Geothermal energy in Poland

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Recent years have highlighted how much society relies on electricity. An additional aspect driving even greater demand for electricity is the electro-dependence of basic household appliances - from heating systems to kitchen appliances or smart systems controlling various components in buildings. All of this makes the lack of power supply impossible for normal functioning. In search of an alternative and following the rapidly growing and popularizing trend of renewable energy sources (RES), interest can be noticed not only in solar energy but also in the possibilities of obtaining thermal energy.

Geothermal energy in Poland has not yet gained as much popularity as other renewable energy sources. However, it is an option increasingly considered both in the prism of single-family housing and societal needs. Geothermal energy is the thermal energy stored in the Earth's mantle. It is formed due to the decay of radioactive elements, during which a large amount of energy is released. In addition, the mantle and core of the Earth emit residual energy left over from the period of our planet's formation. Large amounts of heat also come from a series of phase changes and chemical reactions, causing the temperature inside the Earth to reach several thousand Celsius degrees. As depth decreases, temperature decreases as well, representing the geothermal gradient. This is an indicator describing the change in temperature with depth. For Poland, this parameter is approximately 33°C/km (for contrast, this parameter for Iceland is even 100°C/km). The potential lying dormant in Polish geothermal energy is therefore promising, especially since the area with enhanced geothermal utilization overlaps to a significant extent with the location of agglomerations in southern, central, and western Poland.

Geothermal energy can be used to obtain heat or electricity. In Poland, there are natural sedimentary-structural basins filled with geothermal waters at various temperatures ranging from 20 to 80-90°C, and in extreme cases, over 100°C. These are therefore low-temperature deposits, which are ideal for heat extraction. High-temperature deposits, with temperatures exceeding 150°C, can be used for electricity generation. Such deposits have not been recorded in Poland, however a well is being drilled in Szaflary (in Podhale) to a depth above standard (about 7000 m). The temperature at its bottom is expected to exceed 160°C, and if water deposits occur at this depth, it will be possible to utilize thermal energy for electricity production. In November 2023, this well had a depth of 4000 m and the first water-bearing level was drilled at a temperature of 85-87°C. The year 2023 also saw the start of several drilling projects in Poland. Among other things, a research well was drilled in Wołomin near Warsaw, which met the project's assumptions, and it will be possible to exploit the deposit for the city's heating needs. Also, work began on drilling in Otwock. The estimated temperature of the deposit should range from 40 to 45°C, allowing for the exploitation of the deposit for the city's heating needs and the implementation of an investment related to restoring the spa character of the city. Increased interest in extracting heat from geothermal energy largely results from public support programs. The latest program implemented in the years 2020-2025 concerns carrying out geological works and research related to the exploration and recognition of thermal water deposits for their use. The budget for achieving the program's goal is PLN 480 million.

So far, nine geothermal heating plants operate in Poland: Bańska Niżna, Pyrzyce, Stargard Szczeciński, Mszczonów, Uniejów, Słomniki, Klikuszowa, Czarnków, Toruń. The largest geothermal heating plant in Poland is Geotermia Podhalańska (Bańska Niżna). It is located on the outskirts of the Podhale Basin, one of the most important geothermal areas in Poland. In Zakopane, at a depth of 1000 m, thermal waters' temperature accounts to approx. 26°C, while at depths below 2000 m in the Bańska Niżna area, the water temperature reaches a maximum of 86°C. The total installed capacity at Geotermia Podhalańska is 80.8 MW, of which 40.7 MW comes from geothermal energy. However, the total share of geothermal energy in Poland is only 0.2% in the prism of all renewable energy sources. The main problem in the development of geothermal energy in Poland is location, source efficiency, and the relatively high costs associated with conducting exploratory drilling and implementation. Moreover, such investments are burdened with the risk of obtaining resources with parameters worse than predicted or not obtaining them at all, which will result in a decrease in the economic efficiency of projects or even the impossibility of their implementation. Obtaining thermal water also does not guarantee success, as it is also possible to deplete resources or worsen their parameters. An example is geothermal energy in Kleszczów, where there has been a lowering of the water level, and as a result, in the last two years, the production of geothermal energy amounted to zero.

An alternative for individual consumers is the use of ground source heat pumps, which operate on a similar principle to systems used by heating plants. In single-family buildings, ground heat exchangers, both vertical and horizontal, can be used. In the case of a horizontal installation, the pipes through which the medium circulates are laid below the frost line, i.e. at a depth of about 1.0-1.5 m below ground level. Choosing this option is burdened by the fact that the area where the pipes are located cannot be later built on or shielded in any way, as the proper functioning of the installation requires the infiltration of rainwater into the ground. Additionally, trees cannot be planted near the installation, as over time they could damage the installation elements. The second option, i.e. the vertical installation, does not require the allocation of an area with limited possibilities of use, but the construction costs are higher than in case of a horizontal installation. The vertical system requires the drilling of wells, usually several, to place the installation elements in them. This is a solution that generates higher construction costs with lower operating costs. It also does not require the allocation of a large area of land, as in case of a horizontal installation.

Undoubtedly, the beneficial aspect of using geothermal energy is zero emissions in obtaining thermal energy and the natural process of replenishing the energy source. Furthermore, the installation is not burdensome for users; operating the heat pump does not require specialized training or the allocation of a separate room for operation or fuel storage, as in the case of thermal energy obtained from burning wood or coal. It is an alternative for obtaining thermal energy independent of external suppliers, as in the case of a gas installation. The amount of electricity required to operate the heat pump is so small that, with the additional use of renewable sources of electricity and energy banks, users can ensure independence for their households in crisis situations.

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