Geothermal Resources in Poland

By Deanna Broman &
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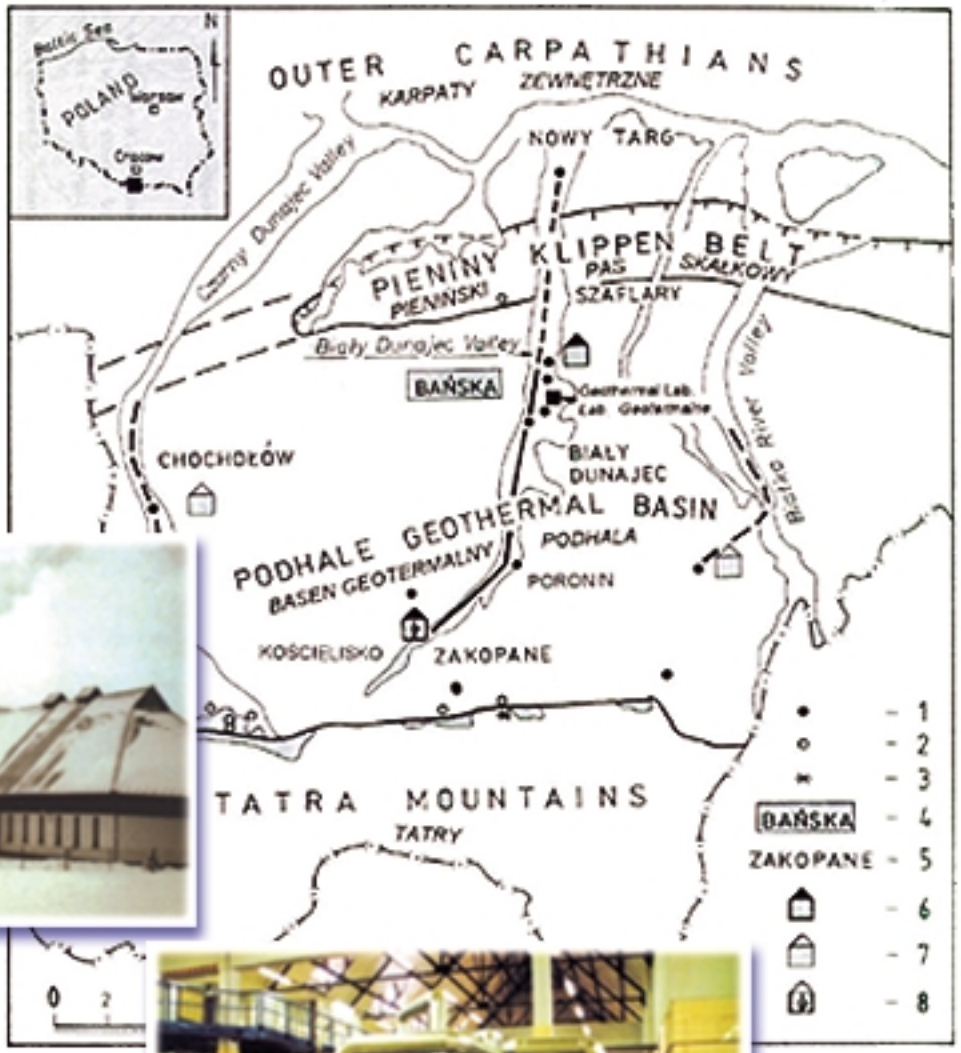
Associates, Inc.



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Geothermal Resources in Poland

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Introduction

The **Database of Geothermal Resources in Poland** includes information on 25 specific geothermal sites, representing at least 80 MWt in direct use potential. The actual figures are much higher as specific potential data is not available for all sites.

The Database includes:

- Power Profile - basic information on Poland, e.g., population, installed capacity, power generation breakdown, electricity prices, etc.;
- Power Summary - brief description of Poland's power sector and privatization;
- Government / Legislation - relevant Polish government agencies and laws; and
- Geothermal Sites / Projects - includes a Site Summary for each:

    1. Name
    2. Location
    3. Status
    4. Temperature
    5. Installed Capacity (MWt)
    6. Potential (MWt)
    7. Chronology
    8. Notes

Dynamic Database

The Database was designed to be dynamic. Created using Microsoft® Access 97, it can be easily updated or modified to include specific data which the industry would find most useful. In addition, the Database can be made more comprehensive by adding pertinent data, e.g., local population and market data, location of transmission lines and roads, etc., using the Geographic Information System (GIS) to the present structure. Finally, the Database could be adapted for posting on the World Wide Web and searched using a variety of variables such as country, desired temperature of resource, estimated power potential, and other parameters.

For immediate dissemination to the industry, the Database has been converted to a PDF file.[1]

The Database of Geothermal Resources in Poland was compiled and built by Deanna Broman and Liz Battocletti of Bob Lawrence & Associates, Inc. for Idaho National Engineering and Environmental Laboratory (INEEL) under Purchase Order No. F99-181039, "Collection and Assembly of Published Data on Geothermal Potential."

Special appreciation goes to Joel Renner of INEEL and Dr. Marshall Reed of the U.S. Department of Energy Office of Geothermal and Wind Technologies for their support. The author also wishes to thank the individuals, companies, and organizations who provided assistance and information.

The map and photos on the cover and title page are, clockwise from upper left: a sketch of the geothermal heating network within the Podhale region (under construction); the inside view of the central peak load in Zakopane, Nowotarska Street (Photo T. Kliscz); geothermal swimming pool, Antalowka Hill in Zakopane (Photo M. Kowalski); and the outside view of the central peak load in Zakopane, Nowotarska Street (Photo T. Kliscz). Source: The Development Trends of Geoenergetics in Poland in the 21st Century, Polish Academy of Science, Mineral and Energy Economy Research Institute, and Polish Geothermal Association, proceedings of the European Geothermal Conference Basel '99, 28-30 September 1999.

[1] PDF files can be read and printed using the free Adobe® Acrobat® Reader which can be downloaded at http://www.adobe.com/prodindex/acrobat/readstep.html).

Poland

Poland

Power Profile

Population (millions) - July 1998	38.92
Overall Electrification (% of population)	99%
GDP (billion US$) - 1998 est.	157.3
Real GDP Growth Rate - 1998 est.	4.8
Inflation Rate (CPI) - 1998	8.6
Total Installed Capacity (MWe) - 1998	33,843
Net Electricity Consumption per Capita (kWh) - 1998	2,800
Energy Demand Growth Rate (not stable)	1-2% p.a.

Prices (US¢/kWh) - November 1999	
Residential	.07
Commercial	.08
Industrial	3.5
Source: ERA or URE: Energy Regulatory Authority	
Estimated Geothermal Direct Use Potential (MWt)	80

Power Summary

Poland--with a population of almost 40 million, high per capita electricity consumption, and dynamic private sector growth–has the largest power generation sector in Central and Eastern Europe (CEE) countries. Electricity consumption in 2010 is estimated to increase from approximately 60 to 90% over 1993, pending the country's future economic situation. The Polish electric energy market is still deeply engaged in the restructuring process, which began in 1990. Major economic initiatives of the Polish government include privatization of state-owned industries, restructuring of the coal and heavy industry sectors, and establishing an attractive investment climate urgently needed for industrial modernization and environmental protection. These

efforts will help Poland create an economically efficient power industry capable of securing national energy requirements in a free market economy.

Projections show that domestic demand for electricity will grow by 50% over the next 20 years. Poland's installed capacity is projected by the Polish Power Grid Company (PPGC) to be 42,200 MWe by 2015 and 45,540 MWe by 2020 (up from its current level of 33,843 MWe).

Poland's current installed capacity of over 33,000 MWe exceeds domestic demand by almost 30% and some of the excess electricity is exported to neighboring countries. Poland is also ranked first among all the CEE countries with a total primary energy consumption of almost 100 toe (Tons of Oil Equivalent). This amount is equivalent to one-third of the total energy consumption of all CEE countries combined. Total energy consumption is estimated to increase by 138 toe by 2010. However, Poland is an inefficient energy consumer, losing up to 30% of energy generated. The country uses about 70% of the European Union's (EU) average energy consumption per capita.

In 1998, Poland consumed about 140 Twh of electricity and generated about 143 Twh. With that, the Polish Power Grid Company (PPGC) has proposed two growth scenarios: 1) Prosperity economic growth scenario- in which electricity demand is expected to increase by 3.3% per year with peak load hitting 52,000 MWe by 2020 and production reaching 315 Twh, and 2) Stagnant economic growth scenario- in which electricity demand is expected to increase by 2.6% per year with peak load reaching 45,000 MWe and production at 267 Twh.

Since 1990, the Polish electrical power sector (part of the CENTREL system) has been restructured and modernized its sector into three components: generation, transmission and distribution. Since Poland's electric generating capacity exceeds current demand, investment needs relate primarily to improving effectiveness and competitiveness and addressing environmental concerns. It is estimated that costs of modernization alone over the next fifteen years will reach $50 billion. This amount is needed to replace 16 GWE of obsolete installed capacity and to satisfy stricter environmental standards set by the EU. Of this amount, approximately $15 billion is needed for the modernization of existing power plants. A substantial portion of modernization costs is expected to be covered by income generated from privatizing power enterprises. According to the Polish government, privatization of the energy sector should be completed by 2001. This has created substantial opportunities for U.S. firms.

Polish power plant technology lags in the development of combustion technology, control systems, and emissions reduction. Construction of generation capacity over the last 30 years has been inconsistent, due to an aging system. More than half of the current capacity was built in the 1970's. Approximately 60% of the system has been in operation for over 15 years and 40% is more than 20 years old. Insufficient funding and expenditure on maintenance and modernization projects are the key reasons for the country's antiquated system.

Out of a total of 33,843 MWe thermal generation capacity,
30,876 MWe is installed in public power stations and 2,967 MWe in industrial power stations (auto producers). The generation capacity of thermal power plants accounts for about 94% of total public power station capacity. The remaining 6% (2040 MWe) belongs to hydroelectric power plants.

Ninety-seven percent of Polish electricity is coal generated in 55 thermal plants, of which 33 are combined power and heat plants (CHPs). Poland's hard coal reserves (high quality, low ash, low sulfur) are concentrated in Upper Silesia, near the Czech Republic border. Other coal basins are located in Lower Silesia and Lublin.

It is estimated that coal will remain the primary domestic source of energy until 2010, accounting for over 95% of Poland's primary energy production and over 70% of total consumption. Together, hard coal (mostly bituminous) and soft coal (lignite) provide nearly all the fuel consumed in Poland's power plants, many of which provide heat and hot water as well as electricity. Hard coal public power stations account for 56.6% of total installed capacity. Lignite- fired public power stations represent 27.5%, industrial power stations 9.9%, and hydro power stations at 6%. Coal exports, which go primarily to customers in Europe and the Commonwealth of Independent States, have been a long and major source of foreign exchange.

Poland's power industry is the main source of the country's environmental degradation. The main ecological problems related to the power industry are: air pollution with SO_2, No_x, CO_2 and dusts, the contamination of the Vistuala and Odra Rivers with salted water from the Upper Silesian Coal Basin, and pollution of areas with tailings, after beneficiation of coal and furnace wastes.

The Polish government plans to restructure and reform the power industry by reducing coal production from 140 million tons in 1995 to 120 million tons by 2000. Eventually, coal's share in primary energy will decrease

continually between 2000-2010 by approximately 0.5% per year, with replacement needs being fulfilled by natural gas and oil. This comprehensive restructuring program has brought about changes that have created positive economic and environmental implications; changes that are imperative for Poland's accession to the EU. Increased consumption of natural gas as an alternative to coal, is considered to be a key component of Poland's plan to meet the strict regulations.

Since Poland produces small volumes of natural gas and produces far less than it consumes, efforts are being made to provide natural gas to areas that do not have it. Most domestic natural gas is produced in the western part of the country which has low energy content, and relies heavily on imports via pipeline from Russia. Plans for larger imports of Russian natural gas through the Yamal-Europe Transit Gas Pipeline are underway. Small volumes of natural gas are also imported via a border exchange with Germany. The state owned Polish Oil and Gas Company (POGC) controls the entire sector and has a monopoly on the importation, transmission, storage and distribution of . Although gas consumption is not currently increasing as quickly as expected, it is still projected to double by 2010. It is estimated that gas will represent about 20% of all fuel used by the Polish energy sector by 2010.

There are presently no gas or nuclear powered generating plants in operation. Construction of a nuclear power plant in Zarnowiec (northern Poland) was begun in the 1980's. However, following the disaster at Chernobyl, construction was halted in 1990 with no further plans for nuclear facilities. Still, the Polish government's policy aims at the diversification of fuels used in the Polish power sector.

According to the International Coal Report, Poland will have to build new power plants in order to face the increasing electricity demand. New power should be commissioned at the rate of 400 MWe per year in 2000-2004. This rate should be increased during the period 2004-2007, when older plants will be "decomissioned". There are currently several gas fired power plant projects under development which includes the construction of new power plants and the modernization of existing ones.
When the PPGC organized a tender for power generation projects based on sources other than coal and a preference put on natural gas, it led the way to the construction of Poland's first natural gas fired independent power project owned by the U.S. Enron Corporation. This 116 MWe CHP plant will formally begin operation at the beginning of the year 2000.

Poland has potential hydro power resources of 12-13 Twh per year, but only 15% of hydroelectricity is presently utilized. Total installed capacity of hydro power plants amounts to about 2008 MWe (about 7.3% capacity of national power system). Out of 21 hydro power plants, only 11 have a capacity of more than 10 MWe and four of these are peak-pump storage power plants. Although thermal power plants dominate Poland, the big hydropower plants play a key role during the off-peak periods, and pump water (with pumping units) to upper reservoirs, thus returning energy back to the grid during the peak load time.

The transmission subsector is still owned by PPGC and represents approximately 10% of the Polish electricity assets. The distribution sector consists of 33 joint-stock distribution companies and represent approximately 40% of all Polish electricity sectors. In 1998, the electricity consumption by households amounted to 19,771 GWh.

Technological inefficiency and severe environmental problems are fundamental issues facing the Polish power generation sector. According to estimates of the PPGC, almost two-thirds of the total installed capacity requires modernization and 2800 MWe will be decommissioned before 2005. The Polish government's policy for fuel use diversification in the Polish energy sector is one of the primary means of increasing the energy security of the country. Poland's status as an ascending EU member makes it even more imperative the country meets efficiency and environmental goals in a timely fashion. Poland committed to adapting its electricity market regulations in November 1998 to EU standards within four years. As previously stated, renovation costs alone will reach about $15 million by 2010, thus creating a great demand for investment.

Multilateral lending institutions, most notably the World Bank, U.S. Trade and Development Agency (TDA), European Bank for Reconstruction and Development (EBRD), and the International Finance Corporation (IFC) are interested in investing in Poland's power sector, such as financing and participating in projects ranging from building new, non-coal facilities to providing cleaner technologies for existing coal fired plants. The EBRD is focusing on joint venture arrangements in large turbine, gas-fired turbines, and hydro turbines as the best opportunities in the sector. The World Bank is heavily involved in the modernization projects within power generation, transmission and distribution. Privatization is the key to modernization and efficiency of the electricity sector. To date, only one generating plant has been fully privatized.

The renewable energy sector in Poland is fairly marginal. Except for small hydropower plants, no other renewable

energy sources are used in Poland. However, there is potential for geothermal and biomass energy. Geothermal energy resources in Poland are estimated to be significant, especially in the southern region of the country. Geothermal waters with a temperature of 70°C or more can be utilized during the winter months for heating purposes. There are several pilot projects throughout the Polish region. and the World Bank in Poland is involved in preparatory work for several possible renewable projects, including use of geothermal energy resources. Project sites are located in the Zakopane, Skierniewice, Stargard and Szczecin areas.

Despite the challenges, due to its prospects for tremendous growth, the U.S. Department of Commerce has designated Poland one of the world's ten Big Emerging Markets (BEMs). Opportunities for investment continue to exist while American companies lead investment in Poland, accounting for over one-fourth of all foreign investment. Prospect for real economic growth, size of the Polish Market and political stability are the top reasons most believe Poland is the best market in CEE for U.S. investment.

Government / Legislation

Poland was one of the first countries to liberate itself from Communist domination in the late 1980's and is essentially a stable democracy. The successive post-communist governments have contributed greatly to Poland's economic recovery with their devotion to a sound fiscal and monetary reform. In early 1997, the central government was reorganized, combining a number of economic-related ministries and separating the government's ownership of State Owned Enterprises (SOEs) and regulatory functions. However, changes of government have tended to limit structural reform and although a fast growing private sector currently dominates it's free-market economy, SOEs still play a decisive role, especially in the energy sector.

The Polish power sector has undergone a mass process of decentralization, demonopolization, and liberalization. The Polish government recently began the process of separating policymaking, regulatory and ownership functions. The Minister of Economy is responsible for preparation and implementation of national energy policy. The President of the Energy Regulatory Authority (ERA or URA) is responsible for the regulation of fuels and energy production, distribution and trade, as well as promotion of competitiveness in the sector. The Minister of State Treasury performs the ownership function of sector enterprises and together with the Minister of Economy, prepares the assumptions of ownership transformation policy in the energy sector.

Poland has disaggregated its power sector and now allows competition among independent generation companies. However, the power generation market is still subject to a variety of regulatory requirements. Also, independent transmission and distribution companies have been created that operate separately from generating companies. Privatization of electricity generation and distribution is also being considered, although the government plans to maintain 51% ownership of the transmission grid. The privatization of SOE is carried out by two methods: 1) Capital Privatization -joint stock enterprises, and 2) Direct Privatization. Foreign investors may also take part in the privatization process under certain requirements.

In November 1995, Poland began distributing vouchers under its mass privatization program which covers about 500 mid-sized companies. The vouchers, which ultimately will be redeemable for shares in 15 national investment funds are now being traded in a second market on the Warsaw Stock Exchange. The government is pursuing limited commercialization of major state owned companies in designated strategic sectors including energy, by forming sector based holding companies prior to full privatization.

Poland has instituted a regulatory and legal regime that protects property rights and investment, allows private business activity in almost every sector of the economy, provides generally equal treatment for domestic and foreign companies and permits the repatriation abroad of profits and capital. Overall, the current regulatory and legal regime complies with free-market principles and is supportive of foreign investment. The new constitution protects the rights of private ownership and succession and in 1996, Poland joined the Organization for Economic Cooperation and Development (OECD). Poland is also a member of the World Trade Organization (WTO).

Ministry of Economy

Established in June 1996, the Ministry of Economy's statutory task is to initiate and implement the state policy in the scope of economic development for the country and to provide for a coordination of the functions of various governmental bodies. These powers include foreign trade, energy and cooperation with economic self-government organizations. Duties include submitting guidelines for the energy policy of the state. Within the organizational structure of the Ministry is the Energy and Environment Department whose primary functions are:

- the elaboration of guidelines for the energy policy of the state and functioning of national energy systems to the Council of Ministers;

- shaping the national policy of governmental prices for electricity, gas and heat, and

- shaping the policy regarding the sector's impact on natural environment.

Tasks include the elaboration of industrial policy guidelines and of programs for industry, issuing opinions on privatization programs and projects, designing activities in support of technological progress in the economy, and cooperation in standardization and working on the implementation of the EU and WTO recommendations.

In September 1996, the Council of Ministers approved the document titled "Demonopolization and Privatization of Electrical Power Industry." It is a comprehensive program for liberalization of the electrical energy monopoly by introduction of a competitive market, privatization and decontrolled electricity prices. The document was prepared by the Ministry of Economy together with the Polish Power Grid Company. The program is a continuation of the power sector reconstruction process begun in 1990 and creates the basis for all the transformations which are currently taking place in the sector. The main features of this program are:

- introduction of competition in the energy generation sector by launching an electricity exchange and contract market;

- privatization of electrical power and CHP generation plants, privatization of Polish Power Grid S.A. and distribution companies;

- withdrawal of PPG from intervention in electricity wholesale trade; and

- freeing up of electricity and heat prices.

Electrical Power Generation

According to the program, all state-owned power and CHP generation plants should be first transformed into joint stock companies wholly owned by the State Treasury, and then privatized. Poland's power plants would be allowed to merge with one another, with the exception of giant plants forming a monopoly structure. The goal is to create five or six large profitable energy producers (about 5000 MWe) capable of providing financing for modernization and competing with each

other. Plants have the option of doing one of the following to remain in the market: 1) merge with another plan, 2) secure a long-term contract with PPGC for energy sales, or 3) merge with an energy distribution company. Those who do not find customers or strategic investors will be liquidated.

Electrical Power Transmission

The Polish Power Grid Company will remain an intermediary in the wholesale trade of electric energy in Poland for the next four to five years. Currently, the electricity exchange and contract markets are created, and ultimately, PPGC will be eliminated as the intermediary of electric sales. Distribution companies and large end-users will take over the long-term contract liabilities for electricity purchase from PPGC. Also, the National Power Dispatch (NPD), which is part of PPGC, will no longer have decisive and regulatory rights over power dispatching. Presently, NPD decides, on the lowest cost basis, which blocks in which stations are to be in operation. When competition develops and electricity pool and contract markets operate, such decisions will be made on the basis of sale/purchase offers presented by energy producers and buyers. NPD will be responding to market signals and this process will be largely automated.

Electrical Power Distribution Companies

These companies will be able to merge in order to create several large consortia capable of financing investment projects. The government is to intervene only if too many distribution companies would form a monopoly entity. According to the Energy Law, the distribution companies will be able to apply for a license for energy supply. The supply will have to be separated from the companies basic activity, such as electricity distribution. In the role of electricity suppliers, the distribution companies will be overseen by the Energy Regulatory Authority (ERA or URE), created under the energy bill.

Privatization

The main purpose of privatization is to create a competitive electricity market in Poland and to assure up-to-date technology and financing for investment projects. Poland's privatization program calls for the full privatization of all CHP plants and distribution companies. Prior to the adoption of the Energy Law, power plants could be privatized only as pilot projects.

The privatization of energy enterprises is regulated by the Law on Commercialization and Privatization of State-Owned Enterprises (SOEs). The authority responsible

for privatization is the Minister of State Treasury. The privatization of the power sector will likely involve either individually negotiated private sales transactions in which a strategic investor acquires a stake of shares of public offering of shares.

Restructuring and privatization of the energy sector has proceeded slowly due to opposition from trade unions and others. Some SOEs have been transformed into state-owned-joint-stock companies. Polish law does permit 100% foreign ownership of most corporations, however, Poland has declared that the state should retain a key role in certain strategic sectors including energy. Thus, the Polish State Treasury retains a significant stake and restricts foreign ownership to less than 50%. So far, only three companies have been privatized.

The Energy Law

The new Energy Law, was adopted by the Parliament on April 10, 1997, and came into force in December 1997. The legal framework created by the Energy Law provides a good foundation for the Polish energy sector to fit within the larger framework of the future European Union energy system. Supplementary legislation and regulations, which are necessary for the support of implementation of the new law, are still in the process of being drafted by the government.

The Energy Law defines the principles for developing a national energy policy, the principles and terms for the supply and use of fuels and energy, including heat and the operation of energy enterprises, and also designates the organizations that have jurisdiction over issues of fuel and energy economy. The purpose of the law is to create the conditions that will provide energy security, efficient and rational use of fuels and energy, development of competition, counteraction of the negative consequences of the existence of natural monopolies, environmental protection, customer interests and minimizing of costs. The Law regulates all areas of the energy sector except the exploration and utilization of natural resources which is covered by the Geological and Mining Law.

The Energy Law defines the conditions of conducting economic activities in the energy sector, and imposes certain obligations on economic entities and guarantees them certain rights. The key provisions of the law include:

- establishing a solid legal framework defining the rights and duties of producers, distributors and users of energy and putting licensing procedures into place;

- setting up an independent regulatory entity which would ensure competition within the energy sector; and

- guaranteeing Third Party Access (TPA) of enterprises to energy distribution grids or pipelines, provided the third parties produce energy domestically and have met contractual and governmental obligations.

The major task of the new law is to introduce a competitive market in the electric energy and gas industries. Under the law, energy enterprises will have to sign contracts for delivery of electric energy, gas and heat and will also have to follow the TPA rule allowing all domestic energy entities equal access to the electricity and gas networks.

Third Party Access (TPA)

The TPA rule is limited only to electricity and gas produced domestically. TPA will enable end-users to sign power purchase contracts directly with power producers and power supply companies. Currently, the electricity end-user is obliged to buy electricity from the regional energy company, a monopoly in the region. Electricity trading companies, i.e., electricity intermediaries, do not presently exist in Poland. The law creates the legal framework to develop the fourth electric energy market segment, electric power trading, in addition to production, transmission and distribution. In practice, this means that when an end-user is not satisfied with its energy company service, it will have the choice to turn to another electricity supplier. The owner of the electricity distribution network in the region will be obliged to render access to the distribution grid for another supplier (on a fee basis). Also, the Polish Power Grid Company will have to make their high voltage power grid accessible to other power trading companies.

Polish Power Grid Company (PPGC or PSE SA)

The PPGC was established in 1990 as a joint-stock company wholly owned by the State Treasury. The target of the PPGC is to ensure cost-efficient operation of the national power system allowing for different generation costs of individual power stations, transmission costs and international exchange. The functions of the PPGC include:

- power dispatching within the national power system in order to ensure continuity and reliability of supply;

- maintaining and developing technical infrastructure necessary for power dispatching;

- managing domestic electricity turnover (wholesale in electricity trade);
- cooperating of the national power system with foreign systems;
- operating and expanding the transmission system;
- maintaining technical reserves of the power transmission system Economic Chamber of *; and
- operating and construction of hydro-power stations and pumped storage power stations.

PPGC owns all transmission assets and a majority share in the Pumped Storage Power Stations Company. This company essentially provides a significant part of the power capacity regulation for the electric power system in Poland.

The privatization of PPGC is planned for 2000-2001. It will then turn over its shares in the long-term power purchase agreements to the distribution companies and will abandon concluding medium and long-term contracts. In the long term, PPGC will not be involved in the domestic trade of electric power. It will however remain the operator of the wholesale distribution of electric energy, as well as the power dispatch center for national energy generation system.

Energy Regulatory Agency (ERA)

The Energy Regulatory Agency (ERA) was established in 1987 to issue licenses for electricity, gas and heat production, transmission, distribution and domestic trade. The ERA also verifies and controls tariffs, supervises the contracts for power supply and intervenes with natural monopolies such as the power grid. The ERA consists of seven members, and the head of the ERA is appointed by the prime minister. Foreign trade in gas and electricity will require a license from the Ministry of Economy, and the necessary intermediary of Polish Oil and Gas Company (for gas) and Polish Power Grid (for electricity) will be required for local distribution.

The new law states that the Ministry of Economy is responsible for overall national energy policy, while the ERA has regulatory rights. A new mechanism for setting energy prices will be established. The government will gradually move away from centrally set prices in favor of prices resulting from completion and determined by energy producers under the supervision of the ERA. Regional electricity and gas price variations will be introduced. Two years after introduction of the energy law, electricity and gas prices will be freed.

Licensing

Conducting business activities within the area of generation, transformation, storage, transmission, distribution or trade of energy or fuels requires obtaining a license. Such licenses are granted by the President of the ERA for a period not shorter than 10 years and not longer than 50 years. Licenses may be issued to enterprises with their seat in the Republic of Poland that demonstrate availability of sufficient funds and technical capabilities, ensure employment of personnel with proper qualifications (as specified by the Energy Law) and have obtained a decision on the conditions of the site development with respect to a particular project.

Foreign trade in gas and electricity requires a license issued by the Minister of Economy, and the necessary intermediary of Polish Oil and Gas Company (gas) and Polish Power Grid (electricity) is required for local distribution.

Pricing and Tariffs

Formally as of January 1999, the prices of electricity and thermal energy are free. However, in order to limit the potential price volatility, the maximum level of price increases for 1999 have been set at 15% for electricity and 14% for thermal energy. The Minister of Finance retains the power to set tariffs for gaseous fuels until December 1999. The energy enterprises are obliged to establish their own tariffs that are subject to approval by the President of ERA. According to the Energy Law ordinances relating to the tariffs should provide detailed regulations aimed of maintaining a balance between coverage of justified costs incurred by energy enterprises and the protection of final consumers against unjustified prices. Under the Energy Law, the President of ERA may exempt the energy enterprises from the obligation of submitting its tariff for approval if he decides that such enterprise operates on a competitive market.

Polish Oil and Gas Company (POGC)

In the 1980's the Polish oil and gas industries were combined into a single legal and economic entity, which became the Polish Oil and Gas Company. This was accomplished in an attempt to improve coordination and efficiency of gas supplies form domestic sources with imported supplies. The POGC is a joint stock company wholly owned by the State Treasury. In recent years, POGC has been undergoing an economic and legal transformation, thus causing the restructuring of the entire oil and gas industry in Poland, considered a restructuring and privatization program. The primary goals of the program are to ensure improved efficiency

within the sector, including the introduction of commercial agreements for all services, transparent pricing for all consumers, and the preparation to face international competition.

Currently, POGC is the only producer of oil and natural gas, which are both marginal. The POGC holds a monopoly on the importation, transmission, storage and distribution of natural gas.

The Polish government considers the oil industry one of the sectors of strategic importance to national security. The domestic refining industry partially meets the demand for oil products and approximately 20% of liquid fuels are imported. Thus, the oil sector, both production and distribution, requires substantial investments in order to keep up with worldwide competition.

Major problems faced by the petroleum industry include lack of capital, obsolete technology, poor energy efficiency, excessive use of raw materials, low utilization of existing capacity (below 80%), and negative environmental impacts.

National Environmental Policy

Poland's "National Environmental Policy" was issued in 1990 and approved by National Parliament in 1991. It was the first of its kind to be issued by an Eastern European country. The document defines the main principles, priorities and goals of the environmental protection in Poland. It is also serving as the basis for further refinements in Poland's environmental policy, including the development of a National Environmental Action Program consistent with the Lucerne Agreement.

Poland's 1990 policy identified priorities for the short, medium and long term. Poland's air pollution control priorities include reducing sulfur dioxide emissions from coal combustion in existing and new boilers, use of "fluidized" bed and coal gas technologies, and substitution of district heating for individual stoves. Poland also plans to improve air quality through the use of lead-free gasoline, non-asbestos brakes, and coal-gasification.

As far as the electricity sector is concerned, Poland's priorities include: completing projects in progress, retrofitting existing capacities with more efficient generating units and environmental protection equipment, install more peak capacity, construct new base-load capacities, and improve the efficiency of transmission and distribution. The country also aims to

pursue new technologies, including combined gas cycle technologies and clean coal technologies.

Credit lines are available for environmental protection investments on preferential conditions, thanks to funds provided by internal sources as well as the World Bank, EBRD, and others. Poland has adopted the "polluter pays" principle. Fees and fines for use and pollution of the environment are being collected by the National and Regional Funds for Environmental Protection and Water Management. These funds offer preferential loans for environmental projects.

No specific law for Geothermal

In Poland, there is no specific law for the development of geothermal resources.


SWEDEN
Bornholm
(DENMARK)
Baltic Sea
0 50 100 km
0 50 100 mi
LITHUANIA
RUSSIA
Ustka
Gdynia
Kołobrzeg
Gdańsk
Swinoujście
Szczecin
Bydgoszcz
Białystok
GERMANY
BELARUS
Poznań
WARSAW
Łódź
Radom
Wrocław
Lublin
Częstochowa
Gliwice
Katowice
Rzeszów
Kraków
CZECH
REPUBLIC
UKRAINE
AUSTRIA
SLOVAKIA

Geothermal Sites / Projects

Low enthalpy geothermal waters have been known in Poland since the 10th century and used mainly for balneological purposes and health resorts.

Geologically, Poland's tectonic structure is complex and may be divided into three diverse tectonic provinces. The northeastern part of the country belongs to the Pre-Cambrian Eastern European craton. The Variscan fold belt of late Paleozoic consolidation dominates the western part of Poland. To the south, the Variscides border on the Alpine belt, which is represented by the western Carpathians (Geothermal Atlas, 1992).

According to other geotectonic criteria, Poland may be divided into two areas: a platform area, belonging to the Pre-Cambrian East European and Paleozoic West-European platforms, and an orogenic area (the Carpathians), belonging to the Alpine orogen. Geological megacomplexes and complexes are separated within the platform area while the orogenic area are divided into the Inner and Outer Carpathians. (Sokolowski, 1995)

According to the Geothermal Atlas, the system of deep reaching fractures running approximately from the northwest to the southeast, following the south-western margin of the East European platform, is called the Teisseyre-Tornquist Zone (TTZ) an area 50 to 90 km wide with anomalous character. The central and northern parts of the TTZ are distinguished by massive manifestations of salt tectonics, which may have greatly affected its local heat flow pattern. The crustal thickness of 50 km in the northern part of the TTZ increases about 55 km in its central part and is more than 60 km in a narrow strip area in its southern part. The depth of the consolidated basement varies from 10 to 12 km along the whole TTZ, confirming its thick sedimentation.

Heat flow observations are regularly monitored in the Polish territory and allow assessment of geothermal activity of all major tectonic areas along with the heat flow patterns of the country. Data has been acquired from borehole logging measurements using temperature gradients and conductivities. Low heat flow values are typical in the southwestern margin of the East European platform (northeastern Poland), and dominate regions where the PreCambrian basement is uplifted. Higher values are typical in areas of depressed basement, such as the Podlasie depression. Geothermal conditions vary within the TTZ and near the central area, many positive geothermal anomalies have been recorded relevant to salt diapirs present. The Paleozoic platform running west and south-west produce higher heat flow, with the highest value reported near Ladek. Meanwhile, the

geothermal activity in the Carpathian range increases from the outer to the inner tectonic units.

There are relatively few thermal springs or geothermal outflows in Poland. Over 80% of the Polish territory is built of geostructural sedimentary basins with numerous geothermal aquifers. The following geothermal Provinces and Regions were distinguished within the country. (Sokolowski, 1993):

- Polish Lowlands - part of Central European Province: with seven districts. (Lower Palaeozoic-Cretaceous). The reservoir temperatures range from 30 to 130 Deg. C. (1-3 km of depth). The Total Dissolved Solids (TDS) range from 1 to 300 g/l. Geothermal resources have been estimated for over 6,225 km^3 water with thermal energy equal to 32,458 million toe.

- Fore-Carpathians - with geothermal aquifers in Mesozoic-Tertiary formations. The reservoir temperatures range from 25 to 50 Deg. C. The TDS is variable, from several to ca. 100 g/l. Geothermal water resources have been estimated for 360 km^3 with thermal energy equal to 1,555 million toe.

- Carpathians - with geothermal aquifers in Mesozoic-Tertiary formations. The TDS range from 0.1 to ca. 100 g/l. Geothermal water resources have been estimated for 361 km^3 with thermal energy equal to 714 million toe.

- Sudetes-Holy Cross Region: with limited possibility of geothermal aquifers' occurrence (fractured Precambrian and Palaeozoic crystalline rocks). (Kepinska et al,1999)

For the above Provinces, the proven geothermal reserves (based on flow tests from numerous wells) amount from several l/s up to 55-150 l/s of geothermal water. The terrestrial heat flow values amount to 20-90 W/m^2, while geothermal gradients are in the range of 1-4 $^oC/100$ m. (Sokolowski, 1995).

Following are the above Districts found within the Polish Lowland Province. The following summaries are from the Geothermal Atlas:

Grudziadz-Warszawa District contains around 2.766 Km^3 of geothermal waters with an energy equivalent of 9.835 Mwt of standard fuel in the Cretaceous and Jurassic

sediments and additionally, 344 Km^3 of geothermal waters equivalent to 2.107 Mt of standard fuel in the Triassic sediments. The greatest resources - 1.845 Km^3 - are contained in the Liassic formation (Gorecki et al. 1986). The temperature of the Liassic waters at a depth of 1-3 Km varies from 25 deg. C to 90 deg. C and their salinity, from 2 to 110 gm/l, while their discharges measured by Sokolski et al (1986) ranged from .003 to 0.04 m^3/sec.

Szczecin-Lodz District (67,000 Km^2) contains resources of geothermal waters about 2.580 Km^3 with an energy equivalent of 16.627 Mt of standard fuel in Cretaceaous and Hurassic sediments. Additional 274 Km^3 of geothermal waters (2.185 Mt of standard fuel) have been found in the Triassic sediments. The greatest resources (1.935 Km^3) also are contained in the Liassic formation (Gorecki et al. 1986). The temperature of the Liassic waters at a depth of 1-3 Km varies from 25 deg. C to 90 deg. C and their salinity, from 2 to 110 gm/l, while their discharges measured by Sokolski et al (1986) ranged from .003 to 0.04 m^3/sec.

Foresudetes-North Swietokrzyski District (39,000 Km^2) contains around 155 KM^3 of geothermal water in Triassic and Permian sediments (995 Mt of standard fuel). These waters are highly mineralized (300 gm/liter).

Coastal District (12,000 Km^2) contains around 21 Km^3 of geothermal waters (162 Mt of standard fuel). The waters occur in several stratigraphic units of the Permian, Carboniferous and Devonian as well as of Liassic and Triassic ages.

Lublin District (12,000 Km^2) contains around 30 Km^3 of geothermal water (193 Mt of standard fuel) in Carboniferous and Devonian formations, characterized by low permeabilities and low discharges (Sokolowski, 1988).

Baltic District (15,000 Km^2) contains around 38 Km^3 of geothermal water (241 Mt of standard fuel) in Carboniferous and partly in Permian and Mesozoic formations

Podlasie District (7000 Km^2) contains around 17 Km^3 of geothermal waters (113 Mt of standard fuel) mainly in Cambrian and Permian formations (Sokolowski, 1988).

Systematically, the first publications showing interest in geothermal sources in the Tatra and Podhale regions in Poland appeared in the middle of the 19th century. Then, in the post war era, initiative of complex investigations of geothermal water occurrences in the Tatra mountains was undertaken by S. Sokolowski, who elaborated the project of a deep well in Zakopane. Geological and

drilling studies were continued, and the drilling of the exploratory well Banska IG-1 in the Podhale region (finished in 1981), proved the occurrence of geothermal waters with a very low mineralization (3g/l), high temperature (82°C) and with artesian pressure of about 26 atm. (Sokolowski,1995).

As a result of these findings, the Polish Academy of Sciences-Mineral and Energy Research Center (MEERC), Academy of Mining and Metallurgy and the State Institute of Geology, conducted detailed investigations. Not until the late 1980's was major research and investigations conducted in matters relating to geothermal water utilization for heating purposes. It was based on data from over 7,000 wells, extensive geological, hydrogeological and geophysical surveys conducted during the past years (Sokolowski, 1995). Recently, new data has been acquired from drillings and other work, with detailed exploration focused on the most promising areas of the Polish Lowland Province and the Podhale Region.

In 1997, the Cieplice Resort in the Sudetes Mountains experienced successful geothermal drilling. For the period of 1995-1999, three deep (2.5-3.5 km) production wells were drilled; two in the Podhale region and one in the Skierniewice town (Polish Lowland). One well was deepened from 660 m to 2002 m and tested (Cieplice Spa, the Sudetes Mts.). As a result, there have been several estimations of thermal potential and utilization projects for the wells previously drilled that revealed geothermal aquifers (Kepinska et al. 1998).

The Polish thermal reservoirs are exclusively low enthalpy and these geological conditions of geothermal water occurrence in Poland were a subject of numerous research works. No evidence has been found, so far of high enthalpy anomalies. There is one promising factor, however, that the thermal waters have, generally, a low mineralization content. This enhances their usefulness for direct heating purposes.

Geothermal energy use in Poland has been only on a limited scale and focused mainly on space heating and balneology. The research implementation works performed since the 1980's have resulted in starting up two geothermal stations in Poland. The country currently has only two geothermal plants on-line, with a third expected to be in operation sometime in 1999. The first was built in the Podhale region in Banska-Bialy Dunajec in 1994. It was initiated by the Polish Academy of Sciences to be commercially continued by Geotermia Podhalanska, SA. The other station was built in Pyrzyce in 1996 and is now operated by the company Geotermia Pyrzycka, Ltd.

The share of renewable energy as a source of energy in Poland is scarce. Thus, making greater use of Poland's low enthalpy geothermal resources could significantly help combat the serious pollution problems caused by years of burning coal for heating purposes. Favorable conditions of geothermal waters also occur over vast areas and in the long run, can be much cheaper than energy obtained from coal, oil or natural gas.

In 1998, the installed geothermal capacity was 36 MWt and although it used mainly as a local energy source, geothermal use will benefit in the reduction of pollutants generated by Poland's traditional heating systems.

Capacity of geothermal heating plants is expected to rise to 5.0 GW (up from 1.3 in 1995) and the capacity of geothermal power plants is expected to double.

The total investments in geothermal sector in Poland in 1995-1998 can be estimated as $50 million. They were financed by Polish means (National Fund for Environmental Protection and Water Management, Ecofund, Committee for Science Researches, counties, cities, geothermal companies) and from the foreign sources (PHARE, The World Bank, Danish, Italian and German means) (Kepinska, 1999).

The geothermal sites in Poland, listed according to District, Province, and Region, are:

I. *Grudziadz-Warsaw District*

1) Ciechocinek
2) Konstancin
3) Mszczonow
4) Skierniewice
5) Zyrardow

II. *Szczecin-Lodz District*

6) Chociwel
7) Czarnkow
8) Koto
9) Nowogard
10) Poddebice
11) Pyrzyce
12) Sleslin
13) Stargard Szczecinski
14) Uniejow
15) Wagrowiec

III. *Fore Carpathian Province*

16) Slominki

IV. *Carpathian Province*

17) Banska-BialyDunajec
18) Iwonicz
19) Myslenice
20) Sucha B
21) Ustron
22) Zakopane

V. *Sudetes-Holycross Region*

23) Cieplice
24) Duszniki Zdroj
25) Ladek Zdroj

GRUDZIADZ-WARSAW REGION

Ciechocinek	
LOCATION Located in Grudziadz-Warsaw Region	
STATUS Direct Use- developed	
TEMPERATURE (°C)	20-62
INSTALLED CAPACITY (MWt)	---
POTENTIAL (MWt)	---
CHRONOLOGY	
NOTES Spas using geothermal waters from springs or wells	

Konstancin	
LOCATION Located in Grudziadz-Warsaw Region	
STATUS Direct Use - developed	
TEMPERATURE (°C)	20-62
INSTALLED CAPACITY (MWt)	---
POTENTIAL (MWt)	---
CHRONOLOGY	
NOTES Spas using geothermal waters from springs or wells	

Mszczonow	
LOCATION Situated between Katowice and Warsaw approximately	

50 km southwest of Warsaw; located in the Grudziadz-Warsaw District.

STATUS
Direct use - developed.

TEMPERATURE (°C)	45
INSTALLED CAPACITY (MWt)	2
POTENTIAL (MWt)	—

CHRONOLOGY
1977 - 1 exploration well drilled, IG-1; encountered temperatures of 45ºC, well suppressed at depth of 4119 m.

1999 - Construction of recreation center began.

Fall 1999 - Pilot plant began operation.

NOTES
IG-1 was selected for the reconstruction and testing of a district heat and hot water project.

The pilot station will use geothermal water and its heat in the amount of 30-60 m^3/h, obtaining heat from the thermal water by a heat pump at the power of about 2 MWt.

The heating system in the Mszczonow town relies on thermal water from IG-1 well and is integrated with two systems: absorption heat pumps or compressed air heating pumps.

The pilot plant will reduce air pollution coming from burning about 4000 tons of coal dust and about 680 tons of ashes per year.

Skierniewice

LOCATION
In the central part of Poland near Warsaw; near 52º latitude, 20º longitude; located in the Grudziadz-Warsaw District

STATUS
Well(s) or hole(s) drilled

TEMPERATURE (°C)	70
INSTALLED CAPACITY (MWt)	—
POTENTIAL (MWt)	—

CHRONOLOGY
1991 and 1997 - 2 exploratory wells drilled, GT-1 and GT-2; each well would produce about 175 m^3/h thermal water at a temperature of around 70ºC. Plans

are to build six wells (in 3 doublets)
NOTES Work at both wells and hydrodynamic tests was performed by Geotermia Mazowiecka SA and financed by the Ministry of Environmental Protection, Natural Abundance and Forestry. This heating project would install absorptive heat pumps and be integrated with existing hot water boilers.

Zyrardow	
LOCATION In the central part of Poland, near Warsaw. Second town in the Skierniewice voivodeship; near 52º latitude, 20.5º longitude; in the Grudziadz-Warsaw District.	
STATUS Preliminary Identification/report	
TEMPERATURE (°C)	75
INSTALLED CAPACITY (MWt)	—
POTENTIAL (MWt)	—

CHRONOLOGY
NOTES Geotermia Mazowiecka S.A. is planning to drill three geothermal doublets in Zyrardow. Like Skierniewice, completion of the heating project will be started by building a geothermal plant the town's heating plant which currently supplies heat and hot water to over 11,000 people. Geothermal heat will be integrated with the plant by installing absorptive heating pump and using the existing coal boilers. Total project cost estimated at$7.4 million.

SZCZECIN-LODZ DISTRICT

Chociwel	
LOCATION Located in the Szczecin-Lodz District just outside Nowogard.	
STATUS Preliminary Identification/report	
TEMPERATURE (°C)	—

INSTALLED CAPACITY (MWt)	—
POTENTIAL (MWt)	—
CHRONOLOGY	
NOTES	

Czarnkow
LOCATION Located in the Szczecin-Lodz District, north of Wagrowiec.
STATUS Preliminary Identification/report
TEMPERATURE (°C) —
INSTALLED CAPACITY (MWt) —
POTENTIAL (MWt) —
CHRONOLOGY
NOTES

Koto
LOCATION Located in the Szczecin-Lodz District, north of Uniejow and south of Slesin; near 52º latitude, 19º longitude.
STATUS Preliminary Identification/report
TEMPERATURE (°C) —-
INSTALLED CAPACITY (MWt) —
POTENTIAL (MWt) —
CHRONOLOGY
NOTES

Nowogard
LOCATION Located in the Szczecin-Lodz District, north of Chociwel.
STATUS Preliminary Identification/ report
TEMPERATURE (°C) —
INSTALLED CAPACITY (MWt) —

POTENTIAL (MWt)	—
CHRONOLOGY	
NOTES	

Poddebice	
LOCATION Located in the Szczecin-Lodz District outside Uniejow.	
STATUS Preliminary Identification/report	
TEMPERATURE (°C)	—
INSTALLED CAPACITY (MWt)	—
POTENTIAL (MWt)	—
CHRONOLOGY	
NOTES	

Pyrzyce
LOCATION In northwestern Poland 40 KM south of Szczecin; in the Szczecin-Lodz District; near 53º latitude, 15º longitude.
STATUS Direct Use - developed
TEMPERATURE (°C) 45-95
INSTALLED CAPACITY (MWt) 50
POTENTIAL (MWt) 50
CHRONOLOGY 1996- First geothermal heating system in Poland began operating, replacing 68 traditional heating plants. The plant supplies central heating (95/45ºC) and hot water to 12,000 customers.
NOTES Pyrzyce was Poland's first geothermal heating system. A district heating system does not exist; buildings are heated by 68 individual coal fired boilers. The power of the plant was estimated at 50 Mwt to meet the demands of the town. Both the town and commune (known for intensive agricultural production) sit outside the area of Miedwie Lake, which is the main source of supply. The heating plant uses 2 production and 2 injection wells, each about 1700 m deep. Geothermal water is

pumped to the surface then flows to heat exchanges, heat pumps and again down to the injection well where it is injected into the same geological layer from which it came. The flow rate found at 103 kg/s of 61ºC water.

Discharge of a single well is about 200 m^3/h while water temperatures found in bedrocks are 64ºC; injected water is 26ºC. Geothermal water is aggressive with high salt content and other minerals. The total dissolved liquids (TDS) amounts to 120 g/l.

The project assumes the development of a town heat distribution network and construction of a heating plant. Plans to build transit pipeline networks connecting the plant with the heat distribution center in town are underway.

Sleslin	
LOCATION Located in the Szczecin-Lodz District outside Koto.	
STATUS Preliminary Identification/report	
TEMPERATURE (°C)	—
INSTALLED CAPACITY (MWt)	—
POTENTIAL (MWt)	—
CHRONOLOGY	
NOTES	

Stargard Szczecinski	
LOCATION Located in the Szczecin-Lodz District outside of Chociwel.	
STATUS Preliminary Identification report	
TEMPERATURE (°C)	—
INSTALLED CAPACITY (MWt)	—
POTENTIAL (MWt)	—
CHRONOLOGY	
NOTES	

Uniejow

LOCATION Located in the Szczecin District south of Koto; 52º latitude, 19º longitude.	
STATUS Direct use -- undeveloped	
TEMPERATURE (°C)	70
INSTALLED CAPACITY (MWt)	—
POTENTIAL (MWt)	—
CHRONOLOGY 1986 to 1991 - 3 geothermal wells drilled; analysis and estimations made. Fall 1998 - Flow tests and technical works on surface equipment performed; bidding opened up to replace a head in the well Uniejow PIG/AGH2. Replacement was made in November 1998 and well is currently ready for exploitation. 1999 - Construction of recreation center and heating system began.	
NOTES Geothermal water was found in Lower Cretaceous sandstones with temperatures of 70ºC and water flow rate of 90 m^3/h. Composition made waters useful for balneological and therapeutic purposes.	

Wagrowiec	
LOCATION Located in the Szczecin District south of Czarnkow.	
STATUS Preliminary Identification/report	
TEMPERATURE (°C)	—
INSTALLED CAPACITY (MWt)	—
POTENTIAL (MWt)	—
CHRONOLOGY	
NOTES	

FORE-CARPATHIAN PROVINCE

Slominki	
LOCATION Located in the Fore-Carpathian Province north of Krakow.	
STATUS	

Direct use -- undeveloped	
TEMPERATURE (°C)	20-23
INSTALLED CAPACITY (MWt)	—
POTENTIAL (MWt)	1.1 -2.2
CHRONOLOGY	

NOTES
One exploration well was drilled, Slomniki Well IG-1, which had a temperature of 20ºC at 200 m and 23ºC at 600 m (Dogger). The well was abandoned.

Work is being continued by Geothermal Laboratory MEERI PAS.

Future plans include building a recreation center heated by the geothermal resource.

CARPATHIAN PROVINCE

Banska- Bialy Dunajec

LOCATION
Located in the Podhale region, 10 km north of Zakopane and about 90 km south of Krakow; in the Carpathian Province; near 49º latitude, 20º longitude.

STATUS Direct use - developed.	
TEMPERATURE (°C)	80-100
INSTALLED CAPACITY (MWt)	15
POTENTIAL (MWt)	15

CHRONOLOGY
1989 - Polish Experimental Geothermal Station completed with installed capacity of 15 MWt; serves about 220 customers.

The station uses 2 wells: Banska IG-1 for production, and Bialy Dunajec PAN-1 for injection. The wells are 2500-3200 m deep and encountered temperatures of 86ºC, pressure of about 2.5 mpa, and an artesian flow rate of 150 l/s.

1998 - -New geothermal heat plant completed using 2 new wells: Bansak PGP-1 (2960 m) and Bialy Dunajec PGP-2 (2450 m). The main pipeline was run to ink geothermal heat station with the district heat station in Zakopane. The system serves another 7000 customers.

By 2001 - Geothermal heat and hot water will be delivered to about 4200 individual houses and 170 large-scale receivers in the central part of Podhale.

NOTES
Geotermia Podhalanska S.A. will extend the geothermal system towards the town of Nowy Targ, drill three new doublets, run a transmission pipeline there, build a peak heat station and distribution pipeline, and connect another 7000 customers. (Bujoakowski, 1999)

The project resulted in major reduction of emissions found in coal, gas and dust. Main sources of financing include the National Fund for Environmental Protection and Water Management, PHARE, Ekofundusz, and Geotermia Podhalanska S.A.

Iwonicz	
LOCATION Located in the Carpathian Province.	
STATUS Direct use - developed	
TEMPERATURE (°C)	20-62
INSTALLED CAPACITY (MWt)	—
POTENTIAL (MWt)	—
CHRONOLOGY	

NOTES
The Iwonicz Resort uses two wells for heating, and the 20ºC brines produced by two wells for the extraction of iodine-bromine which is used for medical and cosmetic salts.

Myslenice	
LOCATION Located in the Carpathian Province.	
STATUS Preliminary Identification/report	
TEMPERATURE (°C)	—
INSTALLED CAPACITY (MWt)	—
POTENTIAL (MWt)	—
CHRONOLOGY	
NOTES	

Sucha B	
LOCATION Located in the Carpathian Province.	
STATUS	

Preliminary Identification/report	
TEMPERATURE (°C)	—
INSTALLED CAPACITY (MWt)	—
POTENTIAL (MWt)	—
CHRONOLOGY	
NOTES	

Ustron	
LOCATION Located in the Carpathian Province near the border with the Czech Republic.	
STATUS Direct use - developed	
TEMPERATURE (°C)	20-62
INSTALLED CAPACITY (MWt)	—
POTENTIAL (MWt)	—
CHRONOLOGY	
NOTES Geothermal springs and wells are used for spas.	

Zakopane	
LOCATION Antalowka Hill in the Podhale region; in the Carpathian Province.	
STATUS Direct use - developed	
TEMPERATURE (°C)	26.6-36
INSTALLED CAPACITY (MWt)	20
POTENTIAL (MWt)	20
CHRONOLOGY 1963 - 1 exploration well drilled, Zakopane IG-1, which encountered temperature of 36ºC at 1540-1620 m; flow rate of 14l/s; TDS of 0.3 g/l. 1973 - Second well, Zakopane-2, drilled; well head temperature of 26.6ºC at 1113 m. Artesian flow of 22 l/s confirmed with average TDS at 0.3 g/l. Water chemistry of HCO_3-SO_4-Ca-Mg. 1997 - Central peak load plant built. 1998 - The average production from Zakopane IG-1 totaled 11/s flow rates with a temperature of 34ºC; and from Zakopane-2, totaled 6.5 l/s flow rates with	

temperatures of 24ºC.

1999 - Central peak load equipped with two water boilers of 10 MWt capacity each, gas fired, with economizers.

In the 1998-99 and 1999-2000 heating seasons, the plant will work as a gas plant (until connected with the geothermal system is Banska Nizna. It presently serves 60 buildings and to date has replaced eight large coal-based heating plants (Kepinska, 1999).

2000 to 2002 - Construction of a large, modern balneological and recreational complex will begin to replace existing swimming pool.

NOTES
The wells at Zakopane serve as a site for comprehensive research carried out by the Institute of Hydrogeology of Warsaw University.

The bathing site is one of the main attractions in Zakopane and is owned by the Polish Tatras S.A. company.

The central peak load plant has 3 functions:

1) Peak heat source (after connection of the heating system in Zakopane to the base load plant system in Banska Nizna.

2) Basic heat source (1998-2000), until the transmission pipeline form the geothermal base load plant in Banska Nizna is complete.

3) Reserve heat source for consumers located between Poronin pressure separation and Zakopane).

Poland also hopes to become the first former communist country to host the 2006Olympics, set in the Zakopane region, (Tatra mountains and Gubalowka ridges) and is considered a very serious contender, depending on the country's ability to clean up its air and water severely damaged from years of coal usage and the country's entry into the European Union. With geothermal projects in progress, especially in Zakopane, these hopes could be realized.

SUDETES-HOLYCROSS REGION

Cieplice

LOCATION
Located in the Western Sudetes Mountains in the Sudetes-Holycross Region.

STATUS Direct use - developed	
TEMPERATURE (°C)	20
INSTALLED CAPACITY (MWt)	—
POTENTIAL (MWt)	—
CHRONOLOGY	
NOTES Two boreholes, Cieplice 1 and Cieplice 2, have been drilled several hundred meters from the hot springs to 660 m and 750 m respectively. Artesian flow is considerable with Cieplice 2 flowing at 50m^3/h. Thermal waters occur within fissured Karkonosze granite. Faults running northwest-southeast and northeast to southwest are the main zones of the thermal water circulation.	

Duszniki Zdroj

LOCATION Located in the Sudetes Mountains in the Sudetes-Holycross Region.	
STATUS	
Direct use - developed	
TEMPERATURE (°C)	20
INSTALLED CAPACITY (MWt)	—
POTENTIAL (MWt)	—
CHRONOLOGY	
NOTES The geothermal resource is used for spas. Duszniki Resort has an on-line installation for CO_2 extraction discharged by a shallow well.	

Ladek Zdroj

LOCATION Located in the eastern part of the Sudetes Mountains, 450 m within the Biala Ladecka valley; in the Sudetes-Holycross Region.	
STATUS Direct use - developed	
TEMPERATURE (°C)	20-29
INSTALLED CAPACITY (MWt)	—
POTENTIAL (MWt)	—

CHRONOLOGY

NOTES

Two boreholes, Ladek 1 and Ladek 2, were drilled. Ladek 2 (700 m) yielded spontaneous flow and, although more than 600 m northeast of the hot springs, caused a decrease in their flow. Results suggest that a fault zone of southeast-northwest direction is the main zone of thermal water circulation. TDS is very low.

Thermal waters circulate in fissured Precambrian rocks and flow out from several springs characterized by constant yield and chemical composition of water.

Conclusion

Poland is facing an ever increasing demand for power in the coming decades. In this past decade, further progress has been made in the exploration and utilization of the country's rich and abundant low-enthalpy geothermal resources. This progress will ultimately benefit Poland's goal to reduce heavy pollutants in the environment generated by traditional heating systems.

To facilitate this, however, investment in the power sector is needed and legislation specific to geothermal resource development should be developed.

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