

COAL IN THE FUTURE OF ROMANIAN ENERGY

Dumitru FODOR, Tiberiu TROTEA***

1. Introduction

Considering the use of primary energy resources in time, we notice that in the 19th century coal was used as a main resource, in the 20th century oil replaced coal, while in the 21st century we expect gas and renewable energy resources to be dominant.

Although exploited and used for centuries, the current quantity of coal known today – over 900.000 million tons – represents 90% of the fossil fuels compared to only 5% oil and 1% gas.

Coal remains, owing to its quantity and quality, an important global energy reserve and, if capitalized efficiently, will serve mankind for a long time in the future.

The National Energy Strategy, currently under public debate, regards the operation, modernization and development of the energy system, having as targets for years 2030-2050 the providing of the energy required by the national economy and the observing of the limits imposed by the European Union through the recently adopted Energy Strategy, which stipulates:

- A 40% reduction of greenhouse gas;
- The share increase of renewable energy to 27% within the total consumption of electric energy;
- A 27% increase of the energy efficiency as compared to 1990.

2. Energy resources in Romania

In Romania the current and future energy resources are:

- Fossil fuel resources (coal, oil, gas);
- Nuclear resources;
- Hydropower resources;
- Renewable resources (wind, photovoltaic, biomass, etc.).

Romania owns a significant number of energy resources, including gas, oil and coal. The current exploitable deposits of gas are over 180 billion m³, exploitable oil represents over 70 million tons, while exploitable coal represents over 100 million tons of black coal and about 1,300 million tons of lignite and brown coal.

Today, Romania deals with a transition period towards the increasing use of renewable energy resources. Romanian coal remains an essential source for the energy stability, but its use has to face two issues: coal costs and the need for

reducing the amount of CO₂ discharged through burning gas into the atmosphere.

These issues lead consequently to the increased tendency of using renewable energy resources with a lower polluting degree, which, nonetheless, display, at their turn, two major issues:

- The discontinue and uneven production of energy
- The lack of large scale methods, economically and technically efficient, for storing the energy, which guarantee the capacity of providing energy during several weeks.

Due to these major problems, two systems of energy supply for the national energy system are required: a system of thermoelectric plants, continually available, and a system of energy supply from wind and photovoltaic sources.

In 2014 the production capacity of the National Energy System represented 24.5 GW, of which 21.1 GW available energy, as follows:

- Coal thermoelectric plants	5.16 GW
- Gas thermoelectric plants	3.65 GW
- Hydroelectric plants	6.74 GW
- Nuclear plants	1.41 GW
- Renewable energy	4.13 GW

The production and use of electric energy from renewable resources needs flexible and stable partners, which, in Romania, are represented by energy groups that use coal or other fossil fuels.

The increase of national energy demand can be carried out in a short time, based only on classic fuels and, consequently, hence the need to maintain the coal exploitations and plants which use these fuels in order to overcome such shortcomings.

The necessity of transition towards the renewable energy production is valid, but should be done according to a long term plan. The transformation of energy supply in Romania can only be controlled by coal. Therefore, the Romanian Energy Strategy should pay more attention to coal.

In 2015 Romania produced 47.5 TWh and the energy production structure was as follows:

28% coal	13.3 TWh
27% hydro	12.8 TWh
18.5% nuclear	8.5 TWh
13% gas	6.2 TWh
11% wind	5.23 TWh
2% photovoltaic	0.9 TWh
1% biomass	0.4 TWh

While analyzing the mining sector with a view to supporting energy production, we used the

* Prof. Ph.D eng., University of Petroșani

** Ph.D eng., Oltenia Energy Complex

requirements of the National Energy Strategy which shows that, compared to 2015, in 2030 the coal will provide only 10% of the national electric energy, hydro 27%, gas plants 24%, nuclear 17% and renewable energy 22%. We notice that in 15 years the quantity of energy given by the nuclear and renewable plants will double, while the coal energy produced will be halved. Hydro and gas energy will maintain the same level.

The estimations are done until 2035-2050 as we cannot predict the achievements in stocking the energy and in collecting and storing CO₂.

In establishing the National Energy Strategy the following aspects were considered:

1 – The energy demand in the near future and between 2030 and 2050;

2 – The electric energy production capacities Romania needs to ensure its energy independence and the safety of the National Energy System and whether energy should be imported or not;

3 – The structure of energy producers, considering the maximization of the energy resource national base;

4 – The opportunity of new investments in production capacities, considering the existence of a production overcapacity of more than 50% than the current energy demand at the level of the country, and also considering the necessity of replacing older capacities, physically and morally worn-out;

5 – The development of new energy production, storage and transport technologies is a challenge which may influence, on long term, the choice of a scenario for new production capacities and investments;

6 – The definition of energy market considering the enlargement of intra-community connections as a major requirement of the European Union;

7 – The need for electric energy considering its use for residence heating and food preparation, replacing gas consumption and reducing CO₂ emissions;

8 – The sustainability of energy costs by the population.

It is assumed that in the future, within the total power required by Romania, the thermo-energy system will ensure 3,400 MW, the hydro will ensure 6,500-6,800 MW, while the nuclear would provide, at least, 1,413 MW. The rest will be provided by hydrocarbs and renewable resources.

Irrespective of the results obtained in energy storage and CO₂ collection and depositing, coal will be used, at least, until the middle of the current century.

Today Romania has 6 large thermo power plants and 10 middle and small ones that use coal from the Jiu Valley and Oltenia Coal Basins.

The analysis made by the authors reveals a series of aspects regarding the future functioning of coal-based thermo-power plants.

3. Coal based thermo-power plants analysis

The thermo-power plants within Hunedoara Energy Complex (Mintia and Paroşeni) own a power capacity of 1,435 MW, being the only energy production plants in the centre and North-Western parts of Romania, operating now to an average level of 350 MW.

The plants were designed to operate and to consume the entire black coal production of about 2.5 million tons / year, for a coal power of about 4,000 kcal/kg.

There are 4 large operating mining units in the Jiu Valley, which can provide a production capacity of 2.055 million tons/ year of black coal (E.M. Lonea 380,000 tons / year, E.M. Livezeni 636,000 tons / year, E.M. Vulcan 400,000 tons / year and E.M. Lupeni 639,000 tons / year).

This production ensures the functioning of the energy plants in Paroşeni and Mintia: one energy group in Paroşeni of 150 MW and two energy groups in Mintia of 210 MW each (groups 3 and 4).

The four mining units own about 47 million tons of black coal exploitable reserves and need in the future years, based on feasibility studies, investments of about 150 million Euro, consisting in mining equipments and underground and surface mining works.

The modernization process of mining will be accompanied by activity reorganizing and personnel decrease.

The thermo-power plants require investments of 174 million USD, to solve the environment and fitting problems at Mintia thermo-power plant.

We believe that through providing the investment funds and the technical and organizational measures taken by the Ministry and the management of Hunedoara Energy Complex in order to improve the situation, the mining and energy activities will be able to operate efficiently.

Therefore, we hope that we can avoid the firing of hundreds of miners and energy workers in Hunedoara County, avoiding a major social impact for the population.

Recently, the technocrat Government during the period 2015-2016 decided that only two mines would operate in the future (Livezeni and Vulcan) in the Jiu Valley, while, in Hunedoara County, the thermo-power plants of Paroşeni and Mintia would

operate each with only one energy group of 150 MW and 210 MW.

As a consequence, they decided the firing, beginning with October 1st, 2016, of 840 workers, as follows: 452 energy workers from Mintia Thermo-power Plant, 100 energy workers from Paroşeni Thermo-power plant and 288 miners from the Jiu Valley mines.

As far as the thermo-plants powered by lignite are concerned and considering the increase of the given power through renewable resources - especially wind power - and the decrease of electric energy consumption, the average power produced in the past years decreased. A part of the coal based energy groups of plants were replaced by gas powered groups (Oradea, Arad) and the thermo-plant from Halanga – Drobeta Tr. Severin was turned off in 2015 together with the heavy water plant.

Today, the consumers of the lignite produced by the mines in Oltenia are the thermo-power plants in Rovinari, Turceni, Craiova and Işalniţa, part of CE Oltenia and the thermo-power plants of CET Govora, Colterm Timișoara, UATA Motru, public institutions and local residence consumers.

The four thermo-power plants part of CE Oltenia include 12 energy groups with a total installed power of 3,570 MW.

Analyzing the modernization-rehabilitation programs of the energy groups included in CE Oltenia, it appears that, in the future, Rovinari Plant will only own four active groups of 330 MW (groups 3, 4, 5 and 6), Turceni Plant - four groups (3, 4, 5 and 7), Işalniţa - two groups (7 and 8) of 315 MW, all condensing, while Craiova II Plant - two CHP groups of 150 MW each, ensuring the heating of the city of Craiova.

The objectives of the modernization-rehabilitation programs were:

- The increase of time and energy availability of the block;
- The increase of the functioning period of the energy block by 15 years;
- The increase of the technical-economic parameters of the energy block through reducing the heat specific consumption;
- The improvement of the environment condition through reducing the CO₂ emissions from 1.58 t / MWh (1989) to 0.96 t CO₂ / MWh currently, reducing the NO_x emissions to 500 mg / Nmc and the powder concentration in the burning gas to <50 mg / Nmc;
- The introduction of modern automation and control systems to perform the technical connections to UCTE;

Together with the modernization-rehabilitation of the energy groups they also built the desulphurization installations and the exhaust installations for slag and ash from burning, in order to reduce the SO₂ and dust emissions to the E.U. standards.

The desulphurization installations of the energy groups are meant to reduce the SO₂ emissions from 4000 mg/Nmc before 1990 to 200 mg/Nmc currently and may contribute to new investments as they produce gypsum in the process of washing the burning gas with chalk. As a consequence, beside Turceni plant, they built a drywall factory, which uses the gypsum produced by the desulphurization installations of the plant.

The mixture of slag and ash may be used as construction materials for platforms and embankments, according to recent studies.

This means that, for about 20 years, the electric energy production based on lignite will have values between 17 and 22 TWh, which will generate a lignite consumption of 20-23 mil tones / year. If newer groups will be established, through increasing the burning efficiency from 32-34% currently to 42-45%, the electric energy production may be 30% higher.

The lignite exploitation to fuel the four thermo-power plants of CE Oltenia occurs in 10 open mines: Tismana I, Tismana II, Rovinari-Est, Pinoasa, Roşia Jiu, Jilţ Sud, Jilţ Nord, Roşiuţa, Lupoiaia, Huşnicioara, equipped with continuous extraction technologies, which may extract lignite production of about 27-28 mil tones / year.

At Rovinari Plant, for an electrical energy production level of about 8.6 TWh / year, the lignite consumption at an average calorific power of 1,800 kcal / kg (7.6 Gjoule / kg) would be about 9.7 mil tones.

The exploitable reserves of Pinoasa, Tismana I and Tismana II open pits are over 140 million tones, and the Roşia de Jiu pit is about 200 mil tones. These four pits may supply Rovinari plant so that it achieves the electrical energy production level of 8.6 TWh / year, during the following 35 years.

Lets notice that after 35 years the pits have the capacity to be developed in the neighbouring perimeters. Roşia pit may extend in the Fărcăşeşti perimeter with reserves of 160 mil tones and an overburden ratio of 11 to 1, and the Valea cu Apă perimeter with reserves of 120 mil tones and an overburden ratio of 12.5 to 1. Pinoasa owned additional resources of about 500 mil tones and an overburden ratio of 7.7 to 1.



For Turceni plant, considering the same production levels of 8.6 TWh / year, the pits of Jilț Sud and Jilț Nord, with a cumulated reserve of 210 million tones, may ensure the consumption during more than 20 years. Jilț Sud may extend on Tehomir perimeter with reserves of 120 mil tones and an overburden ratio of 7.8 to 1.

Turceni plant has the possibility to be supplied with coal from Rovinari and Motru basins.

As for the electric and thermal energy produced by Ișalnița and Craiova II plants, it is evaluated to 4.5 TWh / year, with a yearly consumption of about 5 mil tones of lignite. The coal may be supplied by the pits Roșița – Lupoia, Motru basin having deposits of about 150 mil tones, estimated to operate for 30 more years. As the reserves from Lupoia pit are exhausted, the equipments may be transferred to the future pit Ploștina Nord with reserves of over 50 mil tones, supplying the two plants for 10 years with an overburden ratio of 7.7 to 1.

The four thermo-power plants included in CE Oltenia, namely Rovinari, Turceni, Ișalnița and Craiova II, the current favourable reserves (with an overburden ratio of 6 to 1) of over 700 million tones ensure the electrical energy production level of 22 TWh for 28 years with the current performance of the groups (efficiency of 32-34%).

The current consumption of Govora thermo-plant is about 1.8 mil tones / year, but in time, depending on the decisions concerning the evolution of the units at the Râmnicu Vâlcea industrial platform, it may be modified. The lignite is provided by the mining basin Berbești, from the pits of Olteț and Berbești.

Considering the development of production capacities of renewable energy (of more than 3,757 MW at the end of 2103, of 60% increase compared to 2012), of gas plants, the solution of keeping the lignite thermal-plants in operation is the reduction of coal costs and also the processing costs of the thermal-power plants.

This requirement may be ensured through focusing the extraction on the most efficient perimeters, through modernizing the extraction equipments of the pits, through making flexible schedules based on demand, in order to provide a cost price at the level of the thermo-power plant between 11.5 – 12.5 Euro / ton, calorific of 1,700-1,800 kcal / kg and through building new energy groups equipped with boilers of overcritical parameters.

The average and long term strategy of CE Oltenia stipulates modernizing actions for the energy groups, the achievement of a prototype project for the collecting, transport and storage of CO₂ (CCS – Getica), and the building of new capacities with high efficiency.

Aside from the measures stated above, the future lignite extraction activity should be concentrated in mining perimeters of high economic efficiency, unviable or close to depleting mining objectives (Gârla, Rovinari Est, Hușnicioara, Peșteana Nord, Lupoia, Panga, Berbești Vest) should be terminated, while technologic fluxes should be optimized; pits equipments and installations should continue modernization programs as well as the increase of usage indexes of transport equipments.



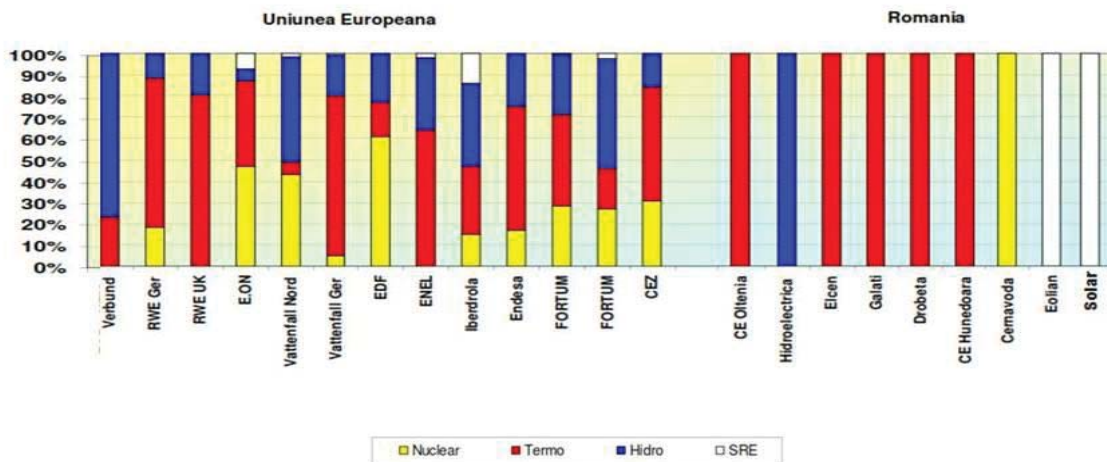
In the future, considering that the average life of transport equipments used for excavators or dump cars is over 50 years (compared to 40 years as planned), the investments should be directed to the rehabilitation of operating equipments with planned lifetime reached. Another action should be directed towards the rehabilitation of affected lands to ensure the expropriation in the advance of pits – this being the most important problem of the mining operators in Oltenia.

4. Conclusions

In order to participate to the energy market, the mines which provide the fuel needed for the thermal-power plants, both based on black coal or lignite, must carry on their development processes through modernization-rehabilitation.



Companii de producere a energiei electrice din UE si Romania
Situatia existenta



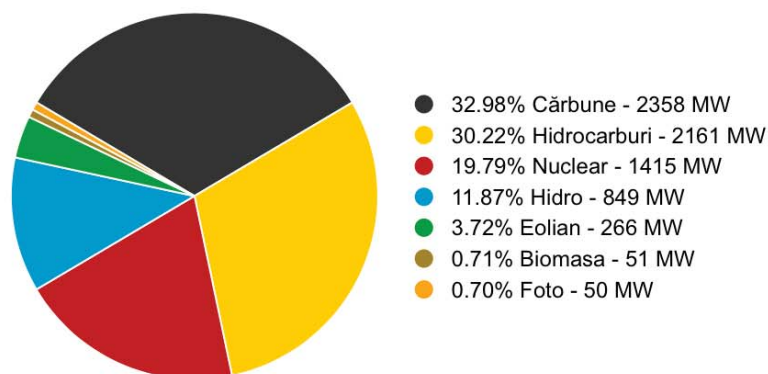
The maintaining in the energy mix of the thermal-power plants based on coal, according to the actions described above, should be done with a view to reduce the production costs of MWh so that the selling price should be competitive on the energy market in Romania; nonetheless, this is not possible provided that:

- They do not reorganize energy producers so that the electrical energy market becomes competitive among companies with energy mixes, similar to the others in Europe (RWE – Germany, ENEL – Italy, CEZ – Czech Republic and others)

- Two units (3 and 4) will be built at Cernavodă, without a strict analysis of costs, compared to building two coal based energy groups of 600 MW each, with all implications related to environment, fuel, system energy integration, etc.

- The pumping station of Tarnița will be built in order to balance the energy system without considering balancing it owing to hydropower plants from water storage, while the coal thermo-plants will operate in-line, a fact that would lead to their increased efficiency which will reduce the production costs by 5-7% for every coal based MWh.

Starea Sistemului Național în timp real	Producție, Consum, Sold	Raport Operativ
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Total 7150 MW - Productia in 29-01-2017 ora 16:39:41

Lets end by emphasizing that the most important concerns of the authorities are: the optimization of the exploitation process of the lignite deposits, exploitation modernization, regulation of the legal issues related to land ownership, financial sanitation of the units, personnel sizing, labour reconversion depending on the area requirements, while noticing the major role of coal in the production of electrical energy in Romania.

Moreover, it is known that the only producer of electrical energy – not depending on conditions – is coal which exists in large amounts in Romania.

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