Situation and Perspectives in Production of Fossil Fuels and the Importance of the Coal in Energy Supply of the World and of Slovenia

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Abstract: Coal is a basic fuel in production of electric energy in China, India, South Africa and also in many other parts of the world. It represents 23% of the basic world energy, 36% of the electric energy and 70% of the whole energy in steel plants. And about 70% of all the fossil fuel reserves consist of coal. Stable increase of the consumption is significant for the consumption of the coal and in the last 25 years it increased for about 50%.
Advantages of the coal are represented by its disposability all over the world, reliably supplies and safe alteration.
Demands and coal consumption will certainly increase in the near future. Clean coal technologies of excavation and consumption represent a certain challenge for the future. But sustainable development represents a future guideline in coal extraction and consumption.

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1. Europe and coal industry

Coal as an energy source was one of the factors, which transformed economic and political development of Europe in the nineteenth and twentieth century. States and industrial regions owe a great part of their economic success to this fuel. But is it going to be the same in the twenty-first century?

According to the discussions about the climate changes and the influence of the carbon dioxide (CO_2), requests for "decarbonization" (without carbon) of the world economy are becoming more intensive. Europe shall overtake the guiding position at these activities and support "progressive" energetic supply without coal and even without nuclear energy. But such requests are simply irrational, furthermore unreasonable.

It is very hard to imagine achieving sufficient energy supply only from diverse sources (energy mix) without coal, even in this European Community of fifteen countries. Coal contribution in electric supply in EU represents 25 %. And beside this fact it is indispensable in steel production and in other energetic intensive branches. Coal the only important domestic energy source assures a certain degree of independence in energetic policy and irreplaceable in fact of a reliable energetic supply.

Short scientific paper

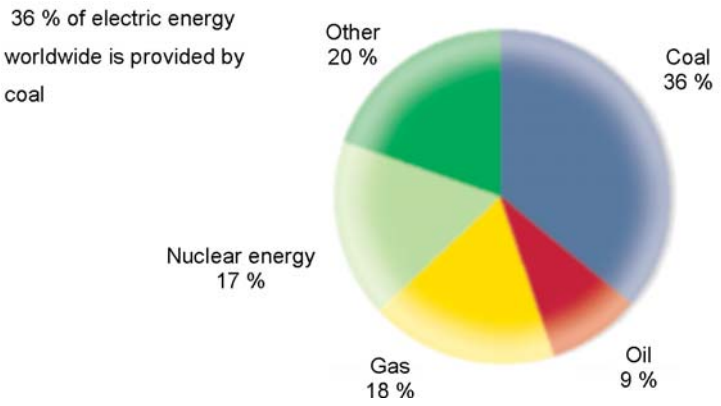

Figure1. Coal share in a common production of electric energy.

But otherwise the truth is that the importance of the coal in European Union is to be increased as a result of the increasing number of members and of the Union itself. Hard, hard coal and lignite are the main factors of energy supply in many countries, future members of the European Union. The coal amounts on the world markets are large enough and can be transported and stored safely. New materials and improved technological methods mean also a higher degree of efficiency in new, modern power plants. It is absolutely clear that there are economic advantages that we deal with and positive environmental and ecologic effects.

And in case that we would renew all the thermal power plants in the world and adapt them to present European standards we would be able to halve the emissions of carbon dioxide (CO_2) in Europe. There are also other potentials for improving efficiency in Europe and there is also a chance for a financial improvement. Building new, high effective power plants would be one of the suggestions how to decrease emissions of carbon dioxide (CO_2). Furthermore, according to the technology and economy development there is a chance to generate electricity even without any emissions of carbon dioxide (CO_2).

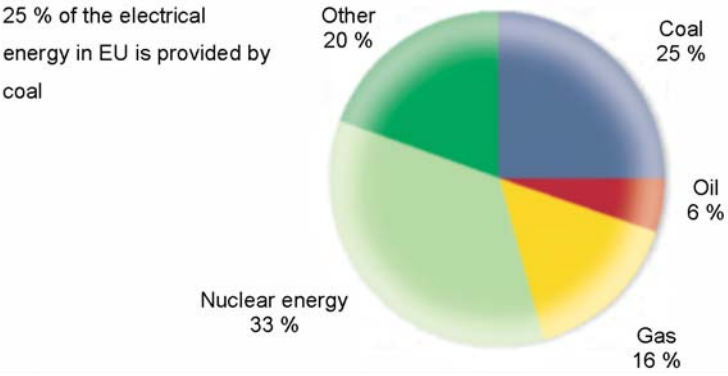

Figure 2. Coal share in the production of the electric energy in EU.

And that is the future of the coal, and opportunity for Europe, which has highly developed coal technologies at its disposal.

2. Coal and sustainability

European coal industry expresses an equivalent support to the three goals of the sustainable development, reestablishment of the balance between humans and environment, preservation of natural sources and biologic heterogeneity and relation to the nature and the environment. Due to that facts reliability of energetic supply represents a part of an economic and social development. The main point of the economic and social development depends of a reliable, cheap and environmental clean energetic supply and in this case coal is one of the most important substances.

It is impossible to foresee that there will be any important changes in shares in the next centuries because of the disposability of the sources and because of the competition. Contribution of renewable sources will not overtake the place of the fossil energy sources. And according to the facts that the energetic consumption is increasing, also consumption of coal is going to increase.

3. Switching from coal (and nuclear energy) to gas, exerts influence on the production of electric energy, makes it politically vulnerable and long termed more expensive

Formula of energetic supply with diverse fuels and large demands for primary energy will prevent from using only gas and fuel for a production of electric energy. It would cause a number of problems at suppliers to cover such enlarged demands only by gas and fuel.

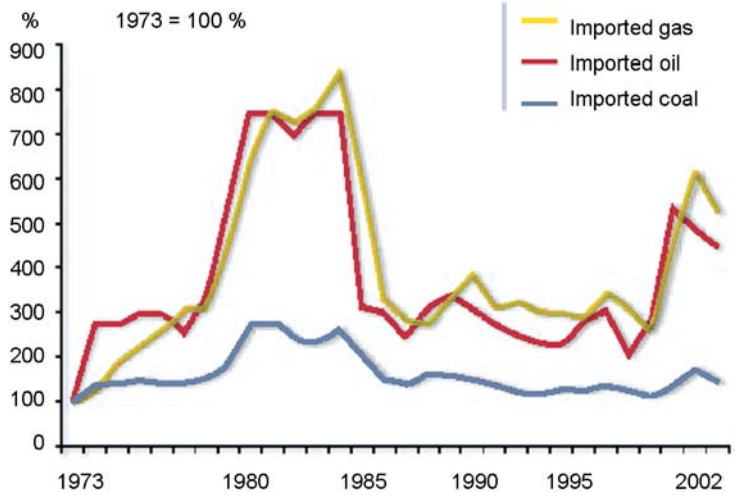

Figure 3. Deviation of prices threatens economic stability.

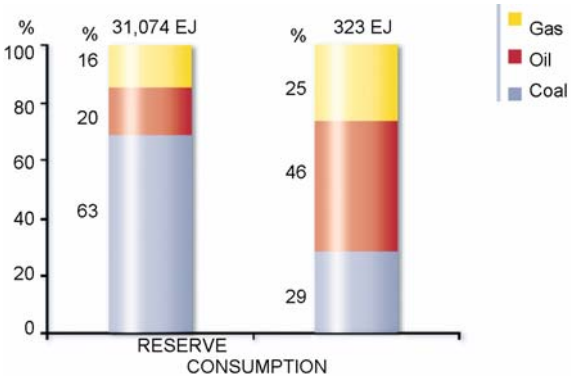

Figure 4. Reserves and consumption of fossil energy sources worldwide.

Coal and nuclear energy, both energents are extremely important for achieving balanced market conditions towards gas. And although coal conversion (into electricity) is capitally intensive process, further costs are relatively low. Production of electricity from gas or oil requests minor investments, but the risk because of variable fuel costs is rather high. Competitive and stable prices of coal enable independency from deviating prices.

Switching from coal and nuclear energy to gas means to move toward deficient sources and invigoration of the position of the states, which dispose with large gas and fuel reserves.

Definition "purposal evaluation of efficiency " of power plants enables to determine effects of diverse primary energents on the climate. This factor includes all the steps in the process, losses that appeared during acquiring and transport and the effects of methane on the climate. A complete study of environmental effects shows that diverse fossil fuels used for production of electric energy have the same effect to the earth climate. So, all our efforts should be focused on raising efficiency and not on other kinds of sources.

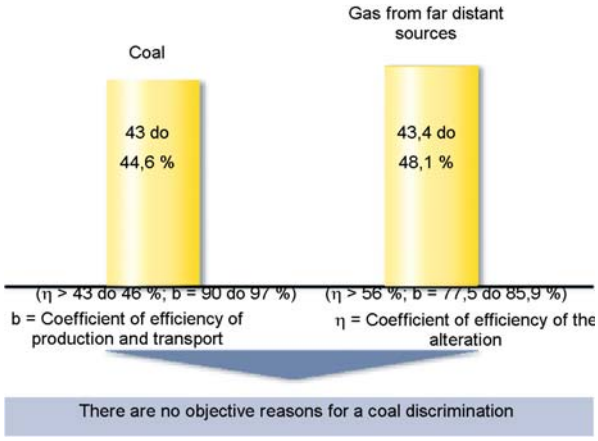

Figure 5. A small distinction in efficiency of modern power plants.

4. Coal industry supports climate protection – increasing the efficiency of using coal for production of electricity

Coal industry efforts preventive protection of the climate (atmosphere). Effectiveness at the energy production is constantly influenced by improvements when building new power plants and also in cases of reconstruction of the old ones and as a result, emissions are decreasing. Building new thermal power plants represents a financial efficient way of decreasing emissions of carbon dioxide (CO_2).

Clean coal technologies, in connection to a sustainable increase of productivity will enable financial efficient energy supply inside the European Union. It is clear and normal that the costs of modern technologies demand larger investments, but investments are to be covered by long-term competitive advantages such as minored demands for employees, minored maintenance costs, less fuel. This final result – minored fuel quantity in thermal power plants has positive effects on economic use of limited energy sources.

Effectiveness of modern thermal power plants exceeds 40 % and about 30 % better in comparison to the power plants built in the fifties and sixties of the 20th century and should be replaced now. Furthermore, modern power plants emit less dust, less sulphur and less NOx, emissions of carbon dioxide (CO_2) are exceedingly lower. In normal circumstances a modern 1000 MW power plant reduces emissions of carbon dioxide (CO_2) for about 2.5 to 3 million tones.

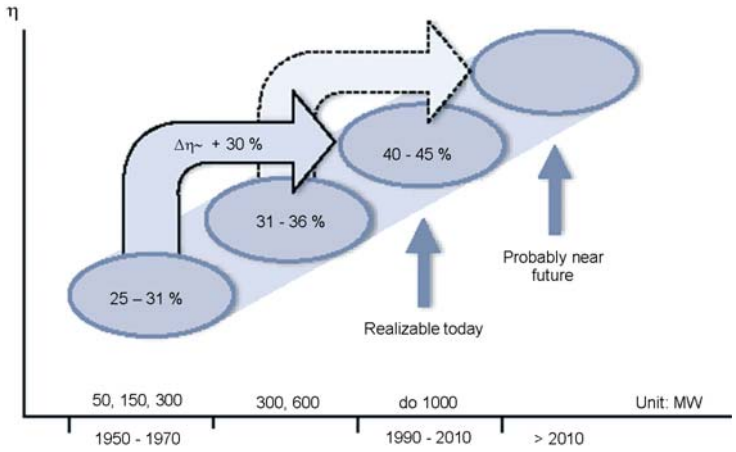

Figure 6. Efficiency development of thermal power plants.

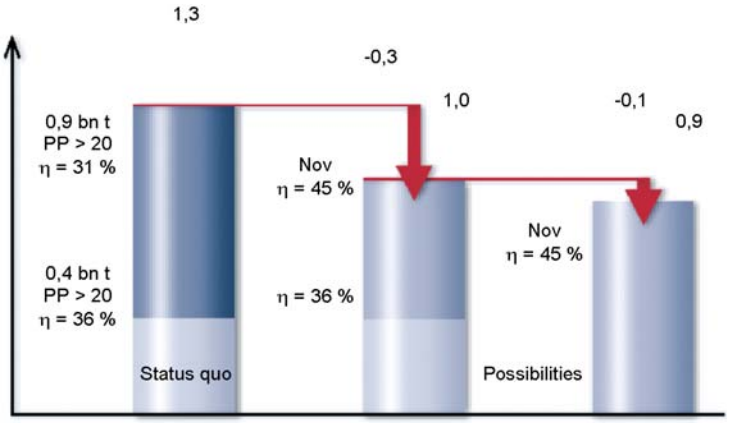

Figure 7. Most effective reduction of the amounts of carbon dioxide (CO2) in Europe would be provided by building new thermal power plants.

5. REDUCTION OF CARBON DIOXIDE (CO_2) EMISSIONS

Development of renewable sources determines that despite of all the efforts, those sources remain limited and cannot replace other energents. Furthermore, such energy is very expensive, except at few markets. Although, wind and biomass generators, small hydro power plants and photo-voltages do not have the costs, which charge thermal power plants because of the removal of carbon dioxide (CO_2) and already exceed 50 €/t of CO_2. Gaining electricity with minimum amounts or without carbon dioxide (CO_2) is in fact possible in the future, but only under one condition: to burn a fossil fuels, such as coal, and to hinder the carbon dioxide emissions into the atmosphere. So the carbon dioxide should be captured and stored, and this is the point on which the research should be focused.

There are some already known solutions. Far too expensive and less effective seems the possibility of capturing carbon dioxide (CO_2) at existing power plants. There are two more possibilities with a marketable technical and economic aspect. First, there is a "combined cycle integrated by gasification (IGCC)", which is already quiet well developed. There is also a possibility of capturing carbon dioxide (CO_2) from flue gases, which appear during coal gasification, already known and proven in the chemical industry. Next possibility, so far proven only in the laboratories, is burning with oxygen into carbon dioxide (CO_2) and water (H_2O), and following that a steam condensation. In comparison to recent power plants, the effectiveness of such power plants would be decreased for about 6 to 8% – and according to this – faster consumption of sources would clearly result.

A basic pre-condition is safety – safe and sustainable storing of carbon dioxide (CO_2). Instead of focusing on the capturing of carbon dioxide (CO_2), our full attention should be focused on researching and testing of the systems, which would enable safe and sustainable storing of carbon dioxide (CO_2).

At present one of the solutions is storing in emptied fields of oil and gas. Water bearing strata is the largest storage potential at the moment. There are many investigations started in Europe, USA and in Japan, but there is also a fact of the environment protection that should be considered as well.

Development of technical procedures for carbon dioxide (CO_2) capture and storage enables, due to a long-term aspect, new power plants without carbon dioxide (CO_2) emissions. And according to the pretentiousness of the research first devices will be ready for testing in industry up from the year 2010. So the first such power plant would be available in 2020.

6. Production and perspective of domestic coals

Coal share due to the energy balance EU-15 is 15 %, by expanding to EU-30 it will rise to 19 %. Today's EU dependence on the imports already exceeds 50 %, and by the year will exceed 70 % by 2030.

Coal production in Slovenia is slowly falling. From the record-breaking 6.8 million tons in early 80's to 4.8 million tons in 2004. Similar or even more drastic trends are noticed in the rest of Europe.

Despite of the economic and environmental shortcomings of coal, EU will not reduce recent domestic and imported coal consumption. Reducing the consumption of domestic coal causes negative effects on regional and social status inside Europe. Certain kinds of state subventions are provided for coal industry. In 1993, according to ECSC contract (EU contract for coal and steel) the decision Nr. 3632/93/ECSC, which arranges the state aid in coal industry, was accepted by a council. On 23. July 2002 validity of the contract expired, a new order followed, (Council Regulation on State Aid to the Coal Industry – EC No 1407/2002 and prolonged state aid for coal industry up to 2010.

In case of coal substitution by other fossil energents (probably gas) in Slovenia, self-sufficiency will deteriorate and dependence of the import of electric energy will increase. So it is important to save domestic reserves of lignite and to make a compromise between adaptation to Kyoto agreement and economic conditions, which would enable production in Coalmine Velenje at a reference price of coal: 2.8 EUR/GJ (in 2002).

Slovenia decided to close the hard coal mines in Zasavje region (Legislation About Progressive Closing of Trbovlje Hrastnik Mines and Reconstruction of the Region - Official Gazette RS, Nr. 61/2000). Up to

Table 1. Situation and projection of the coal consumption up to 2020.

	Situation		Projection				2015/2000		Calorific value
(1000 t)	1997	2000	2005	2010	2015	2020	Index	%/a	MJ/kg
Lignite	4.199	3.756	3.830	3.690	2.910	3.010	77,5	-1,7 %	10,0
Hard coal	868	733	575	0	0	0	0,0	-100 %	12,0
Hard coal import	300	455	521	604	469	221	103,3	0,2 %	18,0
Other	89	72	83	94	95	97	132,6	1,9 %	29,3
Sum	**5.456**	**5.015**	**5.009**	**4.388**	**3.475**	**3.328**	**69,3**	**-2,4 %**	

2009 coal extraction will continue in Trbovlje mine and will cover the demands of a thermal power plant Trbovlje. Later on only closing activities will be performed.

Production in coal mine Velenje will remain, lignite will be further on used in a thermal power plant Šoštanj.

Reducing the production of a domestic coal will increase pressure on the price of coal. In the range of measurements of the European energetic legislations (15 % protection of domestic sources, preferential dispatch) and Council legislation about aids for coal industry (EC No 1407/2002) there should be an appropriate subvention provided as follows:

- Preservation of the excess to potential reserves, which are to be used in future coal technologies.
- Social reconstruction, closing activities.

According to the overview of the exploitation of energetic resources in Slovenia (Strategic Conference 1992, Brdo pri Kranju) northeast part of Slovenia is one of the most perspective areas, there are potential reserves of hard coal in Goričko, Videm ob Ščavnici, Presiki, Lendava and Petišovci.

The area around the west side of Goričko, located between Strukovci and Kuzma, is very important. The Coal quality there is the best in all coals in Slovenia. Calorific value is about 17.5 MJ/kg, inflammable sulphur is present in amounts of 0.91 %, i.e. under the ecologically dangerous limit. Coal layers are shallow, extending to 150 m deep, on the area of 50 km^2 and approximately potential 250 million tons appropriate for opencast exploitation, down to 250 m about 450 million tons, appropriate for underground exploitation. Coal layers are located shallow under quaternary dams. Coal thickness is between 10 and 12 m. These conditions would enable to build an opencast mine with an optimum yearly production of 2,000,000 tons for 40 years and power supply for a thermal power plant object of 500 MW to 600 MW.

Reserve evaluations are based on coal boreholes and measurements of oil boreholes in Goričko. The reserves should be confirmed by appropriate geologic researches (mapping, drilling, sampling, ...) and decategorization from D to C2. Minimum research range consists of:

- Geologic mapping (detailed surface mapping 50-100 km^2).
- Drilling (10 – 12 boreholes depth 150 to 200 m).
- Sampling.

As foreseen gradually research will be performed. Results of single phases will exert influence on further research phases.

Table 2. Evaluated coal reserves in the northeast Slovenia.

Research area	Reserves (mio tons)
Zahodno Goričko	450
Lendava – Petišovci	200
Videm ob Ščavnici	100
Presika – Podgorci	80
SUMM	830

Table 3. Research range of coal reserves in northeast of Slovenia.

	RESEARCH PHASE	DESCRIPTION OF ACTIVITIES	EVALUATION (SIT)
1.	Research drilling	3 boreholes	61 mio
2.	Detailed research drilling	2 pipe piezometres	38 mio
3.	Geologic maps	Maps, 3 research holes, 4 pipe piezometres, preliminary reserve report	235 mio
4.	Detailed report about the reserves and a project about the evaluation of the economy	Space sonding, report, project	1.164 mio
5.	Program of investment		
6.	Starting works		
	SUM		**1.498 mio**

7. Conclusion

Among all the fossil fuels coal is the only energent, which is going to be present on the energy market all over the world for many years to come, because of its quantity. But the emissions of carbon dioxide represent a serious obstacle. However, research activities, focused on how to capture carbon dioxide and thus reduce its emissions, are very intensive, and we are sure that the development of clean technologies for the production and use of coal will lead us to the expected results – thermal power plants and production of electric energy without polluting the atmosphere by carbon dioxide emissions.

In our opinion it is reasonable to prevent coal reserves in Slovenia, to handle rational and to continue the research of coal reserves in northeast of Slovenia and to confirm or to disprove the reserves.