the other side, strong positive effects are reflected in reduced dependence on imports of energy sources, especially by using leading edge technologies in exploitation, processing and use of coal in thermal power plants.
	3	**R-2 / P**	
	17	**N+2 / S**	
	19	**N-2 / P**	
	21	**N-2 / P**	
Expansion of the "Drmno" open-pit coal mine	**2**	**R-3 / P**	The use of the same amount of non-renewable resources or an increase in their the use may cause significant negative effects on water quality (underground water pollution and possible surface water diversion). Negative effects on archeological sites considering that wider area is rich in archeological remains. On the other side, strong positive effects are reflected in reducing dependence on imports of energy sources, especially by using leading edge technologies in exploitation, processing and use of coal in thermal power plants.
	3	**R-2 / P**	
	9	**N-3 / P**	
	17	**N+2 / S**	
	19	**N-2 / P**	
	21	**N-2 / P**	
N A T U R A L G A S			
Construction of "South Stream" gas pipeline	**1**	**N+2 / L**	Significant positive effects on ambient air quality are expected from intensive gasification, stimulation of economic growth and possible promotion of local employment.
	15	**N+3 / P**	
	16	**N+2 / P**	
Providing at least two regional interconnections by 2020	**15**	**R+2 / P**	Significant positive effects on economic development, especially along corridors planned for regional interconnections, i.e. territories of towns and municipalities through which the planned regional interconnections will pass, are possible.
E F F I C I E N T E N R E G R Y U S E			
Energy efficiency reconstruction of the existing buildings	**1**	**N+3 / L**	Significant positive effects are expected which will contribute to reducing harmful air pollution because of reduced need for energy in individual buildings and households.
	20	**N+2 / S**	
Introduction of energy management system in the public sector	**20**	**N+2 / S**	Significant positive effects are expected which will contribute to reducing harmful air pollution because of reduced need for energy in public sector facilities.
L E G I S L A T I V E F R A M E W O R K			
Development of legal norms in the field of energy in accordance with international obligations and EU regulations	**1**	**N+3 / P**	Strong indirect positive effects of legal norms are expected which will be reflected in the creation of preconditions for efficient protection of ambient air, as well as for waste management and monitoring in the energy sector.
	2	**N+3 / P**	
	10	**N+2 / L**	
	14	**N+2 / L**	

Strategic priorities	Identification and evaluation of significant impacts		Reasons explanation
	SEA objective	Rank	
INSTITUTIONAL DEVELOPMENT			
Improvement of the institutional framework for implementation of legal norms based on EU law	**1**	**N+3 / P**	Strong indirect positive effects of legal norms are expected which will be reflected in the creation of preconditions for efficient protection of ambient air, as well as for waste management and monitoring in the energy sector.
	2	**N+3 / P**	
	10	**N+2 / L**	
	14	**N+2 / L**	
Improving the energy statistics system in accordance with the EUROSTAT/IEA system for collection and presentation of national energy data and energy indicators compiled on the basis of the data collected	**14**	**N+2 / P**	Realization of this strategic priority may have significant positive effects which will contribute to improving the environmental protection service and monitoring and control service
SOCIO – ECONOMIC DEVELOPMENT			
Energy development as a contributor to economic growth	**15**	**N+3 / L**	Energy development as a contributor to economic growth would almost certainly significantly spur economic development and, indirectly, enhance environmental quality by using leading edge technologies and legislative measures.
Harmonization of energy, energy products and electricity pricing with energy policy and principles of market economy	**15**	**N+2 / L**	Market-oriented pricing in energy sector would definitely have positive economic effects at the national level.
Development of domestic industry and commercial scientific research sector for transfer of cutting edge technologies in the field of energy	**15**	**N+2 / P**	Economic development based on latest achievements and leading edge technologies will contribute to further economic growth and, consequently, to sustainable development and environmental protection.
	21	**N+2 / P**	
Insistence on energy-efficiency measures in final energy consumption	**15**	**N+2 / P**	Strict implementation of energy-efficiency measures will have positive effects on further economic development.
	20	**N+3 / S**	
Measures aiming at enhancing labor market mobility, training and requalification in accordance with structural changes in energy sector	**15**	**N+2 / P**	Possible strong positive effects may contribute to enhancing economic development by creating labor which will be able to bear burden of structural changes in energy sector, i.e. by creating educational, professional and spatial preconditions for that.

* - criteria according to Table 3.5.

3.3. Summary of significant strategic impacts

On the basis of the evaluation of impact significance shown in Table 3.9, it can be concluded that the Strategy produces significant number of strategically important, both positive and negative, environmental impacts.

Negative impacts are identified as an inexorable consequence of the development and natural potentials of the Republic of Serbia upon which future energy sector development should inevitably be based. This primarily implies: the construction of new thermal power plants and, consequently, opening of new coal open-pit mines, which increases environmental pollution load to a great extent; change in the view of landscape and in biodiversity; as well as social implications which manifest themselves in displacement of settlements from areas in which opening of new coal open-pit mines is planned.

Although most of the above mentioned adverse impacts have a local character in terms of their spatial extent, certain impacts have been evaluated as strategically significant because they manifest themselves at regional and/or national levels, as shown in Table 3.9.

Certain negative implications are also expected due to the construction of the "Bistrica" hydroelectric power plant and/or construction of the "Djerdap 3" reversible hydropower plant, which would have negative effects on hydrological regime of watercourses on which their construction is planned, as well as on biodiversity and ichthyofauna, and will cause possible changes in the use of agricultural and forest lands.

Transboundary impacts are of particular significance considering that they extend beyond the scope of the Strategy.

As a signatory to the Espoo Convention and Kiev Protocol, the Republic of Serbia has bound itself to inform other countries about proposed projects which may have transboundary impacts. In the Espoo Convention Environmental Impact Assessment in a Transboundary Context, the transboundary impact is defined as "any impact not exclusively of a global nature, within an area under the jurisdiction of a Party caused by a proposed activity the physical origin of which is situated wholly or in part within the area under the jurisdiction of another party".

The Espoo Convention requires that if the proposed activity is found to cause significant adverse transboundary impact, the Party, i.e. the Government of the Country undertaking the activity shall, for the purposes of ensuring adequate and effective intervention, notify any other party (other Country's Government) which it considers may be affected by the activity as early as possible and no later than when informing its own public about the proposed activity.

Therefore, adverse impacts are identified as a consequence of implementation of the proposed project in the transboundary belt, i.e. the project may cause internationally significant impacts. In this context, in addition to Strategy priority activities which relate to the construction of the RHPP "Bistrica" and/or construction of RHPP "Djerdap 3", the following projects are singled out:

- Wind farms – possible significant adverse impacts on internationally protected flying fauna (ornithological fauna and chiropters);

- Micro-hydroplants on transboundary watercourses – possible adverse impacts on bentonic organisms and ornithological fauna.

Other identified adverse transboundary impacts were not evaluated as strategically significant because they would not increase environmental load to a significant extent.

On the other hand, a whole series of positive strategic impacts were identified, out of which the most significant ones include the following:

- Environmental quality: reduction in water, air and soil pollution and reduction of greenhouse gas emissions by increasing the use of renewable energy sources and the application of clean technologies in thermal power plants in accordance with Directive 2001/80/EC on the limitation of emissions of certain pollutants into the air from large combustion plants and Directive 2010/75/EU on industrial emissions (integrated pollution prevention and control) for new projects; withdrawal of all thermal power plants with generating capacity less than 300MW (TENT A1 and A2, Kostolac A1 and A2, Morava and Kolubara thermal power plants, Panonnian combined heat and power plants); the implementation of a whole set of energy-efficiency measures will contribute to more rational energy use, i.e. to reducing the production of required amount of energy for the same amount of required energy; development of legal standards in accordance with international obligations and EU regulations and their implementation through an improved institutional framework, thus creating preconditions for reducing the pollution;

- Socio-economic development: Energy sector development as a contributor to economic growth, the market-oriented formation of energy prices and prices for energy-generating products; the development of domestic industry and commercial scientific research sector for the transfer of leading edge technologies in the field energy; strict implementation of energy-efficiency measures in final energy consumption; labor market mobility; as well as overall energy sector development, will represent a long-term contribution to sustainable economic development and rational use of non-renewable energy sources, i.e. to increasing the share of energy from renewable resources.

3.4. Cumulative and synergistic environmental effects assessment

In compliance with the Law on Strategic Environmental Impact Assessment (Art.15), the strategic assessment should also include an assessment of cumulative and synergistic effects on the environment. Significant effects can results from interactions of numerous smaller effects of the existing facilities and activities, as well as planned activities for the area covered by Plan.

Cumulative effects arise when sectoral solutions each have insignificant effects, but together have a significant effect.

Synergistic effects interact to produce a total effect greater than the sum of the individual effects, so that the nature of the final impact is different to the nature of the individual impacts.

Table 3.10. Identification of possible cumulative and synergistic effects of strategic priority activities (according to Table 3.6)

Interaction between priority activities	Field of the SEA
AIR	
1, 2, 10, 11	Dust emissions are dominant in open-pit mines during excavation of coal and overburden, but the GVI for dust is not exceeded in surrounding settlements. After the treatment, the emissions of air pollutants from thermal power plants do not exceed the GVI. Taking into consideration that on these locations there are also other sources of emissions (traffic, industrial plants and households), GVI can be exceeded during unfavorable weather conditions due to cumulative effects. Emissions of SO_2 and NOx from TPP, after the reconstruction which will be carried out in accordance with the Large Combustion Plants Directive, will not exceed the GVI. However, SO_2 and NOx which come from other sources are not purified, so that GVI for these pollutants can be exceeded due to cumulative effects. Greenhouse gas emissions (CO_2, CH_4, N_2O, O_3 and halogenic hydrocarbons) are produced as byproducts during process of converting fossil fuels into energy (thermal power plants, district heating plants, transportation). Considered cumulatively, the existing and new sources will cause an increase in greenhouse gas emissions, but levels at which GHG will be emitted will not be significant at the national level, and certainly not at the global level. Under the Kyoto Protocol, Serbia (as a developing country) is not obliged to reduce greenhouse gas emissions, although it should strive to reduce them.
1, 3, 4, 8, 9, 13, 16	Positive cumulative effects which will help in reducing the exposure of people to air pollutants are achieved through reconstruction of TPPs, the use of RES, construction of combined heat and power plants using gas engines, as well as through gasification of settlements. An increase in depth of processing will have indirect effects, thereby the use of higher quality fuel for vehicles.
WATER	
4, 8, 9, 10, 11, 27	The proposed development of mining activities will inevitably affect the hydrological regime in the open-pit mines and, cumulatively, in a wider surrounding area. Disturbed natural regime of water can have indirect effects on natural regime of surface water, soil fertility and water supply for population. The construction of reversible hydropower plants and small hydro-power plants (especially if a greater number of small hydro-power plants will be built on the same watercourse) will produce similar effects. Due to development of open-pit mines, a certain waterways will have to be diverted. Furthermore, infiltration of pollutants into open pits and waste rock dumps is also possible.
1, 2, 19, 20, 25	Use of cutting edge technologies in thermal power plants will contribute to more efficient wastewater purification which will be supported by legislation and institutional organization harmonized with international obligations and EU regulations.
SOIL	
1, 2, 10, 11, 27	New thermal power plants and the existing ones could, cumulatively and indirectly, cause soil pollution from pollutants which settle on the land. Increasing amount of land used for surface mining will reduce the amount of land needed for agriculture.
1, 13, 16, 25	Use of cutting edge technologies in thermal power plants and in the production of derivatives of oil, as well as the use of RES and the gasification system in Serbia, will contribute to the reduction of soil pollution because of smaller amounts of air pollutants which settle on the land.
NATURAL VALUES	
3, 4, 8, 9, 10, 11	Mining activities, degradation of agricultural land and vegetation destruction in surface mining areas have cumulative effects causing loss of habitats of most of kinds of animals and their migration outside wider area of active open-pit mines. It is expected that the construction of hydroelectric power plants and wind farms will cause negative effects on landscape and biodiversity.
/	/

Interaction between priority activities	Field of the SEA
WASTE	
/	/
1, 2, 19, 20, 21, 25	Use of cutting edge technologies in thermal power plants will contribute to an efficient waste treatment, which will be supported by legislation and institutional organization harmonized with international obligations and EU regulations.
HUMAN HEALTH	
1, 2, 10, 11	Small effects limited to the surface mining areas and thermal power plants can combine with effects of other sources of air and noise pollution (traffic, industry) within the boundaries of coal mining area and become significant, cumulative effects.
3, 4, 8, 9, 16, 19, 20, 21,	Mentioned planning solutions cumulatively contribute to human health by reducing the particulate matter emissions in the atmosphere.
SOCIO-ECONOMIC DEVELOPMENT	
4, 11, 12, 24	Cumulative negative effects lead to changes in size and structure of population, as well as changes in characteristics of settlements, due to development of open-pit mines. Short-term smaller negative effects on standard of living as a result of market corrections of electricity prices.
2, 3, 7, 14, 15, 23, 25, 27, 28, 29	The mentioned priority activities in the energy sector will contribute to socio-economic development from different aspects (economic growth, rising standard of living, growth of employment in the energy sector, etc.). Compared to adverse effects which are considered to be of short-term (initial) character, the Strategy implementation will have long-term positive effects on socio-economic development.

3.5 Description of guidelines for preventing and mitigating negative impacts and maximizing positive impacts on the environment

Environmental protection implies taking into account all general measures for environmental and nature protection and related laws and regulations.

In this context, the guidelines for environmental protection have been established based on the analysis and assessment of current state of the environment, as well as on identified potential environmental impacts.

Guidelines for environmental protection are aimed at identifying adverse environmental impacts directed towards limits of acceptability for the purpose of preventing the threat to the environment and human life. They help maintain the trend of positive environmental impacts. Guidelines for environmental protection enable the development and prevent conflicts in the subject area, which aimed at achieving the sustainable development objectives.

On the basis of the results of multi-criteria analysis of priority activities envisaged in the Strategy, guidelines for environmental protection were established and given for the most significant facilities/projects envisaged in the Strategy, i.e. for those energy facilities/projects which are significant polluters by nature of their operation.

3.5.1. General guidelines

- It is mandatory to strictly obey the laws and regulations pertaining to environmental protection and implementation of internationally undertaken obligations related to the energy sector and environmental protection sector;
- The implementation of environmental protection guidelines set out in the SEA Report is mandatory, as well as their detailed development in the process of the Strategy implementation, through creating a program for the Strategy implementation, and making the planning and project-technical documentation for individual projects;
- It is mandatory to monitor the environmental quality in accordance with the relevant legislation and the Program for Environmental Monitoring set forth in the SEA Report;
- Give priority to the establishment of a cadastre of polluters in the energy sector and emission balances; add desulfurization and denitrification equipment to thermal power plants; install bag filters or reconstruct the existing ones in thermal power plants emitting the suspended particulate matters which exceed the GVI and which pose the greatest risks to the environment and human health;
- Making a greenhouse gas (GHG) inventory in the energy sector, introducing and implementing the ISO 14000 standards for environmental management in energy companies, and introducing the EMAS system;
- Households directly affected by activities related to energy facilities (surface mine development, activities in areas of coal transportation, construction of hydroelectric power plants, etc.), should be displaced to eco-friendly locations. If the displacement of residential buildings, auxiliary and other facilities is inevitable, the property owners must be compensated in accordance with relevant legal regulations;
- Providing the environmental education and public participation the in all stages of the implementation of projects in the energy sector;
- If the proposed activity is found to cause significant adverse transboundary impact, the Party, i.e. the Government of the Country undertaking the activity shall, for the purposes of ensuring appropriate and effective intervention, notify any other party (other Country's Government) which it considers may be affected by the activity as early as possible and no later than when informing its own public about the proposed activity.

3.5.2. Guidelines for important priority activities envisaged in the Strategy

Open-pit mines

- Priority remediation of polluted mining and power plant sites, which includes: carrying out of decontamination and rehabilitation procedures in hot spots – contaminated sites; recultivation and rehabilitation of sites most affected by exploitation of raw mineral (Kolubara and Kostolac lignite basins); and rehabilitation of polluted waterways;
- Concerning the planned exploitation of raw minerals, coal in particular, it is mandatory to undertake complex and appropriate protection measures using the best available technologies (BAT);
- Introducing the systems for spraying water at the coal surface during excavation and conveyor belt transport;
- Tapping the coal loading/unloading points to prevent coal dust spreading into the coal mine area;

- Providing a selective disposal of coal overburden;
- Creating a green belt around open-pit mines before starting the exploitation of coal;
- Installing the "Mini jet" systems for spraying water at the coal face during transportation;
- Using the machinery with reduced emissions of harmful gases;
- Informing the public on environmental protection problems in the area and ensuring the public participation in decision-making on solving environmental protection problems, including all potentially affected and concerned parties;
- Reconstructing and improving the wastewater channeling and purification systems;
- Surface and groundwater monitoring system should be supplemented with measuring points in places susceptible from the aspect of pollution of sources of water supply;
- Creating an automated system for monitoring and control of surface and groundwater in the open-pit mining area and negative effects of water table lowering in areas under influence of open-pit mines;
- Making a plan for observing the land stability and stability of facilities in the area of open-pit mine expansion, as well as creating a system for observing the settling/moving of land by positioning trigonometric points and reference points for observing a wider area, thus enabling an appropriate response in case of damages to facilities;
- Providing selective disposal of waste rock before coal overburden excavation;
- Providing a successive recultivation of open-pit mining surfaces after the completion of mining works, adjusted to schedule of mining works;
- Making a directory of area-specific biodiversity as a basis for projects for biological recultivation of degraded areas and waterways;
- It is necessary to search for the data on possible archeological sites which might be affected by the planned expansion of open-pit mines;
- It is necessary to prepare sites for storage of all hazardous waste, as well as for building the mine waste storage unit, including fuel storage. Waste disposal must be strictly controlled;
- Using the methods for reducing the dust generation from unpaved roads and on surfaces covered by vegetation;
- Limiting the top speed of vehicles to reduce dust emissions generated during the execution of mining works.

Thermal Power Plants

- Mandatory implementation of the Directive 2001/80/EC on the limitation of emissions of certain pollutants into the air from large combustion plants;
- Mandatory implementation of the Directive 2010/75/EU on industrial emissions (integrated pollution prevention and control) for new projects;
- Installing the carbon capture and storage (CCS) system in accordance with the EU CCS Directive. If this will not be possible for financial reasons, the coal-fired thermal power plant operators will be bound to make preparations for CCS retrofits in future ("CCS ready");
- Recycling the fly ash produced from coal combustion in coal-fired power plants in the production of cement, bricks and ceramics, road construction, etc.;
- Wastewater originating from production processes must be purified to the prescribed level in accordance with relevant legislation;
- Machinery halls of thermal power plants should be insulated to minimize noise production from turbines, generators and transformers;

- Using the methods for reducing the dust origination from unpaved roads and on surfaces covered by vegetation;
- Limiting the top speed of vehicles to reduce dust emissions generated during the execution of works.

Hydroelectric power plants and small hydropower plants

- It is not allowed to block a waterway during execution of works or when using hydraulic structures;
- Hydro-technical facilities must be constructed to ensure a minimum flow rate in accordance with Art.8 of the Water Law ("Official Gazette of the Republic of Serbia", No. 30/10), i.e. not to threaten survival and migration of fish and other aquatic organisms. Hydro-biologically acceptable minimum flow rate should be at the level of medium minimum flow rate;
- In developing water intakes, it is mandatory to create a fishway which will provide undisturbed access to aquatic organisms;
- Fishway should be designed in relation to water intake so that the amount of water will ensure an average minimum monthly flow rate to enable undisturbed passage of ichtyofauna and other aquatic organisms;
- If the fishway is comprised of a greater number of smaller basins, the height difference between them should not exceed 0.2 m;
- Turbulence of water through fishway should be at lower speed to enable the passage of migrating juvenile aquatic organisms;
- The bottom of fishway should be covered by natural substrates. The best solution is to use substrates from waterways, i.e. the part of substrates settling downstream form the dam;
- Undisturbed functioning of fishway must have a priority over the electricity generation, which means that in case of minimum flow rate the turbines must be stopped to ensure enough water for fishways;
- The above mentioned water intake system and fishways must be appropriately ensured, including entrance and exit, to prevent unauthorized persons from accessing them, as well as to prevent any type of ichtyofauna catching devices to be placed in them;
- Fishway should be regularly cleaned by removing debris which can disturb movement of aquatic organisms;
- In case fishways are obstructed or in case of other accidents causing their dysfunction, the operation of hydroelectric power plant/small hydropower plant must be stopped until the causes are eliminated;
- In areas which are prone to flooding and, consequently, to landslides, a policy applicable in cases of collapses/landslide occurrence may be adopted to mitigate the probability of occurrence of such accidents after filling the accumulation reservoirs;
- It is necessary to separately plan cumulative impacts of a greater number of small hydropower plants if their construction is planned on the same waterway;
- Using the methods for reducing the dust origination from unpaved roads and on surfaces covered by vegetation;
- Limiting the top speed of vehicles to reduce dust emissions generated during the execution of works;
- Re-cultivating the degraded areas as soon as possible;
- After the construction, the facilities should be insulated to minimize noise production from turbines, generators and transformers;

- Using the topographic features of the terrain and vegetation as visual barriers to prevent visual impacts.

''South Stream'' Gas Pipeline

- If it is necessary for gas pipeline to pass through panoramic view locations, it is necessary to integrate underground facilities into the environment in order to mitigate visual impacts;
- Surface facilities are sensitive facilities of technical infrastructure, particularly in relation to forests and landscape and, therefore, their routing and construction should ensure minimum forest and undergrowth clearing together with careful landscaping and autochthonous grass planting, and with mandatory renewal of vegetable cover;
- Concerning the archeological sites and cultural and historical structures, it is necessary to search for data on possible archeological sites to identify whether certain locations along the gas pipeline route might be affected;
- Carrying out an initial review of data on species and habitats in the planning area along the pipeline route;
- Using the methods for reducing the dust origination from unpaved roads and on surfaces covered by vegetation;
- Limiting the top speed of vehicles to reduce dust emissions generated during the execution of woks.

Development and strengthening of transmission and distribution infrastructure

- Surface facilities – overhead power transmission lines, convector power lines and substations are sensitive facilities of technical infrastructure, particularly in relation to forests and landscape and, therefore, their routing and construction should ensure minimum forest and undergrowth clearing along with careful landscaping and autochthonous grass planting, and with mandatory restoration of vegetable cover;
- Overhead power transmission lines and other surface facilities should be integrated into the environment. If it is necessary to construct them on panoramic view locations, the supporting structures should be positioned so far as possible, to mitigate visual impact;
- Searching the data on species and habitats on the planning area along the overhead power line routes;
- Mark the overhead electricity cables with visible markers, such as colored balls or flags, on key crossings or other areas where they pass over important habitats of birds;
- Using the methods for reducing the dust origination from unpaved roads and on surfaces covered by vegetation;
- Limiting the top speed of vehicles to reduce dust emissions generated during the execution of works.

Wind farms

- In selecting locations for wind farms, and for the purpose of protecting ornithological fauna and chiropters, special attention should be paid to detailed observations of flying fauna through monitoring of ornithological fauna and chiropters;
- In selecting locations for wind farms, special attention should be paid to required distances from environmentally sensitive areas to minimize possible adverse impacts on biodiversity;

- In selecting locations for wind farms, special attention should be paid to required distances from nearby settlements and residential buildings to minimize possible adverse impact of noise on people;
- Monitoring of ornithological fauna and chiropters should be carried out in the phase of project development, as well as the post-construction monitoring;
- Using the methods for reducing the dust origination from unpaved roads and on surfaces covered by vegetation;
- Limiting the top speed of vehicles to reduce dust emissions generated during the execution of woks.

Biomass power plants

- Bag filters should be installed in biomass power plants which are designed to reduce emission of particles originating from stationary combustion plants;
- Biomass power plants can be insulated to minimize noise originating from turbines, generators, pumps, transformers, etc.;
- In selecting locations for biomass power plants, special attention should be paid to required distances from environmentally sensitive areas to minimize possible adverse impacts on biodiversity;
- Using the methods for reducing the dust origination from unpaved roads and on surfaces covered by vegetation;
- Limiting the top speed of vehicles to reduce dust emissions generated during the execution of woks.

4. GUIDELINES FOR UNDERTAKING THE SEA AT LOWER HIERARCHICAL LEVELS

Pursuant to Art.16. of the Law on Strategic Environmental Impact Assessment, the Strategic Environmental Assessment Report contains guidelines for plans or programs at lower hierarchical levels which suggest the need for carrying out the strategic assessment and environmental impact assessment, aspects of environmental protection and other issues of importance for environmental impact assessment for plans and programs at lower hierarchical levels.

The activities set forth in the Strategy will be developed in details in the Program for the Realization of the Energy Sector Development Strategy of the Republic of Serbia (hereinafter referred to as the "Program"). This implies a clear definition of the area at micro-location level for each activity and energy facility, as well as their detailed technical and technological specifications. In this context, for the need of making the Program, it is necessary to estimate capacities of the specific area in relation to planned activities. In this way, an ecological evaluation of the area will be carried out and measures for a complete protection of the environment from adverse effects of pollution prescribed.

The Strategic Environmental Assessment is mandatory for Programs for the implementation of the Energy Sector Development Strategy of the Republic of Serbia by 2025 with projections until 2030.

In addition, for all planned capital energy facilities (reversible hydropower plants, thermal power plants, district heating plants, hydroelectric power plants, greater number of energy facilities using RES which are grouped in the same area (this particularly refers to a greater number of hydroelectric power plants or smaller hydro-power plants to be constructed on the same watercourse), open pit mines, transmission and distribution networks, high capacity networks, storages, gas pipelines, etc.) whose spatial impact dispersion extends beyond local (micro-local) boundaries, it is necessary to make planning documentation for which strategic environmental assessment is mandatory in order to asses potential environmental impacts in a wider context, cumulative and synergistic impacts, and define appropriate protection measures for limiting possible negative environmental impacts.

Pursuant to provisions of the Law on Strategic Environmental Assessment ("Official Gazette of the Republic of Serbia", No. 135/04 and 36/09), the Study on Environmental Impact Assessment within the project and technical documentation can be required for individual energy facilities. In relation to the planned activities set forth in the Strategy, and in relation to the Ordinance on determining the List of projects for which an impact assessment is mandatory and the List of projects for which an impact assessment may be required ("Official Gazette of the Republic of Serbia", No. 114/08), the environmental impact assessment study is mandatory for the following projects[3]:

1. Plants for processing of crude oil and natural gas and oil derivative production;
2. Plants for gasification and liquefaction of coal or bituminous shale, heavy crude-oil residue;

[3] All mentioned projects necessitate making the associated planning document together with the Strategic Environmental Assessment Report in accordance with conclusions given in paragraph 4 of Chapter 4. of the subject SEA.

3. Industrial installations for the production of electricity, steam and hot water, process steam or heated gas, using all types of fuels, as well as installations for work machine operation (thermal power stations, district heating plants, gas turbines, installations with internal combustion engines and other combustion devices, including steam boilers) with installed capacity of 50 MW or more;
4. Facilities for hazardous waste incineration and thermal, chemical and physical treatment;
5. Facilities for non-hazardous waste incineration or chemical treatment with capacity of more than 70 tones per day;
6. Extraction of crude oil and natural gas;
7. Dams and other installations designed for the holding back or permanent storage of water, where a new or additional amount of water held back or stored exceeds 10 million cubic meters;
8. Pipelines for the transport of gas, liquid gas, crude oil and oil derivatives or chemicals with a diameter of more than 800 mm and a length of more than 40;
9. Quarries and open-pit mining where the surface area of the site exceeds 25 hectares, or peat extraction, where the surface area of the site exceeds 150 hectares;
10. Building the overhead electrical power lines with a voltage of 220 kV or more and a length of more than 15 km;
11. Installations for storage of crude oil, underground natural gas, flammable and combustive liquids or chemical products with the capacity of 100.000 tones or more;
12. Activities and installations for which an integrated permit shall be granted pursuant to the Decree on Types of Activities and Installations for Which an Integrated Permit Shall be Granted ("Official Gazette of the Republic of Serbia, No. 84/05);
13. Projects implemented in protected natural environments close to immovable cultural heritage, as well as in other special-purpose areas.

For other energy facilities of smaller capacities, the Project Promoter is, pursuant to Art.8 of the Law on Environmental Impact Assessment, obliged to submit to the authority responsible for issues related to environmental protection the Request for Determining the need for Making the Environmental Impact Assessment Study, pursuant to the Law on Environmental Protection (“Official Gazette of the Republic of Serbia", No.135/04, 36/09 and 72/09 – 43/11 – Constitutional Court), Law on Environment Impact Assessment (“Official Gazette of the Republic of Serbia", No. 135/04 and 36/09), Rules on the Contents of the Environmental Impact Assessment Study (“Official Gazette of the Republic of Serbia", No. 69/2005), and Ordinance on Determining the List of Projects for Which an Impact Assessment is Mandatory and the List of Projects for which an Impact Assessment May be Required (“Official Gazette of the Republic of Serbia", No. 114/08).

5. PROGRAM FOR ENVIRONMENTAL MONITORING DURING THE IMPLEMENTATION OF THE STRATEGY

The precondition for achieving environmental protection objectives, i.e. the SEA objectives, is to establish an efficient monitoring program as one of the main priorities in the Strategy implementation. Pursuant to the Law on Environmental Protection, the Government shall adopt a monitoring program pursuant to special laws for the period of two years for the entire territory of the Republic of Serbia, while local self-government units, i.e. municipalities, shall adopt environmental monitoring programs for their territories, which must be harmonized with the mentioned program of the Government.

The Law on Strategic Environmental Impact Assessment sets forth an obligation of defining the environmental monitoring program during the implementation of plans or programs for which the SEA is undertaken. The Law also specifies the contents of the monitoring program which shall include the following in particular:

1) Description of objectives of plans and programs;
2) Environmental monitoring indicators;
3) Rights and obligations of competent authorities, etc.

Therefore, this program can also be an integral part of the existing monitoring program provided by the competent environmental protection authority. Furthermore, monitoring should provide information on the quality of the existing report, which could be useful in making the future report on the state of the environment.

A continual monitoring in areas of exploitation of mineral raw materials, open-pit mines and power plants (particularly thermal power plants) is of special importance.

5.1. Description of Strategy objectives

The description of general and specific objectives of the Strategy is given in more detail in the Chapter 1 of the SEA Report. Therefore, a greater attention will be dedicated to the objectives of the Environmental Monitoring Program.

The main objective in creating a monitoring system is to provide, amongst other things, a timely response to and warning of possible negative processes and accident situations, as well as a complete insight into the status of elements of the environment and an identification of the need to undertake protection measures depending on threats from pollution and its forms. It is necessary to provide a continuous tracking of the state of the environment and activities, in this specific case for the entire territory of the Republic of Serbia (especially on sites of the existing or planned power plants), thus opening the possibility for rational environmental management.

Pursuant to the Law on Environmental Protection, the Republic or local self-government units, within their competencies specified by the Law, provide a continuous environmental control and monitoring pursuant to this Law and other related laws. Pursuant to Art. 69 of the mentioned Law, objectives of the Environmental Monitoring Program would be:

- Providing the monitoring;

- Defining the contents of and methods for carrying out the monitoring;
- Specifying the organizations which shall be authorized for carrying out the monitoring;
- Defining the pollution monitoring;
- Establishing the information system and define a data delivery method for the purpose of maintaining an integrated cadastre of polluters, and
- Introducing reporting obligations on the state of the environment according to prescribed contents of environmental reports.

The key planning objective in this case is to protect water resources in the catchment areas of reservoirs, as well as other natural and environmental factors, along with creating the conditions for sustainable socio-economic development of the area. In correlation with the above mentioned objectives, the key fields of monitoring are: water, air, soil, air pollutant emissions, noise and natural values (through biodiversity, geoheritage, landscape, forests).

5.2. Indicators for environmental monitoring

The environmental monitoring is carried out through the systematic measurement, identification and evaluation of environmental and pollution indicators, including the monitoring of natural factors, i.e. environmental changes and characteristics.

Considering the spatial coverage of the Strategy and possible pollution, the monitoring system primarily relates to the following indicators:

- Monitoring and control of water quality for the entire territory of the Republic of Serbia;
- Establishment of network of measuring points for the purpose of monitoring the levels of ambient air pollution in sensitive and potentially threatened areas;
- Control of the implementation of sanitary protection in water source protection areas;
- Soil quality monitoring through soil pollution control;
- Establishment of network of measuring points for the purpose of noise level monitoring; and
- Permanent control of facility location planning and development.

All abovementioned parameters should be monitored in relation to indicators given according to environmental receptors which are shown in Table 1, as well as pursuant to laws and by-laws for certain environmental aspects mentioned in points 5.2.1–5.2.6. In addition to the above, monitoring of the implementation of planning protection measures defined within the SEA is also of particular importance.

5.2.1. Water Quality Monitoring System

The Annual Water Quality Monitoring Program is the main document for water quality management. Pursuant to Art.108 and 109 of the Law on Waters („Official Gazette of the Republic of Serbia“, No. 30/10), the Program is defined by ordinance of the Government promulgated at the beginning of each calendar year for the current year. The Program is implemented by the republic organization responsible for hydrometeorological activity and includes monthly, weekly or daily measurement in or observation of watercourses, reservoirs, water sources of special importance and one-off annual sediment quality investigations, as well as annual groundwater explorations. Through the implementation of the Plan, it is

necessary to specify an obligation of extending the network of observation points and determine competencies for implementing additional obligations of water quality monitoring.

The monitoring of hydraulic structures from which water is used for water supply is carried out by institutions for health protection having territorial competence (at the municipal level, where there is one), while the extent and type of the monitoring are adapted to the schedule of the realization of planning solutions related to water supply. It is necessary to increase the number of points/profiles in the observation network in mountain regions in which water is sampled and its quality tested.

5.2.2. Ambient Air Quality Monitoring System

The assessment and monitoring of air quality are aimed at controlling and identifying levels of air pollution, as well as at analyzing air pollution trends, in order to take a prompt action to reduce air pollution to the level that will not significantly affect the environmental quality.

The Law on Environmental Protection ("Official Gazette of the Republic of Serbia", 135/04, 36/09 and 72/09 – 43/11-Constitutional Court):), Law on Air protection („Official Gazette of the Republic of Serbia“, 36/09) and the Ordinance on Monitoring Conditions and Air Quality Requirements („Official Gazette of the Republic of Serbia ", No. 11/2010 and 75/10) provide a legal foundation for ambient air monitoring. Standards and methods for air monitoring are specified by the Regulation on Immission Limit Values, Immission Measurement Methods, Criteria for Setting up Measurement Points and Data Recording ("Official Gazette of the Republic of Serbia" No. 54/92, 30/99, 19/06), which was adopted pursuant to the Law on Environmental Protection.

The systematic measurements include inorganic particulate matter (sulfur dioxide, soot, suspended particulates, nitrogen dioxide, ground-level ozone, carbon monoxide, hydrogen chloride, hydrogen fluoride, ammonia, and hydrogen sulfide), settleable particles, heavy metals in suspended particulates (cadmium, manganese, lead, mercury, copper), volatile organic compounds (Carbon disulfide, acrolein, etc.), and carcinogenic particulate matter (arsenic, benzene, nickel and vinyl chloride).

Furthermore, the Regulation also specifies matters and episode pollution for which air quality warning is issued, frequency of sampling, as well as limit values for air pollutants. Pursuant to the Law, the Government establishes two-year ambient air monitoring programs. According to the Program, systematic measurements of air pollutant emissions are carried out on the given location and within a local network of air monitoring stations. Taking into consideration the type and character of planning solutions and anthropogenic and natural features in the planning area, as well as assessed small or negligible effects of these solutions on the air quality, it is considered that occasional or seasonal measurements of emission values for larger settlements and settlements along main roads will be satisfactory. The Program will be realized by the Republic Hydrometeorological Service and competent district institutes for health protection.

5.2.3. Soil Quality Monitoring System

The soil-quality monitoring intended for agricultural production is specified by the Law on Agricultural Land ("Official Gazette of the Republic of Serbia" No. 62/06 and 65/08). It includes soil quality testing to determine the concentration of harmful and hazardous matter in

soil for agricultural uses and irrigation water. It is carried out according to the program which is adopted by the Minister responsible for agricultural affairs. The soil quality testing can be carried out by qualified legal entities (enterprises, companies, etc.) authorized by the competent ministry.

The Minister also prescribes allowable concentration of hazardous and harmful matter in soil, as well as testing methods. The time frame for adopting bylaws is two years following the adoption of the above mentioned law. Until then, the Regulations on Allowed Concentration of Hazardous and Harmful Matters in Soil and Irrigation Water and Methods of Their Investigation ("Official Gazette of the Republic of Serbia" No. 23/94) will apply.

Fertility control of agricultural land and amount of applied mineral fertilizes and pesticides is carried out if necessary, but at least once in five years. The control can be carried out by a registered, authorized and qualified legal entities, while costs shall be borne by users or owners of agricultural land. The soil test report contains mandatory recommendations for the type of fertilizers to use and best methods for improving chemical and biological soil properties.

The protection of agricultural land, as well as agricultural land quality monitoring, is a mandatory element of the agricultural base, whose content, method and adoption is governed by Articles 5-14 of the Law on Agricultural Land. The same Law also envisages the strategic environmental assessment of the agricultural base.

Monitoring of soil erosion, particularly washouts and accumulation of materials by action of water, is an important instrument for a successful protection both of agricultural land and of forestland and other types of land, which was included in the Law on Agricultural Land and Law on Forests as an implicit obligation, while in the Law on Environmental Protection as a general obligation.

5.2.4. Emissions monitoring

In their methodological postulates, most of the monitoring systems discussed herein are based on measurements and observations of air pollutant *emissions* or *their effects* without considering their sources, i.e. causes.

The Law on Integrated Environmental Pollution and Control ("Official Gazette of the Republic of Serbia" No. 135/04 and 36/09) sets forth an obligation of monitoring the emissions/effects in their source as an integral part of documentation for obtaining an integrated permit for the plants and activities which have negative effects on the environment and human health. This is regulated by enactments of the Government (Regulation On Types of Activities and Installations for which Integrated Permit is to be Issued - "Official Gazette of the Republic of Serbia", No. 84/05), Decree on Content of the Program of Measures for Adapting the Existing Installation and Activities to the Prescribed Conditions ("Official Gazette of the Republic of Serbia", No. 84/05), Decree on the Criteria for Determining the Best Available Techniques for Implementation of Quality Standards and for Determining Emission Limit Values in an Integrated Permit ("Official Gazette of the Republic of Serbia", No. 84/05), or the act of Minister responsible for environmental protection (Regulation on the Content and Methods for Keeping the Register of Issued Integrated Permits - "Official Gazette of the Republic of Serbia", No. 69/05).

The integrated permit, which is issued by the authority responsible for environmental protection (at the national, provincial or municipal level – depending on which authority grants a building permit) also contains a monitoring plan to be implemented by the *operator* (legal or physical entity which operates or controls the plant, etc.).

5.2.5. Noise Monitoring

The noise monitoring is carried out through the systematic measurement, evaluation or calculation of certain noise indicators, pursuant to the Law on Environmental Noise Protection („Official Gazette of the Republic of Serbia", Nos.36/09 and 88/10) and other bylaws:

- Decree on Noise Indicators, Limit Values, Method for Assessment of Noise Indicators, Disturbance and Harmful Environmental Impact of Noise („Official Gazette of the Republic of Serbia", No.75/10);
- Rulebook on Acoustic Zone Methodology („Official Gazette of the Republic of Serbia", No. 72/10);
- Regulation on the Methods for Noise Measurement, Content and Scope of the Noise Test Report („Official Gazette of the Republic of Serbia", No. 72/10);
- The questionnaire of the Regulation which must be filled in by an organization qualified for noise measurement, as well as documentation accompanying the request for obtaining noise measurement authorization („Official Gazette of the Republic of Serbia", No. 72/10);
- Rulebook on Contents and Methods Governing the Preparation of Strategic Noise Maps and Method of their Presentation to the Public („Official Gazette of the Republic of Serbia", No. 80/10).

The noise monitoring data are an integral part of the uniform information system pursuant to the law governing environmental protection.

5.2.6. Natural resource monitoring

The main objective is to establish a biodiversity monitoring system, i.e. to monitor natural habitats and the population of wild flora and fauna, primarily vulnerable habitats and rare, endangered species, but also the condition of landscape features and the state of geoheritage objects and their changes. The mentioned monitoring is a direct responsibility of the Institute for Nature Conservation of Serbia and the Provincial Institute for Nature Protection in Novi Sad respectively, which is carried in accordance with medium-term and annual programs for natural resources protection.

The general monitoring of natural values must be carried out at least once a year, while individual biodiversity monitoring activities are organized if necessary, i.e. in cases of unexpected changes which can have significant negative effects. Monitoring is carried pursuant to the Law on Nature Protection („Official Gazette of the Republic of Serbia", Nos.36/09 and 88/10 and correction 91/10) and related bylaws.

5.3. Rights and Obligations of Competent Authorities

The rights and obligations of competent authorities related to environmental monitoring stem from the Law on Environmental Protection, i.e. Articles 69-78 of the Law. Pursuant to the

mentioned articles of the Law, the rights and obligations of competent authorities are the following:

1. The Government shall adopt monitoring programs for the period of two years;
2. Local self-government units shall adopt monitoring programs for their territories which must be in accordance with the program of the Government;
3. The Government and local self-government units respectively shall provide financial resources for monitoring;
4. The Government shall establish criteria for determining the number and distribution of measurements points, network of measuring points, scope and frequency of measurements, classification of monitored phenomena, methods of work and indicators of environmental pollution and monitoring, data delivery time frame and methods;
5. Monitoring can be carried out only by authorized organizations. The Ministry shall set detailed requirements which authorized organizations must meet, as well as designate authorized organizations upon prior consent of the Minister responsible for the specific field.
6. The Government shall specify the types of air emissions and other phenomena which shall be subject to pollution monitoring, as well as methods of measurement, sampling and recording, and data delivery time frame and methods;
7. Organs of state, organizations and local self-government units, authorized organizations and the polluters, shall be obliged to submit data arising from monitoring to the Serbian Environmental Protection Agency in a prescribed way;
8. The Government shall set contents and method of maintaining the information system, the methods, structure, common databases, categories and levels of data collection, as well as contents of information which shall be regularly and mandatory provided to the public;
9. Information system shall be maintained by the Serbian Environmental Protection Agency;
10. Minister shall set methodology for integrated cadastre of polluters, as well as the type, methods, classification and time frame of data delivery;
11. The Government shall submit annual environmental reports to the National Assembly;
12. Competent local self-government authorities shall submit environment reports for their territories to the assembly once in two years;
13. Environmental reports shall be publish in official gazettes of the Republic of Serbia and local self-government units respectively.

Pursuant to the Law on Environmental Protection and other regulations, the state organs, local self-government units, authorized and other organizations are obliged to timely, completely and objectively inform the public about the current state of the environment, i.e. phenomena which are subject to emissions monitoring, as well as about warning measures or pollution which may pose threat to the life and health of people. Furthermore, pursuant to the same Law, the public has the right to access to prescribed registries or records containing associated information and data.

6. OVERVIEW OF THE USED METHODOLGY AND PROBLEMS ENCOUNTERED IN CARRYING OUT STRATEGIC ENVIRONMENTAL ASSESSMENT

6.1. Methodology for undertaking the SEA

The purpose of the SEA is to facilitate a timely and systematic consideration of possible environmental impacts at the level of strategic decision-making for plans and programs, taking into account the principle of sustainable development.

The SEA has gained in its importance after the adoption of the EU Directive 2001/42/EC on the effects of certain plans and programs on the environment (with its implementation since 2004), while in Serbia, after the adoption the Strategic Environmental Impact Assessment (with its implementation since 2005).

Considering that experiences in the SEA implementation have been insufficient so far, there are plenty of problems to be solved. In the strategic environmental assessment of plans and program, the following two approaches are currently in use:

(1) Technical approach: represents an extension of methodology for environmental assessment impact also to the plans and programs of small spatial coverage where there is no a complex interaction between planning solutions and concepts in which principles of SEA can be used; and

(2) Approach to strategic planning: requires an essentially different methodology for the following reasons:

- Plans are much more complex than projects. They address strategic issues and have less detailed information on the environment and processes and projects which will be implemented in the planning area. Due to this, it is difficult to assess impacts that will occur in the process of planning documents at lower hierarchical level of planning;
- Plans are based on the concept of sustainable development and, in addition to environmental issues, they also address social and economic issues to a greater extent;
- Sophisticated mathematical methods of simulation are not applicable due to the complexity of facilities and processes, as well as cumulative and synergistic effects in the planning area;
- Parties concerned, the public in particular, have greater degree of influence over decision making, thus the used methods and assessment results should be more understandable to the participants in the environmental assessment process, as well as presented in a clear and simple way.

For the mentioned reasons, expert methods are most frequently used in the practice of strategic environmental assessment, such as: control lists and questionnaires, matrices, multi-criteria analysis, spatial analysis, SWOT analysis, Delphi method, evaluation of ecological carrying capacity, cause-and-effect analysis, environmental vulnerability assessment, risk assessment, etc.

Graphs and/or matrices are created to show results of each the methods used. They are used to explore environmental changes which could be caused by the implementation of plans/programs and selected alternatives. Graphs and/or matrices are created by establishing

the relationships between objectives of the plan, planning solutions and SEA objectives, to which associated indicators are assigned.

Specificities of environmental conditions related to the subject assessment are reflected in the fact that the assessment has been carried out as a SEA with the aim to assess objectives of the Energy Sector Development Strategy of the Republic of Serbia and identify characteristics of possible impacts, as well as set guidelines for reducing environmental negative impacts to the level of acceptability.

The content of strategic environmental assessment and, to some extent, also the basic methodological approach are specified by the Law on Strategic Environmental Impact Assessment and the Law on Environmental Protection.

The methodology used in the subject SEA has been developed and supplemented over the last 15 years in Serbia. It is based on recent approaches to and instructions for carrying out the SEA used in the European Union[4, 5, 6]. The evaluation methodology and the method developed within a scientific project under title of „Methods for strategic environmental assessment in planning spatial development of lignite basins" were used. The project was made by the Institute of Architecture and Urban & Spatial Planning of Serbia from Belgrade and financed in the period between 2005 and 2007 by the Ministry of Science and Environmental Protection of the Republic of Serbia.

Methods whose values have been confirmed in European countries were taken as a basis for developing the abovementioned method. The used methodology is based on multi-criteria for quantitative evaluation of the environmental, social and economic aspects of the development in the Strategy area, immediate and wider environment, as a basis for the valorization of the area for further sustainable development.

In the context of general principles of the methodology, SEA was carried out based on previously defined initial elements of the program (content and objectives of the Strategy), initial basis and current state of the environment. A significant part in the analysis was dedicated to:

- The assessment of the current state of the environment, on the basis of which environmental planning guidelines can be given;
- Qualitative analysis of possible effects of planned activities on the basic environmental factors which also served as basic indicators;
- The analysis of strategic determinants on the basis of which environmental guidelines for the implementation of the Strategy, i.e. for determining the scope of the environmental evaluation of the area for further development, are defined.

The value of the used approach has been confirmed in over forty SEA that have been carried out in the country and aboard for different hierarchical levels of planning. Some of the results are presented in highest-ranking international scientific journals (Renewable Energy Journal, Environmental Engineering and Management Journal, etc.).

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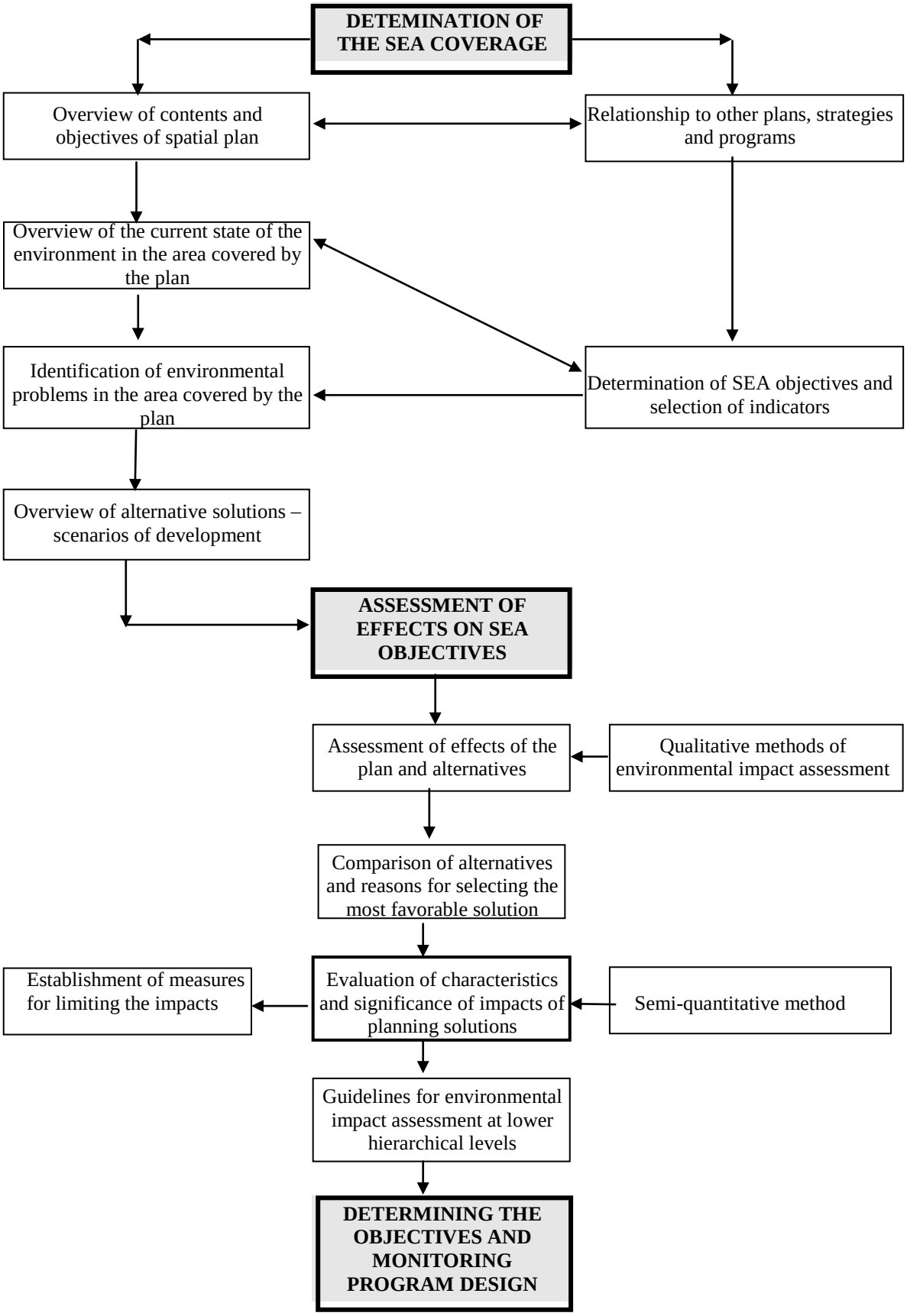
[4] A Source Book on Strategic Environmental Assessment of Transport Infrastructure Plans and Programs, European Commision DG TREN, Brussels, October 2005

[5] A Practical Guide to the Strategic Environmental Assessment Directive, Office of the Deputy Prime Minister, London, UK, September 2005

[6] James E., O. Venn, P. Tomilson, Review of Predictive Techniques for the Aggregates Planning Sector, TRL Limited, Berkshire, UK, March 2004

Figure 6.1. Procedural and methodological framework for carrying out the SEA



6.2. Difficulties in undertaking the SEA

The lack of a uniform methodology for carrying out such type of assessment has necessitated special efforts in order to carry out analysis, assessment and evaluation of strategic commitments in the context of environmental protection and to use an appropriate model for making an strategic document for environmental protection.

Besides, an important problem lies in the fact that an environmental information system, or even spatial information system, does not exist in Serbia, neither there exists a system of indicators for environmental assessment which are appropriate to the strategic planning process.

The similar situation exists with criteria for the evaluation of selected indicators. For this reason, it was decided to select indicators from "CSD Indicators for Sustainable Development" in accordance with the Instructions issued by the Ministry of Science and Environmental Protection in February 2007. This set of indicators is based upon the concept of cause-effect-response. Indicators of cause denote human activities, processes and relationships affecting the environment, indicators of effects denote the state of the environment, while indicators of response define strategic options and other responses aimed at changing "consequences" for the environment.

The problem which refers to the Strategy for which SEA is undertaken lies in the fact that strategic guidelines contained in the Strategy are not based on concrete investments which are certain, but on plans and assumptions. In this context, precise locations for individual energy facilities which will be built in accordance with the Strategy are unknown. Due to this, it was not possible to carry out environmental impact assessment in relation to specific capacities, technological processes and environmental quality on micro-locations, but only to give guidelines for environmental protection which are based on possible impacts that are generalized. Still, they are good basis for the implementation of sustainable development policy in the realization of the Strategy. It would be possible to carry out a detailed evaluation and assessment of possible impacts only in setting the Strategy through programs for its implementation, as well as through actions plans.

The Draft Strategy June 2013 and collected and updated available environmental data for the territory of the Republic of Serbia are the basis for undertaking the SEA.

7. OVERVIEW OF DECISION MAKING METHODS

Adequate and transparent inclusion of parties concerned (investors, competent organs of state, local administration, non-government organizations, and population) in decision making process related to environmental protection issues at higher levels in relation to the current practice of formal organization of public debates on the Draft Strategy is of special importance due to importance of possible negative and positive effects of the proposed Strategy on the environment, human health, social and economic status of local communities.

The Law on Strategic Environmental Impact Assessment (Art.18) provides for the participation of authorities and organizations concerned which can submit their opinion within 30 days from the date of the receipt of the request for opinion.

The authority competent for preparation of plans/programs shall provide for the public participation in the strategic assessment report consideration prior to submission of request for granting the approval for the strategic assessment report (Art.19). The authority competent for the preparation of plans/programs shall inform the public about the method and deadlines for insight into the content of the report and submission of opinions, as well as about the time and venue of public debate organized in accordance with the Law regulating the procedure for adoption of plans and programs.

Competent authorities and organizations shall be provided for the participation through written forms and through presentations in all stages of considering and carrying out the strategic assessment. The participation of the public concerned and non-government organizations shall be provided through public media and public presentations.

The authority competent for the preparation of plans/programs shall make the Report on the Participation of Interested Authorities and Organizations and the Public Concerned which shall contain all opinions on the SEA, as well as opinions submitted during the public insight and public debate. The Strategic Assessment Report shall be submitted together with the report on professional opinions and public debate to the authority competent for environmental protection for evaluation. The evaluation shall be carried out according to criteria specified in Annex II of the Law. On the basis of the evaluation, the authority competent for environmental protection shall approve the strategic environmental assessment report within 30 days from the receipt of the request for evaluation.

After collecting and processing all opinions, the authority competent for the preparation of plans/programs shall submit the draft strategy together with strategic assessment report to the authority competent for decision making.

8. OVERVIEW OF CONCLUSIONS OF THE STRATEGIC ENVIRONMENTAL ASSESSMENT REPORT

Strategic environmental assessment is a decision support process that ensures full integration of objectives and principles of sustainable development in the Strategy, taking into account a need to avoid or limit negative effects on the environment and human health and well-being in the Republic of Serbia.

Strategic environmental assessment carried out for the Energy Sector Development Strategy of the Republic of Serbia included an analysis of the current state of the environment with special view of areas affected by activities in the field of energy, importance and characteristics of the Strategy, characteristics of effects of planned priority activities, as well as other environmental protection problems, according to criteria for identifying possible significant environmental impacts. In this process, a predominant planning approach which was used was the one which considered trends which can result from activities in the field of energy sector, as well as scenarios of energy sector development.

The used methodological approach to carrying out the SEA was based on defining the objectives and indicators of sustainable development, as well as on a multi-criteria evaluation of planned priority activities of the Strategy in relation to defined SEA objectives and associated indicators. In this context, it is especially important to emphasize that SEA is the most important instrument in the implementation of principles and objectives of sustainable development in a planning process. This means that SEA has not addressed only environmental protection (although favorizing it), but also socio-economic aspect of development, so that the SEA objectives have been defined in this context.

Within the SEA, 21 objectives of sustainable development and 33 indicators for evaluating the Strategy sustainability were defined. Indicators were selected from the UN set of indicators of sustainable development and tailored to the need of making the subject document. This set of indicators was based on the Principle of Cause and Effect and on identification of response which allowed for the minimization of environmental problems. In the processes of multi-criteria evaluation, 29 strategically important priority solutions were included, which were evaluated according to the following set of criteria:

- Impact magnitude;
- Spatial extent of possible impacts; and
- Impact probability.

The matrices were formed in which multi-criteria evaluation of defined priority activities (29) was carried out in relation to established criteria/indicators (21/33) and environmental impact assessment criteria (15). The matrix results were shown in graphs for each planning solution separately. The results obtained in this way were shown in a simple and understandable way. This was followed by the assessment of cumulative and synergistic effects of priority activities in relation to the fields of strategic environmental assessment.

The results of the evaluation indicated the fact that Strategy implementation would have a considerable number of strategically significant both positive and negative environmental impacts.

Negative environmental impacts are identified as an unavoidable consequence of development and the use of natural potentials of the Republic of Serbia upon which future energy sector development should inevitably be based. This primarily implies: the construction of new thermal power plants and, consequently, opening of new coal open-pit mines, which, to a great extent, increase environmental load from the aspect of pollution of basic environmental factors; changes in the view of landscape and in biodiversity; as well as social implications which manifest themselves in displacement of settlements from areas in which opening of new coal open-pit mines and expansion of the same, is planned. Although most of the above mentioned adverse impacts are of local character in terms of their spatial extent, certain impacts were also evaluated as strategically significant because they manifest themselves at regional and/or national levels.

Certain negative implications are also expected as the result of the construction of the "Bistrica" hydroelectric power plant and/or construction of the "Djerdap 3" reversible hydropower plant, which will have negative effects on hydrological regime of watercourses on which their construction is planned, as well as on biodiversity and ichthyofauna, and which may lead to change in the use of agricultural and forest lands.

Possible strategically important impacts of transboundary character were singled out considering that they are beyond the spatial framework of the Strategy. In this context, adverse impacts are identified as a consequence of the implementation of the proposed project in the transboundary belt, i.e. the project which may cause internationally significant impacts. In this context, in addition to Strategy priority activities associated with the construction of the RHPP "Bistrica" and/or construction of RHPP "Djerdap 3", the following projects were also singled out:

- Wind farms – possible significant adverse impacts on internationally protected flying fauna (ornithological fauna and chiropters);
- Micro-hydro plants on transboundary watercourses – possible adverse impacts on benthic organisms and ornithological fauna.

In the context of possible transboundary impacts, As a signatory to the Espoo Convention and Kiev Protocol, the Republic of Serbia has bound itself to inform other countries about proposed projects which may have transboundary impacts. In the Espoo Convention Environmental Impact Assessment in a Transboundary Context, the transboundary impact is defined as "any impact not exclusively of a global nature, within an area under the jurisdiction of a Party caused by a proposed activity the physical origin of which is situated wholly or in part within the area under the jurisdiction of another party". The Espoo Convention requires that if the proposed activity is found to cause significant adverse transboundary impact, the Party, i.e. the Government of the Country undertaking the activity shall, for the purposes of ensuring adequate and effective intervention, notify any other party (other Country's Government) which it considers may be affected by the activity as early as possible and no later than when informing its own public about the proposed activity.

The construction of a greater number of hydroelectric power plants or smaller hydro-power plants on the same watercourse is identified as an especially important issue in the context of possible cumulative impacts on the environment. In the Chapter 4 of the SEA, which refers to guidelines for lower hierarchical levels of planning, the preparation of specific planning documents and carrying out of SEA are envisaged for such interventions in space so as to comprehensively consider in a wider context the negative effects of these interventions on the environment.

Other identified adverse transboundary impacts were not evaluated as strategically significant because they would not significantly increase environmental pollution load.

On the other hand, a whole series of positive strategic impacts were identified, out of which the most significant ones include the following:

- Environmental quality: reduction in water, air and soil pollution and reduction of greenhouse gas emissions by increasing the use of renewable energy sources and using the clean technologies in thermal power plants in accordance with Directive 2001/80/EC on the limitation of emissions of certain pollutants into the air from large combustion plants and Directive 2010/75/EU on industrial emissions (integrated pollution prevention and control) for new projects; withdrawal of all thermal power plants of generating capacity less than 300MW (TENT A1 and A2, Kostolac A1 and A2, Morava and Kolubara thermal power plants, Panonnian combined heat and power plants) in the period from 2018 to 2024; the implementation of a set of energy-efficiency measures will contribute to more rational energy use, i.e. to reducing the production of required amount of energy for the same amount of required energy; development of legal standards in accordance with international obligations and EU regulations and their implementation through an improved institutional framework, thus creating preconditions for reducing the pollution;

- Socio-economic development: energy sector development as a contributor to economic growth; the market-oriented formation of energy prices and prices for energy-generating products; the development of domestic industry and commercial scientific-research sector for the transfer of leading edge technologies in the field of energy; strict implementation of energy-efficiency measures in final energy consumption; labor market mobility; as well as overall energy sector development, will represent a long-term contribution to sustainable economic development and rational use of non-renewable energy sources, i.e. to increasing the share of energy from renewable resources.

Environmental protection guidelines were established which should be implemented to prevent and limit the negative effects of the Strategy on the environment in order to maintain positive effects of planning within frameworks which will not increase environmental load, and minimize and/or prevent possible negative effects of planning solutions. A monitoring system was established as an instrument for monitoring the implementation of planned activities and the status of each environmental factor separately.

In addition, from the aspect of environmental protection and cost-effectiveness in the energy sector, it is necessary to insist on the implementation of scenarios which include the implementation of energy-efficiency measures, which were, within the SEA, considered much more favorable relative to the reference scenario ("business as usual").

Summarizing all above mentioned, as well as results of evaluation of possible effects of the Strategy on the environment and elements of sustainable development, the conclusion of the Strategic Environmental Assessment Report is that the Strategy and SEA have analyzed possible effects of the proposed special-purpose use of the subject area and suggested necessary guidelines to ensure that the planned activities would be directed towards the least possible effects on the environmental quality, which is, indeed, in the function of achieving the objectives of sustainable development both in the Republic of Serbia and in neighboring countries.