



Decarbonizing the Bosnian EPBiH power utility through biomass retrofitting at the Tuzla and Kakanj power plants

- BIOFIT Industry session CHP and Fossil fired Power plants -



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 817999.







1. Briefly about EPBiH power utility.

- 2. RD&D Bioenergy activities for TPP Tuzla and TPP Kakanj.
- 3. BIOFIT results for Tuzla TPP and Kakanj TPP.



EPBiH – generation technological mix





- 2 coal-based power plants, Tuzla TPP and Kakanj TPP.
- 3 large hydro power plants on river Neretva.
- 6 sHPP.
- 1 Wind power park (48 MW).
- Annual generation 7,500 GWh of power and 350 GWh of heat.
- Installed capacity Fossil/RES = 66/33.
- Generation ratio Fossil/RES = 75/25.

EPBiH -key energy indicators

- Coal consumption cca 5,000,000 tonnes per year.
- Average net efficiency of thermal power plants (condensing regime) is 31.0%.
- Annual CO₂ emissions cca 5,000,000 tonnes per year.
- Avr. (5Y) CO₂ emission factor of thermal power plants is 1,000 kgCO₂/MWh.
- CO₂ emission factor of EPBiH in 2021 is 770 kg/MWh.
- Avr. (5Y) EPBiH net emission rate (incl. RES accepted) is 670 kgCO₂/MWh.







• EPBiH – 2050 RES and CO₂ cut targets





How to achieve sustainable CO₂ cut until 2050?



EPBiH – 2050 technological mix









- ✓ Energy tranzition from fossils to RES.
- ✓ Decarbonization and coal-phase out until 2050.
- ✓ Just tranzition of coal regions.
- ✓ Bioenergy is part of solution!







1. Briefly about EPBiH power utility.

- 2. RD&D Bioenergy activities for TPP Tuzla and TPP Kakanj.
- 3. BIOFIT results for Tuzla TPP and Kakanj TPP.

EPBiH bioenergy options; logistics



➤Waste woody biomass

SRC and bioenergy crops

Waste-to-energy (RDF/SRF)





R&D - Lab-scale tests; from 2006







1 TET5:WB = 93:7%w 2 TET5:WB = 85:15%w 3 TET5:M = 93:7% w4 TET7:WB = 85:15%w 5 TET7:WB:M = 80:13:7% W6 TET7:WB:M = 75:15:10%w 7 TEK6:WB = 85:15% w8 TEK6:WB = 75:25% w9 TEK6:M = 93:7% W10 TEK8:WB = 75:25% W11 TEK8:WB:M = 85:8:7% w12 TEK8:WB:M = 75:15:10% W

0.1-rate biomass co-firing Kakanj CHP – from 2011





Characteristics of wooden biomass supplied:

- Particle size: max 8 mm (wooden sawdust)
- Hd = 12-14 MJ/kg, W = 20%, A = 0.3%









BIOFIT

Bioenergy Retrofits for Europe's Industry



Bioenergy plantations on former coalmines – from 2020





SRF/RDF cofiring with Coal

Bioenergy Retrofits for Europe's Industry

- R&D programm developed during 2021.
- Activities planned to be completed 2021-2024:
 - Logistic Study Sept. 2021.
 - Lab-scale tests 3-15%t SRF cofiring on entrained flow furnace, 2022.
 - Prea-feasibility study (EPBiH), 2022.
 - Planing of investment, 2022.
 - Trial run in Tuzla and Kakanj power stations, 2022.
 - Feasibility Study with Conceptual Design and ESIA, Permiting, 2023.
 - Installation of SRF feeding system in Tuzla and Kakanj, 2023/2024.
- Operation of SRF cofiring planned to start in 2024.
- Option of full conversion of one unit to waste (or waste&biomass?)









- **1. Briefly about EPBiH power utility.**
- 2. RD&D Bioenergy activities for TPP Tuzla and TPP Kakanj.
- 3. BIOFIT results for Tuzla TPP and Kakanj TPP.

Horizon 2020 project BIOFIT, 2018-2022 - ongoing

JP Elektroprivreda BiH – 2 case-study:

✓ Biomass co-firing on unit 6, 223 MWe in Tuzla CHP

✓ Full biomass repowring on unit 5, 118 MWe in Kakanj CHP



Bioenergy Retrofits for Europe's Industry



Intended retrofits for Tuzla and Kakanj





Biomass co-firing on existing brown coal unit in Tuzla TPP (CHP Unit 6 - 226 MWe) – up to 0.3 biomass cofiring (avr. 0.15)

- Biomass type: waste wood, agricultural biomass and energy crops for co-firing on Tuzla TPP Unit 6

Biomass repowering of one unit in Kakanj TPP (CHP Unit 5 - 118 MWe/150 MWt) – full biomass conversion. -Biomass type: waste wood 90%, energy crops + RDF 10%

TPP Tuzla – Unit 6, 223 MWe - Desrciption



- Unit put into operation in 1978, modernized in 2013.
- Two pass boiler of Unit 6 (223 MW) is water wall type boiler with pulverized coal combustion. Coal milling is performed by six ventilator mills.
- The PC boiler with dry bottom furnace is equipped with 12 burners arranged in two levels, two burners from front and back side and one burner from left and right side. Temp. In furnace 1150-1200 °C.
- Jet low-NOx burners. OFA System. NOx emissions is app. 200-300 mg/mn³ at 6% O2 dry.
- Turbine LP and HP modernized.
- MP turbine reconstruction in preparation with steam extractions for cogeneration (220 MWt).
- ESP modernized (PM <30 mg/mn³ at 6% O2 dry. DeSOx in preparation.
- Brown Coal is used from two nearby coalmines, LHV: 14-16 MJ/kg.
- 15-30% biomass cofiring planned.

Coal burners at Unit 6



Tuzla Unit 6 – 0.15 biomass co-firing, input

Bioenergy Retrofits for Europe's Industry

Inputs / Outputs	Unit	Reference (coal-firing)	Retrofit Scenario A	Retrofit Scenario B	Retrofit Scenario C
Input - Coal	t	830,000	821,107	741,071	705,500
Input - Coal	GJ	13,371,300	13,228,036	11,938,661	11,365,605
Input - Biomass fuel	t	0	8,893	88,929	124,500
Input - Biomass fuel	GJ	0	106,714	1,067,143	1,494,000
Output - fossil CO ₂ emissions	tCO ₂	1,062,400	1,051,017	948,571	903,040
Output - Electricity (coal)	MWh-e	1,249	1,236	1,099	1,046
Output - Electricty (biomass)	MWh-e	0	10	98	137
Output - Electricty (total)	MWh-e	1,249	1,246	1,197	1,183



Tuzla unit 6 biomass cofiring-next steps

Type of biomass:

- Woody biomass (residues: bark, stump, sawdust, chips), agriculture biomass, bioenergy crops.
- Biomass LHV in range 6-14 MJ/kg

Share of biomass to be used:

- 0..30% w biomass co-firing (avr. 15% w).
- Trial run (ongoing): Planned in order to investigate behavior of transport system and boiler
- performance with use of 5%, 10% and 15% biomass co-firing.
- *Option:* 0..15%w biomass co-firing with no or minimal adaptation of transport/Boiler equipme depo (or silos?) and crash/cutting machines included in Investment.

Completion of BIOFIT Study of Tuzla unit 6 - case-study:

Option: 0..30%w biomass co-firing with adaptation of transport/Boiler equipment (along adaptation of depo or silos and crash/cutting machines, a dedicated biomass transport line from depo/silos to boiler as well as biomass mill/burners are included in Investment). CAPEXup to 10 MEur.





TPP Kakanj – Unit 5, 118 MWe - description

- Unit put into operation in 1969, modernized in 2003.
- Cogeneration unit (electricity + heat for district heating)
- PC Boiler with slag tap furnace, temp. in furnace 1450-1500 °C.
- 6 Hammer mils. 12 low-NOx swirl coal burners, placed in two rows.
- OFA system (placed in two rows).
- 91% Boiler efficiency.
- LP and HP Turbine modernized.
- 33% net efficiency of the unit (in condensing regime).
- Hybrid ESP-Buggy dust filter (<10 mg/mn³).
- Brown coal used from nearby coalmines, LHV: 12-13 MJ/kg.
- Opt-out end of 2023.
- Biomass repowering planned to continiu operation.



Kakanj unit 5 - full repowering, input

Parameter	Unit	Condensing (CWT 15 °C)	Condensing / CWT 32 °C	CHP (max heat output) / CWT 15 °C	CHP (actual heat output) / CWT 15 °C	
Biomass fuel input	MW-fuel	213	213	213	213	
Boiler Capacity	MWth	187	187	187	187	
Electrical Power, gross	MWe	77.4	72.8	56.7	72.7	
Electrical Power, net	MWe	68.9	64.3	48.2	64.2	
Heating Capacity	MWth	0	0	80	18	
Operating regime	h/a	2,000	1,500	-	3,500	7,000
Inputs / Outputs	Unit	Condensing Operation (CWT 15°C)	Condensing Operation (CWT 32°C)		CHP mode (CWT 15°C)	Total
Input - Biomass fuel	GJ	1,533,600	1,150,200		2,683,800	5,367,600
Output - Electricity	MWh-e	137,800	96,450		224,700	458,950
Output - Heat	MWh-th	0	0		63,000	63,000
Net electrical efficiency	%	32.3%	30.2%	22.6%	30.1%	30.8%
Net thermal efficiency	%	0.0%	0.0%	37.6%	8.5%	4.2%

- · Sand particle size 0.5 1.5 mm
- Static bed height 40-60 cm
- Fluidizing velocity 0.8 -1.2 m/s
- Bed temperature 700 950 °C
- Pressure drop 6 9 kPa







www.biofit-h2020.eu

Completion of BIOFIT Study of Kakanj unit 5 - case-study: *Option:* 0..100% biomass co-firing with full adaptation of transport/Boiler equipment. Along adaptation of depo or silos and crash/cutting machines, focus is on full conversion of boiler furnace from PC coal combustion to BFB biomass firing or CFB multi-fuel firing. Installed power reduction from 110 MWe/150 MWt to 77 MWe/80 MWt.

Kakanj Unit 5 with use of 10%, 20% and 30% w of biomass. *Option:* 0..30% biomass co-firing with partial adaptation of transport/Boiler equipment. Along adaptation of depo or

silos and crash/cutting machines, focus is on adaptation from PC coal combustion to PC biomass co-firing.

Kakanj unit 5 repowring – next steps

Trial run (1Q this year): planned in order to investigate behavior of existing transport system and boiler performance of

0..100%w – full conversion to biomass



Share of biomass to be used:

Estimation of CAPEX: 30 MEur (BFB).

Type of biomass:





Benefits – concluding remarks



- Biomass use is cost-benefitial in case of Tuzla unit 6 and Kakanj unit 5 compared to the coal only operation.
- Carbon cut is significant (100,000 t/y for Tuzla 6 and 500,000 t/y for Kakanj unit 5).
- Polutant emissions are decreased.
- Increase of Electricity price and ETS price play in favour of biomass use in both cases.
- There is complience with GHG criteria from RED II.

Challenges/risks – concluding remarks



- <u>Commercial</u>: insufficient biomass quantities mobilized to ensure the operation of the unit as foreseen by the economic analysis.
- <u>Regulatory/Technical</u>: RED II is implemented and co-firing operations are not considered as producing renewable energy since biomass is not the main fuel in case of cofiring on Tuzla unit 6.
- <u>Regulatory/Technical</u>: RED II is implemented and the net electrical efficiency criterion (min. 36 %) is not met either in case of Kakanj unit 5 or Tuzla unit 6. Derogation is necessary in Bosnisan RED II or replacement/modernization of Turbine set to incease net efficiency.
- <u>Regulatory/Technical:</u> Both Tuzla unit 6 and Kakanj unit 5 are co-generation units providing significant amount of heat to local people (200,000) and industry in Tuzla, Lukavac and Kakanj. RED II does not recognize importance of social-environmental aspect of large-scale co-generation, only suporting high-efficient cogeneration, which is dificult to achieve for any operator.



THANK YOU FOR YOUR ATTENTION

On behalf EPBiH BIOFIT Team, Anes Kazagic, PhD

JP Elektroprivreda BiH d.d.-Sarajevo Strategic Development Dept.

Email: a.kazagic (at) epbih.ba

The sole responsibility for the content of this flyer lies with the authors. It does not necessarily reflect the opinion of the European Union. Neither the INEA nor the European Commission are responsible for any use that may be made of the information contained therein.

