Market uptake of small modular renewable district heating and cooling grids for communities

Project No: 691679

Feasibility Check of a small modular renewable heating and cooling grid in Municipality of Visoko

Municipality of Visoko (Bosnia and Herzegovina)

District heating in the Municipality of Visoko

WP 6 –D 6.1

April 2018

Authors: Anes Kazagić, EPBiH, Bosnia and Herzegovina
Ajla Merzić, EPBiH, Bosnia and Herzegovina
Elma Redžić, EPBiH, Bosnia and Herzegovina
Dino Trešnjo, EPBiH, Bosnia and Herzegovina
Marin Petrović, Municipality of Visoko, Bosnia and Herzegovina
Rok Sunko, Skupina FABRIKA, Slovenia
Blaž Sunko, Skupina FABRIKA, Slovenia
Ilija Batas Bjelic, University of Belgrade, School of Electrical Engineering, Serbia
Nikola Rajakovic, University of Belgrade, School of Electrical Engineering, Serbia
Christian Doczekal, Güssing Energy Technologies, Austria

Editors: Dominik Rutz
Christian Doczekal

Contact: WIP Renewable Energies
Dominik Rutz
Email: Dominik.rutz@wip-munich.de, Tel: +49 89 720 12 739
Sylvensteinstr. 2
81369 Munich, Germany
www.wip-munich.de

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 691679. The sole responsibility for the content of this report lies with the authors. It does not necessarily reflect the opinion of the European Union nor of the Innovation and Networks Executive Agency (INEA). Neither the INEA nor the European Commission are responsible for any use that may be made of the information contained therein.

CoolHeating website: www.coolheating.eu

Contents

1 Introduction

The heating and cooling demand in Europe accounts for around half of the EU's final energy consumption. Renewable energy policies often mainly focus on the electricity market, whereas policies for renewable heating and cooling are usually much weaker and less discussed in the overall energy debate. Therefore, it is important to support and promote renewable heating and cooling concepts, the core aim of the CoolHeating project.

The objective of the CoolHeating project, funded by the EU's Horizon2020 programme, is to support the implementation of "small modular renewable heating and cooling grids" for communities in South-Eastern Europe. This is achieved through knowledge transfer and mutual activities of partners in countries where renewable district heating and cooling examples exist (Austria, Denmark, Germany) and in countries which have less development (Croatia, Slovenia, Macedonia, Serbia, Bosnia-Herzegovina). Core activities, besides techno-economical assessments, include measures to stimulate the interest of communities and citizens to set-up renewable district heating systems as well as the capacity building on financing and business models. The outcome is the initiation of new small renewable district heating and cooling grids in five target communities up to the investment stage. These lighthouse projects will have a long-term impact on the development of "small modular renewable heating and cooling grids" at the national levels in the target countries.

For each of the CoolHeating target municipalities one or two potential projects have been identified in which small modular renewable heating and cooling grids could be implemented. For these potential projects, technical concepts and individual business models were elaborated by the projects partners from the target countries in cooperation with experts from Austria, Denmark and Germany.

The current document on "Feasibility Check of a small modular renewable heating and cooling grid in the in the Municipality of Visoko presents the results of checking the feasibility of the technical concept and individual business model of the potential project. The results are summarized in the executive summaries in English and national language in order to be promoted among decision makers of the target municipalities.

It is important to note that this is not a feasibility study (more costly and time-consuming task[1]), and the main purpose of this feasibility check is to provide a base for the activities of investment promotion, starting with an information day for attracting the investors before the investment phase. It is likely that during the direct negotiations in the investment phase the modifications of the business model and this feasibility check will be needed.

All prices, costs and revenues in this document are without VAT.

2 Technology assessment

District heating systems were well developed in towns and cities before the war in Bosnia and Herzegovina. During the war, many systems fell into disrepair and after the war could not recover customers due to a fall in the purchasing power of the population. The maintenance and investment in the remaining functioning district heating systems has been low, leading to obsolete technologies, as well as low efficiency and large heat losses on the network.

A district heating and cooling concept based on renewable energy sources would help to meet rising urban energy needs, to improve efficiency, to reduce emissions, and to improve the local air quality in the Municipality of Visoko. Air quality especially badly suffers during the heating season due to heavy use of coal for heating. Existing heating systems are mainly individual and currently dominated by coal as the cheapest energy source on the market. Therefore, they should be upgraded or new networks created, using solid biofuel and solar and geothermal

[1] Source: Behrens, W., Hawranek, P.M., and Organization, United Nations Industrial Development (1991), Manual for the Preparation of Industrial Feasibility Studies (United Nations Industrial Development Organization).

energy technologies. Depending on local conditions, renewable-based DHC would bring a range of benefits, including increased energy security, improved health and reduced climate impact.

By reviewing statistical data compiled through the survey, a great presence of wood as a fuel for the heating system has been noticed, especially in family houses with the heating system that includes individual hand-firing solid-fuel furnaces, but also in a great number of categories of collective housing buildings.

The DHC system concept is planned to cover the central area of the town. The zone includes different types of buildings. The main focus is on public buildings which are in the jurisdiction of the Municipality, which represent the biggest consumers in the town. On the other side, there is private and collective housing outside of the jurisdiction of the Municipality, whose connection to the centralized heating system would contribute to the reduction of air pollution and more rational use of energy resources.

In order to determine the consumer affordability of the heating costs, it is necessary to review the main socio-economic parameters of the population and energy consumption of households in Visoko.

From the very beginning of the project, the aim was to create a **methodology** to find the best solution in accordance with the conditions in the municipality, taking into account similar examples of good practice in the region and in Europe.

The DH system is planned so that the heat production would be achieved with different production units: heat pumps (water-water), solar thermal collectors and existing peak load gas boilers which would start automatically if the heating output of the renewable energy sources in the DHC system is insufficient to cover the demand. All these units would be located in close proximity to the river in the northwest of the city, at the area of approx. 11,000 m², and the solar thermal collectors and heat pumps would be connected to a seasonal pit thermal storage. It will be no problem to expand the currently envisaged location, if the more concrete planning requires a larger surface area for these production units.

Long-term (seasonal) storage would mean storing heat for several months, including from summer to winter. Introducing a large-capacity thermal storage in the district heating system would be a very good solution for a very flexible production from combined production units. Heat storage could also contain an additional heat pump to raise the temperature from the seasonal storage to the DH grid.

It is also planned that photovoltaics would be installed on the roofs of public institutions, which would contribute to the justification and sustainability of such a project. Energy produced by photovoltaics would entirely be fed into the public grid at a price that is a bit higher than the regular price of electricity. The planned locations of production units and the DH grid are shown in the Figure 1 below.

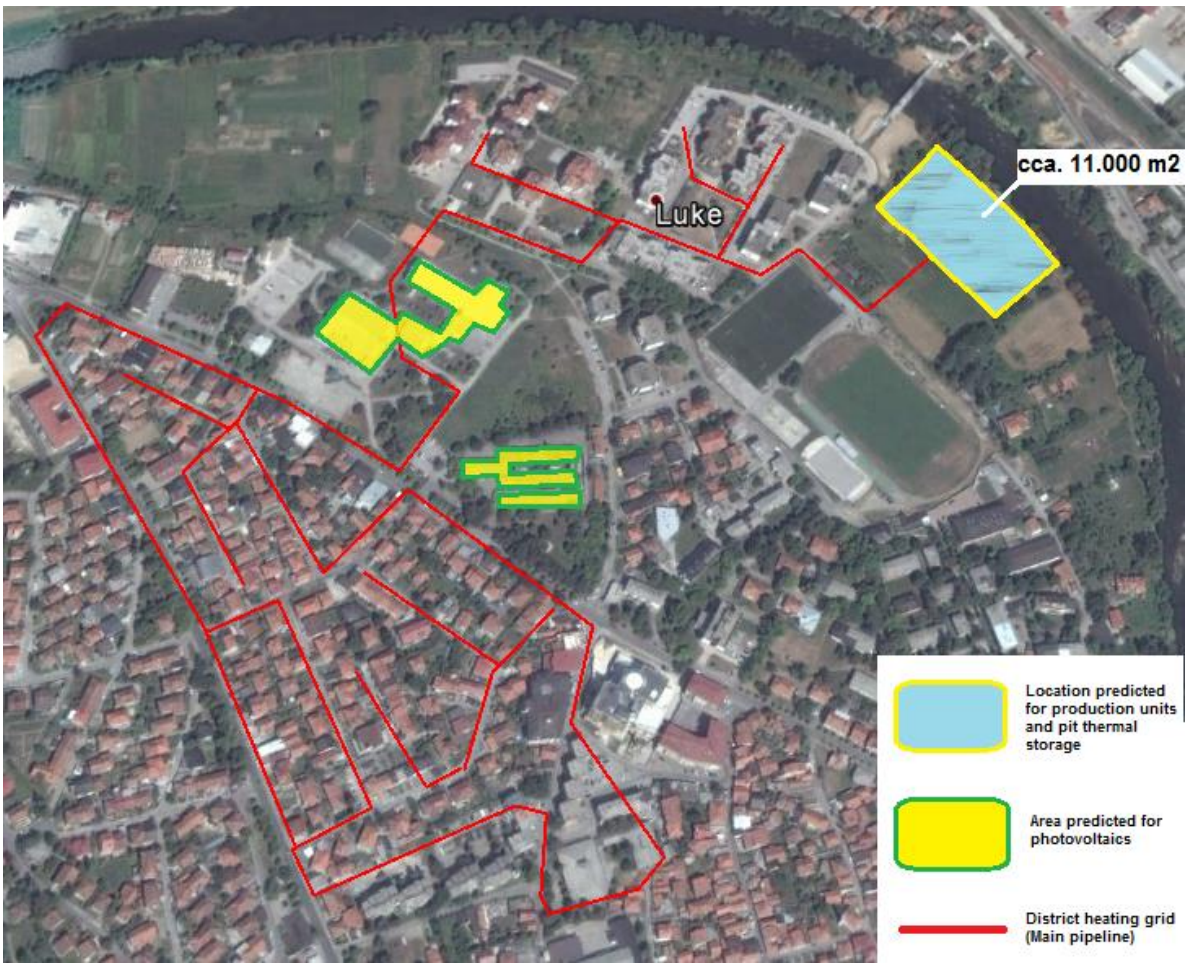


Figure 1: Map of potential locations for installation of production units, thermal storage, photovoltaics

The **key assumptions** in development of the Visoko DH project:

- The Visoko DH project would cover a very densely populated central part of the city with several public facilities which have not solved the problem of heat energy supply in the long term. So, the Visoko DH would have a quite high grid density (~3,500 kWh/m/a) which would certainly contribute to the justification of the project.
- Since there is a large number of individual housing units within the project area which are currently not connected to the natural gas grid, and individual stoves fired by fossil fuels are used for their heating, the implementation of this project would also greatly address the problem of air pollution in the city.
- The DH project would also open the possibility of using sanitary water in the summer, which until now was not the case.
- The final heating price should not be significantly higher than the current one, otherwise the connection rate would be very low due to the low pay power of the population.
- The DH project in Visoko will be feasible without charging a connection fee for the customers. Customers pay only for the delivered heat and setting up internal installations in their facilities.
- Conducted surveys showed that 80% of individual housing units would be ready to connect to the DH system.

The detailed overview of the technical concept for Visoko DH is available at the CoolHeating project website[2]. In the development phase the technical concept was developed and checked in many iterations in order to define a feasible technological layout of the DH plant, feasible and sustainable consumption of locally available RES and a feasible extent of the DH grid in the Municipality of Visoko.

A number of scenarios were considered until the final solution for the DH system in the municipality of Visoko was selected. Different production technologies (biomass plant, CHP unit and etc.), different capacities and locations for the production plant were taken into account, and the final selection was done by an iterative procedure, taking into account the investment costs, energy source prices, O&M cost, etc. Due to the low prices of electrical energy in Bosnia and Herzegovina, CHP plants have proven to be unprofitable in almost all scenarios or have led to extremely high final prices of heat energy. A biomass boiler was considered at one point in the planning of the concept, but because of the already existing natural gas boilers, it was removed from the solution because the new biomass boiler would increase the investment costs unnecessarily. Similarly, in the beginning, heat pumps which would use geothermal energy were considered, but considering the vicinity of the Bosna River, it was concluded that it would be more useful to install water-water heat pumps.

As a best variant, and in some way as the most feasible scenario for realisation, the **heat generation** concept with water-water heat pumps and solar collectors which would be connected to a thermal pit heat storage and existing natural gas peak load boilers has been shown.

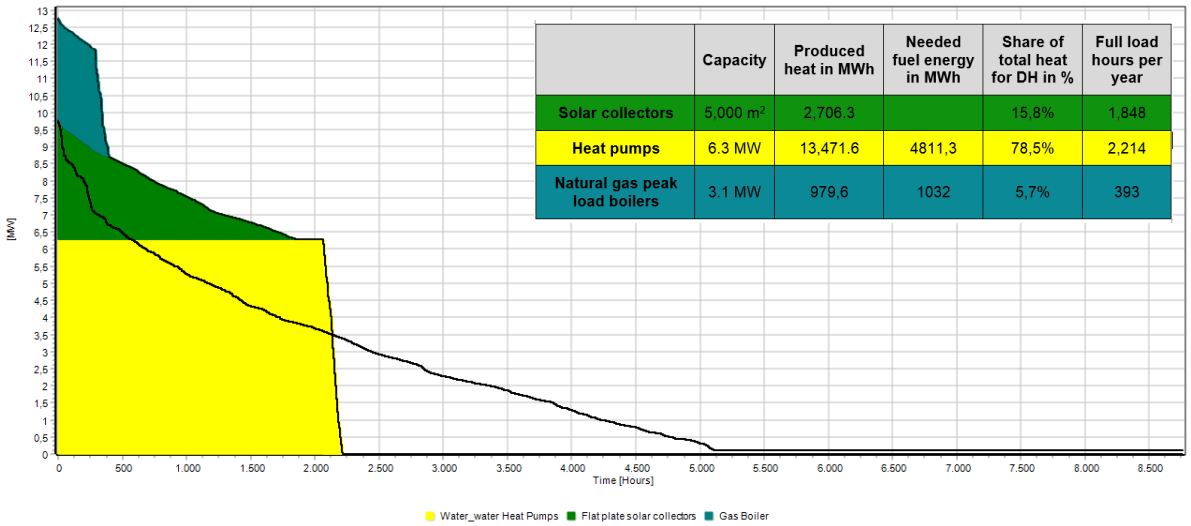
The total installed power for all production units was found to be 9.4 MW_{th}, including the area of 5,000 m^2 of solar collectors. An overview of the obtained capacities of all production units for the most optimal variant in the techno-economic sense is as follows:

- Heat pumps 6.3 MW
- Gas boilers 3.1 MW
- PVs 800 kW
- Solar collectors 5,000 m^2
- Heat storage 13,500 m^3

The **heat generation** concept for Visoko considers a water-water heat pump and solar collectors for baseload, a natural gas peak load boiler and PV panels for electricity production. A seasonal thermal storage will be used for storing heat for several months, including from summer to winter.

The heat for the DH system would come from following heat generation units: solar collectors, heat pumps and gas boilers. In addition to the above mentioned technologies, a thermal storage with a capacity of 13,500 m^3 is also planned, which would ensure reliability and efficiency of the mentioned technologies. One of the main problems in the energy supply, especially in the case of the renewable technologies, is the temporary gap between the availability of the resource and the demand. The storage would allow filling this gap. Therefore, it is a key factor for improvement of the renewable rate in such energy mix. Base heat production would be achieved through solar collectors (15.8%) and heat pumps (78.5%), which would be connected to storage, while the rest and peak loads would cover the gas boiler. Figure 2 shows the annual load line and calculation details of the planned heat production units.

[2] http://www.coolheating.eu/images/downloads/concepts/Report-D4.4-technical-concept-Visoko.pdf



	Capacity	Produced heat in MWh	Needed fuel energy in MWh	Share of total heat for DH in %	Full load hours per year
Solar collectors	5,000 m²	2,706.3		15,8%	1,848
Heat pumps	6.3 MW	13,471.6	4811,3	78,5%	2,214
Natural gas peak load boilers	3.1 MW	979,6	1032	5,7%	393

Figure 1: Annual load line and calculation details for heat production units for DH grid in Visoko

The length of the **DH grid** was calculated with 5,500 m. The temperature level of the DH grid will be designed with 80°C flow and 60°C return flow. There are approximately 150 private residential houses, 30 collective buildings and 6 public institutions within the project area. An important parameter to assess the cost effectiveness of a DH system is the grid density which is defined as the ratio of the annual heat delivered (for consumers) to the total length of the DH piping and network. The calculated grid density for municipality of Visoko is 3,482 kWh per meter of pipeline and per year.

When it comes to **generation and distribution of heat**, it is necessary to emphasize that it was taken into account that technical solutions are realistic and that all potential risks are minimized. Also, all resources are available at affordable prices, and are generally all represented on the local market.

As **heat consumers** all public buildings would be connected to the DH grid, as well as 80% of the households (80% connection rate) in the DH grid supplied area. An indirect system with separate heat exchangers (substations) is suggested for public and large residential buildings. On the other side, a direct system is suggested for individual households, with one heat exchanger for all private housing facilities and one heat exchanger per collective housing facility. Larger substations would require larger diameter pipes increasing the investment price for the pipeline, while single substation for each individual household would again increase investment costs, meaning that a high connection fee would have to be charged. The combination of an indirect and a direct system seems as the optimal compromise.

The amount of heat sold to the consumers is estimated to 17 GWh per year. In total 18.13 GWh/a of thermal energy are needed to be delivered through the DH grid.

Amounts of delivered heat by consumer groups:

- Households: 12,065 MWh/a
- Public objects: 4,935 MWh/a

The project realisation could be implemented in one phase and the **modularity** of the system is expandable. The project is thus conceived to cover a central part of the city at the beginning, and then open up the possibility of extending the DH grid to other parts of the city, primarily to all other public buildings nearby, but also all surrounding settlements they are mostly heated with individual stoves fired by fossil fuels.

About 6% of the total heat demand would be covered with natural gas, so 94% of the heat could be generated from heat pumps and solar collectors. A reduction of 5,046 tons of CO_2 could be achieved each year.

3 Business assessment

In the scope of the economic feasibility assessment, the technical design of the project was used in the economic tool[3] in order to test its potential and to obtain an image of the future project performance. This task included elements of financial statement analysis, asset selection, plan implementation and virtual ongoing monitoring of the investment in the project life-time. In this way a sustainable business model of the project was defined and justified through the employment of the simulation tool. Defining the business model implies defining all the relevant the following dimensions/parameters of the project as a business case:

- Investment and financing structure of the project;
- Costs and revenues;
- Assets, liabilities and equity.

The structure of the defined business model is presented in detail in the document Target community business model – Visoko. In the scope of the feasibility check, a defined business model was extensively tested in order to prove its potential for realization and to provide an investor with a specific insight into the project through the definition of the feasible business case.

The in-depth simulation of the future economic performance of the project is presented as an appendix to this document. It is providing credibility to the indications presented throughout this chapter and shall assist the upcoming steps of the project realization: decisions about the most appropriate strategy and the best way to allocate resources, an overview of the total amount of resources needed to start and to expand the project, assessment of the relative efficiency and equity of project, and to assure cost-effective allocation of resources. In the scope of the economic feasibility assessment of the project, the following tasks were carried out:

- Calculation of projected revenues
- Costs and fixed assets calculation
- Current assets calculation
- Liabilities and equity calculation
- Income statement projection
- Balance sheet projection
- Cash-flow profile projection
- Assessment of the economic viability of the project (equity IRR, NPV…)
- Sensitivity analysis

The process of developing the business model for the project in Visoko was iterative. Simultaneously with developing the model, all its assumptions were tested in the calculation tool. Based on the results of this iterative process a well-supported and sustainable business model was produced. Therefore, in the scope of economic feasibility check, a set of detailed future financial performance calculations of the model was produced which is required in order to assess the credibility and the solidity of the business model proposed.

As reflected in the attached economic feasibility check results, the proposed business model was tested for:

- **Providing satisfactory economic results** for the investor: with the defined business model parameters[5] and the proposed heat price the project reaches 10-11% internal rate of return on invested equity. Profitability is the most basic financial goal of every

[3] http://www.coolheating.eu/images/downloads/D5.2_CoolHeating_Economic-tool.xlsm
[5] Target community business model – Municipality of Visoko, April 2018.

small business. Profitability involves earning more revenues than paying for operating expenses. Business revenues include income from sales, interest on investments and rent on business property. Operating expenses include payroll, rent, materials, vehicle expense, advertising, utilities, interest payments, licenses and taxes. In the case of the Municipality, the primary objective is to solve the problem of air pollution in the city and not the profitability. However, it is very important that the Municipality as an investor does not record economic losses, and it was important to consider and predict many factors which can affect the overall project

- **Analysing in which key quantitative assumptions and computations** (underlying a decision, estimate, or project) are changed systematically to assess their effect on the final outcome. One of the key applications of sensitivity analysis is in the utilization of models by decision-makers. All the content needed for the decision model can be fully utilized only through the repeated application of sensitivity analysis. It helps decision makers to understand the uncertainties, pros and cons with the limitations and scope of a decision model. Sensitivity analysis has shown that the project is quite sensitive to O&M costs, but it is also important to note that the considered input parameters are relatively high compared to current market costs, and it should be kept in mind that the concept contains quite new technologies, and it is usually not expected that in the initial few years there will be any maintenance activities at all except preventive. In addition, to all of the O&M items in the business model, the calculations have taken into account responding year to year (y2y) change percent.

The following paragraphs provide a closer insight into key aspects and outcomes of the economic feasibility check for the proposed investment project in Visoko. A detailed economic simulation of the proposed business model is contained in the appendix and supporting the assumptions throughout this and related documents that are covering the investment project in Visoko.

Current costs and practices

Visoko is a city and municipality in central Bosnia and Herzegovina, covering 232 square kilometres with several characteristic, morphologically distinctive valleys formed by the foothills of the Central Bosnian mountains.

Residential heating is an essential energy service required by many people in Visoko. Even with widespread availability of electricity and natural gas, the use of solid fuels for residential heating continues to be common practice in many places in Bosnia, and so in Visoko. Most fuels are burned in small-scale combustion devices, such as household heating stoves or small boilers for single houses, apartment buildings.

Currently, most burning of solid fuels for space heating is done in devices that incompletely combust the fuel owing to their low combustion temperature and other limitations. This results in relatively high emissions per unit of fuel, including many products of incomplete combustion.

The amount of heating fuel needed in a particular climate is dependent on the fuel efficiency of the stove, as well as the characteristics of the housing in which it is used, such as insulation infiltration.

The existing heating needs in the settlement were assessed in a survey[6] where also the heating costs were assessed. The results have shown that heating expenses for collective households are in the range 250-300 € and for individual housing 500-550 €, because the average size of individual households is much higher than for collective households.

[6] Survey on the energy consumption and attitudes towards renewable heating and cooling in the CoolHeating target communities
http://www.coolheating.eu/images/downloads/CoolHeating_Survey_3.4.pdf

The existing specific cost for heating in Visoko is ca. 35 €/MWh. This average heat price contains households that are using natural gas, electricity, coal, biomass for the heat production. Furthermore, it is important to note, that this heating cost is based on estimations of interviewed households in Visoko. This estimation is undervalued as it does not include costs for operation and maintenance and the depreciation costs. Therefore, it is important to include these parameters in the calculated average heating cost for heating technologies in use in Visoko.

It is important to consider the currently applied four basic heating systems for households (all prices excluding VAT):

1. Heating with natural gas. One part of the city has a developed natural gas grid operated by the public company Visoko Ekoenergija and the gas price for households is 30 €/MWh;
2. Heating with coal. A large number of individual residential and collective heating units use coal because of the low cost and availability. The average coal price is around 80-90 €/t or 10-15 €/MWh.
3. A large number of residential facilities for heating also use electricity, especially for heating individual rooms in apartments which do not have a installed centralized heating system. Electricity is also mainly used throughout the whole year for the preparation of hot water and during summer for cooling using air conditioners. The average electricity price including all taxes for households in BiH, which annually consume between 2,500 and 5,000 kWh of electricity amounted to ca. 70 €/MWh.
4. A proportion of households in Visoko is being heated using biomass. These are mainly facilities that have installed central heating systems using pellet or wood chips, but also those which use individual stoves fired by logwood. The average biomass price on the market amounts 15-25 €/MWh.

It is important to note that the CoolHeating DH energy price developed and obtained here is including also investment costs, where the prices listed above do not consider the same. Therefore, these prices cannot be directly compared to the energy price of the CoolHeating DH developed here.

Initial investment and operating costs of the project

The investment into the Visoko DH project amounts to 4,910,000 €. The assessed investment costs are turn-key. They include all costs for the Visoko DH project to start, including the heat transfer stations at the customers' side. The key revenue and costs parameters are described in detail in the business model and include forecasts for the development in time. Critical parameters also include a quantification of the year to year change. The project includes proven technologies described in previous paragraphs.

As already described in the previous chapter, the core of the technical concept of the Visoko DH project consists of water-water heat pumps. Water from the river Bosna would be a medium with a good storage capability, even temperature levels and an ideal regeneration. There are strong reasons to use it as natural heat source. Compared to air and earth, water is the most effective heat source for a heat pump. An important prerequisite is that enough water with good quality is available. Due to high and constant temperatures of the river water between 8°C and 12°C all over the year, the heat pump starts its function at a higher temperature level compared to brine- or air usage.

The DH project in Visoko requires approximately 4,800 MWh of electricity yearly for its full load operation level. The project feasibility was analysed using the average electricity price of 60 €/MWh with a year to year price increase of 0.5%. In addition, the rest of the base production of thermal energy would be achieved through solar thermal collectors. Solar thermal heat production does not require any fuel like most other sources of renewable energy. This is a huge advantage over other fossil fuels whose costs are increasing at a drastic rate every year.

In addition to the significant investment costs, there are no other high costs other than maintenance. Annual maintenance is recommended. This is because there are a few parts to the system like the pump and antifreeze which need to be checked to ensure that they are performing optimally.

Operation and maintenance costs are assessed according to the manufacturers' specifications and experience from similar projects. Employed technologies are proven and mature which means that with the proper operating and maintenance procedures and practices operating costs may be controlled efficiently. Operating costs for selected technologies are considerable. However, they are variable by nature and thus tied to the amount of annual operating hours. Smaller DH projects require very little presence of the personnel on site. The system incorporated in this business model can be controlled and operated remotely due to the maturity of employed technologies. The district heating system would be managed and operated by an already existing public company Visoko Ekonergija, which has about 10 employees and therefore the costs of labour are relatively low.

Heat price

Revenues within the Visoko DH project are generated by sales of thermal energy (88.48%) and sales of electricity (11.52%). The business model does not foresee other revenue sources, as no connection fees for heat consumers will be charged in order to stimulate high connection rate which is critical for the realisation of the project.

Since no connection fee will be charged, it is suggested to contractually ensure that each customer is obliged to consume at least 3,500 kWh per year. Otherwise, they would be obliged to pay the flat rate of 51.13 € (equivalent to 100.00 BAM) for each year this condition is not satisfied, for the maximum of 10 years. If that is not agreed, it could happen that all customers are connected (without costs), but no one uses the heat.

The sensitivity of the project on the heat price variation was carefully assessed and is presented in the scope of the attached simulation. The attached chart shows that the minimum heat price that would need to be charged from the consumers is 42.30 €/MWh for the project to reach the break-even.

The project in Visoko has a single category of heat users (households and six public buildings) with rather standard energy needs. For this reason, the proposed tariff scheme considers only one consumer category. **The proposed base price is 45 €/MWh**. The proposed heat price for heat consumers supplied in the Visoko DH is the end price without VAT. No other additional costs for heat consumers add to this price. Furthermore, also no investment costs are asked to the heat consumers as they will be connected to the DH grid free of charge. The price model assumes this heat price to be fixed with standard annual price increase index of 0.5%. The effect of the proposed price model on the overall project economic performance has been simulated for duration of 20 years, allowing for the investor to achieve **10-11% IRR on invested equity**. The detailed economic performance and simulations can be observed in the annex to this document. The reference heat price of 45 €/MWh is a feasible reference heat price, which still possesses tolerance for variation according to the specific vision of Municipality of Visoko and its non-profit benefits.

The price of 45 €/MWh should be a competitive price in comparison to existing heating costs in Visoko. Although the mentioned price is slightly higher than the other energy sources used by the municipality's residents for heating, security, sustainability and comfort which are obtained with Visoko DH are significantly higher. Given that this project would solve the problem of pollution of the air in the municipality in the long run, for this reason the benefits would be immeasurable.

Financing options

The Municipality of Visoko plans to participate in this project with private capital of 25% of the total investment. The other 75% would be covered by well-favoured loan (interest rate of 2.5%, 15 years repayment period and 3 years grace period), very similar to some of the already implemented projects in the Municipality of Visoko.

Unfortunately, there are currently no available grants and defined ways of subsidizing such projects in Bosnia and Herzegovina, which does not mean that it will not appear until the beginning of the realization of the project, which would surely in any case contribute to the economic parameters of the project. Guided by positive experiences from previous projects, the Municipality of Visoko would apply the same or very similar loan financing conditions to the implementation of this project.

The outlined financing structure represents a standard financing structure with no specifics or potential risks related to it. It is very feasible that such investment structure can be realised, and it is also possible that the financing structure could be even more favourable.

Licenses and permits required

According to the Constitutional organization of Bosnia and Herzegovina, the jurisdiction for conducting processes and steps within the authorization framework for the development of infrastructure projects is divided among different government levels in Bosnia and Herzegovina (the state, entity, and BD).

State Level

The authorization framework at the state level, as well as at the entities and Brcko district levels, consists of the four typical steps. In addition, the types of Project Documentation that an investor needs to develop and present to the relevant authorities at the different stages of the permitting procedure in the entities and Brcko district are also identified under this chapter, since they are generic and applicable to all government levels in BiH.

- Step 1 - Designation of Status of a “Public (General) Interest”: The state level authorization framework entails a few steps and processes relevant to the implementation of an energy infrastructure project in BiH. However, the legislative framework governing those steps and processes is not well developed.
- Step 2 - Spatial Planning: The adoption of a Spatial Plan at the BiH level is not prescribed by the existing legislative framework. The adoption of Spatial Plans are the competences of Entities; thus, this activity is stipulated by the respective entity legislation.
- Step 3 – Permitting Procedures: There are two procedures at the state level that the investor is required to complete in order to develop an energy infrastructure project in BiH: the first procedure includes obtaining a concession from BiH, provided the state and not another level of government is authorized to grant such concession, and the second procedure pertains to the connection of new facilities to the transmission network.
- Step 4 - Securing Land, or the Right to Use Land: There are no laws or procedures at the state level that would facilitate the acquisition or the right to use land or construct on land in the development of energy infrastructure projects in BiH. The laws regulating property and other subject matters are adopted at the entity level.

Entity Level Authorization Framework: Federation of BiH (FBiH)

- Step 1 - Designation of Status of a “Public (General) Interest”: In a formal legal sense, the energy infrastructure projects in FBiH can get “public (general) interest” status. In compliance with legal provisions, the public interest is determined in a concession granting procedure as a “the grant of a concession in the public interest,” as well as in

an expropriation procedure, which includes the “construction in the public interest for expropriation purposes.”

- Step 2 - Spatial Planning: There is no Spatial Plan for FBiH. The FBiH Spatial Plan Proposal (2008-2028), was discussed by the FBiH Parliament, but it has not been adopted yet. Until the adoption of the FBiH Spatial Plan, the Spatial Plan of the Socialist Republic of BiH (SRBiH) for the period from 1981 to 2000 has been applied, where it has not been contrary to the FBiH Constitution.
- Step 3 - Permitting Procedure: The permitting procedure is the core part of the authorization framework in FBiH. The permitting procedure for the construction of energy infrastructure facilities in FBiH is conducted at the FBiH and/or cantonal level, depending on the type and size of a facility as well as the competences.

Since some procedural steps are optional and depend on the legal requirements for the type and size of generation facility and/or whether the competent authority deems the procedure necessary (e.g., concession, EIA), such procedure is presented in Figure 3 by dotted lines. A solid line is used to identify the required procedural steps that an investor must take.

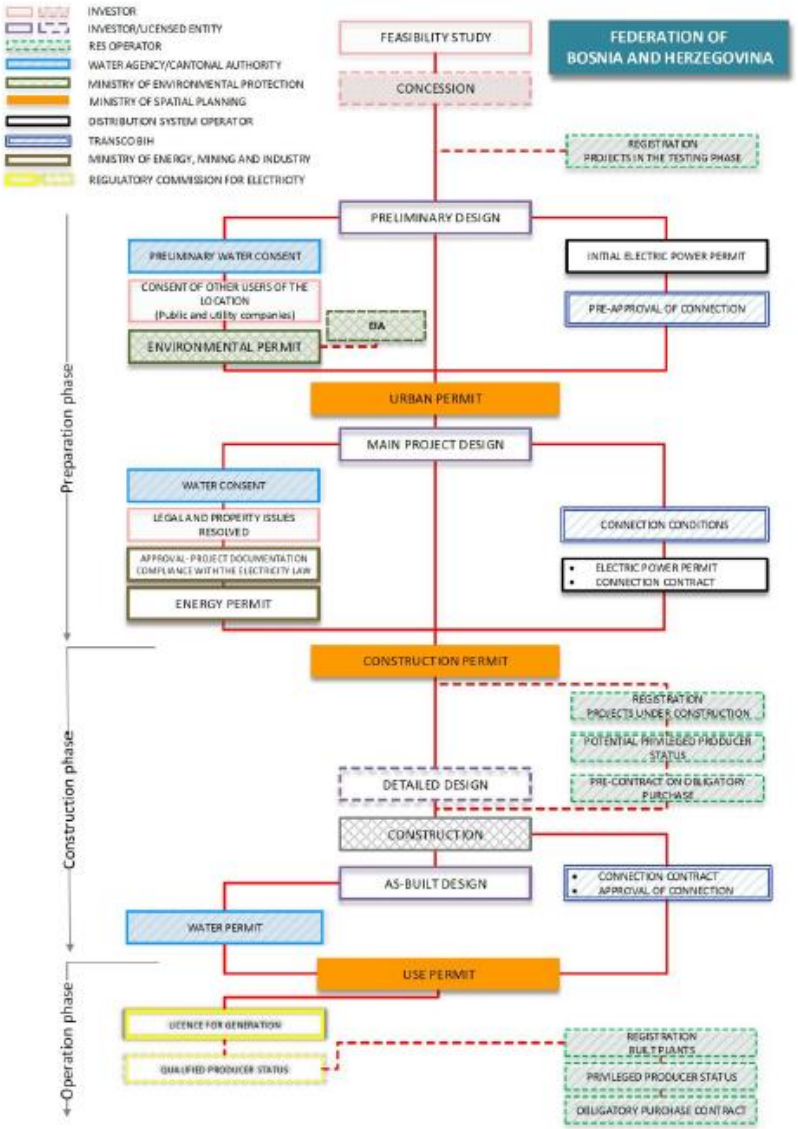


Figure 3: FBiH – Permits and Competent Institutions[7]

[7] Draft Report on the Permitting Regime and Obstacles to Investment in the Energy Infrastructure Projects in Bosnia and Herzegovina, USAID, EIA Project – Energy investment activity

Water Acts: In order to acquire the right to use water by the new generation facility, an investor must go through different steps to acquire administrative documents, which will gradually lead to the final stage of obtaining a Water Permit. As the permitting procedure progresses, the competent authorities require more detailed information. The authorities make and issue administrative decisions – water acts along with this process. Figure 4 below identify the stages and the order of the issuance of water acts in relation to the Urban Permit and the Construction Permit.

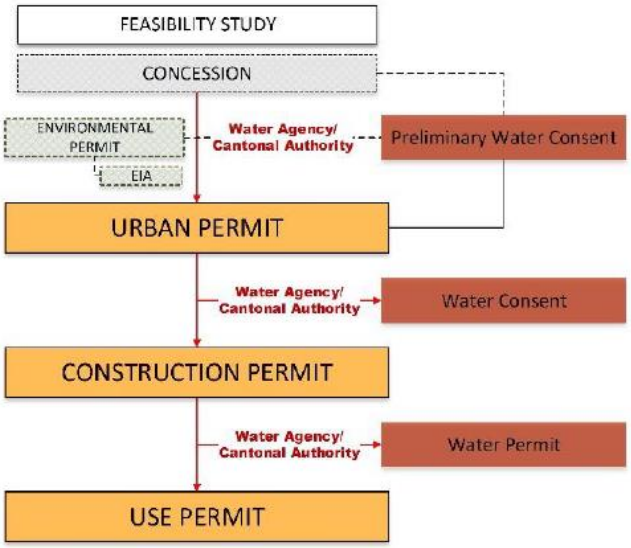


Figure 4: FBiH - Water Acts – Consents and Permits[8]

Connection to the Grid: The Transmission Company "Elektroprenos BiH," headquartered in Banja Luka (Transco BiH), was established by the Law on Establishing the Company for Transmission of Electric Power in Bosnia and Herzegovina. The main competences of Transco BiH include electricity transmission, maintenance, construction and expansion of the electricity transmission network in BiH. This is the only company for the transmission of electric power in the BiH market. Transco BiH operates at the state level, and its activities are regulated by the State Electricity Regulatory Commission (SERC).

Depending on the installed capacity, an electric power facility requires a connection either to transmission or distribution network of Bosnia and Herzegovina. Transco BiH is the only company authorized for the issuance of permits for connection to the transmission network in BiH.

The connection procedure is regulated by the Connection Rules adopted by SERC. The technical aspects of the connection are prescribed by the Independent System Operator in BiH (ISO BiH) and approved by SERC in the Grid Code.

Socio-environmental cost/benefits

To increase the share of renewable energy in global energy consumption, accelerated deployment is needed across all sectors. This includes end-use sectors, such as buildings, industry and transport, and also transformative sectors, such as power generation and district heating and cooling (DHC). While renewable power generation has made clear progress and received considerable attention, the role of renewable DHC remains uncertain.

[8] Draft Report on the Permitting Regime and Obstacles to Investment in the Energy Infrastructure Projects in Bosnia and Herzegovina, USAID, EIA Project – Energy investment activity

Therefore, the key to realising a successful DH scheme is to minimise the capital cost, but maximise the number of customers connecting to the network. This is ideally done by keeping the central heat source as close as possible to the maximum number of dwellings.

Most DH networks start as relatively small systems serving up to 100-200 dwellings. These smaller networks can then be expanded over time to serve much larger communities up to 10,000 dwellings or more. On these larger systems it is possible to have a number of different heat sources which all feed into the same system. These heat sources can be activated to match the fluctuating overall demand of the system.

It is estimated that the realization of this business model will trigger the following direct and indirect impacts on the local environment:

- Reduction of CO_2 emissions by 5,046 tons per year.
- Lower energy costs, high level of energy supply comfort.
- 1 direct new employment and several other indirect employments due to the effects on local economies.
- Improved air quality will result in lower expenses in health services.

The Visoko DH project will replace a significant amount of non-renewable fuels in Municipality of Visoko:

- 3,008 MWh of natural gas
- 4,838 MWh of charcoal
- 1,200 MWh of electric energy

The above presented energy carriers will be replaced by utilisation of water-water heat pumps and solar collectors. The annual cost of the 5,843 MWh of electricity and natural gas used for heating in Visoko is more than 321,000 €.

4 Executive summary for policy makers (in English)

The main objective of this document has been to determine the feasibility of the investment into a district heating system in Bosnia and Herzegovina in the Municipality of Visoko. The Municipality of Visoko is located in central BiH and could represent a model for city districts, villages, and small rural settlements.

The heating demand and the attitude towards a new DH project was assessed within a survey. Based on the heat demand assessment, the technical concept for meeting the heating needs was developed. The estimation of the costs of all elements that entail the construction and operation of a district heating system was conducted; the construction and maintenance of the distribution network, the heat supply, and the interface between the distribution network and the customer's systems, the substations.

The new network can be economically competitive and additionally the system would drastically reduce the emissions and would enable the ageing population a much higher heating comfort and quality of life.

The new **heat generation concept** for the Municipality of Visoko considers water-water heat pumps, solar collectors and existing natural gas peak boilers. All these units would be located in close proximity to the river in the northwest of the city, at an area of approx. 11,000 m². The solar thermal collectors and heat pumps would be connected to a seasonal pit thermal storage. The currently envisaged location could be expanded, if more concrete planning requires a larger surface area for these production units. On the available surface of public roofs of about 6,000 m^2, it is planned to install photovoltaics with 800 kW capacity. According to the performed analysis and taking into account all insolation data) for the Municipality of Visoko, about 1,256 MWh of electricity annually would be generated and fed into grid by photovoltaics. The **investment** into the Visoko DH project is estimated to 4,910,400 €.

Base-load **heat production** would be achieved through solar collectors (15.8%) and heat pumps (78.5%), which would be connected to the storage, while the rest and peak loads would be covered by the gas boiler. The **DH grid** was calculated with 5,500 m. A direct system is suggested for individual households, with one heat exchanger for all private housing facilities and one heat exchanger per collective housing facilities. The predicted heat consumption for the connection rate of 80% private housing facilities and 100% connection rate for public buildings is 18.13 GWh including grid heat losses with about 5.9%. The temperature level of the DH grid will be designed with 80°C flow and 60°C return flow.

The **trend of investing** in the Municipality of Visoko with the aim of solving the problems of the citizens they are facing, should be continued. The focus is on further construction of roads, sewerage infrastructure and district heating system that will enable a higher quality of life and more jobs in Visoko. Realising these investments, which were and will be supported by the majority in the Municipal Council, would also mean the completion of one of the strategic goals of creating better infrastructure preconditions for the development of the municipality.

The Municipality of Visoko plans to participate in this project with private capital of 25% of the total investment. Another 75% would be covered by a well-favoured loan, very similar to some of the already implemented projects in the municipality. The owner of the entire district heating system would be the Municipality of Visoko, and the operator of such a system would be the public, already existing company Visoko Ekoenergija d.o.o.

About 5,046 tons of CO_2 could be saved each year compared to the current state.

The Visoko DH project requires approximately 4,811 MWh of electricity for the heat pumps, and 1,032 MWh of natural gas for the peak load boiler.

Revenues within the Visoko DH project would be generated by sales of thermal energy (88.48%) and sales of electricity (11.52%). **The proposed base price of supplied heat is 45 €/MWh**. No connection fee will be charged, but it is suggested to contractually ensure that each customer is obliged to consume at least 3,500 kWh per year. Otherwise, they would be obliged to pay the flat rate of 51.13 € (equivalent to 100.00 BAM) for each year if this condition

is not met, for maximum 10 years. If that is not agreed, it could happen that all customers are connected (without costs), but no one uses the heat.

The proposed business model is feasible due to its **potential to provide satisfactory economic results** for the investor as it might generate rates of return which are between 10-11% net present value (NPV) of 478,107 €. Thereby, consumers are provided by safe and reliable heat supply, based on environmentally acceptable technologies, and at reasonable price.

The **annual cost for 18 GWh of energy** (electricity and natural gas) used for heating in Visoko is more than 315,000 € annually.

Overall, the proposed business model is robust, beneficial for the local community and fairly resistant to potential negative future developments. The main challenge is to achieve acceptance of the project among the local citizens and broader community in order to reach the defined connection rate and thus the critical size of the project.

5 Executive summary for policy makers (in Bosnian)

Glavni cilj ovog dokumenta jeste utvrditi opravdanost ulaganja u sistem daljinskog grijanja u Bosni i Hercegovini, u općini Visoko. Općina Visoko se nalazi u centralnom dijelu Bosne i Hercegovine BiH i implementacijom jednog ovakvog projekta mogla bi predstavljati dobar primjer za sve druge gradove ili manja naseljena mjesta.

Toplinske potrebe i zainteresovanost za novim sistemom daljinskog grijanja procijenjen je u okviru sprovedene ankete. Na osnovu rezultata ankete i procijenjenih potreba za toplinom razvijen je tehnički koncept s ciljem zadovoljenja tih potreba. Urađena je procjena svih potencijalnih troškova za sve stavke koje podrazumijevaju izgradnju i rad sistema daljinskog grijanja, izgradnju i održavanje distributivne mreže, snabdijevanje toplinom, te za sve podstanice u mreži.

Nova mreža sistema daljinskog grijanja bi bila ekonomski konkurentna, te bi ovakav sistem drastično smanjio emisije i omogućio cjelokupnoj populaciji mnogo veći komfor i kvalitetniji način življenja.

Proizvodnja toplinske energije u općini Visoko bi bila ostvarena pomoću toplinskih pumpi (voda-voda), solarnih kolektora, te postojeći kotlova na gas koji bi pokrivali vršna opterećenja. Sve ove proizvodne jedinice bi bile smještene u neposrednoj blizini rijeke Bosne na sjeverozapadu grada, na lokalitetu površine od cca. 11.000 m², a solarni kolektori i toplinske pumpe bi bile spojene seznoski spremnik topline. Trenutno predviđena lokacija može biti i proširena, ukoliko bi se ispostavilo da instaliranje svih proizvodnih jedinica zahtijeva veću površinu. Na raspoloživim površinama na krovovima javnih ustanova cca. 6.000 m^2 planirano je da se instaliraju fotonaponski paneli ukupne snage od 800 kW. Prema analizi i proračunima koji su izvršeni, uzimajući u obzir sve podatke o insolaciji za područje općine Visoko, godišnje bi se proizvodilo oko 1.256,6 MWh električne energije. Ukupna investicija u projekat sistema daljinskog grijanja u općini Visoko se procjenjuje na 4.910.400 €.

Bazna proizvodnja toplinske energije bi se ostvarivala pomoću solarnih kolektora (15,8%) i toplinskih pumpi (78,5%), koji bi bili povezani sa sezonskim toplinskim spremnikom, dok bi se ostatak i vršna opterećenja pokrivala psotojećim gasnim kotlovima. Dužina mreže daljinskog sistema je oko 5.500 m. Predložen je direktan sistem priključka za domaćinstva, sa jednim izmenjivačem topline za sve privatne stambene objekte i po jedan izmjenjivač topline za kolektivne stambene objekte. Predviđena potrošnja toplinske energije za stopu priključka od 80% za privatne stambene jedinice i 100% za javne ustanove je 18,13 GWh godišnje, uključujući gubitke topline u mreži od oko 5,9%. Nivo temperature mreže sistema daljinskog grijanja biće dizajniran sa izlaznom temperaturom protoka od 80°C i povratnom temperaturom od 60°C.

Trend ulaganja u općinu Visoko sa ciljem rješavanja problema građana sa kojima se suočavaju će se nastaviti. Fokus je na daljnjoj izgradnji putnih komunikacija, vodovodne mreže, poboljšanju kanalizacione infrastructure, te rješavanju problema sistema daljinskog. Realizovanje ovih investicija, koje ima podršku Općinskog vijeća, značilo bi i ispunjavanje postavljenih strateških ciljeva, te stvaranje infrastrukturnih preduslova za razvoj opštine.

Općina Visoko, kao investitor, planira da učestvuje u ovom projektu sa privatnim kapitalom od 25% od ukupne investicije. Preostalih 75% bi bilo pokriveno povoljnom kreditnom linijom, sa vrlo sličnim ili istim uslovima kao na nekim već realizovanim projektima u općtini. Vlasnik cjelokupnog sistema daljinskog grijanja bi bila općina Visoko, a operater takvog sistema bi bilo postojeće javno preduzeće Visoko Ekoenergija d.o.o.

Ovim projektom bi se reducirala emisija od oko 5.046 tona CO_2 u poređenju sa trenutnim stanjem.

Sistem daljinskog grijanja u Visoko za bezbijedan rad zahtijeva oko 4,811.30 MWh električne energije za toplinske pumpe, e oko 1.032.00 MWh prirodnog gasa za rad vršnih kotlova.

Prihodi unutar projekta bi bili ostvarivani prodajom toplinske energije (88,48%) i prodajom električne energije (11,52%). Predložena krajnja cijena isporučene toplinske energije je 45 €/MWh. Planirano je da se ne naplaćuju bilo kakve naknade za priključak, ali se predlaže da

se ugovorom osigura da je svaki krajnji korisnik dužan da potroši najmanje 3,500 kWh godišnje. U suprotnom, bili bi obavezni da plaćaju fiksnu naknadu od 51,13 € (ekvivalentno 100,00 KM) za svaku godinu ako ne ispune prvobitni uslov, a najviše 10 godina. Ukoliko se tako nešto ne ugovori, moglo bi se dogoditi da svi budu povezani na mrežu daljinskog grijanja, a da pritom niko ne koristi toplinsku energiju iz sistema.

Predloženi poslovni model se pokazao izvodljivim i opravdanim zbog njegovog potencijala da obezbijedi zadovoljavajuće ekonomske rezultate za investitora, jer se ekonomskom analizom pokazalo da ostvaruje internu stopu povrata (IRR) od 10-11% i neto sadašnju vrijednost (NPV) od 478.107,00 €. Pri tome građani dobijaju sigurno snabdijevanje toplinske energije proizvedene na okolinski prihvatljiv način, i po prihvatljivoj cijeni.

Trošak za energente (električnu energiju i prirodni gas) kojim bi se proizvodilo oko 18 GWh toplinske energije u općini Visokom bi iznosio nešto više od 315.000 € godišnje.

Sve u svemu, predloženi poslovni model se može činiti malo robusnim, ali također može biti vrlo koristan za lokalnu zajednicu jer je prilično otporan na potencijalne negativne razvoje. Glavni izazov jeste taj da projekat bude prihvaćen među lokalnim stanovništvom, ali i širom zajednicom kako bi se ostvarila predviđena i definisana stopa priključka, a time i dimenzije projekta.

6 Appendix

6.1 Map details

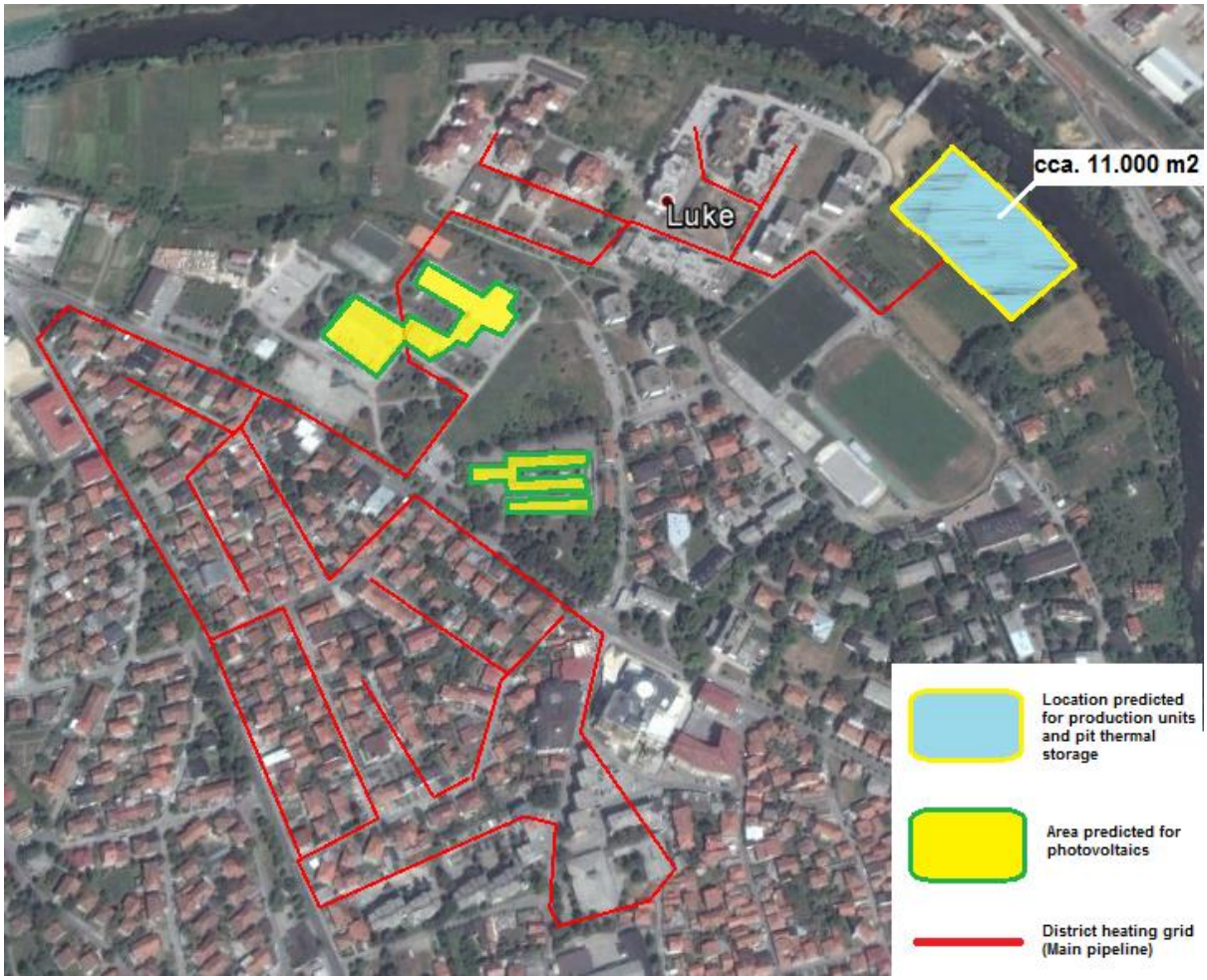
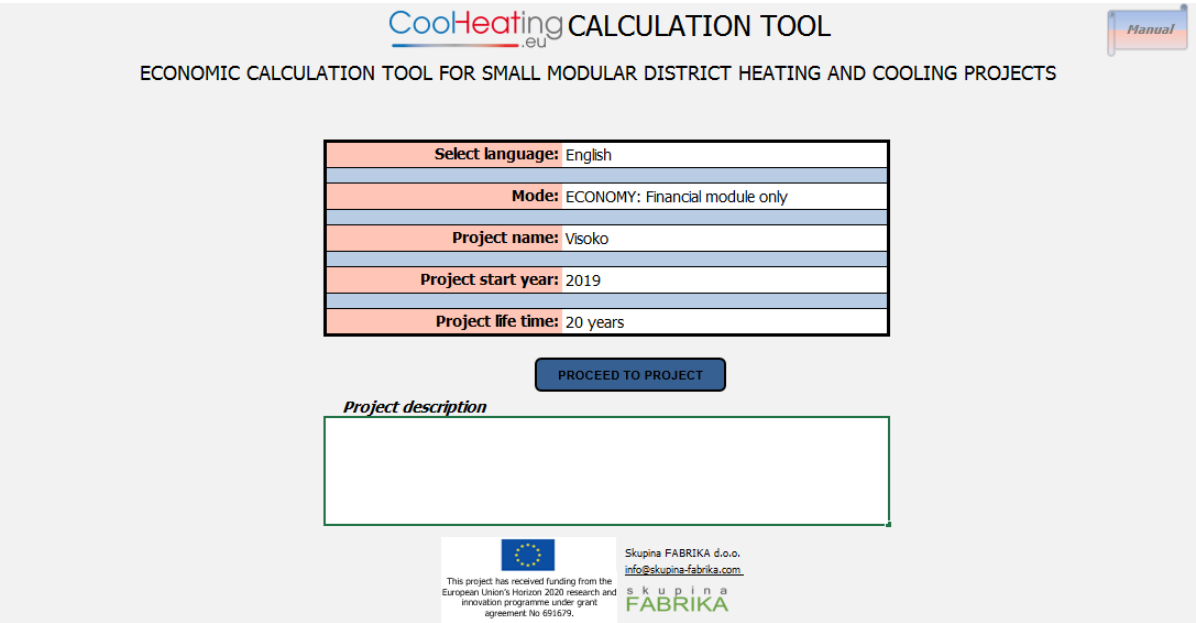


Figure 5: Overview of the DH Visoko heating grid and location of the plot for the DH plant.

6.2 Simulation results from Economic calculation tool for small modular district heating and cooling projects



20 year project life-time period is considered for all calculations and for the simulation period.

5% discount rate is employed in the simulations of the economic performance of the project.

Detailed economic calculations are contained in the following pages.

Projected investment cost in €	Value	Share %
1. Buildings and construction works	50.000	1,0%
2. Plot	60.000	1,2%
3. Equipment/Machinery	4.750.400	96,7%
A. PROPERTY, PLANT AND EQUIPMENT	**4.860.400**	**99,0%**
B. PROJECT AND INVESTMENT DOCUMENTATION	**50.000**	**1,0%**
C. INTANGIBLE ASSETS	**0**	**0,0%**
D. INVESTMENT COST (A+B+C)	**4.910.400**	**100,0%**
E. INITIAL WORKING CAPITAL	**0**	**0,0%**
F. TOTAL INVESTMENT COST (D+E)	**4.910.400**	**100,0%**

Sources of investment cost financing in €	Value	Share %
A. PRIVATE EQUITY	**1.228.350**	**25,0%**
B. BANK LOANS	**3.682.050**	**75,0%**
C. CONNECTION FEES	**0**	**0,0%**
D. INVESTMENT SUBSIDIES	**0**	**0,0%**
E. TOTAL FINANCING (A+B+C+D)	**4.910.400**	**100,0%**

Source of revenue in €	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
1. ELECTRICITY REVENUES	100.528	101.031	101.536	102.043	102.554	103.066	103.582	104.100	104.620	105.143	105.669	106.197	106.728	107.262	107.798	108.337	108.879	109.423	109.970	110.520
2. HEAT REVENUES	772.065	775.925	779.805	783.704	787.622	791.561	795.518	799.496	803.493	807.511	811.549	815.606	819.684	823.783	827.902	832.041	836.201	840.382	844.584	848.807
3. OPERATING SUBSIDIES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A. GROSS OPERATING REVENUES	**872.593**	**876.956**	**881.341**	**885.747**	**890.176**	**894.627**	**899.100**	**903.596**	**908.114**	**912.654**	**917.218**	**921.804**	**926.413**	**931.045**	**935.700**	**940.378**	**945.080**	**949.806**	**954.555**	**959.328**
1. INVESTMENT SUBSIDIES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2. FINANCIAL REVENUES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3. OTHER REVENUES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B. OTHER SOURCES OF REVENUES	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
C. TOTAL REVENUES (A + B)	**872.593**	**876.956**	**881.341**	**885.747**	**890.176**	**894.627**	**899.100**	**903.596**	**908.114**	**912.654**	**917.218**	**921.804**	**926.413**	**931.045**	**935.700**	**940.378**	**945.080**	**949.806**	**954.555**	**959.328**

Cost type in €	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
1. Energy source costs	321.048	322.654	324.267	325.888	327.518	329.155	330.801	332.455	334.117	335.788	337.467	339.154	340.850	342.554	344.267	345.988	347.718	349.457	351.204	352.960
2. Operation and maintainance costs	48.004	48.724	49.455	50.197	50.950	51.714	52.490	53.277	54.076	54.887	55.711	56.546	57.394	58.255	59.129	60.016	60.916	61.830	62.758	63.699
A. TOTAL OPERATING COSTS (1+2)	**369.052**	**371.378**	**373.722**	**376.085**	**378.467**	**380.869**	**383.291**	**385.732**	**388.193**	**390.675**	**393.177**	**395.700**	**398.244**	**400.810**	**403.396**	**406.004**	**408.635**	**411.287**	**413.962**	**416.659**
1. Cost of management, insurance and lease	48.004	48.006	48.009	48.011	48.014	48.016	48.018	48.021	48.023	48.026	48.028	48.030	48.033	48.035	48.038	48.040	48.042	48.045	48.047	48.050
2. Cost of promotional activities	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3. Cost of other services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B. TOTAL COSTS OF SERVICES (1+2+3)	**48.004**	**48.006**	**48.009**	**48.011**	**48.014**	**48.016**	**48.018**	**48.021**	**48.023**	**48.026**	**48.028**	**48.030**	**48.033**	**48.035**	**48.038**	**48.040**	**48.042**	**48.045**	**48.047**	**48.050**
C. COSTS OF LABOUR	**100.000**	**100.500**	**101.003**	**101.508**	**102.015**	**102.525**	**103.038**	**103.553**	**104.071**	**104.591**	**105.114**	**105.640**	**106.168**	**106.699**	**107.232**	**107.768**	**108.307**	**108.849**	**109.393**	**109.940**
D. DEPRECIATION AND AMORTIZATION COSTS	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**
E. FINANCIAL COSTS	**0**	**0**	**0**	**89.714**	**84.532**	**79.220**	**73.772**	**68.188**	**62.461**	**56.591**	**50.571**	**44.400**	**38.072**	**31.584**	**24.933**	**18.113**	**11.120**	**3.951**	**0**	**0**
F. OTHER EXPENSES AND LOSSES	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
G. INCOME TAXES	**19.213**	**19.474**	**19.735**	**4.745**	**5.887**	**7.051**	**8.238**	**9.449**	**10.684**	**11.943**	**13.227**	**14.537**	**15.874**	**17.237**	**18.629**	**20.049**	**21.497**	**22.976**	**23.908**	**24.167**
H. TOTAL COSTS (A+B+C+D+E+F+G)	**778.789**	**781.878**	**784.988**	**862.582**	**861.435**	**860.201**	**858.878**	**857.462**	**855.952**	**854.345**	**852.638**	**850.827**	**848.911**	**846.885**	**844.747**	**842.494**	**840.122**	**837.628**	**837.829**	**841.336**

Inventories in stock and resources needed in €	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
A. Average days of inventory	60,0																			
B. Inventory turnover ratio	6,08																			
C. INVENTORIES IN STOCK ON 31ST OF DECEMBER	13.205	13.350	13.497	13.646	13.797	13.949	14.104	14.261	14.420	14.581	14.744	14.909	15.077	15.246	15.418	15.593	15.769	15.948	16.130	16.314
D. RESOURCES NEEDED TO FINANCE INVENTORIES	2.171	2.195	2.219	2.243	2.268	2.293	2.318	2.344	2.370	2.397	2.424	2.451	2.478	2.506	2.535	2.563	2.592	2.622	2.651	2.682

Accounts receivable and resources needed in €	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
A. Accounts receivable collection period	30,0																			
B. Accounts receivable turnover ratio	12,17																			
C. ACCOUNTS RECEIVABLE ON 31ST OF DECEMBER	71.720	72.079	72.439	72.801	73.165	73.531	73.899	74.268	74.639	75.013	75.388	75.765	76.144	76.524	76.907	77.291	77.678	78.066	78.457	78.849
D. RESOURCES NEEDED TO FINANCE THE ACCOUNTS RECEIVABLE	5.895	5.924	5.954	5.984	6.014	6.044	6.074	6.104	6.135	6.165	6.196	6.227	6.258	6.290	6.321	6.353	6.384	6.416	6.448	6.481
E. LONG-TERM ACCOUNTS RECEIVABLE ON 31ST OF DECEMBER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Annual depreciation rates in % Calculation of planned depreciation	
A. INTANGIBLE ASSETS	10,0%
B. PROPERTY, PLANT AND EQUIPMENT	
1. Buildings and constructions	5,0%
2. Equipment, plant, vehicles, mechanization	5,0%

Depreciation cost in €	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
A. INTANGIBLE ASSETS	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
1. Buildings and constructions	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
2. Equipment, plant, vehicles, mechanization	240.020	240.020	240.020	240.020	240.020	240.020	240.020	240.020	240.020	240.020	240.020	240.020	240.020	240.020	240.020	240.020	240.020	240.020	240.020	240.020
B. TOTAL PROPERTY, PLANT AND EQUIPMENT (1+2)	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**
C. TOTAL (A+B)	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**	**242.520**

Fixes assets value on 31st of December in €	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
A. INTANGIBLE ASSETS	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
1. Buildings and constructions	47.500	45.000	42.500	40.000	37.500	35.000	32.500	30.000	27.500	25.000	22.500	20.000	17.500	15.000	12.500	10.000	7.500	5.000	2.500	0
2. Equipment, plant, vehicles, mechanization	4.620.380	4.380.360	4.140.340	3.900.320	3.660.300	3.420.280	3.180.260	2.940.240	2.700.220	2.460.200	2.220.180	1.980.160	1.740.140	1.500.120	1.260.100	1.020.080	780.060	540.040	300.020	60.000
B. TOTAL PROPERTY, PLANT AND EQUIPMENT (1+2)	**4.667.880**	**4.425.360**	**4.182.840**	**3.940.320**	**3.697.800**	**3.455.280**	**3.212.760**	**2.970.240**	**2.727.720**	**2.485.200**	**2.242.680**	**2.000.160**	**1.757.640**	**1.515.120**	**1.272.600**	**1.030.080**	**787.560**	**545.040**	**302.520**	**60.000**
C. TOTAL (A+B)	**4.667.880**	**4.425.360**	**4.182.840**	**3.940.320**	**3.697.800**	**3.455.280**	**3.212.760**	**2.970.240**	**2.727.720**	**2.485.200**	**2.242.680**	**2.000.160**	**1.757.640**	**1.515.120**	**1.272.600**	**1.030.080**	**787.560**	**545.040**	**302.520**	**60.000**

Accounts payable and deliveries financed by suppliers in €	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
A. Days payable	30,0																			
B. Accounts payable turnover ratio	12,17																			
C. ACCOUNTS PAYABLE ON 31ST OF DECEMBER	34.279	34.470	34.663	34.857	35.053	35.251	35.450	35.651	35.853	36.058	36.263	36.471	36.680	36.891	37.104	37.319	37.535	37.753	37.973	38.195
D. DELIVERIES FINANCED BY SUPPLIERS	2.817	2.833	2.849	2.865	2.881	2.897	2.914	2.930	2.947	2.964	2.981	2.998	3.015	3.032	3.050	3.067	3.085	3.103	3.121	3.139
E. LONG-TERM ACCOUNTS PAYABLE ON 31ST OF DECEMBER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Working capital requirements in €	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
1. Resources needed to finance inventories	2.171	2.195	2.219	2.243	2.268	2.293	2.318	2.344	2.370	2.397	2.424	2.451	2.478	2.506	2.535	2.563	2.592	2.622	2.651	2.682
2. Resources needed to finance the accounts receivable	5.895	5.924	5.954	5.984	6.014	6.044	6.074	6.104	6.135	6.165	6.196	6.227	6.258	6.290	6.321	6.353	6.384	6.416	6.448	6.481
3. Deliveries financed by suppliers	2.817	2.833	2.849	2.865	2.881	2.897	2.914	2.930	2.947	2.964	2.981	2.998	3.015	3.032	3.050	3.067	3.085	3.103	3.121	3.139
A. WORKING CAPITAL SURPLUS (+) OR DEFICIT (-) (3-2-1)	**-5.248**	**-5.286**	**-5.324**	**-5.362**	**-5.400**	**-5.439**	**-5.479**	**-5.518**	**-5.558**	**-5.599**	**-5.639**	**-5.680**	**-5.722**	**-5.764**	**-5.806**	**-5.849**	**-5.892**	**-5.935**	**-5.979**	**-6.023**

Debt financing	Prinicpal in €	Interest rate	Repayment starting year	Number of instalments
Loan 1	3.682.050	2,50%	2022	180
Loan 2	0	5,00%	2016	120
Loan 3	0	5,00%	2016	60
Bridge financing	**Prinicpal in €**	**Interest rate**	**Payment due after**	**Number of instalments**
Bridge financing loan	0			
TOTAL LOANS in €	**3.682.050**			

Trend of loans and payment of principal and interest in €	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
A. TOTAL LOAN BALANCE ON 31ST OF DECEMBER	**3.682.050**	**3.682.050**	**3.682.050**	**3.477.146**	**3.267.060**	**3.051.661**	**2.830.816**	**2.604.385**	**2.372.228**	**2.134.201**	**1.890.154**	**1.639.936**	**1.383.389**	**1.120.356**	**850.670**	**574.165**	**290.667**	**0**	**0**	**0**
Annual Loan 1 payments	0	0	0	204.904	210.086	215.399	220.846	226.431	232.157	238.028	244.047	250.218	256.546	263.034	269.685	276.505	283.498	290.667	0	0
Annual Loan 2 payments	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Loan 3 payments	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bridge financing loan payments	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B. TOTAL ANNUAL LOAN PAYMENTS	**0**	**0**	**0**	**204.904**	**210.086**	**215.399**	**220.846**	**226.431**	**232.157**	**238.028**	**244.047**	**250.218**	**256.546**	**263.034**	**269.685**	**276.505**	**283.498**	**290.667**	**0**	**0**
Annual payments of interests on Loan 1	0	0	0	89.714	84.532	79.220	73.772	68.188	62.461	56.591	50.571	44.400	38.072	31.584	24.933	18.113	11.120	3.951	0	0
Annual payments of interests on Loan 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual payments of interests on Loan 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual payments of interests on bridge financing loan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C. TOTAL ANNUAL PAYMENTS OF INTERESTS ON LOANS	**0**	**0**	**0**	**89.714**	**84.532**	**79.220**	**73.772**	**68.188**	**62.461**	**56.591**	**50.571**	**44.400**	**38.072**	**31.584**	**24.933**	**18.113**	**11.120**	**3.951**	**0**	**0**

Shareholders equity in € on 31st of December	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
1. Owner's equity	1.228.350	1.322.154	1.417.232	1.513.585	1.536.750	1.565.491	1.599.917	1.640.140	1.686.273	1.738.435	1.796.744	1.861.323	1.932.299	2.009.801	2.093.961	2.184.913	2.282.798	2.387.756	2.499.934	2.616.659
2. Retained earnings	93.804	95.078	96.353	23.165	28.741	34.426	40.223	46.133	52.161	58.309	64.580	70.976	77.502	84.159	90.953	97.884	104.958	112.178	116.725	117.992
TOTAL EQUITY (1 to 2)	**1.322.154**	**1.417.232**	**1.513.585**	**1.536.750**	**1.565.491**	**1.599.917**	**1.640.140**	**1.686.273**	**1.738.435**	**1.796.744**	**1.861.323**	**1.932.299**	**2.009.801**	**2.093.961**	**2.184.913**	**2.282.798**	**2.387.756**	**2.499.934**	**2.616.659**	**2.734.651**

Acquisition and consumption of investment subsidies in €	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
1. Subsidies	0																			
2. Subsidized fixed assets on 31st of December	4.850.400	4.607.880	4.365.360	4.122.840	3.880.320	3.637.800	3.395.280	3.152.760	2.910.240	2.667.720	2.425.200	2.182.680	1.940.160	1.697.640	1.455.120	1.212.600	970.080	727.560	485.040	242.520
3. Share of subsidies in subsidized fixed assets	0,0%																			
4. Depreciation cost	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520
5. Other sources of revenues	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LONG-TERM ACCRUED COSTS AND DEFERRED REVENUES ON 31ST OF DECEMBER	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

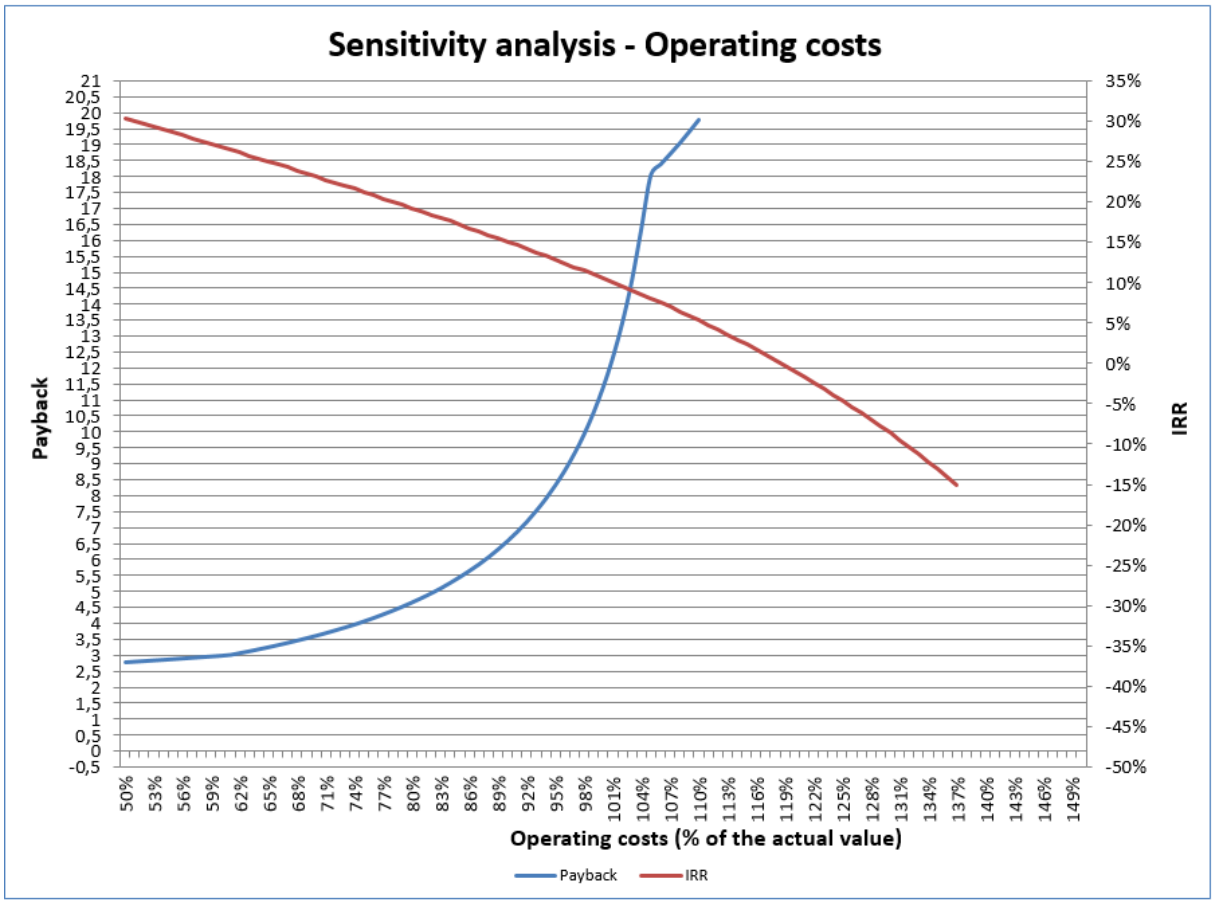
Income statement in €	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
1. Total operating income	872.593	876.956	881.341	885.747	890.176	894.627	899.100	903.596	908.114	912.654	917.218	921.804	926.413	931.045	935.700	940.378	945.080	949.806	954.555	959.328
2. Investment subsidies	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3. Total cost of goods and services	417.056	419.384	421.731	424.096	426.481	428.885	431.309	433.753	436.217	438.701	441.205	443.731	446.277	448.845	451.434	454.044	456.677	459.332	462.009	464.709
a) Total operating costs	369.052	371.378	373.722	376.085	378.467	380.869	383.291	385.732	388.193	390.675	393.177	395.700	398.244	400.810	403.396	406.004	408.635	411.287	413.962	416.659
1. Energy source costs	321.048	322.654	324.267	325.888	327.518	329.155	330.801	332.455	334.117	335.788	337.467	339.154	340.850	342.554	344.267	345.988	347.718	349.457	351.204	352.960
2. Operation and maintainance costs	48.004	48.724	49.455	50.197	50.950	51.714	52.490	53.277	54.076	54.887	55.711	56.546	57.394	58.255	59.129	60.016	60.916	61.830	62.758	63.699
b) Total cost of operating services	48.004	48.006	48.009	48.011	48.014	48.016	48.018	48.021	48.023	48.026	48.028	48.030	48.033	48.035	48.038	48.040	48.042	48.045	48.047	48.050
1. Cost of management, insurance and lease	48.004	48.006	48.009	48.011	48.014	48.016	48.018	48.021	48.023	48.026	48.028	48.030	48.033	48.035	48.038	48.040	48.042	48.045	48.047	48.050
2. Cost of promotional activities	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3. Cost of other services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4. Cost of labour	100.000	100.500	101.003	101.508	102.015	102.525	103.038	103.553	104.071	104.591	105.114	105.640	106.168	106.699	107.232	107.768	108.307	108.849	109.393	109.940
EBITDA	***40,74%***	***40,72%***	***40,69%***	***40,66%***	***40,63%***	***40,60%***	***40,57%***	***40,54%***	***40,50%***	***40,47%***	***40,44%***	***40,40%***	***40,37%***	***40,33%***	***40,29%***	***40,26%***	***40,22%***	***40,18%***	***40,14%***	***40,10%***
5. Depreciation and amortization	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520
1. Intangible assets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2. Property, plant and equipment	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520
2.1. Buildings and constructions	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
2.2. Equipment, plant, vehicles, mechanization	240.020	240.020	240.020	240.020	240.020	240.020	240.020	240.020	240.020	240.020	240.020	240.020	240.020	240.020	240.020	240.020	240.020	240.020	240.020	240.020
EBIT	***12,95%***	***13,06%***	***13,17%***	***13,28%***	***13,39%***	***13,49%***	***13,60%***	***13,70%***	***13,80%***	***13,90%***	***14,00%***	***14,09%***	***14,19%***	***14,28%***	***14,38%***	***14,47%***	***14,56%***	***14,65%***	***14,73%***	***14,82%***
6. Revenues from financial activities	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7. Financial costs	0	0	0	89.714	84.532	79.220	73.772	68.188	62.461	56.591	50.571	44.400	38.072	31.584	24.933	18.113	11.120	3.951	0	0
8. Other revenues and gains	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9. Other expenses and losses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10. INCOME BEFORE TAXES	**113.017**	**114.552**	**116.088**	**27.910**	**34.628**	**41.477**	**48.461**	**55.582**	**62.845**	**70.252**	**77.807**	**85.514**	**93.376**	**101.397**	**109.581**	**117.933**	**126.456**	**135.154**	**140.633**	**142.159**
EBT	***12,95%***	***13,06%***	***13,17%***	***3,15%***	***3,89%***	***4,64%***	***5,39%***	***6,15%***	***6,92%***	***7,70%***	***8,48%***	***9,28%***	***10,08%***	***10,89%***	***11,71%***	***12,54%***	***13,38%***	***14,23%***	***14,73%***	***14,82%***
11. Income taxes	19.213	19.474	19.735	4.745	5.887	7.051	8.238	9.449	10.684	11.943	13.227	14.537	15.874	17.237	18.629	20.049	21.497	22.976	23.908	24.167
12. NET INCOME	**93.804**	**95.078**	**96.353**	**23.165**	**28.741**	**34.426**	**40.223**	**46.133**	**52.161**	**58.309**	**64.580**	**70.976**	**77.502**	**84.159**	**90.953**	**97.884**	**104.958**	**112.178**	**116.725**	**117.992**
13. Number of employees	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

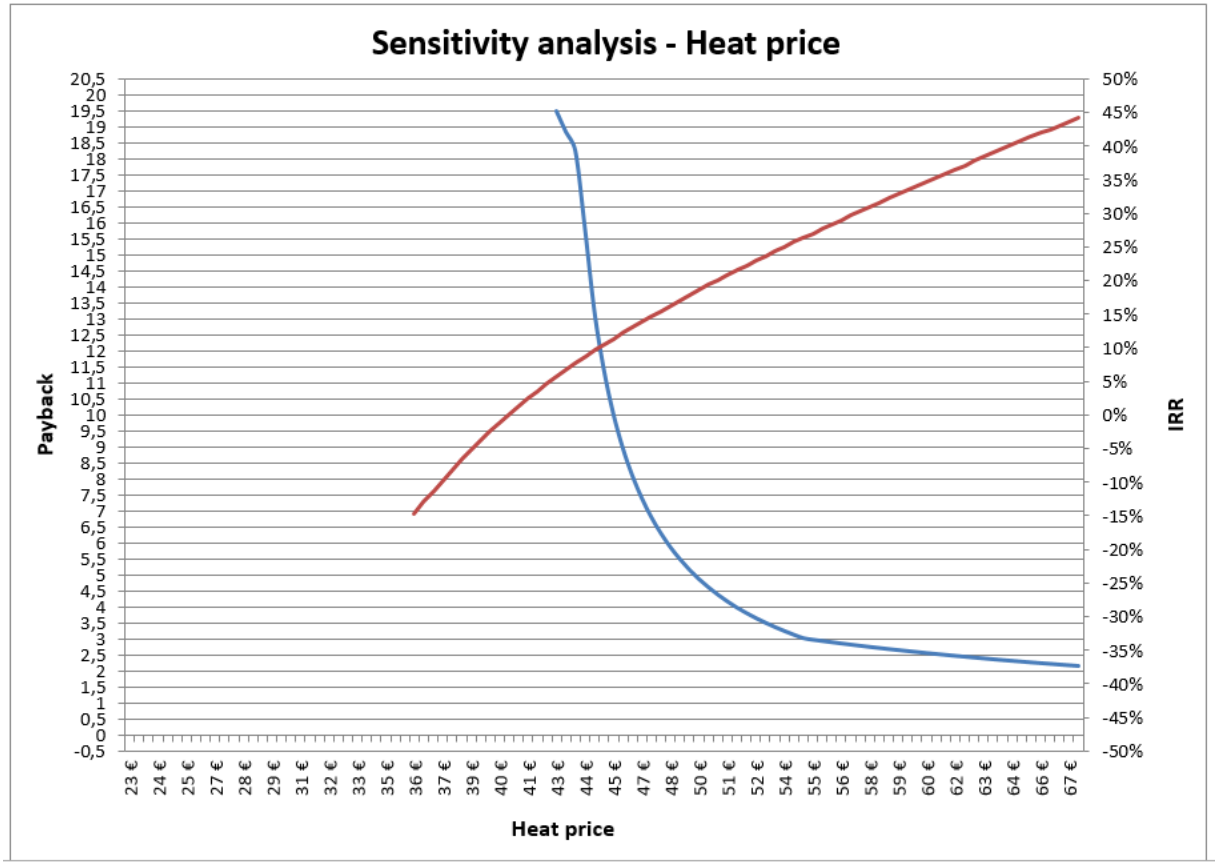
Balance sheet on 31st of December in €	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
A. FIXED ASSETS	**4.667.880**	**4.425.360**	**4.182.840**	**3.940.320**	**3.697.800**	**3.455.280**	**3.212.760**	**2.970.240**	**2.727.720**	**2.485.200**	**2.242.680**	**2.000.160**	**1.757.640**	**1.515.120**	**1.272.600**	**1.030.080**	**787.560**	**545.040**	**302.520**	**60.000**
I. Intangible assets and long-term deferred costs and accrued revenues	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
II. Property, plant and equipment	4.667.880	4.425.360	4.182.840	3.940.320	3.697.800	3.455.280	3.212.760	2.970.240	2.727.720	2.485.200	2.242.680	2.000.160	1.757.640	1.515.120	1.272.600	1.030.080	787.560	545.040	302.520	60.000
1. Buildings and constructions	47.500	45.000	42.500	40.000	37.500	35.000	32.500	30.000	27.500	25.000	22.500	20.000	17.500	15.000	12.500	10.000	7.500	5.000	2.500	0
2. Equipment, plant, vehicles, mechanization	4.620.380	4.380.360	4.140.340	3.900.320	3.660.300	3.420.280	3.180.260	2.940.240	2.700.220	2.460.200	2.220.180	1.980.160	1.740.140	1.500.120	1.260.100	1.020.080	780.060	540.040	300.020	60.000
III. Long-term accounts receivable	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B. CURRENT ASSETS	**370.602**	**708.392**	**1.047.458**	**1.108.433**	**1.169.804**	**1.231.549**	**1.293.646**	**1.356.069**	**1.418.796**	**1.481.802**	**1.545.061**	**1.608.546**	**1.672.231**	**1.736.088**	**1.800.088**	**1.864.201**	**1.928.398**	**1.992.647**	**2.352.113**	**2.712.847**
I. Inventories	13.205	13.350	13.497	13.646	13.797	13.949	14.104	14.261	14.420	14.581	14.744	14.909	15.077	15.246	15.418	15.593	15.769	15.948	16.130	16.314
II. Accounts receivable	71.720	72.079	72.439	72.801	73.165	73.531	73.899	74.268	74.639	75.013	75.388	75.765	76.144	76.524	76.907	77.291	77.678	78.066	78.457	78.849
III. Cash and cash equivalents	285.677	622.963	961.521	1.021.986	1.082.842	1.144.069	1.205.643	1.267.540	1.329.737	1.392.208	1.454.929	1.517.872	1.581.011	1.644.317	1.707.762	1.771.317	1.834.951	1.898.633	2.257.526	2.617.684
TOTAL ASSETS	**5.038.482**	**5.133.752**	**5.230.298**	**5.048.753**	**4.867.604**	**4.686.829**	**4.506.406**	**4.326.309**	**4.146.516**	**3.967.002**	**3.787.741**	**3.608.706**	**3.429.871**	**3.251.208**	**3.072.688**	**2.894.281**	**2.715.958**	**2.537.687**	**2.654.633**	**2.772.847**
A. OWNER'S EQUITY	**1.322.154**	**1.417.232**	**1.513.585**	**1.536.750**	**1.565.491**	**1.599.917**	**1.640.140**	**1.686.273**	**1.738.435**	**1.796.744**	**1.861.323**	**1.932.299**	**2.009.801**	**2.093.961**	**2.184.913**	**2.282.798**	**2.387.756**	**2.499.934**	**2.616.659**	**2.734.651**
B. PROVISIONS AND LONG-TERM ACCRUED COSTS AND DEFERRED REVENUES	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
C. LONG-TERM LIABILITIES	**3.682.050**	**3.682.050**	**3.477.146**	**3.267.060**	**3.051.661**	**2.830.816**	**2.604.385**	**2.372.228**	**2.134.201**	**1.890.154**	**1.639.936**	**1.383.389**	**1.120.356**	**850.670**	**574.165**	**290.667**	**0**	**0**	**0**	**0**
I. Long-term financial liabilities	3.682.050	3.682.050	3.477.146	3.267.060	3.051.661	2.830.816	2.604.385	2.372.228	2.134.201	1.890.154	1.639.936	1.383.389	1.120.356	850.670	574.165	290.667	0	0	0	0
II. Long-term accounts payable	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D. CURRENT LIABILITIES	**34.279**	**34.470**	**239.567**	**244.943**	**250.452**	**256.097**	**261.881**	**267.808**	**273.881**	**280.104**	**286.482**	**293.017**	**299.714**	**306.577**	**313.610**	**320.817**	**328.202**	**37.753**	**37.973**	**38.195**
I. Short-term financial liabilities	0	0	204.904	210.086	215.399	220.846	226.431	232.157	238.028	244.047	250.218	256.546	263.034	269.685	276.505	283.498	290.667	0	0	0
II. Accounts payable	34.279	34.470	34.663	34.857	35.053	35.251	35.450	35.651	35.853	36.058	36.263	36.471	36.680	36.891	37.104	37.319	37.535	37.753	37.973	38.195
TOTAL LIABILITIES AND OWNER'S EQUITY	**5.038.482**	**5.133.752**	**5.230.298**	**5.048.753**	**4.867.604**	**4.686.829**	**4.506.406**	**4.326.309**	**4.146.516**	**3.967.002**	**3.787.741**	**3.608.706**	**3.429.871**	**3.251.208**	**3.072.688**	**2.894.281**	**2.715.958**	**2.537.687**	**2.654.633**	**2.772.847**

Cash-flow statement in €	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
A. CASH FLOW FROM OPERATING ACTIVITIES																				
1. Income before taxes	113.017	114.552	116.088	27.910	34.628	41.477	48.461	55.582	62.845	70.252	77.807	85.514	93.376	101.397	109.581	117.933	126.456	135.154	140.633	142.159
2. Depreciation and amortization	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520	242.520
3. Income taxes	-19.213	-19.474	-19.735	-4.745	-5.887	-7.051	-8.238	-9.449	-10.684	-11.943	-13.227	-14.537	-15.874	-17.237	-18.629	-20.049	-21.497	-22.976	-23.908	-24.167
4. Decrease (- increase) in accounts receivable	-71.720	-359	-360	-362	-364	-366	-368	-369	-371	-373	-375	-377	-379	-381	-383	-385	-388	-388	-390	-392
5. Decrease (- increase) in inventories	-13.205	-145	-147	-149	-151	-153	-155	-157	-159	-161	-163	-165	-167	-170	-172	-174	-177	-179	-181	-184
6. Increase (- decrease) in accounts payable	34.279	191	193	194	196	198	199	201	203	204	206	208	209	211	213	215	216	218	220	222
7. Financial costs	0	0	0	89.714	84.532	79.220	73.772	68.188	62.461	56.591	50.571	44.400	38.072	31.584	24.933	18.113	11.120	3.951	0	0
8. Income related to long-term accrued costs and deferred revenues (subsidies)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net cash flow from operating activities	**285.677**	**337.286**	**338.558**	**355.083**	**355.475**	**355.845**	**356.192**	**356.516**	**356.815**	**357.090**	**357.339**	**357.561**	**357.757**	**357.924**	**358.063**	**358.173**	**358.252**	**358.300**	**358.894**	**360.158**
B. CASH FLOW FROM INVESTING ACTIVITIES																				
1. Receipts (+) and disbursements (-) in intangible assets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2. Receipts (+) and disbursements (-) in property, plant and equipment	-4.910.400	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net cash flow from investing activities	**-4.910.400**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
C. CASH FLOW FROM FINANCING ACTIVITIES																				
1. Receipts from capital pay-in (+) and dividends paid (-)	1.228.350	0	0	0	0	0	0	0	0	0	0	-0	0	0	0	0	0	0	0	0
2. Receipts (+) and disbursements (-) in financial liabilities and accrued costs and deferred revenues	3.682.050	0	0	-294.618	-294.618	-294.618	-294.618	-294.618	-294.618	-294.618	-294.618	-294.618	-294.618	-294.618	-294.618	-294.618	-294.618	-294.618	0	0
Net cash flow from financing activities	**4.910.400**	**0**	**0**	**-294.618**	**-294.618**	**-294.618**	**-294.618**	**-294.618**	**-294.618**	**-294.618**	**-294.618**	**-294.618**	**-294.618**	**-294.618**	**-294.618**	**-294.618**	**-294.618**	**-294.618**	**0**	**0**
D. NET BALANCE IN CASH AND CASH EQUIVALENTS																				
1. Net cash flow	285.677	337.286	338.558	60.464	60.857	61.227	61.574	61.897	62.197	62.471	62.720	62.943	63.139	63.306	63.445	63.555	63.634	63.682	358.894	360.158
2. Cash and cash equivalents, beginning of year	0	285.677	622.963	961.521	1.021.986	1.082.842	1.144.069	1.205.643	1.267.540	1.329.737	1.392.208	1.454.929	1.517.872	1.581.011	1.644.317	1.707.762	1.771.317	1.834.951	1.898.633	2.257.526
3. Cash and cash equivalents, end of year	**285.677**	**622.963**	**961.521**	**1.021.986**	**1.082.842**	**1.144.069**	**1.205.643**	**1.267.540**	**1.329.737**	**1.392.208**	**1.454.929**	**1.517.872**	**1.581.011**	**1.644.317**	**1.707.762**	**1.771.317**	**1.834.951**	**1.898.633**	**2.257.526**	**2.617.684**

Profitability	Cash flow
Initial capital investment (discounted for received subsidies)	4.910.400,00
Private equity invested	1.228.350,00
Equity net present value (NPV)	**478.127,07**
Equity internal rate of return (IRR)	**10,50%**

CASH FLOW in €		Discount rate: 5,00%
Year	**Cash flow**	**Discounted Cash flow**
C0	-1.228.350	-1.228.350
CF1	285.677	272.073
CF2	337.286	305.928
CF3	338.558	292.459
CF4	60.464	49.744
CF5	60.857	47.683
CF6	61.227	45.688
CF7	61.574	43.759
CF8	61.897	41.895
CF9	62.197	40.093
CF10	62.471	38.352
CF11	62.720	36.671
CF12	62.943	35.049
CF13	63.139	33.484
CF14	63.306	31.974
CF15	63.445	30.518
CF16	63.555	29.115
CF17	63.634	27.763
CF18	63.682	26.461
CF19	358.894	142.026
CF20	360.158	135.740
TOTAL	**1.389.334**	**Payback: 11,4 years**


Sensitivity analysis - Operating costs
Payback
IRR
Operating costs (% of the actual value)
Payback
IRR


Sensitivity analysis - Heat price
Payback
IRR
Heat price

Projected investment cost in €	Amount	Share %
A. PROPERTY, PLANT AND EQUIPMENT	4.860.400	99,0%
B. PROJECT AND INVESTMENT DOCUMENTATION	50.000	1,0%
C. INTANGIBLE ASSETS	0	0,0%
D. INVESTMENT COST (A+B+C)	4.910.400	100,0%
E. INITIAL WORKING CAPITAL	0	0,0%
F. TOTAL INVESTMENT COST (D+E)	4.910.400	100,0%

Sources of investment cost financing in €	Amount	Share %
A. PRIVATE EQUITY	1.228.350	25,0%
B. BANK LOANS	3.682.050	75,0%
C. CONNECTION FEES	0	0,0%
D. INVESTMENT SUBSIDIES	0	0,0%
E. TOTAL FINANCING (A+B+C+D)	4.910.400	100,0%

Project performance in €	2019	2020	2021	2022	2023
1. Total income	872.593	876.956	881.341	885.747	890.176
2. Total costs of goods and services	417.056	419.384	421.731	424.096	426.481
3. Cost of labour	100.000	100.500	101.003	101.508	102.015
4. Depreciation and amortization	242.520	242.520	242.520	242.520	242.520
5. Financial costs	0	0	0	89.714	84.532
6. Other costs	0	0	0	0	0
7. EBT	113.017	114.552	116.088	27.910	34.628
Balance sum	5.038.482	5.133.752	5.230.298	5.048.753	4.867.604
Cash Flow	285.677	337.286	338.558	60.464	60.857
Cost of MWh heat sold	45	46	46	50	50
Cost of MWh energy sold (heat + electricity)	42	42	43	47	47

Private equity invested	1.228.350 €
Net present value (NPV)	478.127 €
Equity internal rate of return (IRR)	10,50%
Payback (discount rate: 5%)	11,4 years