GEOTHERMAL DEVELOPMENT IN HUNGARY COUNTRY UPDATE REPORT 2000–2002

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ABSTRACT

Information is provided on the status of the geothermal energy utilization – direct use – in Hungary with emphasis on developments between 2000–2002.

Level of utilization of geothermal energy in the World **has been increased** in this period. Geothermal energy was the leading producer with 70% of the total electricity production of the renewables energy sources (wind. solar, geothermal and tidal) followed by wind energy with 28% of the electricity production. The current cost in USD¢/kWh of direct heat use from biomass is 1–5, geothermal 0,5–5 and solar heating 3–20.

The parameters of direct use in Hungary were **decreased in this period** and the proportion of geothermal energy utilization in the energy balance of Hungary, despite the significance proven dynamic reserves (with reinjection) of 380 Mm^3/a with heat content of 63,5 PJ/a at ΔT = 40 ^oC is **remained** very low (0,25%).

The utilization of the geothermal energy only for direct use, despite of the possibility of production of geothermal fluids with surface temperature higher than 100^oC, no electricity has been generated. Geothermal energy utilization for direct use is estimated to **324,5 MW_t** of geothermal capacity and to currently supply **2804 TJ/a** of utilized heat energy through direct application in Hungary, by December 31, 2002.

Geothermal heat pumps represent about 4,0 MW_t of installed capacity.

The quantity of produced thermal water for direct use in year 2002 was approximately **15.0 million cu.m.** with average utilization temperature of 30^oC.

The main consumer of geothermal energy remained the horticultural utilization (68% of total amount of utilized geothermal heat for direct use).

No utilization of geothermal heat in balneology (260 spas in country) **despite** the huge amount – 82 million cu.m. in year 2002 – of produced thermal water with average surface temperature = 68^oC.

Amount of **non utilized** geothermal capacity in spas of Hungary approximately **1250 MW_t** that more than **3 times more** than utilized capacity for direct use in Hungary, by 31 December 2002 (**324,5 MW_t**).

Key words: country update, balneology, direct use

INTRODUCTION

Hungary as one of the Central and Eastern European (CEE) Countries in transition has significant low and medium enthalpy (30–171^{o}C) geothermal reserves suitable for direct use (greenhouse heating, SHW supply, aquaculture, etc.) and power generation. [1–7]

1. GEOTHERMAL BACKGROUND

The Carpathian Basin centered by Hungary, one of the biggest sedimentary basins of the World and has an uniform geothermal system see Fig 1. “Geothermy has no knowledge of the country borders”.

The main geothermal reservoir systems of Hungary are the Mesozoic carbonate-karstic basement rocks and the Pliocene-Upper Pannonian porous sedimentary formations with the thermal water wells, mostly in the low to medium temperature range (30^{o}C to 100^{o}C).

According to a results of the different assessments (Boldizsár, 1967 and Bobok 1998 et al) of the geothermal resources, Hungary has the biggest underground thermal water reserves and geothermal energy potential of low and medium enthalpy in Europe.

2. GEOTHERMAL UPDATE (Geothermal statistic)

The geothermal resources of Hungary have been identified by geological exploration and by wells drilled for thermal water management (over 85% of the drinking water of the country is supplied from deep wells) and wells drilled for hydrocarbon resources.

Over 1200 drilled geothermal and about 10000 oil and gas exploitation wells provided reliable information about the existence of geothermal reserves. The main data of geothermal reserves and actual utilization data for direct use in Hungary, by December 31, 2002 are shown in Table 1 and 2.

Geothermal energy is an **most important renewable energy source (RES)** in Hungary as shown in Table 3.

Table 1 Geothermal reserves and utilization data of Hungary

Geothermal reserves		*Heat content of the dynamic reserves with reinjection ($\Delta T=40^{o}C$)*		*Utilized geothermal heat in 31. December 2002 PJ*	*Utilized heat vs. dynamic reserves %*
Static cu. km	*Dynamic M cu.m/year*	*PJ*	*Mtoe*		
1	2	3	4	5	6
4000	**380**	**63,5**	**1,5**	**2,80**	**4,4**

Table 2 Geothermal update of Hungary (31 December 2002)

Utilization	*Thermal water production Mm^3/year*	*Utilization step Δt* ^oC*	*Utilized geothermal heat TJ/year (PJ/year)*	*Geothermal MW_t*
1	2	3	4	5
1. Agricultural	12,497	34,1	1785 (1,79)	206,67
2. Space heating SHW	5,65	26,6	631 (0,63)	73,11
3. Others	3,370	27,4	386 (0,39)	44,79
Summary	**21,525**	**31,1**	**2804 (2,8)**	**324,57**

* averaged Source: HGA, 2002

Table 3 Hungarian renewable energy: current use, technical potential and feasible objective (2002)

	Biomass	*Hydro*	*Wind*	*Wastes*	***Geothermal***	*Solar*	*Total*
Current usage	2,8–3%	0,07%	–	0,075%	**0,26%**	0,0095%	3,8%
Technical potential	9%	1,5%	–	?	**30%**	6,5%	–
Feasible objective	5,4–8,2%	–	–	?	**20%**	1%	–

Note: Figures are indicative as different estimates do not always agree
Source: Various

According to a Hungarian Government Decree issued on December 21, 2000, part of renewable energy sources in the energy balance of the country has to be increased from 3,6% to 7,2% in 2010, which corresponds to 36 PJ/a level.

The production in of geothermal fluids 2002 was **103 million cu.m.**, out of which 67% represents thermal water with temperatures of 30–50^{o}C (utilized for health and recreational bathing and drinking water supply), the rest of 33% being utilized for energetic purposes (greenhouse heating, space heating, SHW supply, etc.).

Out of the **1275** geothermal wells, in 2002, **803** wells were in production; 516 producing thermal water with temperatures between 30–50^{o}C, and 289 wells producing thermal water with temperatures between 50–100^{o}C the geothermal water being partially utilized for energetic purposes.

3. GEOTHERMAL DEVELOPMENT

The research of new possibilities for the direct use is first of all reasonable due to the fact that it is mostly seasonal in Hungary, too, i.e. traditional applications are mainly used only in the heating season.

Regardless of the fact whether the geothermal energy is utilized in the agriculture, industry of for the district heating, it can be equally stated that the old systems by now have became physically outdated and obsolete.

As indicated in papers [3–7] **the integrated, multipurpose thermal water utilization in energy cascade use is playing especially an important role.**

The process diagram of multipurpose utilization of thermal water (Hódmezővásárhely) shown in Fig. 2.

4. UTILIZATION POSSIBILITY OF GEOTHERMAL HEAT OF PRODUCED THERMAL WATER

In Hungary out of the currently operating 260 public baths and spas (including **89** classified as **medical** waters and **140** as mineral waters) in territory of **5** spas the heat content of produced thermal water is being utilized for direct use (space heating and SHW) by heat exchangers and/or heat pumps (Bükkfürdő, Zalakaros, Harkány, Kiskunmajsa, Hajdúszoboszló Spa).

Only **5** above mentioned are profitable, i.e. *remaining* 255 spas operate at loss.

Why do our spas and baths operate at loss? Mostly because the too hot 40–99°C thermal water is made suitable for bathing **admixing** by cold tap water. With this the quality of the medical water is lowered and it results in extra cost then after bathing the used water yet having significant heat content (~25°C) is **discharged**.

In addition to the foregoing, all the buildings of the public bath, the hotels and other buildings are heated with mainly imported natural gas.

According to the estimation made for determination of possibility of geothermal heat contents utilization of produced thermal water in Hungarian spas a huge amount of geothermal capacity (1250 MW_t) could be utilized, more than three times more than an actual level of geothermal (See Table 2) energy utilization for direct use (See Table 4).

Table 4 Possibility of geothermal heat utilization in balneology of Hungary (without reinjection)

Number of thermal water production wells, pc	*Well-head (outflow) temperature °C*	*ΔT °C*	*Yield of thermal water 10^3•cu.m/d*	*Summarized production (Exhaustion of reserves) cu.km*	*Possible capacity of the geothermal heat utilization MW_t*	*Capacity of direct use MW_t*
1	2	3	4	5	6	7
64	30–39,9 (20–23)	10	200	1,0	303	
242	40–49,9 (25)	15	95	0,4	17	
420	50–100,0	50	205	1,2	754	
726	**30–100,0**	**30**	**500**	**2,6**	**1250**	**340**
According to IGA recommendations:					***1590***	
Possible growth					**467%**	

5. LEGAL BACKGROUND AND SUPPORTING POLICY OF THE UTILIZATION OF GEOTHERMAL ENERGY IN HUNGARY

The actual regulation of the utilization of thermal waters in full of contradictions.

- The Mining Act, 1997 states that:
  "Geothermal energy exploited with thermal water is **not** geothermal energy, because it entails thermal water production", therefore it is **not** subject to the Mining Act.
  It is subject to the Water Management Act instead, but this Act **does not include** the terms of geothermal energy utilization and its heat recovery, either.
- There is **no concession** and **no mining pot** can be laid for the research and utilization of geothermal energy.
- The **proprietary** questions of the **abandoned oil and gas wells** are not clarified.
  There is a big danger of deforcing big amount of the abandoned wells (~3000 wells)
  It is a schizophrenic and artificially contradictory situation that makes utilization of geothermal energy not easy in Hungary.

The Hungarian State has not been supporting the utilization of geothermal energy (since 1985). It sanctions and levies multiple taxes on it instead: tax for the quantity of produced thermal water (VKJ) is about 3 cent/cu.m., royalty for used geothermal heat, "waste water" penalty.

6. GEOTHERMAL ENERGY UTILIZATION AND ENVIRONMENTAL PROTECTION IN HUNGARY

Geothermal energy is an environmentally benign renewable energy source, it is a stable energy source, independent of the climate and time of the day, which distinguishes it form hydroelectricity, wind and solar energy.

Geothermal energy is being played a main role on reduction of air pollution (CO_2, SO_2, NO_x emissions).

In Hungary is a wide array of hindrances to the advancement of renewable geothermal energy source for environmental safety and the need to achieve conformity with EU standards of clean air are not emphasized enough. The low GNP and the tight national budget impede systematic support schemes for geothermal energy.

The Environmental Protection Target Fund (KAC) is supporting the extension of natural gas networks by 20% even at present on the other hand **not** any financial support for utilization of the geothermal energy a main RES of the country!

7. ACCESSION OF HUNGARY TO THE EUROPEAN UNION – FUTURE OF THE GEOTHERMAL ENERGY IN HUNGARY

Before 1990, in year of big political and economic changes in Hungary (conversation of he country into free democratic policy and market economy) fossile energy sources were cheep and frequently sold for prices below production cost. After 1990, a lot has changed especially in terms of electricity and fossile energy prices (except natural gas) becoming more real.

Competent Hungarian authorities attitude to the exploitation and utilization of geothermal energy, as a most important renewable energy source (RES) in Hungary, remains indifferent in spite of declaration that have been made by the Hungarian Government(s) in support of the development of geothermal energy.

At the same time the European Union recognizes all RES as a high priority not only in declarations, but also in a tangible by putting into operation real programs.

EU member states have expressed their stance toward the progressive development of RES in a number of official documents for example the White Paper, Blue Book etc., where they set the objective of attaining, by 2010, minimum market penetration of 12% of RES (EC, 1997).

The EU Directive on the promotion of electricity produced from RES obliges the member states to raise the national level of electricity produced from RES to 22% 2010 from the current level of 13,9% in 2001 [8]. It should be noted that in Hungary no (RES) based electricity generation, and concerning sources, only a geothermal based electricity generation can be implemented in the country.

An executive legislation in "Green Electricity" production in Hungary has been an Decree 56/2002 (28 December, 2002) issued by Ministry of Economy and Transport on the obligatory purchases of electricity from RES in cost covered prices (8–12 USD¢/kWh).

It should be remarked that in Hungary the proportion of RES stands now (in 2002) at 3,6% (82% of it by firing wood), compared to 5,8% in the European Union.

The EU member states, as well as other industriliased countries which have enough conventional energy available, develop of the utilization of RES mainly in view of ecological concerns, as well as in order to reduce their dependence in imports of fossile energy sources, mainly crude oil and natural gas, whose main documented reserves are located in the politically and strategically unstable countries, as the countries of Near and Middle East and Russia.

Hungary as one of the associated members of EU now, after accession of he country to EU after 1 May 2004 has to be take into consideration the strategy of RES existing in European Union, now (mainly on reduction of dependence in crude oil and natural gas import from Russia).

In EU there have been a number of real R and D projects and implementations with guaranted funding, aimed at designing and implementing energy systems to achieve specific quality and quantity of geothermal energy output.

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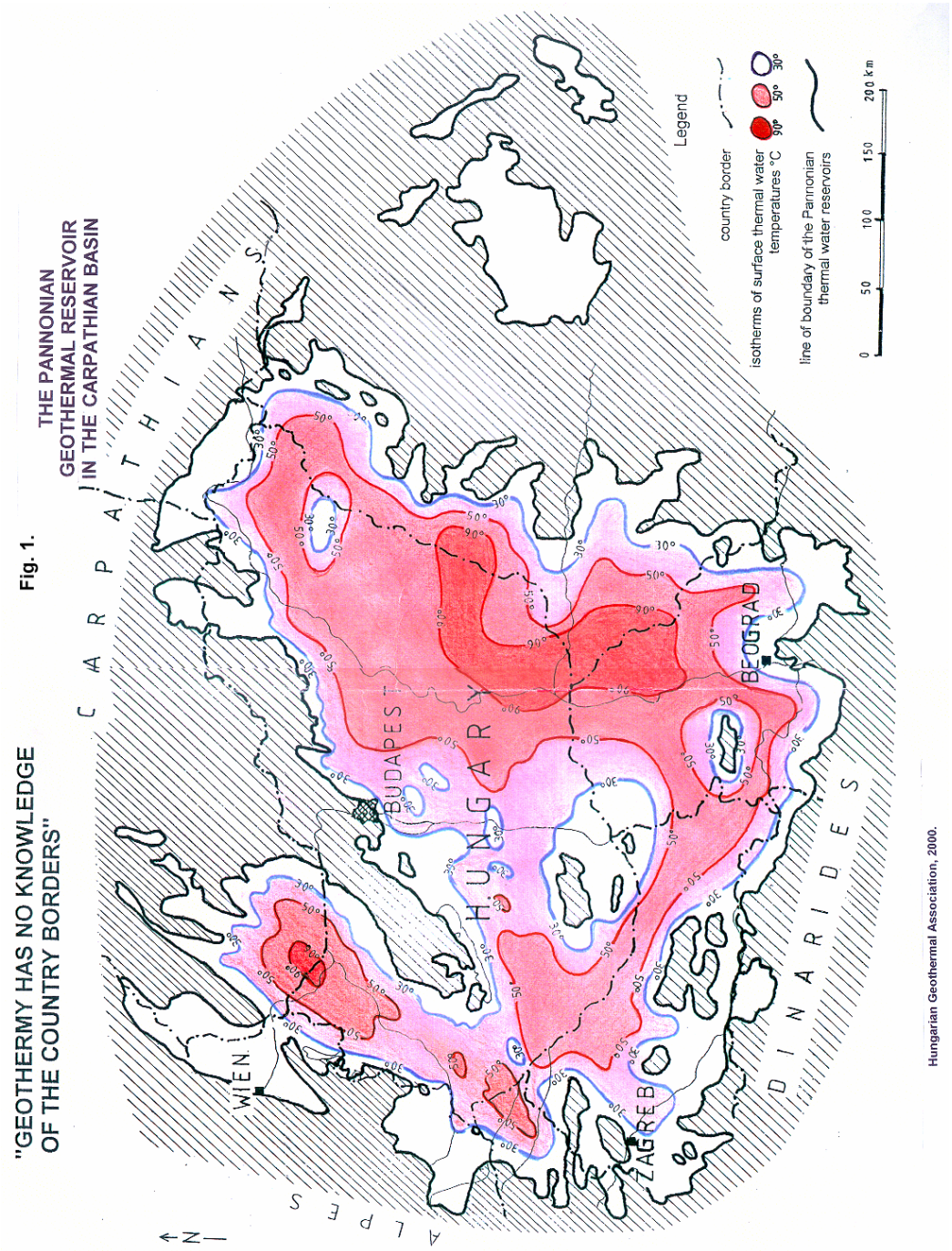
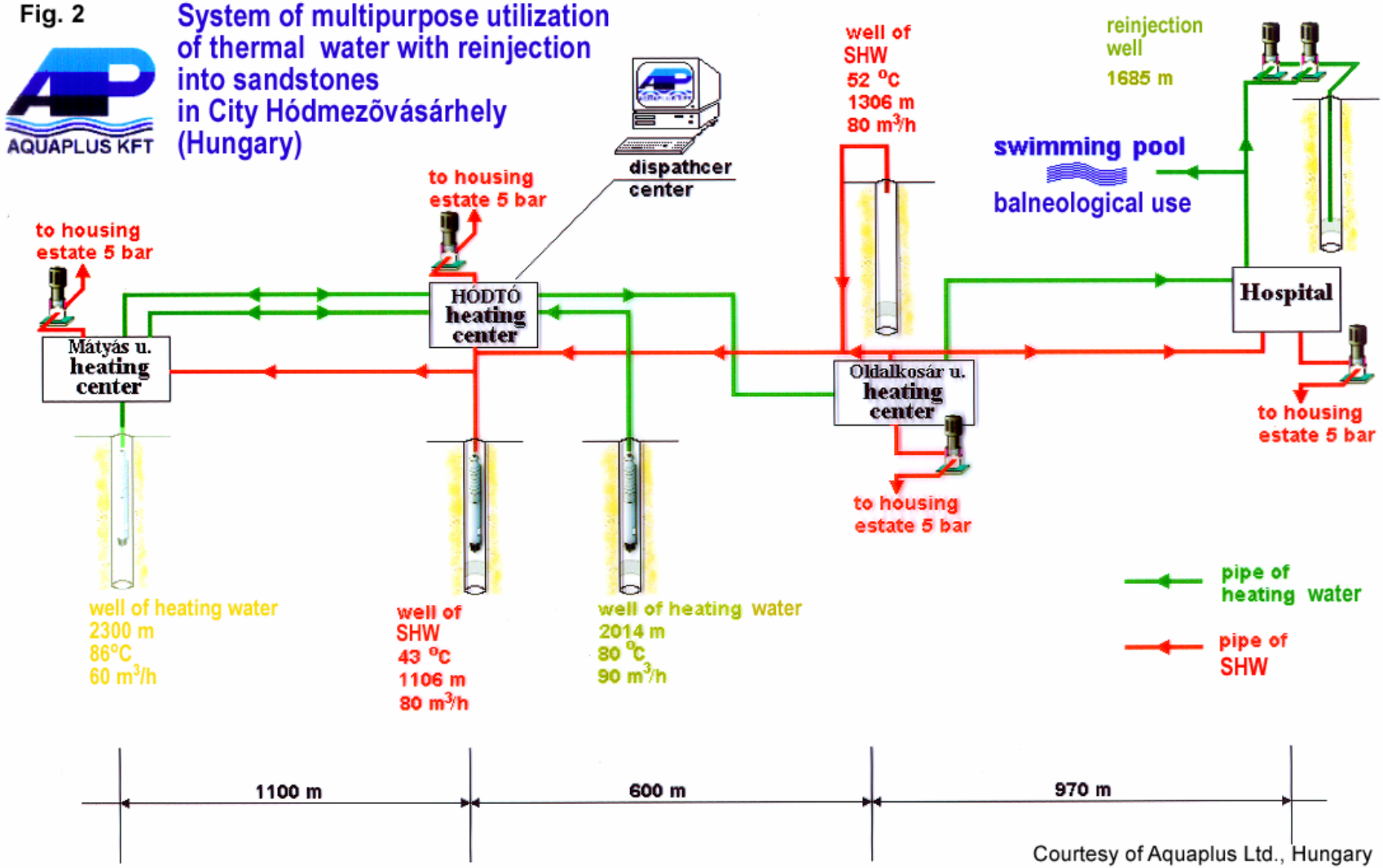


Fig. 1.

Fig. 2

System of multipurpose utilization of thermal water with reinjection into sandstones in City Hódmezõvásárhely (Hungary)



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