

# Investment in the energy sector of Bosnia and Herzegovina

Enver Agić<sup>1</sup>, Damir Šljivac<sup>2</sup>,

<sup>1</sup>President of the Supervisory Board of Elektroprivreda BiH, Tuzla ARBiH 19/IV/15, Federation of Bosnia and Herzegovina

<sup>2</sup>Electrotechnical Faculty of Osijek, Kneza Trpimira 28, 31 000 Osijek, Croatia

E-mail: agabiem@bih.net.ba, enveragic99@gmail.com, damir.sljivac@etfos.hr

**Abstract.** The energy sector, as a part of the economy of the Federation of Bosnia and Herzegovina, directly and indirectly contributes to the development of its potentials.

The paper analyzes the investment cycle laid down in documents that shape and define the national energy development potential. So far to there has been no national energy strategy adopted that would define objectives harmonized with various EU documents, shape the national energy policy which is highly dependent on energy imports from countries traditionally exporting oil and gas. In particular, the Bosnian and Herzegovian dependence on energy imports and high energy prices impose a considerable economic issue.

**Keywords:** energy sector, energy potential, strategy, development

## Investicije v energetske sektor v Federaciji Bosne in Hercegovine

Energetski sektor neposredno in posredno vpliva na razvoj Federacije Bosne in Hercegovine (BiH). V članku je predstavljen investicijski cikel v razvoj energetskega sektorja Federacije BiH, ki v tej fazi še ni sprejela energetske strategije, harmonizirane z dokumenti in politiko EU. Analiza potrjuje, da predstavlja energetska odvisnost Federacije BiH od uvoženih energetskih virov velik izziv.

## 1 INVESTMENT IN THE ENERGY SECTOR – EXAMPLE OF BOSNIA AND HERZEGOVINA

The conducted macroeconomic analysis shows that the energy sector employs a significant number of the manpower and its proportion in the total gross added value is approximately 20 percents.

The negative trade balance is expected to significantly increase the energy imports. The analysis of the capital projects of the energy sector and energy policy shows that the economic effects are usually not analyzed and their economic results are either questionable or non-existent.

The energy sector and its development potential as a part of the overall development potential of the national economy as well as implementation of the energy policy can contribute to the economic development, but cannot provide the basis for the economic growth in terms of its relative share in the macroeconomy.

The decision of closing down some of the existing thermal power plants (TPP) is based on their age, years of service and the foreseen operational life prolongation following their refurbishment.

The TPPs of the of age of 47-50 years, except for the Kakanj Unit 7, will be put out of operation or will be refurbished depending on the completion of a new unit of Kakanj (G9) [1].

The construction of new power facilities has been planned to meet the public power demand.

## 1.1 OPTIONS TO STRENGTHEN THE POWER GENERATION INDUSTRY OF BOSNIA AND HERZEGOVINA

New capacities need to replace worn out ones to assure power-demand meeting, continuity of the mining industry and implementation of the environmental rules and regulations.

The first priority is completion of the Tuzla TPP G7 to be put in operation by 2018. The Kreka coal mine will cover the needs for lignite on the level of 2013 until commissioning a new unit [2].

The national plan foresees construction of 14 projects, 2 TPPs, 2 accompanying mining capacities, in total 18 investments.

In the second iteration, the dynamics of the renewable energy projects has been changed and the construction of the Kakanj Unit 8 has been postponed for one year. So the year of implementation of the planned projects is 2022.

In the optimistic scenario, 2-3 new projects will be implemented in a year; in total 9 - 11 projects will be completed.

**Table 1.** The existing power generation capacities

Thermal power plants	In operation since	Age in 2015	Reconstruction	Years in extended operation life	End of operation in	Total at the end of operation		Specific energy kJ/kWh	Coeff. of effic. $\eta$	Installed capacity MW
						years	hours			
Tuzla A3	1996	49	1997	18	2015	49	324.147,00	13.982	26	100
Tuzla A4	1971	44	2002	16	2018	47	233.981,00	11.650	31	200
Tuzla A5	1974	41	2008	16	2024	50	251.512,00	11.800	31	200
Tuzla A6	1978	37	2012	15	2017	49	269.524,00	11.396	32	215
<b>TUZLA</b>								<b>11.823</b>	<b>30</b>	<b>715</b>
Kakanj A5	1969	43	43	15	2019	50	264.979,00	11.500	31	110
Kakanj A6	1977	35	35	15	2026	49	243.400,00	13.500	27	110
Kakanj A7	1988	24	24	25	2030	42	208.261,00	11.000	33	230
<b>KAKANJ</b>								<b>11.532</b>	<b>31</b>	<b>450</b>
<b>Total thermal power plant output</b>								<b>11.690</b>	<b>31</b>	<b>1.165</b>

**Table 2.** Dynamics of construction of new power facilities

Thermal power plants	Total installed power MW	Potential annual production GWh	Total investment mil €	Investments in 2012-2014 (mil €)			Total mil €	Start of construction year	Entry into service year	
				2012	2013	2014				
1	Tuzla G7	450	2.535	769	7	45	136	188	2013	2018
2	Kakanj G8	300	1.690	530	3	3	18	24	2014	2018
3	Bugojno	300	1.600	693	0.5	1	2	3.5		
4	Consulting			1	0.25	0.25		0.50		
	<b>TPP</b>	<b>1.050</b>	<b>5.915</b>	<b>1.994</b>	<b>10</b>	<b>49</b>	<b>156</b>	<b>215</b>		
	<b>TOTAL</b>	<b>1.286</b>	<b>6.711</b>	<b>2.445</b>	<b>40</b>	<b>130</b>	<b>240</b>	<b>410</b>		
	HPP	MW	GWh	mil €	2012	2013	2014	mil €	year	year
1	Vranduk	20	96	65	8	15	23	46	2012	2015
2	Janjići	13	60	33,5	1	3	9	13	2013	2017
3	Ustikolina	60	247	123	0.30	1.70	7	9	2014	2017
4	Čaplje	12	57	33	0.50	1	5.50	7	2014	2017
5	Kruševo/Zeleni source	0	0	0	0.50	0.50	3	4		2018
6	HPP Development and preparation	0	0	0	1	2	3	6		
	<b>∑ HPP*</b>	<b>105</b>	<b>460</b>	<b>254</b>	<b>12</b>	<b>24</b>	<b>50</b>	<b>86</b>		
	Small HPP	MW	GWh	mil €	2012	2013	2014	mil €	year	year
1	Small HPP Neretva	26,1	102	50	5	13	15	33	2012	2014/15/16
2	Small HPP UNA Kostela-anex	6,4	21	10	1	3	4	8	2013	2015
3	Small HPP Kakanj	4,5	22	6	10	41.02	1.02	1,02	2014	2016
	<b>Total WP**</b>	<b>37</b>	<b>145</b>	<b>66</b>	<b>16</b>	<b>57</b>	<b>20</b>	<b>9,23</b>		
	WP**	MW	GWh	mil €	2012	2013	2014	mil €	year	year
1	WP Poodveležje	46	93	64	10	41	13	64	2012	2014
2	WP Vlašić	48	98	64	0.75	0.75	0.50	2	2015	2017
3	New RES projects	0	0	4	0.5	0.5	1	2		
	<b>Total</b>	<b>94</b>	<b>191</b>	<b>130</b>	<b>11</b>	<b>42</b>	<b>13</b>	<b>66</b>		

\* HPP- hidro power plant,

\*\* WP- wind park

The Tuzla power plant Unit 7 will be completed in the period 2013 - 2017. This will reduce the need for brown coal and after closing down Unit 5 (after 2024) MU 1 (brown coal) will no longer be needed.

The Unit G7 is the first replacement unit (lignite fired). At the Kakanj TPP the use of coal will be reduced by 2018, this will reduce the working hours the Unit 5 will remain in operation and the Unit 8 will be put in operation.

## 1.2. PROBLEMS CONNECTED WITH THE CONSTRUCTION OF THE PLANNED NEW CAPACITIES

The priority production capacities of the Elektroprivreda BiH will be constructed in parallel with the below projects:

- power-demand meeting,
- mining and
- industrial capacity exploitation.

The construction of other production facilities is of a lesser importance as they constitute only 20% of the total planned new production. The other tasks to be also accomplished are the use of the renewable energy sources and involvement of the local industry to enable economic growth and employment.

## 2 MINING

In future the reduced demand for coal is respected, jeopardize the mining industry. Operation of new capacities will increase coal mining. Substantial changes in demand meeting will increase productivity, the number of the manpower will be reduced and the operationally expensive unsustainable facilities will be closed down.

In the ideal scenario foreseeing restructuring the coal mines, the major problem is starting-up new capacities. This can take 7 - 8 years.

The main issue to be solved by the time the planned new facilities are put into operation is how to efficiently operate the mines so that their capacity will allow for a long-term TPP power supply.

To meet the above, the following steps need to be taken:

- Adoption of policies to increase the coal-mining rate to meet the needs of new capacities,
- investing in coal mines and manpower. Restructuring of the coal mining, investment and manpower policy [4],
- restructuring of coal mining to allow for a long-term TPP supply.

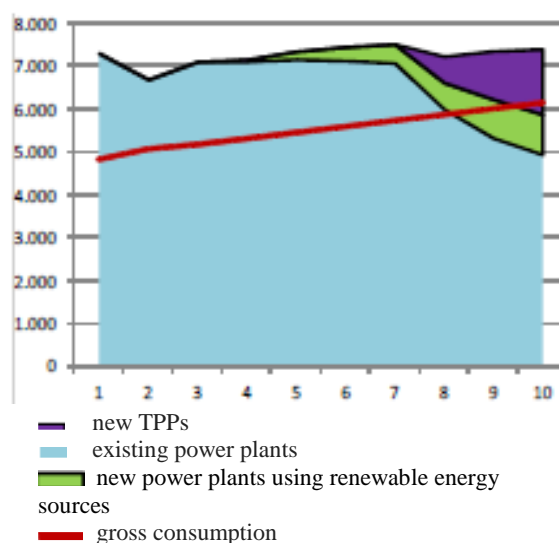


Figure 1 shows the investment scenarios

## 3 SCENARIO WITH NO CONSTRUCTION

The facilities using renewable energy sources will not be able to meet the demand without building new capacities, because of closing down the Tuzla Units 3 and 4 and Kakanj Unit 5.

Despite constructing the planned capacities using renewable energy sources, the total production in 2020 will not meet the demand. In this scenario, the need for coal drastically falls. By 2020, the Tuzla TPP will be needing only 624,000 tons of lignite and 170,000 tons of brown coal 1, meaning that the majority of the mines shall have to be closed down.

Based on this scenario, new facilities need to be constructed. Delaying their construction can have serious consequences.

The investment in production facilities is assessed at 2.02 billion €. It includes 14 plants using renewable energy sources (0.615 billion €) and two thermal plants necessitating an additional mining capacity of 1.41 billion €.

Besides the planned new capacities, there are investments under process in the existing production capacities and mining facilities which will in 10 years amount to 0.71 billion €: the total investment cost is over 2,72 billion €. The disproportion between the needs and possibilities is considerable.

The own sources are limited by depreciation which is further reduced because of loan servicing.

The structure of the financial model to solve the issue of constructing new production capacities involves:

- Increased credit indebtedness and
- Joint ventures with strategic partners.

To meet the target, the following two basic models financing should be pursued:

- corporate finance-borrowing to expand power generation,
- shareholding project financing and / or an energy strategic partner.

The first model can be used for small projects using renewable energy sources and constructed through favorable loans. The rate of indebtedness of the Elektroprivreda is low, so there is enough space for new long-term indebtedment.

Another reason for not looking for strategic partners is the lack of time, selecting a partner would significantly postpone the beginning of realization of some projects that should be completed this year.

With new coal-fired TPPs, the volume of investment increases significantly and exceeds the loan possibilities in terms of financial indicators, complexity, size and risk of these projects.

A solution is to implement models of projects to be implemented with a strategic partner. The dynamics of implementation of new projects depends on funding and fulfillment of formal procedures and requirements.

The time needed to prepare the projects and obtain permits and licences should be well considered to avoid prolongation of their implementation and limitation of the number of projects.

#### 4 PREFERENCES

Notwithstanding the above, the priority should be given to:

- beginning of realization of one project from the portfolio of the renewable energy sources and a new Tuzla unit,
- coal mining restructuring on a long-term basis,
- continuation of the preparatory activities for other projects, setting up a model of the financial construction.

Based on the funding opportunities and the expected reduced production of the existing capacities, the dynamics of starting the construction of new capacities and their commissioning should be laid down. [5].

#### 5 CONCLUSIONS

The energy sector of the Federation of Bosnia and Herzegovina, is certainly one of the most important generators of its economic, industrial and overall development and in future its impact will even further strengthened.

The Elektroprivreda BiH, as a carrier of the energy sector, is continuously working on modernization of the federal power grid by improving the production facilities, reducing the network power losses and contributing to a better quality of service.

The Federation of Bosnia and Herzegovina is in the process of approaching the EU with many challenges concerning the energy industry, because the EU has set very high goals and standards for the sector.

The EU countries themselves are a strong competitor on the free, unique and liberal electricity market.

The Elektroprivreda BiH has the capacity to be an equal player in the electricity market.

The advantage of the Federation of Bosnia and Herzegovina is its national power independence. Its future priority is towards improving the consumer power supply and stable and sustainable power system. One such example is the Tuzla TPP Unit 7 which meets the power demand and shows a steady surplus of electricity.

Apparently, realization of certain Elektroprivreda investments has been delayed for some time because of the current political situation in the country and also because of the developments on the capital market.

Table 3. Specific projects and targeted dynamics

	Object	Total installed power (MW)	Potential annual production (GWh)	Investment (mil. €)	Start of construction	Entry into service	Financing model
1	Vranduk HPP	20	96	64	2012	2015	Corporate
2	Small HPP Neretvica	26	102	49.7	2012	2014/15/16	Corporate
3	WP Podveležje	46	93	64.1	2012	2014	Corporate
	<b>TOTAL RES</b>	<b>92</b>	<b>291</b>	<b>178.46</b>			
	Tuzla G7	450	2535	769.23	2013		Project-foreign partners
<b>4</b>	<b>TOTAL</b>	<b>653</b>	<b>2826</b>	<b>947.69</b>			

\*\*\* WP- wind park

## REFERENCES

- [1] The analysis of the possibilities for the realization of capital investments in EP BiH ", NO EP BiH, 13. 2. 2012 g., Page 17..
- [2] The three- year business plan JP Elektroprivreda BiH dd Sarajevo, 2013.2014. 2015 p. 9
- [3] Analysis of mining management in the context of Concern Elektroprivreda BiH, 2013, page 6th
- [4] The three-year business plan JP Elektroprivreda BiH dd Sarajevo, 2013,2014,2015.g. p 12
- [5] Decision on preparation and construction of the HPP Vranduk 23 MW and 19.63 MW on the Bosna River (Fig. Gazette FBiH No. 13/10 and 34/11); p. 2,

**Enver Agić** received his Ph.D. degree in electrical engineering in 2014 from the Faculty of Electrical Engineering, University of Osijek, Croatia. He is working at the Council of Ministers of Bosnia and Herzegovina and has been a Chairman of the Supervisory Board of the Elektroprivreda BiH since 2011. He is a vicepresident of the BiH Committee of CIGRE. His research interests are in renewable energy sources, energy efficiency, research in the electricity market energy economy.

**Damir Šljivac** received his Ph.D. degree in electrical engineering in 2005 from the Faculty of Electrical Engineering, University of Zagreb, Croatia. He is employed with the Faculty of Electrical Engineering, University of Osijek, Croatia. His research interests are in power system analysis, power system dynamics and stability, efficiency, research in the electricity market, energy economy, etc.