SWOT Analysis of Romanian Coal Resources in the Context of Ensuring Energy Security

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Abstract: - A safe and secure coal industry gives a strong energy industry and economy. Just in this way Romania can become a good and strong strategic partner with powerful energy states from all over the world. Thus, energy security becomes one of the most important pillars of Romanian security. For a secure energy industry, Romania needs strategic energy resources and highly specialized human resources, and Romania has a key role creating stability and security factors for the supply of energy resources that are quantified by coal. The authors consider that the security supply with coal of Romania is a strictly national and European security issue because the lack of coal can cause enormous damage to the European industry and economy, which are almost entirely dependent on coal-energy resources. But EU policy is contrary to this energy resource which is coal, but most EU countries are dependent on this. If coal mining is stopped, the EU may enter into energy insecurity, which is very harmful to the current security environment. The SWOT analysis of the security supply with coal to the National Energy System, comes in the context in which the possibility of a black-out is very likely, and the lack of coal can cause major damage through enormous financial losses, which through the domino effect can spread economic and Romanian insecurity. In this context, the analysis of the security supply with coal becomes an essential issue of European security and makes this paper of real interest.

Key-Words: - SWOT analysis, safe, secure, industry, economy, coal resources, energy security.

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1 Introduction

In the new context of global security, coal, which is energy strategic resource plays among the most important roles in the position occupied by Romania and its role in the system of international relations, in the context of ensuring national, European, and global energy security.

Lack or precariousness of energy resources (coal) of less energy and economically developed countries, they has led to the amplification of games on their side and have allowed some energy dependencies in terms of energy security control.

Under these conditions, energy security is no longer just an objective of foreign policy, but has become a solid and constant concern for the international energy community, in the context of ensuring national, European and global security. To prevent a collapse of the European Energy System, each European state must have energy security strategies and secure its energy resources or critical power infrastructures that facilitate the population's access to energy resources, an important factor in European security.

These energy security strategies are developed only by preventive assessing the level of

vulnerability of critical energy infrastructures and the security of energy resources supply, by identifying all risks, threats, and vulnerabilities with energy insecurity effect. The EU has assessed the supply of energy resources, but the authors also come to the aid through a more intrinsic analysis, analyzing all possible coal supply routes and the effects that can be generated in the event of an energy collapse, [1].

SWOT analysis is the most important technical and managerial analysis on understanding and knowing the strategic position of an organization, industry or national economy and has the following objectives: *the detailed knowledge of threats, risks and vulnerabilities and the possibilities to counter them related to energy organizations, industry and the national economy; development opportunities of national energy organizations, industry and economy; the safety and security level of the national industry and economy; the real state of the national economy and economic security; the recommendation of strategies that ensure the best alignment between the internal and external environment and choosing the right strategy for adapting strengths to opportunities, minimizing risks and eliminating weaknesses.*

SWOT analysis on energy resources (coal) becomes an extremely important and essential thing and shows the exact situation of the state of national energy security, how to supply other missing energy resources and ways forward in the event of an energy crisis. These energy security strategies are developed only by SWOT analysis to know the strengths, weaknesses, opportunities and threats of energy resources, which ensure stability and energy security, [2].

2 History of Coal and Description of Primary Energy Resources (Reserves)

2.1 History of Coal

Century XIX – Coal, through its importance and the multitude of its uses, transforms the quiet Jiu Valley into the main source of raw materials, so necessary for the development of railway and naval transport - on the Danube, the energy and steel industry. The development of the coal deposits discovered here marks the beginning of the industrial and technical revolution, which is rapidly penetrating the young mining industry, which is becoming more and more pronounced in the coal basin on the two Jiuri. The Hungarian underground, as well as some large companies financed by the Hungarian bank capital, which is under the control of the German, French, Belgian and English banks, have focused on the great underground wealth.

1840 – Baron Victor Maderspach, the heir to large estates in the Jiu Valley, discovers the outcrops of coal on the bottom of the valleys in his estate. Urged by the economic capitalization of his discoveries, he used the services of brothers Karol and Rafael Hoffman, mine owners at Rusca Montană and mining specialists, who came to the Jiu Valley to study geologically the existence and possibility of exploiting the discovered coal deposits. Against the protectionist background created by the Austro-Hungarian state, the brothers Hoffmann and Karol Maderspach started the surface exploitation of the coal deposit from Vulcan, Petroșani, and Petrila.

1854 – The initiators of the Jiu Valley Mining have joined the "Transylvania-West Mining Company".

1857 – The mines of this company were bought by the "Brasov Mining and Furnace Joint-Stock Company", which, being financially supported by Wiener Bankverein, the Commercial Bank of Pest, Deutsche Bank and Banque de Paris et Pays-Bas, became the fourth largest producer of cast iron. EMPIRE.

1865 – The first acquisitions of mining perimeters in the Jiu Valley of the Austrian state. The company from Brașov expanded its possessions, buying coal and iron deposits and forests in addition to mining, also building smelters and the railway Simeria - Petroșani (1867 - 1870), extended in 1867 to Petrila.

1879 – The state mines, no longer able to compete, were leased for 27 years by the "Brașov Mining and Furnace Corporation".

1885 – The Germans Iosif Ritter and G. Gerbert founded the "Coal Mine Company of the Upper Jiu Valley", based in Vulcan and with some possessions in the northern part of the basin, in Dâlja, Iscroni and Vulcan and others in the western part in Uricani and Neag's field. The company operated until 1930 when it was absorbed by the "Petroșani Society".

1890 – The "Jiu - Uricani Coal Mining Joint Stock Company" with Hungarian private capital was established, which undertook the construction of the Petroșani - Lupeni railway and leased the mining perimeters located along the railway under construction.

1891 – By associating with a series of French capitalists, supported by the bank "Credit Lyonnais", the company changed its name

becoming "The joint-stock company of mines and coals from Uricani-Valea Jiului", based in Lupeni.

1899 – Together with the German company "OberschlesicheKokswerke", was founded the "Cricket Company of Uricani-Jiu Valley", built 1900 the first coke shop in the area, which supplied the kilns in Călan.

1894 – "Salgotarjan Coal Mining Joint Stock Company", financially supported by Wiener Bankverein, bought all the mines and leasing rights of the Braşov Mining and Furnace Joint Stock Company.

1920 – The Romanian joint-stock company "Petroşani" was set up, consisting of two large groups of shareholders: the group formed by the former joint-stock company "Salgotarjan" together with Banque Comerciale Hongroise and a group of 19 large banks.

1924 – A group of 12 Romanian banks, together with the company "Uricani-Valea Jiului" formed the Romanian Joint Stock Company "Lupeni".

1926 – The "Lonea Coal Company" was founded, and owned by the Romanian state.

1928 – Due to the economic crisis, the closure of some mines began: Lonea I (1928), Lonea II (1931), and Dâlja and Vulcan (1931).

1931 – On May 29, the "Petroşani" and "Lupeni" companies merged under the name "Petroşani" Mining Company. At Petrila, a modern preparation was built, with a capacity of 270 tons/hour, which was considered one of the largest in the world.

1949 – On August 20, by the Decree Law published in the Official Gazette no. 54, the ROMANIAN - SOVIET SOCIETY ON SHARES "SOVROMCĂRBUNE" was established with its headquarters in Bucharest, the General Directorate of Sovromcărbune moves its headquarters to Petroşani, based on order no. 8477.

1952 – Several trusts are set up: 1. The Petroşani Coal Trust (to which the Petrila mine also belonged); 2. Lupeni Mining Trust; 3. Petroşani Mining and Construction Constructions Trust; 4. Anina Coal Trust; 5. Câmpulung-Muscel Coal Trust; 6. Petroşani Mining Equipment Repair Plant (URUMP); 7. Petroşani Geological Research Division; 8. Vulcan Power Plant.

1953 – The company SOVROMCĂRBUNE is liquidated, and the Romanian part, on April 1, 1954, took over the management of the subordinated enterprises, the final liquidation being made on June 1, 1954.

1956 – On September 14, by Order of the Ministry of Mines, the Valea Jiului Coal Plant was established, which operated from October 1, 1956 to April 1, 1969.

1969 – On April 1, the Valea Jiului Coal Plant becomes the "Petroşani Coal Plant", and from August 1977 "Valea Jiului Mining Plant".

1991 – Following the abolition of the CMVJ, the Romanian Autonomous Coal Authority is established and an extensive restructuring/reorganization process begins.

1994 – Lonea Pilier Mining ceases operation.

1998 – On November 20, Regia was transformed into the "National Coal Company SA - Petroşani", on which occasion the mining operations in Banat were detached and the Petroşani Electronic Computing Center.

1999 – Câmpu lui Neag and Petrila Sud Mining Operations ceased their activity.

2003 – Dâlja Mining has ceased its activity.

2004 – Valea de Brazi Mining Exploitation ceased its activity.

2006 – Aninoasa Mining ceased its activity.

2012 – On November 26, the National Mine Closure Company Valea Jiului SA was established - Romanian legal entity with full state capital, sole shareholder of the Romanian state through the Ministry of Economy, having the legal form of a joint stock company and operating in accordance with Romanian laws, [3] [4].

2.2 Description of Primary Energy Resources (Reserves)

The main primary energy resources were, in 2017, 34 291 tons, of which (Table 1), [5]

- 21303 tons from domestic production;
- 12987 tons from import.

Table 1. The main primary energy resources for 2017

Resources of primary energy	TOTAL Tons of oil equivalent	From which:		Mix [%]
		output intern	import	
Coal	5164	4654	510	15
Crude oil (oil)	11175	3421	7754	32
Natural gases	9282	8337	944	27
Energy: - hydroelectric; - nuclear power; - solar; - imported electricity.	5203	4889	314	15
Petroleum products (import)	-	-	2985	8
TOTAL	34291	21303	12987	-
Source: National Institute of Statistics (www.insse, 2024)				

Romania has a balanced and diversified energy mix, according to Table 2, [5].

Table 2. Situation of National Primary Energy Resources

Primary energy carrier resources	Resources		Reserves		Estimated annual production		Insurance period with resources and reserves	
							resources	reserves
	million tone [1)]	million met	million tone [1)]	million met	million tone [1)]	million met	years	years
Lignite	690	124	290	52	25	4.5	28	12
Coal	232	85	83	30	0.8	0.3	290	104
Crude oil (oil)	229.2	-	52.6	-	3.4	-	67.4	15.5
Natural gases	726.8	-	153	-	10.5	-	69.2	14.6
Uranium [2)]	-	-	-	-	-	-	-	-

[1)] - exclusively natural gas expressed in billions m ^{3} ; [2)] - data (classified).
(source: National Agency for Mineral Resources) (www.insse, 2024)

Coal is the primary energy resource in the energy mix, being a strategic fuel in support of national and regional energy security. In extreme weather conditions, coal is the basis for the resilience of the energy supply and the proper functioning of the National Energy System, covering one-third of the electricity needs.

Lignite resources in Romania are estimated at 690 million tons (124 million toe), of which 290 million tons (52 million toe) can be exploited in concessioned perimeters. At an average resource consumption of 4.5 million tone/year, the degree of insurance with lignite resources is 28 years, provided that in the next 25 years the consumption will remain constant and no other deposits will be valued. of lignite.

The average calorific value of lignite mined in Romania is 1800 kcal / kg. As the lignite deposit in Oltenia consists of 1-8 layers of exploitable coal, their superior recovery requires the urgent adoption of regulations that guarantee rational exploitation in conditions of safety and efficiency, with minimal losses. The known coal resources in Romania are 232 million tons (85 million toe), of which 83 million tons (30 million toe) can be exploitation in concessioned perimeters.

At an average consumption of reserves of 0.3 million toe / year, the degree of insurance with coal resources is 104 years, but the exploitation of this primary energy resource is conditioned by the economic feasibility of the exploitations. The average calorific value of coal mined in Romania is 3650 kcal / kg, [5].

3 SWOT Analysis of Coal Resources

3.1 Hard Coal

Table 3 (Appendix) is a SWOT analysis of hard coal, [6], [7].

While hard coal remains a part of Romania's energy landscape, its long-term viability is challenged by high costs, environmental concerns, and EU decarbonization goals. The transition toward renewable energy and alternative industries is crucial for ensuring economic stability and energy security in the future.

3.2 Lignite

Table 4 (Appendix) is SWOT analysis for lignite, [8], [9], [10].

Lignite plays a crucial role in Romania's energy mix but faces increasing environmental, economic, and regulatory challenges. The industry must adapt by modernizing operations, exploring alternative uses, and transitioning to sustainable energy solutions.

4 Conclusion

Because coal (hard coal and lignite) is a strategic energy resource, in the context where there are no hydrocarbon resources, our safety and security elements for those who own, control, exploit, distribute and/or use them, they can generate conflicts or energy wars, which is characterized by the use of energy instruments to compel the adversary to change his policy or behavior, or to undermine the capacity of that state to maintain normal relations with other states, in times of peace or war, which may be: customs barriers, embargoes, boycotts, royalties, blockades, takeovers and mergers, espionage, naval piracy, economic-energy terrorism, etc. [1], [7].

Without coal the entire economy can collapse, because almost all industry and the european economy depend on these indispensable elements, although EU policy is unfavorable and any short circuit in the European energy market, is a danger to energy security and therefore energy security is an important component of the European security and foreign policy strategy.

For this reason, coal (hard coal and lignite) is often used as instrument of political and economic pressure in order to gain some strategic advantages on the complex and dynamic stage of international relations, where some states or economic groups in power, use this energy weapon to set some strategic goals.

In this context, the SWOT analysis of the security supply with energy resources (coal) becomes an essential issue of European security and makes this paper of real interest.

The authors consider that the security supply with coal of the EU is strictly national for every country and a European security issue because the lack of energy resources can cause enormous damage to the European industry and economy, which are almost entirely dependent on energy resources.

To ensure energy security, Romanian decision-makers need to create energy stability factors in order to combat energy poverty, and vulnerable consumers and ensure energy security through the following actions, [2], [8].

- reducing energy dependence by ensuring the minimum need for energy resources for underdeveloped or developing countries;
- protection of national and European critical infrastructure for the transport of energy resources to ensure continuity of supply and prevent energy collapse;
- exploring new energy sources of coal; new critical energy infrastructures;
- development of renewable energy sources; introduction of clear and transparent energy efficiency measures;
- rationalization of energy use: electricity;
- coal, natural gas; oil; fuel, etc. stopping the exodus abroad by energy specialists (ultra-qualified human resource);
- place major investments in the energy research and development segment; development of specialization courses for energy sector personnel;
- increase the salaries for the human resources in the energy sector;
- improving working conditions.

All these actions must be carried out by the state through its mechanisms for ensuring strong energy security, and in this context, national energy security is in fact European and regional security.

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APPENDIX

Table 3. SWOT analysis for hard coal

STRENGTHS	WEAKNESSES
• The geological reserve existing in the coal basin Jiului Valley covers the internal consumption of Romanian coal for a period of about 100 years, thus contributing to ensuring Romanian energy security; • The existence of infrastructure necessary for the extraction, processing and transport of coal which is concentrated in a restricted geographical area; • The existence of the need for quantitative and qualitative specialized personnel, especially in disadvantaged areas with many unemployed miners; • The extraction technologies used in the Jiu Valley are suitable for the geological-mining characteristics of the coal layers; • Small distances to Paroseni Thermal Power Plant, the main beneficiary; • Paroseni Thermal Power Plant is designed to work with solid fuel having the qualitative parameters of the hard coal from the Jiu Valley; • Paroseni Thermal Power Plant can be provided with the necessary amounts of energy coal, at the proper quality of its own needs and at a lower price than that of imported coal; • Relative price stability compared to oil and natural gas; • Strategic hard coal reserves can play an anti-segmental role, a fact underlined by the European Commission in the context of the European Union's inability to negotiate energy prices and put pressure on these markets; • The high share of transport costs in imported coal prices (about 50% of the price of energy coal imported into Europe and Japan), which pleads for the use of coal from the Jiu Valley.	• It is uncompetitive and economically inefficient; • Difficult geological extraction conditions; • Relatively low heat output, high sulfur content; • Requires large storage spaces; • Generates pollution at every stage of the production and use cycle; • The exploitation of the hard coal contributed to mono-industrialization, generating major social problems; • Low mining productivity (under 300 tonnes/person/year) below the world level; • Advanced, physical and moral wear of extraction and preparation equipment; • All the exploitations are underground with great problems regarding safety and health at work, due to the imminent danger of explosion of gas from the field and coal dust, this causes fatal or serious work-related accidents, collective or individual, and occupational diseases (silicosis); • Unit production costs consistently exceed coal delivery prices by about two times; • Jiului Valley is facing serious social problems due to the lack of solutions to the problems of the redundant personnel; • The exploitation of the coal is heavily subsidized from the state, the removal of subsidies at present would amount to the disappearance of mining from the Jiu Valley.
OPPORTUNITIES	THREATS
• The introduction of modern technologies in the hard coal-based extractive industry that will help increase efficiency and lower extraction and preparation costs; • Investments in high-performance mining, which lead to lower costs and increased environmental protection; • Sustainable social and regional restructuring policy, in line with European Union rules; • The Jiu Valley Energy Complex allows the development of a network of small and medium-sized enterprises to provide it with goods and services; • Maintaining the diversity of energy sources (given external risk factors) as the best guarantee of the security of energy supply, given that current forecasts suggest the impossibility of stopping the growth of EU dependence on the outside.	• European Union policy (2024), which is detrimental to coal, and may lead to its disappearance; • The abundance of coal resources worldwide and the great geopolitical diversity of supply; • Calorific value less than liquid or gaseous hydrocarbons; • The average production costs of European coal, are 3-4 times higher than in the world market, and in this context European coal cannot compete with that of the main exporters: USA, Australia, South Africa, Colombia; • Diversity of outside suppliers; • The stability of the price of imported coal compared to other energy products, coal being traded on a competitive international market; • Flexibility of concluded contracts and development of the spot market, which allowed the price of coal to adapt permanently to the situation on the international market; • The lack of any economic or political risk and the opening up of the international market on the supply side, which explains the minor price differences compared to hydrocarbons; • Restriction of mining activity in the Jiu Valley, in order to increase efficiency, which triggers negative social effects and burdens the State Budget, and funds are needed for social protection and professional reconversion; • International trade in marine coal, which plays an important role in supplying the world market with coal.

Table 4. SWOT analysis for hard coal

STRENGTHS	WEAKNESSES
• The exploitation of lignite is cost-effective and does not require state subsidies; • The high volume of lignite reserves (can cover national domestic consumption for a period of about 60 years), contributing to ensuring the energy security of the country; • The technologies used are at the level of those used worldwide; • Constant demand for lignite for the operation of the thermal power plants within Oltenia Energy Complex; • Successive programs of restructuring, modernization, efficiency and social accompaniment applied; • Elasticity and adaptability of Oltenia Energy Complex structures; • The existence of infrastructure investments and the provision of qualified personnel for the exploitation of 1.2 billion tonnes of lignite, in conditions of economic efficiency, this means at the level of the current application a period of more than 50 years; • The physical productivity of labor has been steadily increasing; • Relative price stability compared to oil and natural gas.	• The location of lignite deposits below the hydrostatic level is necessary to lay down and excavate 10 m^3 water/tonne of coal; • The large volume of tailings to be excavated for quarry extraction (8-10 sterile m^3/tonne of coal); • Relatively low calorific value, high sulfur content; • Requires large storage spaces; • Technical wear of the equipment; • Lack of financial resources necessary to modernize technological flows; • Relatively low capacity utilisation; • Social responses to efficiency programs; • Generates pollution at every stage of the production and use cycle; • Low productivity of exploitations (about 700 tons/person/year at underground exploitations and about 1500 tons/person/year at quarries), located below the world level.
OPPORTUNITIES	**THREATS**
• The introduction of modern technologies in the lignite extractive industry, which will help increase efficiency and lower extraction and preparation costs; • Investments in high-performance mining, which lead to lower costs and increased environmental protection; • Sustainable social and regional restructuring policy, in line with European Union rules; • The Oltenia Energy Complex allows the development of a network of small and medium-sized enterprises to provide it with goods and services; • Maintaining the diversity of energy sources (given external risk factors) as the best guarantee of the security of energy supply, given that current forecasts suggest the impossibility of stopping the growth of EU dependence on the outside.	• European Union policy that is detrimental to coal; • The abundance of lignite resources worldwide and the great geopolitical diversity of supply; • Calorific value less than liquid or gaseous hydrocarbons; • The average production costs of European coal, are 3-4 times higher than in the world market, and in this context European coal cannot compete with that of the main exporters: USA, Australia, South Africa, Colombia; • Diversity of outside suppliers; • The stability of the price of imported coal compared to other energy products, coal being traded on a competitive international market; • Flexibility of concluded contracts and development of the spot market, which allowed the price of coal to adapt permanently to the situation on the international market; • The lack of any economic or political risk and the opening up of the international market on the supply side, which explains the minor price differences compared to hydrocarbons; • Restriction of mining activity in Oltenia, in order to increase efficiency, which triggers negative social effects and burdens the State Budget, and funds are needed for social protection and professional reconversion; • International trade in marine coal, which plays an important role in supplying the world market with coal.

Contribution of Individual Authors to the Creation of a Scientific Article (Ghostwriting Policy)

- Gheorghe Eugen Safta presented in the introduction and conclusions the importance of coal resources (hard coal and lignite) in the economic and industrial circuit of Romania and the major role they play in ensuring energy security and essential action to create energy stability and security and to combat energy poverty.
- Nicolae Daniel Fita carried out the SWOT analysis of the hard coal and lignite resources on the Romanian territory and developed strategies by strengths, weaknesses, opportunities and threats.
- Sorin Mihai Radu outlined the history of coal in Romania, especially the Carboniferous Basin in the Jiu Valley, which is very rich in coal resources.
- Florin Gabriel Popescu carried out he importance of coal resources in electricity generation for ensuring energy security.
- Mila Ilieva Obretenova was responsible for the descriprion of primary energy resorces (reserves) from table 1 – The main primary energy resources for 2017 and table 2 – Situation of national primary energy resources.

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Conflict of Interest

The authors have no conflicts of interest to declare.