COUNTRY UPDATE REPORT FROM HUNGARY

Dr. Miklós ÁRPÁSI

MOL Plc. H-1311 P.O.B. 43 HUNGARY

Keywords : Geothermal energy utilization, direct heat use, geothermal investments, geothermal energy research and development

ABSTRACT

The calculated volumes and heat content of geothermal resources and reserves of Hungary from a new assessment (1993), are presented.

The results of the thermal water management i.e. non-energetic purpose utilization of thermal water in December 1993 are presented.

The situation in direct application of geothermal energy in December 1993 is also shown.

1. GEOTHERMAL RESOURCES AND RESERVES OF HUNGARY

The results of geothermal potential assessment of Hungary (Arpási, M. et. al, 1993) are summarized in Table 1

Table I. **Geothermal potential of Hungary**

Parameters	Reservoir systems	
	Pannonian (Pliocene)	Mesozoic
Effective volume of geothermal reservoirs system, cu.km.	3800	200
1 Geological resources without reinjection with utilization step ΔT=55°C, cu.km.	2300	
2 Heat content of geological resources, PJ	$570 \cdot 10^3$	
Dynamic reserves, MM cu.m./a with utilization step ΔT=40°C		
3.1 without reinjection (open system)	260	
3.2 with reinjection (closed system of doublets)	380	
Heat content of dynamic reserves, PJ/a		
3.1 without reinjection	43,5	
3.2 with reinjection	63,5	

2. THE THERMAL WATER RESERVOIRS

The 2 (two) types of reservoirs, systems low and medium temperature water dominated systems are tapped in Hungary

1. Upper Pannonian (Pliocene) hydrodynamic system as is the main reservoirs system; type of rocks: terrigenous, clastic parous sandstones, with confined aquifers.

The average outflow temperature at the well-head of wells producing thermal water (above 30°C) from Upper Pannonian reservoirs is 68°C. The part of thermal water production from Upper Pannonian reservoirs is 87% of total amount of production .

2. The Mesozoic hydrodynamic system is formed by carbonate fractured and carstic rocks.

13%-of the thermal water is tapped from Mesozoic system.

Some indications of geopressured reservoirs have been found in the course of oil and gas exploration in the upper parts of cristallic and metamorphic basement of sedimentary basin (Stegena, et. al 1992)

No assessment of the reserves of geopressured reservoirs was made.

3. HISTORIC USE OF THERMAL WATER PRODUCTION

Thermal springs have been used for bathing, washing and cooking for many hundred years in Hungary, but with intensive production only after the Second World War.

The total amount of underground waters produced in Hungary since 1950 to December 31, 1993 is 9051,2 MM cu.m.

In Table 2. the total quantity of thermal water, with aquifer temperature above 50°C, produced from Upper Pannonian reservoirs system, to the present (December 31, 1993) is summarized.

Table 2. **The yield of thermal waters produced in Hungary between 1950-1993 (Upper Pannonian), MMcu. m.**

Aquifer temperature °C	Total
50 - 60 *	113,5
60 - 70	343,2
70 - 80	164,2
80 - 90	328,0
90-100	198,7
Total	1168,6

4. THE RECENT STATUS OF THERMAL WATER PRODUCTION

The distribution of active thermal water wells according to the outflow temperature and summarized flow-rates on December 31, 1993 are presented in Table 3

Árpási

'able 3

Outflow emperatu-re, °C	Number of active thermal water wells	Percentage of wells %	Flow-rates cu.m./min (kg/s)	Percentage of flowrates %
30 - 39,9	384	47	134,6 (2244,4)	37
40 - 49,9	163	20	74,3 (1239,3)	21
50 - 59,9	80	10	38,1 (640,1)	11
60 - 69,9	72	9	39,2 (652,0)	10
70 - 79,9	45	6	27,3 (453,6)	8
80 - 89,9	34	4	23,9 (399,8)	7
90 - 99,9	30	4	23,2 (387,5)	6
Over 100	2	-	2,6 (43,3)	-
Summary	810	100	(6032,1)	100

5. GEOTHERMAL UTILIZATION

Geothermal utilization is in Hungary divided into the following categories

1. Thermal water management **without** thermal energy utilization i.e. extraction of heat content of produceded geothermal water for direct application and electricity production (balneology, drinking water supply, etc)
2. Utilization of geothermal energy **with heat** content extraction from thermal water, i.e. **direct** application (Space heating of **buildings** and greenhouses, SHW supply, etc.)

The current **status of** geothermal utilization is summarized in Tables 4 and 5.

Table 4. The main uses for geothermal resources in Hungary as of December 31, **1993**

Kind of utilization	Percentage %
1. Drinking water supply	29,9
2. Balneology	27,3
Subtotal	57,2
3. Agriculture	26,0
4. Space heating and SHW supply	1,3
5. others	15,5

This table shows that the main area of domestic thermal water utilization is "thermal water management" i.e. non-energy related use (balneology, drinking water supply, others), the proportion of which is 72,7 %.

The proportion of direct geothermal energy utilization is 27,3 %

Table 5. The domesti ıermal w produ and comparison of geotherm Decemi 1, 1993

Kind of utilization	Number of wells, pc	In roportion of full mount ot vells. %	In oropor-tion of active ells, %	Produced [2] ıermal wa-ter (summari-zed) fMcu.m./a (kg/s).	In proportior of summar zed water pro- duction %
Thermal water manage-ment 1 Drink water supply	213	18,5	26,2	54,7	
2 Balneo-gy	282	24,4	34,8	59.8	
3 Others	42	3.6	5,18	11,43	
otal of 1.1-3	537	46,6	66,2	(4318,3)	68,2
Geother-al energy ilization 1 Agricul-ture	254	22.04	31,3	60,35	
2 District eating and HW	19	1,65	2,34	3,77	
otal of 2.1-2	273	23,7	33,7	1713,8	31,8
otal .+2.)	810 (in opera-tion)	70,3	100	(6032,1)	I00
Closed[1] wells	342	29,6	42,2	-	-
otal .+2.+3.)	1152	100	-	-	-

) = Closed wells becau of different reasons (t ical, economic, etc.)
)= Summarized data water production du a given period (year, ason etc.)

Thermal water pmduction and utilization data in December 31, 1993

1. Thermal **water** production, Million cu.m./a	190,2
(kg/s)	(6032,2)
1.1 Water management (non-energetic use) Million cu.m *la*	126,1
(kg/s)	(4318,3)
1.2 Energetic use Million cu.m./a	64,12
(kg/s)	(1713,9)
2. Estimated heat content ofproduced thermal **water,** at utilization **step** AT= 40°C, PJ/a	32,0
2.1 **Water** management, PJ/a	21,1
2.2 Energetic **use**	10,84
5. Saved oil **(estimated)** TOEx10^3	760

Utilization data at December 31,1993

1. Geothermal energy used, PJ		3,2
1.1 Space heating and SHW supply		0,33
1.2 Agriculture	2,87	
2. Saved oil, TOE x 10^3		38,1
5. Proportion of **used** energy (I.) with **estimated heat** content ofproduced thermal **water,** %		9,68
4. Proportion of used energy (1.) with heat content of dynamic reserves (see **Table** 1), %		5,14

The values of load factor for different kind of utilization (December 31,1993)

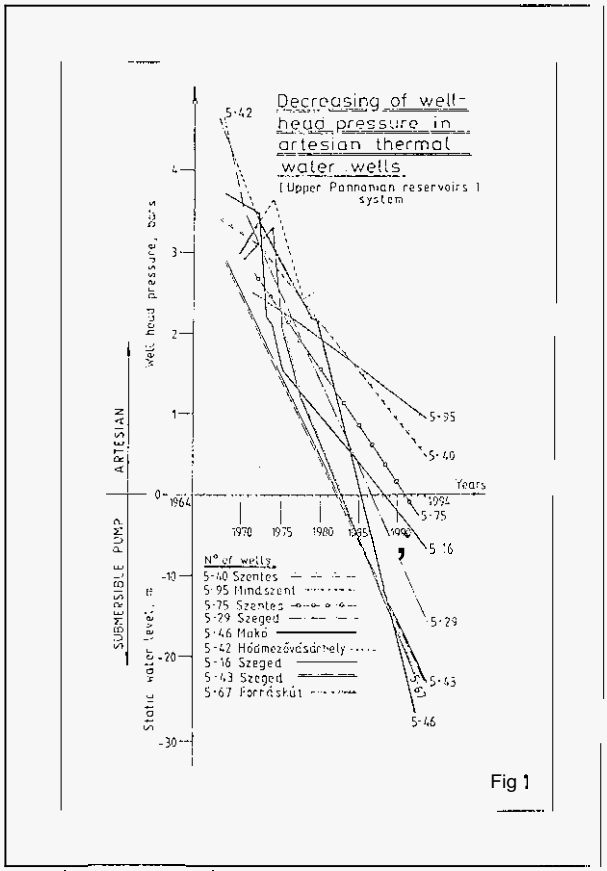
1. Space heating **for** buildings	0,5
2. Sanitary hot **water** (SHW) **supply**	*0.6*
3. Space heating for greenhouses	0,4
4. Thermal **water** management	0,8

Based on tield analyses **of** geothermal utilization in Hungary as of December, 1993 the following **would** be concluded :

Thermal water production	Years		
	1985	1989	1993
MMcu.m/a	**420**	493	190

b) The **production** of thermal water **is** extensive. The situation would be characterized as overproduction of thermal water.

c) Reinjection of used thermal **waters is** not practiced. Waters are disposed into surface basins. Overproduction and the absence of reinjection **have** had effects on well-head pressures in the primarily artesian thermal water wells as shown in Fig1: Based on the **results** of **pressure** measurements in production and observer **wells).**



re 1, **Decreases** of **wellhead pressure in artesian thern wafer wells**

d) No electricity generation *on* geothermal base

e) The direct heat **use** (space heating of buildings wid greenhouses) has **a** seasonal character, of only 160-IS0 days. The lieat **step** of utilization is very **low,** abaut 20-30 °C.

f) There are no heat pumps used anywhere for increasing the efficiency of geothermal heat utilization;

g) The total mount of geothermal energy used **(December31,** 1993) was 3,2 PJ, i.e 0,25%-of total energy consumption of Hungary;

h) Tho *mount* of geothermal energy **used** for **space heating** of buildings and SHW **supply** was 0,33 PJ (in **December** 31, 1993). This was 0,38% of the total amount of energy used for direct use in Hungary. (Heating of 11599 **flats** in 14 systems, with 9 towns by geothermy)

i) The number of **closed** thermal wells was significantly increased for different reasons between 1989-1994 (138 closed **wells** in 1990 and 304 closed wells in December 31, 1993)

j) Since 1990 was installed only was built 1 system of communal utilisation (Hódmezővásárhely). The **5-year projects prepared** in 1988-89 for technical development of the utilization of geothermal energy (10000 **flats)** were stopped:

k) After 1990, due to the start-up of a **market** economy in Hungary, practically no domestic centralized **funds** were available for promotion of geothermal **energy** utilization

REFERENCES

(Report)

Árpási, M. (1993). *Assessment of geothermal resources mid reserves of Hungary wirh special regard of interests of Oil and Gas Industry Study of* MOL PLC-OGIL, Budapest, p. *250* (In Hungarian)

The** Hungarian **Energy** Policy **1990-1993 December, 1993, Ministry of Industry and Trade Budapest 1993 (In English)

Information about mineral resources of Hungary (Magyarország ásványi nyersanyag vagyona) Issued by Land Registry, p. **245** Budapest, 1993

*Magyarország termálvíz készletei, **(The thermal wafer resources of Hungary)*** VITUKI Rt **Budapest,** 1993 (In Hungarian)

Stegena, L. (1987) ***Possibilities and methods of exploitation of deep geothernial reserve.*** Report of Central Land Registry, Budapest.

(Book)

***The** Mining **Code** of Hungary Law XLVIII of April 20, 1993* Budapest (In Hungarian)

(Journal Article)

Friedleifson, I.B.-Freeston D.H.: Geothermal **energy** research **and** development, *Geothermics*, Vol. 23, No. 2, pp. 175-214, 1994

Arpási, M. (1994). Investment in Geothermal Energy Worldwide; Geothermics 94 in Europe, *International Symposium, **Orleans** February* 1994 pp. 345