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Decreased Opportunities for Geothermal in Hungary

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ABSTRACT

There is no geothermal act in Hungary. Thus many different rules regulate the conditions of geothermal utilisation. Since January of 2004 the regulation has changed to the injury of energetic use of geothermal waters contrary the thermal baths and spas. For instance geothermal water utilised for energetic purpose has to be re-injected, while re-injection is forbidden if the water has been used in a bath. Meanwhile there is an existing governmental target to triple the present rate of geothermal energy utilisation by the year of 2010. The article shows the decreased opportunity of geothermal in Hungary, and that how antinomic and indefensible is the situation emerged.

1. HISTORY

In Hungary, the harnessing of geothermal energy is carried out practically one hundred per cent by exploiting geothermal waters. The only exceptions are the ammonia heat mining implemented in the second half of the eighties in Szolnok as an experiment, and the heat pump utilisation method applied in recent years.

Accordingly, the legal regulations were developed in a way that the ground heat utilisation facilities were considered as water facilities, for which the water authorities issued an installation and operations licence, and a water reserves contribution had to be paid on the water volume utilised. Even currently there is a Water Act, which includes the definition of geothermal water: accordingly, geothermal water is a water coming from all underground aquifers, the outlet (surface measured) temperature of which is 30°C or higher.

The idea of separating geothermal water and its heat content only appeared in the Mining Act passed in 1993. According to the currently applicable amended Mining Act of 1997, the exploration and exploitation of underground waters carrying geothermal energy do not fall within the scope of the Act, but the harnessing of geothermal energy does. On the basis of the Mining Act, the statutory provisions covering environmental and water conservation matters apply to waters.

2. WATER RIGHTS LICENSING

For the implementing or substantial conversion of a geothermal energy harnessing facility, a water rights licence is to be applied for. This covers making or converting a borehole, the components of the surface system and the method of water disposal. The application for a licence is to be submitted to the water inspectorate having jurisdiction in the area. The inspectorate issues three types of licences:

1. a conceptual water rights licence – this gives eligibility for planning
2. a water rights licence for installation – this gives eligibility for constructing facilities
3. a water rights licence for operations – this gives eligibility for operating the facilities.

In all cases, the following organisations participate in the licensing procedure: the relevant environmental inspectorate and all those other authorities the involvement of which is either stipulated by statutory provisions or believed to be necessary by the licensing authority. The opinion of these contributing public administration bodies must appear on an obligatory basis in the licence.

In certain cases, a separate environmental process must also be conducted prior to the water rights licensing. Such a case is, for example, water exploitation if its daily rate from a carstic reservoir exceeds 1000m^3 or from a sedimentary reservoir 2000m^3, as well as water re-injection (regardless of the volume). In such cases a preliminary environmental study or perhaps a detailed study is to be submitted to the environmental inspectorate, and on this basis the authority issues an environmental licence.

It is worth noting here that whereas in the past the authority issued an operations licence for an unlimited period of time on running a water facility, today it only issues licences for a predefined period of time. This applies also to geothermal water users who have been in existence for many decades, and who have to have their operations licence renewed on the basis of a government decree. Of course, the new licences cover a predefined period of time only, perhaps with such deadline obligations (e.g. re-injection), due to which these operators will know when they have to end their activities as a result of conditions impossible to meet.

3. WATER RESERVES CONTRIBUTION (WRC)

This is a contribution to be paid to the central budget on all water utilisations. In the case of surface waters, for example in a water plant or regarding water used for irrigation, and in the case of underground waters, e.g. drinking water, bathing water, etc., the basis for the contribution is the water volume actually used as determined by measurement and the water fee (HUF/m^3) which is identical in each water application, but because of the different multiplication factors, significant differences arise among the various utilisation approaches.

From the aspect of harnessing geothermal water, there are only two important subsurface water categories: naturally one is geothermal water and the other is qualified medicinal water, because most of the latter are geothermal waters as well ($t>=30$ °C). The water fee depends on the type of water utilisation and water reserves, and it is modified by the multiplier ‘g’ subject to the water reserves management situation in the relevant area. The rates of the multiplier ‘g’ are the following:

Energetic utilisation falls into the ‘economic’ ‘other’ category and hence has the highest multiplier.

Type of water reserves	Type of water utilisation				
	medicinal	public	economic		
			drinking water	bathing water	other
Geothermal water	1.0	1.0	3.0	3.0	7.5
Medicinal water (qualified)	1.0	5.0	5.0	5.0	10.0

Table 1: The rates of the multiplier 'g'

Consequently, the KHVM (Ministry of Environmental and Water Conservation Affairs) decree 43/1999 (XII. 26)KHVM which includes the table above, expressly gives preference to medication and considers energetic utilisation as the least desirable.

No water reserves contribution is to be paid, if after energetic utilisation the spent geothermal water is returned to the underground aquifer. (And this is absolutely logical, because in this case no use (consumption) of the water reserves is involved).

The rate of water fee is determined by the State Budget Act, and hence it changes from year to year. And it has indeed doubtlessly and dramatically increased in the last two years. I will show in the following diagram – when 1993 is regarded as the reference year – how the water fee, natural gas and electricity prices have grown, along with the annual inflation. It can be seen that the rise in water charges has slightly exceeded the inflation up to 2000, and then sharply climbed afterwards. Expressed in figures, this means that in two years the water fee grew by 79% nominally. Vis-à-vis energy supplied through conduits, the situation is even worse, as a result of which it can be stated that the competitiveness of harnessing geothermal energy has deteriorated as against the major competitor natural gas.

4. SEWAGE PENALTY

Apart from minor exceptions, geothermal waters exploited in Hungary are supplied to a surface reservoir after utilisation. Thereby they are covered by the same regulations as any other water drained to surface waters. Such waters comprise characteristically the wastewater coming from settlements or industrial facilities, regardless of whether a treatment technology is applied or not. Consequently, the statutory provisions covering sewage disposal also apply to spent geothermal waters drained to surface waters, consequently a sewage penalty also applies if the emission exceeds any of the limits prescribed in the statutory provisions. This basic approach is understandable from the aspect of a burden imposed on a water stream, but at the same time it is also true that no change arises in the chemical composition of geothermal waters during an energetic utilisation, unlike in the case of communal or industrial wastewater.

The regulation of sewage penalty has changed from the beginning of the year, but before dwelling on describing the new statutory provisions, let us cast a glance on the former regulations, to be able to make a comparison.

The instructions of the President of the Hungarian Water Conservation Office were issued on the sewage penalty in 1984. In these instructions, the Hungarian surface waters were classified in six water quality protection groups, and for each one the emission limit of each contaminant was determined, along with the penalty items imposed in case any deviations were found. Therefore, there were some water quality protection areas of priority importance, and the definition of industrial water also existed. Naturally, stricter limits applied to the former and milder limits to the latter. At the same time, there were sections of the rivers Danube and Tisza for which no limits were determined, in other words no limit applied to the materials dumped into those sections. It is important to note that these instructions did not make a distinction among the various water users.

The 1984 instructions were replaced by the government decree 203/2001 (X. 26) dwelling on the various regulations of protecting the quality of surface waters, and which would fully enter into force on 1 January 2005. The new statutory provisions define three different limit groups; according to the purpose of water utilisation (*technological*), regional location (*nation-wide regional*) and the individual characteristics of the area (*unique catchment area*). I hereby quote the statutory provisions.

- The technological limits:

Para. 10, clause (1) The limits applying to the given technology shall be determined by taking as a basis the best available technology and the wastewater emission rates stemming from the related sewage treatment activities.

(2) The technological limits and the rules of their application are determined by separate statutory provisions.

- Nation-wide regional emission limits:

Para. 11 The nation-wide regional emission limits are determined by separate statutory provisions in accordance with the regional categories of water quality protection.

- Unique catchment area limits:

Para. 12 The unique catchment area limits are determined by the inspectorate in accordance with the water protection action project of the water catchment management plan elaborated on the basis of separate statutory provisions, by taking into consideration the sensitivity of the reservoir and the water quality requirements.

Separate statutory provisions have so far been issued regarding the technological limits only. Let us see what this says. The next table shows the technological limits of 'sewages' introduced into surface waters after the harnessing of geothermal water, concerning three methods of utilisation: in energetics, medical fields and geothermal baths.

Denominate	Measure-ment	Energetic utilization	Medical utilization	Bathing
		Qualified point sample or two hours average sample		
Oxygen consumption (KOI_k)	mg/l	–	150	–
Total dissolved salt (TDS)	mg/l	3000	5000	2000
Sodium (Na) equivalent %	%	45	95	45
Ammonia-ammonium nitrogen	mg/l	–	10	–
Sulphate	mg/l	–	2	–
Phenols	mg/l	1,0	–	–
Total barium	mg/l	–	0,5	–
Temperature (max)	^oC	30	30	30

Table 2.

(1) Requirements applying to sewage prior to draining into the reservoir

(2) After harnessing the geothermal water for medical purposes or in a geothermal bath, in case the spent water is blended prior to draining, the limits applying to medicinal water shall be met.

(3) After harnessing geothermal water in a geothermal bath (and for medical purposes, respectively), the spent geothermal water may be blended with the water of cold water pools prior to being drained into the reservoir.

The most important change is that instead of the limits formerly applying to all geothermal water users, the legislator now divided the users into three groups, distinguishing the harnessing methods of geothermal water as follows:

1. for energetic purposes,
2. for medical purposes and
3. for bathing purposes.

And, the legislator determined different emission limits for the different groups. Therefore, the strange situation arose that even when the same geothermal water was drained to the same reservoir, this was subject to penalty if the geothermal water had been used for an energetic purpose before, but there was no penalty if people bathed in the geothermal water before it was drained. I would like to emphasise once again just in case you do not believe your eyes: the same water quality is supplied to the same reservoir, and yet there is penalty in one case and no penalty in the other!

Therefore we have been able to put our finger on a new discrimination, which is disadvantageous to the energetic utilisation as against bathing utilisation, in addition to paying the water reserves contribution. (Note: it is worth reading the two paragraphs below the table, which identifies a 'loophole' for geothermal bathers to avoid paying a penalty).

Knowing the geothermal waters in Hungary, it can be said that the total salt content and – even more so – the Na equivalent % is the figure which serves for the basis of most of the sewage penalties. Their common feature is that their removal (screening) from the geothermal water cannot be implemented by a cost efficient technology. And hence this is the end of the story, although not quite.

As we all know, it never rains…but it pours. This also applies to sewage penalty. As if discrimination were not enough, the amount of penalties to be paid would be much higher than before. This is because the government decree 203/2001 already mentioned increased the penalty items of over-the-limit emissions 70 (that is seventy) times as against the former rate. And although there is a transition period when only 5, 25 and 75%, respectively, of the specified penalty is to be paid, unless someone is absolutely ignorant in the field of harnessing geothermal water, it is easy to know that this reduction is like flogging a dead horse.

5. RE-INJECTION: 'THE WISE HOT WATER RESERVOIR'

The story called 'Returning energetically spent geothermal waters to the earth' looks back to a past of 25 years in Hungary. This quarter of a century is far from being called a success story. The biggest problem, however, is the lack of saying the truth and that an Act was passed based on lies.

For example, the Act on the 'wise hot water reservoir' was passed at the end of last year.

On 15 December 2003, the Hungarian Parliament passed the stipulations of Act CXX of 2003 on amending the regulations of certain Acts regarding environmental issues. The Act was promulgated on 23 December and it entered into force on 7 January 2004. In this Act, the Act LVII of 1995 on water management was also amended. Let me just quote one paragraph:

Para. 19 Replacing para. 15, clause (3) of the Act on Water Management (Vgtv.) the following stipulations shall apply:

"(3) In harnessing mineral, medicinal and geothermal waters, preference shall be given to applications in therapeutical fields and at spa resorts. Any geothermal water exploited exclusively for the purpose of energy utilisation shall be returned to earth – according to the wording of separate statutory provisions".

The wording is unambiguous. By the way, the separate statutory provisions referred to have not yet been issued.

As shown by the text, only the energetically harnessed geothermal waters must be returned to earth, and not the bathing waters.

From a water reserves aspect, this is where the 'wise hot water reservoir' comes in.

A 'wise hot water reservoir' may indeed distinguish the purpose of exploiting geothermal water from it. This means that if this is done for a bathing purpose, then it replenishes itself, and if it is for an energetic purpose then it does not. (I believe the reader has already found out that I am using the quotation marks because of the obvious absurdity.)

Of course the question arises why isn't it allowed to reinject the bathing water? The common response to this question is that because it is inevitably contaminated with bacteria and that the contamination of subsurface water reservoirs is impermissible. Very well, but then a new question arises: isn't it possible to disinfect bathing waters? It probably is, but it would cost a lot of money.

This, however, does not end our controversy regarding re-injection. It is worth examining the background of passing this Act, too.

In 2001, information from the Hydrological Institute of the Scientific Research Institute for Water Management (VITUKI) Rt. was published under the title 'Hungary's geothermal water reserves, their harnessing and protection'. This document details re-injection also, reaching the conclusion that *'a new hot water exploitation for energetic purposes may not be practically permitted without returning the spent water to earth'*. And, it is also added that '*All this does not mean that the already licensed energetic purpose hot water utilisations are immediately obliged to reinject the hot water, but after a certain 'tolerance' period this is the goal to be achieved'*. The information also features two tables *'with the figures of experiments and actually implemented re-injections carried out so far'* concerning both porous and fissure formations. I will show below the chart of re-injections into porous reservoirs, i.e. in our case without exception into the upper Pannonian sandstone.

Area (year)	Depths (m-m)	Temp. C°)	Note
Szeged, hydrocarbon field of Algyő (operated since 1969)	950-1700 (expl.) 1900-2000 (re-inj.)		To 500 wells 20-200 m3/d injection at 50-140 bars, 10-50 mg/l
Szeged, Szentmihálytelek (1978-79, experiment)	1450-1800	80-100	832-592 m3/d injection. at 6 bars, injectivity decline to 1/5th-1/10th
Szeged, Móra F. MgTSZ. (since 1993-94)	1653-1850 (expl.) 1655-1812 (re-inj.)	80	300-1250 m3/d injection at -2-8 m, cooled static level: -52,8 m.
Szeged, FLÓRATOM Ltd. (MOL Rt., 1996)	1076-1284 1490-1653	55 74	2 wells: 840 and 1610 m3/d injection at 26-32 C°, 2,5-3,5 and 4,7-5,0 bars
Szeged, Felsőváros (experiment 1984-85, 1992 operated since 1994)	Deviated wells 1745-1898 (expl..) 1696-1917 (re-inj.)	 82 85	480m3/d - 67 C° bars; 1080 m/d - 80 C° -10,5 bars; 720 m3/d - 34 C° - 1,6 bars; 1995/96: 600-720 m3/d at 3-19 bars.
Hódmezővásárhely, District-heating (operated since 1986)	Double-function well 2060-2273 (expl.) 1386-1601 (re-inj.)	 86 60	960 m3/d 15-16 bars. Re-injection pressure doubled during 10 years of operation.
Hódmezővásárhely, Hódtó building-estate (GEOHÓD Ltd.) (since 1998)	Separate wells 1833-1997 (expl.) 1473-1669 (re-inj.)	 74 61	In 1998 after several days the pressure settled at 1060 m3/d 3,0-3,5 bars, and at the end of the 1999 at 700-840 m3/d 4,0-4,5 bars.
Szentes, District heating Co. (operated since 1988)	Double-function well 1094-2309 (expl.) 1065-1252 (re-inj.)	 95 56	Start: 720 m3/d 4,5-5,1 bars, 528-600 m3/d 4,8 bars

Table 3. Summary of experiences of re-injection into porous reservoirs (VITUKI, 2001.)

Only some other comments finally:

- the Algyő re-injection **is not aimed at water disposal,** consequently it may not be taken into consideration as a reference
- in Szeged-Mihálytelek, there was only a short term **experiment,** during which the injectinity has deteriorated dramatically
- in Szeged-Felsőváros, a re-injection – correctly – commenced in June 1995, but it has **not been in use** since April 1998
- at the double function well in Hódmezővásárhely, there has been **no re-injection** for a long time due to the high pressure demand
- only a few people have been able to see the Szentes re-injection in actual operation.

The balance of re-injection attempts looking back to a past of 10-15 years can be drawn as follows:

1. The common feature of the re-injection systems applied so far is that the geothermal water may 'flow out of the system' upstream of the re-injection well, consequently there is a psychical and in certain cases permitted opportunity for disposal above ground. The only exception was Szeged-Felsőváros, as long as it was in use.
2. The 'operators' of the re-injection systems are financially interested in water disposal above ground and also in documenting a successful re-injection (to the authority). This is because in this way they do not have to pay a water reserves contribution or a sewage penalty and furthermore they spare the electric operations cost of re-injection as well as the maintenance cost, while the geothermal water is supplied to a surface (overground) reservoir.
3. Those having a re-injection operations licence must count on the withdrawing of their licence if they report an unsuccessful re-injection attempt.

The statutory provisions on re-injection threaten the very existence of Hungarian geothermal energy utilisers – provided that they do not go bankrupt before, due to the higher contribution and penalty as shown by me above.

6. THE ROAD TO THE FUTURE

I have not dealt with all statutory provisions that make an impact on the harnessing of geothermal energy. According to the description above it is obvious anyway that an extremely narrow road leads to the future, unless the statutory provisions described above change very quickly. In time, this may mean a survival for 1-2 years, but not more than 5 years in any case. After that time, only those geothermal water harnessing operations will stay afloat where actual re-injection is carried out – there are some examples, but only with seamy reservoirs – or in case re-injection is reported to the authority, but actually the water is drained to an overground water stream.

The future consequently raises lots of questions. But who is willing to answer these:

- what justifies the triple discrimination of the energetic utilisation of heat from the ground?
- how will Hungary - now a member of the EU - meet the requirement of providing a higher utilisation of renewable energy sources?
- how many non-operating re-injections will the current statutory provisions bring and for these 'applications' how much state support will be used?
- how will the countryside retain its population, if geothermal water based horticulturists – believing that their situation is hopeless – give up their production activities?

The author of this paper knows the answers, but he will not speak. Because he is superstitious. Maybe things will not be as bad as they seem after all.

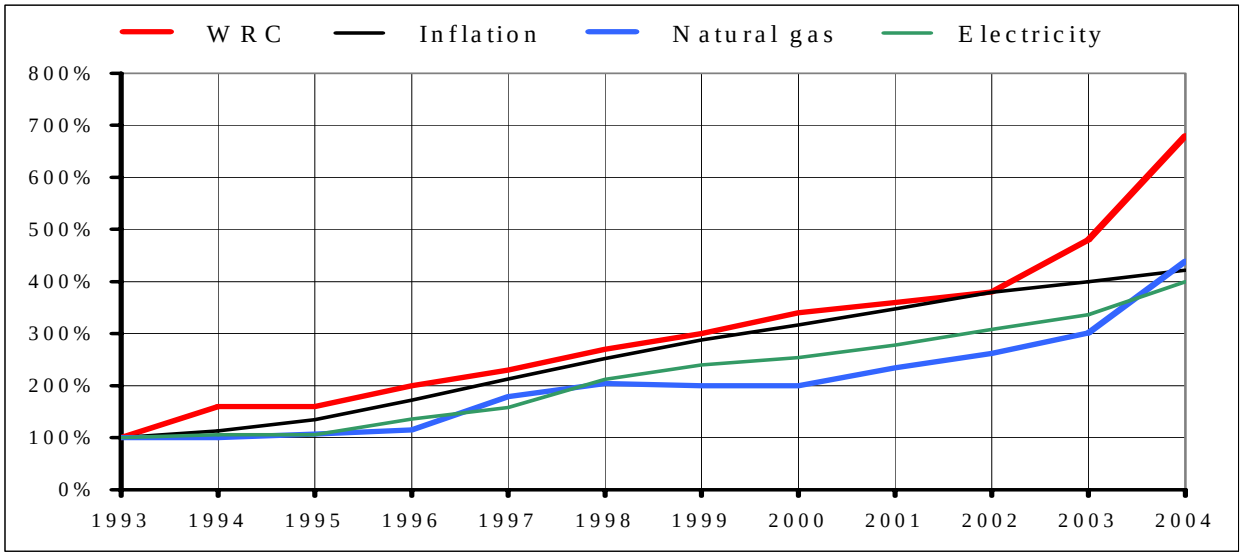

Figure 1: Growth of WRC, inflation and the price of natural gas and electricity - Base year: 1993 (=100%)