Zakopane Municipality

Expansion and development of Geothermal Energy, Zakopane, Poland

Project Design Document

Version 3.1
Prepared by AAEN A/S
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ANNEXES

A General description of project activity

A.1 Title of the project activity

Expansion and development of Geothermal Energy, Zakopane, Poland

A.2 Description of project activity

Zakopane in the very south of Poland is a town with 30.000 inhabitants and one of the most frequented tourist areas receiving around 3 million visitors annually. It is known as the winter Capital of Poland and is depending in many ways on the many tourists visiting the Zakopane area every year.
The Podhale Region on the foot of the mountains in the Tatry National Park is on of the most beautiful and precious natural resort areas in all Poland and is well preserved wildlife and tourist resorts.
During the last decade the municipality of Zakopane has made a great effort to maintain and preserve the nature and wildlife in the region. The City of Zakopane insists on preserving a clean environment in spite of a fast development in tourism and production.
The resent years heavy activities and investments in Waste Management, Drinking Water Management and Waste Water Management has been made with support from national and international funds.
As the Zakopane area is one of Poland's most frequented tourist areas and the need for clean fuel for district heating, proper handling of waste, wastewater and wastewater sludge is of major priority. The previous investments have been in establishment of sewage network and renovation of the wastewater treatment plant.
This project aims to assist in the expansion and development of the geothermal energy sources available in the area by establishing new boreholes for increasing the capacity of the geothermal energy production, optimization and expanding the distribution net for increasing the amount of connections.

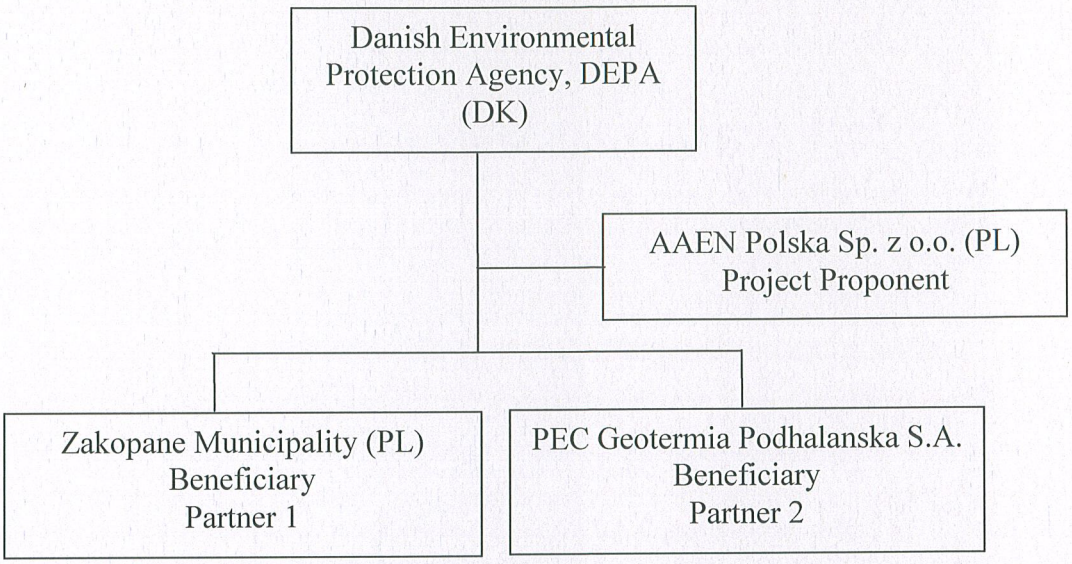
The Project activities described in this PDD will be performed in two phases.

Phase 1 concerns the development of the geothermal district heating in Zakopane, including expansion and optimization of the distribution network and new consumer connections. Details and calculation of emission reductions from phase 1 are included in this PDD.

Phase 2 concerns the expansion of geothermal energy to the City of Nowy Tag. This part is described as an agreed overall approach. Calculation of emission reductions from phase 2 is not included in this PDD.

A.3 Project participants

A consortium has been established for this project based on previous successful corporation between the partners in the field of environmental protection projects in Zakopane and surrounding areas. Furthermore, AAEN Consulting Engineers A/S has participated in two projects concerning Waste Management and Recycling and Modernization of the Drinking Water system during the past five years in Zakopane area. The overall organization of the project will be as shown in the figure below. In Annex 1 is data for each of the partners listed below.



The partner's main tasks and responsibilities in the project are described below:

Zakopane Municipality

- Beneficiary – Responsible for energy plans and share holder in Geotermia Podhalanska
- Review for planes
- Participation in Project Meetings
- Administration and funding
- Public information

PEC Geotermia Podhalanska S.A.

- Responsible for geothermal energy production and distribution
- Provide needed process information
- Application for building permission
- Establish all needed installations
- Maintenance and operation of the established plant

AAEN Polska Sp. z o.o.

- Project Proponent
- Technical assistance in the project
- Funds administration
- Project management meetings
- Project progress and minutes of meetings
- Assistance in tendering and contracting
- Technical assistance supervision during construction works

A.4 Technical description of the project activity

A.4.1 Location of the project activity

A.4.1.1 Host Country

The Host Country is Poland.

A.4.1.2 Region

The region in Poland of the project areas is: Podhale Region consisting of 5 municipalities including the municipality of Zakopane. Podhale Region has a total amount of inhabitants of approximately 70.000. The project includes the City of Zakopane with approximately 30.000 inhabitants. Furthermore the future development of the project is expected to include the City of Nowy Targ with approximately 50.000 inhabitants and Szaflary with approximately 5.000 inhabitants.

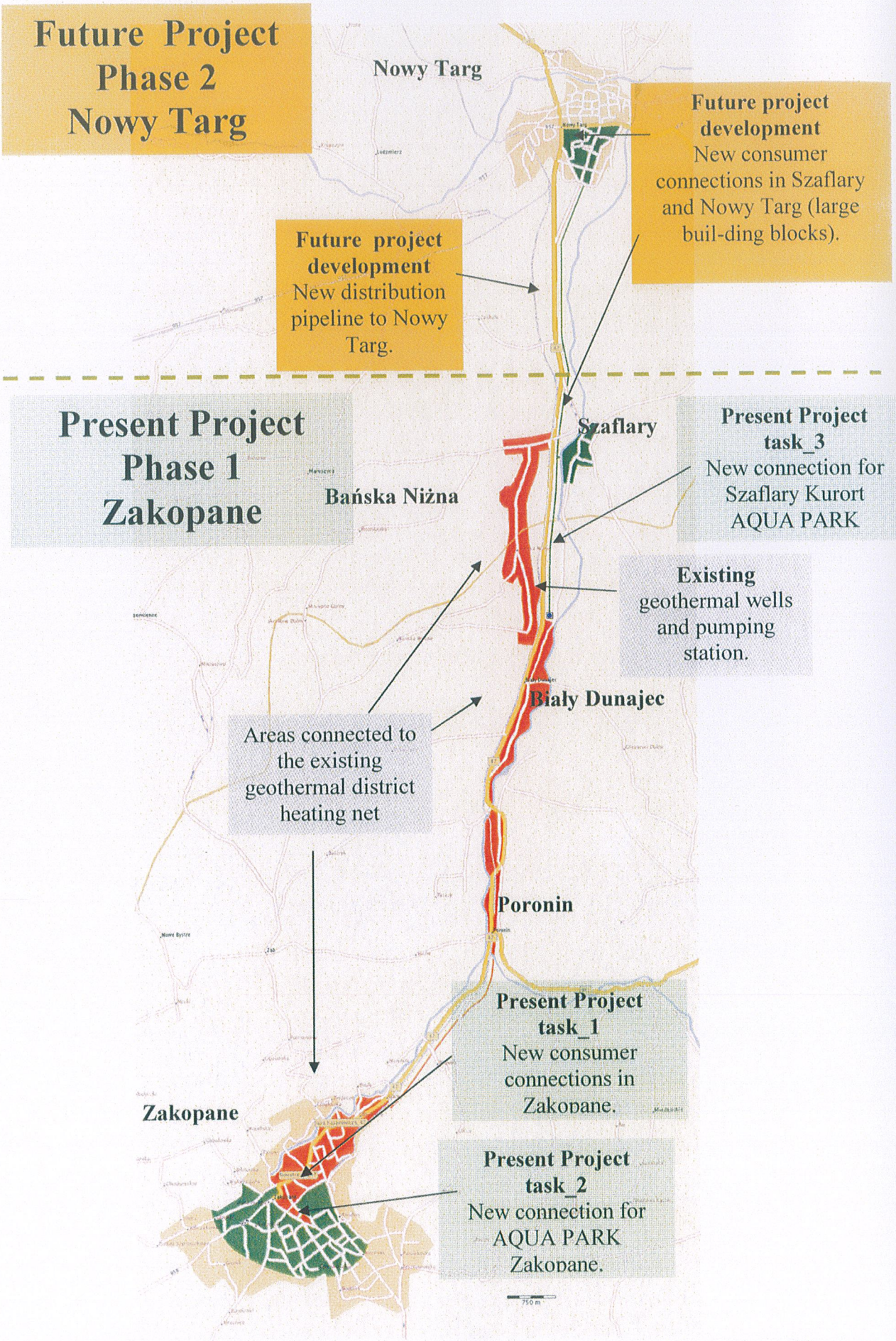
A.4.1.3 City

The specific city in Podhale Region is: Zakopane with approximately 30.000 inhabitants.

A.4.1.4 Details of location

Below is shown the location of Zakopane.

The involved cities nearby Zakopane within the project area are shown on the next page.

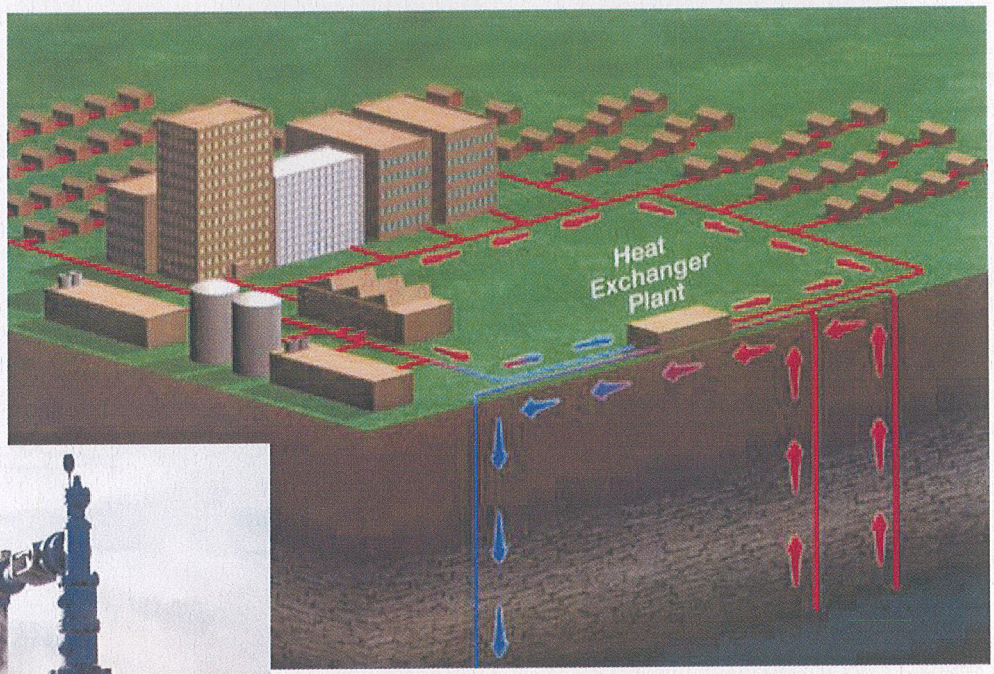

Future Project
Phase 2
Nowy Targ
Nowy Targ
Future project development
New consumer connections in Szaflary and Nowy Targ (large buil-ding blocks).
Future project development
New distribution pipeline to Nowy Targ.
Present Project
Phase 1
Zakopane
Bańska Niżna
Szaflary
Present Project task_3
New connection for Szaflary Kurort AQUA PARK
Existing
geothermal wells and pumping station.
Biały Dunajec
Areas connected to the existing geothermal district heating net
Poronin
Present Project task_1
New consumer connections in Zakopane.
Zakopane
Present Project task_2
New connection for AQUA PARK Zakopane.

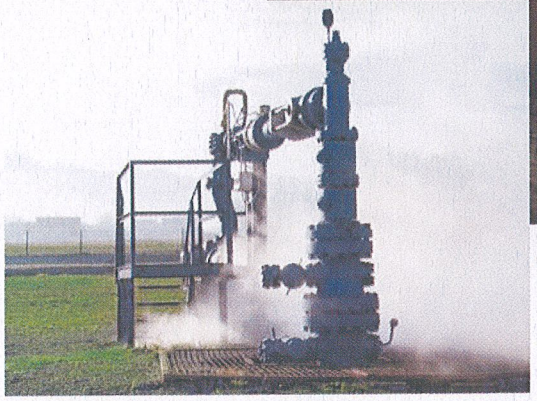
A.4.1.5 The history of the existing geothermal district heating system

Geothermal energy is the internal heat of the Earth accumulated in the rocks and water filling the rock pores and cracks. Geothermal energy can be classified as renewable because its source – the hot Earth interior – is practically inexhaustible.

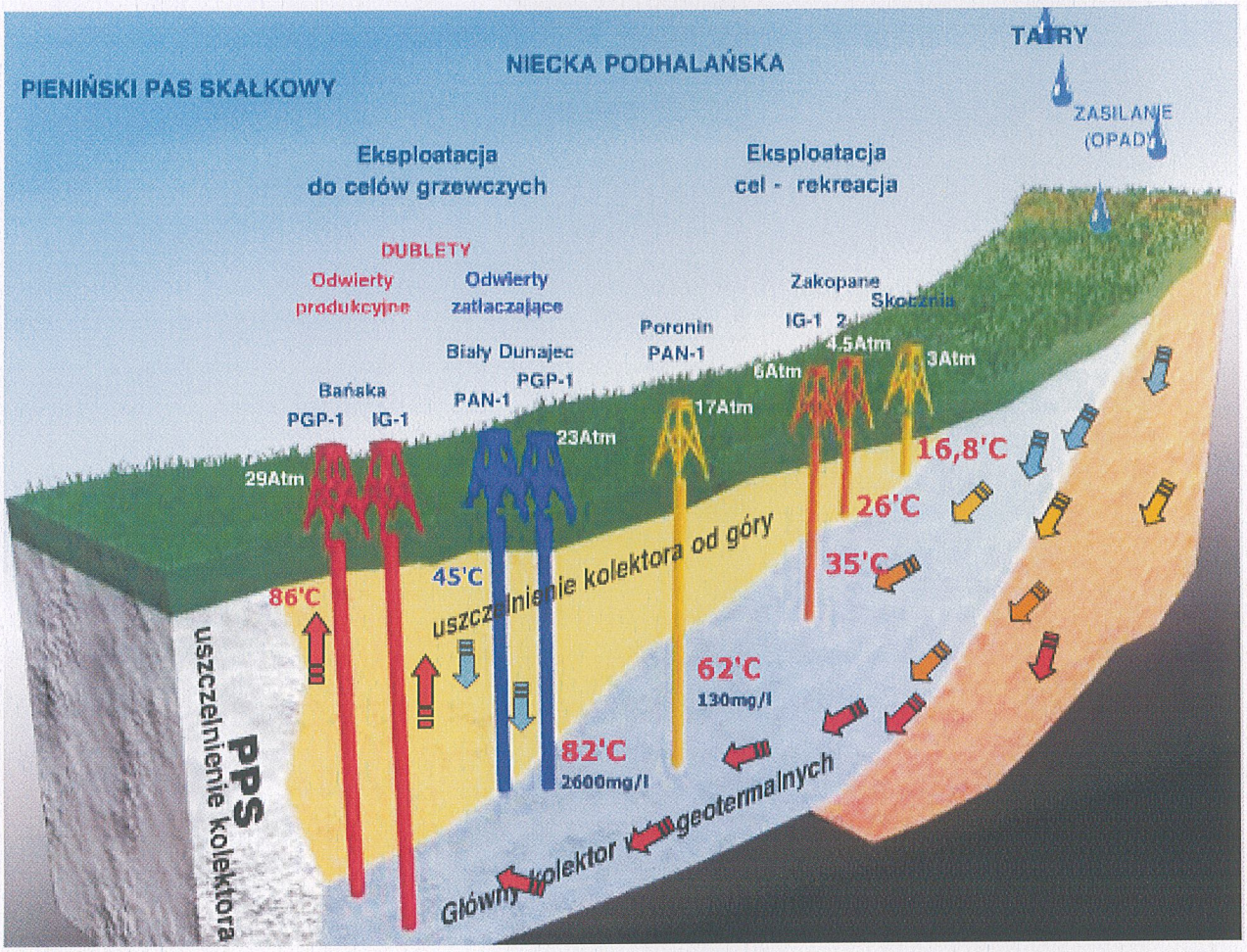
It is a regularity of our planet's structure, especially of its lithosphere, that the temperature grows together with going into the Earth's interior. If there is water in the great depths, its temperature comes to a few dozen or even above 100°C.

In general the existing geothermal energy plant consists of boreholes where hot water from the underground by own pressure is lead into a heat exchanger plant and then back into the underground as shown on the below sketch and picture.





The Podhale Trough (Niecka Podhalańska) is an important reservoir of thermal waters. The reservoir's coverage extends from the edge of the Tatra mountains, where natural outflows of warm waters and caves are known and whose origin is associated with the thermal end, probably up to the structure of the Pieniny Mountains' rock belt which constitutes a natural barrier – the north boundary of the thermal waters reservoir. The region supplying the thermal waters reservoir of the Podhale region is the Tatra Mountains massif. The area of supply region may be estimated at about 350 km². Rain waters penetrate through the crack system deep into the towered Tatra Mountains massif and move, basically, northwards under waterproof complex of the paleogene sedimentary rock layers (schistose rocks and sandstone). When penetrating into the rock massif, the waters gradually warm up. In the depth of about 1000 meters in Zakopane the waters have about 26°C and in the depth greater than 2000 meters in the region of Biały Dunajec and Bańska they reach more than 80°C. At the same time the water mineralization increases as well as their pressure in the reservoir. The principle of geothermal energy reserves of Podhale region is shown below.



People became interested in making use of the geothermal springs in the Podhale region as early as in the half of the 19th century. Hot springs in Jaszczurówka near Zakopane became very popular. Their existence was connected with infiltration of rain waters into great depths where under influence of the Earth heat they were warmed up and lifted (along the tectonic cracks) due to hydrostatic pressure (the average temperature of water in a swimming pool was 18°C with the average annual air temperature in this region of 4,8°C). In the post-war period the scientists took the initiative to investigate the conditions of geothermal waters appearance in a complex way. There was prepared a project of a deep hole in Zakopane localized on the Antałówka slope; it was realized up till the depth of 3000 meters and it revealed a presence of geothermal waters. In the years 1981–1997 10 boreholes were carried out. In all of them geothermal waters were found; they had 58-95°C and productivity up to 550 m³/h. One of their great advantages when compared with waters exploited in other regions of Poland is their very low mineralization up to 3g/l and the fact that they flow out onto the surface due to their own pressure, except for one hole located on the top of Furmanowa.

IGSMiE of the Polish Academy of Sciences (PAN) built the Experimental Geothermal Plant Bańska Niżna–Biały Dunajec in the years 1989–1993. Several buildings from the nearby village Bańska Niżna were connected to the geothermal heat distribution network. Production of heat was carried out on the basis of two bore holes: Bańska IG–1 and Biały Dunajec PAN-1. By this it was proved that it is technically possible to heat houses with the heat coming from geothermal waters. In December 1993 Geotermia Podhalańska S.A. was established by the National Fund of Environment Protection and Water Management.

Below are stipulated an overall timeline with major achievement throughout the years 1989-2004.

Years 1989 – 1993

Taking into use the DZG Bańska Niżna – Biały Dunajec through IGSM and E of the Polish Academy of Science.

Connection of several first buildings in Bańska Niżna to the geothermal distribution network.

Production of heat on the basis of two holes: Bańska IG-1 and Biały Dunajec PAN–1.

December 93' – the origin of Geotermia Podhalańska S.A. on the initiative of the National Fund of Environment Protection and Water Management.

Year 1994

Starting of the experimental phase of the project called „Heat supply of the Bańska Niżna village" as the first active geothermal network in Poland.

February – registration of Geotermia Podhalańska S.A. in the Register Court in Nowy Sącz.

Year 1995

Construction of the heat distribution network in Biały Dunajec.

Sale of heat in the amount of 18.000 GJ/year.

Year 1996

Beginning of construction of the Geothermal Base Lload Plantin Bańska Niżna.

Construction of 3,5 km of the transmitting line to Zakopane.The total length of the final transmission system to Zakopane is 14 km.

Connecting to the heat distribution network of 27 households in Biały Dunajec.

Year 1997

March – completion of boring the hole Biały Dunajec PGP–2.

September – completion of boring the hole Bańska Niżna PGP–1.

Hydrodynamic tests of the holes: Poronin PAN–1, Chochołów PJG–1, Furmanowa PJG–1, Biały Dunajec PAN–1, Bańska IG–1.

Calculation and documentation of the operating resources for individual holes and the whole structure of the Podhale Trough.

Year 1998

June – origin of Przedsiębiorstwo Energetyki Cieplnej (PEC) Geotermia Podhalańska S.A. (as a result of a merge with PEC „TATRY")

November – starting of the Peak Load Plant in Zakopane (till the moment of connection of the geothermal line from Bańska Niżna the basic fuel in the boiler house was gas).

Year 1999

Construction of the heat distribution network in Zakopane.

Sale of heat at the level of 120.000 GJ/year.

Year 2000

Expansion of the heat distribution network in Zakopane.

By December: 212 individual consumers, 51 great-scale consumers and 119 blocks of flats.

Year 2001

Zakopane – liquidation of the last housing estate boiler house heated with coke.

Completion of construction of the heating line Bańska Niżna – the Peak Load Plant Zakopane.

June – starting of three gas engines of the total power of 1,5 MWe and 2,1 MWt in the Peak Load Plant.

December – starting of the gas and oil boiler of 16 MW in the Peak Load Plant.

Connection of new consumers in Zakopane and Biały Dunajec.

Starting of construction of "Aqua Park" in Zakopane.

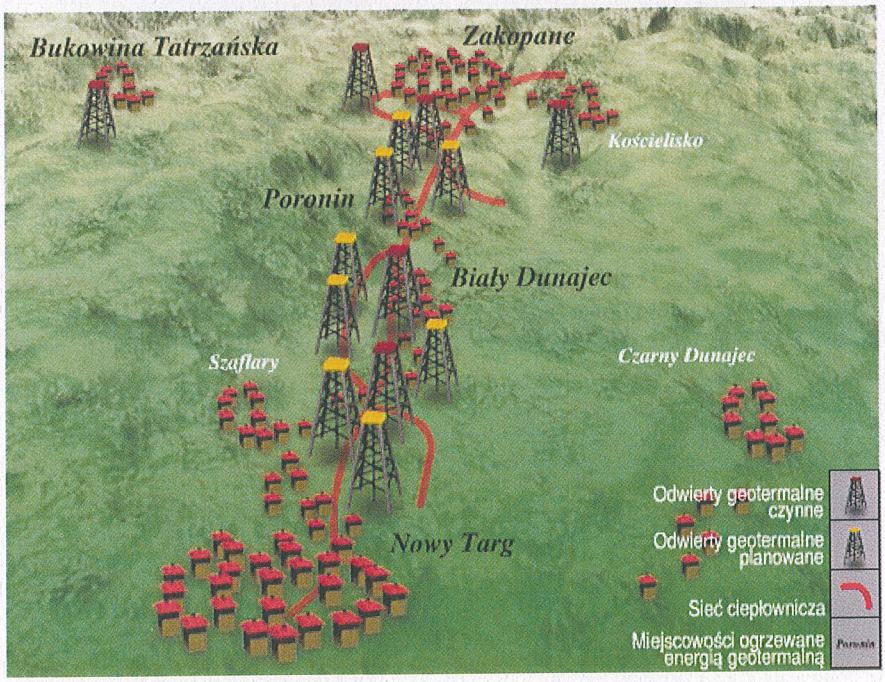
Length of the heat distribution network is 47,6 km long.

Year 2002
Expansion of the heat distribution network and connection of new consumers on the area of Zakopane and the communes of Biały Dunajec and Poronin.
Construction of „Water Park" reached the raw completed condition.
The heating line in the direction of Kościelisko reached Polana Szymoszkowa.
Completion of construction of the Educational Information and Administration Centre in Nowotarska Street in Zakopane.
Sale of heat reached 188.000 GJ/ year,
The length of the heat distribution line at the end of 2002 – 56,5 km.

Year 2003
Further expansion of the heat distribution line and connection of new consumers on the area of Zakopane and the communes of Biały Dunajec and Poronin.
Development of educational and information activities: lectures, sight-seeing, professional training organization, presentation, content-related aid for diploma works.
Sale of heat at the level of 244.500 GJ/year.
Till the end of 2003, to the distribution network of P.E.C. Geotermia Podhalańska S.A. there had been connected 490 individual consumers, 146 great-scale consumers (including 90% of hotels in Zakopane) and 27 former coal and coke boiler houses heating block of flats in Zakopane.

Year 2004
June – an agreement for supplying the heat to the outer swimming pool on Polana Szymoszkowa with DORADO was signed.

But, very early in this process of developing the capacity and amount of consumer connections for the geothermal energy plans were prepared for further boreholes and faster expansion of the distribution net as can be seen to the right.



However, lack of financing and the need for environmental development in other areas within the region stopped the progress of the plans. But with the possibility of co-financing from the Joint Implementation program the plans of expansion and development of the geothermal energy and thereby eliminating large parts of the present coal, oil and gas based energy production has been renewed and has resulted in this application with plan of development as shown on the last map of chapter A.4.1.4.

A.4.1.6 The existing geothermal district heating systems technical aspects

The heat system of PEC Geotermia Podhalańska S.A. consists of three circulation systems:

- Geothermal system.
- Heat distribution network.
- Consumer's inner installations.

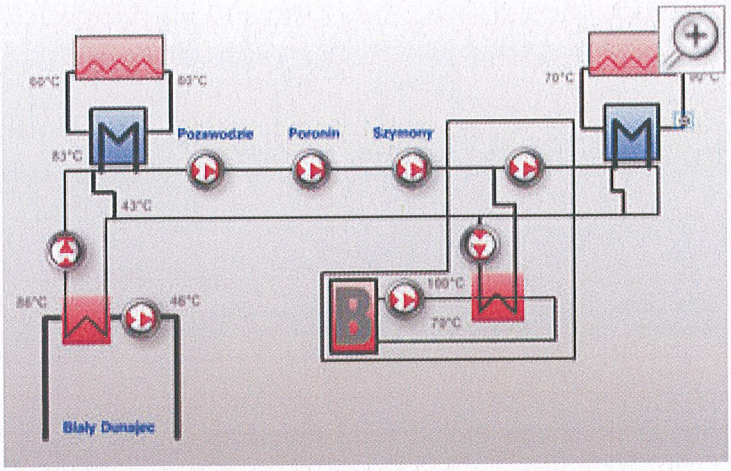
The geothermal installation is a closed system in which hot waters from the interior of the Earth flow out onto the surface thanks to exploiting the bore holes, give the heat to the water in the system and are pressed through absorptive bore holes back to the bed. The heat generated in this way is used to heat buildings and to the preparation of hot usable water. PEC Geotermia Podhalańska S.A. has two doublets of bore holes: PGP–1, PGP–2 and IG-1, PAN–1. Thanks to the static pressure difference between the exploiting bore holes (PGP–1, IG–1) 29 Atm and the absorptive bore holes (PGP–2, PAN–1) 23 Atm, about 100 m³/h of spontaneous flow of geothermal water is gained. In case of greater demand for heat, in order to increase extract of geothermal water, pumps built into the geothermal system are additionally activated. The geothermal system is built for nominal pressure of 40 bars on the stretch from the exploiting bore holes to the geothermal pumps. The nominal pressure of the pipeline behind the pumps comes to 64 bars.

From the exploiting bore hole PGP–1 it is possible to generate 550 m³/h of geothermal water of the temperature T = 86 °C and the distance between the exploiting bore holes and the absorptive ones is in straight line 1800 m. The geothermal water before being pressed back to the bed is cleared by a set of filters with the filtration level of 1μm.

In the Geothermal Heat – Generating Plant Bańska – Biały Dunajec, which is the basic source of heat in the system, there are five plate heat exchangers of total power 40 MW, in which heat from the geothermal water is given to the water in the system.

In the building of the Geothermal Base Load Plant there is also a system of network water treatment with capacity of 50 m³/h, an expansive system securing the 2 and 3 pressure areas and the network water pumps with a capacity of 3 x 470 m³/h.

Because of high temperature of the pressed geothermal water (55°C), it is considered to apply absorptive heat pumps as the basic source of heat for the pressure area (Nowy Targ) with the power of 14 MW. It will allow to cool down the geothermal water by 20°C.



In June 1981 a chemical analysis of water from the exploiting bore hole Bańska IG–1 was carried out. The total content of permanent components hesitates from 2995 to 3021,9 mg/dm³. The basic components are ions (in mg/dm³): SO_4^{2-} (909,4-925,9), Cl^- (634,6-570,8), Na+ (550,0-525,0), Ca^{2+} (240,4-221,2), Mg^{2+} (57,3-51,06), in small quantities: Li^+ (0,4), Be^{2+} (0,11), Sr^{2+} (6,0), Al^{3+} (1,1), F^- (4,0), Br^- (1,73), H_2SiO_4 (0,75), HBO_3 (40,5) and in slight quantities: Fe^{2+}, Mn^{2+}, Ag^+, Zn^{2+}, Cu^{2+}, Ni^{2+}, Cr^{2+}, Mo^{4+}, V^{2+} and H_2S (0,09), water pH accepted values of 6,7-7,8.
Natural gas was also found in the quantity of about 20 ml/dm³. It contains 17,9% of flammable components, 43% of nitrogen, 37,7% of carbon dioxide and 1,25% of inert gases (He, Ar).

The Peak Load Plant in Zakopane covers the system load in those periods of the year when the heat generated from geothermal waters does not cover the consumers' demand.

In the boiler house there are two water boilers of 10 MW each, of middle-temperature, running on gas, equipped with economizers of 1 MW each allowing to regain heat of water steam condensation contained in the fumes, one boiler with a two-function burner facilitating supplying with gas or fuel oil of 16 MW, three gas engines of the total power of 1,5 MWe and 2,1 MWt, which generate heat and electric energy, a system of the network water treatment ensuring its proper quality with the capacity of 35 m³/h, three expansive systems securing the 3 and 4 pressure areas and the boiler system, system water pumps with the capacity of 3 x 250m³/h together with a pressure reduction system and a separation system.

The boiler system is hydraulically separated from the network system by three plate exchangers of 17 MW each. The boiler system works on nominal pressure of 6 bars as opposed to the nominal pressure of 16 bars in the heat distribution network.

Achieving the proper temperature of the network water in the Peak Load Plant is realized by heating the return network water and directing it into the supply pipeline.

The low-temperature heat distribution network is completely built of pre-isolated pipes. Thanks to this a temperature drop in the main pipeline on the distance of 15 km is not higher than 2–3°C. All the pipelines with diameters above 100mm are equipped with a leak detection system.

The network water system was created for the nominal pressure of 16 bars. Because of big differences in the region ordinates, the system has been divided into four pressure areas.

The first pressure area extends from the Geothermal Base Lload PlantSzaflary – Bańska Niżna to Nowy Targ and is completely separated from the rest of the system. In this part of the system, the network water pumping stations are located on the return (in the plan).

In the pressure areas 2, 3 and 4 the situation is reverse because of the ordinates difference of the Geothermal Heat Plant (672m above sea level) and the maximum span of the system (930m above sea level), the pumping stations are located on the supply, and on the return there are pressure reduction systems.

The heat line consists of the network water pumping station in the Heat Plant Bańska – Biały Dunajec, three pumping stations (Pozawodzie 703m above sea level, Poronin 732m above sea level, Ustup 762m above sea level) together with pressure reduction systems, the network water pumping station together with a pressure reduction system in the Peak Load Plant 825m above sea level.

Each of the system water pumping stations is to ensure proper disposing pressure on the entry to the pumping station lying above. Pressure reduction systems are to ensure proper pressure on the entry to buildings lying below the given station.
The number of the pumping stations and the pressure reduction stations results from the land form and the accepted assumption of not exceeding the pressure drop in the main pipeline 70 Pa/m. In order to keep the transmission system pressure below 16 bars a solution of pressure separation was accepted. Different parts of the system are hydraulically connected but they work at different levels of pressure without a temperature drop.

The structure of system regulation is of a quantity – quality type. The system water temperature depends on the outer temperature, and a variable flow in the system is gained thanks to the proper work of system pumps equipped with frequency converters.

During regular work of the system optimal pressures in the network are kept by pumps and regulatory valves. Some emergency situations might happen, e.g. a lack of power supply, fall out of the pumps where it will be required to quickly disconnect particular pressure areas so that in the lower part of the pipeline pressure could not exceed 16 bars. Slowing down of the water stream with quick closing of blocking valves in big systems is always risky because of a hydraulic hit. A solution to this problem lies in building in a heat exchanger with proper construction of valves into the system. The heat exchanger functions as resistance to the hydraulic hit and counteracts heat stresses.

Such systems appear in the pumping station building of Poronin and in the Peak Load Plant in Zakopane. The systems confirm innovation and efficiency of the applied technology through their correctness of work.

The technical equipment of all the buildings was chosen on the basis of international tenders which allowed to purchase appliances of the highest quality. The applied technical solutions are completely new in Poland.

Automation of the geothermal heat distribution network is realized through the control system and the remote data acquisition – SCADA.
Equipment level – consisting of automatics executive components such as servomotors of valves, pumps engines, remote pressure and temperature converters.
Control and data acquisition level – created by microprocessor systems (PLC), responsible for data processing and realizing of local algorithms resulting from the heat distribution network technology. The processed information is sent to the superior system where there is a possibility of direct co-operation between the user and the driver.
Operation level – this level consists of computer positions with installed software, fulfilling the function of visualizing the work stages, measured values, remote control of executive appliances, filing up the measuring data, signalizing of emergency situations.
Controlled and monitored buildings are located in great distance from each other. There is a necessity of co-ordination of their work and of superior control. Therefore, the system is integrated in such a way that the information received from one place is immediately available and it is possible to process it in the other ones. Such integration is achieved thanks to the data transmission system among the buildings. Data transmission is realized through an optical fibre cable set along the main network and the geothermal pipeline.

A.4.2 Category of Project Activity

The project activities are within the categories of: Environmental Protection and Energy Efficiency.

A.4.3 Technology to be employed by the project activity

A description follows of the technology involved in the two main activities of the project.

A.4.4 Present Project (Phase 1)

A.4.4.1 Task 1: New consumer connection in Zakopane

Task 1 includes expansion and development of the consumer connections in Zakopane City to the existing geothermal district heating net in Zakopane, utilizing the existing geothermal wells to 100 % capacity. The technology to be employed is well known, similar to the existing and state of the art.

A.4.4.2 Task 2: Zakopane AQUA Park

Task 2 includes establishment of distribution pipelines to the new Zakopane AQUA Park under construction in Zakopane City. The AQUA Park is expected to open in the end of year 2006 and will become one of the big consumers of geothermal heat in Zakopane. The energy utilization will help optimize the utilizing of geothermal energy sources.
The technology to be employed is well known, similar to the existing and state of the art.

A.4.4.3 Task 3: Szaflary Kurort AQUA Park

Task 3 includes establishment of distribution pipelines to the new Szaflary Kurort (Szaflary Spa) AQUA Park under construction near the town of Szaflary. The AQUA Park is expected to open during the summer 2006. The energy utilization will help optimize the utilizing of geothermal energy sources.
The technology to be employed is well known, similar to the existing and state of the art.

A.4.5 Future Project Development (Phase 2)

A.4.5.1 Transmission pipeline to Nowy Targ

The future project development includes establishment of a transmission pipeline to Nowy Targ including new geothermal wells, power supply for pumps, pumping station, steering and control module, work plans and supervision. The technology to be employed is well known, similar to the existing and state of the art.

A.4.5.2 New consumer connections in Nowy Targ and Szaflary

The future development project will provide the possibility distribution of geothermal energy for large areas in Nowy Targ and Szaflary (large buil-ding blocks).
The technology to be employed is well known, similar to the existing and state of the art.

A.4.6 GHG emission reduction

A description follows of the GHG emission reduction in the two main activities of the project.

A.4.6.1 Task 1: New consumer connection in Zakopane

Still a large number of households in Zakopane heat up individually with coal, coke or oil. This way of heating is common practice throughout many cities in Poland.
At present there are no current or future plans to introduce nationally or locally regulations requiring controlled development for eliminating the coal and/or coke based energy production and when these fossil fuels are combusted, CO_2 is emitted to the atmosphere.
However, when geothermal energy is produced less fossil fuels are to be used and the production of energy will reduce the CO_2 emissions.
Financially the PEC Geotermia Podhalanska S.A. is in a delicate situation with too few consumers to pay for the large investment costs in the needed expansion and development of the geothermal energy. Concentration has been on increasing the capacity as well as on daily operation and maintenance and not enough attention has been laid on the need for sufficient income from sale of heat through more consumer connections. In addition, financial analyses show that implementation of new consumers is not financially feasible, without additional funding from the JI program. The cost savings from the energy utilization can not justify the increased investment, operation and maintenance costs. Therefore, the emission reduction would not occur in the absence of the proposed project activity.

A.4.6.2 Task 2: Zakopane Aqua Park

As one of the most visited summer resorts and recreation centers the City of Zakopane needs to constantly develop new modern facilities to keep the tourists attention. The construction of the new Aqua Park in Zakopane will be finished for the summer season 2006 and will become one of the largest consumers in Zakopane.
However supply of geothermal heat for the new Aqua Park demands extension of the exiting district heating network in Zakopane as described under task 1.
Alternative to the proposed expansion and development of the geothermal energy is heating by utilization of gas boilers fired with natural gas. The Aqua Park is located outside the existing district heating network. Therefore, the emission reduction would not occur in the absence of the proposed project activity

A.4.6.3 Task 3: Szaflary Kurort Aqua Park

Establishment of distribution pipelines for the planed new Szaflary Kurort Aqua Park is under consideration. The energy utilization will help optimize the utilization of geothermal energy sources as the heat will be extracted from the primary return.
The technology to be employed is well known, simple and state of the art but will demand new large investments from the customer as well as the heating company.
Alternative to the proposed expansion and development of the geothermal energy is heating by utilization of oil or coke boilers.
The cost savings from the energy utilization can not justify the increased investment, operation and maintenance costs. Therefore, the emission reduction would not occur in the absence of the proposed project activity

A.4.6.4 Future Development Phase 2: Transmission pipeline to Nowy Targ

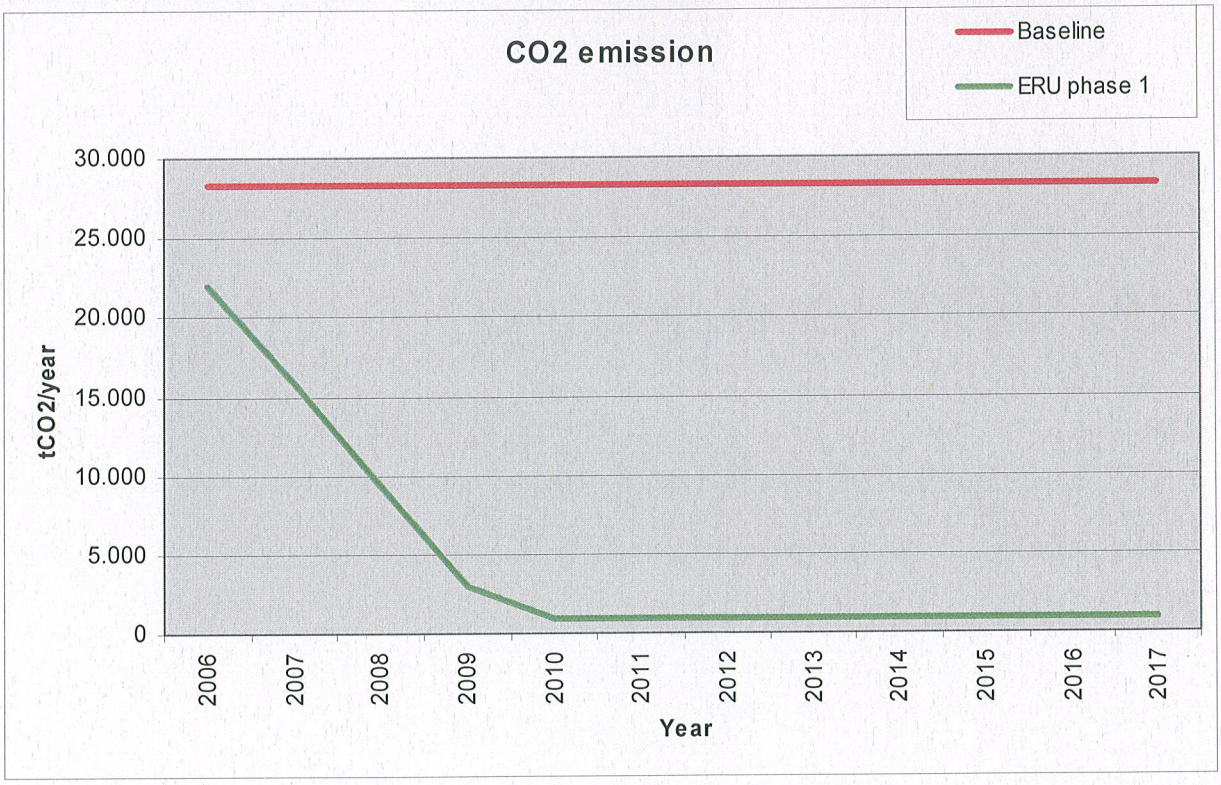
Almost same situation is valid in the project development as for the existing project. A lot of the larger building blocks in Nowy Targ is heated with coal and/or coke. The investment needed for to increase the capacity with new boreholes and a distribution net is high and the cost savings from the energy utilization can not justify the increased investment, operation and maintenance costs without additional funding from the JI program.

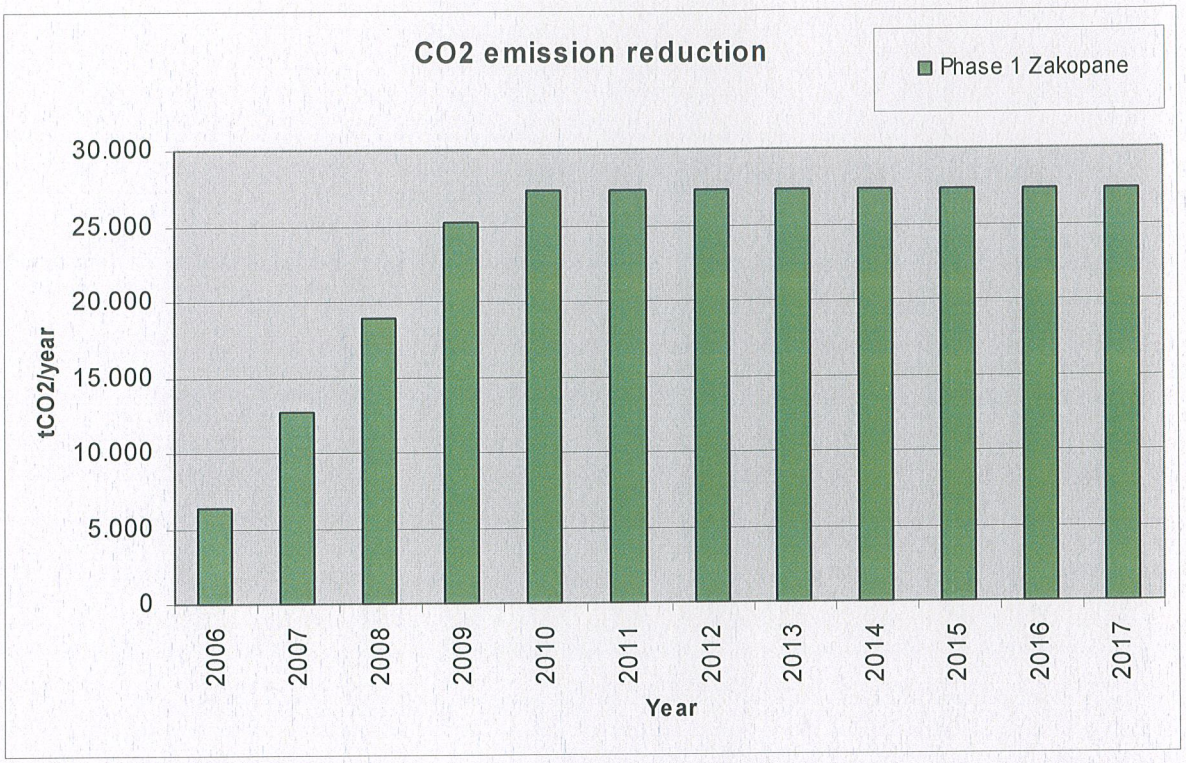
A.4.6.5 New consumer connections in Phase 2:Nowy Targ and Szaflary

The future development project will provide the possibility for distribution of geothermal energy for large areas in Nowy Targ and Szaflary (large building blocks).
The technology to be employed is well known, similar to the existing and state of the art however the feasibility study the project development is ongoing and the PDD for this project part will be made separately after agreements with the existing heating companies in Nowy Targ and Szaflary .

A.4.6.6 Estimated amount of emission reductions for phase 1 in the chosen crediting period

Below is shown the anticipated reductions in tones of CO_2-equivalents with light green color indicating the emission reduction from the project (phase 1, Zakopane) compared to the baseline, indicated by a red color. Details of the calculated emission reduction are provided in section E.





As can be seen in the above graph the total emission reduction by the end of the crediting period (2012) will be 27 thousand tons of CO_2/year. For details concerning the phases and cities connected to the net please refer to the section E. Below are indicated results from the calculations.

Year 20xx	06	07	08	09	10	11	12	06-07	08-12
Estimated baseline emission in 1000 ton CO_2 equivalents	28	28	28	28	28	28	28	57	142
Annual project emission reduction in 1000 ton CO_2 equivalents	6	13	19	25	27	27	27	19	125

A.4.7 Public funding of the project activity

The Danish Government's purchase of ERUs (and related monitoring, verification and certification of emission reductions) under the JI program does not use or cause a diversion of Official Development Assistance (ODA) Funds. The ERU purchase is separate from, and not counted towards, the Government of Denmark's financial obligations under the UNFCCC and the Koyoto Protocol.

B Application of a baseline methodology

B.1 Title and reference of the proposed new baseline methodology

The proposed new baseline methodology titled: "Estimated CO_2 emission from energy production based on fossil fuel combustion" has been applied.

An explanation of the methodology and the condition under which it can be applied is provided in annex 3.

A justification of the method's appropriateness given the project circumstances are given below.

B.2 Justification of the choice of the methodology

The methodology represents the resulting baseline scenario assuming that economically rational behavior determines the most likely future baseline scenario.

Since the breakdown of Eastern Europe communism control system Poland has experienced a dramatic decrease in the economy. Now, the economic situation is improving, but in a very moderate pace.

Even though the Polish government has concerns about the GHG emission from the coal or oil based energy production, it is not planned to make a regulation that enforces the energy suppliers to convert the energy production facilities from fossil based fuel into renewable fuel and thereby to bring down the GHG emissions. The needed investments caused by such legislation are not prioritized among all the other important investments that need to be done in Poland.

Since there are no present or planned national guidelines or regulations which specific describes fuel conversion as described above the methodology is deemed relevant.

B.3 Description of how the methodology is applied

The methodology is a financial test. In this section, the alternative possibilities will be discussed in the context of the project activity and their economic performance evaluated. Hereby, the baseline scenario can be determined. The methodology is applied in the following simplified steps:

1. Possible baseline scenarios.
2. Most likely baseline scenarios.
3. Calculate project economy, not taking carbon finance into account.
4. Evaluation of calculated project economy.
5. Economical conclusion.
6. Calculate baseline emissions.

A more detailed description of the steps above is given in section Annex 3.

B.3.1 Step 1: Possible baseline scenarios

A number of technical possibilities for energy production as possible baseline scenarios have been identified as described below with brief description of the single technologies.

a) Fossil based energy production: This is the most common energy production in Poland. the present development of PEC Geotermia Podhalanska will only very slowly if at all eliminate the remaining coal, oil and gas based energy production in Zakopane.
b) Hydropower energy production: Is already present in Zakopane. However, with at limited capacity and with no feasible possibility of expansion.
c) Waste Incineration energy production: The collected waste is brought to an incineration plant for combustion. The chemical components for the possible methane generation will be combusted during the incineration process. However, with the limited amount of waste in Zakopane this will not be a feasible possibility.
d) Methane gas energy production: The methane production from the deposited waste can be collected and used for energy production. Project is ongoing. However, with the limited amount of waste in Zakopane this will only contribute with less than 1 % of the total needed energy production in the area.
e) Georhermal energy production: The proposed project.

B.3.2 Step 2: Most likely baseline scenario

In Annex 3 comments concerning likelihood for the step 1 potential scenarios are listed. The conclusion is the following.

The fossil based energy production represents the most likely scenario and business as usual (BAU).

B.3.3 Step 3: Project economy

Apart from the above mentioned BAU scenario, the proposed project was identified as a possible baseline scenario. Therefore, a calculation of the project economy for these scenarios can be calculated. However, even with optimistic assumptions given to the project economy analysis indicates that, the payback time calculated for this alternative is more than 10 years, which is not acceptable in any investment projects in Poland or elsewhere. PEC Geotermia Podhalanska S.A. does not have any savings or other access to capital sufficient for the investment, and therefore the investment must be based on bank loans which make these solutions even more unlikely. Hence, the results show that the alternative is not an economically attractive course of action. The only other plausible scenario is BAU.
Furthermore, final price for the ERU as well as the final shares of the obtained amount of ERU to be transferred from the Polish Ministry to the Danish Ministry are 2 major points in the negotiations with the Polish and the Danish Ministry, which is ongoing and not yet completed. In fact they will not be completed before both Ministries have received a determination report of this PDD. Because of this only the PDD will be determinated at the present stage of the project and does not include a Business Plan. It is not possible to complete the Business Plan before the negotiations with the Ministries have been completed.

B.3.4 Step 4 and 5: Formulated baseline

The baseline scenario can be described as follows:

"No new consumer connections in Zakopane, no new boreholes and no new distribution pipeline to Nowy Targ and thus the unimpeded release of CO_2 to the atmosphere until some future time when the expansion and development of geothermal energy becomes required by law or becomes an economically attractive course of action."

There are no specific present or planned national guidelines or regulations which prescribe fuel conversion of the DH plants. For the time being, Poland has adopted Climate Change Convention and ratified Kyoto Protocol. Poland thereby aims at emission reduction, but no measurable and time-bound targets have been set so-far, and no CO2 reduction technologies have been appointed as preferred or recommended. Requirements from national or municipality level which are relevant to fuel conversion and thereby to the emission reduction from Peak Load Plant are not expected, either.

The BAU scenario is a credible baseline scenario based on the following points:

- Financing: The financial situation of the geothermal plant is such that it would not be able to finance the project totally. PEC Geotermia Podhalanska S.A. does not have savings or other capital sufficient to cover the investment, and therefore the investment must be based on bank loans. The continued DH energy production based on coal represents the most credible scenario from a financing perspective.
- Local support: There are no legal or policy changes foreseen in the region. However, the municipality of Zakopane supports the idea of changing the situation with more and more geothermal energy and less and less coal, oil and gas based energy production.
- Physical obstruction: No physical obstructions are anticipated. No shortage of geothermal water is expected and the existing building contains space enough for to implement and expand the existing pumping station.
- Legislation: See above under Local support.

B.3.5 Step 6: Calculation of baseline and project emissions

This methodology for estimating emission reductions includes the GHG emission from Peak Load Plant. For the above mentioned the difference of CO_2 emissions between the baseline and the project are calculated. Emissions from Peak Load Plant will be maintained at present status or with a minor increase by implementation of improved heat distributions techniques.

In the baseline scenario all the CO_2 emission from the present coal, oil and gas based energy production will be lead out into the atmosphere. However, in the project the geothermal energy will be utilized for district heating replacing coal, oil and gas based energy production.

B.4 Description of how the anthropogenic emissions of GHG by sources are reduced

In this section, it will be described how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered project activity including explanation of how and why this project is additional and therefore not the baseline scenario.

The application of the baseline methodology has shown the following:

1. The most likely baseline scenario is BAU, which means continued emission of CO_2 from the coal, oil and gas based energy production.
2. The project is not an economically attractive course of action as the project payback time is to long.
3. There are no existing legal requirements for fuel conversion, nor are such requirements expected.

The Zakopane Municipality and PEC Geotermia Podhalanska S.A. would like to build the facilities for expansion and development of the geothermal energy production. The project economy can be calculated based on the existing situation and even though the initial works has been done, initial economy calculations indicate that the payback time of the project is too long to fulfill the project without grants and/or ERU's.

The project will generate emission reductions due to fact that energy produced from local coal, oil or natural gas based boilers can be saved and thereby save emission of GHG from the combustion of fossil fuels compared with the energy production of geothermal water.

Details of the calculation of estimated emission reductions are provided in section E.

B.5 Project boundary

In this section, it will be described how the definition of the project boundary related to the baseline methodology selected is applied to the project activity.

Please refer to the last map of chapter A.4.1.4 including the phases of the project.

B.6 Details of baseline information

B.6.1 Date of completion of the baseline study

The baseline study was completed as the date of the submission of this application.

B.6.2 Name of person (s)/entity (ies) determining the baseline

The total scheme for the baseline studies was conducted in accordance with the project design established by AAEN Consulting Engineers A/S. The need for baseline audit must be determined by the DANCEE (DEPA) and if needed the accredited audit company or person is to be nominated.

C Duration of the project activity / Crediting period

C.1 Duration of the project activity

C.1.1 Starting date of the project activity

The starting date of the project activity is expected to be the 1st of July 2006 and is defined as the start of the detailed designing of the extension of the district heating network in Zakopane.

C.1.2 Expected operational lifetime of the project activity

The expected operational lifetime of the project activity is 30-40 years, depending on maintenance of the equipment.

C.2 Choice of the crediting period and related information

The crediting period will be specified in the agreement between Poland and Denmark for the project as well as in the Emission Reduction Purchase Agreement (ERPA) between DEPA and AAEN Polska Sp. z o.o. For the first commitment period, the framework for setting the crediting period is given in C.2.1.

C.2.1 Renewable crediting period

The ERPA between the Danish Ministry and AAEN Consulting Engineers A/S, which is expected signed in May 2006, includes the below definitions concerning the crediting period.

"Assigned Amount Unit" or "AAU" means a tradable unit equivalent to one metric tones of carbon dioxide emission or an amount of any other Green House Gas (GHG) with an equivalent global warming potential that are listed in Annex A and transferred on the basis of Article 17 of the Kyoto Protocol.
"Early AAU's" means AAU's provided by a Host Country Government in respect of a GHG reduction achieved by a JI project in the period 2006 to 2008."
"Crediting Period" means the period from the 1st of January 2006 to 31st of December 2012 during which the project is expected to generate emission reduction."

C.2.1.1 Starting date of the first crediting period

The starting date of the first crediting period is expected to be the 1st of July 2006. Same time as first emission reductions is expected obtained after commissioning of the first new consumer connections.

C.2.1.2 Length of the crediting period

Length of the crediting period will be from 1st of January 2006 to 31st December 2012 equals 7 years.

C.2.2 Fixed crediting period

C.2.2.1 Starting date

Not applicable.

C.2.2.2 Length

Not applicable.

D Application of a monitoring methodology and plan

D.1 Name and reference of proposed new monitoring methodology

The proposed new monitoring methodology titled: "Monitoring of the GHG emission reduction generated by replacing fossil fuel based combustion with geothermal based DH" has been applied.

An explanation of the methodology and the condition under which it can be applied is provided in annex 4.

A justification of the method's appropriateness given the project circumstances are listed below.

D.2 Justification of the choice of the methodology

For to consider the monitoring methodology the two phases of the project has to be treated separate:

1. For the phase 1 it is most appropriate to accurately measure the new connected household heat exchangers consumption.
2. For the phase 2 it is most appropriate to accurately measure the new connected heat exchangers consumption.

Characteristic for the both phases of the project of the kind described above is that the emissions not released to the atmosphere can directly be monitored. The emission reductions achieved by the project do not have to be derived from a comparison between baseline and project emissions, because every ton of CO_2 determined equals a certain amount of CO_2 not released to the atmosphere. When the extra CO_2 emission the Project causes are taken into account the total emission reduction can be calculated.

In other words, a monitoring and emission reduction calculation method can be used that does not rely on information about baseline emissions, i.e. the quantity of emissions in the baseline scenario can remain unknown. This is convenient, since the monitoring of baseline emissions from small scale furnaces in the single houses is unpractical, and maybe even impossible.

The proposed monitoring and emission reduction calculation method can also be expected to be more accurate than an attempt to derive emission reductions as the difference between monitored or estimated baseline and project emissions.

The monitoring plan sets out a number of monitoring tasks in order to ensure that all aspects of projected GHG emission reductions for the project are controlled and reported. This requires an ongoing monitoring of the project to ensure performance according to its design and that claimed ERU's are actually achieved.

D.3 Data on emissions from project entity

Instead of collecting data on emissions, data on emission reductions will be collected as indicated in the table in Annex 4.2.3.

Monitoring of most parameters will take place on-line. Registration of data will be done electronically and stored in a computer located at the offices of PEC Geotermia Podhalanska S.A.. The software installed in the computer will be able to produce reporting in formats and frequencies, ranging from on-line data to daily, weekly, to annually.

The electrical systems, pumps etc. will use a minor amount of energy. On the other hand, transportation and energy will be saved when coal is not to be transported to the single furnaces in the baseline scenario. The difference in energy consumption between baseline and project is estimated to be negligible.

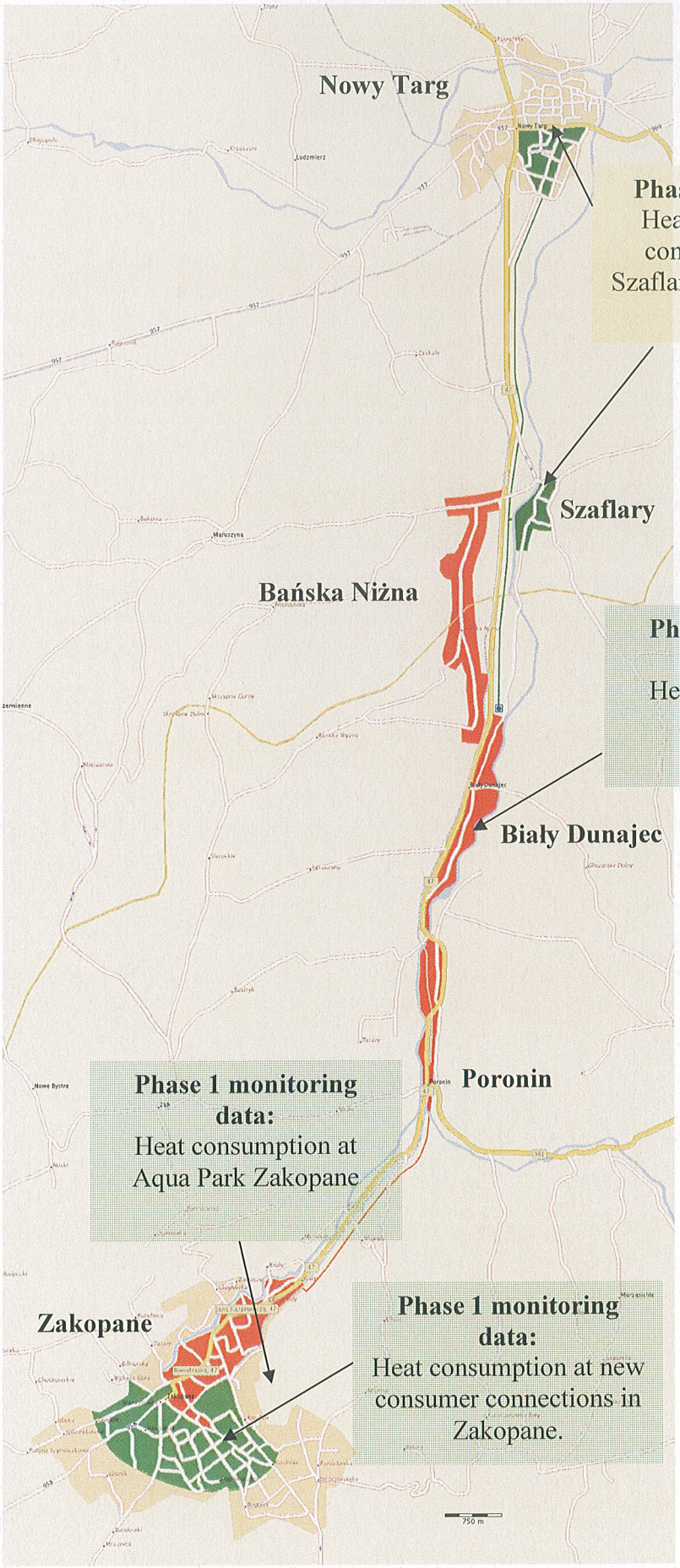
The production and supply of DH requires temporally use of peak load production facilities in Zakopane. The peek load plant operates on direct demand and has, at present, no facilities for heat storage.
The need for peak load production can be reduced by applying heat storage facilities. An heat accumulation tank will reduce the need for peak load production.

The efficiency of the production geothermal facilities depends strongly of the consumers cooling efficiency. The potential for improving consumers cooling efficiency is high and will optimize the distribution system, reduce energy loses and improve the capacity of the geothermal installations.

By implementing strategies for improvement in the distribution and consumer installations the need for further peak load production eliminated or even reduced.

A system for monitoring of CO_2 emission from production will be applied based on yearly utilization of fuels however no increase in CO_2 emission are expected due to applied strategies for efficiency improvements in the production and distributions system.

On the following page are shown with indicators where data are monitored.


Nowy Targ
Phase 2 monitoring data:
Heat consumption at new consumer connections in Szaflary and Nowy Targ (large building blocks).
Szaflary
Bańska Niżna
Phase 1 monitoring data:
Heat consumption at Aqua Park Szaflary Kurort
Biały Dunajec
Poronin
Phase 1 monitoring data:
Heat consumption at Aqua Park Zakopane
Zakopane
Phase 1 monitoring data:
Heat consumption at new consumer connections in Zakopane.
750 m

The electrical systems, pumps etc. will use a minor amount of energy. On the other hand, transportation and energy will be saved when coal is not to be transported to the single furnaces in the baseline scenario. The difference in energy consumption between baseline and project is estimated to be negligible.

D.4 Data on sources of emissions outside project boundary

Only the construction of the installed equipment will potentially lead to some GHG emissions that would not have occurred in the absence of the project. However, these emissions are insignificant. No increase in emissions is included other than those targeted and directly monitored by the project.

D.5 Data on baseline emissions

Not applicable, because the project directly monitors and calculate emission reductions. The data mentioned in D.3 will be collected. Nevertheless, the baseline data is estimated for the calculations in section E. All data used for the baseline calculation are based assumptions described in annex 3. No attempt will be carried out to determine the actual baseline emissions.

D.6 Quality control (QC) and quality assurance (QA) procedures

The QC and QA practice that will be implemented in the context of the project are as follows:

Most data monitored for the emission reduction calculations as listed in section D.3 will be registered on-line at a present determined interval (e.g. every 5 minutes). A monitoring report will be prepared on weekly basis. These reports will be checked for any anomalies before filed for future reference.

Below is shown routine records for major components within the project:

Parameter	Frequency
Phase 1 household heat exchangers The heat exchangers will be subject to a regular maintenance and testing regime to ensure as high efficiency as possible.	According to supplier
Production audit The heat production, production hours, and fuel consumption will be monitored and presented regularly	Daily/ Monthly
Routine reminder procedures A routine reminder procedure will be prepared to guide the staff through their daily, weekly and monthly routines in general for the plants.	Daily
Site audits The responsible manager makes regular site visits of the plants.	Monthly
Service sheets A specialist geothermal company (e.g. the unit supplier) carries out regular service routines. Service sheets will be completed for each service to ensure all aspects of the service are completed and recorded.	According to contract with supplier

In addition to the QC and QA measures described above, the suppliers and contractors for the plants and systems will prepare operational manuals. The operation manuals will include procedures for training, proper handling of equipment, service and maintenance plans, emergency plans and work security plans.

D.7 Name of person (s)/entity (ies) determining the monitoring methodology

The monitoring methodology is based on exact monitoring of output and was conducted in accordance with the project design established by AAEN Consulting Engineers A/S. The need for review of proposed monitoring methodology must be determined by the DANCEE (DEPA) and if needed the accredited audit company or person is to be nominated.

E Estimation of GHG emission by sources

E.1 Estimated GHG emissions of the project activities

This section could include a description of the formulae used to estimate anthropogenic emissions by sources of GHG's of the project activity within the project. However, this is not applicable, because the project directly monitors and calculates the emission reductions. See discussion under D.4.

E.2 Estimated leakage

This section could include a description of formulae used to estimate leakage, defined as: the net change of anthropogenic emission by sources of GHG's which occurs outside the project boundary, and that is measurable and attributable to the project activity. However, this is not applicable, because of the discussion under D.4.

E.3 Project activity emissions

This section could include the sum of E.1 and E.2 representing the project activity emissions. However, this is not applicable, because the project directly monitors and calculates the emission reduction. The only discernable yet insignificant (indirect) modification of emissions is associated with the physical construction of the project. See the discussion under D.4 above.

E.4 Estimated GHG emissions of the baseline

This section includes the estimated anthropogenic emission by sources of GHG's of the baseline.

For comments to the GHG emission of the baseline please refer to Annex 3.7.

E.5 Emission reductions of the project activity

This section includes the difference between E.4 and E.3 representing the emission reduction of the project activity. The monitoring plan provides for the calculation of the emission reductions in the following way.

The emission reduction due to change of energy production follows the below procedure.

1. Heat consumption
2. Substituted coal, oil or gas based heat production
3. Increased peak load emission
4. Equivalent emission reduction

E.6 Table providing values obtained when applying formula

Due to the nature of the emission reduction monitoring and calculation process most appropriate for this project, formulas to the above mentioned procedures cannot directly be used to complete the table below. However, based on a variety of assumptions regarding operation hours and efficiency and so fourth, the projected emission reductions are as shown in the following tables.

Please note that these tables are only estimates of expected values.

Year	Unit	2005	2006	2007	2008	2009	2010	2011	2012
Total	TJ	280	333	386	440	493	510	510	510
Phase 0 baseline	MWh	77778	77778	77778	77778	77778	77778	77778	77778
Phase 0 baseline	tCO2e	34533	34533	34533	34533	34533	34533	34533	34533
Phase 1 Zakopane	MWh		14777	29553	44330	59106	63784	63784	63784
Phase 1 Zakopane	tCO2e		6311	12622	18932	25243	27320	27320	27320
ERU	tCO2e		6311	12622	18932	25243	27320	27320	27320

Emission reductions

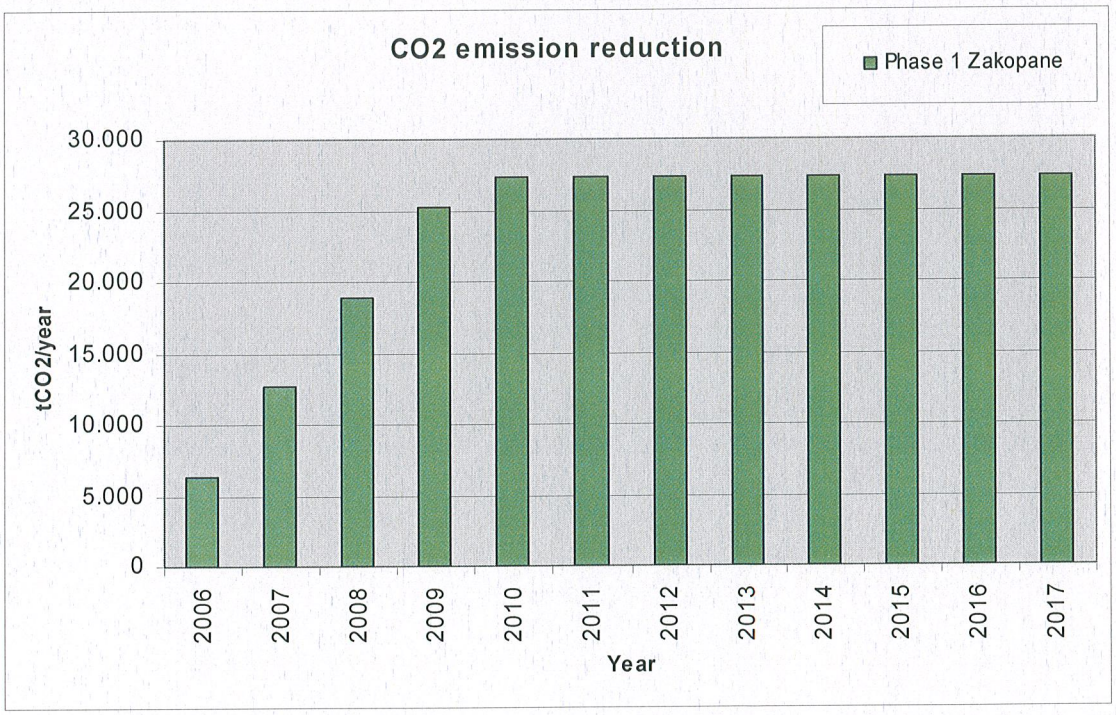
Year	Unit	2005	2006	2007	2008	2009	2010	2011	2012
Phase 1 Zakopane	tCO2e	0	6311	12622	18932	25243	27320	27320	27320

Included peak load emission

E.6.1 Total emission reduction

Below is shown the total emission reduction for the entire project.

Below is shown the anticipated reductions in tones of CO_2-equivalents with light green color indicating the emission reduction from the present project design phase 1. Estimate of the emission reduction from the future (phase 2) is not included.



As can be seen in the above graph the total emission reduction by the end of the crediting period (2012) will be approximately 27 thousand tons of CO_2/year in the present project.

F Environmental Impacts

F.1 Analysis of the environmental impacts

Below is stipulated typical potential significant environmental effects from substituting coal, oil and gas based energy production with geothermal energy production and the impact from implementation of the projects are presented, in general terms. However, in general the implementation of the projects will have very few negative environmental impacts.

F.1.1 Human beings

Influence on health and personal safety, residential amenity and nuisance.
The risk of smog related diseases due to operation of the coal, oil and gas based heat production is lowered.

F.1.2 Flora and fauna

Impact on existing terrestrial and aquatic fauna. Birds, rodents and insects as pests and disease vectors.
The more clean air will have a positive influence on the lives of the above.

F.1.3 Water

Contamination by uncontrolled surface water and leakage into the groundwater.
The surface water will be cleaner and thereby the leakage into the groundwater will be less.

F.1.4 Air

Generation of smog by coal, oil and gas based energy production will be less. In general the CO_2 emission is reduced. The less CO_2 emission and smog production will reduce the bad odor from these factors. The noise level from the pumping stations, generator etc. will be minimum because they will be located in already existing noise insulated containers or buildings.

F.1.5 The landscape

Visual impact and change in character due to perimeter fences, bunds and signs, access roads, entrances, smoke and site structures.
The existing building for the geothermal plant can be used for the new installations. Otherwise there will be only few visible features from the plants and the visible equipment needed in the household will only be a small heat exchanger situated in connection with existing buildings.

F.2 Environmental impacts assessment (EIA)

The negative environmental impacts from the geothermal energy production are negligible and the impacts are considered not significant. Implementation of equipment in already approved and legalized buildings will not require an Environmental Impact Assessment according to EU directives. Public consultations will take place, where all questions and inquiries regarding possible environmental impacts will be discussed and clarified by specialists. Furthermore the project has already passed the approval procedures in the municipality as specified in the stakeholders comments. Only requirement before for the actual construction work of phase 2 can begin is the final building permission.
The negative environmental impacts from the projects are therefore negligible, and the impacts are considered not significant. Hence, an EIA is not required.

G Stakeholders' comments

G.1 Comments by local stakeholders

This section includes a brief description of how comments by local stakeholders have been invited and compiled.

During the last 5 years AAEN Consulting Engineers have been project manager for several DANCEE related projects in Zakopane including continuous cooperation with all of the partners mentioned in section A.3. Meetings are continuously held with the partners and the latest meeting was held in May 2005 with representatives from all partners and DANCEE, see Annex 6.1. Furthermore, several meetings have been held in the Polish Ministry as well as with representatives from DANCEE.

LoE from Polish Ministry will be performed after determination of the present PDD

All of the above have expressed their support to the project and letters of understanding signed and sealed by the stakeholders is included in Annex 6.2.

Further stakeholders will be addressed by publication of this project application on the website of the Zakopane City or/and in local paper(s). This will take place prior to the project validation. Stakeholders to be addressed will be a possible implementing agency, municipalities, NGO's and the public. However, any stakeholders are invited to submit any report to the project or objection against the project in any time.

A 1 month of public hearing has taken place on the homepage of the Danish Ministry and the Polish Beneficiary. The PDD was published on the homepage of the Danish Ministry and on the homepage of the Zakopane Municipality from 13th February 2006 till 13th March 2006. The PDD has been moderately been revised according to the incoming comments.

Procedure for public consultation in the host country
There are no existing local planning/approval/permitting procedures for public consultation in Zakopane City or in Poland. However, the public consultation process in Zakopane is planned to be carried out as presented in the below schedule.

Activity	Accomplished/comments
Identify all local stakeholders affected or likely to be affected by the JI-project activity	Identified stakeholders beyond partners within the project will be the Local District Heating Company, the Local Electricity Company, Representatives from inhabitants close to the Plants and installations and Relevant NGO's
Announcement of the project on the website of Zakopane City and in the newspaper for invitation of further stakeholders and for comments	Will be carried out when the PDD are ready in Polish. The documents will be handed over on request. The announcement will include an invitation to participate in a workshop and call for written ore verbal comments.

Workshop	All stakeholders will be invited to attend in a workshop regarding the project. Workshop organizer will recorded all responses in minutes of meeting or via written responses.
Report on the consultation exercise	All written and verbal responses will be recorded and included in the Final Report. The Final Report will be available for all stakeholders.

G.2 Summary of the comments received

Below are summaries of the stakeholders comments received. Letters of intend is found in Annex 6: Stakeholders' letters of understanding.

In general the municipality of Zakopane desires to clarify the project as a JI project for to be able to implement the proposed expansion and development of geothermal energy according to the needed investments.

The proposed project demands transfer of knowledge and technology and especially concerning design and dimensioning of the plants. Training by skilled personal is needed to introduce the advanced technology.

G.3 Report on how due account was taken of any comments received

Due account on the above comments have been taken according to the below initiatives taking place prior to this application.

The Zakopane geothermal energy production has been subject for detailed investigations and calculations. Furthermore forecasts calculations for future energy production have been investigated.

The PEC Geotermia Podhalanska S.A. has been subject for investigations and investments in order to fulfill the present legislation. Changed processes and implementation of clean technology is the only possibility solution to eliminate the existing problems. The long experience and expertise for implementation of the expansion and development is found at the AAEN Consulting Engineers A/S.