

1.1.7 Geothermal district heating network and station - Zlatograd (BG)

Zlatograd is a municipality of Rhodope Mountains region of Bulgaria located at 385 -1.118 m above the sea level, *with* surrounding mountain relief. Climate conditions are mountainous but due to the influence from the Mediterranean climate the winter is mild and the summer is not very hot. Zlatograd municipality has 12.321 inhabitants. A major asset for the municipality is the abundance of geothermal springs on its territory which is favourable for spa tourism especially combined with beautiful mountains and natural parks around. Geothermal is also a valuable renewable energy heating source.

Zlatograd has developed the technical and environmental part of a project for **geothermal utilisation for district heating** and has started with the drilling and welling works. The project needs financing for the major part of its construction - pipe-line and heating station construction. In the framework of Green-Twinning project, SEC has assisted Zlatograd in the **assessment of the economic feasibility of the construction of the District Heating (DH) station and network**. The aim is to achieve energy and cost savings by replacement of heavy fuel oil and electricity heated municipal buildings with space geothermal heating while, increasing comfort for the citizens and reduction of GHG emissions. This sustainable energy action is considered an important part of the municipal RE/EE policy and is expected to significantly contribute to the CoM obligations as well as to the local socio-economic development.

There is no DH network in Zlatograd and all buildings are heated individually. The **8 municipal buildings** planned to be supplied by geothermal DH are currently heated by heavy fuel oil and due to its high prices comfort is low and additional electricity based heating is needed. At present the consumption of the 8 municipal buildings is about 207 tonnes of heavy fuel oil and about 540 MWh electricity per annum. As the already done drilling and welling works have proven that the capacity of the geothermal spring is almost 5 MW while the current municipal buildings have 1/3 of this capacity, it is envisaged to connect and supply additionally more municipal buildings situated conveniently as well as private buildings - spa-hotels currently being heated by heavy fuel oil. As the investment costs of the geothermal DH network are quite high the inclusion of more consumers will improve the economic feasibility of the project as well as its technical and environmental results.

The current heavy fuel oil price is around 650 €/t (VAT excluded), electricity price is 0,08 €/kWh in average. Taking into account these parameters, the **baseline expenses amount to 214.000 €/year and the CO₂ emissions**, as per emission factors approved by Bulgarian Ministry of Environment and Water, **amount to 1.571 tCO₂/year**.

Technical aspects

The geothermal source is located in the region of village Erma reka (at about 13 km from the town of Zlatograd) where a big underground Artesian lake has been discovered with hot water

of 90°C. The main aim of the project is to tap this geothermal potential and supply it to the town.

The project has four main components. The first one has been already implemented - it is geological investigations and drilling/ welling works that have proven 4.950 kW capacity of the geothermal source - much more than previously expected and needed by the 8 municipal buildings. The second, third and fourth components comprise of:

- Component 2: construction of heat supply main pipe-line from the geothermal source to the DH station. The piping will be pre-insulated made of epoxy resin reinforced with glass fiber. The overall length of the main pipe-line is 13 500 meters. Along the pipe-line there will be shaft with monitoring and measuring equipment.
- Component 3: building the geothermal heating station with monitoring and control equipment for water temperature and pressure control over the network.
- Component 4: building the heat distribution network and substations. The distribution network will be done with pre-insulated steel pipes, construction of seven substations, as well as construction of two bridges (18 meters and 32 meters) for crossing the river Varbitsa within the town of Zlatograd.

The mineral water from the source is very hot - at temperature of 90°C and due to the high insulation of the piping it will be supplied at DH station at temperature of 80°C thus ensuring effective space heating.

Additionally to the current 8 municipal buildings, It is planned to include other suitable municipal buildings as well as private buildings (spa hotels) currently being heated by heavy fuel oil.

Environmental aspects

The action will contribute significantly to the municipal targets for environmental performance.

GHG emission reductions envisaged by the project amount to 743,42 tonnes/annum.

The main part of these reductions is due to replacement of heavy fuel oil with geothermal heat and a smaller portion comes from replacement of electricity for heating with geothermal heat.

Financial aspects

The foreseen method of financing of Components 2, 3 and 4 is own financing combined with grant funds from donors allocating money for environmentally favorable projects such as National Trust Eco Fund. It should be mentioned that **due to the lack of financial appraisal the project has been twice rejected for funding** and the **opportunity to assist Zlatograd municipality within the Green Twinning project was very much welcomed by the municipal authorities** as a way to overcome this barrier (hopefully the last one) to project implementation.

The economic appraisal shows however that the action has **poor profitability with a discounted NVP of (-757 000 Euro) over the project life-time** mainly due to the high costs of digging and construction of the main pipe-line. Even taking into account the numerous social and environmental benefits of the project it is doubtful that there will be fund providers at these financial parameters. In order to improve the profitability of the action SEC has advised Zlatograd municipal authorities to enlarge the clients of the DH network with more municipal buildings suitably situated within the town as well as private hotels and possibly households. As the major costs of the project (about 7.500.000 Euro or about 80 % of required investment) are related to the main pipe-line construction, the more clients are connected to the network the bigger will be the effects (economic and environmental) of the action within the technical limit of 5 MW capacity of the geothermal source.

The major risk associated with the project results is the ability to attract clients mainly from the private sector (hotels and/or housing) and the standard of living/solvency of the private clients, i.e. citizens.

Socio-economic aspects

The project considers significant socio-economic revenues related to the reduction of costs of thermal energy due to the utilization of free local geothermal resource with very high temperature and located in the vicinity of the DH station. Furthermore heavy fuel oil is currently the most expensive energy source and is imported to Bulgaria; its substitution with free local waste resource will have positive economic impact over heat energy prices. Important socio-economic benefits are also the increased energy independence, the improved comfort in the heated buildings, the local socio-economic development and the GHG emissions reduction.

Table 7 below summarises the results of the technical, financial, socio-economic and organizational analysis of the action entitled “Geothermal DH network and station in Zlatograd”.

Table 6 Summary of the findings of the assessment study of the action “Geothermal DH network and station in Zlatograd”

Technical/ Environmental Assessment	Title	Geothermal DH network and station in Zlatograd
	Baseline scenario data (kWh, tCO₂, €)	<ul style="list-style-type: none"> • 207 t/year of heavy fuel oil • 538 MWh/year electricity • 1.571 tCO₂ • 213.530 €
	Technology employed	DH network, station and substations for municipal buildings utilizing the heat form geothermal source at 90° C
	Technology providers	Various
	Technical specifications	<ul style="list-style-type: none"> • Main pipeline of 13.500 meters with pre-insulated epoxy resin pipes; • DH station with control and monitoring equipment

		<ul style="list-style-type: none"> Heat distribution network and substations to 8 municipal buildings
	RE produced	11.880 MWh/year
	CO ₂ savings	743 tCO ₂
Financial assessment	Financing scheme	Own plus grant funding
	Project cost	9.647.000 €
	Annual maintenance costs	50.800 €
	Annual project revenues	587.310 €
	Discount rate	4 %
	NPV (€)	- 757 256 €
	Payback period (years)	51 years
Organisational assessment	Time-schedule	Start 1/6/2014