

Renewable Energy Coordination Group 8th Meeting
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Renewable Energy in Heating – projects in Serbia
(Program: Promotion of Renewable Energies – Developing the
Biomass Market in Serbia)

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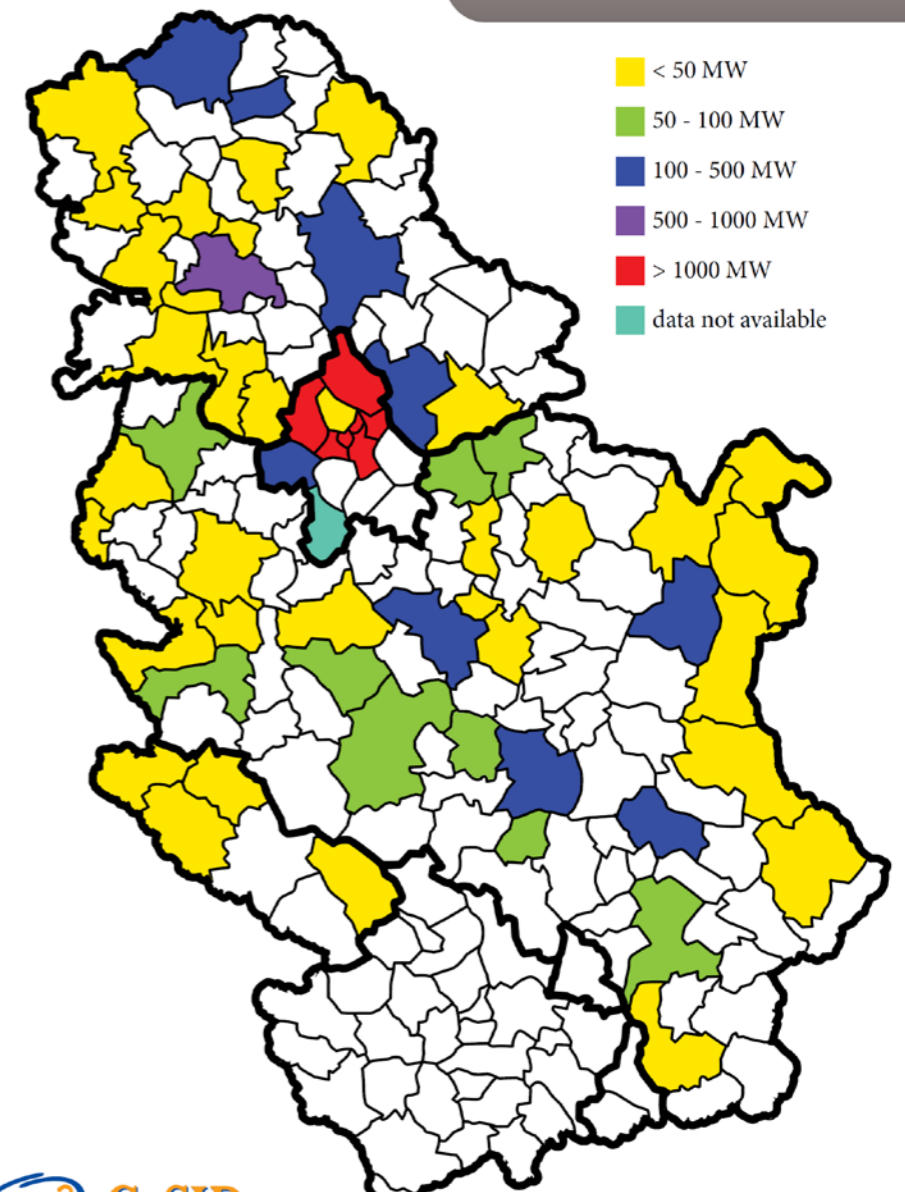
Contents:

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- 2) RES (biomass) potential in Serbia**
- 3) Key information about the project**
- 4) Expected project outcomes**
- 5) Key project indicators and targets**
- 6) Key risk and challenges**

1. DHS in Serbia

- DHS exists in 58 towns or municipalities in Serbia
- Total installed heat capacity of boilers in DHS is 6,587 GW
- In accordance with the Law of Local Self-Government, the Law on Communal Activities and the Law on Energy, DHS are fully under the jurisdiction of local self-governments

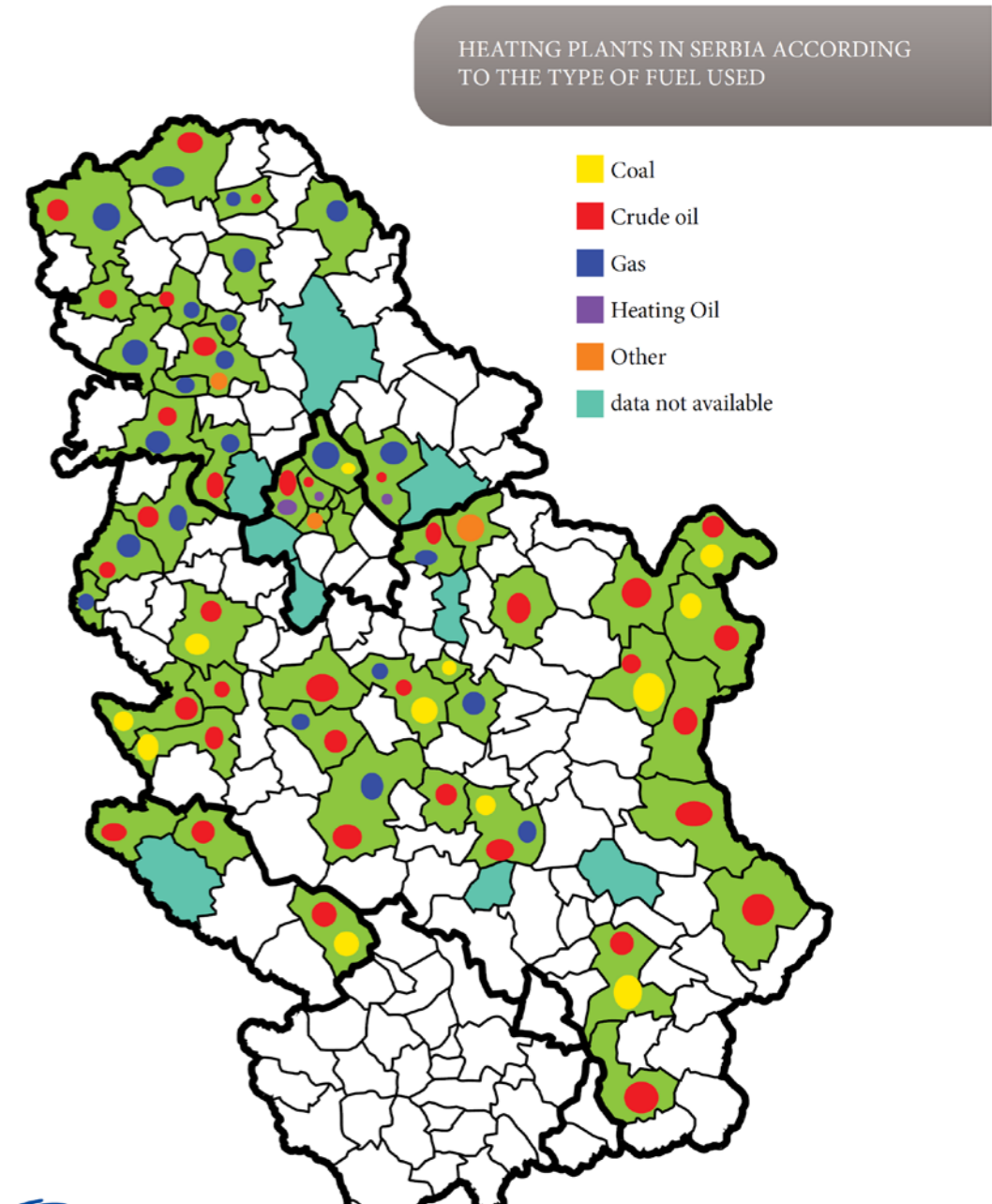
HEATING PLANTS IN SERBIA ACCORDING TO THE INSTALLED CAPACITY (MW)



Heating plants according to installed capacity

1. DHS in Serbia

- For the production of heat in district heating systems uses natural gas, coal, heavy crude oil, petroleum and biomass.
- 558 790 million m³ of natural gas, 180 920 tons of coal, 92 822 of tons petroleum products and 3 559 tons of biomass were consumed in DHS in 2015.
- Natural gas accounts for 74% of total consumption, oil derivatives for 15%, coal for 11% and biomass for less than 0.5 %.



Heating plants according to the type of fuel used

1. DHS in Serbia

Program "Rehabilitation Of Distance Heating System In Serbia"

- This development program has been implemented since 2001 within the framework of Serbo-German financial cooperation.
- The program are implemented in partnership of the Republic of Serbia, the German Federal Ministry for Economic Cooperation and Development (BMZ) and the German Development Bank (KfW).



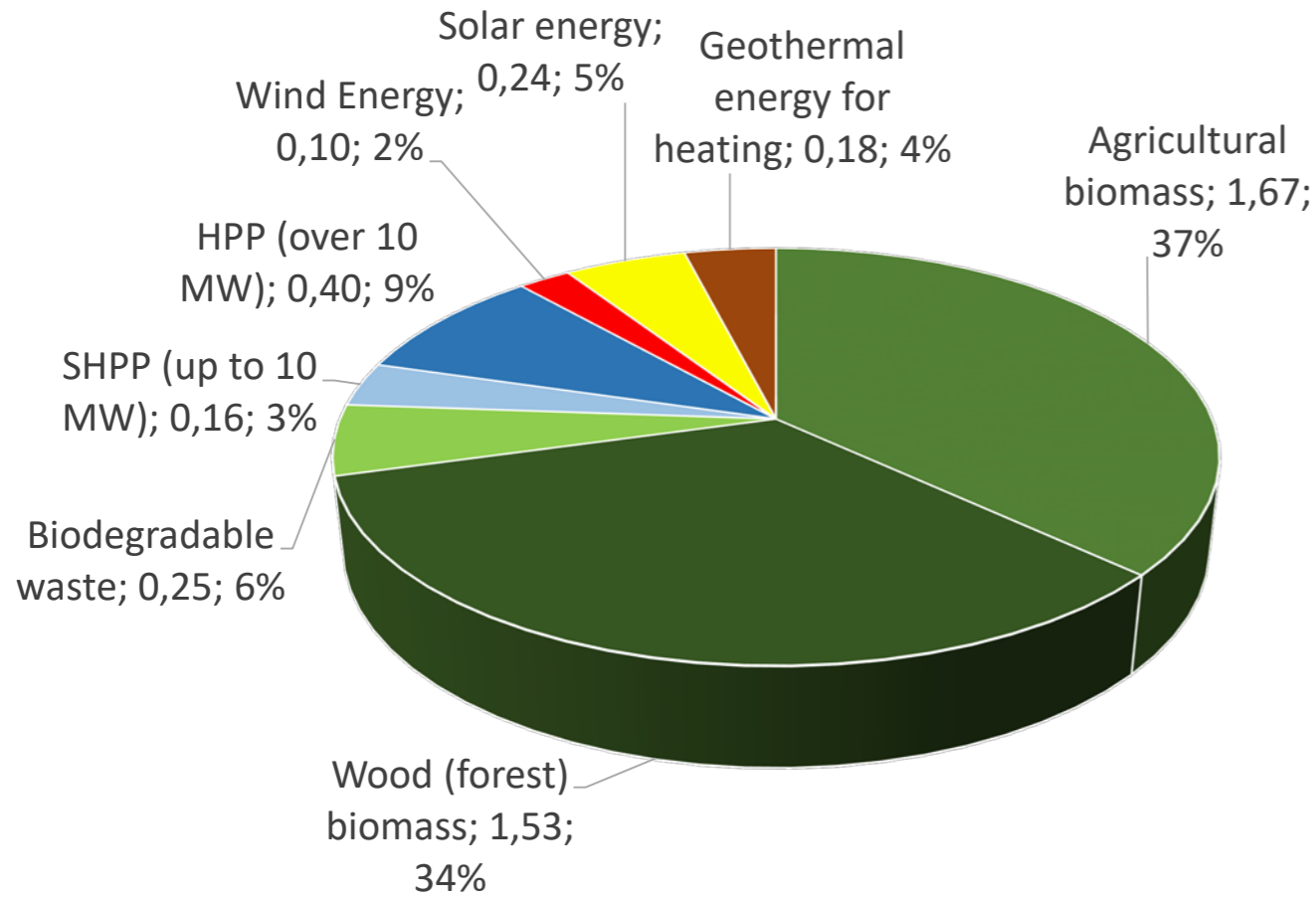
1. DHS in Serbia

- The main objectives of the Program are to **improve energy efficiency and environmental protection in the district heating sub-sector.**
- So far, four phases of the Program have been implemented, worth **123 mil. euro** through which **21 DHS were completely or partially rehabilitated**
 - Replacement of boilers and installation of new ones with rehabilitation and modernization of boiler rooms,
 - Rehabilitation and construction of hot water pipelines;
 - Reconstruction and modernization substations;
 - Construction of cogeneration plants,
 - Delivery and installation of a modern remote control and monitoring system (SCADA)

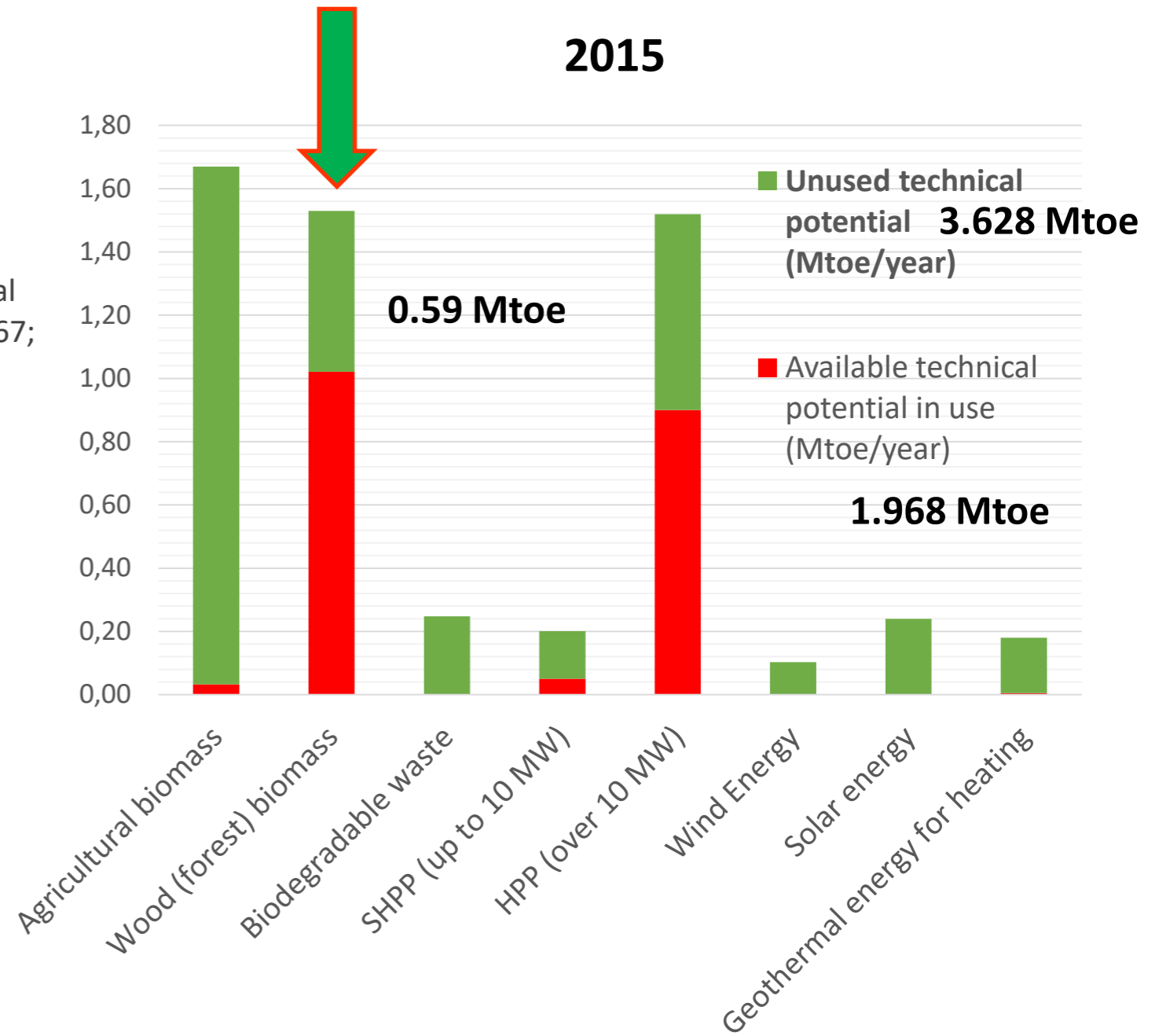


2. RES potential in Serbia

Total technical potential (Mtoe / year)



Estimation 5.65 Mtoe



2015

■ Unused technical potential **3.628 Mtoe** (Mtoe/year)

■ Available technical potential in use (Mtoe/year)

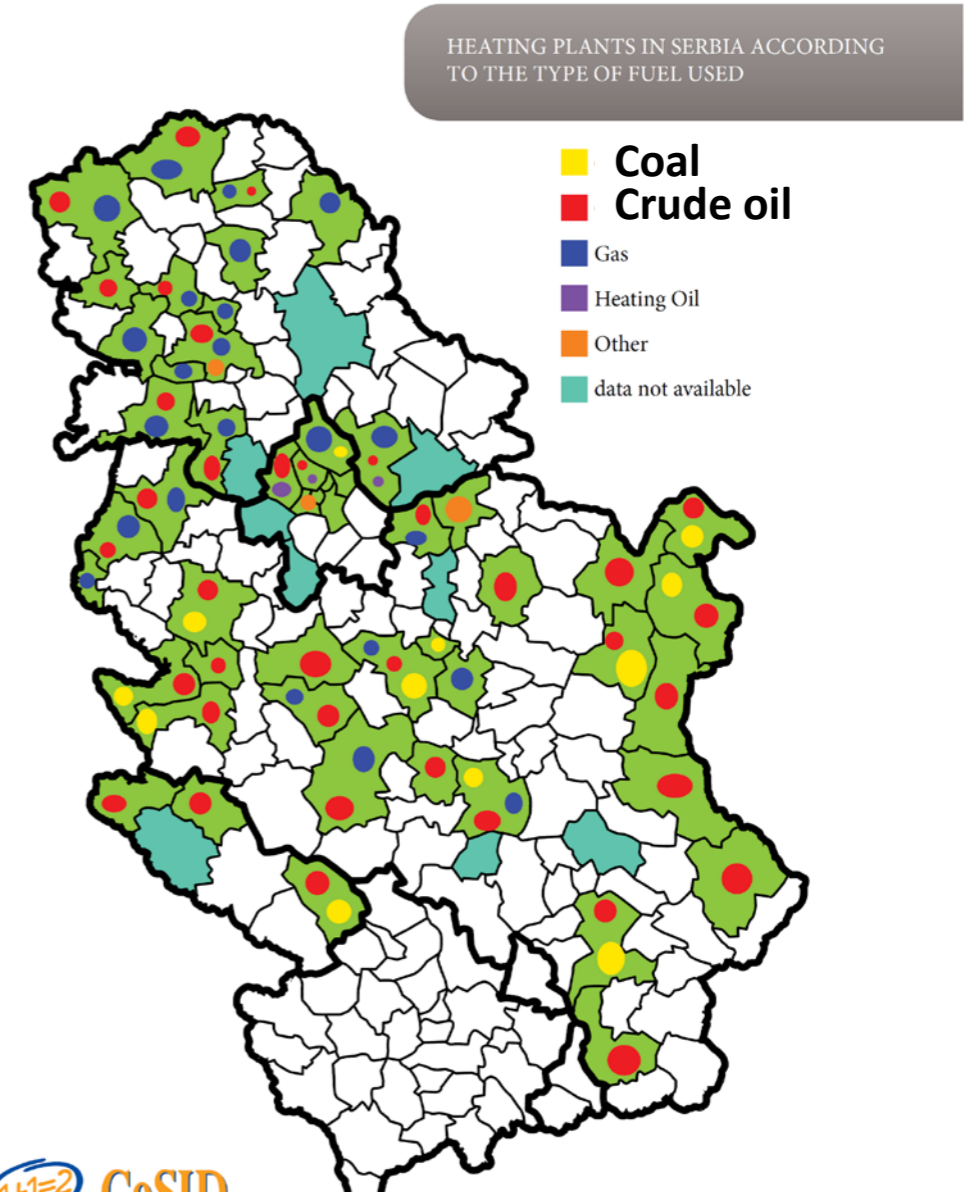
1.968 Mtoe

0.59 Mtoe

2. RES potential in Serbia



Distribution of forest areas in Serbia



Position of heating plants according to the type of fuel used

3. Key information about the project

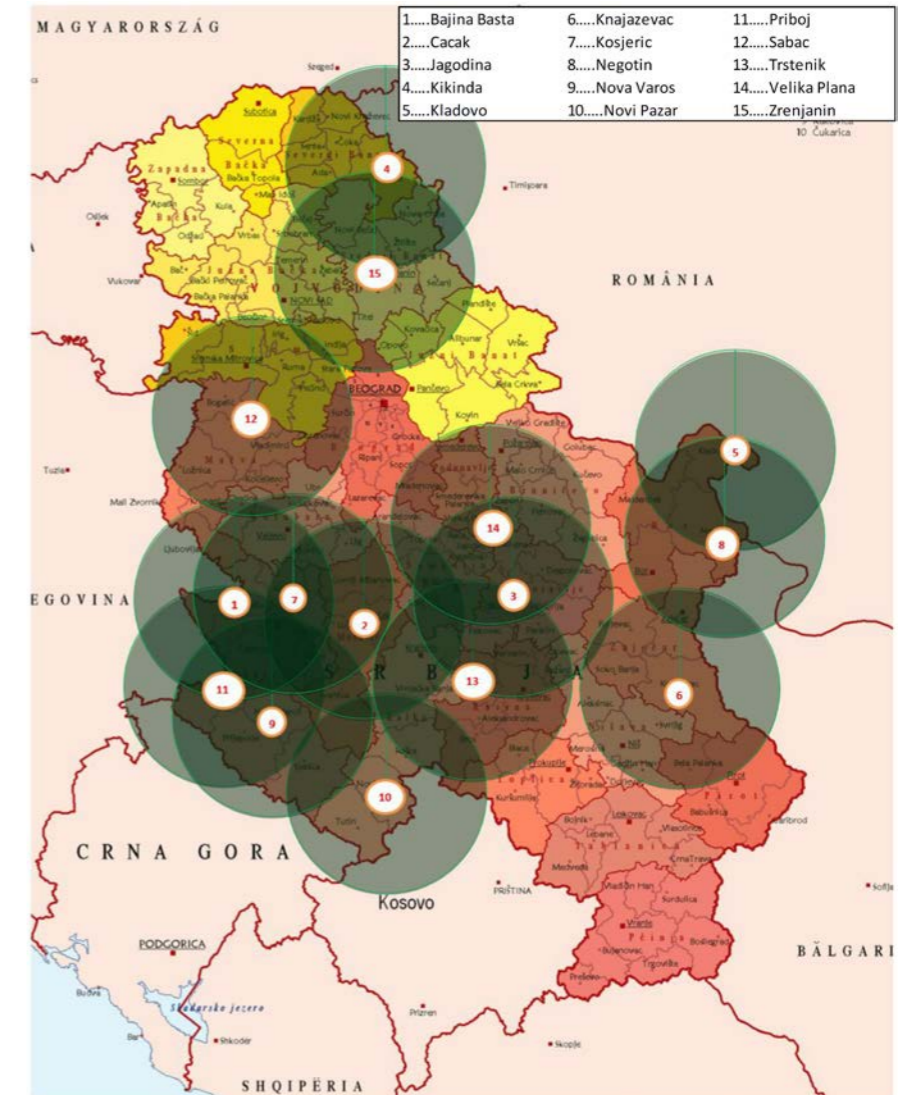
Program: *"Promotion of Renewable Energies: Developing the Biomass Market in the Republic of Serbia"*

Starting point

- Very successful cooperation with KfW Bank, SECO - Swiss State Secretariat for Economic Affairs
- Unused potential of forest biomass
- Widespread DHS throughout the whole Serbia
- Inefficient use of biomass in individual households
- **The basic idea** of the project is to **make the transition from the use of fossil fuels** (fuel oil, coal, fuel oil, gas) **to biomass** in as many DHS as possible, **under condition that it is economically feasible**

3. Key information about the project

- Although **the beginnings of the development** of this project date back to **2012**, when Serbia, through a **loan from KfW Bank, was offered the use of 100 million euros** and 2 million euros grants for technical assistance for the implementation of this project and another **8 million euros that was given to GIZ for technical assistance**, the beginning of the project is **had to wait for 2017**.
- The first pre-feasibility studies of **switching 15 DHS to CHP biomass plants** have shown that this switching projects are economically unprofitable



Map of 15 selected municipalities with areas for biomass procurement

3. Key information about the project

- The next phase was to check the economic viability of transition from DHS from the use of fossil fuels (fuel oil, coal, fuel oil, gas) to biomass
- 10 DHS in 10 municipality
- In the end, there were only 6 municipalities left that were ready to sign pre-contracts: **Priboj, Mali Zvornik, Nova Varoš, Novi Pazar, Prijepolje, Majdanpek**
- I Phase – 27 milion EUR



Location of forest in Serbia



Location of municipalities

3. Key information about the project

CURRENT SITUATION IN THOSE 6 DHS

	Majdanpek	Mali Zvornik	Nova Varos	Novi Pazar	Priboj	Prijepolje
Fuels used	Mazut	Natural gas	Mazut, pellets	Mazut, coal	Mazut	Mazut, coal pellets
Fossil fuel demand	32.354 MWh	4.321 MWh	5.915 MWh	22.300 MWh	26.174 MWh	7.286 MWh
Share on renewables	0%	0%	10%	0%	0%	5%
CO ₂ emissions	9.059 ton	894 to	1.656 ton	6.820 ton	7.329 ton	2.086 ton
SO ₂ emissions	143 ton	0 ton	31 ton	22 ton	113 ton	30 ton

3. Key information about the project

The installed capacities:

DHC	Mazut	Natural gas	Coal	Pellets
Majdanpek	18.6 MW 12.6 MW			
Mali Zvornik		2.3 MW 2.3 MW 1.8 MW		
Nova Varoš	2 x 1.7 MW 3 x 2.0 MW 1 x 2.2 MW 2 x 1.6 MW 2 x 0.8 MW			2 x 0.3 MW 0.5 MW
Novi Pazar	2 x 7.0 MW			
Priboj	29 MW 25 MW			
Prijepolje	3.5 MW 4 x 1.86 MW 3.72 MW		1.0 MW 0.7 MW	0.6 MW

3. Key information about the project

Program financing

Financing source:

KfW loan EUR 20.000.000

German government - grant EUR 2.000.000

SECO State Secretariat for Economic Affairs - grant EUR 5.000.000

Total Fund EUR 27.000.000

3. Key information about the project

Loan terms:

- Repayment period	20 years
- Grace period	5 years
- Annual interest	1,1 %

Financing source:

- investments	EUR	23.100.000
- consulting services	EUR	2.950.000
- engineering services	EUR	700.000
- KfW's implementation fee	EUR	250.000

- Total:	EUR	27.000.000

3. Key information about the project

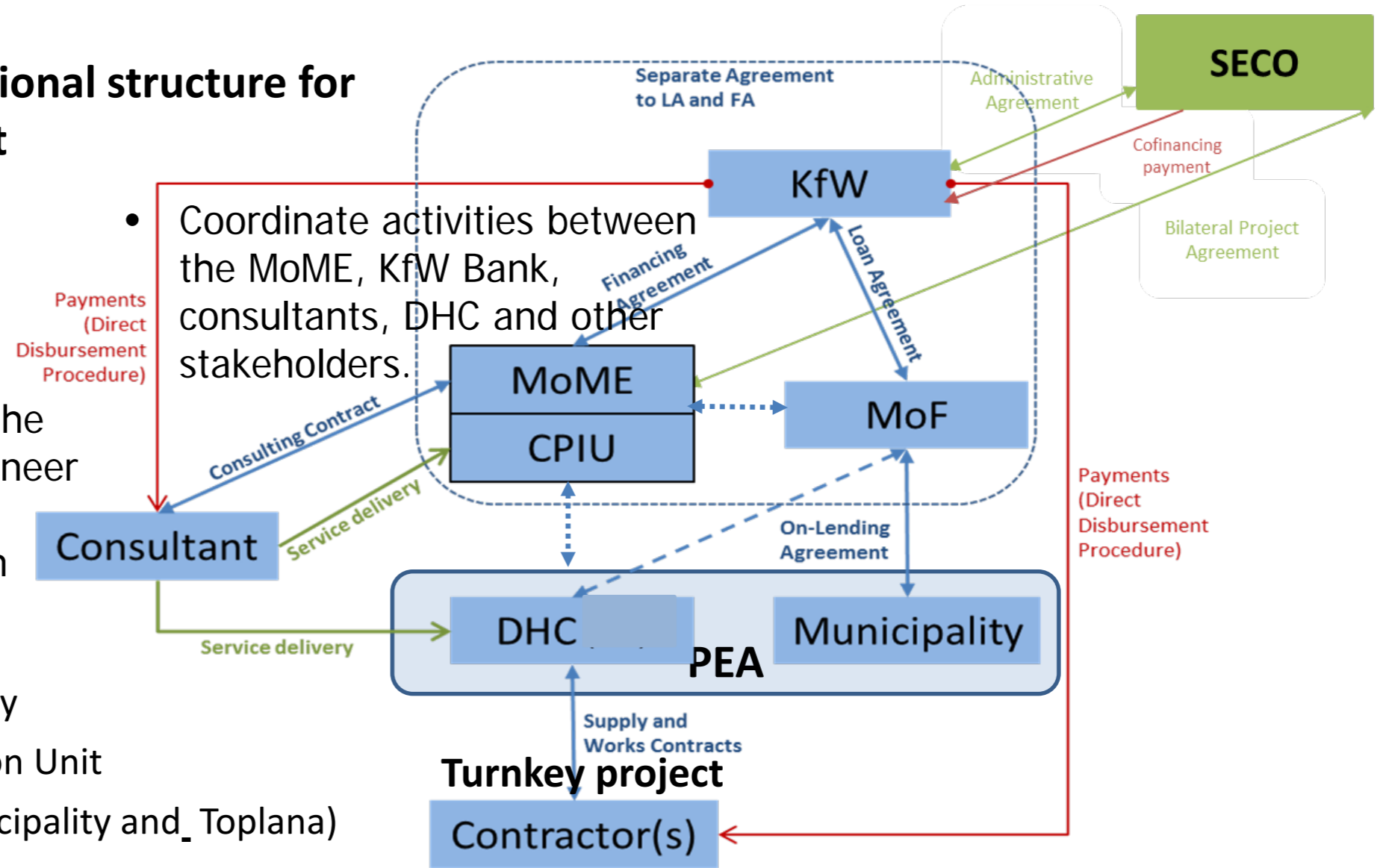
Timeline of main events

- The Loan Agreement and Separate Agreement were signed with KfW Bank on June 21, 2017.
- Grant Agreements (Financial Agreement I and Financial Agreement II) were signed with SECO. All of the agreements were signed on June 21, 2017.
- **The Parliament of the Republic of Serbia ratified the Loan agreement in April 2018.**
- **Consortium Clean Energy Solutions - Vienna, Austria and DECON, Mannheim, Germany were selected for consultants on the project.** The consultants started to work in June 2018.
- The Ministry of Mining and Energy (MoME) formed the Central Project Implementation Unit (CPIU) in November 2018.
- The CPIU has 9 member of which two are professionally engaged - a technical and financial expert.
- **November 2018 is the official start of the Project.**

3. Key information about the project

Overview of the organizational structure for implementation of project

- Coordinate activities between the MoME, KfW Bank, consultants, DHC and other stakeholders.
- Consultants play the role of FIDIC engineer and tender agent.
- Conceptual design



MoME- Ministry of Mining and Energy
CPIU – Central Project Implementation Unit
PEA -Project Executing Agency (Municipality and Toplana)

3. Key information about the project

PRE-FEASIBILITY STUDIES

PFSs were prepared for all municipalities except for Majdanpek, which is ongoing.

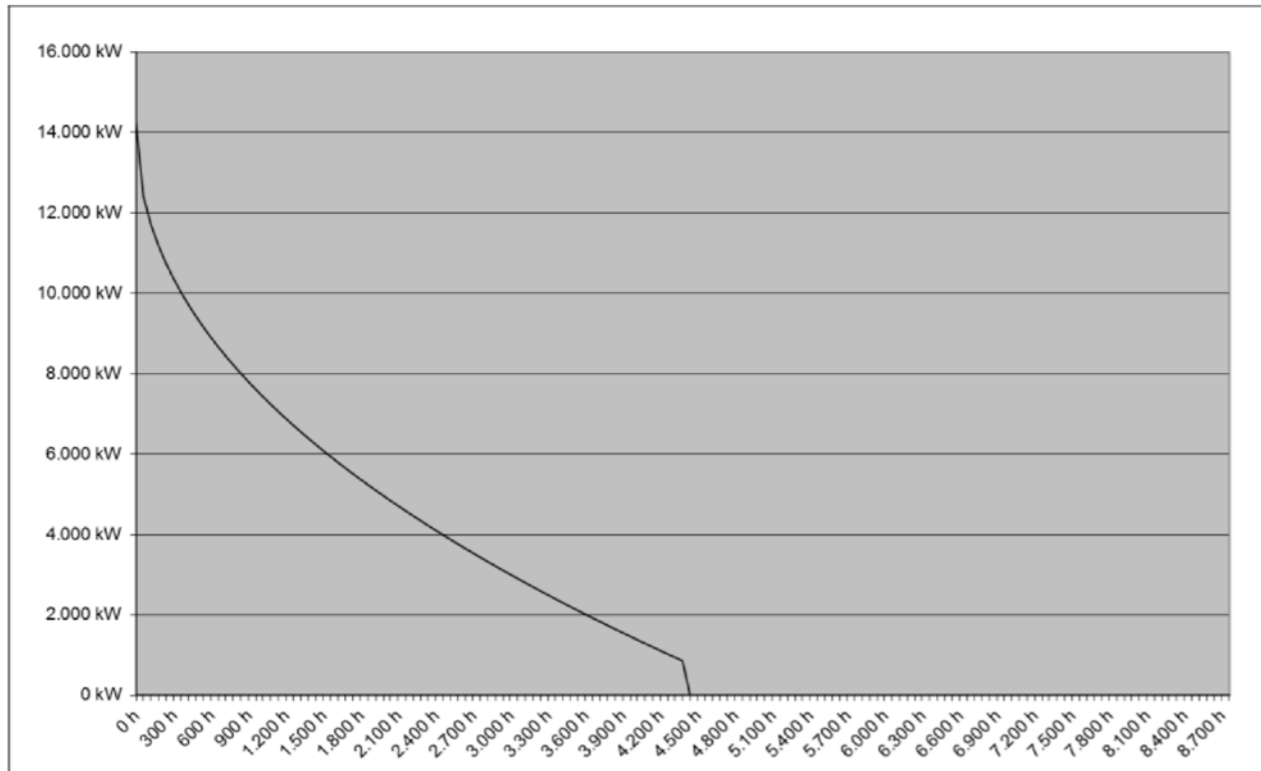
PFS contains:

- Current status of the DH system
- Heat Market Analyses
- Heat Demand Forecast
- Design Concept of the new Heating Station
- Plant Operation
- Biomass Procurement and Valuation
- Cost Estimates
- Preliminary Financial Analyses
- Institutional Analyses & Measures
- Steps for Project Implementation
- Risk Analysis

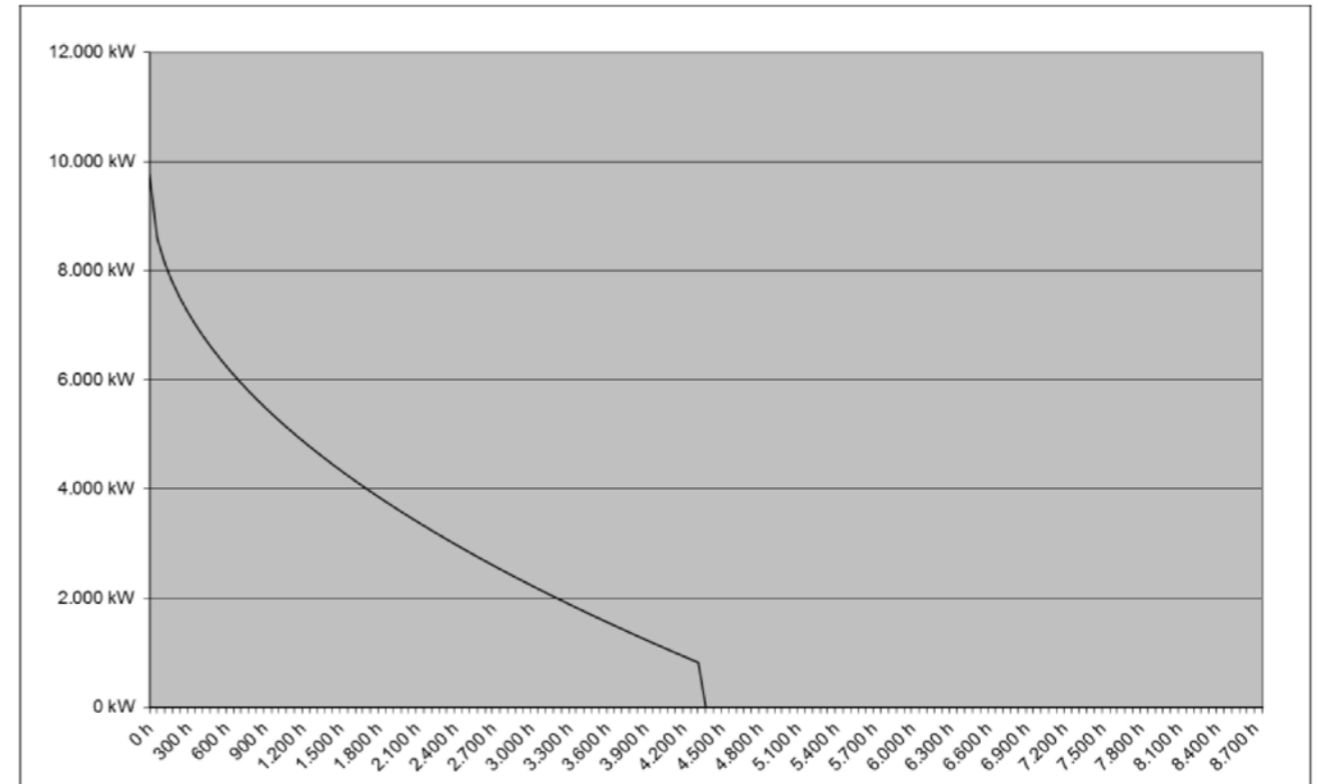
3. Key information about the project

PRE-FEASIBILITY STUDIES

Heat Market Analyses



Current load duration curve

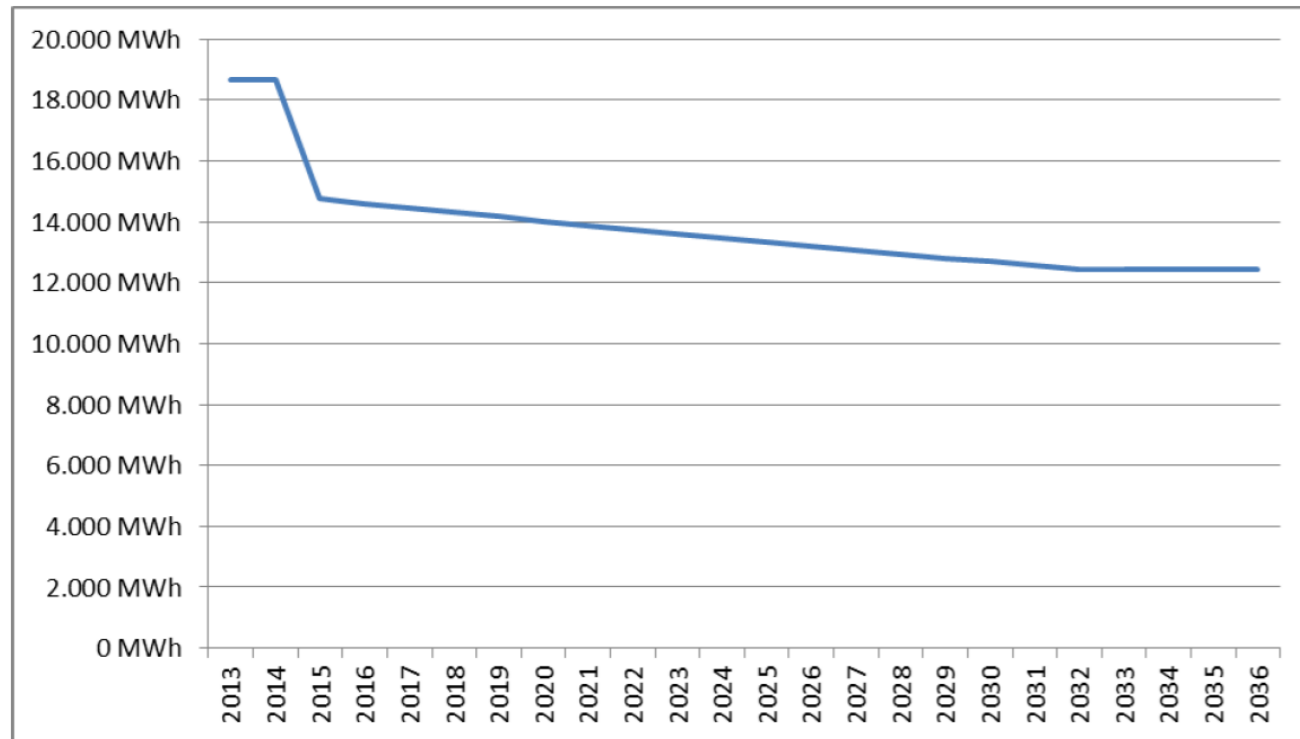


Future load duration curve - FORECASTS

3. Key information about the project

PRE-FEASIBILITY STUDIES

Heat Market Analyses



Development of heat demand until 2036

Influence of :

- Raising the comfort of heat supply by automatic substations and indirect heat transfer into the buildings
- Consumption based billing
- Effects of demand side measures like individual sub-stations with heat meters, regulating valves at consumer's heating devices
- Effects on energy efficiency measures at buildings like insulation, new windows, etc.
- Reduction of network losses by replacement of pipes

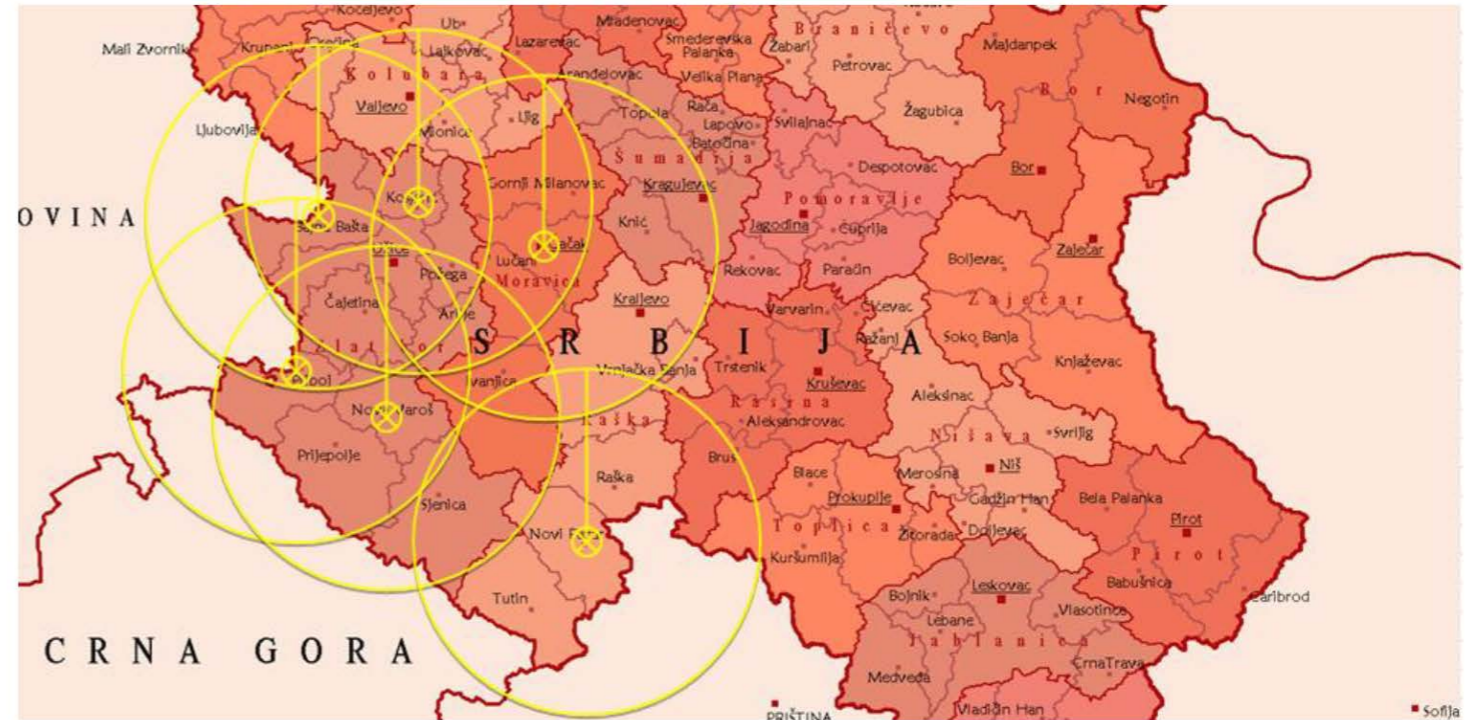
3. Key information about the project

PRE-FEASIBILITY STUDIES

PRELIMINARY BIOMASS MARKET ANALYSES

The goal of the preliminary biomass analysis for DH was the determination of wood and agriculture biomass potentials in the area along with a market analysis.

- Enough biomass
- Provide supply chain

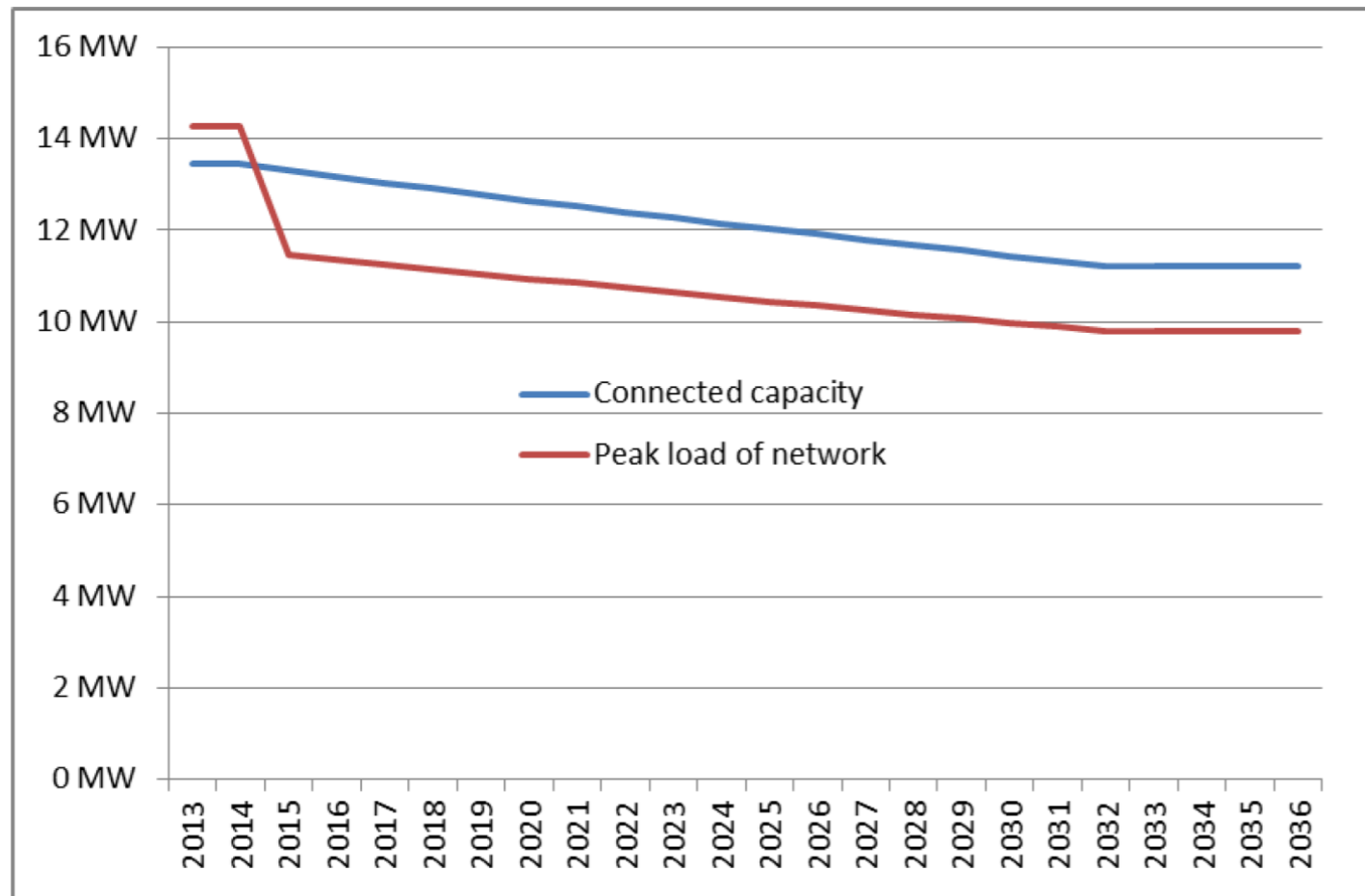


The map below shows circle of possible supply for Priboj area, with overlapping of areas of other possible DH such as: Nova Varos, Novi Pazar, Kosjeric, Bajina Basta and Cacak.

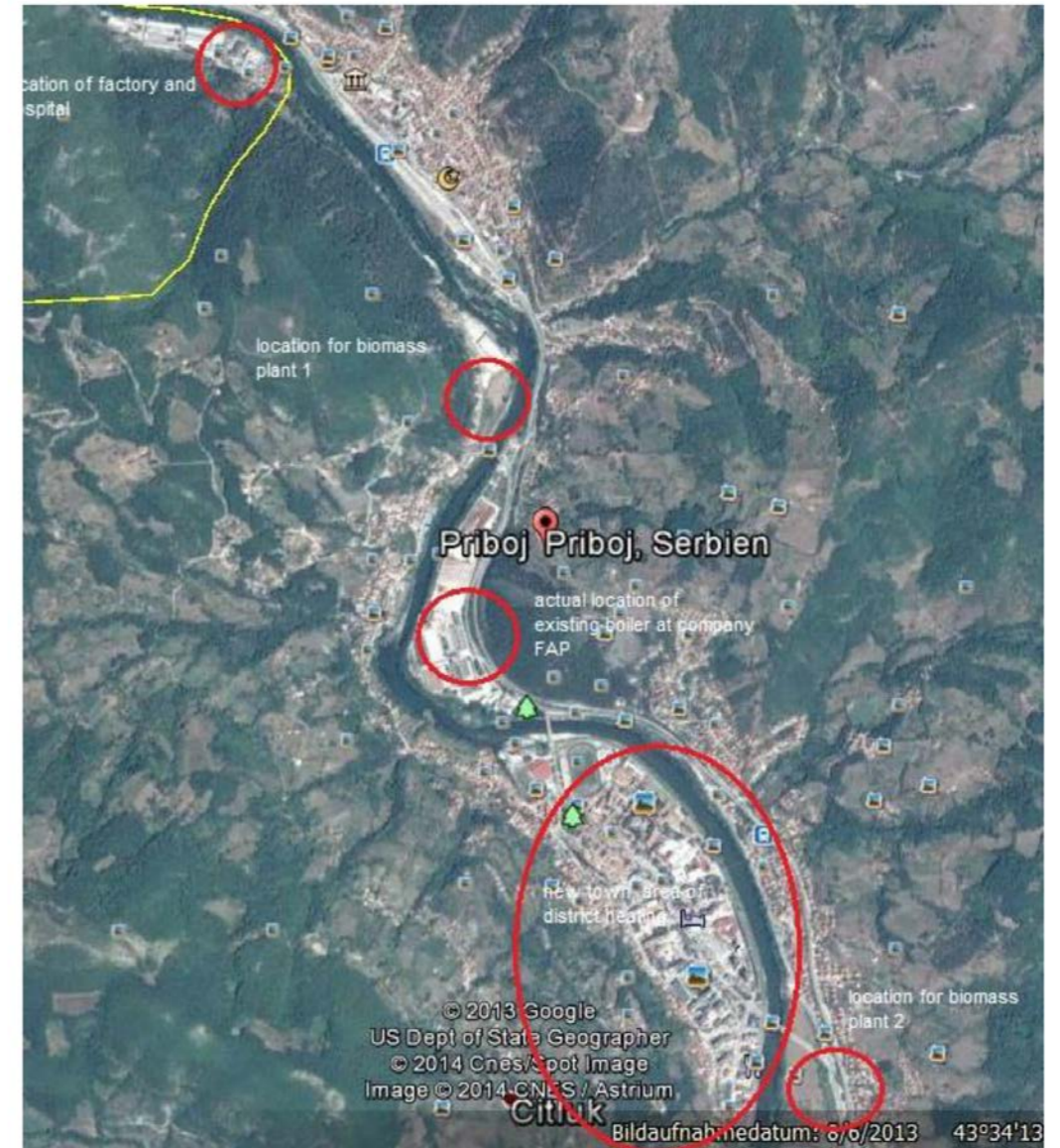
3. Key information about the project

PRE-FEASIBILITY STUDIES

TECHNICAL DESIGN CONCEPTS



Forecast on connected capacity and peak capacity of the network

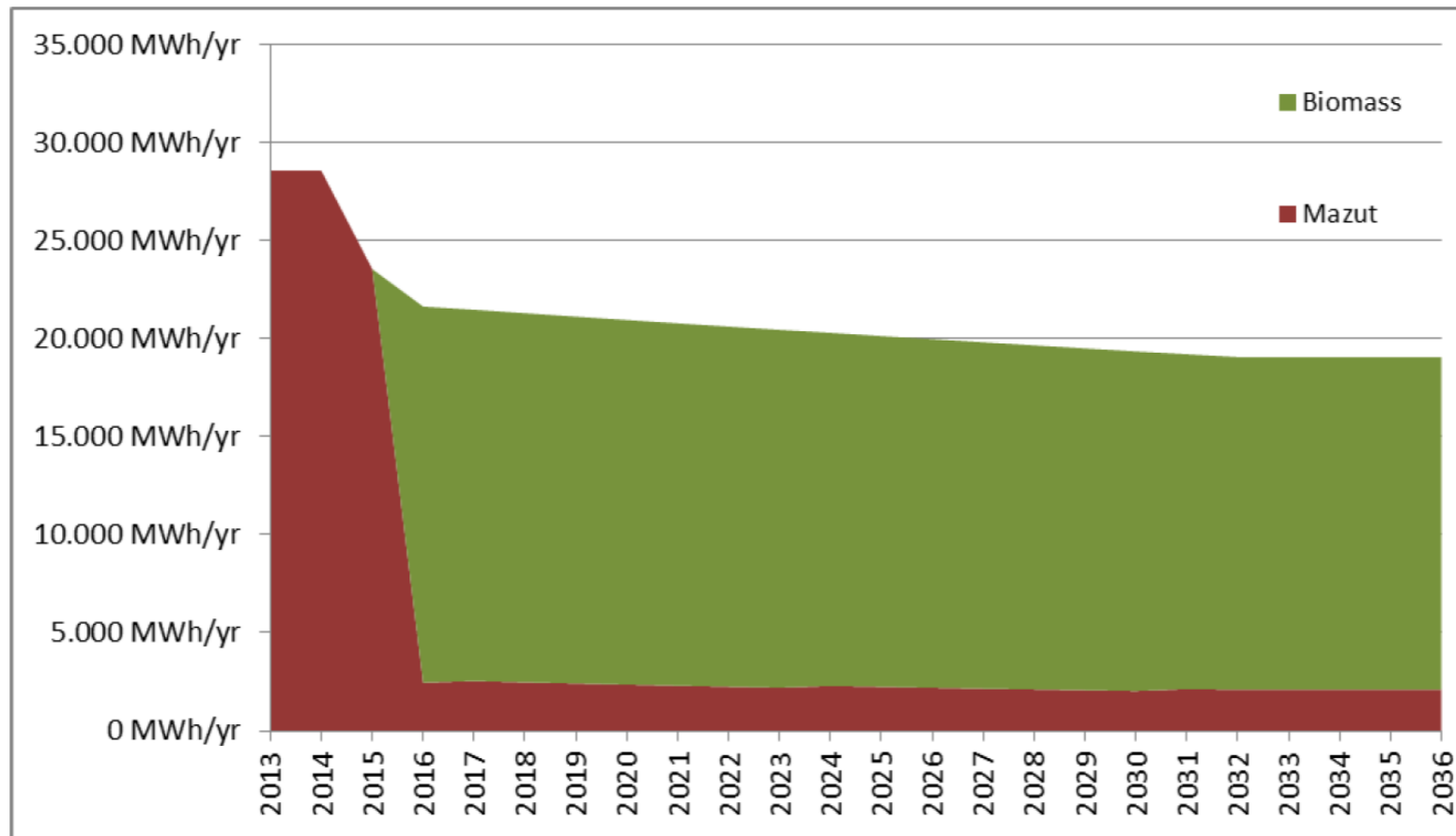


Locations for a biomass heating plant.

3. Key information about the project

PRE-FEASIBILITY STUDIES

TECHNICAL DESIGN CONCEPTS

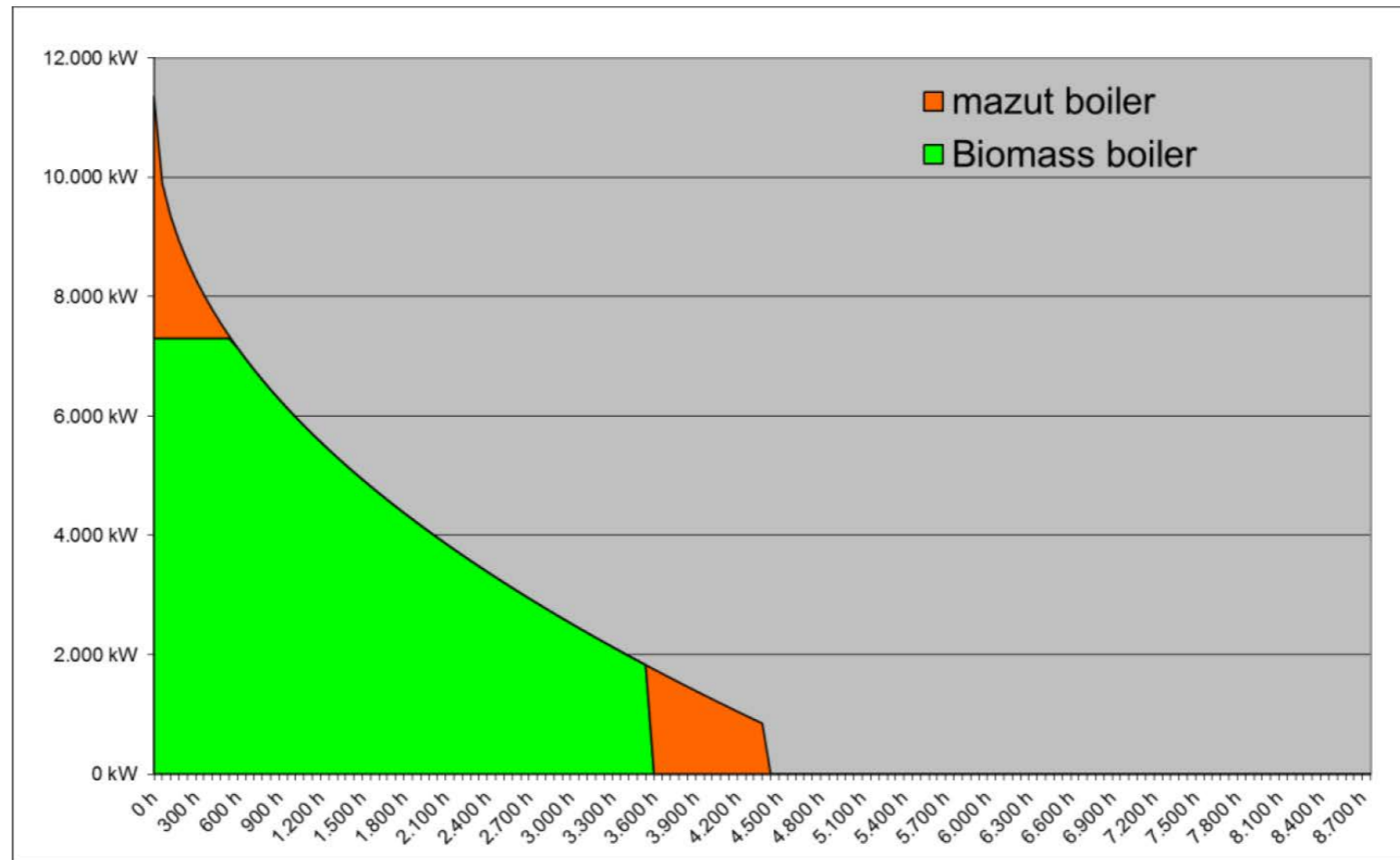


Forecast on shares of heat generation by types of boilers

3. Key information about the project

PRE-FEASIBILITY STUDIES

TECHNICAL DESIGN CONCEPTS



Heat load curve after installation of the HoB plant

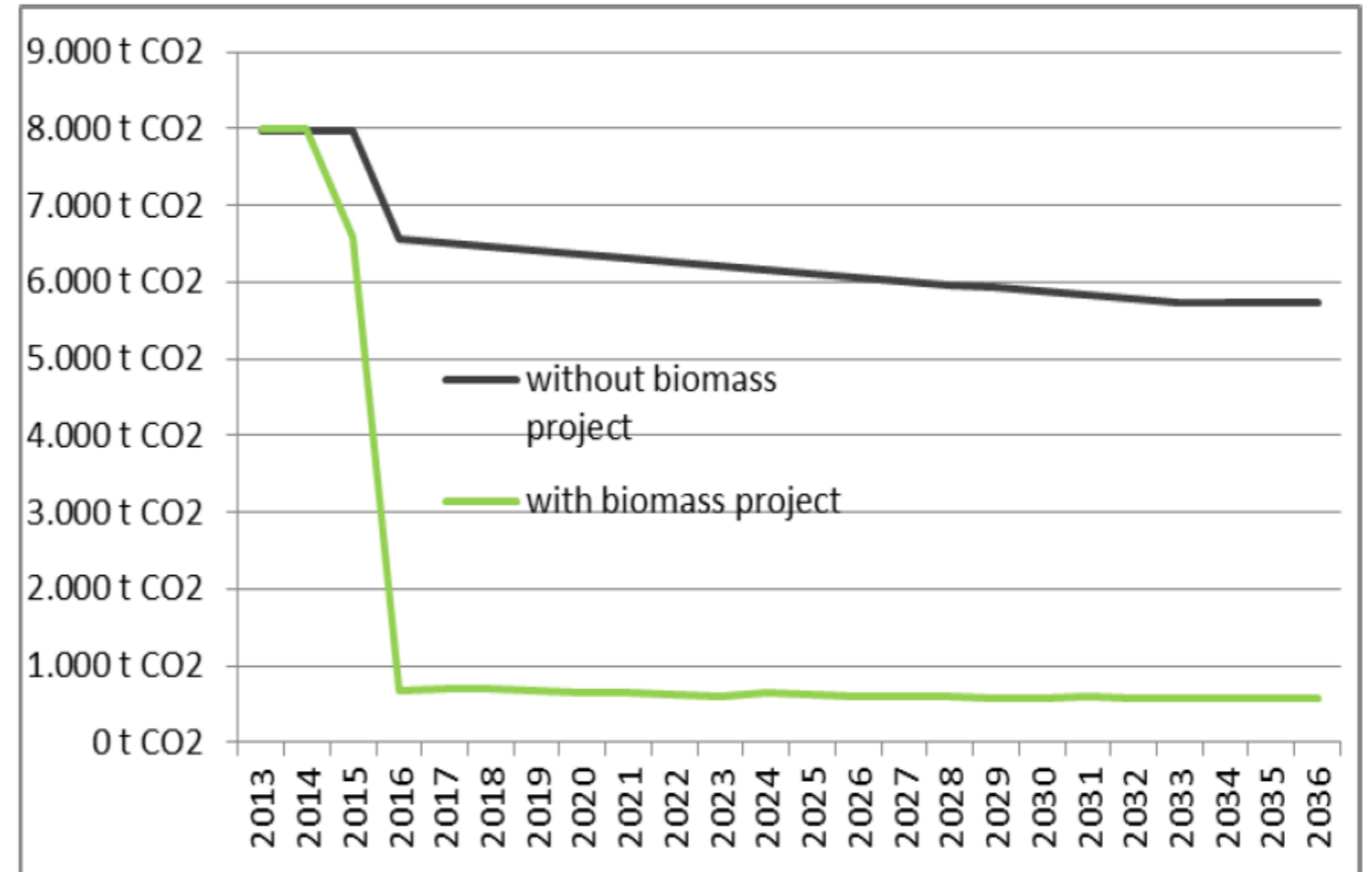
3. Key information about the project

PRE-FEASIBILITY STUDIES

ENVIRONMENTAL IMPACTS OF THE PROJECT

The calculation of CO₂ savings considers the replacement of mazut and gas for heating and the replacement of power generated by the power demand operated thermal power plants of Serbia with green power based on CO₂ neutral biomass.

- The combustion of 1 MWh of natural gas releases 207 kg CO₂.
- The combustion of 1 MWh of Mazut releases 280 kg CO₂.
- The combustion of 1 MWh of coal releases 380 kg CO₂.



3. Key information about the project

PRE-FEASIBILITY STUDIES

Preliminary Financial Analyses

- The financial models have shown that biomass (wood chips) heating is about 20% cheaper than heating based on mazut with a significant reduction in CO₂ and SO₂ emissions, which also has a price.
- The pay-back period of the investment is 17 years.
- All projects met the primary financial indicator: the Debt Service Coverage Ratio (DSCR > 1.15 starting from the second year of operation).

3. Key information about the project

Capacities of new biomass boilers

Municipality	Capacity of Biomass Boiler	Yearly Biomass Demand		
		Heating Value	30% water	50% water
Mali Zvornik	1.8 MW	5 000 MWh/yr	1 500 tons	2 200 tons
Majdanpek	7.0 MW	25 000 MWh/yr	7 500 tons	11 100 tons
Nova Varos	2.5 MW	8 000 MWh/yr	2 400 tons	3 600 tons
Novi Pazar	8.0 MW	20 000 MWh/yr	6 000 tons	8 900 tons
Priboj	8.0 MW	25 000 MWh/yr	7 500 tons	11 100 tons
Prijepolje	3.0 MW	9 000 MWh/yr	2 700 tons	4 000 tons
Total	30.3 MW	92 000 MWh/yr	27 600 tons	40 900 tons

3. Key information about the project

Financing of the DHCs

Investments per DHC:

- Priboj	EUR 6.160.000
- Mali Zvornik	EUR 2.250.000
- Novi Pazar	EUR 6.100.000
- Prijepolje	EUR 2.800.000
- Nova Varoš	EUR 2.800.000
- <u>Majdanpek</u>	<u>EUR 2.990.000</u>
- otal:	EUR 23.100.000

Fund's term of use:

- loan share	83,55%
- grant share	16,45%

3. Key information about the project

Contracts have been signed for the construction of the wood chips boilers for the cities of Priboj and Mali Zvornik (September 2019).

For other cities, contracts will be signed in December 2019.

Launching tenders for the procurement of goods and services:

- | | |
|------------------------|----------------|
| - Priboj, Mali Zvornik | October 2019 |
| - Others | September 2020 |

Completion period:

- | | |
|------------------------|---------------------|
| - Priboj, Mali Zvornik | 1st quarter of 2022 |
| - Others | 1st quarter of 2023 |

4. Expected project outcomes

With Program the following benefits for Serbia are expected:

- Increase share of RES
- Reduction of fossil fuel consumption
- Reduction of CO₂ and SO₂ emissions
- Improvement of overall efficiency
- Improvement of air quality
- Sustainable development of the district heating sector
- Improvement of comfort and reliability

5. Key project indicators and targets

REVIEW OF THE PROGRAM INDICATORS

Municipality	Forecast of the reduction of			Share on renewables
	CO ₂	SO ₂	Heat losses	
Mali Zvornik	70%	n.a.	10%	70%
Majdanpek	70%	70%	50%	70%
Nova Varoš	70%	70%	25%	70%
Novi Pazar	80%	80%	0%	80%
Priboj	70%	70%	30%	70%
Prijepolje	75%	70%	0%	70%
Required target	70%	70%	25%	70%

6. Key risk and challenges

Challenges that we encountered during implementation:

- Underestimated investment capacity (It was originally planned that 23.1 million euro could be enough for DHCs in 10 municipalities. The sum is sufficient for only 6 heating plants.
- At the local level, the problem was land ownership.
- The project started with the old PFSs, so all the studies had to be updated in accordance with the existing situation in the municipalities.
- Domestic biomass market is not developed yet.
- Threats: Biomass price fluctuations and therefore disconnection of consumers if heat price becomes too high.

Thank you for your attention!