

# MOGUĆNOSTI DALJINSKOG GRIJANJA I KOGENERACIJE ZA EFIKASNIJE I OKOLINSKI PRIHVATLJIVIJE SNABDIJEVANJE TOPLINSKOM ENERGIJOM

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**JP ELEKTROPRIVREDA BiH**

d.d. - Sarajevo



**TOPLANE SARAJEVO**  
DISTRICT HEATING SYSTEM

# UVODNE NAPOMENE

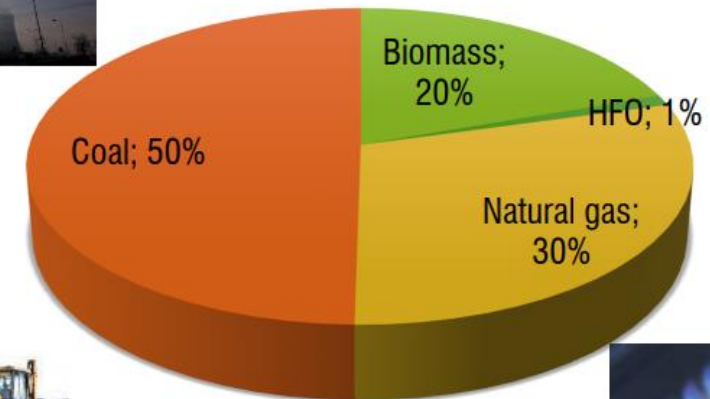
- ▶ Heat supply from fossil fuels is still very high, both in the world (90%) and in the European Union (70%).
- ▶ In Europe, the heating and cooling demand accounts for around 50% of the final energy consumption.
- ▶ The contribution of DH in the EU accounts for 9% and is mainly driven by fossil fuels such as gas and coal.
- ▶ The contribution of DH in Bosnia nad Hercegovina accounts also for 9% and is driven by fossil (coal and gas) and biomass.
- ▶ Decarbonization policy: In order to reduce carbon dioxide emissions in the heating/cooling sector, DH and cogeneration should increase, while new non-fossil heat sources must replace the current fossil-based plants.

# OVERVIEW OF DHS IN BOSNIA AND HERZEGOVINA



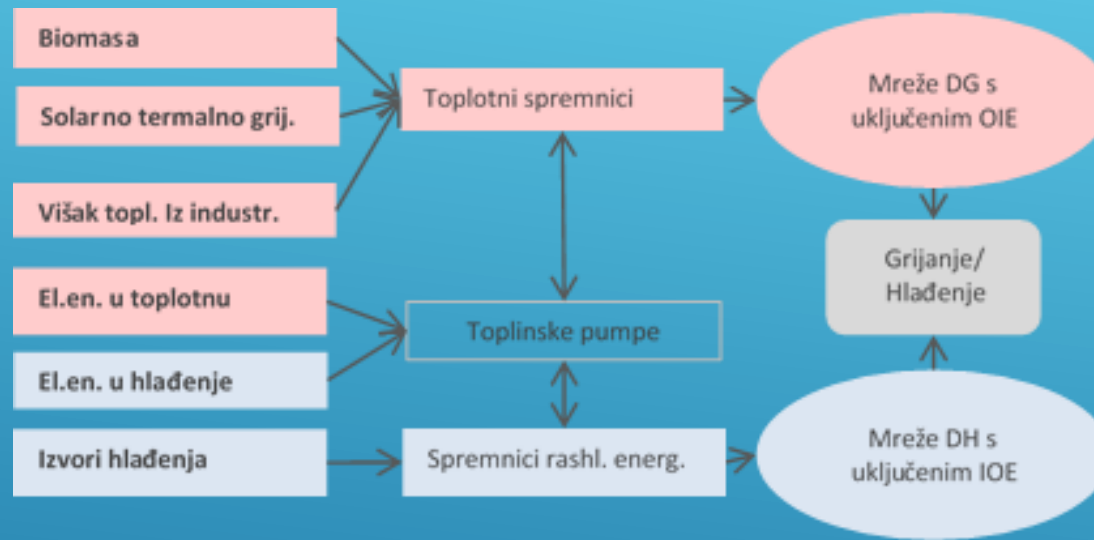
## DHS in BiH

- DHS in urban places
  - DHS in energy utilities
  - Local DHS from local factory
- 35 systems for heating
  - 25 yrs old (avrg)
  - Installed capacity: 1,8 GW
  - Heat production: 1,5 TWh/a
- Heat plant  
 TPP/HP  
 Non operate



# SADRŽAJ

- **COOLHEATING CONCEPT**  
- MALE MODULARNE MREŽE DALJINSKOG GRIJANJA I HLAĐENJA NA OIE



- **UPGRADE DH CONCEPT**  
- POBOLJŠANJE SDG POVEĆANJEM EN.EF., DIGITALIZACIJOM I UVOĐENJEM OIE



- **COGENERATION CONCEPT – PROJEKTI SDG I KONVERZIJE U KOGENERACIJU;**  
- PPRIMJERI EPBIH I TOPLANE SARAJEVO



**TOPLANE SARAJEVO**  
DISTRICT HEATING SYSTEM

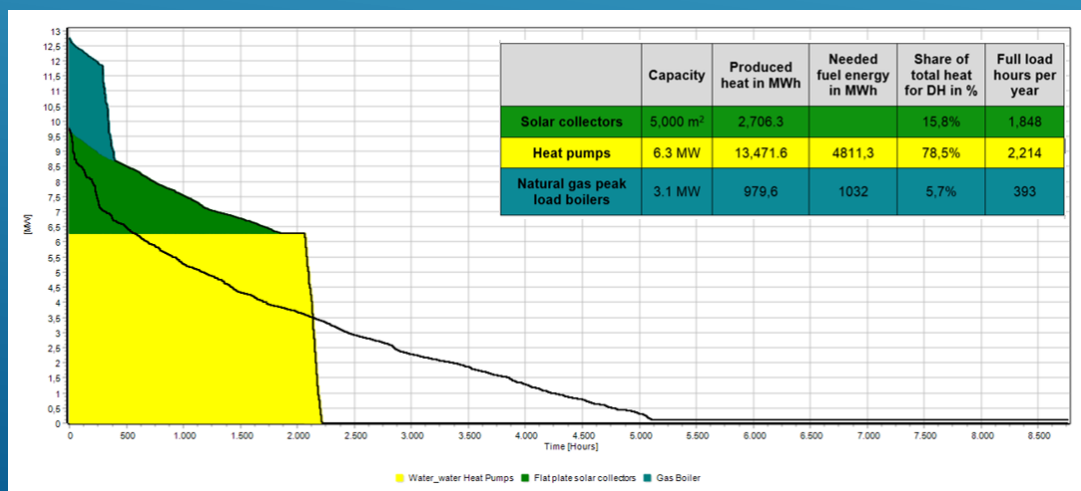
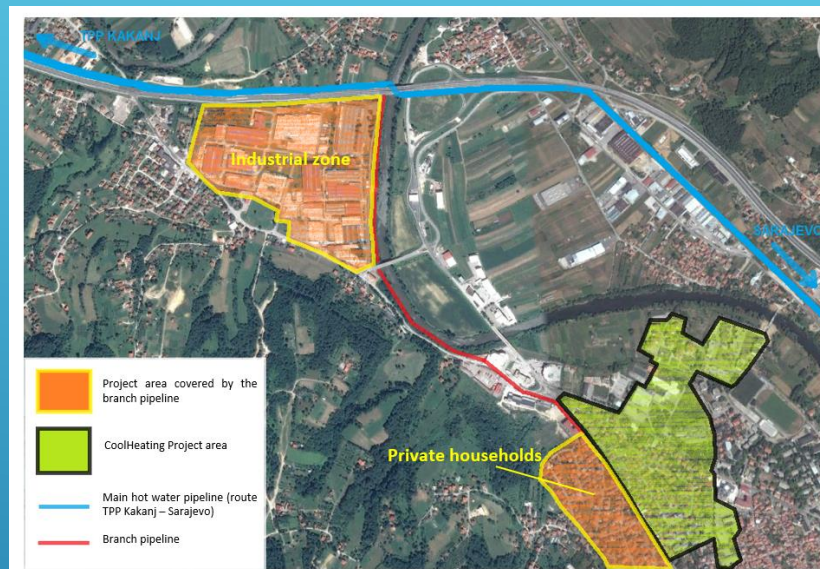
# TARGET COOLHEATING COMMUNITY IN BIH - MUNICIPALITY VISOKO



- ▶ Current sources of heating:
  - gas - part of town covered by gas distribution system
  - coal and wood in individual small household boilers
  - electricity
- ▶ Ratio: 10% gas vs 90% household boilers (coal, wood) & electricity
- ▶ Due to price of natural gas → many consumers turn to individual solutions for heating
- ▶ Sources of heat considered:
  - alternatives based on bio-waste
  - waste heat from TPP Kakanj (can operate in co-firing mode of coal & biomass)
  - CoolHeating concept

|                                                   |                                        |
|---------------------------------------------------|----------------------------------------|
| <b>Population:</b>                                | <b>41.352</b>                          |
| <b>Number of households - individual housing:</b> | <b>12.953</b>                          |
| <b>Number of households - collective housing:</b> | <b>16.628</b>                          |
| <b>Local areas:</b>                               | <b>26 areas (5 urban, 21 suburban)</b> |

# ZNAČAJKE COOLHEATING PROJEKTA VISOKO



- Toplotne pumpe
- Gasni kotlovi (postojeći) – **rezerva i vrhovi**
- Solarni fotonaponski modul
- Solarni termalni kolektori
- Spremnik topline (jamski)
- Ukupna dužina mreže DG

6.3 MW  
3.1 MW  
800 kW  
5,000 m²  
13,500 m³  
5.500m

- Ukupna instalirana snaga za sve proizvodne jedinice 9,4 MWt.
- Godišnja potrošnja topline 17 GWht

# POKAZATELJI COOLHEATING PROJEKTA VISOKO

- Godišnja potrošnja el.energije i goriva predviđenog CoolHeating sistema Visoko:
  - o 4811 MWh električne energije za toplinske pumpe
  - o 1032 MWh prirodnog plina za kotao vršnog opterećenja

Uštede u troškovima goriva i uštede u emisijama CO<sub>2</sub> i polutanata

| Current situation:                      |             |              |                         | Emission factors (g/GJ and kg/MWh for electricity) <sup>1)</sup> |                         |             |         |         |         |          |              |           |         | Emission (t) |                 |          |                       | Fuel unit price |                  | Fuel costs |                | Investment costs<br>(Replacement of existing units and equipment) |  |
|-----------------------------------------|-------------|--------------|-------------------------|------------------------------------------------------------------|-------------------------|-------------|---------|---------|---------|----------|--------------|-----------|---------|--------------|-----------------|----------|-----------------------|-----------------|------------------|------------|----------------|-------------------------------------------------------------------|--|
| Heat production - Collective households |             |              |                         | Lower heating value (LHV)                                        |                         | Fuel amount |         | CO2     | NOx     | SOx      | PM10         | PM2.5     | CO2     | NOx          | SOx             | PM10     | PM2.5                 | CO2             | NOx              | SOx        | PM10           | PM2.5                                                             |  |
| Logwood                                 | 17%         | 1989 MWh     | 11000 kJ/kg             | 0,003056 MWh/kg                                                  | 685205,7 kg             | 7537,26 GJ  | 8000    | 74,5    | 20      | 695      | 695          | 60,30     | 0,56    | 0,15         | 5,24            | 5,24     | 45 €/m3               | 0,06 €/kg       | €                | 41.112,34  |                |                                                                   |  |
| Woodchips                               | 13%         | 1521 MWh     | 11500 kJ/kg             | 0,003194 MWh/kg                                                  | 501199,1 kg             | 5763,79 GJ  | 11760   | 74,5    | 20      | 695      | 695          | 67,78     | 0,43    | 0,12         | 4,01            | 4,01     | 75 €/t                | 0,075 €/kg      | €                | 37.589,93  |                |                                                                   |  |
| Pellets                                 | 3%          | 351 MWh      | 17000 kJ/kg             | 0,004722 MWh/kg                                                  | 78241,49 kg             | 1330,11 GJ  | 9560    | 74,5    | 20      | 695      | 695          | 12,72     | 0,10    | 0,03         | 0,92            | 0,92     | 225 €/t               | 0,225 €/kg      | €                | 17.604,33  |                |                                                                   |  |
| Natural gas                             | 27%         | 3159 MWh     | 34000 kJ/m <sup>3</sup> | 0,009444 MWh/kg                                                  | 334482,4 m <sup>3</sup> | 11372,4 GJ  | 61170   | 57      | 0,5     | 0,5      | 0,5          | 695,65    | 0,65    | 0,01         | 0,01            | 0,01     | 0,33 €/m <sup>3</sup> |                 | €                | 110.379,18 |                |                                                                   |  |
| Electricity                             | 32%         | 3744 MWh     |                         |                                                                  | 3781,818 MWh            |             | 755     | 1,51    | 16,40   | 0,13     | 0,13         | 2855      | 6       | 62           | 0               | 0        | 60 €/MWh              |                 | €                | 226.909,09 |                |                                                                   |  |
| Brown coal                              | 8%          | 936 MWh      | 10000 kJ/kg             | 0,002778 MWh/kg                                                  | 354694,7 kg             | 3546,95 GJ  | 98000   | 110     | 900     | 404      | 398          | 347,60    | 0,39    | 3,19         | 1,43            | 1,41     | 80 €/t                | 0,08 €/kg       | €                | 28.375,58  |                |                                                                   |  |
| Total                                   | 100%        | 11700 MWh    |                         |                                                                  |                         |             | 4039,32 | 7,84    | 65,53   | 12,09    | 12,07        |           |         |              |                 |          |                       |                 | €                | 461.970,46 |                |                                                                   |  |
| Heat production - Private households    |             |              |                         | Lower heating value (LHV)                                        |                         | Fuel amount |         | CO2     | NOx     | SOx      | PM10         | PM2.5     | CO2     | NOx          | SOx             | PM10     | PM2.5                 | CO2             | NOx              | SOx        | PM10           | PM2.5                                                             |  |
| Logwood                                 | 13%         | 1079 MWh     | 11000 kJ/kg             | 0,003056 MWh/kg                                                  | 371712,9 kg             | 4088,84 GJ  | 8000    | 74,5    | 20      | 695      | 695          | 32,71     | 0,30    | 0,08         | 2,84            | 2,84     | 45 €/m3               | 0,06 €/kg       | €                | 22.302,78  |                |                                                                   |  |
| Woodchips                               | 18%         | 1494 MWh     | 11500 kJ/kg             | 0,003194 MWh/kg                                                  | 492302,1 kg             | 5661,47 GJ  | 11760   | 74,5    | 20      | 695      | 695          | 66,58     | 0,42    | 0,11         | 3,93            | 3,93     | 75 €/t                | 0,075 €/kg      | €                | 36.922,65  |                |                                                                   |  |
| Pellets                                 | 9%          | 747 MWh      | 17000 kJ/kg             | 0,004722 MWh/kg                                                  | 166513,9 kg             | 2830,74 GJ  | 9560    | 74,5    | 20      | 695      | 695          | 27,06     | 0,21    | 0,06         | 1,97            | 1,97     | 225 €/t               | 0,225 €/kg      | €                | 37.465,63  |                |                                                                   |  |
| Natural gas                             | 10%         | 830 MWh      | 34000 kJ/m <sup>3</sup> | 0,009444 MWh/m <sup>3</sup>                                      | 92507,74 m <sup>3</sup> | 3145,26 GJ  | 61170   | 57      | 0,5     | 0,5      | 0,5          | 192,40    | 0,18    | 0,00         | 0,00            | 0,00     | 0,33 €/MWh            |                 | €                | 30.527,55  |                |                                                                   |  |
| Electricity                             | 3%          | 249 MWh      |                         |                                                                  | 251,5152 MWh            |             | 755     | 1,51    | 16,40   | 0,13     | 0,13         | 189,89    | 0,38    | 4,13         | 0,03            | 0,03     | 60 €/MWh              |                 | €                | 15.090,91  |                |                                                                   |  |
| Brown coal                              | 47%         | 3901 MWh     | 10000 kJ/kg             | 0,002778 MWh/kg                                                  | 1478274 kg              | 14782,7 GJ  | 98000   | 110     | 900     | 404      | 398          | 1448,71   | 1,63    | 13,30        | 5,97            | 5,88     | 80 €/t                | 0,08 €/kg       | €                | 118.261,89 |                |                                                                   |  |
| Total                                   | 100%        | 8300 MWh     |                         |                                                                  |                         |             | 5996,67 | 10,96   | 83,21   | 26,84    | 26,73        |           |         |              |                 |          |                       |                 | €                | 722.541,88 | € 1.033.830,00 |                                                                   |  |
| CoolHeating project:                    |             |              |                         | Emission factors (g/GJ and kg/MWh for electricity) <sup>1)</sup> |                         |             |         |         |         |          | Emission (t) |           |         |              | Fuel unit price |          | Fuel costs            |                 | Investment costs |            |                |                                                                   |  |
| Heat pumps                              | 14801,6 MWh |              | 34000 kJ/m <sup>3</sup> | 0,009444 MWh/m <sup>3</sup>                                      | 3555,3 MWh              |             | 755     | 1,50952 | 16,4047 | 0,127    | 0,127108434  | 2684,252  | 5,36679 | 58,3236      | 0,451909        | 0,451909 | 60 €/MWh              |                 | €                | 213.318,00 |                |                                                                   |  |
| Natural gas                             | 2492,4 MWh  |              |                         |                                                                  | 277790,7 m <sup>3</sup> | 9444,88     | 61170   | 57      | 0,5     | 0,5      | 0,5          | 577,74    | 0,54    | 0,00         | 0,00            | 0,00     | 0,33 €/m <sup>3</sup> |                 | €                | 91.670,93  |                |                                                                   |  |
| Solar energy                            | 2706 MWh    |              |                         |                                                                  |                         |             |         |         |         |          |              |           |         |              |                 |          |                       |                 |                  |            |                |                                                                   |  |
| Electricity production                  | 20000 MWh   |              |                         |                                                                  |                         |             |         |         |         |          |              |           |         |              |                 |          |                       |                 |                  |            |                |                                                                   |  |
| PVs (800 kW)                            | 1256 MWh    |              |                         |                                                                  |                         |             |         |         |         |          |              |           |         |              |                 |          |                       |                 |                  |            |                |                                                                   |  |
| Investment                              |             | Fuel cost    |                         | CO2 (t)                                                          |                         | SOx (t)     |         | NOx (t) |         | PM10 (t) |              | PM2.5 (t) |         |              |                 |          |                       |                 |                  |            |                |                                                                   |  |
| Current situation:                      | €           | 1.033.830,00 | €                       | 722.541,88                                                       | 5996,67                 | 10,96       | 83,21   | 26,84   | 26,73   |          |              |           |         |              |                 |          |                       |                 |                  |            |                |                                                                   |  |
| CoolHeating project:                    | €           | 5.000.000,00 | €                       | 304.988,93                                                       | 3262,00                 | 5,91        | 58,33   | 0,46    | 0,46    |          |              |           |         |              |                 |          |                       |                 |                  |            |                |                                                                   |  |
| 1 year                                  | -€          | 3.966.170,00 | €                       | 417.552,94                                                       | 2734,7                  | 5,1         | 24,9    | 26,4    | 26,3    |          |              |           |         |              |                 |          |                       |                 |                  |            |                |                                                                   |  |
| SAVINGS 20 years                        | -€          | 3.966.170,00 | €                       | 8.351.058,88                                                     | 54693,5                 | 101,1       | 497,7   | 527,6   | 525,4   |          |              |           |         |              |                 |          |                       |                 |                  |            |                |                                                                   |  |

## Finansijski parametri:

- Prodajna cijena topline: **45 € / MWh**
- Procijenjena investicija: **4.910.000,00 EUR**
- Investitor:  
**Općina Visoko (budžet i grantovi: 20%, kredit 80%)**

# UPGRADE DH TUZLA



50 MW<sub>t</sub>



Lukavac



CHP Tuzla

220 MW<sub>t</sub>



Tuzla

70 MW<sub>t</sub>



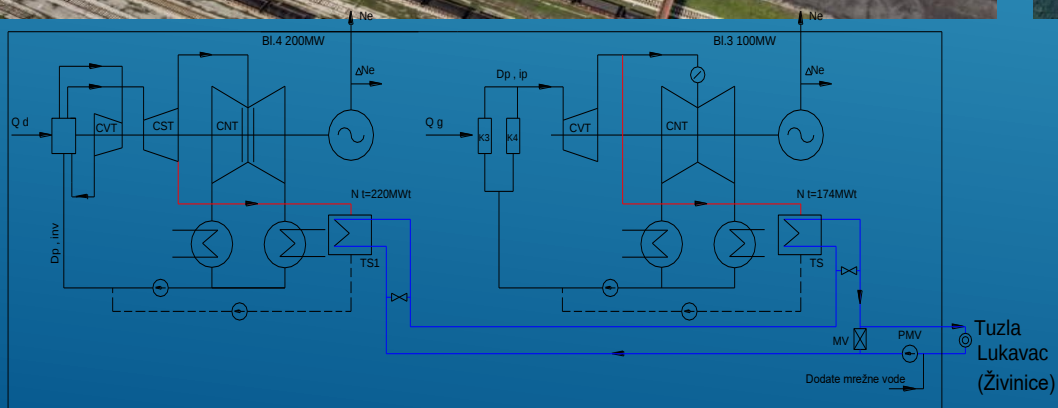
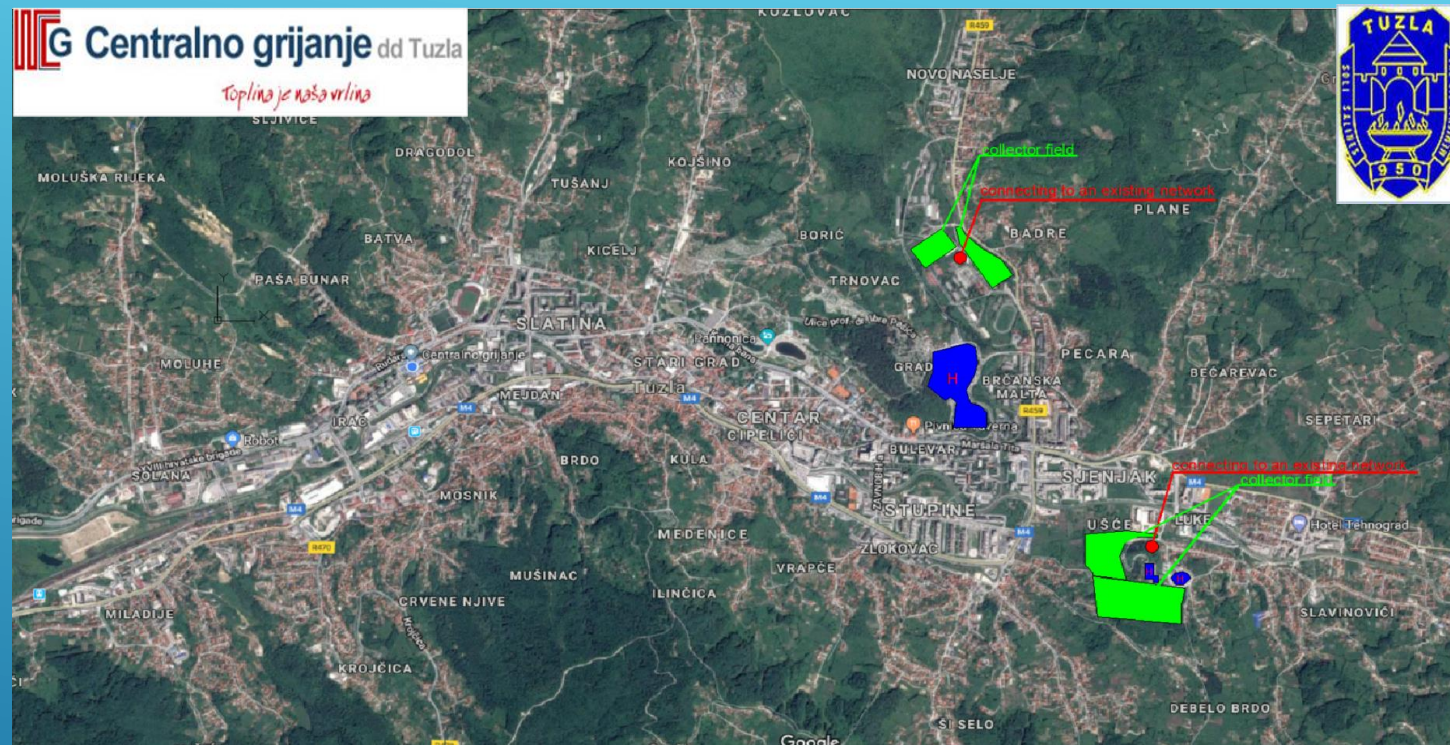
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CHP TUZLA, OWNED BY  
EPBIH POWER UTILITY



Distribution utility,  
owned by Tuzla City

End users



**1977**  
construction year,  
gradually  
expanded and  
substantially  
upgraded in the past 15  
years

**220 MWt**  
instantaneous  
power

**310 GWht**  
primary heat energy demand  
with annual 20 GWht tendency  
increase

# TUZLA DHS

**23,500**  
users (ca. 90% flats,  
other 10% commercials)

**10 km**  
primary pipeline  
(DN600-DN250) length

**180 km**  
secondary network length

**80% +**  
consumers in Tuzla City  
are connected to the DHS



**1,732,660 m<sup>2</sup>**  
total heating area

**1,100**  
heat substations

**SCADA and  
THERMIS**

**145/75 °C**  
designed temperature  
regime  
at -17°C outdoor air  
temperature  
and steady fluid flow

## ***DHS Tuzla – upgrading measures - I phase, 2010-2016***

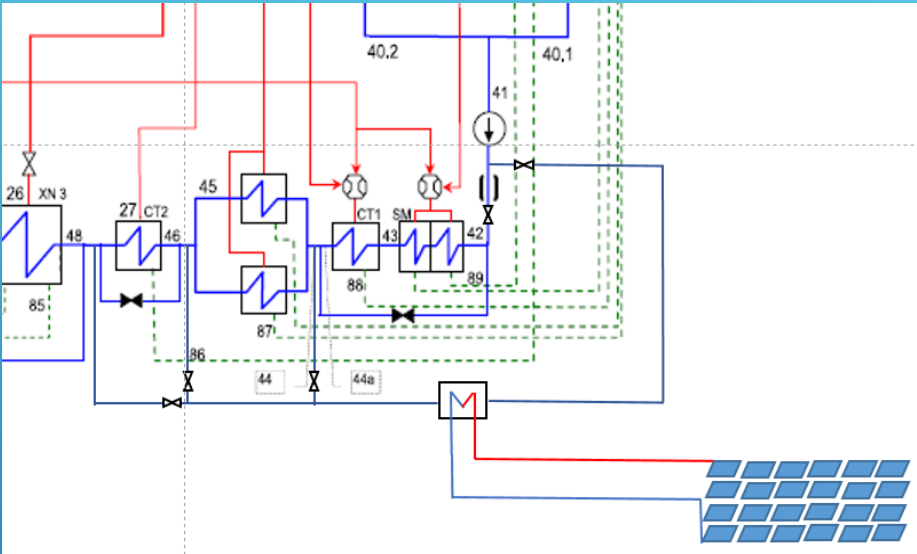
- Replacement of heat exchangers in thermal substations.
- Replacement of old distribution pumps by electronic pumps.
- Replacement of distribution pipe networks.
- Introducing SCADA and Thermis.

## ***DHS TUZLA – TARGETS OF THE UPGRADE DH - II PHASE, 2018-2025***

- ▶ **20% of energy savings** - reducing annual primary energy demand (PED) from 350 GWh down to 270 GWh in PED (80 GWh<sub>t</sub>).
- ▶ **20% of GHG emissions be reduced** - CO<sub>2</sub> cut from today 115 000 t/a for producing 350 GWh of heat down to max. 92 000 tCO<sub>2</sub>/a.
- ▶ **20% of RES to be introduced** - Solar thermal collectors, biomass co-firing and heat pumps (geothermal).

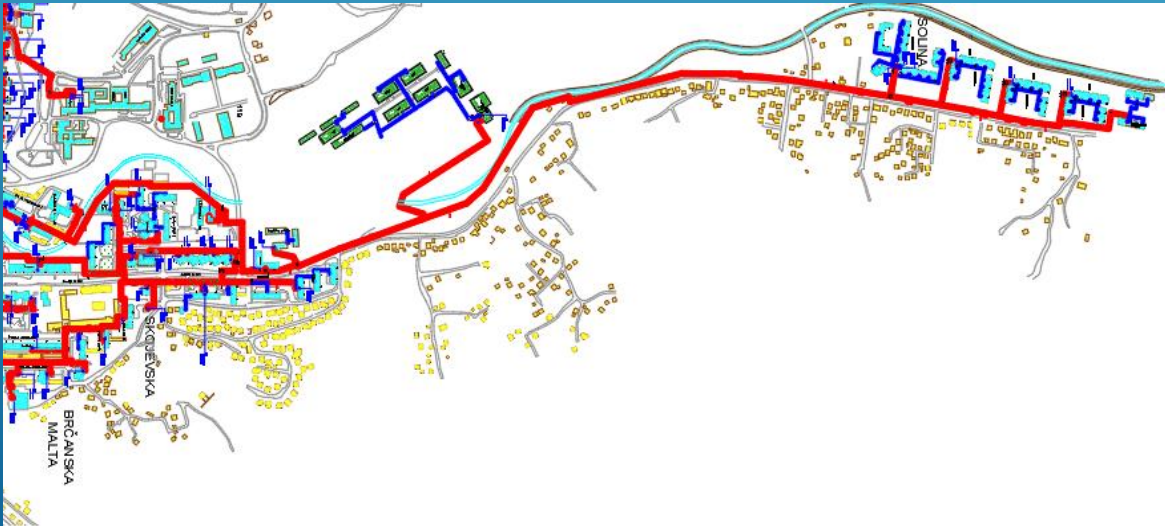
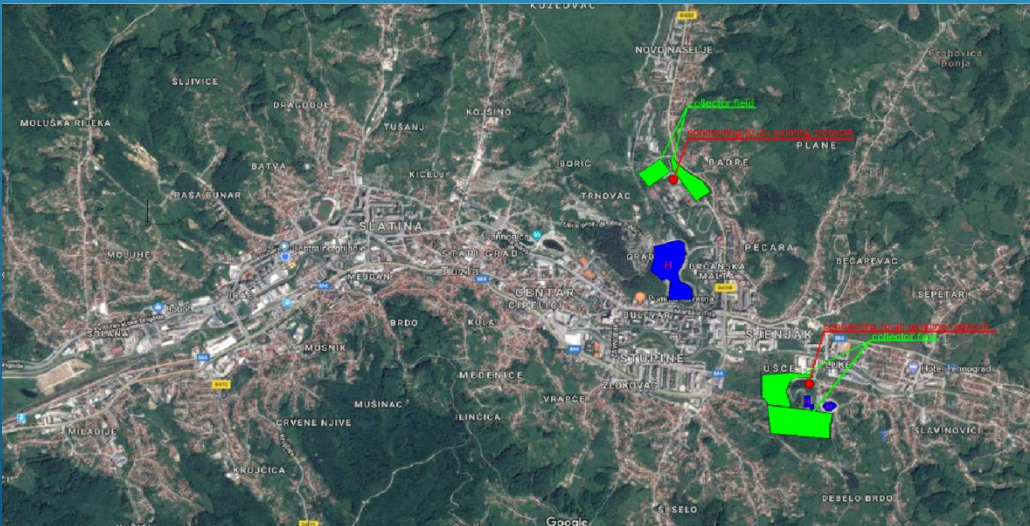
# INTEGRATION OF SOLAR THERMAL COLLECTORS IN TUZLA

TPP Tuzla: collector area 25,000 m<sup>2</sup>; 10 GWh/a

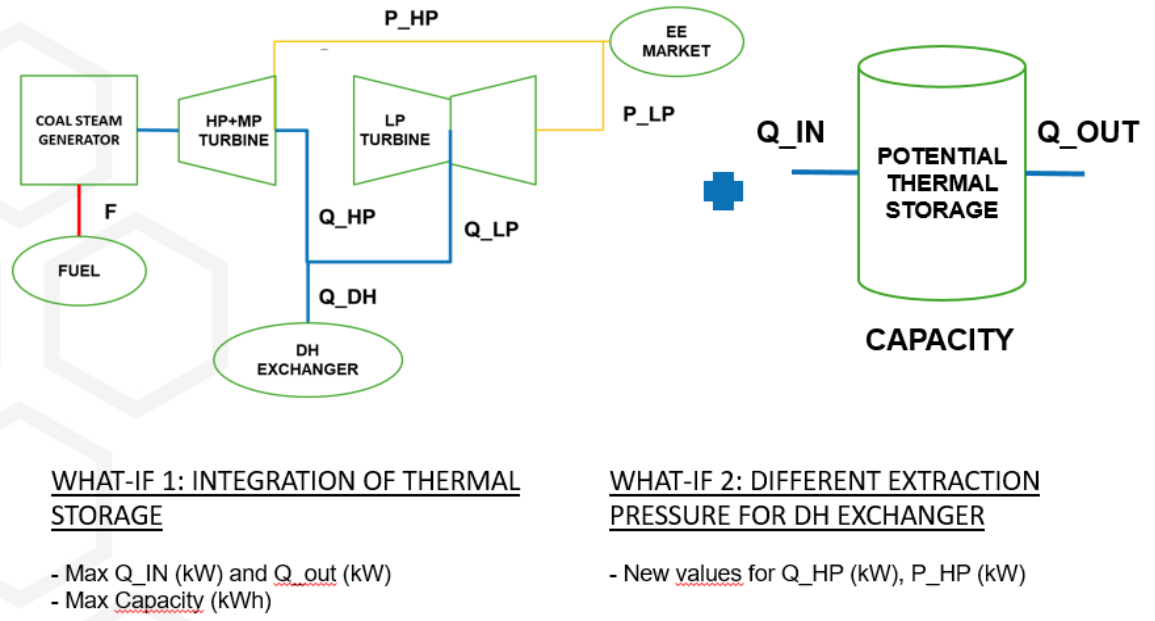
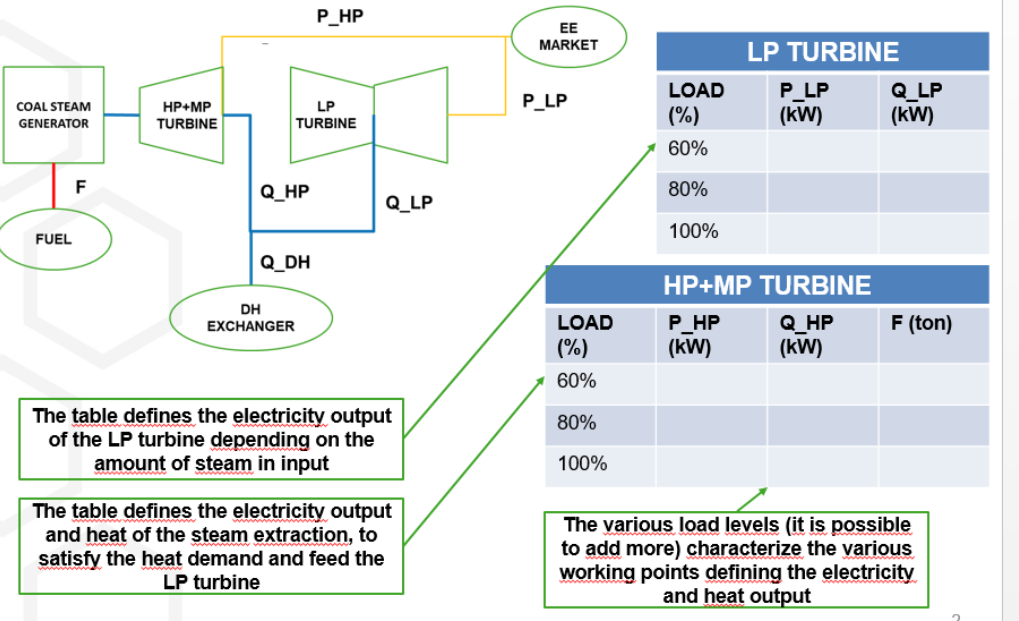


| KPI                                        | Baseline | Expected | Evaluation method |
|--------------------------------------------|----------|----------|-------------------|
| Primary Energy Demand [GWh/a]              | 350      | 337.7    | Estimated         |
| GHG emissions [t <sub>CO2(equiv)</sub> /a] | 115,271  | 110,989  | Estimated         |
| Use of renewable sources [%]               | 0        | 3.51     | Estimated         |

University Campus and Hospital, Soline settlement: collector area 4,000 m<sup>2</sup>; 2.3 GWh/a



# OPTIMIZATION OF COGENERATION OPERATION AND HEAT STORAGE



## WHAT-IF 1: INTEGRATION OF THERMAL STORAGE

- Max Q\_IN (kW) and Q\_out (kW)
- Max Capacity (kWh)

## WHAT-IF 2: DIFFERENT EXTRACTION PRESSURE FOR DH EXCHANGER

- New values for Q\_HP (kW), P\_HP (kW)

| KPI                                        | Baseline | Expected | Evaluation method |
|--------------------------------------------|----------|----------|-------------------|
| Primary Energy Demand [GWh/a]              | 350      | 300      | Estimated         |
| GHG emissions [t <sub>CO2(equiv)</sub> /a] | 115,271  | 98,271   | Estimated         |
| Use of renewable sources [%]               | 0        | 0        | Estimated         |



# RESOLVING HYDRAULIC ISSUE

Five groups of sub-measures are being considered within this UM:

1. Upgrade of the main pipeline.
2. Reduction of the temperature regime.
3. Separated thermal stations for Tuzla DH, Lukavac DH and future Zivinice DH.
4. Replacement of the existing main network pump with new pumps (for each DH system independently)
5. Installing temperature limiters



| KPI                                        | Baseline | Expected | Evaluation method |
|--------------------------------------------|----------|----------|-------------------|
| Primary Energy Demand [GWh/a]              | 350      | 330      | Estimated         |
| GHG emissions [t <sub>CO2(equiv)</sub> /a] | 115,271  | 108,684  | Estimated         |
| Use of renewable sources [%]               | 0        | 0        | Estimated         |



# BIOMASS CO-FIRING AND COGENERATION ON TUZLA CHP UNIT 6

## Retrofitting case CHP Tuzla -EPBiH

BIOFIT Horizont 2020 project

-Case study owner: EPBiH

-Scope (evolving and up for discussion): Up to 30% co-firing with local biomass sources (sawdust, agricultural residues and SRC) in Unit 6 (223 MWe) of Tuzla power plant.

**TPP Tuzla unit 6 (223 MWe) – planned trial run with biomass co-firing (10, 15 and 20% of biomass) performed in February 2022.**

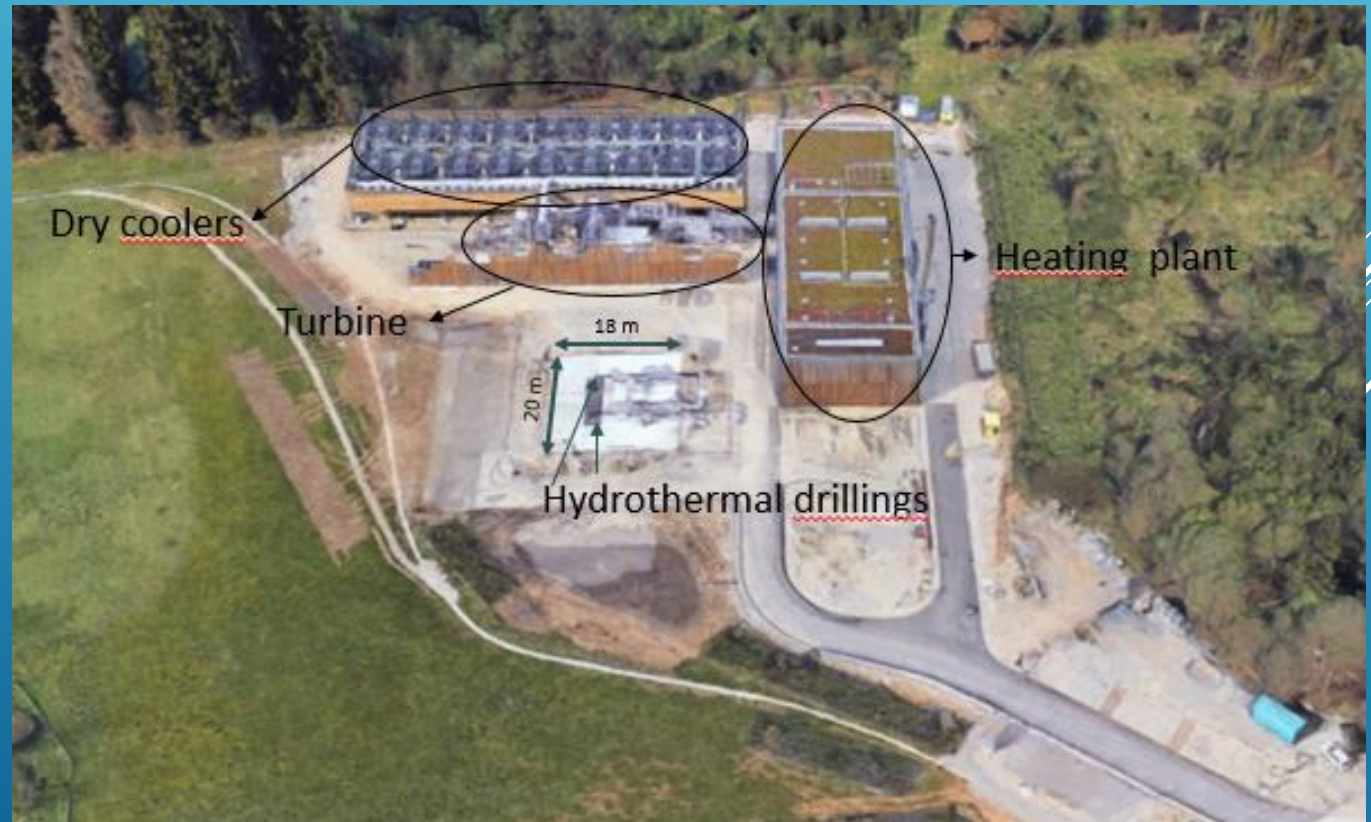
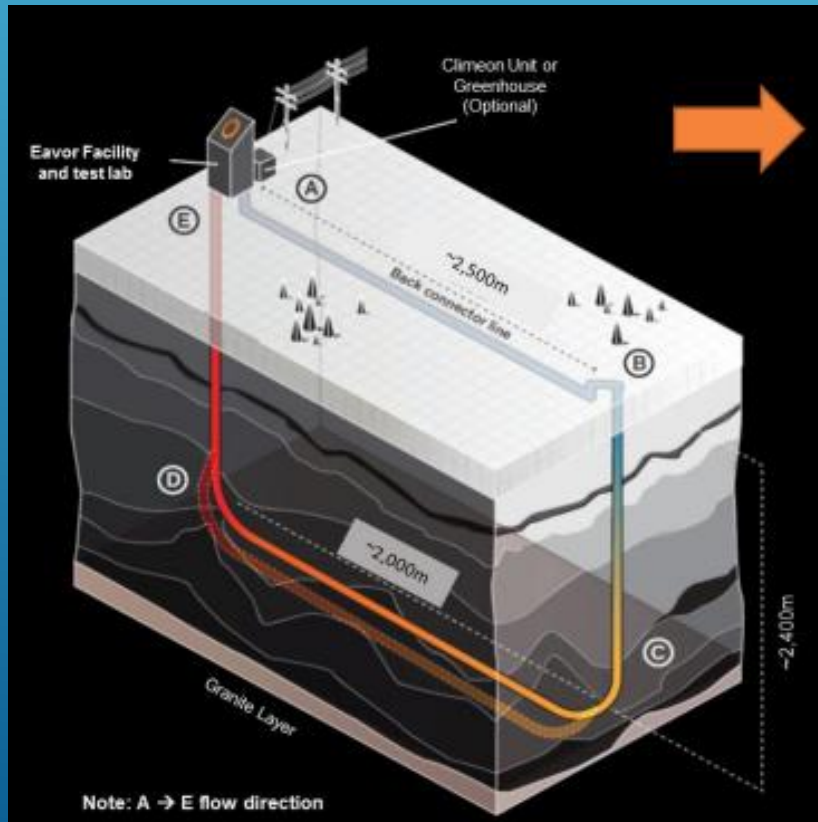
*TPP Tuzla unit 6 (223 MWe) is being converted into cogeneration - project is ongoing; works ongoing, in operation by August 2022.*



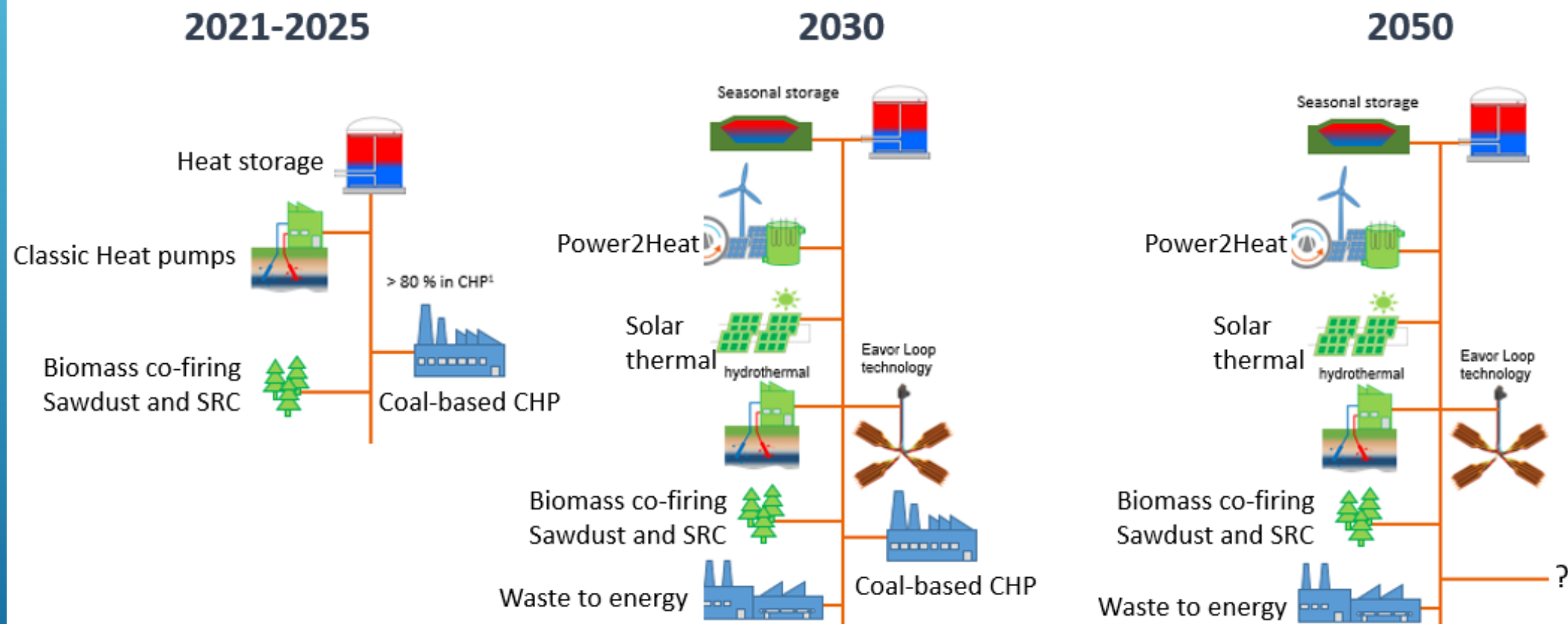
| KPI                                        | Baseline | Expected | Evaluation method |
|--------------------------------------------|----------|----------|-------------------|
| Primary Energy Demand [GWh/a]              | 350      | 350      | Estimated         |
| GHG emissions [t <sub>CO2(equiv)</sub> /a] | 115,271  | 80,690   | Estimated         |
| Use of renewable sources [%]               | 0        | 30       | Estimated         |

# DEEP GEOTHERMAL

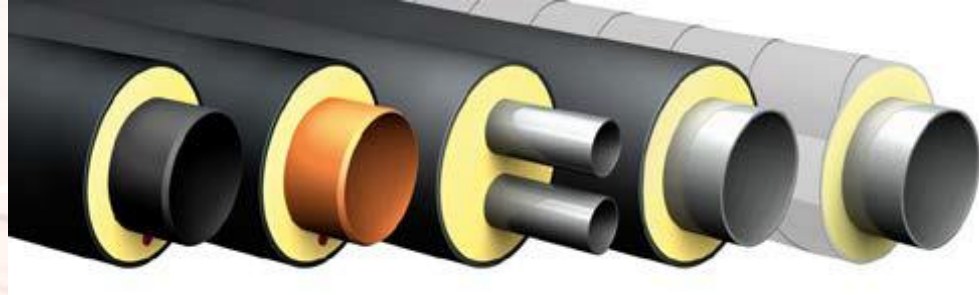
- ▶ Considerations ongoing in cooperation with AGFW (Eavor technology).
- ▶ Demonstration installation to be considered in Tuzla region.
- ▶ Former coal area under consideration for project installation.



# TUZLA HEAT TECHNOLOGICAL MIX 2030 AND 2050



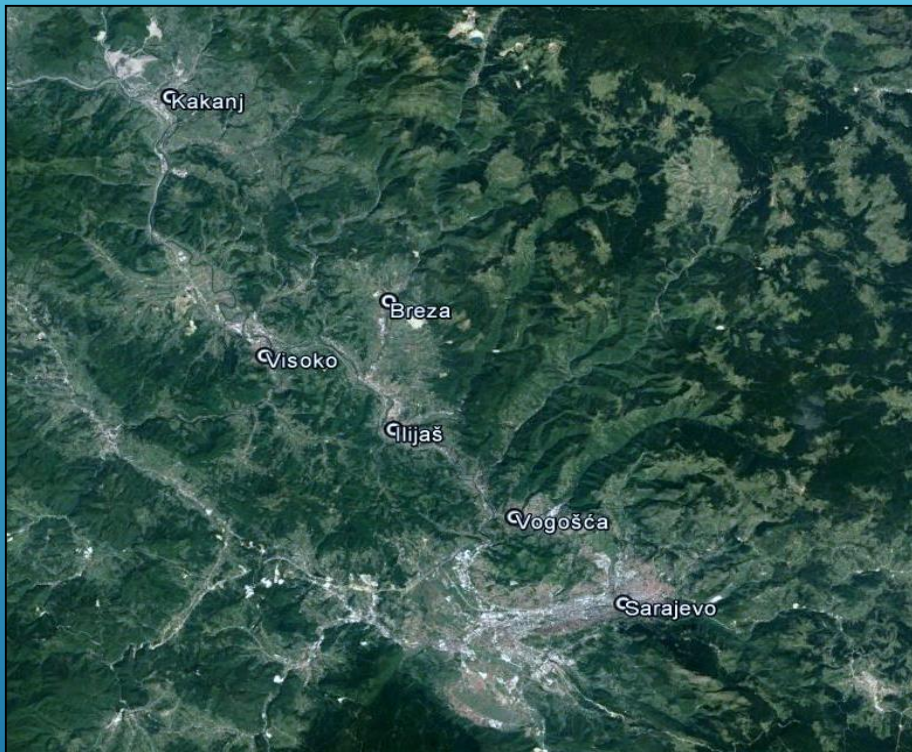
# TRANSITION OF CHP KAKANJ TO HIGH EFFICIENT COGENERATION WITH BIOMASS CO-FIRING



- ✓ EXPANDING COGENERATION IN CHP KAKANJ
- ✓ CCGT UNIT KAKANJ
- ✓ BIOMASS COFIRING IN CHP KAKANJ
- ✓ FULL BIOMASS REPOWERING OF UNIT KAKANJ 5



# THERMAL ENERGY SUPPLY FROM CHP KAKANJ TO AREA OF SARAJEVO (300 MW THERMAL)



|                     | Main hot water pipeline                | Branche hot water pipeline |
|---------------------|----------------------------------------|----------------------------|
| Route               | Kakanj - Sarajevo                      | -                          |
| Route via           | Koridor Vc                             | -                          |
| Length              | 46 km (which 3.95 km above the ground) | 39 km                      |
| Power               | <b>300 MWt</b>                         | -                          |
| Dimensions          | DN350 – DN800                          | DN25 - DN700               |
| Temperature regim   | 150/75°C                               | 150/75°C                   |
| Design temperatures | -18°C                                  | -18°C                      |
| Type of pipe        | Steel pre-insulated pipes              | Steel pre-insulated pipes  |

Heat consumption area: *Visoko, Breza, Ilijas, Vogosca, parts of Sarajevo*

CAPEX: 120 mil €, NPV: cca. 27 mil €, IRR: 16,4 % (izvor: Projektna Studija, 2016).

CAPEX: 185 mil €, IRR: 7% za cijenu isporuke 60 KM/MWh (izvor: Idejni Projekt, 2019).

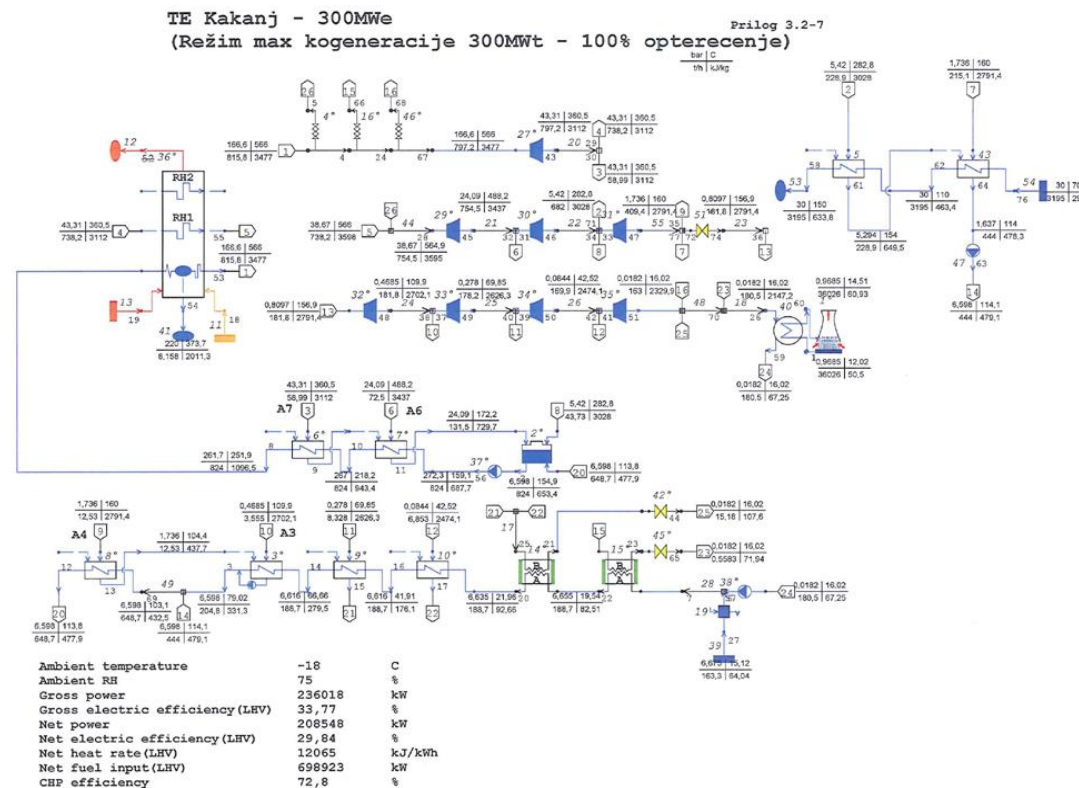
Procjena: cijena MWh topline (predajna toplina u Toplane SA): cca 40-50 EUR/MWht.



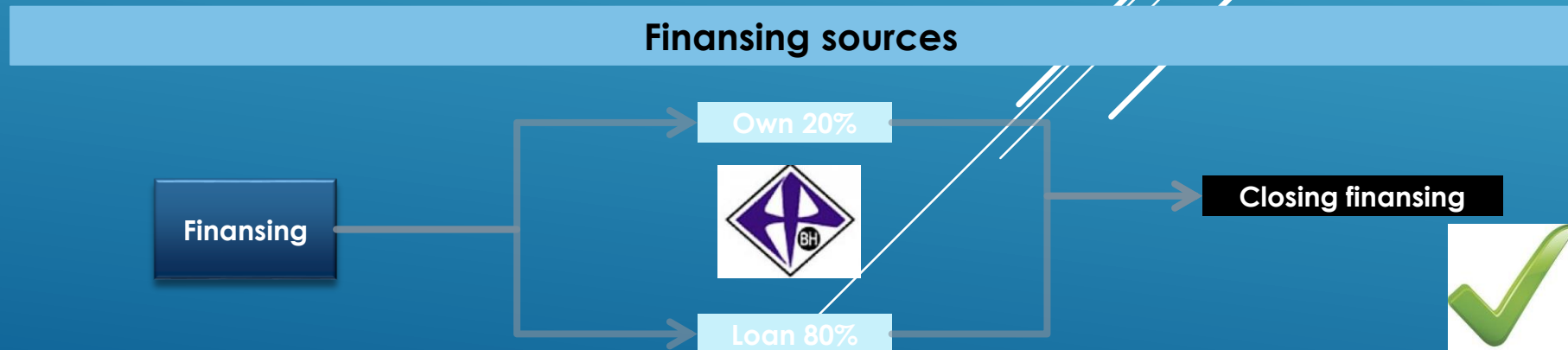
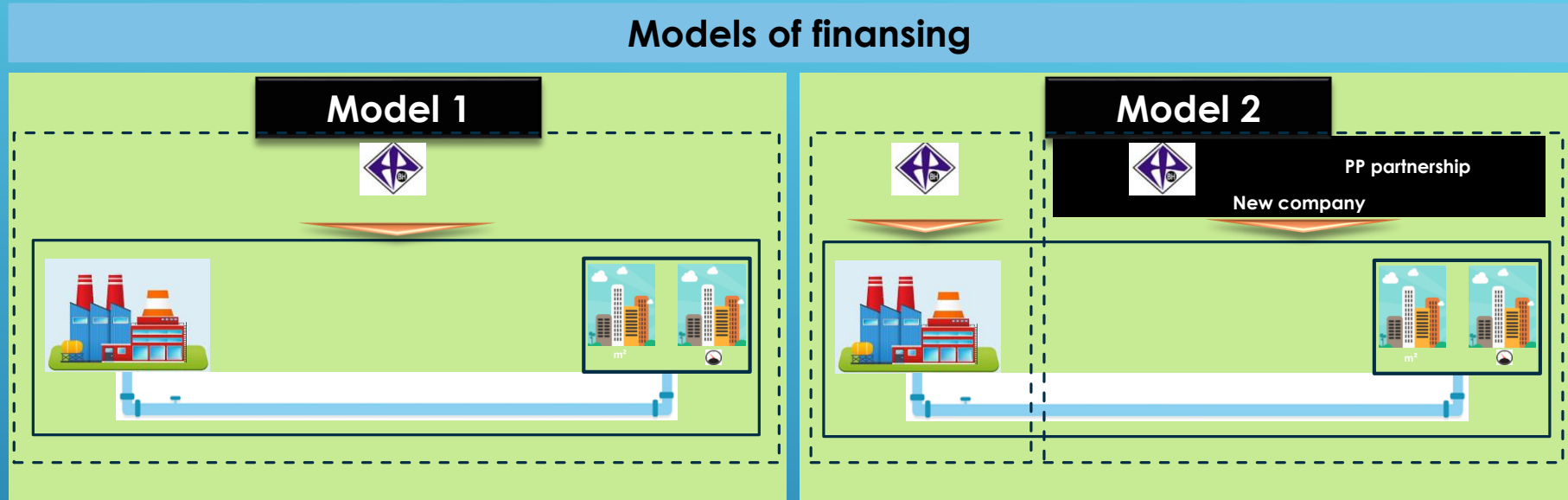
# Project benefits

- diverzifikacija izvora snabdijevanja toplionskom energijom u obuhvatu projekta
- sigurna opskrba toplinske energije, energetska neovisnost,
- smanjenje emisije CO2 u obuhvatu Projekta,
- smanjenje emisija polutanata u obuhvatu Projekta,
- dostizanje visokoeфикаsne kogeneacije u TE Kakanj.

## 300 MWt TPP Kakanj cogeneration scheme



# Models of financing – to be considered



# CCGT KAKANJ – MOTIVATION AND OBJECTIVES

- **CCGT Kakanj** is **Combined Cycle Gas Turbine unit** planned to be installed in Kakanj power station, as support to EPBiH electricity system **balancing issue**, as well as **district heating systems** supplied from Kakanj power station.
- **CCGT Kakanj** may **contribute to continuation of electricity and heat generation from Kakanj power station** in long-term, up to 2050 and beyond.
- **CCGT Kakanj** is planned to be of capacity cca **120 MWe, designed acc. BAT/BREF and IED** and operate as a **high-efficient co-generation unit**, with min. 52% net efficiency in condensing regime and possibility to provide cca 87 MWt of thermal energy for district heating systems to reach required fuel utilisation efficiency.
- **CCGT Kakanj** would significantly increase energy efficiency and environmental issue of Kakanj power station, **reducing coal consumption and CO<sub>2</sub> emission**.
- Main fuel is **natural gas** (avr. LHV = 34 MJ/m<sub>s</sub><sup>3</sup>) and up to 5% of **fuel oil** (avr. LHV = 41 MJ/kg) for support of combustion.

# CCGT KAKANJ - CONCEPTUAL DESIGN

- ▶ **Feasibility Study** with **conceptual design** has been completed in 2011.
- ▶ Recommended Kakanj CCGT unit option is **General Electric (GE)**: S106FA (118,4 MW;  $P_{GT}=76,30$  MW and  $P_{ST}=43,90$  MW) with turbo-generator **GE** - PG6111 (FA).
- ▶ Installed electrical power **118.5 MWe** and **87 MWt** of heat.
- ▶ **Location** of CCGT Kakanj is area of **decommissioned Kakanj units 1-4**.
- ▶ **New compressor station in Kladanj (46 bar)** is conceptualised to provide necessary pressure and supply of natural gas for Kakanj CCGT.
- ▶ Reduction station for CCGT Kakanj is **DN 200 / 23 000 m<sup>3</sup>/h / 27 bar**.
- ▶ **Net el. efficiency** of Kakanj CCGT is **52.5%**. **Fuel utilization rate** is over **75%**.
- ▶ For an average operation **6,000 h/a**, electricity production is **700 GWh/a**.
- ▶ **Emissions: CO** = < 9 ppm, **NOx** < 15 ppm, **CO<sub>2</sub>** < 377 kg/MWh (**3 times smaller than from coal**).
- ▶ **CAPEX** total **cca 180 MEUR for CCGT incl. co-generation option**, or **150 MEUR for CCGT without co-generation facilities**. – it was price in 2011, today CAPEX is expected to be much smaller.

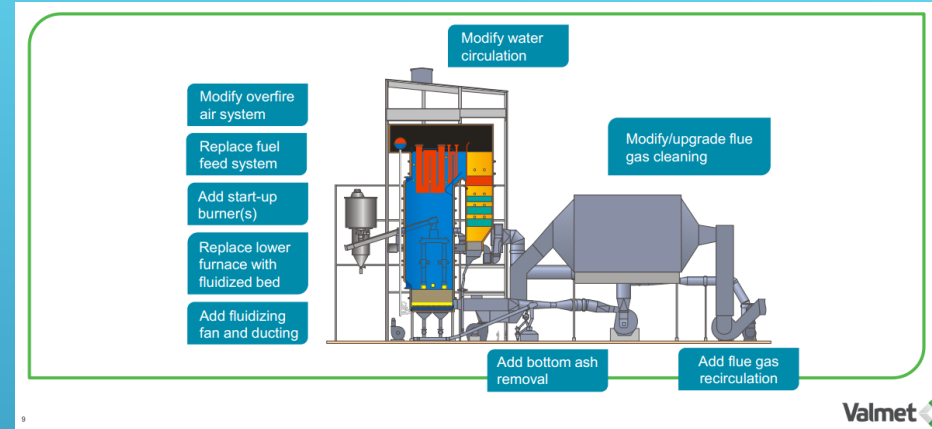
# CCGT KAKANJ – RISKS AND OPPORTUNITIES

- ▶ Natural gas is identified by **Energy Community and EU** as a **transition fuel**, while there is a strong pressure to stop investment in coal projects.
- ▶ **CAPEX and OPEX** - financial capability of EPBiH to invest in construction of CCGT Kakanj and manage positive cash-flow of the company during operation phase.
- ▶ **Security of gas supply** - at the moment there is **only one direction of gas supply**: Serbia – Zvornik – Kladanj (DN 400 / 50 bar) - Sarajevo/Zenica. – **high risk!**
- ▶ Existing pipeline passes **quite near** Kakanj power station.
- ▶ Long-term forecasts for **natural gas price**, **electricity price** and **CO<sub>2</sub> tax price**.
- ▶ Realisation of Project of **supply thermal energy (300 MWt) from Kakanj TPP to Sarajevo area**.
- ▶ Long term **price of heat** for District heating systems.
- ▶ Possibility to provide **subsidies** for *high-efficient co-generation*, through Feed-in or other fund of Federation BiH.

# CHP KAKANJ BIOMASS COFIRING PROJECTS – DOPRINOS DEKARBONIZACIJI SISTEMA DALJINSKOG GRIJANJA

## Completion of BIOFIT Study of Kakanj unit 5 - case-study:

Option: 0..100%w 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. Estimation of CAPEX: 30 MEur (BFB).



TPP Kakanj unit 6 (110 MWe) – trial run with biomass co-firing (10, 15 and 20% of biomass) performed in April 2022.



# PROJEKTI KOGENERACIJE TOPLANA SARAJEVO

Konverzija KDIII-2 u kogeneraciju

Projekti geotermalne energije

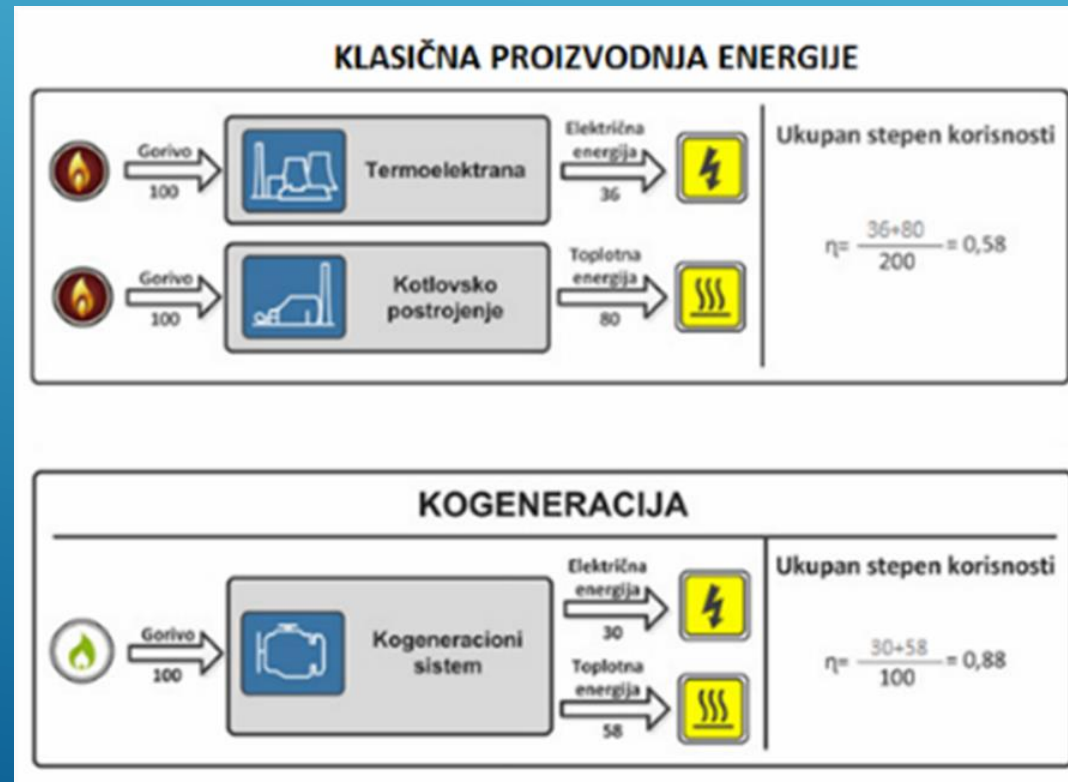
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**TOPLANE SARAJEVO**  
DISTRICT HEATING SYSTEM

# KOGENERACIJA

- Studija izvodljivosti i isplativosti kogeneracije KDIII-2
- Planirana snaga postrojenja je 20 MW<sub>t</sub>
- Pokrenute su aktivnosti sa JP Elektroprivreda BiH
- 8 kotlovnica na Dobrinji: KDI-1, KDI-2, KDI-3, KDI-4, KDI-5, KDI-6, KDI-7 i KDI-8



## Cijene gasa u 2021. godini

- Od 01.01. do 31.10.2021. godine:
  - Nabavna cijena gasa: 0,485 KM/Sm<sup>3</sup>
  - Cijena distribucije gasa: 0,080 KM/Sm<sup>3</sup>
  - Cijena gasa za Toplane 0,565 KM/Sm<sup>3</sup>
- Od 01.11. do 31.12.2021. godine:
  - Nabavna cijena gasa: 0,599 KM/Sm<sup>3</sup>
  - Cijena distribucije gasa: 0,080 KM/Sm<sup>3</sup>
  - Cijena gasa za Toplane 0,679 KM/Sm<sup>3</sup>

# KOGENERACIJA

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- Od 01.01.2022:
  - Nabavna cijena gasa: 0,665 KM/Sm<sup>3</sup>
  - Cijena distribucije gasa: 0,080 KM/Sm<sup>3</sup>
  - Cijena gasa za Toplane: 0,745 KM/Sm<sup>3</sup>
- Od 01.04.2022:
  - Nabavna cijena gasa: 0,809 KM/Sm<sup>3</sup>
  - Cijena distribucije gasa: 0,080 KM/Sm<sup>3</sup>
  - Cijena gasa za Toplane: 0,889 KM/Sm<sup>3</sup>
- Povećanje cijene gasa za Toplane u odnosu na cijenu 0,679 KM/Sm<sup>3</sup> je 30,93%
- Vlada Kantona Sarajevo je odlučila subvencionirati polovinu iznosa povećane cijene gasa u Kantonu Sarajevo u periodu 01.01.-31.03.2022. godine u iznosu 0,09 KM/Sm<sup>3</sup>.
- Vlada KS je dala saglasnost na povećanje cijene grijanja za 10% sa primjenom od 01.02.2022. godine i 16,3% sa primjenom od 01.04.2022. godine.



# EKSPLOATACIJA IZVORA GEOTERMALNIH VODA NA PODRUČJU OPĆINE ILIDŽA U CILJU ZAGRIJAVANJA OBJEKATA

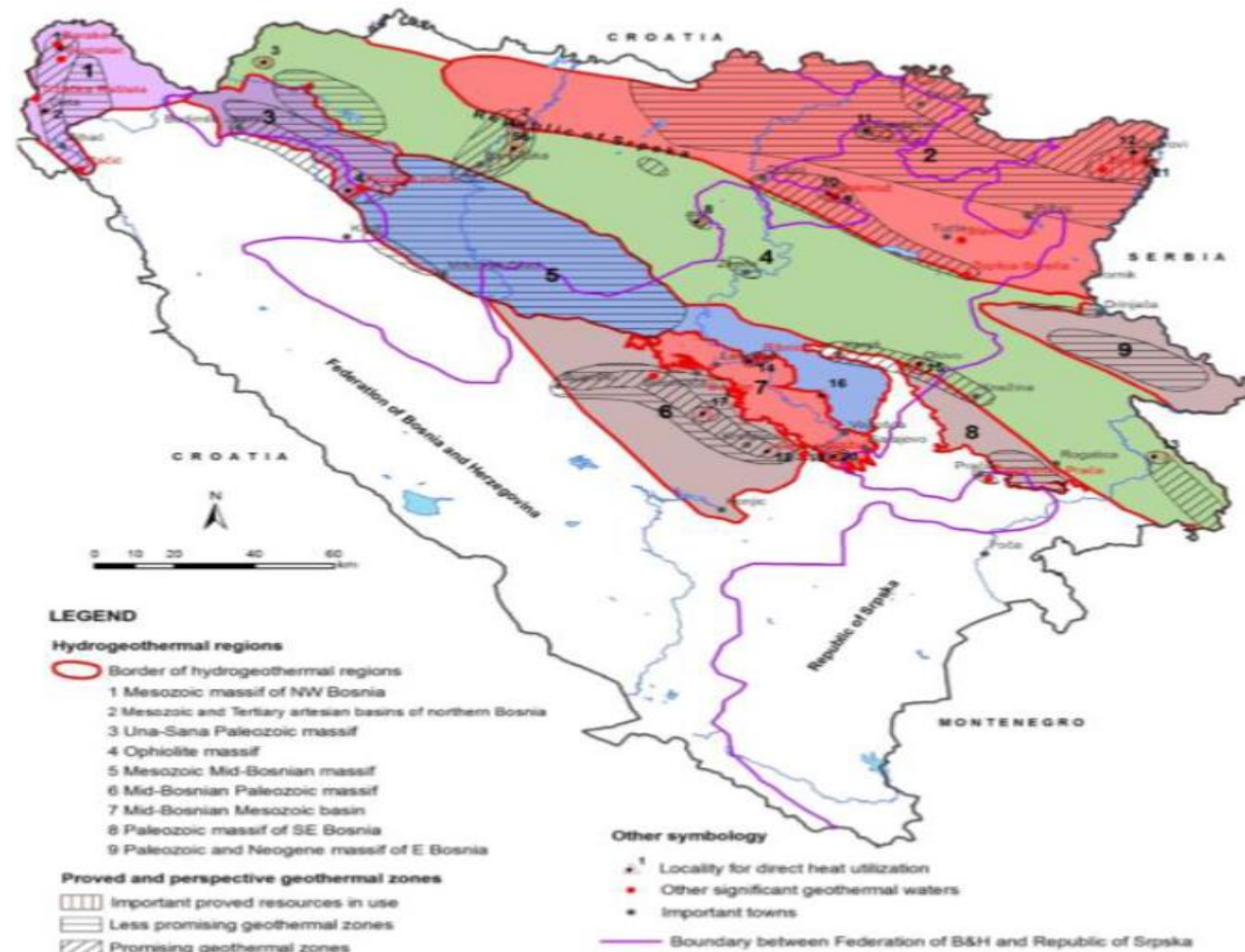
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# EKSPLOATACIJA IZVORA GEOTERMALNIH VODA NA PODRUČJU OPĆINE ILIDŽA U CILJU ZAGRIJAVANJA OBJEKATA

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- Izvori geotermalne vode u Bosni i Hercegovini zasad nisu primjereno iskorišteni za proizvodnju toplotne energije, za zagrijavanje objekata, u poljoprivrednoj proizvodnji i industriji, te za proizvodnju električne energije.
- Zbog geološke građe podzemlja Bosne i Hercegovine, geotermalni lokaliteti se uglavnom nalaze na području Panonskog bazena i u dijelu sliva rijeke Bosne, takozvani sarajevsko-zenički bazen koji se proteže od sarajevskog polja do Busovače, odnosno, pod stručnim terminom Busovački razlom.
- Najizrazitiji reprezent Busovačkog razloma je sjeveroistočna strana Igmana. Rasjedni otsjek je vidljiv od Krupca do Vrela Bosne i dalje prema Rakovici i Lepenici. Širina Busovačke razlomne zone između Hrasnice i Miljevića je oko 10 km, a između Vrela Bosne i Nahoreva preko 13 km. Oko Semizovca, Vogošće i Sarajeva teren je znatno blaži, sa generalnim nagibom prema jugozapadu.
- Na osnovu gore pomenutog, i predočene karte nalazišta geotermalnih voda, vidimo da je područje Ilidže vrlo interesantno i značajno za istraživanje i eksploataciju geotermalne vode.



| Lithostratigraphic distribution                                                            | Hydrogeothermal regions | Number of aquifers through depth |
|--------------------------------------------------------------------------------------------|-------------------------|----------------------------------|
| Paleozoic limestones, dolomites, marbles and quartzites                                    | 8, 6                    | 2 aquifers                       |
| Paleozoic and Triassic limestones and dolomites                                            | 4                       | 2 separated aquifers             |
| Paleozoic, Triassic and Jurassic limestones                                                | 5                       | 3 separated aquifers             |
| Paleozoic, Triassic, Jurassic and Cretaceous limestones and dolomites                      | 1                       | 4 aquifers                       |
| Paleozoic, Triassic, Jurassic, Cretaceous and Tertiary limestones, dolomites and clastites | 2, 7                    | >5 separated aquifers            |
| Triassic, Jurassic and Cretaceous limestones and dolomites                                 | 3                       | 3 separated aquifers             |

# EKSPLOATACIJA IZVORA GEOTERMALNIH VODA NA PODRUČJU OPĆINE ILIDŽA U CILJU ZAGRIJAVANJA OBJEKATA

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- U periodu od 1984 - 1987. godine, izvedeno je nekoliko istražno-eksploatacionih bušotina (IB-1, IB-2 i IB-7 ), koje su zahvatile termalne i termomineralne vode temperature 22 - 58 °C.
- Eksploatacioni bunar B-1, izveden 1999. godine na lokalitetu Slana bara kod Blažuja, je zahvatio termomineralnu vodu temperature 24 °C koja se flašira pod komercijalnim nazivom "Ilidžanski dijamant"
- Termoenergetsko korištenje termomineralnih voda Ilidže je započelo 1985. godine, izgradnjom postrojenja kod bušotine IB-1 kojim se zagrijava hotel " Terme ".
- Termomineralne vode Ilidže izvire iz krečnjačko-dolomitskog bloka, koji je konstatovan bušotinom IB-2, kod Zmijske stijene, u čijoj se blizini nalaze eksploatacione bušotine TB1 i TB2 koje koristi Termalna rivijera Ilidža, prostor hotela „Hills“ i „Hollywood“, i koje trenutno toplotnom energijom zagrijavaju objekte kapaciteta cca 9,0 MW.

# EKSPLOATACIJA IZVORA GEOTERMALNIH VODA NA PODRUČJU OPĆINE ILIDŽA U CILJU ZAGRIJAVANJA OBJEKATA

- Geotermalni izvori toplote odavno se u svijetu koriste za zagrijavanje objekata u sistemima daljinskog grijanja.
- Na području Ilidže trenutno se nalaze dva aktivna geotermalna izvora toplote (eksploatacione bušotine IB1 i IB2) temperature 58 °C, čija se geotermalna voda koristi u svrhu zagrijavanja objekta.
- Termomineralne vode na Ilidži prirodnim putem izbijaju u neposrednoj blizini hotela "Terme".

| Prosječna izdašnost<br>( l/s ) | Srednja T pojave<br>(°C) | Iskoristiva temperatura<br>MWth | Snaga |
|--------------------------------|--------------------------|---------------------------------|-------|
| Preko 100                      | 57,5                     | 45,5                            | 19,11 |

# EKSPLOATACIJA IZVORA GEOTERMALNIH VODA NA PODRUČJU OPĆINE ILIDŽA U CILJU ZAGRIJAVANJA OBJEKATA

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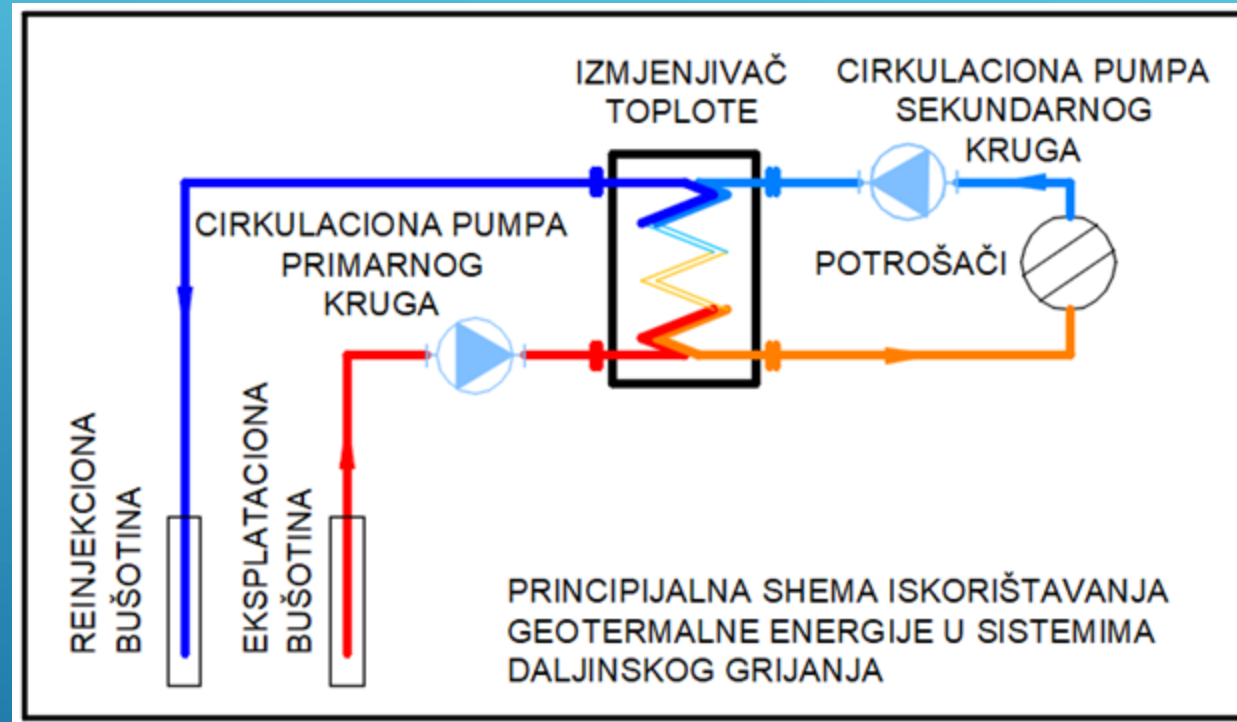
- Oko glavnog izvorišta termomineralnih voda Ilidže su urađene bušotine: IB-10a, IB-1, IB-2, PP-1 i B-3a, koje su aktivne. Međutim, samo je bušotina IB-2 eksploatacioni objekat, jer je odgovarajuće opremljena, i samo je za ovu bušotinu izdata koncesija za korištenje.
- Na području Općine Ilidža postoje četiri kotlovnice u vlasništvu KJKP Toplane-Sarajevo, sa čijeg se toplifikacionog sistema zagrijava 1.805 stambenih jedinica i 137 poslovnih prostora. Od ove četiri kotlovnice, tri su toplovodne (kotlovnice: Mala Aleja, Tome Međe i Mlade Bosne), temperaturnog gradijenta 90/70 °C i jedna je vrelovodna, temperaturnog gradijenta 140/75 °C (kotlovnica Lužani).
- Projektna ideja se odnosi na mogućnost iskorištavanja toplotne energije iz geotermalne vode, za potrebe gore pomenutih kotlovnica, u prvom redu tri toplovodne kotlovnice.
- Pod pretpostavkom da je temperatura geotermalne vode 58 °C, može se zaključiti da je zagrijavanje stambenih i poslovnih jedinica, na području Ilidže moguće pomoću geotermalne energije

# EKSPLOATACIJA IZVORA GEOTERMALNIH VODA NA PODRUČJU OPĆINE ILIDŽA U CILJU ZAGRIJAVANJA OBJEKATA

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- Da bi se ova ideja realizovala, potrebno je izvesti slijedeće radove:
  - Izgraditi novu eksploatacionu bušotina iz koje bi se crpila geotermalna voda, sa pratećom reinjekcionom bušotinom,
  - rekonstrukcija postojeće kotlovnice Mala Aleja
  - prespajanje toplotnog konzuma kotlovnica Mlada Bosna i Tome Međe na toplifikacioni sistem kotlovnice Mala Aleja
- Kako bi se stvorili uslovi za eksploataciju izvora geotermalne vode prvo se mora uraditi projekat istraživanja, i dobiti pravo na istražne radove – ispitne bušotine IB.
- Nakon završetka istražnih radova se podnosi zahtjev za koncesiju.
- Nakon dobivanja koncesije, i sprovedenih svih postupaka, išlo bi se u rekonstrukciju postrojenja i njihovo spajanje.
- Ovim poduhvatom bi se ugasila tri ložišta na području Ilidže angažovane snage cca. 10 MW.

# EKSPLOATACIJA IZVORA GEOTERMALNIH VODA NA PODRUČJU OPĆINE ILIDŽA U CILJU ZAGRIJAVANJA OBJEKATA



# EKSPLOATACIJA IZVORA GEOTERMALNIH VODA NA PODRUČJU OPĆINE ILIDŽA U CILJU ZAGRIJAVANJA OBJEKATA

- Sistem daljinskog grijanja KJKP “Toplane Sarajevo” je zasnovan na principu periodičnog dnevnog rada u terminu od 05-22 h, sa temperaturnim gradijentom 90/70 °C.
- Očekivana temperature geotermalne vode je 58 °C , tako da se i u sistemu grijanja očekuje teperatura polazne vode max. 55 °C.
- Režim grijanja u sistemu koji koristi geotermalnu vodu 24 h.

| Rb.        | Naziv kotlovnice | Broj stanova | Broj poslovnih prostora | Površina stambeni prostor (m <sup>2</sup> ) | Površina poslovni prostor( m <sup>2</sup> ) | Ukupna površina (m <sup>2</sup> ) | Instalisan a snaga - GIS baza (kW) | Izmjerena max. snaga sa mjerila (kW) | Pokrivenosti priključnih mjesta sa mjerilima (%) | Izmjerena max. snaga + snaga iz Gis baze za objekte bez mjerila (kW) |
|------------|------------------|--------------|-------------------------|---------------------------------------------|---------------------------------------------|-----------------------------------|------------------------------------|--------------------------------------|--------------------------------------------------|----------------------------------------------------------------------|
| 1          | MALA ALEJA       | 449          | 52                      | 26501                                       | 21956                                       | 48457                             | 8162                               | 2196,7                               | 90                                               | 3012,9                                                               |
| 2          | TOME MEDE        | 125          | 2                       | 7881                                        | 488                                         | 8369                              | 1225                               | 543                                  | 80                                               | 788                                                                  |
| 3          | MLADE BOSNE      | 278          | 8                       | 16230                                       | 199                                         | 16429                             | 2092                               | 1270,2                               | 35,1                                             | 2627,908                                                             |
| UKUPNO     |                  | 852          | 62                      | 50612                                       | 22643                                       | 73255                             | 11479                              | 4010                                 | 65                                               | 6429                                                                 |
| 1          | LUŽANI           | 953          | 75                      | 72204                                       | 4600,9                                      | 76804,9                           | 9207,87                            | 4981,9                               | 56                                               | 8941,2841                                                            |
| SVE UKUPNO |                  | 1805         | 137                     | 122816                                      | 27244                                       | 150060                            | 20687                              | 8992                                 | 60                                               | 15370                                                                |

# EKSPLOATACIJA IZVORA GEOTERMALNIH VODA NA PODRUČJU OPĆINE ILIDŽA U CILJU ZAGRIJAVANJA OBJEKATA

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- Ušteda u potrošnji energenata za proizvodnju toplotne energije, kao i smanjenje emisije stakleničkih plinova i ostalih čestica, koje utiču na loš kavlitet zraka u Sarajevu.
  - Početak primjene obnovljivih izvora energije u sistemu daljinskog grijanja KJKP Toplane Sarajevo
  - Smanjenje troškova proizvodnje toplotne energije
  - Pобоljšanje kvaliteta zraka
  - Opredjeljenje za primjenu novih tehničko-tehnoloških dostignuća u primjeni obnovljivih izvora energije u sistemima daljinskog grijanja.
  - Strategija KJKP Toplane Sarajevo
- 

# EKSPLOATACIJA IZVORA GEOTERMALNIH VODA NA PODRUČJU OPĆINE ILIDŽA U CILJU ZAGRIJAVANJA OBJEKATA

- Svaki projekat u sklopu svoje realizacije ima i stavku finasijske opravdanosti
- Geološka istraživanja geotermalne vode na području Ilidže

Investicija obuhvata slijedeće stavke:

- Izrada projektne dokumentacije geoloških istraživanja, sa svim potrebnim ovjerama i dozvolama
- Izrada četiri ispitne bušotine dubine oko 50,0 m
- Izgradnja eksploatacione bušotine sa reinjekcionom buštinom
- Izgradnja postrojenja sa izmjenjivačima, pumpom za geotermalnu vodu, i ostalom pratećom opremom KM
- Uvezivanje tri koltlovnice u jedan sistem (Mala Aleja, Tome Međe i Mlade Bosne)

cca 40.000,00 KM

cca 100.000,00 KM

cca 200.000,00 KM

cca 500.000,00

cca 760.000,00 KM

**SVE UKUPNO: cca 1.600.000,00 KM**

# EKSPLOATACIJA IZVORA GEOTERMALNIH VODA NA PODRUČJU OPĆINE ILIDŽA U CILJU ZAGRIJAVANJA OBJEKATA

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- Potrošnja gasa za predmetne tri kotlovnice:
  - 2015. god – 870.672,16 KM
  - 2016. god – 687.320,47 KM
  - 2017. god – 668.494,21 KM
- Prosječna potrošnja gasa za prethodne tri godine 742.162,28 KM, što dovodi do zaključka da bi se uložena investicija za ovaj projekat samo na uštedi gasa vratila za nešto više od dvije godine.
- Nepovratna sredstva
- Javni objekti na području Općine Ilidža

# EKSPLOATACIJA IZVORA GEOTERMALNIH VODA NA PODRUČJU OPĆINE ILIDŽA U CILJU ZAGRIJAVANJA OBJEKATA

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- Iako postoji rizik za realizaciju ove projektne ideje, pronalazak geotermalne vode procentualno je 50:50 %, ipak je pozitivan rezultat ovih napora, veoma značajan.
- Kada pogledamo finansijsku konstrukciju vidimo da bi cca nekih 150.000,00 KM bilo izgubljeno, ukoliko bi rezultati istraživanja bušotina bili negativni, što u konačnici predstavlja cca 10 % od ukupne vrijednosti investicije.
- Pristup razvoju KJKP Toplana Sarajevo.
- Korištenjem prirodnih domaćih resursa obnovljivih izvora energije, isključuje se ovisnost o dešavanjima na svjetskoj sceni trgovine energentima.
- Ukoliko se projektna ideja uspješno realizuje za predmetne tri kotlovnice, stvaraju se preduslovi da se ista projekta ideja primijeni i na kotlovnicu Lužani.

# HVALA NA PAŽNJI I STRPLJENJU

