Initiating new small district heating and cooling grids in Šabac

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Wednesday, 06 June 2018, Belgrade
What are small, modular, renewable heating and cooling systems?

- Biomass heating
- Solar heating
- Excess heat
- Power-to-heat
- Power-to-cold
- Cooling sources

Heat storage

Heat pumps

Cold storage

Small modular RE district heating grid

Heating/ Cooling Consumers

Small modular RE district cooling grid
Geographical Focus

Target countries with best practice examples (in green) and target countries (orange) with less developed renewable district heating sector

- Austria
- Croatia
- Slovenia
- Bosnia-Herzegovina
- Germany
- Macedonia
- Serbia
- Denmark
- Slovenia
- Germany
- Macedonia
- Serbia
- Austria
- Croatia
- Slovenia
- Bosnia-Herzegovina
- Germany
- Macedonia
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- Germany
- Macedonia
- Serbia
Work Packages

WP1: Project management

WP2: Best Practices & framework analysis

WP3: Stimulating communities’ interest

WP4: Technical knowledge transfer & capacity building

WP5: Capacity building on financing & business models

WP6: Initiating new small district heating/cooling grids

WP7: Communication and dissemination
The place of the business plans and feasibility checks in “CoolHeating”

- D5.4 Target community business models
  - City of SABAC-

- D5.3 Guideline on drafting heat/cold supply contracts for small DHC systems

- D4.4 Heating/cooling demand and technical concept for district heating/cooling in Sabac,

- D5.2 Economic calculation tool for small modular district heating and cooling projects

- D5.1 Guidelines on improved business models and financing schemes of small renewable heating and cooling grids

- D6.1 Feasibility Checks of small modular renewable heating and cooling grids: Letnjikovac & Nova Toplana
Both projects are focused on biomass and public private partnership model of investment and operation.

"Letnjikovac", the smaller size implementation of the biomass-based DH in the suburban area.
Technical concepts

"Nova Toplana":
• 3 biomass boilers 3 x 4.5 MW,
• existing natural gas boilers,
• buffer storage tank 200 m³,
• connecting pipeline 2.2 km

"Letnjikovac":
• Biomass load boiler 1.5 MW,
• fuel oil peak boiler 3.5 MW,
• buffer storage tank 60 m³,
• grid length of 7.7 km,
• 250 individual substations.
## Investment costs and financing

<table>
<thead>
<tr>
<th>Category</th>
<th>&quot;Letnjikovac&quot;</th>
<th>&quot;Nova Toplana&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TOTAL [€]</strong></td>
<td>2,095,000.00</td>
<td>7,200,000.00</td>
</tr>
<tr>
<td>Equipment/Machinery</td>
<td>1,845,000.00</td>
<td>6,250,000.00</td>
</tr>
<tr>
<td>Buildings and construction works</td>
<td>200,000.00</td>
<td>900,000.00</td>
</tr>
<tr>
<td>Plot</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Project and investment documentation</td>
<td>50,000.00</td>
<td>50,000.00</td>
</tr>
<tr>
<td>Intangible assets (patents, licenses, software)</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Initial working capital</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

| **TOTAL [€]**                                 | 2,095,000.00   | 7,200,000.00   |
| Private equity                                | 370,000.00     | 2,200,000.00   |
| i=1%, repayment period 15 years, grace period 4 years | 1,450,000.00   | 5,000,000.00   |
| Connection fees                               | 150,000.00     | 0.00           |
| Investment subsidies                          | 125,000.00     | 0.00           |
| Bridge loan (6 months delay, i=5%)            | -              | -              |

1. Based on the best available non-commercial credit lines for the switching to biomass in Serbian utilities from the international cooperation agreements.
### Key costs

#### Fuel Heat value

<table>
<thead>
<tr>
<th>Type</th>
<th>MWh/a</th>
<th>t/a</th>
<th>l/a</th>
<th>GJ/t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biomass</td>
<td>4,740</td>
<td>1,422</td>
<td>/</td>
<td>12</td>
</tr>
<tr>
<td>Heating oil</td>
<td>484</td>
<td>44</td>
<td>46,106</td>
<td>40</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>5,224</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Table: Fuel Heat value

<table>
<thead>
<tr>
<th>Type</th>
<th>MWh/a</th>
<th>t/a</th>
<th>m³</th>
<th>GJ/t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biomass</td>
<td>44,315</td>
<td>13,295</td>
<td>/</td>
<td>12</td>
</tr>
<tr>
<td>Natural gas</td>
<td>26,397</td>
<td></td>
<td>2,566,278</td>
<td>37</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>70,712</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Biomass: 18 €/MWh (yty 1.00%)
- Natural gas: 35.71 €/MWh (yty 2.80%)
- Electricity: 50 €/MWh (yty 1.00%)
- Heating oil: 100 €/MWh (yty 2.80%)

- O&M: 1.5% of the investment costs, (yty 2.50%)
- Cost of management, insurance and lease: 1% of the investment costs (yty 2%)
Socio-environmental impacts

"Letnjikovac":
- Lower energy costs,
- High level of energy supply comfort.
- 1 direct new employee and several other indirect employments due to the effects on local economy.
- Improved air quality and lower expenses for health services.
- New opportunities for owners of forests and agricultural areas in providing biomass for the DH plant.
- Improved energy efficiency in biomass use.
- Introduction of energy cooperatives.

"Nova Toplana":
- Decrease in the heating costs;
- Reduction of CO₂ equivalent emissions by 7,540 tons per year;
- Creation of the regional and national biomass market;
- Increased security of biomass supply and lower dependency on gas imports.

<table>
<thead>
<tr>
<th>Energy</th>
<th>Volume</th>
<th>Economic value</th>
<th>Emission CO₂eq/a</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MWh/a</td>
<td>m³/a</td>
<td>tons/a</td>
</tr>
<tr>
<td>Natural gas</td>
<td>40,943</td>
<td>3,980,459</td>
<td>-</td>
</tr>
<tr>
<td>Biomass (η=20%)</td>
<td>19,435</td>
<td>-</td>
<td>5,831</td>
</tr>
<tr>
<td>Total</td>
<td>60,378</td>
<td>3,980,459</td>
<td>5,831</td>
</tr>
</tbody>
</table>
Key revenue parameters: Letnjikovac

4% discount rate is employed in the simulations of the economic performance of the projects. The following show economic calculations are contained simulation results from Economic calculation tool for small modular district heating and cooling project.
Sensitivity analysis: Letnjikovac

- **Operating costs**: 
  - increase of 5%: 
    - significantly increase the payback time to **around 15 years**, 
    - decrease the internal rate of return towards **unprofitability**. 
  - decrease of 5%: 
    - reduce the payback time to around **5 years** 
    - increase the internal rate of return to around **12.5%**.

- more sensitive to the **operating cost increase** and more sensitive is its **payback time**.

- **Heat price**: 
  - increase of **average heat price** to around **82 €/MWh** 
    - decrease the payback time to around **5 years** 
    - increase the internal rate of return to around **12%**. 
  - decrease of **average heat price** to around **78 €/MWh** 
    - increase the payback time to **around 15 years** 
    - decrease the internal rate of return towards **4%**(marginal profitability).

- more sensitive to the **heat price decrease** and more sensitive is its **payback time**.
Key revenue parameters Nova Toplana

<table>
<thead>
<tr>
<th>Year</th>
<th>Cash flow</th>
<th>Discounted Cash flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-2,200,000</td>
<td>-2,200,000</td>
</tr>
<tr>
<td>CF1</td>
<td>616,819</td>
<td>593,096</td>
</tr>
<tr>
<td>CF2</td>
<td>1,034,851</td>
<td>956,777</td>
</tr>
<tr>
<td>CF3</td>
<td>1,054,046</td>
<td>937,043</td>
</tr>
<tr>
<td>CF4</td>
<td>1,073,509</td>
<td>917,640</td>
</tr>
<tr>
<td>CF5</td>
<td>743,860</td>
<td>611,399</td>
</tr>
<tr>
<td>CF6</td>
<td>763,237</td>
<td>603,198</td>
</tr>
<tr>
<td>CF7</td>
<td>782,879</td>
<td>594,924</td>
</tr>
<tr>
<td>CF8</td>
<td>802,786</td>
<td>586,588</td>
</tr>
<tr>
<td>CF9</td>
<td>822,957</td>
<td>578,199</td>
</tr>
<tr>
<td>CF10</td>
<td>843,395</td>
<td>569,767</td>
</tr>
<tr>
<td>TOTAL</td>
<td>6,338,339</td>
<td>Payback: 2.69 years</td>
</tr>
</tbody>
</table>

4% discount rate is employed in the simulations of the economic performance of the projects. The following show economic calculations are contained simulation results from Economic calculation tool for small modular district heating and cooling project.
Sensitivity analysis Nova Toplana

- **Operating costs:**
  - increase of operating cost of 20%:
    - increase the payback time to **4 years**
    - decrease the internal rate of return to **20%**.
  - decrease of operating cost of 20%:
    - reduce the payback time to around **2 years**
    - increase the internal rate of return to around **50%**.
  - more sensitive to the *operating cost increase* and more sensitive is its *internal rate of return*.

- **Heat price:**
  - increase of *average heat price* to around **67 €/MWh**
    - decrease the payback time to around **2 years**
    - increase the internal rate of return to around **55%**.
  - decrease of *average heat price* to around **47€/MWh**
    - increase the payback time to **5 years**
    - decrease the internal rate of return to **15%**.
  - more sensitive to the *heat price decrease* and more sensitive is its *internal rate of return*. 
Conclusions

"Nova Toplana": 7,200,000 €
• average yearly price 423 €
  based on the 10 years contract (2019-2029), very attractive IRR 37.40% short payback time of (2.69 years).
• reductions in the of 7,540 t CO₂eq
• increased energy security
• storage for biomass up to 90 days of yearly
• regional biomass market
• economic activity in the biomass supply sector.

"Letnjikovac": 2,095,000 €.
• IRR 8.76% the average yearly price of 1,016 €. The contract minimum period of 15 years (2019-2033) payback time of the project (9.05 years).
• increased quality of life through better comfort,
• better air quality,
• economic opportunities on the local level avoided biomass cutting and costs for inefficient use of biomass

The successful realization of one of those projects will be indicative for the overall direction of possible energy transition in the heating sector of Republic of Serbia!
Next steps

- Signing the (“Letters of commitments”) in Šabac
- First meeting to define tender procedure with (24-26 IX 2018.) in Šabac.

- Press release on the project results 24. XII 2018.
- Conference: Policy recommendations at national level (3-5. XII 2018.) in Šabac.

- End of the project: 31. XII 2018.
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Useful links:


https://balkangreenenergynews.com/rs/coolheating-u-sapcu-koriscenje-biomase-za-daljinsko-grejanje