European Geothermal Conference Basel '99
September 28-30, 1999 - Basel, Switzerland
Proceedings, Volume 2

The conception of geothermal energy utilisation in Hungary

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ABSTRACT

Geothermal energy in Hungary represented by a geothermal fluid /thermal water/ as a heat carrier. Utilisation of geothermal energy covers direct use. It is characteristic to the contradictory situation that Hungary is very rich in geothermal energy resources, but the utilised volume of geothermal heat is not enough big and the technical level of utilisation in open system practically (not reinjection) is low.

Many factors explain the need for utilisation such as to:

- improve utilisation of the geothermal reserves of the country,
- reduce emission of gases (SO_x, NO_x, greenhouse, gases, etc.) and air pollution,
- decrease import dependence in hydrocarbons,
- create new jobs, improve unemployment and solve problem of land utilisation.

The main aim outlined conception the extension of the rate of geothermal energy in the total energy consumption of Hungary to 1% in 2001 year against present value of rate of 0,26%.

KEYWORDS

Geothermics, environment policy, pilot projects, Hungary.

Introduction

Hungary's geothermal resource potential is associated with the Pannonian Basin (figurel). The basin's geothermal reserves are extensive and have been recognised to be significant in World-wide geothermal assessment. More recently, several studies have been carried out to summarise the reserve base (ÁRPÁSI 1993).

Current uses of geothermal fluids in Hungary range fiom water management (drinking water supply, bathing and balneology) and utilisation for direct use. All are low volume and low energy utilisation methods. According to estimates current application us no more that 4% of the annual geothermal heat capacity in Hungary.

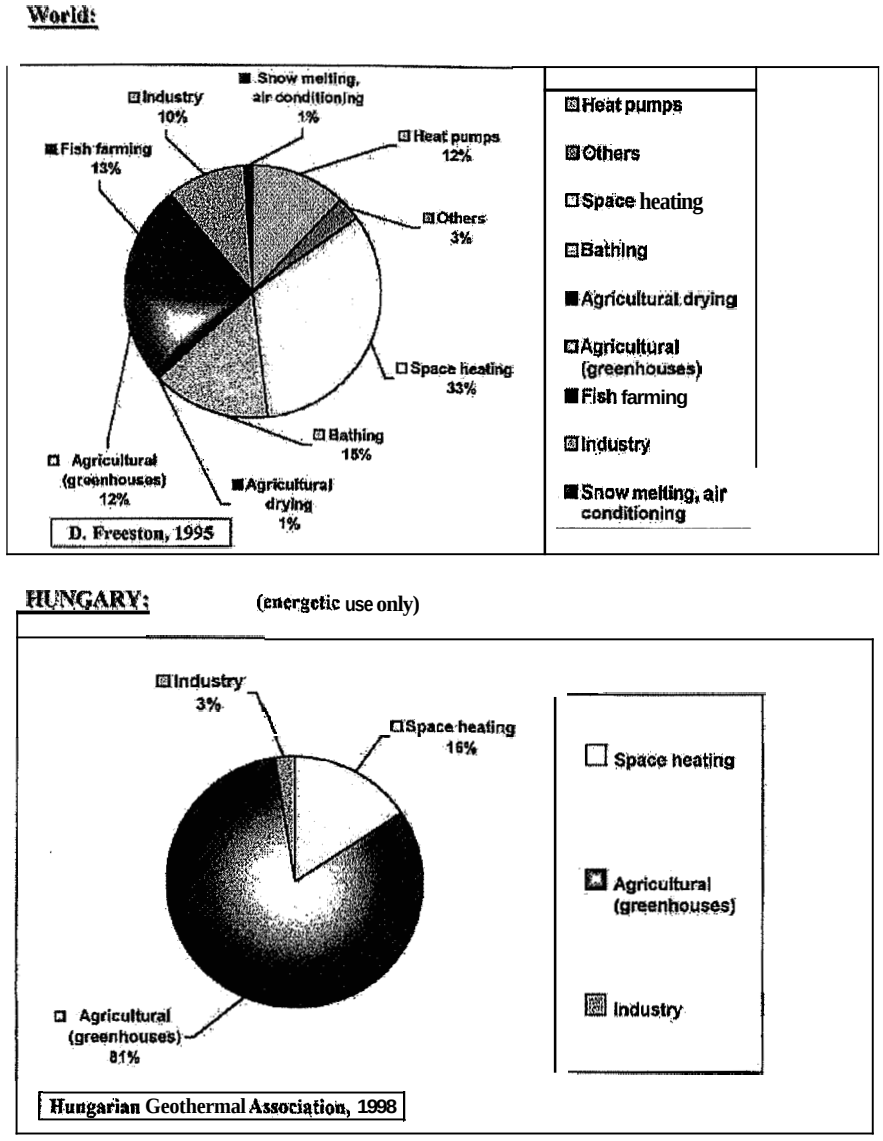

Figure 1: Direct use of geothermal energy in the World and in Hungary

Geothermal statistics

Utilisation area	Quantity of the produced thermal water Mm^3/year	Utilisation heat stage, AT* °C	Utilised heat TJ/year (PJlyear)	Thermal power MW_t
Agriculture	12,497	34,1	1 785,8 (1,79)	206,67
District heating	5,658	26,6	631,6 (0,63)	73,11
Others	3,370	27,4	386,7 (0,39)	44,79
Total	21,.52	31,1	2 804,3 (2,80)	324,5

* Weighted average

In Hungary the geothermal energy utilisation is an economically profitable enterprise. Concerning the utilised thermal heat quantity, by comparing it with the data of 1995, (FREESTON 1995). Hungary is the 5th in the World's top list, while concerning specific geothermal energy utilisation, Hungary is the 3rd (33,1 W_t/person). As for the agricultural purpose thermal heat utilisation, however, Hungary is the first in the World's top list.

We could come to the conclusion that the quantitative indices of the proven profitable utilisation are good in World comparison, but with respect to efficiency, we considerably lag behind, because:

- the thermal water production and utilisation are of extensive nature,
- the efficiency of the mostly only seasonal type of heat utilisation is low,
- fundamentally no re-injection is applied.

Geothermal energy utilisation by heat pumps

The proportionate rate of heat pumps in the direct thermal energy utilisation of the World is significant (13%) (FREESTON 1995). For the time being the situation in Hungary is different. In the country at present there are only eight geothermal energy based heat pumps operating with a total capacity of approx. 3,38 MW.

Heat utilisation by heat pumps can or could be an important chain-link in the multistage space heating purpose thermal energy utilisation of energy cascade system even in Hungary. The widespread utilisation of heat pumps is currently hedged in by the different obstacles in the country.

The question of water reinjection

It is well-known that in Hungary both the water management and energetically utilisation of thermal waters is implemented in an open, so called free drain system (without water reinjection). The waste waters are drained and stored in surface storage's, on the one hand, or drained into living waters. **A** fundamental condition and requirement of thermal water utilisation that it is performed without the decrease of the water resource and the pollution of the environment.

Under the Hungarian geological and hydrogeological conditions the question of water reinjection appears in two ways:

The reinjection into reservoirs of spent thermal water with carbonated rocks is a technically realisable and not costly solution.

The experiences of re-injection into porous, clastic (sandstone) formations obtained until now indicated that the results were antinomic and could not be regarded to be the references providing basis for commercial application. The technical solution of this question can be fostered by the application of the water disposal experiences obtained in the oil industry. Despite the unfavourable or missing international experiences the planning of the pilot application is inducing belief on the basis of the results of the only successful commercial application.

Air pollution reduction by the application of geothermal energy

By the signing of the Kyoto Atmospheric Purity Convention (1997) Hungary assumed liability for the reduction of CO_2 emission causing greenhouse effect (a decrease of *6%* until 2010). One of the possible ways of decreasing CO_2 emission is the replacement of fossil energy carriers (coal, oil, natural gas) by alternative and renewable energy carriers, thus for example by geothermal energy.

According to an international survey, with respect to the specific of the CO_2 emission reduction the geothermal energy as far the most inexpensive fiom among the renewable energy carriers =75 cent/t, which is only 9% of the specific cost of solar energy (figure 2).

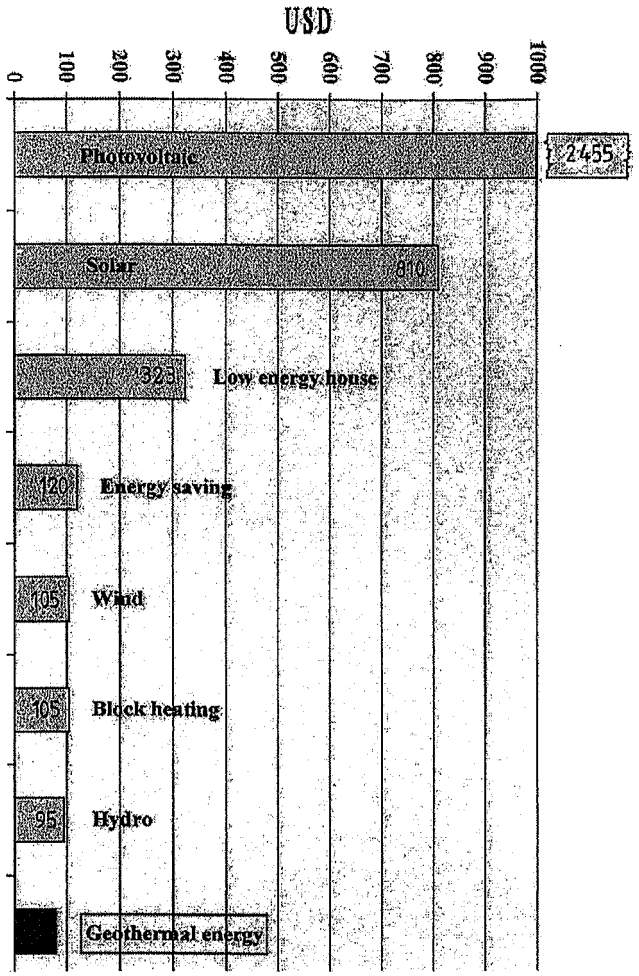

Figure 2: Cost of reducing 1 ton of CO_2 when substituting different renewable energies for fossil fuels in electricity or heat generation (after Clauser 1997).

Geothermal power generation potentials of Hungary

The "geopressured" type of reservoirs explored in the area of Nagyszénás-Fábiánsebestyén, Hungary, have extraordinary significance in World relation, and have considerable geothermal resources. This is indicated by the data presented in table 2. At the SE part of Hungary in well Nsz-3 located in this area, during the formation testing 171°C wellhead pressure was measured, which is the highest water-steam mixture temperature measured until now in Hungary.

Table 2: Comparison of the Hungarian (Nagyszénás-Fábiánsebestyén) and (USA) geopressured type geothermal reservoirs

Reservoir Parameters	**USA (Texas, Louisiana)**	**Hungary (Nagyszénás-Fábiánsebestyén)**
Depth (m)	4,800	3,165 - 4,034
Reservoir rock type	Clastic rocks (sandstone)	Carbonate rocks (dolomite), quartz, porphyry
Formation temperature (°C)	150	–190
Reservoir porosity (%)	20 - 30	3 - 4
Reservoir permeability (mD)	20 - 120	11 - 120
Reservoir fluid volume (Mm^3)	10^3	10^5
Reservoir pressure gradient (MPa/km)	13.5 - 18.1	20.0

Conception

The total energy consumption of Hungary was 1055 PJ in 1996. The proportionate rate of geothermal energy, according to the survey performed within the frames of the study, (ÁRPÁSI 1998) based on the status on December 31, 1997, was 2,8 PJ, which represent a 0,26% proportionate rate in the total energy consumption of the country.

It is a realistic objective to enhance proportionally the rate of thermal energy in the national energy balance to 1%, which means 10,5 PJ/year geothermal heat energy utilisation being projected to the total energy consumption of 1996. Duration of the realisation of the objective is between 1999-2001 (3 years).

The extension of the utilisation to the planned extent can be realised in two ways:

- By the increase of the efficiency of the existing heat utilisation systems,
- By the establishment, by investments, of new geothermal heat use systems.

On the basis of geothermal pilot projects (MOL Co.) the specific capital cost is 400 USD/kW, in the case of new geothermal heat utilisation investments. The 10,5 PJ geothermal heat quantity can be produced in utilisation systems with a calculated thermal power of 540 MW.

Measures and acts necessary to be taken so that the strategic aim can be achieved

Creation of an unambiguous legal situation

The regulation should provide legal basis to the renewable type of utilisation of geothermal energy, which protects the thermal water resources and does not pollute the environment. The legal regulations should support and not hinder the economically profitable utilisation of geothermal energy in Hungary. So that the foregoing can be achieved, it is necessary to terminate the existing legal gaps by the releasing of the legal controversy existing between the Mining Act and its execution instructions, and by way of the codification of a new, independent Geothermal Act.

Creation of governmental tools

The establishment of central funds, and the creation of preferential subsidy system and inspiring taxation policy it is necessary to support the realisation of the described conceptual target. This includes the broad scale application of the measures focusing on guaranteeing the environment sound nature of the existing utilisation systems (water disposal) and enhancing their efficiency (e.g. heat pumps).

Creation of geothermal pilot projects

The tool for achieving the described conceptual target is to establish geothermal pilot projects for demonstrationpurposes to solve the following tasks:

- Implementation of the constant water production / water re-injection system, with special regard to water disposal in porous, clastic (sandstone) aquifer systems.
- Realisation of an integrated, multistage, energy cascade system utilisation.
- Combination of power generation and direct heat utilisation in the above system, on the areas being suitable for that from resources side and economical efficiency aspects.

It is expedient to implement the geothermal pilot projects at areas being outstandingly favourable from hydrogeological point of view. It is also recommended to use the considerable number of abandoned oil and gas wells located in Hungary as a base. The implementation of the projects together with the preparation of the feasibility studies shall be assigned to capital intensive, professionally suitable contracting organisations (e.g. oil industry).

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