

# Bioheat Žetale

## Report of the technical training in Slovenia



### Summary

Due to a positive economic and environmental assessment in a first rough analysis, a successful realization of the project “Bioheat Žetale” may be expected.

With this project 75,000 litres of fuel oil with a value of € 56,000 and 200,000 kg of climate-damaging CO<sub>2</sub> can be substituted. The continuous expansions of renewable energies secure not only the long-term energy independence from troubled countries, but also strengthen the sustainable regional development by jobs created and saved.

For a further evaluation of the project, however, the exact heat consumption (kWh / year) of each customer (heat using survey) has to determine. Subsequently, it is recommended that further discussions with interested persons cause to continue the project to advance quickly.

## Starting information

Žetale is a small municipality in East part of Slovenia with around 1500 inhabitants. Climate is sub continental and sub Pannonia, with average winter months 0,8 D; -1,7 J; 0 F; 4,4 M, degrees Celsius.

12 farmers which all together own 250 hectares of forest some of them also own saw mill and working communal works for municipality decided to invest in wood biomass heating system and establish cooperative. Some of these farmers were participating on Woodheats Solution project activities ([www.woodheatsolutions.eu](http://www.woodheatsolutions.eu)).

They made a survey from which they found out potential customers and their energy needs. On the base of survey they selected also potential location of district heating system. Until now they had preliminary meetings with two boilers sellers (Fröling and KWB). On the base of preliminary meetings with the boiler sellers they get some project key facts (investment costs, project size...). They already had meetings with bank and with local community which are supporting this project. Before they will go in investment they will like to get a second opinion about their project, operation tips info, best practice examples of comparatives project.

## Project description

The heating of the community Žetale should be made in the future with a biomass heating plant with a boiler house and fuel store in the town centre. In order to supply the village of a 400 kW biomass wood chip boiler and a memory load of at least 10,000 cubic meters to install. About 700 meters long district heating network are 14 customers connected with a load of 395 kW (kilowatt) and provides year-round heat with a home safe. The estimated annual sales amount of heat is about 490 MWh (megawatt hour).

The heat supply via heat pipes buried in a double pipe system, with the net loss amounted to about 15% (heat losses greater than 20% are considered critical). Due to the limited space in the centre a year-round fuel storage is not possible. The filling of the bunker fuel is about 5 to 7 times per year, depending on actual size of the bunker, making a good paved access road is to respect (filling, especially in the winter months).

The fuel bunker should have a minimum storage volume of 200 loose cubic metres to even in the coldest winter months have a reserve. The annual fuel consumption spruce wood-chips G30 (ÖNORM; G30=cross-section of the wood chip is less than 5 cm<sup>2</sup>) is 1,000 loose cubic meters. For the fuel supply in about 100 hectares of forest are essential.

**Tab.1: Customers of heat consumption (estimated data) & land map**

*For a detailed analysis you need an energy load assessment for every object!*

| Prices excl. VAT | Connected load (kW) | Full-load hours (hours/year) | Connection costs (€/kW) | Heat transfer system (€) | Specific connected costs (€/kW) | Connected costs incl. heat transfer system | Base price (€/kW/a) | Sum base price (€/a) | Kilowatt-hour rate (€/a) | Mesaure price €/a excl. VAT | Heating con. MWh/a | Heating costs €/a |
|------------------|---------------------|------------------------------|-------------------------|--------------------------|---------------------------------|--|---------------------|----------------------|--------------------------|-----------------------------|--------------------|-------------------|
| School           | 200                 | 1350                         | 80                      | 9000                     | 125                             | 25000                                      | 25                  | 5000                 | 17010                    | 166                         | 270                | 22176             |
| Municipality     | 50                  | 1100                         | 150                     | 4400                     | 238                             | 11900                                      | 25                  | 1250                 | 3465                     | 129                         | 55                 | 4844              |
| Ambulance        | 20                  | 1200                         | 200                     | 4000                     | 400                             | 8000                                       | 25                  | 500                  | 1512                     | 129                         | 24                 | 2141              |
| Kindergarden     | 10                  | 1200                         | 200                     | 4000                     | 600                             | 6000                                       | 25                  | 250                  | 756                      | 129                         | 12                 | 1135              |
| Fire Service     | 10                  | 1500                         | 200                     | 4000                     | 600                             | 6000                                       | 25                  | 250                  | 945                      | 129                         | 15                 | 1324              |
| Presbitery       | 10                  | 1000                         | 200                     | 4000                     | 600                             | 6000                                       | 25                  | 250                  | 630                      | 129                         | 10                 | 1009              |
| Religion School  | 10                  | 500                          | 200                     | 4000                     | 600                             | 6000                                       | 25                  | 250                  | 315                      | 129                         | 5                  | 694               |
| Church           | 10                  | 400                          | 200                     | 4000                     | 600                             | 6000                                       | 25                  | 250                  | 252                      | 129                         | 4                  | 631               |
| House Nr. 44     | 10                  | 1400                         | 200                     | 4000                     | 600                             | 6000                                       | 25                  | 250                  | 882                      | 129                         | 14                 | 1261              |
| House Nr. 43     | 15                  | 1400                         | 200                     | 4000                     | 467                             | 7000                                       | 25                  | 375                  | 1323                     | 129                         | 21                 | 1827              |
| House Nr. 4 b    | 15                  | 1400                         | 200                     | 4000                     | 467                             | 7000                                       | 25                  | 375                  | 1323                     | 129                         | 21                 | 1827              |
| House Nr. 4 a    | 15                  | 1400                         | 200                     | 4000                     | 467                             | 7000                                       | 25                  | 375                  | 1323                     | 129                         | 21                 | 1827              |
| House Nr. 5 a    | 10                  | 1400                         | 200                     | 4000                     | 600                             | 6000                                       | 25                  | 250                  | 882                      | 129                         | 14                 | 1261              |
| Shop             | 10                  | 1300                         | 200                     | 4000                     | 600                             | 6000                                       | 25                  | 250                  | 819                      | 129                         | 13                 | 1198              |
| <b>Total</b>     | <b>395</b>          |                              |                         | <b>61,400</b>            |                                 | <b>113,900</b>                             |                     | <b>9,875</b>         | <b>31,437</b>            | <b>1,843</b>                | <b>499</b>         | <b>43,155</b>     |



**Tab.2: Key facts of the project**

|  |
|--|
| <b>Project size in kW:</b> 400 kW  |
| <b>Energy consumption of the customers in kWh:</b> 490.000 kWh                 |
| <b>Mixed energy price per MWh:</b> € 86  |
| <b>Length of heat-pipe in meter:</b> 700 meters                                |
| <b>Operators of the project:</b> farmers and forest owners,                    |
| <b>Wood chip price (soft wood) for the investors:</b> € 20 / loose cubic meter |
| <b>Specific investment costs per kW:</b> € 1.250                               |
| <b>Investment costs:</b> approx. € 500.000                                     |
| <b>Payback time:</b> 11 years  |

## Ecological/efficiency evaluation of the project

**Heat losses in the network:** 15 % per year **OKAY**

*The losses of the heating network should not on average be higher than 20%. The network losses affect the electricity and fuel costs in a sustainable way (life of the plant). Optimized heating plants have a net loss of less than 10%.*

**Sold heat per meter pipe:** 713 kWh/m **So-So**

*The connected load per meter path should be more than 900 kWh / m. The shortfall of this value is an important prerequisite for obtaining funding in Austria. In this case the value is a little bit to less but it is in the limit of tolerance.*

**Connected load per meter route:** 0,56 kW/m **Okay**

*The connected load per meter path allows a first, rapid assessment of the given situation. The value should be higher than 0.5 kW/m.*

**Substituted fuel oil:** 75.000 litres with an amount of € 56.300

**Saved CO<sub>2</sub>-emissions:** 200.000 kg CO<sub>2</sub>

## Economic evaluation of the project:

The total costs are estimated with € 500,000. The following calculations are based on practical experiences from Austria. The costs must be adapted to the national situation.

Due to a **positive economic assessment** in a first rough analysis, a successful realization of the project “Bioheat Žetale” may be expected. The annually profit is positive (€ 300).



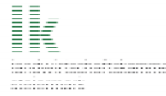
The farmers and forestry owners (investors) get the profit through the delivery right of wood chips. The calculation allows paying **€ 20 per loose cubic meter (soft wood)**.

The calculation supposed that € 100.000 (20% of the total investment) will be funded by the investors (farmers and forest owners). The rest will be financed by funding, connected load and bank credit.

The **internal interest rate is > interest rate on external capital**, so the project seems in a first rough analysis as a good investment.

### Tab.3: Economic calculation

Data source: [www.publicconsulting.at](http://www.publicconsulting.at)  
  
 UMWELTFÖRDERUNG IM INLAND  
Umweltförderung des Bundes – managed by Kommunalkredit Public Consulting



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## Calculation tool for biomass district heating systems

### Part A: Technical Data

|           |  |  |         |
|-----------|--|--|---------|
| <b>A0</b> | <b>NOTE: This data sheet (green boxes) has to be fully completed!</b>  |  |         |
| <b>A1</b> | <b>Description of the heating system</b>   |  |         |
|           | basic concept (number of boilers, gradual expansion, summer-winter operation, etc.)  | The heating of the community Zetale should in future be made with a biomass heating plant with a boiler house and fuel storage in the town centre. In order to supply the village of a 400 kW biomass wood chip boiler and a memory load of at least 10,000 cubic meters to install. About 700 meters long district heating network are 14 customers connected with a load of 395 kW (kilowatt) and provides year-round heat with a home safe. The estimated annual sales amount of heat is about 490 MWh (megawatt hour). |         |
| <b>A2</b> | <b>Implementation period</b>   |  |         |
|           |  | Requested extension  |         |
|           | start of construction  | Apr 11   |         |
|           | end of construction  | Oct 2011   |         |
| <b>!</b>  | For expansion of existing district heating systems, the information on the current situation (existing facilities) quote in section A3. The point A4 concerns the proposed stage.  |  |         |
| <b>A3</b> | <b>Description of the <u>already existing heating plant</u> (otherwise jump to A4)</b>   |  |         |
|           | <b>(just fill out, if it is an extension of an existing district heating system)</b>   |  |         |
|           | <b>A3.1 Heat production system from the already existing heating plant</b>   |  |         |
|           |  | Plant 1  | Plant 2 |
|           | description  |  |         |
|           | year of construction   |  |         |
|           | fuel power [kW]  |  |         |
|           | thermal nominal capacity [kW]  |  |         |
|           | produced amount of heat [MWh]  |  |         |
|           | annual utilization rate [%] <sup>1)</sup>  |  |         |
|           | annual full-load hours [h] <sup>2)</sup>   |  |         |
|           | type of fuel   |  |         |
|           | buffer [m <sup>3</sup> ]   |  |         |
|           | flue gas cleaning technology <sup>3)</sup>   |  |         |
|           | 1) annual utilization rate = annual amount of heat generated / used annual fuel heat (Hu); Hu=lower heating value<br>2) annual full-load hours = annual amount of heat generated / thermal nominal capacity<br>3) e.g. multizyklon, multizyklon + electric-filter, electric-filter, etc. |  |         |
|           | <b>A3.2 Heat recovery system of the already existing heating plant</b>   |  |         |
|           |  | Plant 1  | Plant 2 |
|           | description of the plant   |  |         |
|           | thermal nominal capacity [kW]  |  |         |
|           | produced amount of heat [MWh/a]  |  |         |
|           | annual full-load hours [h]   |  |         |
|           | <b>A3.3 Heat distribution of the already existing plant</b>  |  |         |
|           | sold heat [MWh/a]  |  |         |
|           | connected load [kW]  |  |         |
|           | number of heat consumers   |  |         |
|           | length of pipes [m]  |  |         |

#### A3.4 Details about the use of biomass in the already existing heating plant

|                         | quantity [loose m <sup>3</sup> /a] | price [EUR/loose m <sup>3</sup> ] | fuel heat [MWh/a] <sup>4)</sup> | transport distance [km] <sup>5)</sup> |
|-------------------------|------------------------------------|-----------------------------------|---------------------------------|---------------------------------------|
| energy wood (soft wood) |                                    |                                   |                                 |                                       |
| energy wood (hard wood) |                                    |                                   |                                 |                                       |
| bark                    |                                    |                                   |                                 |                                       |
| forest residues         |                                    |                                   |                                 |                                       |
| other                   |                                    |                                   |                                 |                                       |
| <b>Total</b>            | <b>0</b>                           |                                   |                                 | <b>0</b>                              |

4) heating value based on fresh matter:

**wood chips** (spruce G30, w=30 %): 756 kWh/loose m<sup>3</sup>; **wood chips** (mixed hardwood, G30, w=30 %): 967 kWh/loose m<sup>3</sup>

**bark** (spruce, crushed, w=50 %): 582 kWh/loose m<sup>3</sup>; **forest residues** (spruce, G50, w=50 %): 576 kWh/loose m<sup>3</sup>

5) Average transport distance from the point of biomass production to the heating plant

#### A3.5 Details about the fossil fuel use of the already existing heating plant

|             | amount [l/a] respectively [kWh/a] |
|-------------|-----------------------------------|
| heating oil | 0 l/a                             |
| natural gas | 0 kWh/a                           |

### A4 Description of the extension or new heating plant

#### A4.1 Heat distribution of the extension or new heating plant

|                          |     |
|--------------------------|-----|
| sold heat [MWh/a]        | 499 |
| connected load [kW]      | 395 |
| number of heat consumers | 14  |
| length of pipes [m]      | 700 |

#### A4.2 Heat production system for the extension or new heating plant

|  | Plant 1       | Plant 2 | Plant 3 |
|--|---------------|---------|---------|
| description                                | not definiend |         |         |
| fuel power [kW]                            | 500           |         |         |
| thermal nominal capacity [kW]              | 400           |         |         |
| produced amount of heat [MWh]              | 597           |         |         |
| annual utilization rate [%] <sup>6)</sup>  | 80            |         |         |
| annual full-load hours [h] <sup>7)</sup>   | 1500          |         |         |
| type of fuel                               | wood chips    |         |         |
| puffer [m <sup>3</sup> ]                   | 10            |         |         |
| flue gas cleaning technology <sup>8)</sup> | multizyklon   |         |         |

6) annual utilization rate = annual amount of heat generated / used annual fuel heat (Hu); Hu=lower heating value

7) annual full-load hours = annual amount of heat generated / Thermal capacity

8) e.g. multizyklon, multizyklon + e-filter, e-filter, etc.

#### A4.3 Heat recovery systems for the extension or new heating plant

|                               | plant 1 | plant 2 | plant 3 |
|-------------------------------|---------|---------|---------|
| description                   |         |         |         |
| thermal nominal capacity [kW] |         |         |         |
| produced amount of heat [MWh] |         |         |         |
| annual full-load hours [h]    |         |         |         |

#### A4.4 Guaranteed emission limits<sup>9)</sup>

|   |     |
|---|-----|
| CO [mg/Nm <sup>3</sup> ]                            | 10  |
| NO <sub>x</sub> [mg/Nm <sup>3</sup> ]               | 180 |
| SO <sub>2</sub> [mg/Nm <sup>3</sup> ]               | 0   |
| C <sub>x</sub> H <sub>y</sub> [mg/Nm <sup>3</sup> ] | 4   |
| Dust [mg/Nm <sup>3</sup> ]                          | 80  |

9) related to dry flue gas at 0° C, 1013 hPa and 13% oxygen, full-load

**A5 Used fuel**
**A5.1 Details about the use of biomass for the extension or new heating plant**

|   | quantity [loose m <sup>3</sup> /a] | price [EUR/loose m <sup>3</sup> ] | fuel heat [MWh/a] <sup>10)</sup> | transport distance [km] <sup>11)</sup> |
|---|------------------------------------|-----------------------------------|----------------------------------|--|
| energy wood (soft wood)                           | 982                                | 20                                | 747                              | 15                                     |
| energy wood (hard wood)                           |                                    |                                   |                                  |  |
| bark  |                                    |                                   |                                  |  |
| forest residues                                   |                                    |                                   |                                  |  |
| other   |                                    |                                   |                                  |  |
| <b>Total</b>                                      | <b>982</b>                         |                                   | <b>747 MWh</b>                   |  |
| proportion of total biomass use in wood chips [%] |                                    |                                   | 100,0%                           |  |
| weighted travel distance for wood chips [km]      |                                    |                                   | 15 km                            |  |

10) average transport distance from the point attack of biomass to the heating plant

11) heating value based on fresh matter:

**wood chips** (spruce G30, w=30 %): 756 kWh/loose m<sup>3</sup>; **wood chips** ( mixed hardwood, G30, w=30 %): 967 kWh/loose m<sup>3</sup>

**bark** (spruce, crushed, w=50 %): 582 kWh/loose m<sup>3</sup>; **forest residues** (spruce, G50, w=50 %): 576 kWh/loose m<sup>3</sup>

**A5.2 Details about the fossil fuel use for the extension or new heating plant**

|             | amount [l/a] respectively [kWh/a] | price exkl. VAT [EUR/l] respectively [EUR/kWh] |
|-------------|-----------------------------------|--|
| heating oil | 0 l/a                             | 0,0 EUR/l                                      |
| natural gas | 0 kWh/a                           | 0,00 EUR/kWh                                   |

**A6 Characteristics of the district heating plant**

|   | before extension (existing plant) | after extension |
|---|-----------------------------------|-----------------|
| thermal nominal capacity heating plant [MW <sub>th</sub> ] <sup>12)</sup> | 400                               |                 |
| annual full-load hours of the total biomass plant [h] <sup>13)</sup>      | 1500                              |                 |
| annual utilization rate: biomass plant [%] <sup>14)</sup>                 | 80                                |                 |
| produced, net given heat [MWh/a]  | 597                               |                 |
| thereof produced fossil heat [MWh/a]                                      | 0                                 |                 |
| netloss [MWh/a]   | 98                                |                 |
| annual utilization ratio: district heating grid [%] <sup>15)</sup>        | 84                                |                 |
| sold heat [MWh/a]   | 499                               |                 |
| connected load customers [kW]   | 395                               |                 |
| length of heating pipes incl. houseconnections [m]                        | 700                               |                 |
| specific connected load [kW/m]  | 0,56                              | #DIV/0!         |
| heat occupancy [kWh/m] <sup>16)</sup>                                     | 713                               | #DIV/0!         |
| Nominal diameter of the main string [DN]                                  | 50                                |                 |
| Temperature spread of the network [°C]                                    | 30                                |                 |
| Simultaneity factor[-]  | 0,8                               |                 |
| volume fuel storage [m <sup>3</sup> ]                                     | 200                               |                 |
| volume fuel storage as a percentage of annual fuel requirement [%]        | 20                                |                 |

12) Included peak load

13) Years full-load hours = annual generated biogenic heat / biomass connected load

14) Annual utilization = annual biomass plant generated biogenic heat including heat recovery / annual fuel heat used

15) Annual efficiency heating network = annual heat sales / annual heat fed into the grid

16) Heat load u003d annual heat sales / length of section incl. Houseconnections

**A7 Heat rates for the proposed project (net, excluding VAT.)**

|                               |     |
|-------------------------------|-----|
| base price [EUR/kW/a]         | 25  |
| meter charge [EUR/a]          | 129 |
| killowatt-hour rate [EUR/MWh] | 63  |
| average heat price [EUR/MWh]  | 86  |

## Part B: Economic Data

| B1 Technical data network                            |           |
|--|-----------|
| degree of heat transfer                              |           |
| 1st year   | 100%      |
| 2nd year   | 100%      |
| 3rd year   | 100%      |
| sold heat [MWh/a]                                    | 499 MWh/a |
| produced, quantity of heat given to the grid [MWh/a] | 597 MWh/a |
| heat from biomass fuel used [MWh/a]                  | 747 MWh/a |
| development of the grid expansion                    |           |
| 1st year   | 100%      |
| 2nd year   | 100%      |
| 3rd year   | 100%      |

| B2 Economic data   |   |
|--|---|
| <b>Details on operating expenses (net, excluding VAT.)</b>               |   |
| biomass price excl. VAT [€/MWh (Hu) fuel]                                | 26  |
| staff costs (excluding maintenance) [€/a]                                | 1.000,00  |
| specific electricity consumption [kWh <sub>el</sub> /MWh <sub>th</sub> ] | 15  |
| electricity costs [€/kWh]  | 0,17  |
| annual other costs (e.g. insurance) [%]                                  | 0,50%   |
| annual fuel cost of peak load [€/a]                                      | 0,00 €  |
| annual land costs (e.g. rent) [€/a]                                      | 500,00 €  |
| <b>Details of operating income (net, excluding VAT.)</b>                 |   |
| average heat price [EUR/MWh]   | 86,00   |
| value adjustment of the heat price in [%/a]                              | 3,0%  |
| connection costs (years of operation 1-3) [€]                            | 113.900,00 €                                      |
| <b>Details of the financing</b>  |   |
| equity [€]   | 100.000,00 €                                      |
| long-term loans [€]  | 200.000,00 €                                      |
| interest long-term credit [%]  | 5,0%  |
| duration of long-term credit [a]   | 15 a  |
| current account interest rate [%]  | 5,00%   |
| credit interest for short-time overlap [%]                               | 2,00%   |
| end of construction  | 2011  |
| only for Austrian projects   | 0%  |
| funding rate   | 40% because the funding is limited with € 200.000 |

**B3 Total project costs (net, excluding VAT)**

|                                   | Offer | amount [EUR]        |
|-----------------------------------|-------|---------------------|
| <b>plant costs</b>                |       | <b>154.600,00 €</b> |
| furnace and boiler                |       | 110.000,00 €        |
| flue gas cleaning                 |       | 0,00 €              |
| measuring and control engineering |       | 0,00 €              |
| heat recovery                     |       | 0,00 €              |
| fuel loading                      |       | 0,00 €              |
| electrical installations          |       | 14.000,00 €         |
| heating installations             |       | 30.600,00 €         |
| steel construction                |       | 0,00 €              |
| peak load cover *                 |       | 0,00 €              |
| vehicles *                        |       | 0,00 €              |
| <b>district heating grid</b>      |       | <b>215.400,00 €</b> |
| heat pipes                        |       | 98.000,00 €         |
| excavation work                   |       | 56.000,00 €         |
| heat transfer stations            |       | 61.400,00 €         |
| <b>construction costs</b>         |       | <b>100.000,00 €</b> |
| boiler house                      |       | 50.000,00 €         |
| storage                           |       | 50.000,00 €         |
| grounds                           |       | 0,00 €              |
| digestion costs *                 |       | 0,00 €              |
| others *                          |       | 0,00 €              |
| costs for quality management      |       | 0,00 €              |
| planning                          |       | 30.000,00 €         |
| <b>eligible investment costs</b>  |       | <b>500.000,00 €</b> |
| <b>total investment costs</b>     |       | <b>500.000,00 €</b> |

\* any eligible investment shares

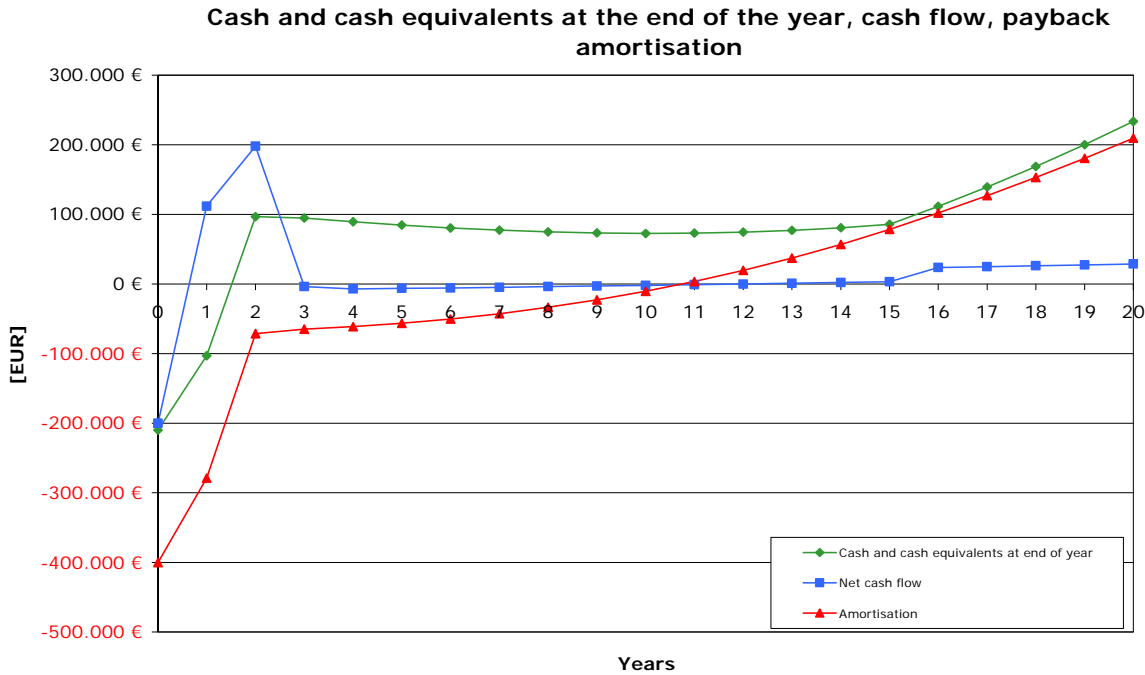


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**Dynamized cost accounting**

| year  | 2011       | 2012       | 2013       | 2014      | 2015      | 2016      | 2017      | 2018      | 2019      | 2020     | 2021     | 2022     | 2023     | 2024     | 2025     | 2026     | 2027      | 2028      | 2029      | 2030      | 2031      | 20 |  |
|---|------------|------------|------------|-----------|-----------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------|-----------|-----------|-----------|----|--|
| <b>Operative cash flow</b>                                    |            |            |            |           |           |           |           |           |           |          |          |          |          |          |          |          |           |           |           |           |           |    |  |
| + revenues  | 0 €        | 42,914 €   | 44,201 €   | 45,577 €  | 46,959 €  | 48,300 €  | 49,749 €  | 51,242 €  | 52,779 €  | 54,362 € | 55,993 € | 57,673 € | 59,403 € | 61,189 € | 63,021 € | 64,911 € | 66,859 €  | 68,864 €  | 70,930 €  | 73,059 €  | 75,250 €  |    |  |
| - business costs  | 0 €        | 19,422 €   | 19,713 €   | 20,009 €  | 20,309 €  | 20,614 €  | 20,923 €  | 21,237 €  | 21,556 €  | 21,879 € | 22,207 € | 22,540 € | 22,878 € | 23,221 € | 23,570 € | 23,924 € | 24,283 €  | 24,646 €  | 25,016 €  | 25,391 €  | 25,772 €  |    |  |
| - additional gas costs  | 0 €        | 0 €        | 0 €        | 0 €       | 0 €       | 0 €       | 0 €       | 0 €       | 0 €       | 0 €      | 0 €      | 0 €      | 0 €      | 0 €      | 0 €      | 0 €      | 0 €       | 0 €       | 0 €       | 0 €       | 0 €       |    |  |
| - maintenance costs   | 0 €        | 0 €        | 0 €        | 0 €       | 0 €       | 0 €       | 0 €       | 0 €       | 0 €       | 0 €      | 0 €      | 0 €      | 0 €      | 0 €      | 0 €      | 0 €      | 0 €       | 0 €       | 0 €       | 0 €       | 0 €       |    |  |
| - network costs   | 0 €        | 0 €        | 0 €        | 0 €       | 0 €       | 0 €       | 0 €       | 0 €       | 0 €       | 0 €      | 0 €      | 0 €      | 0 €      | 0 €      | 0 €      | 0 €      | 0 €       | 0 €       | 0 €       | 0 €       | 0 €       |    |  |
| - personnel costs   | 0 €        | 1,000 €    | 1,000 €    | 1,000 €   | 1,000 €   | 1,000 €   | 1,000 €   | 1,000 €   | 1,000 €   | 1,000 €  | 1,000 €  | 1,000 €  | 1,000 €  | 1,000 €  | 1,000 €  | 1,000 €  | 1,000 €   | 1,000 €   | 1,000 €   | 1,000 €   | 1,000 €   |    |  |
| - material costs (incl. Other costs)                          | 0 €        | 2,500 €    | 2,500 €    | 2,500 €   | 2,500 €   | 2,500 €   | 2,500 €   | 2,500 €   | 2,500 €   | 2,500 €  | 2,500 €  | 2,500 €  | 2,500 €  | 2,500 €  | 2,500 €  | 2,500 €  | 2,500 €   | 2,500 €   | 2,500 €   | 2,500 €   | 2,500 €   |    |  |
| total operative CF  | 0 €        | 17,174 €   | 17,779 €   | 18,567 €  | 19,441 €  | 19,886 €  | 20,326 €  | 20,769 €  | 21,215 €  | 21,664 € | 22,116 € | 22,571 € | 23,029 € | 23,490 € | 23,954 € | 24,421 € | 24,891 €  | 25,364 €  | 25,840 €  | 26,319 €  | 26,801 €  |    |  |
| <b>Cash flow from investments</b>                             |            |            |            |           |           |           |           |           |           |          |          |          |          |          |          |          |           |           |           |           |           |    |  |
| - fixed assets investment                                     | -500,000 € | 0 €        | 0 €        | 0 €       | 0 €       | 0 €       | 0 €       | 0 €       | 0 €       | 0 €      | 0 €      | 0 €      | 0 €      | 0 €      | 0 €      | 0 €      | 0 €       | 0 €       | 0 €       | 0 €       | 0 €       |    |  |
| + payments  | 0 €        | 0 €        | 0 €        | 0 €       | 0 €       | 0 €       | 0 €       | 0 €       | 0 €       | 0 €      | 0 €      | 0 €      | 0 €      | 0 €      | 0 €      | 0 €      | 0 €       | 0 €       | 0 €       | 0 €       | 0 €       |    |  |
| total CF from investments                                     | -500,000 € | 0 €        | 0 €        | 0 €       | 0 €       | 0 €       | 0 €       | 0 €       | 0 €       | 0 €      | 0 €      | 0 €      | 0 €      | 0 €      | 0 €      | 0 €      | 0 €       | 0 €       | 0 €       | 0 €       | 0 €       |    |  |
| <b>Cash flow after investment cumulated CF for investment</b> | -500,000 € | 131,024 €  | 217,179 €  | 15,507 €  | 13,845 €  | 13,845 €  | 13,845 €  | 14,403 €  | 15,379 €  | 16,298 € | 17,233 € | 18,216 € | 19,248 € | 20,321 € | 21,436 € | 22,584 € | 23,766 €  | 24,983 €  | 26,236 €  | 27,526 €  | 28,854 €  |    |  |
| <b>Cash flow from financing</b>                               |            |            |            |           |           |           |           |           |           |          |          |          |          |          |          |          |           |           |           |           |           |    |  |
| + capital inflow  | 100,000 €  | 0 €        | 0 €        | 0 €       | 0 €       | 0 €       | 0 €       | 0 €       | 0 €       | 0 €      | 0 €      | 0 €      | 0 €      | 0 €      | 0 €      | 0 €      | 0 €       | 0 €       | 0 €       | 0 €       | 0 €       |    |  |
| + additional inflow   | 200,000 €  | 0 €        | 0 €        | 0 €       | 0 €       | 0 €       | 0 €       | 0 €       | 0 €       | 0 €      | 0 €      | 0 €      | 0 €      | 0 €      | 0 €      | 0 €      | 0 €       | 0 €       | 0 €       | 0 €       | 0 €       |    |  |
| - interest current financing                                  | 0 €        | -10,000 €  | -9,237 €   | -8,539 €  | -7,898 €  | -7,318 €  | -6,794 €  | -6,321 €  | -5,903 €  | -5,535 € | -5,212 € | -4,930 € | -4,686 € | -4,477 € | -4,298 € | -4,145 € | -4,014 €  | -3,901 €  | -3,802 €  | -3,715 €  | -3,638 €  |    |  |
| total CF from financing                                       | 300,000 €  | -10,000 €  | -9,237 €   | -8,539 €  | -7,898 €  | -7,318 €  | -6,794 €  | -6,321 €  | -5,903 €  | -5,535 € | -5,212 € | -4,930 € | -4,686 € | -4,477 € | -4,298 € | -4,145 € | -4,014 €  | -3,901 €  | -3,802 €  | -3,715 €  | -3,638 €  |    |  |
| <b>net-cash flow</b>  | -200,000 € | 111,024 €  | 107,942 €  | 7,968 €   | -7,222 €  | -6,242 €  | -5,923 €  | -4,793 €  | -3,894 €  | -2,932 € | -2,015 € | -1,053 € | -314 €   | 1,022 €  | 2,117 €  | 3,252 €  | 4,397 €   | 5,551 €   | 6,715 €   | 7,888 €   | 9,061 €   |    |  |
| <b>Cash amount</b>  | 0 €        | -210,000 € | -102,056 € | 98,756 €  | 94,799 €  | 89,232 €  | 84,541 €  | 80,496 €  | 77,236 €  | 74,807 € | 73,201 € | 72,461 € | 73,338 € | 74,453 € | 76,097 € | 80,895 € | 85,697 €  | 111,500 € | 138,145 € | 168,631 € | 200,841 € |    |  |
| cash on 01.01   | 111,800 €  | 111,800 €  | 107,910 €  | 3,762 €   | -7,222 €  | -6,440 €  | -5,833 €  | -4,735 €  | -3,898 €  | -2,982 € | -2,033 € | -1,033 € | -384 €   | 1,022 €  | 2,117 €  | 3,252 €  | 4,397 €   | 5,551 €   | 6,715 €   | 7,888 €   | 9,061 €   |    |  |
| cash on 31.12   | -210,000 € | -102,056 € | 98,756 €   | 94,799 €  | 89,232 €  | 84,541 €  | 80,496 €  | 77,236 €  | 74,807 €  | 73,201 € | 72,461 € | 73,338 € | 74,453 € | 76,097 € | 80,895 € | 85,697 € | 111,500 € | 138,145 € | 168,631 € | 200,841 € |           |    |  |
| <b>Cash and cash equivalents at end of year</b>               | -102,056 € | -102,056 € | 98,756 €   | 94,799 €  | 89,232 €  | 84,541 €  | 80,496 €  | 77,236 €  | 74,807 €  | 73,201 € | 72,461 € | 73,338 € | 74,453 € | 76,097 € | 80,895 € | 85,697 € | 111,500 € | 138,145 € | 168,631 € | 200,841 € |           |    |  |
| <b>Guarantee conditions</b>                                   |            |            |            |           |           |           |           |           |           |          |          |          |          |          |          |          |           |           |           |           |           |    |  |
| Long-term credit  | 10,000 €   | 10,000 €   | 10,000 €   | 10,000 €  | 10,000 €  | 10,000 €  | 10,000 €  | 10,000 €  | 10,000 €  | 10,000 € | 10,000 € | 10,000 € | 10,000 € | 10,000 € | 10,000 € | 10,000 € | 10,000 €  | 10,000 €  | 10,000 €  | 10,000 €  | 10,000 €  |    |  |
| banking rates   | 9,200 €    | 9,200 €    | 9,200 €    | 9,200 €   | 9,200 €   | 9,200 €   | 9,200 €   | 9,200 €   | 9,200 €   | 9,200 €  | 9,200 €  | 9,200 €  | 9,200 €  | 9,200 €  | 9,200 €  | 9,200 €  | 9,200 €   | 9,200 €   | 9,200 €   | 9,200 €   | 9,200 €   |    |  |
| annual loan   | 9,200 €    | 9,200 €    | 9,200 €    | 9,200 €   | 9,200 €   | 9,200 €   | 9,200 €   | 9,200 €   | 9,200 €   | 9,200 €  | 9,200 €  | 9,200 €  | 9,200 €  | 9,200 €  | 9,200 €  | 9,200 €  | 9,200 €   | 9,200 €   | 9,200 €   | 9,200 €   | 9,200 €   |    |  |
| credit balance  | 200,000 €  | 180,732 €  | 181,000 €  | 170,791 € | 160,052 € | 148,786 € | 138,857 € | 124,538 € | 111,494 € | 97,801 € | 83,422 € | 68,325 € | 52,473 € | 35,828 € | 18,331 € | 0 €      | 0 €       | 0 €       | 0 €       | 0 €       | 0 €       |    |  |
| <b>Key figures</b>  |            |            |            |           |           |           |           |           |           |          |          |          |          |          |          |          |           |           |           |           |           |    |  |
| Project IRR (before tax)                                      | 40,000 %   | 131,024 %  | 217,179 %  | 15,507 %  | 13,845 %  | 13,845 %  | 13,845 %  | 14,403 %  | 15,379 %  | 16,298 % | 17,233 % | 18,216 % | 19,248 % | 20,321 % | 21,436 % | 22,584 % | 23,766 %  | 24,983 %  | 26,236 %  | 27,526 %  | 28,854 %  |    |  |
| IRR with residual value                                       | 12,4%      | 131,024 %  | 217,179 %  | 15,507 %  | 13,845 %  | 13,845 %  | 13,845 %  | 14,403 %  | 15,379 %  | 16,298 % | 17,233 % | 18,216 % | 19,248 % | 20,321 % | 21,436 % | 22,584 % | 23,766 %  | 24,983 %  | 26,236 %  | 27,526 %  | 28,854 %  |    |  |
| Internal Rate of Return (IRR)                                 | 12,4%      | 131,024 %  | 217,179 %  | 15,507 %  | 13,845 %  | 13,845 %  | 13,845 %  | 14,403 %  | 15,379 %  | 16,298 % | 17,233 % | 18,216 % | 19,248 % | 20,321 % | 21,436 % | 22,584 % | 23,766 %  | 24,983 %  | 26,236 %  | 27,526 %  | 28,854 %  |    |  |
| Amortisation  | 400,000 €  | 121,074 €  | 207,842 €  | 6,497 €   | 4,826 €   | 4,826 €   | 4,826 €   | 4,826 €   | 4,826 €   | 4,826 €  | 4,826 €  | 4,826 €  | 4,826 €  | 4,826 €  | 4,826 €  | 4,826 €  | 4,826 €   | 4,826 €   | 4,826 €   | 4,826 €   | 4,826 €   |    |  |
| Years without sufficient liquidity                            | 0          | 1          | 2          | 3         | 4         | 5         | 6         | 7         | 8         | 9        | 10       | 11       | 12       | 13       | 14       | 15       | 16        | 17        | 18        | 19        | 20        |    |  |

**Fig.1: Cash and cash equivalents at the end of the year, cash flow, payback amortisation**



The payback period (amortisation, red line) illustrates the economic viability of the project as a chart. The sooner a project comes in the positive area, the better. Therefore a biomass district heating should not be realised if the payback period is higher than 15 years.

Under the assumed framework conditions the project investments will be profitable in the 11th year. One reason for this “short” payback period is the high funding from the government (50 %, limit: € 200.000).

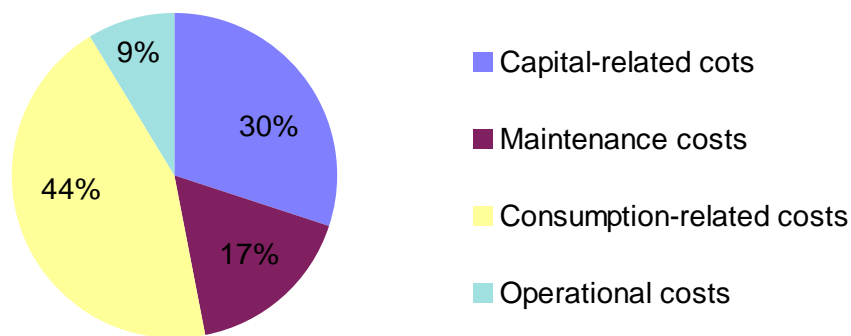
**These conditions are pleaded for an investment in this project.**

**Tab.4: Specific heat cost & annual total costs**

The table gives an overview about the annual total costs and the specific heat cost in €/MWh sold.

| Static heat production cost lt. VDI 2067                |                  |                       |                   |                           |                   |                       |                    |
|---|------------------|-----------------------|-------------------|---------------------------|-------------------|-----------------------|--------------------|
|   | Investment costs | Capital-related costs | Maintenance costs | Consumption-related costs | Operational costs | Sum of the heat costs | Specific heat cost |
|   | EUR              | EUR p.a.              | EUR p.a.          | EUR p.a.                  | EUR p.a.          | EUR p.a.              | EUR / MWh sold     |
| <b>Construction costs</b>                               |                  |                       |                   |                           |                   |                       |                    |
| boiler house  | 50.000           | 1.728                 | 500               |                           |                   | 2.228                 | 4,5                |
| storage   | 50.000           | 1.728                 | 500               |                           |                   | 2.228                 | 4,5                |
| outdoor   | -                | -                     | -                 |                           |                   | -                     | -                  |
| digestion costs   | -                | -                     | -                 |                           |                   | -                     | -                  |
| <b>District heating grid</b>                            |                  |                       |                   |                           |                   |                       |                    |
| pipng   | 98.000           | 3.585                 | 980               |                           |                   | 4.565                 | 9,1                |
| excavation work   | 56.000           | 2.049                 | 560               |                           |                   | 2.609                 | 5,2                |
| heat transfer stations                                  | 61.400           | 2.895                 | 1.228             |                           |                   | 4.123                 | 8,3                |
| <b>Mechanical engineering investment costs</b>          |                  |                       |                   |                           |                   |                       |                    |
| furnance and boiler                                     | 110.000          | 6.990                 | 3.300             |                           |                   | 10.290                | 20,6               |
| flue gas cleaning                                       | -                | -                     | -                 |                           |                   | -                     | -                  |
| measuring and Control Engineering                       | -                | -                     | -                 |                           |                   | -                     | -                  |
| heat recovery   | -                | -                     | -                 |                           |                   | -                     | -                  |
| fuel loading  | -                | -                     | -                 |                           |                   | -                     | -                  |
| e-installation  | 14.000           | 890                   | 280               |                           |                   | 1.170                 | 2,3                |
| h-installation  | 30.600           | 1.944                 | 612               |                           |                   | 2.556                 | 5,1                |
| steel construction                                      | -                | -                     | -                 |                           |                   | -                     | -                  |
| peak load cover   | -                | -                     | -                 |                           |                   | -                     | -                  |
| vehicles  | -                | -                     | -                 |                           |                   | -                     | -                  |
| planning  | 30.000           | 1.610                 | -                 |                           |                   | 1.610                 | 3,2                |
| others  | -                | -                     | -                 |                           |                   | -                     | -                  |
| <b>Fuel costs</b>                                       |                  |                       |                   |                           |                   |                       |                    |
| biomass   |                  |                       |                   | 19.422                    |                   | 19.422                | 38,9               |
| oil/natural gas/others                                  |                  |                       |                   | -                         |                   | -                     | -                  |
| <b>Other operating costs and consumption tied costs</b> |                  |                       |                   |                           |                   |                       |                    |
| staff costs   |                  |                       |                   |                           | 1.000             | 1.000                 | 2,0                |
| electricity   |                  |                       |                   | 1.522                     |                   | 1.522                 | 3,1                |
| other costs (e.g material costs)                        |                  |                       |                   |                           | 2.500             | 2.500                 | 5,0                |
| land costs (e.g rent)                                   |                  |                       |                   |                           | 500               | 500                   | 1,0                |
| <b>Total costs</b>                                      | <b>500.000</b>   | <b>23.417</b>         | <b>7.960</b>      | <b>20.944</b>             | <b>4.000</b>      | <b>56.322</b>         | <b>112,9</b>       |
| Specific heat costs with subsidies                      |                  | 28,2                  | 16,0              | 42,0                      | 8,0               |                       | 94,1               |

**Fig.2: Distribution of the specific heat costs with subsidies (specific heat costs)**



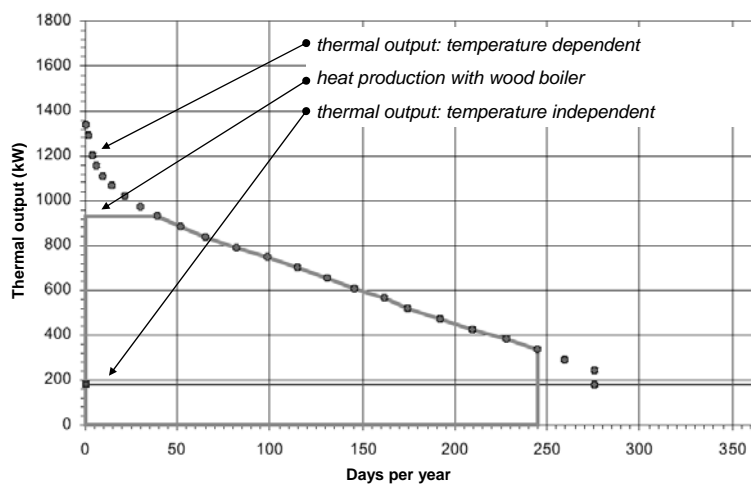
The consumption-related costs, i.e. the wood fuel costs, have a great influence on the heat production costs. The total production cost will be mainly influenced (>40%) by the wood fuel costs.

## Discussion points

### – Boiler

To optimize utilization of the boiler, the installation of 2 x 200 kW would recommend instead of 1 x 400 kW, but this increases the investment costs. The maximum heat output of the boiler (full load) is only to some, a few days per year required; the remaining days of the boiler is running at part load. In contrast to the 200 kW boiler, a 400 kW boiler is available in an industrial version, which can also be lesser quality fuels burn easily (boiler is running more robust). The decision for a particular boiler should also be made on the basis of the available fuel range.

**Fig.2: Thermal output over the year**



Nor should the argument be made that the existing gas system (school) should be taken as recourse for peak loads (a few days a year). In this case a 250 kW biomass boiler would be sufficient.

### – District heating grid

The decisions whether iron or plastic pipes are a question of price. The transfer takes place in a double tube. A plastic tube is limited due to the fact of pressure and temperature (manufacturer). At high pressures and temperatures the lifetime of the network decreases. The district heating network should not be dimensioned in any case too large, it increases the pump electricity costs, increase the heat losses and capital costs are greater. For the main pipe DN 50 is recommended (see Fig.3).





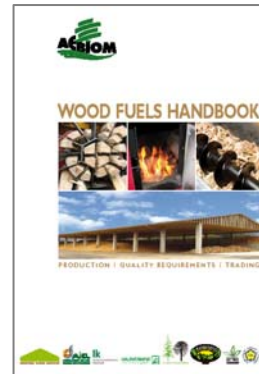
## – Fuel Quality

Information about quality requirements and reference standards are available in the WOOD FUELS HANDBOOK (download under: [www.biomassstradecentres.eu](http://www.biomassstradecentres.eu)).

*Quality requirements for:*

**2x 200 kW plant:** water content up to 35%, max. size pieces G50 mm (ÖNROM, G50=cross-section of the wood chip is > 5 cm<sup>2</sup>), homogeneous fuel is advantageous

**400 kW plant:** water content up to 50%, size pieces > G50 mm



## – Back-up System

Today's biomass heating systems generally have a low error rate. Nevertheless, it may lead, as with any other fossil fuel heating system malfunctions. Most accidents are due to insufficient fuel quality (e.g. contaminants such as stones and iron, non-homogeneous fuel size). In the selection of the heating system is to ensure that the boiler or boiler manufacturer seller, if possible, can offer a 24-hour service. A good service should be a top priority in the selection of the boiler manufacturer. *There are the following options for a back-up system:*

- 1) In variant 2 x 200 kW you have a boiler automatically as a reserve, provided that the fuel supply is disconnected (2 space host systems).
- 2) For a short time (3 - 5 h), the buffer offset a loss.
- 3) It is possible to implement the gas tank of the school into the system.
- 4) It could be the existing gas boiler (school) to develop and install new biomass heating plant. Instead of the existing LPG storage could install a smaller underground tank that could take over in an emergency supply of 2 - 5 days.

## – Year-round heat

The heating is carried out at newly installed district heating systems almost exclusively in the year-round operation. The district heating customers are mostly on a year-round supply. The heating is done during the heating season or year-round on the local conditions (existing water heating systems) and customer demands. The heating plant can also be extended to a solar system. Such solutions can usually represent economically difficult, but were put into practice already. A year-round

operation has higher net losses resulted because the network must be maintained all year round temperature. For the project Žetale be clarified whether the school has the largest customers in the summer heat a hot water demand.

#### – **Back up memory**

For practical experience, a buffer is recommended by at least 10,000 litres. The memory should be small in any case, bigger would be good. The tank is used to cover peak times (morning panel) and short-term reserve at the failure of the heating system.

#### – **Woodchips storage**

The wood chips bunker should take at least 200 loose m<sup>3</sup> wood chips. This reaches for 5 -6 weeks in the coldest time. As a rule I need in the coldest month about 15% - 20% of the total annual demand. A small wood chips storages in practice leads to problems.

The wood chips delivery done either through central wood chips storage or direct from the participating farmers. It is important to ensure that the contract is set to be delivered wood chips quality.

#### – **Woodchips delivery**

The heating value of wood chips is determined by the type of material (hard and soft wood) and water content. In the EU project Biomass Trade Centres ([www.biomassstradecentres.eu](http://www.biomassstradecentres.eu)) a handbook was created, where the relationships are described.

*The account of the fuel delivery can be achieved by:*

- Weight and water content
- volume (loose cubic meters)
- generated heat (MWh)

It is recommended to settle the wood chips by weight and water content and prevent future problems. The settlement brings to volume in practice always problems with it (e.g. A gets 20 for wet spruce wood chips and B gets 20 for dry beech wood chips, although the energy content is higher in B by a multiple)!

## Contact & Information

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## Impressions of Žetale



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