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## NATURAL LIGNITE RESOURCES IN KOSOVO AND METOHILJA AND THEIR INFLUENCE ON THE ENVIRONMENT

### **Abstract**

*The objective of this paper is to point out the significance of the natural lignite resources in the region of Kosovo and Metohija and to consider their influence on the environment of the said part of the territory of the Republic of Serbia. The region of Kosovo and Metohija is extremely rich in lignite. It makes up 76% of the total coal reserves in Serbia and it is the third biggest region in Europe regarding the coal reserves. Lignite is burned in the existing thermal power plants in Kosovo and Metohija, and the construction of the additional blocks is being planned at the moment. Lignite reserves are so immense that on one hand they enable the energy independence, but on the other hand the overall negative impact of reliance on lignite must be taken into account, especially since the existing thermal power plants operate according to the out-dated environmental standards, producing large emissions of air pollutants (harmful gases resulting from lignite combustion in thermal power plants) that have negative impact on health. In order to reduce the environmental pollution that such thermal power plants create, operating of the said power plants needs to be adjusted to the stricter standards in compliance with the legal requirements and the Industrial Emissions Directive of the European Union.*

**Keywords:** lignite, natural resources, energy independence, environment, environmental standards

### **1 INTRODUCTION**

The region of Kosovo and Metohija is rich in mineral resources. Its energy resources and non-ferrous metal resources represent a considerable potential for the overall development. Not all parts of Kosovo and Metohija are equally rich in mineral raw materials. Mineral deposits represent a true natural basis for development of industry, i.e. economy as a whole. Some of the most important resources are lignite, minerals of lead, zinc, silver and gold, silicate minerals of nickel and cobalt, iron – bauxite, manganese and magnesite. Moreover, there are also significant amounts of the non-metallic, industrial minerals and geological construction materials. Specified mineral resources and

their rational exploitation, combined with a good management approach, represent a solid basis for quick and sustainable economic and social development.

All kinds of the existing resources that the country has at its disposal make up a foundation for planning and implementation of development and energy strategy. Each of the specified resources has bigger or smaller resource potential, but planning and strategic exploitation are insufficient. That is why it is necessary to define the accurate sector policies and strategies and to select the proper mechanisms for their implementation. Regarding Serbia, this goal is extremely difficult to realize at this moment because the region of the Auto-

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nomous Province of Kosovo and Metohija is the UN protectorate and subject to the Resolution 1244. In fact, at this moment, Serbia as a country does not have any mechanisms that could be used to protect those natural mineral resources from exploitation. On the other hand, the interim institutions in Kosovo and Metohija do everything in their power to use those resources for their own development. Pursu

ant to any natural and international law, including resolution 1244, the mineral resources of Kosovo and Metohija should stay in Serbia. Since Serbia has been exposed to double standards by the developed Western countries that recognized the unilateral independence of the AP of Kosovo and Metohija, the so called independent state of Kosovo was given the opportunity to exploit all of the mineral resources.



Figure 1 Mineral resources in Kosovo and Metohija [1]

## 2 LIGNITE RESERVES IN KOSOVO AND METOHIJA

Lignite reserves are by far the most abundant among mineral resources in the region of Kosovo and Metohija. There are still no accurate estimates of the amount of lignite in the region of Kosovo and Metohija. According to the Serbian scientists, Nikolic and Dimitrijevic [2], lignite reserves in the Kosovo, Metohija and Drenica basin are 7.35 billion tons (Bt). Out of the specified

amount, only 1.6 Bt in the Kosovo basin are economically exploitable, while 4.8 Bt are non-exploitable (as well as 0.7 Bt in the Metohija basin, and 0.25 Bt in the Drenica basin). As for the thickness of exploitable seam, it is the biggest in the Kosovo basin (24-60 meters) than in the Metohija basin (36-40 meters) and than in the Drenica basin (5-18 meters). Only in the Kosovo basin,

the thickness of overburden is smaller than the thickness of lignite seam. In the Metohija basin, this overburden thickness is 2.5 times bigger than the thickness of lignite seam. Bigger overburden thickness implies more expensive lignite exploitation and, consequently, smaller profit, i.e. lignite-based wealth of the region. The average overburden to lignite ratio in the Kosovo basin is 1.3 m<sup>3</sup>/t and 2.4 m<sup>3</sup>/t in the Metohija basin

On one hand, it is positive that there are large amounts of lignite, but on the other hand the negative factor implies high contents of moisture and ash (because of gangues) and increased contents of toxic microelements of Ni and Cr in lignite, enriched in the thermal power plants smoke, so this lignite represents an important but law-budget raw material for exploitation and production of electric energy that pays off only with minimal transport or exploitation on the site. [3]

According to the data of interim institution, the Ministry of Economic Develop-

ment, the estimated lignite resources on entire territory of Kosovo and Metohija are 12.4 Bt. [4]

In Rainer Hengstmann's report from 2004, the Independent Commission for Mines and Minerals of Kosovo, regulated by the UNMIK, published that the World Bank estimated the mineral reserves of Kosovo to be worth 13.5 billion euro. The most significant resource is lignite, with geological reserves of about 15 billion tons. [5]

This estimate is in line with the estimates by the experts from the Faculty of Mining and Geology in Belgrade who also estimated that the lignite potential in Kosovo would be sufficient to supply two thermal power plants, and to provide the electricity production in a hundred-year period which, according to the estimate of our Ministry of Mining and Energy from 2009, equals the value of 100 billion euro. Therefore, a major part of lignite reserves in the Republic of Serbia (over 76%) is located in the Kosovo-Metohija basin. [6]

**Table 1** Lignite reserves in Kosovo and Metohija [4]

Basin	Reserves		
	Geological	Balance reserves*	Off-balance reserves**
Kosovo	10.09	8.77	1.31
Metohija	2.24	2.04	0.19
Drenica	0.10	0.07	0.03
Total	12.44	10.89	1.54

\* Balance reserves are reserves in which thermal power of coal exceeds 5,450 kJ/kg

\*\* Off-balance reserves are reserves in which the thermal power is smaller than 5,450 kJ/kg

In one of its reports, the United States' CIA says that, according to the international standards, Kosovo is worth 500 billion dollars (estimated reserves of coal, natural gas and metal), and the remaining part of Serbia with Vojvodina only about 200 billion dollars. In line with one study mentioned in that report, the USA experts estimate that in Serbia there are coal reserves for maximum 35 to 40 years, while in Kosovo there is coal for as much as 16 centuries. Another study estimates that the

coal reserves in Serbia are sufficient for 60 years, and in Kosovo for 200 years. They point out that the value of localities of seven strategic ore (lead, zinc, silver, nickel, manganese, molybdenum and boron) was estimated to as much as 1,000 billion dollars. [7]

It could be concluded that there is enough lignite to last more than one century, even with the increased exploitation. Importance of lignite for the region of Kosovo and Metohija is supported by the

fact that the share of lignite in the total electric energy production is about 97%, while the hydroelectric power plants account for 3% of production. [8]

With the estimated lignite value of about 12[9] -15[7] Bt, Kosovo ranks as the third (after Germany and Poland) in Europe, and as the fifth in the world regarding the established lignite reserves.

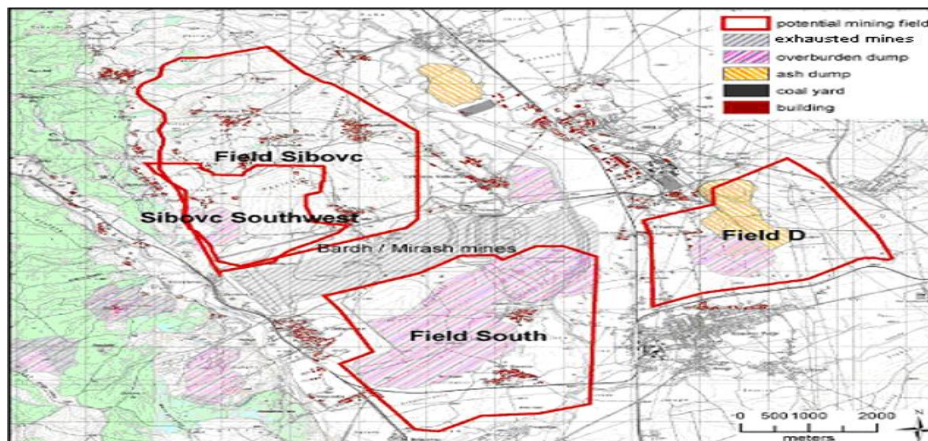
### 3 EXPLOITATION OF LIGNITE IN KOSOVO AND METOHILJA

The main energy sources in Kosovo are located in two major lignite basins known as the “Kosovo” basin and “Metohija” basin, with the usable lignite deposits. [10] The Kosovo basin covers the area of 274 km<sup>2</sup>, and Metohija basin the area of 49 km<sup>2</sup>, while the other basins cover 5.1 km<sup>2</sup>. [11]

The first systematized data on the lignite exploitation, i.e. small-scale lignite mining in the Kosovo basin, dates back to 1922. More extensive lignite production started with opening the open-pit mines Miras (1958) and Belacevac (1969), and

by application of modern excavators (diggers). Lignite exploitation in those open-pit mines, that represented one collective exploitation area, ended in 2012. The annual production capacity in both mines was 28,000,000 m<sup>3</sup> of gangue (solid mass) and about 17,000,000 tons of coal. Since 2010, coal has also been exploited from the so called “New Mine” (southwest of Sibovac), and this mine is in the final phase of development.

Among the lignite fields in Kosovo and Metohija, the Field Sibovac is the largest exploitation reserve. It comprises approximately 330 metric tons of exploitation reserves and has the smallest portion of overburden. The Field Sibovac covers the area of 16 km<sup>2</sup>, with maximal depth of 3.8 km and length of about 6 km. In addition to the new mine, the Sibovac Southwest, in which lignite has already being exploited, the plan is to start with exploitation of the southeast part of Sibovac field that has been explored, as well as with two alternative fields: Field D and Field South Sibovac. [12]



**Figure 2** Mining fields of lignite - Sibovac [12]

Figure above presents the potential mining fields of lignite (Field Sibovac, Sibovac Southwest, Field D and Field South), as well as the mines in which the exploitable

lignite has been depleted (Miras and Belacevac).

It is important to mention that the prospects of finding the new coal localities are

very favourable and realistic due to the good geological prerequisites. There are indications that there is coal in many other locations, especially in the south part of the Pec lowland, in the part of Djakovica and Prizren. Also, one of potential locations is the Neogene basin of Kriva Reka that represents a tectonic basin, formed in the cross-border area of the Dardani massif in the east, and Vardar zone in the west, whereby the thickness of coal seam in this region reaches 5 m. It would be reasonable to expect an intensification of explorations aiming at discovery the new lignite localities.

Taking into account the specified lignite amounts, it would be reasonable to expect that lignite, as an energy generating product, will continue to be the main source of energy in Kosovo and Metohija. With that in mind, it is necessary to:

- follow up the developments, in our neighboring countries and worldwide, related to the technology of clean combustion of lignite, intended for increased utilization in the industry and heating plants and economically justifiable from the social and environmental aspect;
- intensify the geological explorations in order to develop the strategy of lignite exploitation planning;
- apply an economically and environmentally justifiable procedure of lignite refinement in order to comply with the modern technological solutions for utilization of lignite in the industry and mass consumption. [13]

#### **4 THERMAL POWER PLANTS IN THE REGION OF KOSOVO AND METOHIIJA**

In the region of Kosovo and Metohija there are two thermal power plants: "Kosovo A" and "Kosovo B". The Thermal

Power Plant "**Kosovo A**" consists of five working blocks, known as the A1, A2, A3, A4 and A5. The Block A1 of this Thermal Power Plant was put into operation in 1962 with the power of 65 MWe; A2 in 1965 with the power of 125 MWe; A3 in 1970 with the power of 200 MWe; A4 in 1971 with the power of 200 MWe and A5 in 1975 with the power of 210 MWe. At the moment, the blocks A3, A4 and A5 are in operation. According to the current production plan, two blocks are in use (A3 and A5), while one of them (A4) is a hot reserve because of their low readiness and age. The Blocks A1 and A2 are non-functional and are without defined status and, according to the current plans, they will remain like that until the end, when their decommissioning is expected. The whole Thermal Power Plant "Kosovo A" is in a bad condition, and considered to be the worst single pollution source in Europe. The interim institutions in Pristina plan to decommission it, but it cannot be done until the sufficient amount of electricity has been provided, which is not feasible at the moment. The annual electric energy production from the Thermal Power Plant Kosovo A is around 1500 GWh. [14]

The Thermal Power Plant "Kosovo B" Block 1, built in 1983, is active (339 MWe) and so the Block 2, constructed in 1984 (339 MWe), and they both need a rehabilitation after being operational for 35 years in order to be aligned with the environmental standards of the European Union.

The total capacity of these two thermal power plants (Kosovo A and Kosovo B) amounts to 988 MWe. The plan is to have the thermal power Plant Kosovo C, with Block 1 (300 Mwe) and Block 2 (300 Mwe), built and put into operation until the end of 2018 [15].

**Table 2** Thermal Power Plants in the region of Kosovo and Metohija [15]

Thermal power plant name	Thermal power plant Kosovo A		Thermal power plant Kosovo B		Thermal power plant Kosovo C	
Block	Block 3	Block 5	Block 1	Block 2	Block 1	Block 2
Status	existing	existing	existing	existing	new*	new*
Operating since	1970	1975	1983	1984	2018	2018
Capacity MVe	200	210	339	339	300	300

\* Beginning the operation of the new plants is based on estimate



**Figure 3** Thermal Power Plants “Kosovo A” and “Kosovo B” [16]

According to the plan, the Thermal Power Plant Kosovo A will be decommissioned by the beginning of 2023, when the Thermal Power Plant Novo Kosovo, currently under construction, is expected to be put into operation, and after that, the Thermal Power Plant Kosovo B will undergo a rehabilitation. [17]

### 5 ENVIRONMENTAL POLLUTION BY THE THERMAL POWER PLANTS IN KOSOVO AND METOHIJA

In this part, the environmental pollution related to air emissions of pollutants, created by lignite combustion in thermal power plants in Kosovo and Metohija will be discussed. As it was already mentioned, 97% of electric energy production is based on lignite exploitation in Kosovo and Metohija. The first step in this process is a procurement of raw material for further processing and transformation. [18] Large amount of lignite makes possible a certain level of

energy independence on one side, while on the other side<sup>3</sup>, the negative effects of reliance on lignite must be taken into account. The Thermal Power Plants “Kosovo A” and “Kosovo B” operate according to the outdated environmental standards, thus producing the high emissions of harmful gases which, consequently, greatly affect the environment and human health. In order to reduce the harmful gases emission and, consequently, their negative influence, the Thermal Power Plant “Kosovo A” needs to be shut down (which is planned to be done until the end of 2023), while the Thermal Power Plant “Kosovo B” needs to be improved in order to comply with the new legal requirements based on the standards that are much stricter than those that are currently applied to the existing thermal power plants. Those new standards have been defined by the Industrial Emissions Directive (IED) of the EU. [19]

Regardless of the stricter standards, the negative consequences cannot be avoided

100%, but at least they can be reduced to a minimum that will not affect severely the environment and human health. If the quality of air in the region complies with the requirements, it does not mean that people who live in that region are fully protected from the influence of air pollutants from a certain source. Estimate of pollutant influence on the environment represents a subjective attitude and does not imply the absence of that influence. There are numerous studies of influence the air pollutants on health, both in our country and worldwide, according to which the risks are not limited to the areas in the imminent surrounding of the plants or other combustion objects, but extend to larger areas, sometimes several hundred kilometers away, because the said particles are transmitted by wind and end up deposited on the ground. These harmful substances bring about enormous environmental problems and are a threat to the human life and human health. [20] What can be done to reduce the harmful consequences of lignite combustion in the thermal power plants is to adjust them to the specified standards, and to increase the competitiveness of renewable technologies for the energy production in relation to the lignite exploitation and utilization in the thermal power plants.

By lignite combustion in the thermal power plants, the harmful particles (sulphur-dioxide SO<sub>2</sub>, nitrogen-dioxide NO<sub>2</sub> and particulate matter (PM)) are emitted, which

causes pollution of air. Influence of SO<sub>2</sub> and NO<sub>2</sub> is connected not only with exposure to the pollutants in the form in which they are emitted, but also to the products of their reactions, since they react with the other pollutants in the atmosphere forming the aerosol (ammonium-sulphate and ammonium-nitrate in particular) that contributes to the overall particulate loading of air. Nitrogen-dioxide also reacts with the volatile organic compounds in the presence of sunlight which results in production the increased levels of ozone, the other pollutant that is considered to be a threat to health. [15]. Other dangerous substances, emitted from flue-gas stacks of the coal thermal power plants, are heavy metals, e.g. mercury, and persistent organic pollutants such as dioxins and polycyclic aromatic chemicals. High emissions of mercury from the lignite-fired thermal power plants raise the special concerns about the health of children. [21]

The influence of air pollutants on health includes death due to the respiratory and heart problems, bronchitis, hospitalization and many other negative effects. Exposure to the open air contamination is associated with a large number of acute and chronic health conditions, ranging from irritation to death. [22]

Table below shows the annual number of cases of premature death in Europe that can be ascribed to the thermal power plants in Kosovo and Metohija.

**Table 3** Annual numbers of cases of premature death in Europe that can be ascribed to any plant operating with the capacity adjusted to the loading factor [15]

	Sulphur-dioxide	Nitrogen-dioxide	PM2.5*	Total
Kosovo A, block 3	17	11	21	49
Kosovo A, block 5	36	22	45	103
Kosovo B, block 1	53	38	18	109
Kosovo B, block 2	53	38	18	109
Total	159	109	102	370

\*PM2.5, fraction of "dust" with diameter smaller than 2.5 micrometers



The latest data, published in the HEAL report, show that the influence of harmful particles, produced by lignite combustion in the thermal power plants at the annual level round the European Union resulted in over 18,200 cases of premature death, around 8,500 cases of chronic bronchitis, and over 4 million days of absence from work. Economic costs of coal combustion impact on human health in Europe are estimated as 42.8 billion euro per year. [23]

In addition to the negative health consequences, the harmful effects caused by the air pollution by the lignite-fired thermal power plants have the financial consequences as well, regarding both population and the state. Monetization of the influence of lignite combustion in thermal power plants is related to several factors: additional health care costs resulting from the hospitalization, increased consumption of medicines, etc.; lost productivity of workers who take the sick leaves because they themselves are ill or to take care of ill family members and; loss of what is labeled as the “usefulness“ or “pleasure“ in economic literature due to the pain, suffering and reduced life expectancy. [15]

Due to everything aforesaid, the air pollution brought by the lignite combustion in the thermal power plants is being increasingly acknowledged as a considerable threat to the public health.

## CONCLUSION

If a country wishes to plan and realize the energy strategy, it should possess the energy resources. It is typical that the countries with larger reserves of energy resources have a higher level of energy independence.

The actual lignite reserves in Kosovo and Metohija are still not known as a fact. All lignite localities in Kosovo and Metohija are still not sufficiently known and have not been sufficiently explored. What is unknown known at the moment is that those reserves are so immense that owing to them Kosovo

ranks as the third in Europe and fifth in the world, regarding the amount of lignite.

The big world players have joined the battle for exploitation the Kosovo resources. In addition to the American companies, German, British, French and Turkish companies are also interested in investing into the mining localities and exploitation the natural resources of Kosovo. It is an interesting fact that the American company “Envidity”, run by a retired NATO general Wesley Clark, asked for a license to explore the coal reserves in order to be able to produce the synthetic oil from coal, with the production plan of 100,000 barrels of oil per day.

Lignite is the main energy source in Kosovo and Metohija. Its share in the total electric energy production is about 97%, while the hydroelectric power plants account for only 3% of production. Due to a large amount of lignite reserves, the situation is likely to remain the same in the period to come. According to the European Association for Coal and Lignite (EUROCOAL), coal will continue to be important as a factor among the energy generating products for a long time for the purpose of electric energy production, whose increasing needs are definite and will continue to grow. In order to meet the need for electric energy, it is necessary to modernize the existing and to apply the new, technologically innovative processes of obtaining lignite as an energy generating product.

Currently, there are two active thermal power plants in the region of Kosovo and Metohija: the thermal power plant “Kosovo A” (blocks A3, A4, A5) and thermal power plant “Kosovo “B” (block 1, block 2). These two lignite-fired thermal power plants emit thousands of tons of harmful pollutants every year, thus contributing to the air pollution considerably and not only in the region of Kosovo and Metohija, but in the Balkans region and farther, because the pollutants are transmitted by air to a greater distance. Operating of the said thermal power plants is characterized by the



outdated environmental standards, which contribute to creation the high levels of emission of pollutants that have numerous negative effects on the environment and human health. Therefore, it is necessary to revise the energy production plans in order to reduce the reliance on lignite and exclude it in the end and in order to increase investments into renewable energy sources.

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