

The Potential of Renewable Energy Sources in Bosnia and Herzegovina

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PHYSICAL CHARACTERISTICS AND TERRITORIAL ORGANIZATION

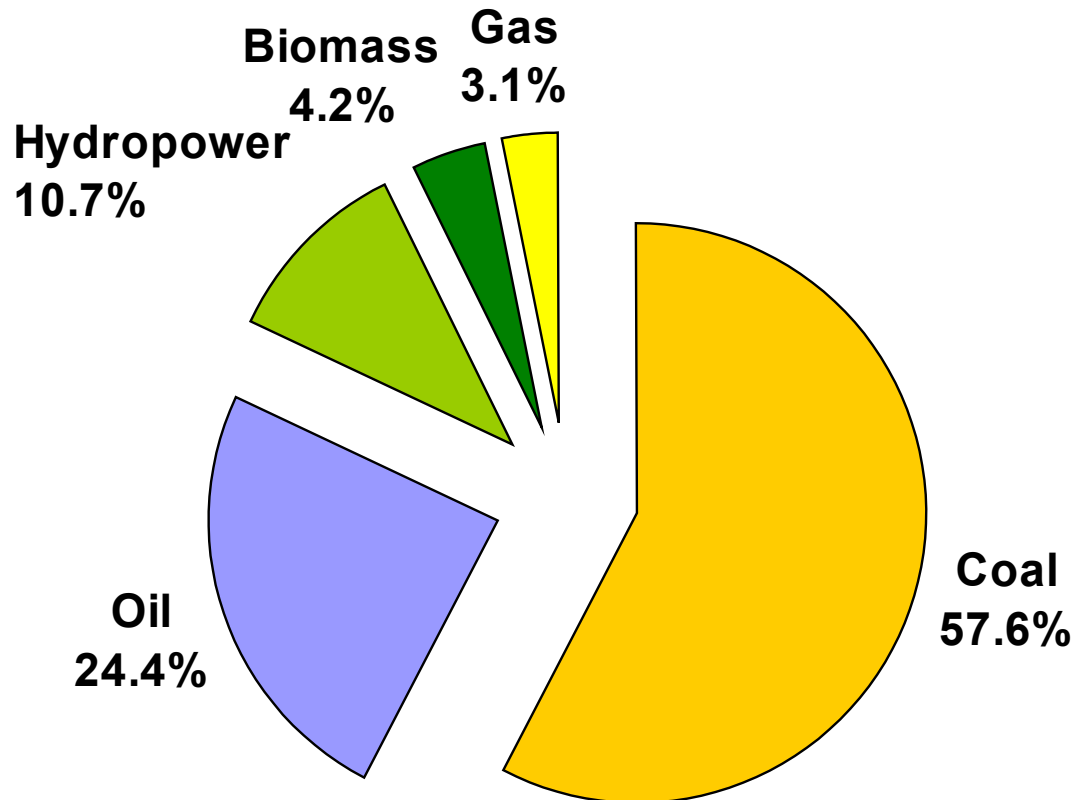


- Country is positioned in SEE region, Balkan Peninsula, bordering to the N, W, and SW to Croatia (932 km), and to the east to Serbia and Montenegro (606 km).
- 13 km long coastline along the Adriatic Sea around the town of Neum.
- The climate is moderately continental, and in southern part Mediterranean.
- Territorial organisation differs in two entities. Republic of Srpska has municipal structure (64 municipalities), while Federation B&H consists of 10 cantons.

PHYSICAL CHARACTERISTICS AND TERRITORIAL ORGANIZATION

- ❑ Bosnia and Herzegovina is a hilly-and-mountainous country. Of the total surface area, 5% are lowlands, 24% hills, 42% mountains and 29% karst.
- ❑ Forests and forestlands cover about 50% of the territory.
- ❑ The total agricultural land covers 2.5 million hectares or 0.7 hectares per capita.
- ❑ Bosnia and Herzegovina possesses significant water resources (average annual precipitation on the territory of Bosnia and Herzegovina is 1250 l/m², which is some 250 l/m² higher than the average in European countries).

PRIMARY ENERGY DEMAND IN BOSNIA AND HERZEGOVINA IN 2003



SMALL HYDRO

No	Watershed – River	Maximum Electrical Capacity	Annual Energy Output
		MW	GWh
1.	Una*	392.10	1566.7
2.	Vrbas	616.89	2427.47
3.	Bosna	365.78	1593.60
4.	Drina*	1838.61	7107.66
5.	Sava*	55.55	283.05
6.	Cetina	197.00	594.40
7.	Neretva	1548.00	5048.21
8.	Trebišnjica*	1112.4	3429.50
BiH – TOTAL		6126.33	22050.59

SMALL HYDRO

- Development of small hydro power plants (HPPs) is most promising renewable energy source in Bosnia & Herzegovina at the moment.
- The potential convenient for construction of small hydro power plants in BiH amounts to 1004.63 MW or 3519.74 GWh.
- Out of that, FB&H has at it's disposal about 2090 GWh, and Republic of Srpska 1430 GWh.

GEO THERMAL

- ❑ Northern Part of Bosnia & Herzegovina is a part of Panonian basin collector.
- ❑ Temperature of thermal water 80-100°C.
- ❑ Average depth 2 km.
- ❑ Reservoir thickness up to 1000m.
- ❑ Energy equivalent rough estimation $7 \times 10^6 t_{e_0}$.
- ❑ It can be possible establish thermal units 50-100MW_t for district heating systems.
- ❑ It is economically effective to produce electricity based on binary cycles concept (analysis based on 1MW_e power plant example).

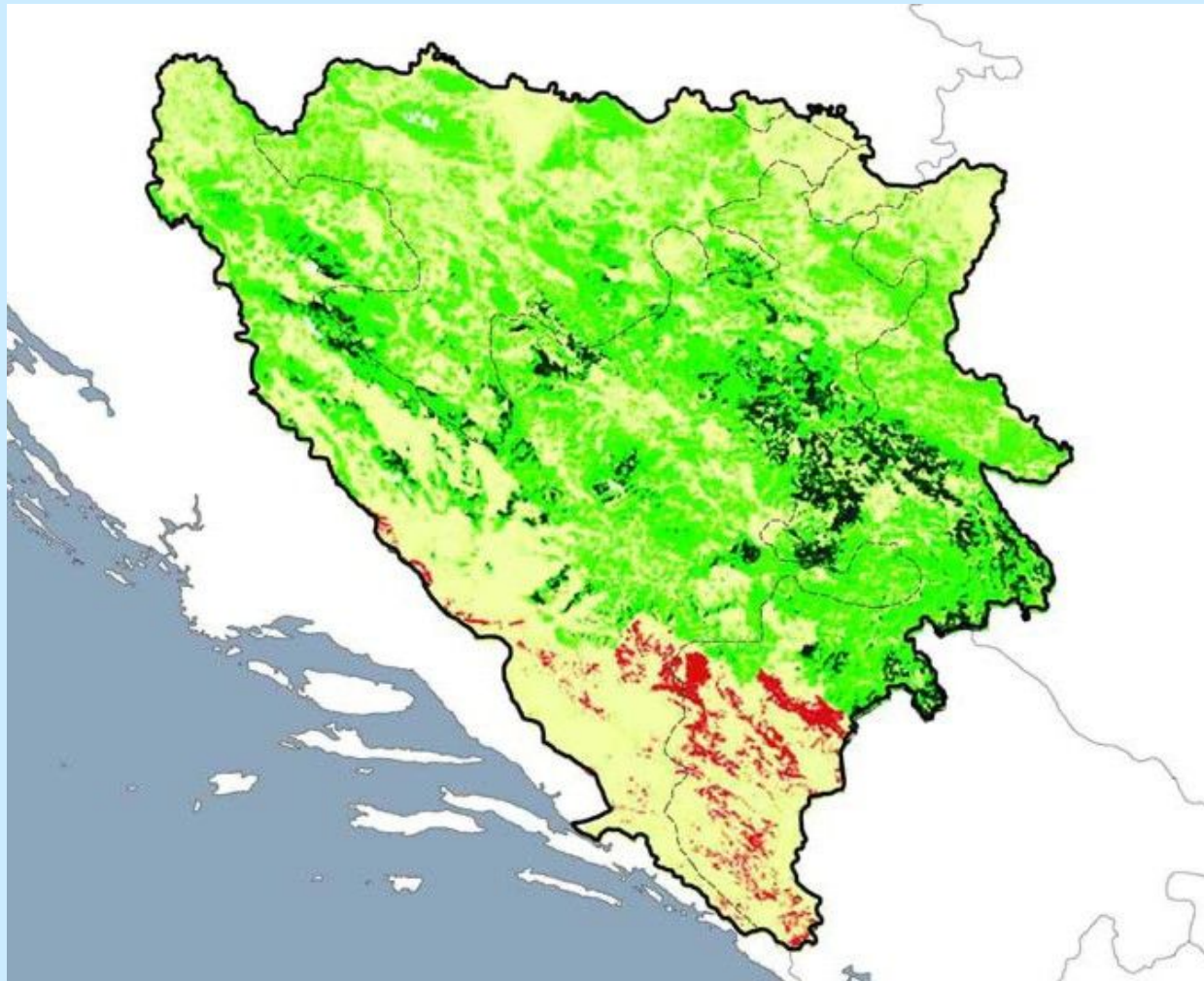
BIOMASS

- One of the most promising renewable sources in Bosnia and Herzegovina
- Wood biomass
 - Forest waste
 - Wood processing industry waste
- Agriculture
 - Animal waste – biogas production
 - Agricultural waste
 - Synthetic fuels

Total biomass energy potential in Bosnia and Herzegovina

Biomass origin	Biomass available	Energy potential in PJ
Biogas from livestock, m ³	20 100 000	0.506
Fruit tree branches, t	211 257	0.739
Grain residues, t	634 000	8.876
Leguminosae and oil crops residues, t	3 858	0.038
Residues from log processing, m ³	1 141 398	7.524
Firewood, m ³	1 464 706	13.181
Branches, m ³	599 251	2.621
Additional theoretical potential	unknown	unknown
Total		33.485

Forest area in Bosnia and Herzegovina (approx. 2.7mil.ha)



Annual production of wood assortment per regions of Bosnia and Herzegovina [m³]

	Logs	Firewood	Wood residue	Total
Federation of B&H	2795227	947732	576887	4319846
Republic of Srpska	1798894	516974	271619	2587577
Brcko District B&H	3420	2267	683	6370
Total (Bosnia and Herzegovina)	4597627	1466973	849189	6913783

BIOMASS – WOOD WASTE

- There are about **1600 sawmills** operating in Bosnia and Herzegovina (most of them are small scale, established after the war).
- The national saw milling capacity is estimated about **2000000 m³** of sawn timber per annum.
- Wood waste in Bosnia & Herzegovina can generate about 5200 GWh of thermal equivalent, which means ~600 MW of installed thermal capacity.
- Potential cogeneration can produce ~ **410 MW** of heat and ~ **200 MW** of electric energy per annum.

Estimated costs of plants for the transformation of wood residues into electricity in BaH

Investment costs	€ 250,000	€ 2,500,000	€ 20,000,000	€ 22,000,000	€ 40,000,000
Capacity el. MW	0.20	1.00	5.00	10.00	20.00
Years of depreciation	15	15	15	20	20
Nominal interest	6 %	6 %	6 %	6 %	6 %
Operation hours (h)	5,000	5,000	7,000	7,000	7,000
Operation hours of heat emission (h)	2,000	2,000	1,500		
Fuel expenses	€ 15.00	€ 15.00	€ 15.00	€ 12.00	€ 12.00
Employees (Empl.)	2	6	13	15	18
Costs /Empl.*a	€ 1,000.00	€ 1,000.00	€ 1,000.00	€ 1,000.00	€ 1,000.00
Variable costs	2.0 %	2.0 %	2.0 %	2.0 %	2.0 %
Maintenance	1.2 %	1.2 %	1.2 %	1.2 %	1.2 %
Spec. costs/MWh	€ 1.40	€ 1.40	€ 2.10	€ 2.60	€ 3.30
Electr. efficiency	20 %	13 %	25 %	27 %	29 %
Calorific value (MWh/t)	3.8	3.8	3.8	3.8	3.8

Costs overview for different kind of fuels and energy carriers by using them for heating during winter period

Fuel, energy carrier (kind of energy)		Cost difference amongst to natural gas, %	Price of 1 kWh of finaly energy, KM/kWh
1		6	7
Electricity (commercial subjects and industry)	HT	+427.3	0.427
	LT	+175.4	0.223
	MT	+301.5	0.326
Electricity (households)	HT	+139.5	0.194
	LT	+28.9	0.105
	MT	+84.2	0.149
Natural gas (commercial subjects and industry)		+33,8	0.109
Natural gas (households)		0.00	0.081
Fuel oil (EL)		+151.9	0.204
LPG (propan-buthan)		+80,4	0.146
Coal		- 12,6	0.072
Wood		-25,6	0.065

Potential of wood waste in several municipalities

Municipality	Total wood mass [m ³]	Forest waste [m ³]	Sawmill waste [m ³]	Final processing industry waste [m ³]	Firewood [m ³]	Lignite equivalent [t]x10 ³
Han Pijesak	141.176	21.176	25.264	26.527	3.697	49,8
Rogatica	65.260	8.260	12.326	12.943	6.800	26,2
Kneževo	60.028	7.104	10.811	11.351	6.432	23,2
Kotor Varoš	96.889	14.534	13.356	14.024	32.200	48,2
Pale	112.416	19.099	18.972	19.920	15.322	47,1

BIOMASS – BIOGAS

Cattle fund in North Western part of Bosnia and Herzegovina

	Cows	Sheeps	Goats	Pigs	Poultry
Part in RS	108.050	126.030	7.423	126.740	1.423.799
Part in FB&H	44.203	88.492	4.660	11.150	684.333
TOTAL	152.253	214.522	12.083	137.890	2.108.132

Daily biogas production from typical farms

	Cows	Pigs	Poultry	
Capaacity	20	100	5000	12000
Biogas production m ³ /day	18.4	24.2	39.42	94.17

Biogas – economy

- Gas engine and biogas production plant for 6 kW 20.000 – 25.000 EURO.
- Payback period according to present electricity and fertilizers market conditions (without any subventions):
 - Cow farm 8 - 10 years,
 - Pig farm 11 - 14 years,
 - Poultry farm 7.5 - 9.5 years.

What do we need in order to improve position of RENEWABLE ENERGY SOURCES in Bosnia and Herzegovina?

- ❑ Energy Strategy on entity and state level, which have to define position of renewables in energy sector.
- ❑ Mechanisms for promotion of renewable energy sources (Feed-in tariffs, Green certificates, Renewable obligations, Cofinancing, Taxes, etc.).
- ❑ Ratification of Kyoto, in order to use Kyoto mechanisms (CDM).

THANK YOU!

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