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ENERGY SITUATION IN BOSNIA-HERZEGOVINA AND THE POSSIBILITY OF USING ALTERNATIVE ENERGY SOURCES

Introduction

Bosnia-Herzegovina is a country which is rich in various energy resources, but for the past 60 years its energy sector was mainly oriented towards fossil fuels (mainly coal) and hydropower. Due to the fact there was a war in this region in the 1990-ies, there was a certain stagnation in the development of energy sector. All comparisons are made with the data from year of 1991 (before the war).

Table 1 shows comparison of power plants capacities as well as production of electrical energy in the years of 1991 and 2010. In the year of 1991, there was 3,991 MW of installed power plant capacities of which 51% in thermal power plants and 49% in hydropower plants. In the year 2010, the situation was slightly changed, with total of 3,890 MW of installed capacities of which 47% in thermal power plants and 53% in hydropower plants.

The situation changed since some of thermal power plant blocks were shut down and new hydropower capacities were built.

TABLE 1. Energy capacities and production in Bosnia-Herzegovina

	Year of 1991	Year of 2010
Installed power plant capacities	Installed capacities 3,991 MW (TPP 51%: HPP 49%)	Installed capacities 3,890 MW (TPP 47%: HPP 53%)
Electricity production	~14,000 GWh	~ 15,623 GWh
Electricity consumption	~11,300 GWh	~ 11,469 GWh
Coal consumption	~17.5 mill. tons	~11.61 mill. tons
Oil consumption	~1.7 mill. tons	~1.4 mill. tons
Natural gas	~490 million of m ³	~ 250 million of m ³
Renewable energy sources	12 PJ	16.5 PJ

Regarding consumption of coal, there is a significant decrease from 17.5 million tons in 1991 to 11.61 million tons in 2010 (of which approx. 0.84 million of tons was exported). Bosnia-Herzegovina doesn't have extraction of oil and gas from own sources, although numerous studies have shown reserves of oil and gas in this area. However, all amounts of natural gas comes from import, and the use has decreased from 490 million of m³ in 1991, of which 20% is domestic use and 80% industrial, to approx. 250 million of m³ in 2010, of which 60% are for domestic use and 40% for industrial. These data, together with indicators of coal use, show that there were major changes in the structure of production, before the war and after the war. Most of industrial capacities were either shut down, or

have continued to work in small scale, while there was an increasing number of total households which have shown major increase in energy consumption. All oil consumption also comes from import, with total consumption of 1.7 million of tons in 1991 and 1.4 million of tons in 2010.

Regarding renewable energy sources (other than hydro), our country is rich in biomass, mostly wood since 50% of its territory is covered with forests. There are numerous geothermal locations that could be used for heat production, as well as numerous locations that are good for wind farms. Our country is in the region which has insolation of 1,500-2,000 hrs/year, which is quite a good potential for small scale solar energy plants.

Current data show that Bosnia-Herzegovina has enough coal amounting for 2.8 billion tons in exploitation reserves and almost 4.0 billion tons in balance reserves. Regarding hydropower, studies have shown that the technical potential of our country is approx. 6,800 MW of new capacities in large hydropower plants that could amount for additional 24,000 GWh/year of electrical energy. There is potential for additional 700 MW in small hydropower plants that could bring another 2,600 GWh/year. In the year of 1991, Bosnia-Herzegovina had the lowest use of hydropower in Europe, with total use of capacities of 38% (per energy production) or 35% (per installed capacities).

Current use of hydro potentials in our country is still below 40%, which is alarmingly low. For comparison, use of capacities for some other countries is much higher (Austria over 90%, Italy 95%, Germany 100%, Switzerland and France 100% etc.) All neighbouring countries also have higher use of hydro potentials than Bosnia-Herzegovina (Slovenia > 60%, Croatia > 65%, Serbia > 55% and Albania ~70%).

Numerous studies have shown that wind energy potential is approx. 1,000 MW, while biomass potential is approx. 33 PJ (0.79 Mtoe) which is sufficient for electrical energy production of 9,200 GWh/year. All above mentioned data show that renewable energy sources participate with 13-15% in total energy consumption which is above european average. However, there is much potential in further development of these sources. The biggest challenge for Bosnia-Herzegovina and its energy sector are oil and gas, which are imported in total amount, with gas being provided by only one distributor.

Since numerous analysis have proven that average energy consumption have been increasing in the last few decades, our country is in the same position. Studies have shown that there will be a significant increase in electrical energy demands, which will not be met by current installed capacities (Fig. 1).

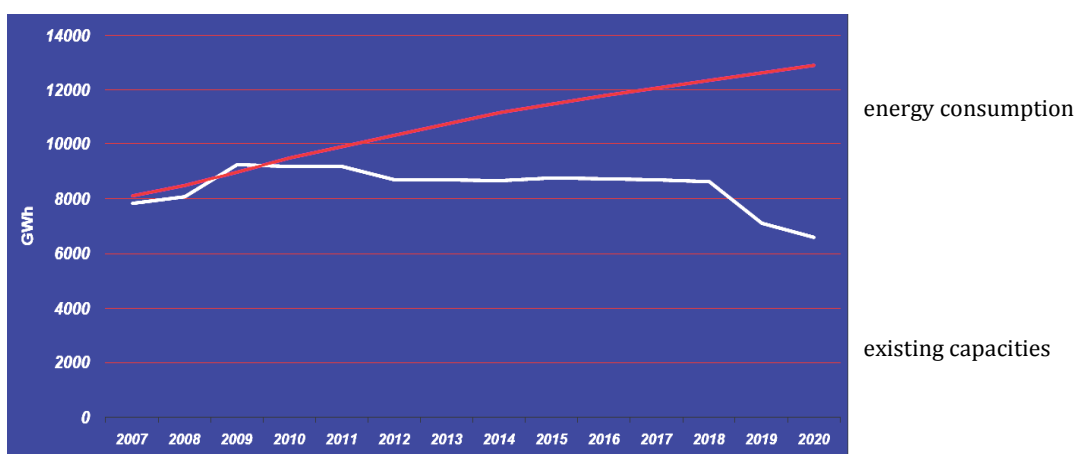


FIGURE 1. The expected deficit of electricity in the period 2007-2020

Nowadays, the consumption of electrical energy in Bosnia-Herzegovina is structured as follows: households ~43.4%, industry ~38%, and other consumers including construction works, transportation and agriculture ~18.6%. In the industrial sector, the biggest participation in electrical energy consumption has industrial non-ferrous metal production ~53.3%, and the iron and steel industry ~12.4 %.

Total heat production in BiH is structured in a way that is ~48.8% was produced in heating plants, ~29% is produced in thermal power plants, while ~22.2% is produced in industrial heating plants. The final consumption of thermal energy has the largest share of households with about 72%, and other sectors with 28%.

Plans for further development of energy sector in bosnia-herzegovina

Bosnia and Herzegovina not only has the potential to balance their own needs, but, if he created an appropriate model of financing the construction of manufacturing and other facilities, has the ability to increase the GDP on the basis of electricity that will be made available to the electricity market.

Bosnia-Herzegovina is in the first phase of preparations for the construction of thirty new power facilities over the next few years. That includes 6 large thermal power plants (total capacity 2 GW), 16 HPP (total capacity ~1.2 GW), 6 wind power plants WPP (total capacity 270 MW) and a number of mini power plants. However, the application of new energy efficient and environmentally friendly technologies is imperative. Without these technologies one can not talk about the development and competitiveness of the electric power system of Bosnia and Herzegovina in relation to the current environment, and on the international energy market. These technologies include the possibility of decentralized production of electricity and heat in combined systems.

Analysis of influencing factors on the pricing of electricity

The price of electricity varies from country to country, for which there are a number of reasons. The price of electricity to a large extent depends on the type of fuel used, incentives from the government and even the climatic conditions. In markets that are regulated monopoly issues standards, these rates are significantly different for individual, business and industrial customers and within each of these categories can vary within days.

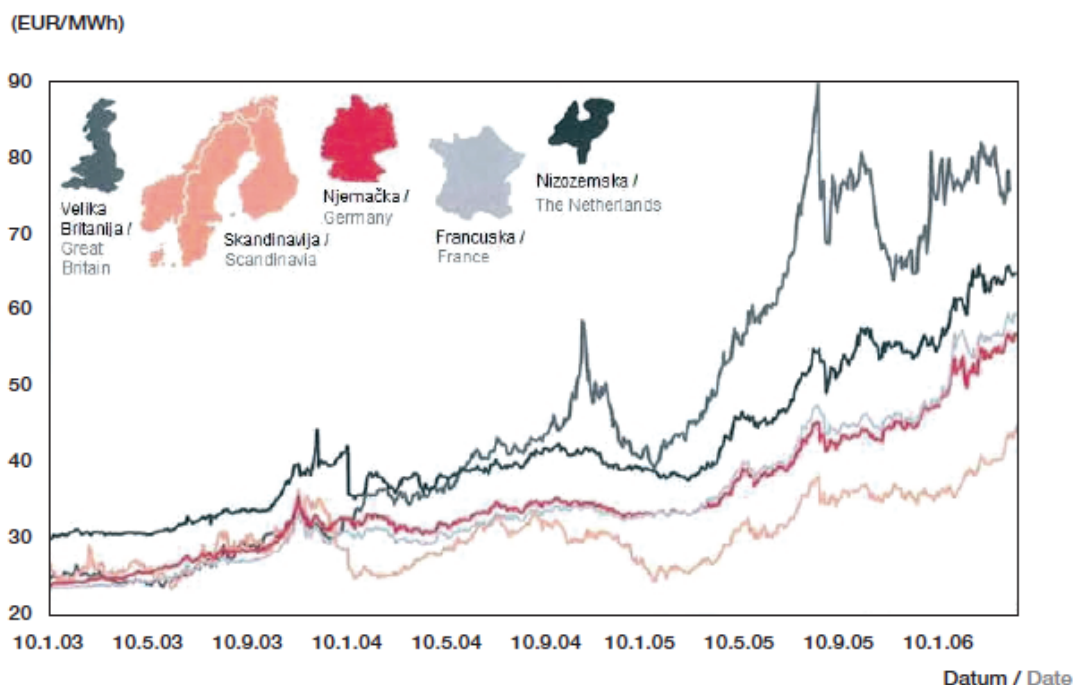


FIGURE 2. Showing an increase in electricity prices in some European countries in the period 2003-2006

If it is a market that allows for the dynamic pricing model in real time, which is a very common option markets in the world today, electricity prices may vary in amount up to 10 times. The liberalization of the electricity market in the EU at the beginning of the nineties caused a reduction in electricity prices as a result of the reduction in production costs. Discontinued are irrational and expensive production facilities, and shut down and investment in new power plants because of low electricity prices in the

market. Since 2000. was evident, however, an increasing trend in electricity prices. From 2002 to the beginning of the introduction of trade in CO₂ certificates (in early 2005). Prices rise to the level of total production costs, enabling the launch of a new investment cycle in power generation. The significant rise in the price of 30 EUR/MWh late in 1994. to 45 EUR/MWh in the autumn 2005th year, mainly due to the prices of CO₂ certificates. According to the analysis of the German institute RWI there is 95% correlation between the increase in electricity prices and price levels of CO₂ certificates. Market CO₂ certificates is organized to affect the price of electricity, in order to achieve the desired environmental effects.

Overview of the price of electricity for households and industry in 29 European countries shows all the diversity of markets within the EU. For example, during 2008. Serbia's electricity prices compared to other countries in the region and Europe and was the lowest for households and industry. Price kWh for households was 4.65 EURc and industry EURc 5.15. The price of electricity for households in in Slovenia is 9.19 EURc/kWh, while Croatia 9.61. Data are not published for BiH and Montenegro. Industrial companies kWh of electricity in Bulgaria pay EURc – 6.44, Croatia – 9.33, Slovenia – 9.51, Hungary – 11.95, Greece – 16.11. The electricity industry is the most expensive in Malta and is EURc 16.19 and 17.85 Cyprus EURc/kWh.

Since June 2009.god Denmark has najskuplju el.energiju in the world after tax, and is followed by Italy. Ireland has the highest price before taxes. France has the lowest el. energy in Europe before tax of 4.75 EURc/kWh, and also the second lowest rate in Europe after taxes. List price comparison from June 2009.god. shown in Table 2 (European Household Electricity Price Index).

The relative price of electricity produced from different energy sources is a measure of the cost of generation of electricity including initial capital costs, continuous operation and maintenance as well as fuel costs. When calculating the costs to consider several influential factors on costs, with no thought to the price of electricity, ie the price at which it is sold, given that the cost resulting from the action of influencing factors such as government incentives, depending on the type of source energy.

Table 2. Electricity prices in the world market

Country/Region	US cents/1 kWh	Country/Region	US cents/1 kWh
Australia	7.11	Italy	37.23
Belgium	11.43	Malaysia	7.42
Canada	6.18	Netherlands	34.70
Croatia	17.55	Perú	10.44
Denmark	42.89	Philippines	28.80
Finland	6.95	Portugal	16.39
France	19.25	Singapore	15.31
Germany	30.66	Spain	19.50
Hong Kong (Kowloon/ NT)	11.80	South Africa	10.15
Hong Kong (HK Is.)	12.30	Sweden	27.34
Iceland	11.61	UK	18.59
Ireland	23.89	USA	9.28

Capital costs (typically low for TE on fossil fuels; tall for renewable energy and NO; very high for combustion plants, waste, power of waves and tides and solar elektrane).

Operation and maintenance costs (high to NO, power, coal and waste while these costs low for renewable energy, power, oil and gas).

Fuel costs (for high power plants using fossil fuels and biomass, very low for nuclear fuel and renewable, can be negative for solid waste).

Expected number of hours per year – at least 3% for diesel plants, 30% for wind power and 90% for NO. Revenues from sales of thermal energy can be offset against operating costs but also reduce the net costs in case of cogeneration and district heating.

In Table 3 data are forecasting price movements electricity production for 2010 (information taken from 1997. Studies from the Institute RWI, Germany), and for comparison in Table 4 presents data on the costs of electricity production in new plants in 2010.

TABLE 3. Prediction of electricity production costs for 2010

Type of fuel	Cost per kWh
Nuclear energy	10.7 €ct – 12.4 €ct
Lignite	8.8 €ct – 9.7 €ct
Coal	10.4 €ct – 10.7 €ct
Natural gas	11.8 €ct – 10.6 €ct.

TABLE 4. The cost of electricity production in new plants in the 2010

The energy source	The cost of electricity production €ct/kWh
Nuclear energy	10.70 – 12.40
Lignite and brown coal	8.80 – 9.70
Coal	10.40 – 10.70
Natural gas	10.60 – 11.80
Wind farms at sea	4.97 – 9.61
other wind farms	3.50 – 15.00
Hydroenergy	3.47 – 12.67
Biomass	7.71 – 11.55
Solar energy	28.43 – 39.14

Conclusion

At the global level, significant resources and research efforts are invested to increase the technological feasibility and economic viability of using coal to generate electricity, with the focus mainly geared towards reducing CO₂ emissions. At the present moment the technology of separating and storing CO₂ from the combustion of fossil fuels is expensive, with the price of 40-60 USD/tCO₂. This gives a gain of about 3.5 to 5.5 Usc/kWh on electricity prices, with the average level of utilization of the coal power plant of 35%.

Planning the development of the energy sector is currently the biggest challenge faced by the responsible institutions and individuals who are dealing with this problem. Understanding the current situation in the energy sector in our country, and different scenarios that may happen in the future requires a very serious and responsible approach to this issue. However, the most important prerequisite is the existence of political will, knowledge, responsibility and courage needed to be planned and offered development based on the principles of long-term sustainability. Bosnia-Herzegovina is not an exception to these issues, and complex administrative arrangement makes the development of the energy sector even more complex. Activities in the planning and construction of

new energy infrastructure is in many cases accompanied by opposition from local residents. The reasons for opposition are essentially inadequate and untimely awareness, ignoring the interests of local communities, questionable economic justification for building and to the environment (especially in case of small hydro power plants).

The overall amount of electricity in BiH is mainly produced in hydro and thermal power plants, and development of new energy capacities is aimed in this direction. However, if Bosnia-Herzegovina wants to be part of European energy community, it will have to build more capacities in renewable energy sources, in accordance with European Energy Strategy. This would enable more job opportunities and further development of our country. In addition to the above, saving and improving energy efficiency must always be our imperative.

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