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*Coal industry in transition:
state of affairs of coal mine closure in the selected UNECE member States -
challenges, lessons learned, ongoing projects, perspectives for the future*

SERBIAN COAL DEPOSITS AND COAL MINES AT ACTUAL TRANSITION TO GREEN AGENDA

**UNECE Group of Experts on Coal Mine Methane
Workshop on Mine Closure in Serbia and Albania
Tirana, Albania, 9 December 2022**

INTRODUCTION

□ PART ONE

- **Basic information of coal deposits of Serbia and electricity production**
- **Green agenda**

□ PART TWO

- **Underground coal mines at Public company Resavica (JPPEU Resavica) and basic parameters of coal production**

□ PART TREE

- **Strategic goal and stages of implementation of the adopted program of consolidation at JPPEU Resavica (2018)**
- **Program for the closure of the 4 mines (Vrška čuka, Bogovina, Jasenovac and Ibarski mine)**

PRESENT PRODUCTION OF ELECTRICITY IN SERBIA

- ❑ The public company "Elektroprivreda Srbije" (JP EPS) is the largest producer of lignite in the Republic of Serbia and this energy source is the largest source of electricity in the country

- 1. About **70 %** of electricity is obtained from the coal (open-pit and underground) used in the thermal power plants of EPS (<https://www.eps.rs/lat/poslovanje-ugalj>)

- 2. Hydroelectric power plants make up about **30 %** of the total electricity production of JP EPS, of which more than two thirds is production at HPP Đerdap. Apart from HPP Đerdap, EPS produces electricity in the branches of the Kladovo and Drina-Lim hydropower plants "Bajina Bašta" (<https://www.oie.rs>)

Wednesday, December 8, 2021. Minister Mihajlović: „Serbia to be a leader in the production of energy from renewable energy sources,OIE, the first auctions at the beginning of the year: "The goal is to have a minimum of 40 percent of energy obtained from renewable sources by 2040" (statement of the ex-minister; www.mre.gov.rs)

At the reception for Miners' Day, the President of the Republic of Serbia said: "Mining is an economic branch that will continue to grow, and not be extinguished as many outsiders would like. Energy security is important and Serbia will not follow world fashion trends in that area. We will follow the needs of Serbia", (<https://www.ekapija.com>; <https://www.blic.com>).

THE DECLARATION ON THE GREEN AGENDA 2020

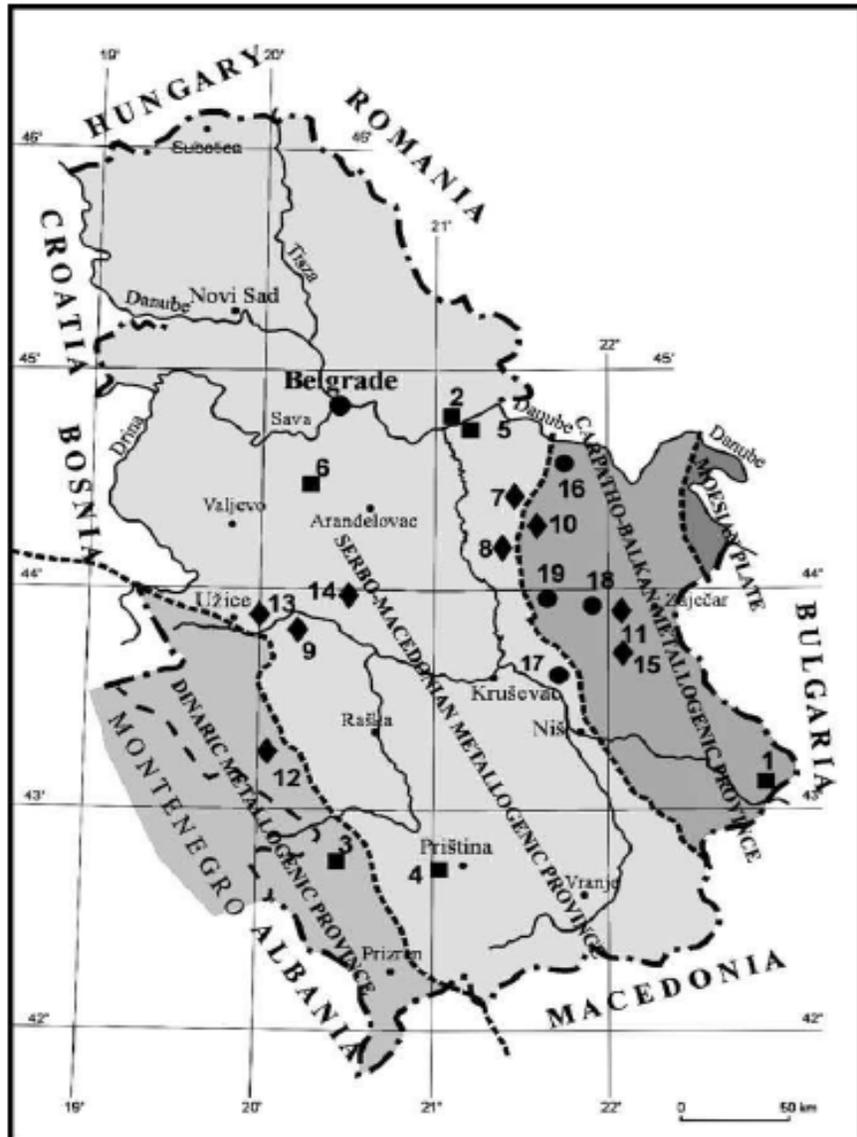
- ▶ **SERBIA SIGNED THE DECLARATION ON THE GREEN AGENDA AT THE SUMMIT OF WESTERN BALKAN COUNTRIES IN SOFIA IN NOVEMBER 2020**
- ▶ **THE DECLARATION PREDICTS THAT THE CANDIDATE COUNTRIES FOR MEMBERSHIP IN THE EUROPEAN UNION, AS WELL AS THE MEMBERS OF THAT COMMUNITY, WILL REDUCE THE USE OF FOSSIL FUEL AND THE EMISSION OF HARMFUL GASES (DECARBONIZATION) BY 2050**
- ▶ **IN THE SOFIA DECLARATION IT IS STATED: "THE CONTRACTING PARTIES COMMITTED TO WORK TOGETHER WITH THE EUROPEAN UNION TO MAKE EUROPE CLIMATE NEUTRAL BY 2050"**
- ▶ **SERBIA COMMITTED TO INCREASE THE SHARE OF ENERGY FROM RENEWABLE SOURCES, AS WELL AS TO PROVIDE THE NECESSARY CONDITIONS FOR INVESTMENTS IN THAT AREA**

Source: <https://jwww.ekapija.com/news/1970483/država-u-2018-daje-5-mil-eur-za-pocetak-zatvaranja-rudnika-resavica>

GEOLOGICAL COAL POTENTIAL OF SERBIA

Genetic-industrial classification of brown coals in Serbia

Marko Ercegovac a,*, Dragana Životić b, Aleksandar Kostić b DISTRIBUTION COAL DEPOSITITS



LEGEND:

--- Boundary of Metallogenic units
(modified, Dimitrijević, 2000)

■ Soft brown coal (Low-Rank C):

1. Mazgoš, 2. Kovin, 3. Metohija,
4. Kosovo, 5. Kostolac, 6. Kolubara.

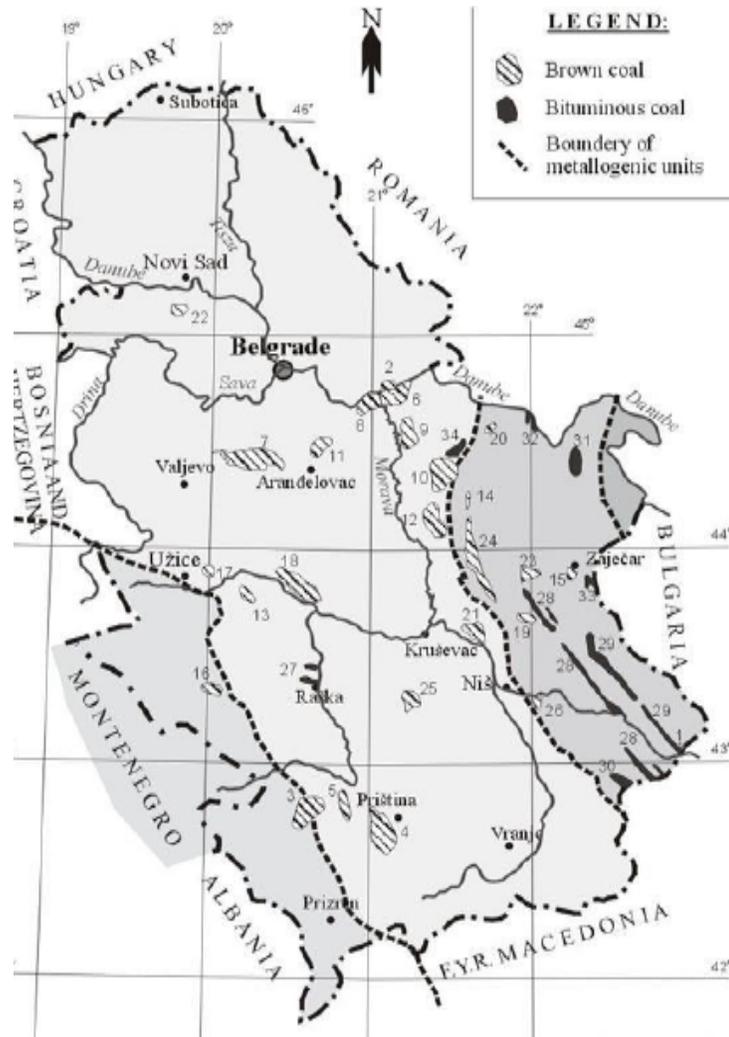
◆ Dull brown coal (Low-Rank B):

7. Mlava (Melnica deposit),
8. Despotovac,
9. Dragačevo (Tijanje deposit),
10. Krepoljin, 11. Lubnica,
12. Sjenica (Štavalj deposit),
13. Požega (Rasna deposit),
14. Zapadna Morava, 15. Soko Banja.

● Bright brown coal (Low-Rank A):

16. Zvižd (Derezna deposit),
17. Aleksinac,
18. Bogovina (East Field),
19. Senje-Resavica.

PUBLIC COMPANY FOR UNDERGROUND COAL EXPLOITATION (JP PEU) RESAVICA



1. Coal mine “VRŠKA ČUKA” (anthracite)
2. Coal mines “IBARSKI RUDNICI” (hard coal)
3. Coal mine “REMBAS” (brown coal)
4. Coal mine “SOKO” (brown coal)
5. Coal mine “ŠTAVALJ” (brown coal)
6. Coal mine “BOGOVINA” (brown coal)
7. Coal mine “JASENOVAC” (brown coal)
8. Coal mine “LUBNICA” (lignite)
9. Coal mines “ALEKSINAČKI RUDNICI”

COAL MINING

Method of exploitation of coal reserves

- ❑ **Column and chamber-column excavation methods are applied in all mines Construction of pit rooms is carried out by drilling and mining operations with manual loading of demined material**
- ❑ **Coal mining is carried out by drilling and mining operations with manual loading of demined material**
- ▶ **Coal is exported in a combined way: by conveyor belts and pit wagons**
- ▶ **Coal seams of different thicknesses are excavated: from 1.5M to 10m**

RISK MANAGEMENT

□ MINING-GEOLOGICAL CONDITIONS:

- ▶ Irregularities in the spread and occurrence of deposits, as well as fault zones in almost all the pits of our mines, often disrupt the realization of the planned production.
- ▶ The dangers of endogenous fires and submersion of underground production systems can also be classified here, as a result of which production can be interrupted for several months in certain parts and even in entire pits.

□ CLIMATIC CONDITIONS:

- ▶ Due to frequent and heavy rainfall (as was the case in the spring of 2014), it is not possible to organize production work at the Progorelica open pit, Ibarski coal mines

BASIC GEOLOGICAL AND MINING PARAMETERS OF COAL PRODUCTION IN JPPEU RESAVICA

(Source: 3 INFORMATION ON THE WORK OF JP PEU RESAVICA (www.jppeu.rs); R. Cvetičanin: Geology of coal, Faculty of Mining and Geology in Belgrade, 1972; Savic_DSGM (www.un.org), 2015: www.jppeu.rs)

Coal deposits/ Mine	Type of coal	Geology	Coal reserves (A+B+C ₁); (t)	Quality	Metan (Q _{rs} -relative; Q _{aş} = absolute)	Explosive coal dust	Produce (t/year End 2017)	Employers End 2016
Vrška žuka	anthracite	Productive horizon in Lower Liassic sediments (shale sandstones, clayey and quartz sandstones and coal seams)	2.276.678	7% Volatiles, ash 14%, S about 1%, moisture 2-3%, DTE >7000 kCal	Q _{rs} =8,93 m ³ CH ₄ /t Q _{aş} =0,147m ³ CH ₄ /min		5.002	125
Ibarski rudnici	Hard coal	Tertiary lacustrine coal basin, Miocene age, with three horizons (sandstones, conglomerates, argillites, clays, tuffs and coal beds)	1.211.588	-30% volatile, ash 12-40%, S 5-6%, DTE 6000 K/čal	Q _{rs} =0,025-0,245 m ³ CH ₄ /t Q _{aş} =0,008-0,079m ³ CH ₄ /min	✓	69.135	486
Rembas	Brown coal	Seni-Resava Miocene, lake coal basin: conglomerates, sandstones and red clays and sandstones,	7.429.150	Moisture up to 18%, ash up to 18%, S below 1%, DTE about 4500 k/čal		✓	169.010	1.172
Soko	Brown coal	Freshwater Tertiary series of the Sokobani coal-bearing basin (conglomerates, sandstones and argillaceous sandstones overlying Upper Cretaceous limestone)	50.935.724	Moisture -23%, ash 18%, DTE 4000k/čal	Q _{rs} =11,74 m ³ CH ₄ /t Q _{aş} =2,71m ³ CH ₄ /min	✓	83.277	539
Štavali	Brown coal	The Sjenica-Stavali basin represents a deep tectonic basin. The coal-bearing sediments are of Miocene age (M2,3) and consist of four characteristic lithological horizons.	185.001.495	Moisture 24.93%, S 0.98%, coke 51.26%, GTE 20638 kJ/kg		✓	85.125	460
Bogovina	Brown coal	Lake Oligocene; a narrow zone of tuffs, andesites and marls divided into the western and eastern part; one and two coal layer		Moisture 24.50%, ash 28%, S 2.23%, DTE 10948 kJ/kg			11.245	255
Jasenovac	Brown coal	Kučai - Beljanica autochthonous, Jurassic.Miocene	176.744	Moisture 22.79%, ash 11.40%, S 1.01%, DTE 16 871 kJ/kg		✓	33.800	263
Lubinca	Lignite	Freshwater tertiary basin formations: conglomerates, sandstones, argillaceous sandstones and clays: two layers	10.025.533	Moisture -35%, ash 14% TDe 3000 k/čal		✓	48.807	342
Aleksinac* * Not active		Lake basin of Miocene age (sandstones, clays, marls, shales)		Moisture -0%, ash 10%, S 3%, TDE 500-5500k/čal	Gas coal	9		268

Some basic data for a Study on mine closure in Serbia

INFORMATION ON THE WORK OF JPPEU RESAVICA ***(www.jppeu.rs)***

- ❑ **STRATEGIC GOALS AND STAGES OF IMPLEMENTATION OF THE ADOPTED CONSOLIDATION PROGRAM:**
 - To continuously raise the level of production in the Soko, Štavalj, Rembas and Lubnica mines, from the current 395,000 t/year to 600,000 t/year after the introduction of mechanization;
 - To begin intensive construction work on the Poljana mine, with a production capacity of over 700,000 t/year;

- ❑ **TO START A PROGRAM OF PLANNED CLOSURE OF MINES WHOSE COAL RESERVES EXHAUSTED, AT THE FIRST STAGE ONE COAL MINE**
- ❑ Increasing the volume of coal deliveries for TENT Obrenovac and TE Morava, up to the size of 80% of the quantities produced from underground mines;
 - To change the structure and reduce the number of employed non-production workers in the company to the optimal number;

MINES WITH SMALL REMAINING COAL RESERVES: CONSOLIDATION PROGRAM IN JPPEU (2018, ADOPTED)

PARTS OF INVESTMENTS - GOALS AND METHODS OF THEIR ACHIEVEMENT

- ▶ **FOR THE MINES WITH SMALL REMAINING COAL RESERVES: TADENJE, JARANDO, VRŠKA ČUKA, BOGOVINA AND SENJSKI MINE**
- ▶ concrete dynamic programs were created, which precisely defined:
 - the remaining life of the mine,
 - dynamic production plan,
 - dynamics of labor movement and necessary funds until the end of exploitation,
- ▶ **PROGRAMS FOR THE CLOSURE OF THE UNDERGROUND COAL MINES CHANGED AT PRESENT ENERGY CONDITIONS: ONLY JASENOVAC MINE IS THE FIRST AT THE PLAN**
- ▶ After the adoption of the program, the development of the Main mining closure projects will be started, which will define in detail the activities, dynamics, deadlines and necessary funds for closure.
 - Closure mines, and all in accordance with the Law on Mining and Geological Research ("Official Gazette of RS" number 101/15, 95/18 and 40/21), there are many challenges

GENERAL SITUATION REGARDING THE CLOSURE OF COAL MINES IN SERBIA AND PROBLEMS ARISING WITH THE PROCESS OF CLOSING THE MINES

▶ BASIC REASONS FOR CLOSING:

- Exhausted coal reserves or remaining small quantities, without potential for further development
- Unprofitable current exploitation of coal
- Outdated technique and technology of coal mining
- Safety risks of coal mining in current natural mining-geological conditions (mountain shocks and methane)

▶ BASIC CLOSURE PROBLEMS:

- Closing costs
- The safety of closing the mine and "conquering new activities for the survival of people, overqualified workers in that area" in the future,
- Solving the problems of the local community after the closure of the mine (water supply, electricity, road infrastructure that was destroyed during coal mining and transport, redundant workers, retraining of workers, development of other profiles of workers)
- Monitoring the condition of environmental factors
- Geochemical monitoring around mine and conversion for the purpose of future land use
- Rehabilitation of the field surface, costs and persons responsible for rehabilitation...

- **THE GLOBAL IMPACT OF TRANSITIONAL AND POLITICAL PROCESSES IN ENERGY SECTOR OF STATE ON COAL EXPLOITATION; PROCURMENT, PRODUCE AND PRICE OF ENERGY; POSSIBILITY CHANGING THE PROGRAM OF USING NATURAL RESOURCES-A-COAL IN THE NEWLY CREATED CONDITIONS,...**

EXAMPLE OF THE EARLIER PLAN OF CLOSING OF THE BOGOVINA COAL MINE

04SER01/06/004-SUSTAINABILITY, MINE CLOSERS AND SOCIAL MITIGATION MEASURES, DEUTSCHE MONTAN TECHNOLOGIE GMBH,
10/24/2005 ([source:http://europa.rs](http://europa.rs) › upload › documents)

❑ RATIONAL FOR CLOSURE

- Limited coal reserves-without potential for development
- No potential to introduce mechanization and increase productivity-difficult mining condition and very poor quality and products

❑ PROPOSAL FOR CHECKING THE REMAINING COAL POTENTIAL BY DRILLING IN THE EXPLOITATION AREA BEFORE IMPLEMENTING THE CLOSURE PLAN

❑ CLOSURE PROCEDURE

- ▶ Closure procedures will commence following decision of proper authorities (Company Management and Ministry of Mining and Energy)

- ▶ Issues connected to closure of the mine are:

- Legal and financial issues
- Physical closure issues
- Environmental issues (coal dumps: self-ignition of coal, dust emission,...) and
- Social mitigation issues

❑ PHYSICAL CLOSURE

- ▶ Physical closure of the mine starts with development of technical documentation regarding:
- ▶ Disassembly and recovery of underground equipment, including steel support
- ▶ Isolation of all mine accesses – backfilling of shafts and construction of concrete slabs on shafts entries and construction of isolation dams on drifts entries
- ▶ Demolition of surface facilities and Rehabilitation and reclamation of mine industrial estate

Conclusion:

- 1. Closure is the only real option regardless of the cost.**
- 2. Geology and working conditions are such that there is no hope of achieving sustainable performance.**

GENERAL CONCLUSIONS

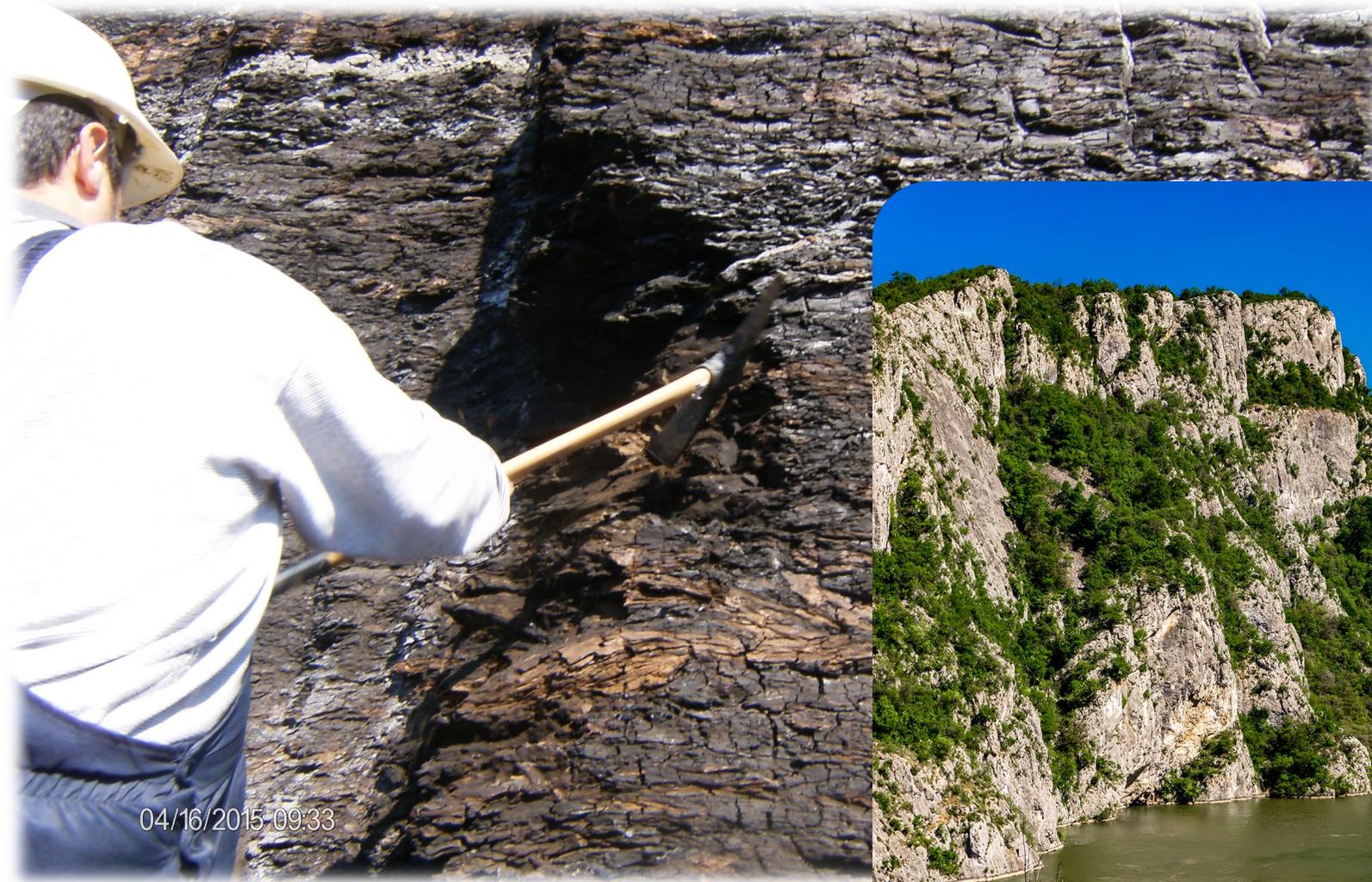
- 1. In JPPEU Resavica, the program for the closure of 4 coal mines with underground exploitation where all coal reserves were mined was adopted in 2018, but and at the moment plan is changed, Jasenovac mine is the first at plane**
- 2. The reasons for the closure are the lack of coal reserves (they were exhausted during exploitation), the existing bad geological and mining working conditions, and the impossibility of introducing new mechanization for mining the remaining reserves, and the impossibility of profitable business**
- 3. Before closing the mine, it is necessary to carry out appropriate geological exploration (by drilling) of the coal deposits in question, in order to check and re-evaluate the current geological data or discover new quantities of coal in the exploitation area**
- 4. The closure of the mine (as well as the opening of the mine) is carried out in accordance with the provisions of the Law on Mining and Geological Research (Official Gazette of RS No. 101/15, 95/18, and 40/21) and other acts**
- 5. Mine closure, i.e. permanent suspension of work, is carried out according to the legally prescribed mining technical documentation**
- 6. The Governement and Ministry of Mining and Energy of the Republic of Serbia are responsible for mine closure**
- 7. The impact of global energy supply conditions on the adopted state program of consolidation at public company, and the plan of closure coal mines**

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Thank you for your attention!

Questions?



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