POSSIBILITIES FOR GEOTHERMAL DEVELOPMENT IN CENTRAL/EAST EUROPEAN COUNTRIES

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ABSTRACT

Central/East European region is composed mainly from the states of ex-East block, neighboring a group of countries with different level of development and political future. They altogether compose a region with a challenging market for development of different economy sectors, being of great interest for the EC.

When geothermal energy is in question, Central/East European countries have a rather different character and disposition of resources and different previous experience in application. Probably no one separately is interesting for concentration of efforts and capital of an EC organized action for further and intensive development but altogether, that is presently the most attractive region in the world for development of low enthalpy direct application of geothermal energy. Some facts, information and data are given in this paper, confirming the justifiableness of it. Most attractive sub-regions are identified and feasible directions of development underlined. Also, necessary measures and initial organizational activities are identified and a kind of strategic approach proposed.

Fig.1. Central/East European countries

INTRODUCTION

New EC member states Czech Republic, Slovakia, Poland, Lithuania, Latvia, Estonia, Hungary and Slovenia, together with the candidate countries Bulgaria and Romania, and neighboring Croatia, Bosnia & Herzegovina, Macedonia, Serbia & Montenegro, Belarus, Moldova and Ukraine plus the European part of the Russian Federation create a characteristic region of a great interest for EC. Accommodation of the economy systems of the member and candidate states is connected with the break or reorganization of the traditional and still present inter-connections and dependences with the neighboring countries. From one side, that results with loose of some markets but, from the other side, that opens new ones not only for the states in

question but also for the other EC members.

Geothermal energy application is probably of very marginal importance in all these processes of economy transition and inter-accommodation. However, it is necessary not to forget that most of the countries in question are poor with energy sources and that nearly all of them have inheritance of a developed dirty industries and intensive energy use and production based on coal or heavy oil. Not only the obligation according to the Kyoto protocol but for all of them a real need exists to liberate of these negative factors for the human environment due to the pure economy reasons. It's for sure that only one solution to resolve the problem doesn't exist but different combinations of existing natural and convenient economical solutions, accommodated to the possibilities of concrete region or country. Not everywhere but in some of them geothermal energy can give a significant positive contribution.

1. STATE-OF-THE-ART OF GEOTHERMAL ENERGY APPLICATION

1.1. Geothermal resource and application

Active hydro-geothermal resource in the countries of Central/Eastern Europe can be followed in the Table.1, where also the data for the heat power and annual utilization of geothermal energy are given. It is immediately clear that the biggest resources are concentrated in the South/East European Region and in Russia. However for the later one, the data is not only for the European but also for the Asian and far East part of the biggest country in the world. Even the level of exploration is very different across the region, it is possible to state that the possibilities of development of new hydro-geothermal resources are similar to the present distribution of the active part of it (Fig.2, 3).

Country	Flow kg/s	Capacity MWt	Annual Utilization TJ/yr	GWh/yr
Bulgaria	1,690	107.2	1,637	455
Croatia	927	113.9	555	154
Czech Republic	12.5	128	36	0.33
Georgia	894	250.0	6,307	1,752
Hungary	677	328.3	2,825	785
Lithuania	13	21.0	599	166
Macedonia	761	81.2	510	142
Poland	242	68.5	275	76
Romania	890	152.4	2,871	797
Russia	1,466	307.0	6,132	1,703
Serbia	827	80.0	2,375	660
Slovak Republic	623	132.3	2,118	588
Slovenia	656	42.0	705	196

(According to Lund, Freeston, 2000)

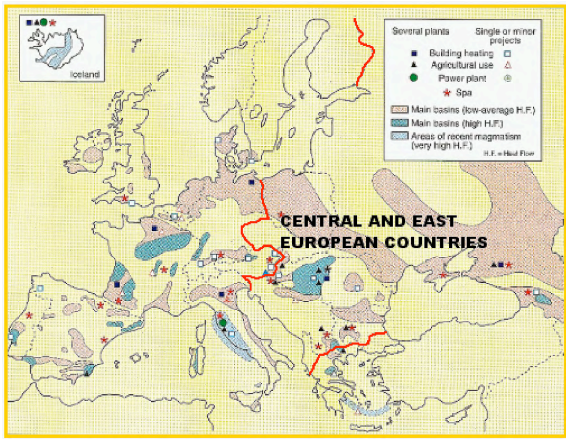
Table 1. Geothermal energy use for direct application in Central/East European countries

GEOTHERMAL ENERGY USE IN CENTRAL/EAST EUROPEAN COUNTRIES

Geothermally Heated Greenhouses in East & South/East European Contries			
Hungary			130.40 ha
Macedonia			62.46 ha
Greece			17.95 ha
Bulgaria			17.60 ha
Slovakia			17.36 ha
Georgia			16.50 ha
Romania			13.00 ha
Serbia			10.13 ha
Slovenia			6.00 ha
Bosnia&Herzegovina			2.00 ha
Croatia			0.25 ha
Total	68.55%	35.25%	293.69 ha
Europe	100%	51.42%	428.45 ha
World		100%	833.11 ha

(Popovski, 1998)

Table 2. Geothermally heated greenhouses in Central/East European countries



(Aquater, 2000)

Fig.2. European geothermal resources

(Kononov, 2000)

Fig.3. Russian geothermal resources

1.2. Technologies

Most of the applied technologies have been developed during the 80-es of the last century, with the exceptions of some new projects in Poland, Lithuania, Slovakia and Hungary which have been completed during the recent decade. Their characteristics are as follows:

1.2.1. Heating Greenhouses with Geothermal Energy

In many countries of the region that was the initial direct application of geothermal energy and is still a rather important part of the present geothermal energy utilization. Although not in order of importance the reasons for that were:

1. Good correlation between the sites of greenhouse production areas and low enthalpy geothermal reservoirs.
2. The fact that greenhouses are one of the largest energy consumers in agriculture.
3. Geothermal energy requires relatively simple heating systems, but advanced computerized installations can later be added for total conditioning of the inside climate in the greenhouses.
4. Economic competitiveness of geothermal energy for greenhouse heating in many situations.
5. Strategic importance of energy sources that are locally available for food production.

Even the first applications appeared before (Macedonia, 1962), the real development began during the energy crisis of 70-es of the last century. Practically, there was no East and South/East European country (Table 2), where some trial has not been made. That is the region with the most dense concentration of geothermally heated greenhouses in the world.

Quality and type of the applied technical solutions depended on the type of greenhouse construction. Normally, in the socialist countries, these were large glasshouse complexes (6 ha units or larger), in opposite to the other European countries, where small soft plastic covered greenhouses (0.2 to 1000 m^2) has been heated. First type conditioned completion of large heating systems and professional team for its exploitation, and the second one didn't allow such an organization, i.e. growers themself governed the exploitation of the geothermal heating systems.

Typical type of heating installation of the first group has been with heating registers made of steel pipes positioned along the growing rows of the plant (Fig.4), or below the benches (Fig.5). For the second group, normally it was an installation made of corrugated or smooth plastic pipes positioned on the soil surface along the rows (Fig.6). Normally, higher temperature regimes have been applied in the first and lower in the second group. In addition, efforts to reach full conditioning of the air temperature in the greenhouse interior have been put in the first, and only its increase in comparison with the outside one in the second group.

Main resulting difference is that positive experience of the geothermal energy application has been understood by the decision makers as a serious possibility to increase the economy of greenhouses application in the East European countries (Macedonia and Hungary) and as a not interesting "play" of scientists in the West ones. Trials with larger units in Italy and France couldn't change the initial impression and they have been abandoned later on.

Fig.4. Heating installation of metal pipes positioned above the crop and between the cultivation rows (Vinica, Macedonia)

Fig.5. Heating installations positioned below the benches (Vinica, Macedonia)

However, from the technical point of view, it is important that it was proven that satisfactory heating can be reached with the use of low-temperature heating fluids and cheap and simple heating installations made of plastic pipes. Even more, they can be better accommodated to the re-

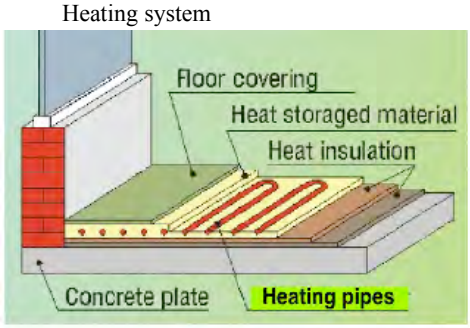
quests of modern growing technologies than the expensive metallic ones. As result of that, reconstruction of big complexes in the East European countries has been normally composed of the introduction of low temperature in combination with middle and high temperature systems in cascades, enabling increase of the economy of the geothermal energy use. That is now a "normal" composition of geothermal heating systems for greenhouses.

Fig.6. Floor heating installation of corrugated plastic pipes (Xanti, Greece)

Fig. 7. Air heating system for flowers growing

1.2.2. Space heating

Fig.8. Basic characteristics of low temperature floor Heating system



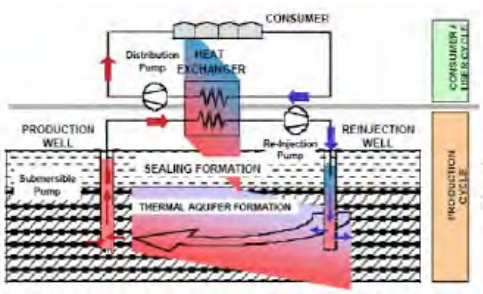


Fig.9. Geothermal district heating in Kocani (MK) (basic concept)

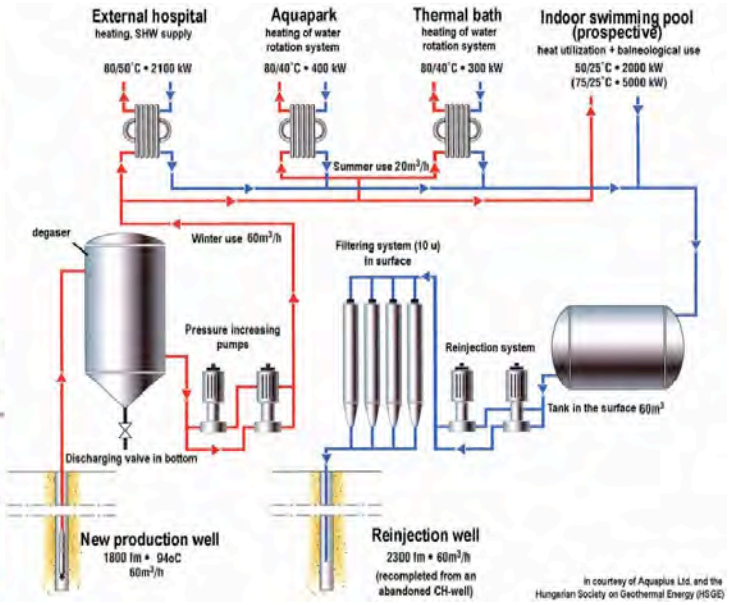


Fig.10. Concept for a new geothermal district heating system in Hungary

In difference to the development in U.S.A. and New Zealand, independent heating of small private houses has never been developed in this region. Heating of spa medical centers and larger district heating systems in Russia, Slovenia, Romania, Macedonia and Bulgaria proved the economic viability of different technologies. If the main characteristic of the elder applications is the poor equipment with the control and regulation equipment and use of classic heat exchangers, the new ones are already properly completed (Fig. 8, 9, 10) with low-temperature heat exchangers and automatic control systems. Presently, development of larger geothermal district heating systems is a proven economically justified solution. Good examples can be followed in Poland, Slovakia, Hungary, etc.

1.2.3. Balneology and heating of spa's facilities and buildings

Balneology has been always one of the known characteristics of the Central and East Europe. Czech Republic, Hungary and recently Slovenia are between the world's most known concentrations