The first full scale low-enthalpygeothermal plant in Pynyce, Poland

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Abstract

Conversion of coal fired boiler plants for the town of Pyrzyce, Poland to low-enthalpi geothermal energy and natural gas for district heating by using absorption heat pumps. Building a new low temperature district heating system and conversion of existing 68 coal fired boiler plants in close co-operation with local consultants and the local municipality.
The experience of obtaining the necessary financing from local national and international sources.

1. Introduction

Houe & Olsen were exclusively engaged by Pyrzyce Municipality and District Municipal Utilities and Housing Company (DMUHC) for designing the geothermal project and working out a model for financing the Geothermal District heating plant in Pyrzyce. Pyrzyce District Municipal Utilities and Housing company were seeking a 16.3 million US Dollar financing for a new geothermal district heating plant. The following is a summary of the technical feasibility study, financing plan and closer description of Pyrzyce geothermal plant.

In Pyrzyce we started early in 1991 to discuss the possibilities for establishing a new district heating plant based on straw, wood, peat or other sources.

During the meetings we recognised the possibilities of using geothermal energy and the mayor of the town Mr. Jan Lemparty decided to build the first geothermal plant in Poland with the latest technology.

To get started Houe & Olsen in co-operation with Pyrzyce applied for a grant from the Danish Government. This grant of 42.000 USD was given with the purpose of investigating the technical possibilities of a geothermal district heating plant in Pyrzyce and other towns in the Szczecin area.

Due to preliminary information about the possible geothermal reservoir we found similarity to the Danish geothermal plant in Thisted, i.g. sandstone reservoir, high salinity and low-enthalpi. In the Thisted Plant the Danish Oil and National Gas Company in co-operation with Houe & Olsen have constructed a geothermal plant with an absorption heat pump from *SANYO*. The Thisted Plant has been operating since 1984 as a pilot plant and from 1988 as a demonstration plant (with absorption heat pump). The technology is well proven and the Thisted Plant has been operating without any problems.

The technology with the use of absorption heat pumps has been transferred to Neubrandenburg, former DDR, where Houe & Olsen have been responsible for the reconstruction of the existing geothermal plant.
The solution with absorption heat pumps was chosen for the Pyrzyce project as well.

Parallel to the technical study it was important to investigate the possibilities of creating an organisation structure which could lead to implementation of a geothermal project if the technical prestudy showed feasibility.

2. Description of Pynyce

The Commune of Pyrzyce is situated in the south-east region of the Szczecin province in the centre of the most fertile soils in Pomerania. The total area of town and commune is **205 km2**. The town of Pyrzyce is localised in the centre of the commune, close to Szczecin. The town and commune temtory is inhabited by **19810** people. **12903** in the town of Pyrzyce and **6907** in the villages.

45% of the total population are professionally active, i.e. in numbers approximately **5800** people in the town itself and **3100** in the commune. The number of unemployed is approximately **850** people, equalling **10%.**

The Pyrzyce region is often called a granary of the Szczecin Province. It is famous for its fertile soils and highly developed agriculture. Orchards are particularly important for the agriculture.

The town and the commune of Pyrzyce is in the medium protection zone **A**, because of their neighbourhood to Miedwie Lake. This lake is a reservoir of drinking water for the town of Szczecin.
In order to protect the environment a new sewage treatment plant operated by DMUHC was built.

3. Alternatives

Due to environmental and economical aspects it was decided to establish a new District Heating plant in Pyrzyce. The main reason was to convert **68** coal fired boiler plants to environmentally sound energy systems. Furthermore the purpose was to establish an energy system based on the tremendous potential of local energy sources from geothermal water.

The purpose of the project was to establish an energy system compatible to the existing prices and with the lowest sensitivity to changes in the price level for energy.

In the feasibility study **3** alternatives were included.:

1. Converting existing boilers to natural gas
2. Building a new natural gas based district heating plant
3. Building a new district heating plant based on natural gas and geothermal energy

The alternatives show the following energy prices.:

1.	Heat cost USD/GJ	**8.66**
2.	Heat cost USD/GJ	**8.61**
3.	Heat cost USD/GJ	**7.39**

As it appears alternative **3** was the cheapest to operate, on the other hand, it requires the largest investment costs.

The investment costs are as follows.:

1.	**1,4** Mln USD
2.	7,9 Mln USD
3.	**16,3** Mln USD

The consumer heat prices are not higher than the existing prices today, and the investment cost in geothermal energy shows a simple time of repayment over less than **8** years with an interest of **12%.**

For the town of Pyrzyce a district heating system based on geothermal heat and natural gas is very feasible and has a very strong insensitiveness to changes of the basic data

4. Sensitiveness

Under the present condition the basic data could be changed **as** follows.:

-The heat demand may fall to less than **70%** before alt. **3** is more expensive than other alternatives

-The natural gas price may fall 50 % before alt. 3 is more expensive than other alternatives.

-The electricity price must increase more than 250% before alt. 3 is more expensive.

-The total project price for alt. 3. can change 10 % and this results in an increase in heat price of 5 Yo only.

-The interest rate may go up to about 20% before alt. 3 is as expensive as alternative 1.

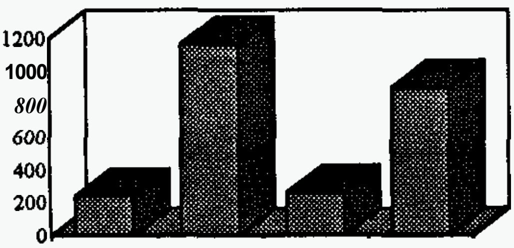
-The period of amortisation must be less than 8 years before alt. 3 is more expensive than alt. 1.

5. Environmental aspects.

The present heating system for the town of Pynyce is decentralised, coal fired boiler plants. The heat is distributed from the coal fired boiler plants as internal district heating. At present there are 68 coal fired boiler plants.

Current emissions for the coal plant are as follows.:

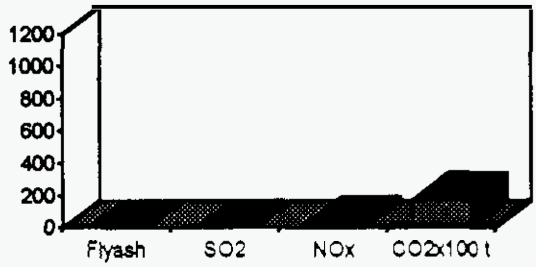
Emissions t/yr



In order to stop erosion of the environment and to restore the atmosphere it is planned to build a new heat plant using geothermal energy

The emission figures estimated for the geothermal/natural gas plant are:

Emissions t/yr



The district heating system and the adherent geothermal plant give the following advantages compared to the traditional technology:

-Consumption of fossil fuel is reduced to less than 50%
-The pollution is reduced to a minimum, no particles, no SO, emission, very low NOx-emission, very low CO_2 emission.

6. The organisation/consumers

Pyrzyce District Municipal Utilities and Housing Company is the operator. The company is well functioning and operates in the municipality supplying heat, electricity, and water. The staff is professional and the company has a net capital of 4.2. mill. USD
The consumers connected to the existing coal fired plants will all be connected to the geothermal heating plant.

7. The financing plan.

We were investigating different alternatives where the plant was operated by a limited company.

During the period we recognised the problems in connection with introducing new District Heating Plants based on geothermal energy. Geothermal energy is still a new energy source practically unknown to international finance. The interest from EBRD and the credit schemes from WBK in Poland were available and ready to go for it, but the heavy administration and the overwhelming requirement of data are not acceptable to any western country.

Having spent a long time and considerable efforts we decided to be alternative and seek the financing locally and from international grants.

The financing was completed as follows:

Financing	Amount in DKK
Own Resources	257.200
Phare II	14.285.000
Szczecin Fund	4.457.000
Deutsch-Polische Stiftung	15.714.000
University	1.285.700
Polish Gas Company	3.428.600
National Fund for Environmental Protection	42.290.000
Danish Environmental Fund	3.000.000
Ecofund	5.714.000
Total	90.431.500

8. Geothermal Plant.

.1 Geothermal reservoir.

The geothermal plant is supplied with two doublets, i.g. two production wells and two injection wells.

The geothermal reservoir is a Jurassic sandstone reservoir with good conditions for low enthalpy utilisation.

- Reservoir depth	1450-1650 m
- Net reservoir thickness	60 m
- Temperature (average)	65°C
- Porosity (average)	25%
- Transmissivity	360 Dm
- Static pressure (below surface)	-34 m
- salinity	121 g/l
- Density	1062 kg/m^3
- pH	-6,5

The production from each doublet is 175 m^3/h. The production well is supplied with submersible pumps (high voltage motors).

.2 District Heating Plant.

The district heating plant is constructed to meet the heat demand for the town with max. 48 MW at an outdoor temperature of -16°C.

The plant has the following equipment (see figure 1):

-heat exchanger, direct exchange	7,2 MW
-heat exchanger for absorption heat pumps	7,6 MW
-absorption heat pumps (2 pcs)	19,0 MW
-high temperature boilers (2 pcs)	16 MW
-condenser fluegas coolers	1,8 MW
-low temp. boilers (2 pcs)	20,0 MW
-condensing fluegas coolers (2 pcs)	2,2 MW

The boilers are supplied with natural gas burners (low NOx emission) and with condensing fluegas coolers in order to obtain high efficiency (–100%).

The yearly heat demand is 182.900 MWh/year (–658 T/year).
The heat demand is covered by (see figure 2)

Geothermal heat	–1 10.000 MWh/yr,	60%
Natural gas	–72.000 MWh/yr,	40%

.3 District Heating Network.

The district heating network is the preinsulated type with an alarm system for leak detection.

.4 Conversion of existing boiler plants.

The existing coal fired boiler plants are converted to district heating via heat exchanger units fully equipped with modem electronic automatics and electronic heat meters.

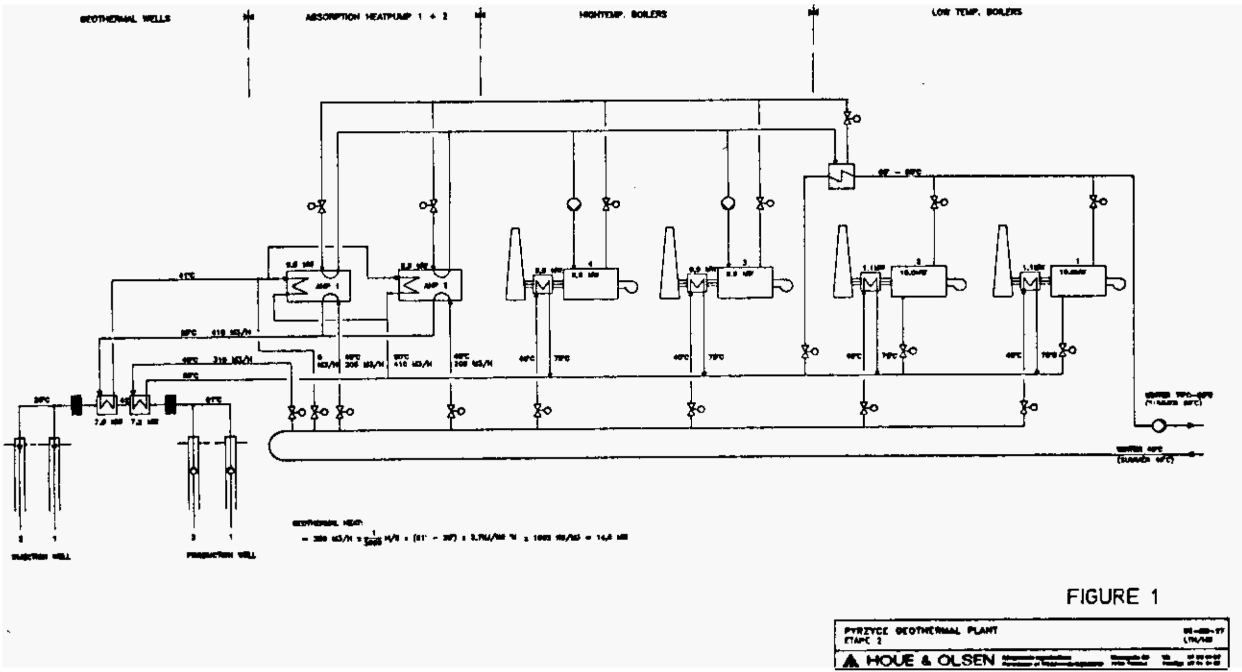
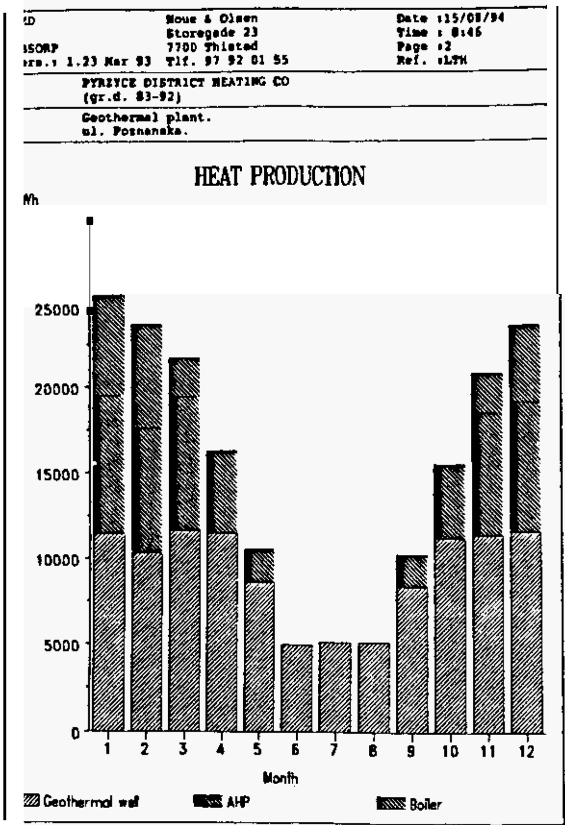


FIGURE 1

FIGURE 2



9. Conclusions

From the initial idea to final reality, there is a long way. To introduce a new energy source such as geothermal energy in Eastern Europe it takes a lot more than good ideas.
We succeeded in Pyrzyce, and are now continuing in Podhale (Poland), Lithuania, and Slovakia but there is no doubt, that geothermal energy will be a success in future. We recommend the following essential rules for a successful application of geothermal energy:

1. Establish a good organization with proper consulting support.

2. Choose a key-person to handle the project from the start to the end phase.

3. Collect all information carefully and set up the possible solutions.

4. Select the best solution for the specific project Each geothermal project is unique

5. Investigate the operational risks and make the design safe and robust to withstand changes.

6. All legal and institutional considerations should be resolved before the realization of the project is started.

7. Because of high investment costs and low running costs the financial package must be carefully combined,