

Complex Approach of Establishing a Geothermal Power Plant in Hungary

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Keywords: geothermal power plant, pilot project, common concept

ABSTRACT

Geothermal power plants have not yet been established in Hungary. Despite the apparently advantageous geothermal potential, those who intend to establish the first geothermal power plant will have to face several technical, economic and legal difficulties.

It is not easy to find a reservoir with appropriate size, thermal yield and temperature, and re-injection of the significant volume of used thermal water to the sandstones is not solved either. In order to define the real capacity of the power plant and the parameters of the reservoir we need to perform expensive production/re-injection tests, which also bear geological risk. Moreover, regulations have become increasingly severe in respect to conditions of mining, water matters and environment protection.

In the meantime, the business environment of utilising geothermal energy has improved in recent years. Therefore MOL Plc. decided to investigate, within the scope of a pilot project, the opportunities of establishing a small geothermal power plant. The activity requires a complex approach regarding geology, technology, financing and authorization process. This means an approach coming from four different professional areas. Risks can be mitigated only through a common management of the concepts.

1. INTRODUCTION: OBSTACLES OF ESTABLISHING OF A GEOTHERMAL POWER PLANT

It is not easy in Hungary to find a reservoir for a geothermal power plant with appropriate size, thermal water yield and temperature. The temperature of thermal waters is not as high as in the volcanic regions. The 140°C isotherm map shows that the temperature minimally suitable for establishing a power plant can be reached in quite deep wells. (Figure 1.)

Moreover, a proven technical solution to re-injecting the significant volume of used thermal water to the sandstones has not been found either. To define the real capacity of the power plant and the reservoir parameters production and re-injection tests should be performed. However, the well operations required for establishing a system suitable for test operation and the construction of the pipeline would cost a lot also.

One of the major obstacles of establishing a geothermal power plant is the geological risk. However, geological risk can be reduced by the information on the existing hydrocarbon well portfolio. The map of distribution of the wells is provided on Figure 2.

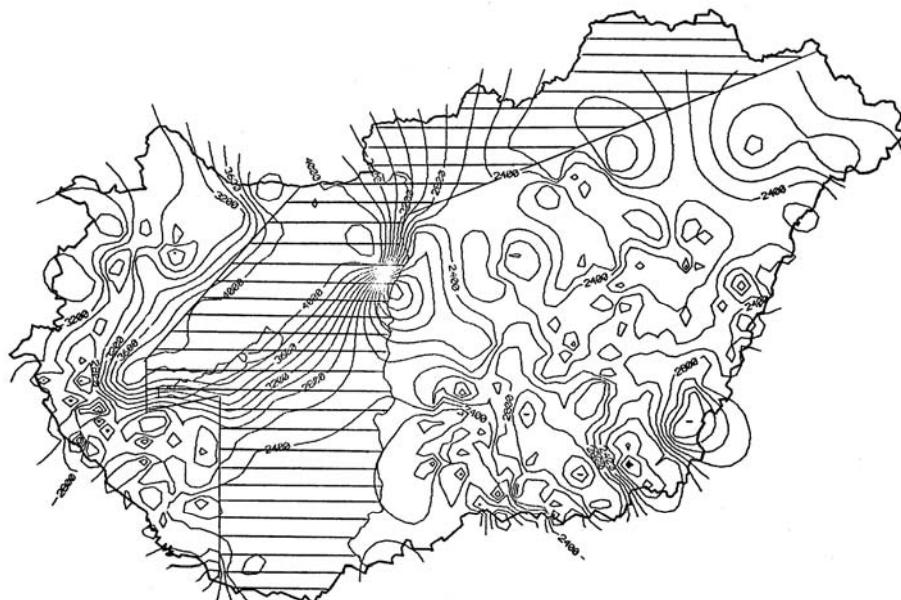


Figure 1: 140°C isotherm map of Hungary

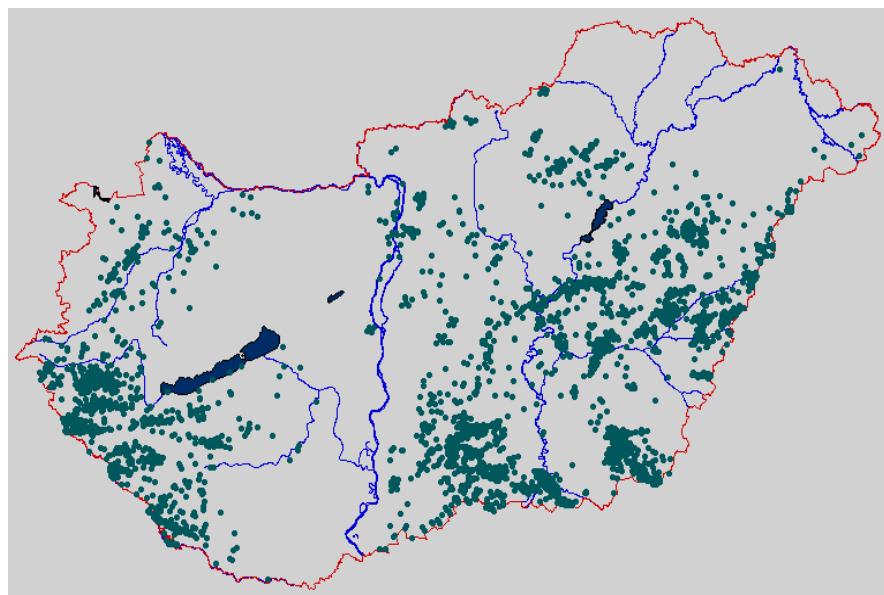


Figure 2.: Regional distribution of hydrocarbon wells drilled in Hungary

The history of hydrocarbon exploration in Hungary goes back more than 60 years. Taking into consideration that the existing wells were involved in hydrocarbon exploration, field development or production processes, drilling, completion and testing of them were focused on hydrocarbons. They have often just touched the water producing formation. In the drilling period we did not spend funds on deeply drilling the water producing formation and perform expensive water formation tests since the purpose of drilling and formation tests was to recover hydrocarbons. Consequently, though we know the subsurface formations very well, we can only estimate the thermal water producing capacity of the wells.

The temperature of thermal water can be estimated well, but it is quite risky to estimate the yield.

The related regulations set forth increasingly restrict conditions on mining, water matters, environment and nature protection. As a result of Hungary's joining the EU, several regulations on environment protection have come into effect.

The Hungarian government decree of the European Natura-2000 regulation sets for restrictions of different level to industrial activity for 21% of the country's territory. The regulation distinguishes between:

- Special nature preservation regions
- Extremely important special nature preservation regions
- Special bird protection regions

The regulation has also set forth reviewing the effective mining licenses.

The government decree on the protection of subsurface water has also become significantly stricter, which raises tasks to be solved in respect of re-injection and treatment of thermal waters with aggregates.

From a financing aspect we have to accept that a geothermal power plant project is not competitive

compared to a hydrocarbon project. The geothermal power plant project needs external support. This is why it had no chance to launch a geothermal power plant project in Hungary prior to 2002 when the Electric Energy Act became effective.

2. CHANGES IN THE BUSINESS SPHERE

The obligatory take-over and the take-over prices produced from renewable energy sources are guaranteed by the Hungarian government through the Electric Energy Act effective as from 2002. The price fixed in 2002 was raised with inflation in the end of 2003. The average obligatory take-over price in 2004 is 18.40 Ft/kWh (8.7 USA cent, 7.2 Eurocent). This allowed making real calculations on establishing a geothermal power plant.

Similarly, the Electric Energy Act also regulates the introduction of the so-called "green certificate" as from the end of this decade. According to this system the producer of electric energy producing from renewable energy is entitled to issue a green certificate, which is confirmed by the energy authority. Electric energy traders will be obliged to buy a certain number of green certificates, which will significantly upgrade the green energy.

With Hungary's joining the European Union the opportunity has opened to increasingly support public environmental protection and infrastructure programs. What may cause difficulty is that the European Union wishes to subsidize mainly small and medium size businesses. Such businesses are unable to take the significant financial risk born by the exploration of geothermal energy. To subsidize financially strong companies is not the preference of the EU.

With the changes in the regulation system, both domestic and international companies have started to be increasingly interested in geothermal projects in Hungary. This resulted in competition and opportunities for business co-operation and sharing the risks.

3. THE HUNGARIAN CONCEPT OF RENEWABLE ENERGY

The European Union is strongly committed to expand renewable energy. In line with that, Hungary has also ambitious plans regarding the power plant capacity for renewable energy to be established by 2010.

Present plans envisage producing 1600 GWh electric energy until 2010 from renewable energy, including 100 GWh from geothermal energy. Calculating with 7-8000 hour/year net capacities, it requires 12-14 MW power plant capacities. In countries with more favourable natural endowments this could be achieved with one single power plant. In Hungary it is probably more reasonable to cover this capacity demand with 3 or 4 small power plants with capacities in the range of 2-5 MW.

The Electric Energy Act and its provisions related to statutory take-over, and the national concept of renewable energy allow assuming solvent market for geothermal power plants even on the long term.

4. PREPARATIONS FOR THE GEOTHERMAL POWER PLANT PROJECT

Since the business environment has become more favorable, MOL Plc. has studied the opportunity to establish a Pilot Project.

MOL basically aims to investigate the opportunities of entering into the geothermal energy business. The company can obtain green certificate as a result of exploration of geothermal energy and production of electric energy through generating electric energy from producing geothermal energy.

When considering the aspects of the project, it should be kept in mind that it will replace fossil energy-based electric energy generation with geothermal based production, thus reducing the emission of carbon dioxide. This way the project fits well the international programs connected to climate change.

Actions already taken to get prepared for the project (drawing up a complex concept):

The well pair suitable for operation test should be selected on the basis of thoroughly considered geological concept.

First we should find a geological structure with appropriate size, temperature and productivity. This requires appropriate porosity and permeability of the water producing formation. The formation should contain water in sufficient volume and quality, and pressure conditions should allow flowing production. The same formation should absorb the re-injected water and allow the water to return into the producing well after re-warming.

On the basis of the above, we have selected and graded the possible sites.

Establishment of the necessary thermal wells is based on the existing dry hydrocarbon wells. The only acceptable solution from technological aspect is to re-inject the produced thermal water into its own formation. It is not enough to find a producing well in appropriate technical status, but also a re-injection well should be found. Therefore, we had to consider well pairs when analyzing the well portfolio and selecting the well suitable for test operation.

The geothermal team of MOL Plc. has elaborated the ranking of the most prospective well pairs.

On the basis of available data the work team has found that the realistic goal could be to establish a small power plant with 2-5 MW capacities. Table 1 was prepared on the basis of international experiences, which can be used for preliminary capacity calculations for informative purposes.

In the financing aspect, when partial concepts are developed, we should constantly consider the statutory take-over price level, because this is the basis to calculate the return related to the analyzed formation or well pair. It makes the calculations more difficult that economic advantages resulting from the potential green certificate cannot be estimated now and the income earned from selling the remaining heat of the thermal water coming out of the power plant cannot be estimated either.

Preliminary calculations however suggest that the planned small power plant could be operated economically.

To define the potential capacity of the power plant we should know the water temperature and yield on the long term and also the parameters of the reservoir. We need to have an operational test for that. Depending on the particular geometrical, geological and technical parameters, the operational test may last 3-6 months.

During the operational test we start production in the producing well, cool the water if necessary, convey it to the injection well and re-inject it. In the meantime, we measure and note each possible parameter and prepare the modelling of the reservoir.

Evaluation of the results will allow us to determine what is the capacity of the geothermal power plant that the reservoir and the well pair can supply with thermal water.

5. SUMMARY: A COMPLEX APPROACH IS NEEDED

To establish a geothermal power plant under the Hungarian circumstances is a complex work, which can be realized, only supported by the co-operation of several professional areas. The best appropriate doublet should be selected for test operation on the basis of the developed geological, technological and financing concept, taking them as a whole into consideration. In case of a successful test operation the location of the potential geothermal power plant will be finalized.

Table 1: Capacity of binary type power plant (MW) (preliminary calculations)

Yield m3/d	litre/min	Temperature C		120	130	140	150
		100	110				
6000	4100	0.56	0.85	1.14	1.42	1.69	1.97
8000	5500	0.75	1.13	1.51	1.9	2.28	2.64
10000	6900	0.93	1.41	1.89	2.37	2.83	3.31
12000	8300	1.11	1.69	2.27	2.85	3.41	3.98
14000	9700	1.3	1.98	2.65	3.32	3.99	4.66
16000	11100	1.49	2.26	3.03	3.8	4.56	5.33
18000	12500	1.68	2.54	3.41	4.27	5.14	6
20000	13900	1.86	2.82	3.79	4.75	5.71	6.67
22000	15300	2.05	3.11	4.16	5.22	6.29	7.34