Introducing the Most Extended Geothermal Heating System in Hungary

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ABSTRACT

The paper aims to introduce the geothermal energy utilisation system in the town of Veresegyház (Hungary), which is maybe the most exemplary geothermal reference in the country. The local government realized all the developments and it was the Porció Ltd that acted as a designer and main contractor in all investments from the very beginning. The system has been extended since 1993 in several steps, supplying geothermal energy of 60 TJ/yr for all of the local governmental institutes and big factories in the town. The total track length of the geothermal pipeline has already reached 15 km, which makes this system the most extended geothermal utility in Hungary.

The spread of the system, its financial and summarised energetic data, natural gas redemption, geological model of the area, production and injection well data, along with the future plans has been presented.

1. INTRODUCTION

Veresegyház is a 17 000-inhabitant town located ca. 30 km from the capital city Budapest. In the last 20 years it became rightly famous not only for its bear farm but for the step by step developing geothermal energy utilization system that has been realized due to the determined local government and the Porció Ltd.

2. DEVELOPMENT IN TIME

The first step was to drill the well B-15 in 1987, which gave 64 °C mineral water. This thermal water had been only used in the local spa until the geothermal heating and domestic hot water supply was constructed for the grammar school in 1993. After 4 years the cultural centre and the music school was also joined to the heating system, and then one after the other, the new grammar school, its swimming pool, gym and the innovation centre got geothermal energy as well.



Figure 1: The thermal spa in Veresegyház

The next great step in the expansion was the successful application for the subsidy of the Environmental and Infrastructure Operational Program in 2006-2007, financed by the European Union and the Hungarian government. The total investment cost of this project was around 1.10 million €, 40 % of which was non return subsidy. Despite of the significant amount, the payback time of the total investment cost is only 12.7 years. The local government had an injection well drill because there has been an overall re-injection obligation regarding only energetic utilisations in Hungary since 2004. New pump stations, pipelines of 6 km track length were built and new heat consumers were attached to the system: the Calvinistic and Catholic parishes, the Catholic church, the cinema, a department store, the Innovation Centre, the post office, the Mayor's office, a retirement home, the health centre, a nursery, a day-nursery and the senior club.



Figure 2: Old oil burners and the new geothermal heating system

The town applied again for subsidy of the Central Hungary Operational Program in 2010 for a further extension of the geothermal system. After having gained the support, in a 2.16 million € project they drilled a new production well, built a new pump station and extended the other one, laid 6.6 km pipelines and bound not only local governmental institutes (the new Calvinistic grammar school, the new side wing of the other grammar school, the Micro-Regional Centre, a new retirement home, a nursery) but factories as well (a pharmaceutical company, the General Electric Hungary Ltd., the General Electric Aviation Ltd., an electricity network design and installation company (Juko Ltd.) and a sewing company (Mey Hungária Ltd.)).



Figure 3: Wellhead hut and the architecturally designed pump station at the well K-25



Figure 4: Pump station at the well K-25

This project was carried out last year and was also subsidized by the EU in 60 %. The project has a payback time of 15.7 years regarding the total investment cost.

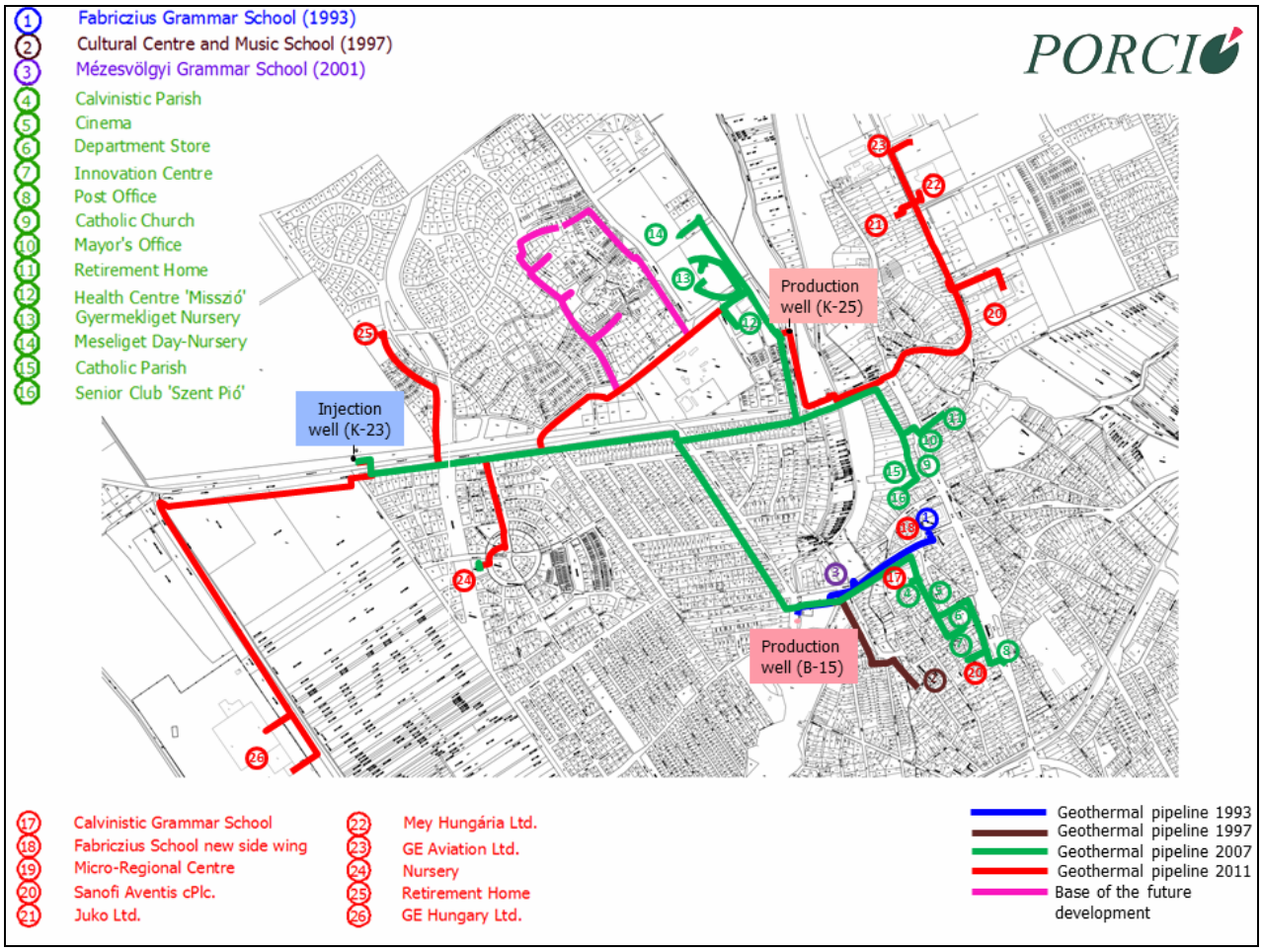

Figure 5: Spread of the system

3. TECHNICAL DETAILS

Summarizing all energetic data, the total installed capacity of 6 MW has to be highlighted. The annual geothermal energy utilisation exceeds 60 TJ, which leads to 2.06 million m^3 natural gas redemption a year. It means that at those institutions and factories that are part of the geothermal heating system fossil fuel use can be substituted in 98 %. The total track length of the geothermal pipeline in the town of Veresegyház is 15 km, which makes this system the most extended geothermal utility in Hungary.

4. GEOLOGICAL BACKGROUND

With regard to the geology we created a conceptual model of the area using the geological data obtained by drilling the 3 thermal wells and the data of the Hungarian Geological Institute. At about 1100 m depth below sea level in the northwest and more than 1900 m depth in the southeast the non karstic part of the Triassic Dachstein Limestone can be reached. We considered the upper part of this formation as our first model layer. We do not know how thick it is but it can reach some 1000 meters even. Above that, our second model layer is the karstic part of this limestone, the depth of reinjection. The next one, the layer of production contains some younger formations as well: Eocene Szépvölgy Limestone and Buda Marl. These two layers together are roughly 250 m thick.

Above that there is a thick Oligocene succession containing mainly claystones that act as aquitards (Tard Clay, Kiscell Clay, Törökbálint Sandstone). To separate the uppermost, permeable layer we created a last model layer containing the soil and Burdigalian gravel.

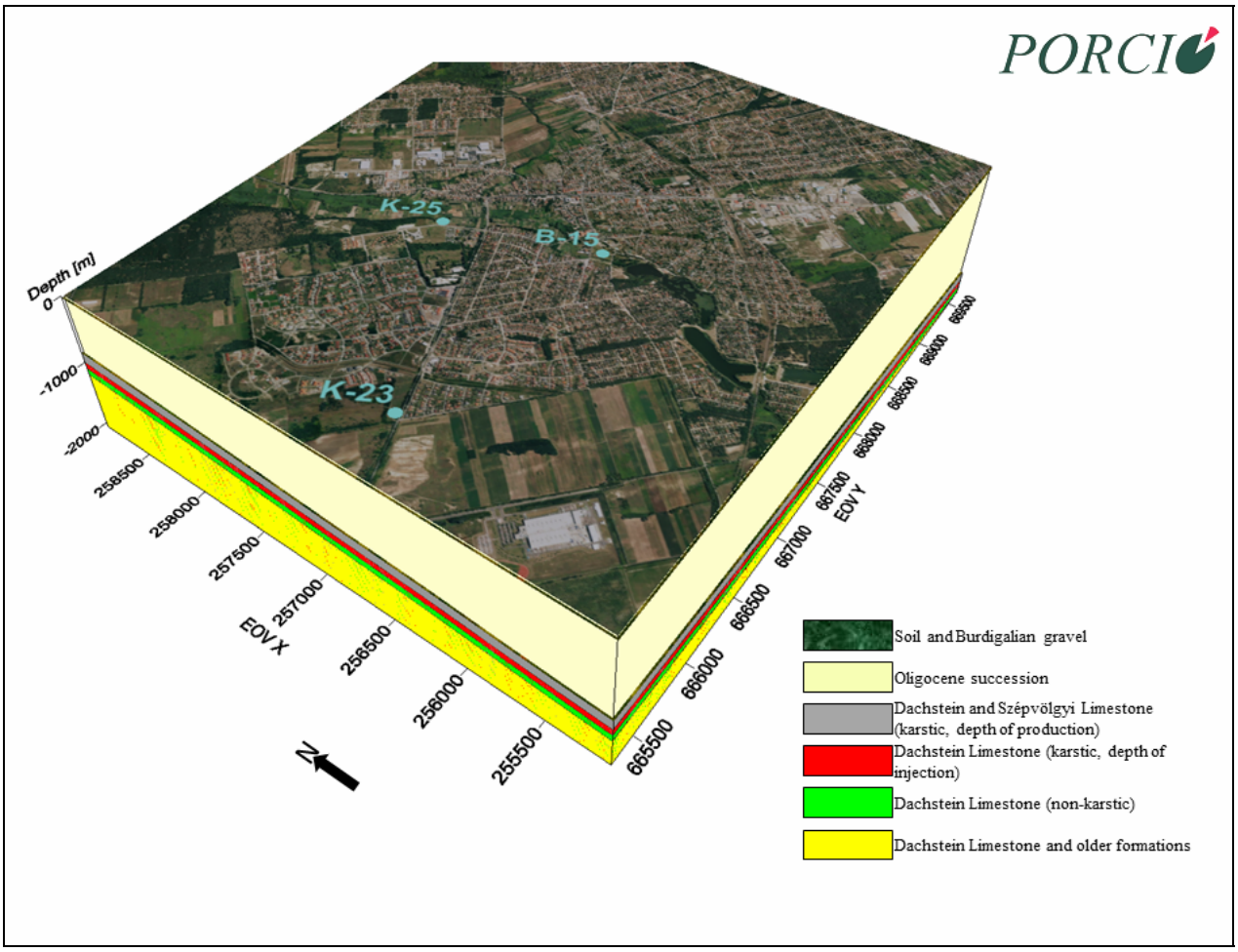

Figure 6: Model layers of the region

Table 1: Well data

Production Wells		
	B-15	**K-25**
Drilled	1987	2011
Depth	1462 m	1202 m
Screen	1414-1457 m (1 section)	1126-1202 m (6 sections)
Outflow temperature	65,5 °C	63,7 °C
Bottom hole temperature	69,7 °C	67,9 °C
Capacity	66 m^3/h	72 m^3/h
Age of the layers	Triassic	Triassic, Eocene

Injection Well	
	K-23
Drilled	2006
Depth	1600 m
Screen	1310-1403 m (3 sections)
Average injection temperature	38 °C
Production/Bottom hole temperature	64 °C/67,9 °C
Capacity	94 m^3/h
Age of the layers	Triassic

In summary, the reservoir is a karstic limestone, mainly Triassic with some Eocene limestone and marl in the uppermost part. The reservoir temperature is 68-70 °C and the outflow temperature is around 64 °C. The re-injected water is around 38 °C. The total production is around 780 000 m^3/yr and the injection is 680 000 m^3/half a year.

The demand of the thermal spa is 100 000 m^3 in a year and since this quantity is used for bathing, it must not be re-injected. The injection well is not used during the summer because the thermal water used for domestic hot water supply in the summer can be further utilized in the spa.

The static well head pressures in the region have increased in the last 10-15 years because of the close of big bauxite mines in the Transdanubian Mountain Range and the stop the intense karst water level lowering. In Veresegyház we could observe some pressure increase as well. Right after the drilling of the production well B-15 in 1987 the static well head pressure was measured only when the well was still warmed up. In 2011 the same conditions prevailed when the measurement was repeated and the water level was already higher. In 2004 and 2011 the static pressure was also measured but when the well was cooled down and a one-meter increase could be observed during these 7 years.

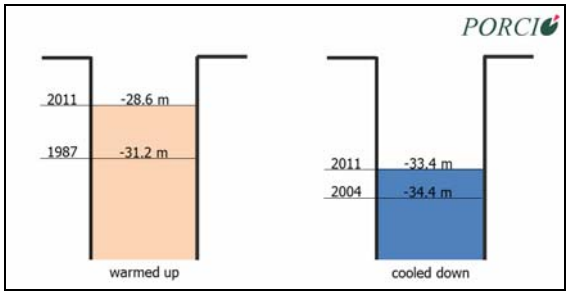

Figure 7: Static well head pressure changes in time in the production well B-15

5. FUTURE PLANS

The next step would be to supply geothermal energy for townspeople, that is, to join the residential areas into the system. This would be a unique development in Hungary. An application has been already submitted for such a development. Its evaluation was positive, meaning that it would be a subsidized investment but unfortunately because of the decrease of the residential gas price at the beginning of 2013 the local government desisted from the realization.

In 2011 we at Porció Ltd. got an assignment from the town of Veresegyház to analyse the possibility of the further extension of the geothermal system. We calculated on 3 additional wells, one more injection and 2 production wells. This development seems to be enough to cover the half of the energy demand of the recent population in the town. But of course there are still plenty of open questions so a comprehensive feasibility study has to be done when new application possibilities arise.