GEOTHERMAL DEVELOPMENT IN CENTRAL AND EASTERN EUROPE
TRANSFER OF TECHNOLOGY AND FINANCIAL RESOURCES

JÓN SIGURÐSSON

NORDIC INVESTMENT BANK
HELSINKI, FINLAND

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Abstract: *This paper surveys the geothermal potential in Poland, the Czech Republic, Slovakia and Hungary. It is shown that a significant part of the domestic heating needs of these countries could be met by geothermal resources, which would reduce air pollution in Central Europe. The author discusses the obstacles to the development of geothermal resources, such as unrealistically low energy prices and weak financial and institutional infrastructure, and puts them in the context of the transition of the countries in Central and Eastern Europe from command to market economy. He emphasizes the need for market price reform, new financing mechanisms and technology-transfer to promote geothermal development in the formerly communist countries, as well as the importance of well-prepared pilot projects.*

INTRODUCTION

It is common knowledge in economic history that an abundance of natural resources is neither a sufficient nor even a necessary condition for economic progress. History is replete with such examples. The European countries that fell under the spell of communism for a substantial part of the twentieth century provide ample evidence of this. Many of them are richly endowed with natural resources, but the system of government and economy under communism led to an enormous waste of resources. After the collapse of communism it became clear that the communist system had been not only inefficient, but also abusive of the environment. Sustainable material benefits cannot be won through despoliation of the environment. On the contrary, economic efficiency and environmental protection go hand in hand, if proper regard is paid to all costs and prices in the exploitation of natural resources. The development of geothermal resources is a case in point.

Many of the countries of Central and Eastern Europe that are now in the process of transition from command to market economic systems have considerable geothermal potential that could be developed to increase energy supply and to reduce atmospheric pollution. The indiscriminate use of fossil fuels for industrial and domestic heating is a serious economic and environmental problem in many of the countries in transition. Even if geothermal sources, properly harnessed, can make only a limited contribution to overall energy supply, they have the added advantage of providing the means to improve the quality of everyday life through cleaner air and better space heating.

1. THE POTENTIAL

Surveys that have been made of the geothermal energy potential in Central and Eastern Europe (Pálmason 1990, Fridleifsson 1993, Fridleifsson and Freeston 1994) show clearly that throughout the region there are exploitable sources in reasonable proximity to populated areas, which obviously is a prerequisite for the economic harnessing of low-temperature geothermal fields. I have chosen to look mainly at four countries: Poland, the Czech Republic, Slovakia and Hungary, the so-called Visegrad countries. In many other Eastern European countries there are also clear indications of economically exploitable geothermal resources, e.g. in Romania, Bulgaria, Croatia, Ukraine, Georgia, in the Caucasus region of Russia and also further afield in the former Soviet Union, e.g. in Kamchatka and the Kuril Island in the Pacific.

To illustrate the energy potential of geothermal resources in the transition countries, the Visegrad group provides interesting examples. The maps (fig. 1-4) indicate the location of known geothermal fields in these countries. In all four countries, geothermal sources have been utilized for centuries. Historically, however, the natural flow from surface hot springs has mainly been used for baths, health spas and some horticultural and agricultural applications. Hitherto, systematic exploitation on a significant scale for efficient space heating or industrial use has been very limited.

Poland

Poland is relatively well-endowed with low-enthalpy geothermal resources. These resources are mainly located in the fore-Carpathians, Carpathians and in the sedimentary basins of the Polish Lowlands.

Fig. 1. Geothermal Resources in Poland

Natural hot springs in the Sudeten reginn of south-west Poland have been used for baths and health spas for a thousand years or more in places such as Cieplice and Ladek. In the Podhale district of the Taua mountains in the south-east, promising geothermal resources have in recent years been located through deep drilling. These resources could he used for district heating in Zakopane and Nowy Targ, but also far developing health resorts and tourism.

According to recent studies, based on geological and petroleum exploration, the total potential heat energy contained in geothermal waters in Poland has tentatively been estimated at close to 35 billion tons of Standard Fuel. Only a very small fraction of this potential has *so* far been utilized. (Gladysz et al., 1994, Sokolowski, 1993). A significant part of this potential is thought to he economically exploitable, making geothermal waters an important alternative energy source for district heating, horticulture and agriculture. The harnessing of this resource would also make an important contribution to environmental protection. It has been estimated that heating Poland with geothermal energy and natural gas could reduce present-day pollutanr emissions by about some 25-35% (Sokolowski, 1993). Several studies also indicate that the cost of geothermal heating may in some cases be lower than that of conventional energy sources such as coal, lignite, natural gas or fuel oil (Sokolowski, 1993).

The Czech Republic

In the Czech Republic, as in Poland, there is also a long tradition for baths and spas based on natural hot springs in places such as Karlovy Vary, Marianske Lame and Teplice. But other uses based on the systematic exploitation of geothermal resources through drilling and pumping have been rather limited. Even if the Czech Republic is relatively less endowed with geothermal resources than its neighbours, Poland and Slovakia, the thermal waters still represent a viable potential source of energy.

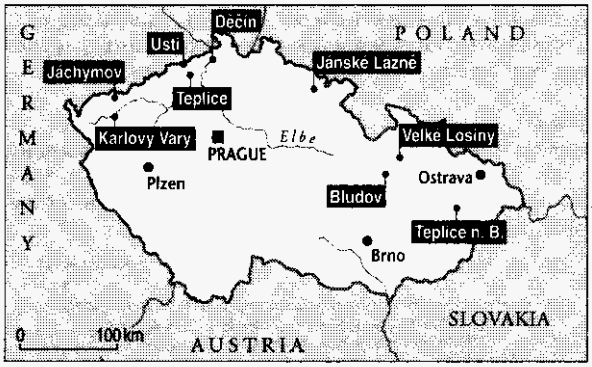

Fig. 2. Geothermal Resources in the Czech Republic

Various theoretical studies indicate that the heat-energy potential of geothermal waters in the Czech Republic may be of the order of 3,300 MW (O.Franko et al., 1990, and an unpublished note by J. Franko, 1994). This figure is by its very nature highly tentative and, due to the dispersed and local nature of the resource, its potential economic importance greatly depends on the mode and intensity of utilization. But it seems likely that a significant proportion of the domestic heating needs in the Czech Republic could be met with geothermal water instead of fossil fuels (Jónatansson, 1993).

Slovakia

The geothermal potential in Slovakia is of considerable significance. Geothermal resources are found both under the Danube-plain near Bratislava in aquiferous layers of sand- and limestone and in limestone layers in the easternmost pan of rhe counuy, and in the Tatra mountains in the north Slovakia too has a tradition of health spas based on natural hot spnngs, but recent years have brought some limited development of geothermal energy for heating systems

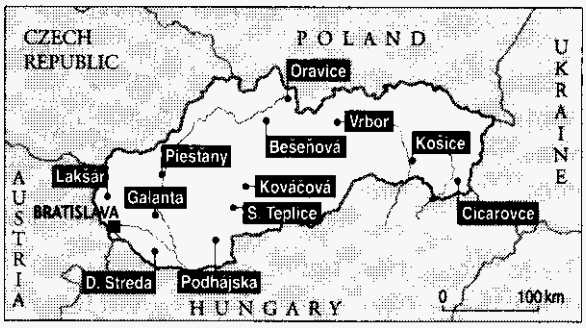

Fig. 3. Geothermal Resources in Slovakia

It is quite clear that the geothermal resources of **Slovakia** are considerably more important than those of the Czech Republic It has been estimated (O Franko et al 1990, and an unpublished note by J Franko, 1994) by much the Same methods as for the Czech Republic that the heat-energy potential of geothermal resources in Slovakia is around **5,700** MW in power, of which probably 40% is economically exploitable These quantitative indications are highly tentative, hut they indicate that it is indeed worthwhile to continue the exploration of the geothermal potential in Slovakia in order to replace fossil fuel, wherever economically feasible, with geothermal energy A reduction in a r pollution would be an added benefit to the economic gain from geothermal development

Hungary

Naturally flowing thermal spnngs indicate above average geothermal activity in Hungary and have been used for bathing since antiquity Thermal springs occur manly in two areas (1) the weaern part of Budapest and (2) the Hévíz area south-west of Lake Balaton In the 20th century, manly as a by-product of oil explorauon, substantial reserves of geothermal water have been discovered in sedimentary strata under the Pannonian pldne Among the Central and Eastern European countries, Hungary has been a leader in the utilization of geothermal energy, yet only a minor fraction of its geothermal potential has been developed *so* far

Fig. 4. Geothermal Resources in Hungary

In recent decades a significant use of thermal water has been developed for horticultural and agricultural purposes in greenhouses (Ottlik et al., 1981). In recent years, more modern technology has been employed to harness geothermal resources in Hungary, but the systems in use remain relatively primitive, have low energy efficiency and do not optimize production from the geothermal reservoirs. Better solutions are also needed to deal with the environmental impact of geothermal development.

No comprehensive estimates are available for the total economically exploitable geothermal resources in Hungary. but it is certain that only a very small fraction of this potential has been harnessed. It has been tentatively estimated that some 10-12% of the heating needs of Hungary's urban papulation could economically be met with geothermal energy (Jónatansson, 1993). In several Hungarian towns, plans have been made for geothermal heating systems, which could result in considerable economic and environmental benefits (Jónatansson, 1993).

Visegrad countries

Summing up, it does not seem farfetched to say that up to 10% of the space heating needs of the Visegrad countries could economically be met using low-temperature geothermal energy instead of conventional fuel (Jónatansson, 1993). Such a replacement of fossil fuels would reduce air pollution in Central Europe significantly. This is not only in the interest of the inhabitants of the Visegrad countries, but also in that of their neighbours. In view of the serious environmental problems facing Central and Eastern Europe and the economic significance of the potential energy savings, it is of great importance to pursue the study of the geothermal potential and its harnessing in these countries.

2. THE OBSTACLES

The technology for the utilization of geothermal heat is already established and available. Exploitation can be made commercially successful on a significant scale at prevailing world market oil prices. In addition, the substitution of geothermal for fossil energy sources has a significant positive effect on air quality. *So* why is it that the Central and Eastern European counmes have not developed their geothermal resources? The reasons are manifold, and some of them have to do with the heritage of the communist system.

It is difficult to generalize about this issue, but obstacles to the development of efficient consumer services are to some extent rooted in the priority given under communism to the military and other state activities. Intellectual effort simply did not focus on solving the everyday problems of the household sector. It is clear that the central planning mechanism and inadequate pricing of intermediate goods and services, including energy, with prices too low to cover the full real cost of supply, did not give priority to or provide incentives for the effective provision of services such as space heating. For these reasons, energy efficiency was not given priority. Inadequate insulation of buildings and pipelines was the rule rather than the exception, and heating and ventilation systems paid scant regard to real energy costs. Collective housing seldom had individual heat meters for each dwelling unit, which further reduced consumer awareness of the real costs of heating. The inflexible central planning of the supply of energy could at the same time be wasteful of energy and unsatisfactory for private household needs.

These are some of the root causes of lack of investment in efficient heating systems in general and in geothermal energy development in particular. The most profound problem is the unrealistically low price of intermediate products. including energy, which in fact is still prevalent in many of the countries in transition. It is also a fact that the use of geothermal energy requires (in common with most other renewable and nuclear energy technologies) the bulk of the costs over the lifetime of the project to be incurred prior to start-up of the operation. Expenditures on exploration of the geothermal resource and other pre-investment costs are large compared with conventional fuel heating systems. The costs and benefits are, of course, always project specific and the profitability of geothermal projects depends heavily on the price of conventional fuels and the cost of capital, i.e. interest rates, but the circumstances in the general economic environment described above have been an impediment to geothermal development.

These considerations bring us out of the nexus of problems belonging to the communist heritage and into the problems of transition and the policies of both the authorities of the countries in transition and the fin.ncial institutions that are actively engaged in facilitating the transition and the transfer of resources and technology from the Western democratic counmes lo Central and Eastern Europe. The decision-makers on both sides tend to favour large scale projects with very shon pay-back periods and high internal rates of return in a Strictly commercial sense. There is also a tendency to favour export-oriented rather than import-saving projects. Furthermore, there may still be an inclination to favour high-profile, national projects. Projects aiming at direct use of geothermal heat are most often relatively small and low-key, and always local rather than national in character.

The environmental impact of geothermal energy systems is clearly dependent on local site conditions and the choice of technology. However, geothermal systems generally can have an impact on the environment through one or more of the following: airborne emissions, solid wastes, brine disposal, chemical and thermal pollution of surface and ground water, noise, induced seismicity and ground subsidence. It is important to consider all these potential impacts for each project separately and compare them with alternative energy sources. In most cases the environmental impact of geothermal solutions compares very favourably with Conventional fuel systems. In spite of the desire of the countries in transition to give high priority to investments in environmental protection, financing may be more difficult to find far geothermal projects as the environmental benefits do not directly show up in the cash-flows of the projects. But in spite of all these obstacles, there are good examples of geothermal projects with a satisfactory financial rate of return.

3. NEED FOR NEW FINANCING MECHANISMS

A thorough understanding of the obstacles to investment in geothermal energy is necessary for effective remedial action by national authorities as well as by an international community desiring to facilitate the process of transition. The key to a successful geothermal project is to ensure by careful surveying, exploration, evaluation and monitoring that there is a good match between the scheduled lifetime of the necessary installations and the endurance of the geothermal reservoir itself. and that the project will pay its way, calculating all inputs and outputs at market prices.

Grants

The Visegrad counmes (and several other Eastern European countries) have made initial country surveys of geothermal activity and have outstanding geologists and geophysicists to carry out further surveys. But there is a need for financial support for surveying and exploration as well as for the transfer of knowledge of modern geothermal technology and its management. There is a need to train professionals for these specialized tasks and to assist local authorities and entrepreneurs in making feasibility studies for the most promising projects.

Grants for these tasks constitute without doubt a very effective

use of technical assistance funds.

Because of the environmental benefits derived from geothermal energy use, consideration should also be given to a system of outright grants to get geothermal project investment going beyond the surveying, exploring and feasibility study stages. In some Western European countries, public grants are given for geothermal exploration and later converted into commercially priced loans if the project turns out to be profitable.

Lines of Credit

Most importantly, there need to be special financing mechanisms to provide financing for public utilities interested in geothermal district heating systems. One important approach to this problem would be for the multilateral financial institutions to establish lines of credit with national lending institutions in each country for this purpose, as most individual projects of this kind may be too small to warrant separate loans from the multilateral banks. In this way, financing would be further facilitated if these countries' governments would demonstrate their support by putting sovereign guarantees behind such lines of credit, and national financial intermediaries to provide finance for local authorities and reliable companies wanting to undertake long-term investments in energy efficiency and renewable energy. The financial position of the local authorities or utility companies that are responsible for heating systems is weak in most of the countries in transition, and so central government backing is needed for significant investments.

It is important to recognize that it is precisely during the transition phase that official government backing is needed, while the domestic prices of fossil fuels are being brought up to world market prices and a stable economic environment established. Careful studies need to be made in each case of whether district hearing systems are more efficient than individual household heating systems, e.g. systems based on natural gas. using separate heating units for each household. But the environmental aspects should always be considered when assessing the costs and benefits of alternative systems.

The Example of the Visegrad Countries

For a successful transition to democracy and market economy it is essential to develop efficient consumer-oriented infrastructures in the countries in transition to improve the quality of daily life. Far this reason it may be necessary to adopt new methods and financial mechanisms. The most important single, general measure is comprehensive price reform including all the prices in the input/output table of the economy. In the long run the introduction of market prices for energy - as well as for other goods and services - will create new possibilities for the harnessing of geothermal resources.

A general economic environment that is conducive to sound investment is a very important condition for economic progress. In this respect we face a very contrasting situation among the countries in transition. On the one hand, we have countries where structural reform and macro-economic stabilisation are well underway and whose economic performance is improving, such as the Visegrad and Baltic countries. On the other hand there are countries in transition that are still wrestling with the initial problems of political and structural reform, and where the economic situation is still very difficult. There is a clear need to demonstrate that the transition to democracy and a market economy can bring with it positive social development and improved living standards. The Visegrad countries could and should lead the way. It is not enough to achieve short-term economic stabilisation. Essential to sustainable economic growth is opportunity for local utilities and small and medium- size businesses to develop. For this purpose, market-oriented local financial institutions are of critical importance. A coordinated effort is needed among the international financial institutions that are engaged in assisting the transition process in central and eastern Europe and the former Soviet Union, to refinance local financial intermediaries and to attract other sources of finance, public as well as private, for this important task. The European Bank for Reconstruction and Development, the World Bank and its affiliates, the European Investment Bank and the Nordic Investment Bank and other agencies assisting in the transition process should separately and jointly address this question.

4. PILOT PROJECTS

Successful pilot projects that demonstrate the advantages of geothermal energy are very important for the future of geothermal development. For this purpose, it is advisable to build on existing geothermal systems, improving and extending them, technically and economically. Small-scale projects are best suited to this task.

A promising pilot project is being implemented by the town council of Pyrzyce in Poland, where a combined geothermal/natural gas power plant is under construction to heat this town of 14,000 residents. (Sokolowski, 1993). Another interesting pilot project is under way in the Slovakian town of Galanta where the local authorities, together with the government owned gas company, Slovensky Plynarensky Priemysel, the Nordic Environment Finance Corporation, and Icelandic interests have formed a company to build and operate a geothermal district heating system for the town's 35,000 inhabitants, 1,300 households, schools, hospital and health facilities. It is expected that the Icelandic shareholders will contribute not only project engineering and financing but also provide management support for the operation of the system on the basis of many decades of experience of running geothermal heating systems with great success in the city of Reykjavik and other Icelandic communities.

The Galanta project is seen to he technically, financially and economically viable, with an estimated internal rate of return before taxes of more than 10%, a sustainable cash-flow through the lifetime of the project, and a pay-back period of 7-8 years. The preparations for the project have been made by the Galanta city council. The existing district heating system will be upgraded and provided with geothermally heated water. This interesting project will also be partly financed by the Nordic Investment Bank, and pre-investment support was granted to the project by the Nordic Project Fund. The Galanta project seems to contain all the necessary elements for a good pilot project: careful local preparation, good international cooperation and transfer of financial resources and technology to improve energy efficiency and economy in the heating system of this small Slovakian community. Hopefully, the gallant examples of Galanta and Pyrzyce are a harbinger of a new phase of geothermal development in Central and Eastern Europe.

5. CONCLUSIONS

The main conclusions that can be drawn from the available material on geothermal potential in the four Visegrad countries are the following:

- A significant proportion of space heating needs could be economically met using geothermal resources.
- Development of geothermal energy to replace fossil fuel could reduce air pollution in Central Europe significantly.
- Price reform is needed to secure realistic market-based pricing of energy, which would facilitate investment in geothermal energy systems.
- New financing mechanisms are needed to promote investment in energy efficiency and renewable energy. The multilateral financial institutions operating in the counmes in transition should establish special lines of credit for this purpose in cooperation with national financial intermediaries. It is particularly important that the central governments in the transition countries back up the local authorities in this undertaking.
- Transfer of technology and management know-how for geothermal systems from countries that have developed expertise in this field is as imponant as the transfer of financial resources.
- Well-prepared pilot projects are important to demonstrate the potential for geothermal development to improve energy efficiency and air quality.

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