



# Geothermal-energy resources in the Polish Lowlands and the possibility of their industrial utilization

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## Abstract

Increasing participation of alternative energy sources (including geothermal energy) in the domestic sector will improve the natural environment of Poland. Also current recognition of geothermal energy reserves and conditions of their occurrence in the Polish Lowlands point to possibilities for their industrial-scale utilization. This, is confirmed by detailed cost-effectiveness analyses based upon the standard assessment methods for investment projects (NPV, IRR) made for some tens of towns in the Polish Lowlands. An example of the possible localization of cost-effective geothermal installation is the Czarnków project.

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*Keywords:* Geothermal energy; Reserves; Project cost-effectiveness assessment

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## 1. Introduction

As with members of the European Union and the majority of other countries in the world, Poland aims at achieving sustainable development in which the economy, environment and mineral resources protection are integrated into a coherent system. Such an attempt is represented also in prognoses for the development of the energy market issued by eminent institutions in the European Union and in the USA, which anticipate a significant increase of ecologically clean energy-sources in the balance of primary energy carriers in the succeeding years of the 21st century. For Poland, important is the standpoint of the European Union where current preferences aim at

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the reduction of greenhouse-gas emissions and other pollutant releases (including those originating from the fuel and energy sector) by an extension of the role of renewable energy sources in energy production.

Among the various renewable energy-sources available in Poland, geothermal energy may play an important role in both the local and regional energy balances. Studies and analyses carried on at the Department of Fossil Fuels of the University of Mining and Metallurgy in Kraków point out that utilization of reserves of environmentally clean geothermal energy in Poland is realistic and cost-effective over vast areas of potential geothermal aquifers in the Polish Lowlands. Considering the future membership of European Union, heat generation in Poland will be subjected to still more rigorous standards. Hence, the features of geothermal energy—low sensitivity to price fluctuations, renewable reserves and the lack of environmentally hazardous wastes—will probably cause the systematic growth of competitiveness of geothermal investments in comparison with traditional heat-generation methods.

The following paper aims to present the current opportunities provided by the utilization of geothermal energy in the Polish Lowlands. The estimated reserves of geothermal waters and energy will be given along with the selection of the most likely areas for development of geothermal installations. Moreover, the problems of economic effectiveness of geothermal plants will be commented on and an analysis for a cost-effective, geothermal plant in Czarńków will be presented.

## 2. Geothermal-energy reserves in the Polish Lowlands

### 2.1. General categorization of geothermal-energy reserves

The categorization of geothermal reserves applied in some countries [1] and based upon the temperature of heat-carrying media aims to separate the reserves suitable for electric-power generation (temperatures higher than or equal to 150 °C) from those available for direct utilization (temperatures below 150 °C). Moreover, the local and regional reserves are usually distinguished depending on the scale of possible utilization of geothermal-heat energy. In practice, both categorizations can be reduced to that which considers the energetic value of geothermal reserves.

In Poland for the specific conditions of geothermal-energy occurrence, i.e. the dominance of waters at temperatures usually below 90 °C, the following categorization of geothermal waters and energy has been applied [2–4]:

- **Accessible geothermal resources**—The amount of heat energy stored within the Earth's crust down to 3 km depth related to the average annual temperature at the surface, expressed in joules (J).
- **Static geothermal waters and energy resources**—The volume of free (gravitational) geothermal water filling the pores, fractures or cavities in the specific hydrogeothermal rock horizon, expressed in cubic metres or cubic kilometres or recalculated as energy in joules. Such “static” reserves are calculated if continuous water horizons or layers can be distinguished in the study area.

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