ISSN 2052-0018 (print)
Geographical Locality Studies – June 2013, Volume 1, Number 1. pp. 166–177.

GABRIELLA ANCSIN
PhD, Retired Senior Lecturer
University of Szeged, Faculty of Science and Informatics, Department of Economic and Human Geography
szonoky@geo.u-szeged.hu

Local Geothermal Energy Sources in Csongrád County, Hungary: A New Way for a More Sustainable Energy Supply

Abstract

Szeged and Csongrád County are among the lucky few territories which are well supplied with potential energy resources. Numerous hydrocarbon fields are found under the city itself as well as in its vicinity. The resources have been extensively exploited for local public and economic purposes. At the same time, the abundance of potentially available thermal waters found in the geological layers underneath opens up new possibilities for multi-focal usage as well. Geothermal energy offered by these local resources is unfortunately not fully exploited yet. Industrial usage of thermal waters still prevails, followed by balneological and touristic purposes. Excellent examples are the recently constructed or developed, well-equipped, thermal bath complexes found in and around the city (Algyő, Mórahalom and Makó), many of which have also gained increasing international reputation and visitors across the borders. This present study discusses the potential areas where thermal waters could be more widely used in Szeged touching upon the modern geothermal cascade systems already installed and running in some of the neighbouring settlements.

Key words

Geothermal energy; Thermal waters; Exploitation; Southern Great Plain

Introduction

Social and economic changes accompanying the change of the regime in 1989–1990 resulted in significant transformations of energy production and consumption in *Hungary*. There is a constant decrease in local production parallel to an increasing import from the 1990s onwards *(Table 1)*. This unfortunate trend directed the attention of professionals to the utilisation of the new type of energy resources.

Table 1 – The energy budget of Hungary (1990–2010) (in PJ)

Source: KSH (Central Statistics Office) STADAT

Year	Production	Import	Total	Export	Change in	Total
1990	634.1	653.5	1,287.6	70.8	13.1	1,203.7
1995	575.0	617.5	1,192.5	98.8	9.1	1,084.6
2000	485.2	665.4	1,150.6	82.8	12.7	1,055.1
2005	428.0	873.6	1,301.6	140.8	7.5	1,153.2
2010	460.6	770.4	1,231.0	134.6	9.7	1,086.7

Hungary has largely run out of conventional energy sources in the past few decades. Black coal mines were shut down in 2005, with ongoing mining focusing on the exploitation of lignite and brown coal reserves alone. While natural gas production could meet the domestic demands in 1980, today it can only account for 26% of the total needs. The remaining is imported. Oil production has seen an even larger decrease by ca. 35% in the past 10 years. The country's nuclear power station contributed to the national electricity production by 172 PJ in 2010, providing for 42% of the local demands. This resource provides for 15% of the total domestic energy demands. If we consider the energy policy and status of the *European Union*, there is an obvious dependence on imported energy to varying degrees which fundamentally affects the safety as well as the price of supply. In 2006, the rate of dependence on the imported energy supply was 54% in the *EU-27* (the index is given by the ratio of net import and usage in per cent). In *Hungary*, the same index was 62.5% assigning it to rank 14 among the *EU* countries.

The negative influences of burning fossil fuels on the environment are clearly known. Recent policies of the *EU* are thus calling for and supporting a larger reliance on renewable energy sources. According to the 2009/28/EC policy of the *European Parliament and Council*, *Hungary* has to gain at least 13% of its energy demands from renewable sources by 2020. This value was only 7.4% in 2007 and has not changed much since then.

1. Geothermal energy

Hungary boasts of an outstanding potential in geothermal energy sources, especially in the area of the *Great Hungarian Plain* due to its unique geological endowments ranking it among the leading countries. This is clearly evident from the exploitation numbers and with a second rank among renewable energy production after biomass. In the past ten years, a rapid increase in utilisation of this type of energy has been witnessed *(Table 2) since it is* a reliable and environmentally friendly resource.

Table 2 – Energy derived from renewables by type (1995–2010) (in TJ)
Source: KSH (Central Statistics Office) STADAT

Name	1995	2000	2005	2010
Electricity from hydroelectric	587	641	728	677
Electricity from wind power	0	0	36	1,922
Wood and other solid waste	31,095	29,295	43,535	63,756
Geothermal energy	3,600	3,600	3,627	4,130
Biogas	0	6	297	1,516
Heat from solar energy	0	0	81	225
Electricity from solar energy	0	0	0	3
Renewable communal waste	1,085	1,218	1,382	2,229
Biofuels	0	0	214	5 947
TOTAL	**36,366.8**	**34,759.8**	**49,900.1**	**80,405.2**

Despite the high investment costs, the running costs are extremely low. Furthermore, as this type of resource is a local one, it can significantly enhance economic development of the rural, economically disadvantaged regions. Cheap running costs offer significant savings for the local governments. Balneological uses, on the other hand, can contribute to tourism development. The geothermal industry opens up new employment possibilities along with training needs (BOBOK, E. – TÓTH, A. 2010).

A moderate estimate of the local geothermal potential is 100–110 PJ annually. This would provide for ca. 20% of the annual heating demands. In other words, ca. 10% of the primary energy demand could be met via the sufficient exploitation of this energy resource. The number of exploited thermal wells in 2007 in *Hungary* was 971, 33% of which were used for balneological purposes. 43% of the wells are exploited for heating purposes in local agriculture, various branches of the industry as well as to ensure public hot water and heating demands. Roughly 25% of the working wells are run by waterworks (SZANYI, J. *et al.* 2009).

The first thermal water wells were established in the second half of the 1950s. Due to a relative economic upheaval and positive policies of the period, exploitation flourished in the 1960s. Non-productive oil wells deepened in the same period which meant a further impetus, as it can be seen on the example of *Zalakaros*. There was a significant decrease following the stagnation in the 1970s, when a relative increase in recent market demands brought about a second upheaval in utilisation. Formerly, used waters were driven into rivers, lakes and canals. According to a bill passed in 2004, these waters must be pumped back in case of the newly established wells *(No. LVII Act of 1995, modified in 2003 on Water Management)* (ÁGOSTON, B. *et al.* 2008) This policy is in line with the expectations of the leading experts of the field as increasing usage of the thermal waters puts greater and greater pressure on the reservoirs with a limited storage. In order to ensure increased production in the heat transfer, cooled waters are to be pumped back to allow reheating and some other types of renewable utilisation. Several well-known examples for this type of technology are known locally and internationally as well (SZANYI, J. – KOVÁCS, B. 2011.). The geothermal public utility system of *Hódmezővásárhely*, which was opened in 1998, is one of such examples, where the used waters are pumped back into a sandstone reservoir.

2. Geothermal energy exploitation in the Southern Great Plain Region

The region of the *Southern Great Plain* has an outstanding potential for geothermal energy as sandy layers of the *Upper Pannonian* and *Pleistocene* age, acting as potential reservoirs, are the thickest here. These layers render as number one among domestic thermal water reservoirs. The temperature of productive waters increases with the depth of the established wells ranging between 50–60°C (122–140°F) at a depth of 1,000 m (3,280 ft), 90–100°C (194–212°F) at a depth of ca. 2,000 m (6,561 ft) and 110–120°C (230–248°F) at 2,500 m (8,202 ft) (SZANYI, J. – KOVÁCS, B. 2010). The referred extraordinary hydrogeological endowments allowed for a wide-scale utilisation of thermal waters in the area studied *(Figure 1)*.

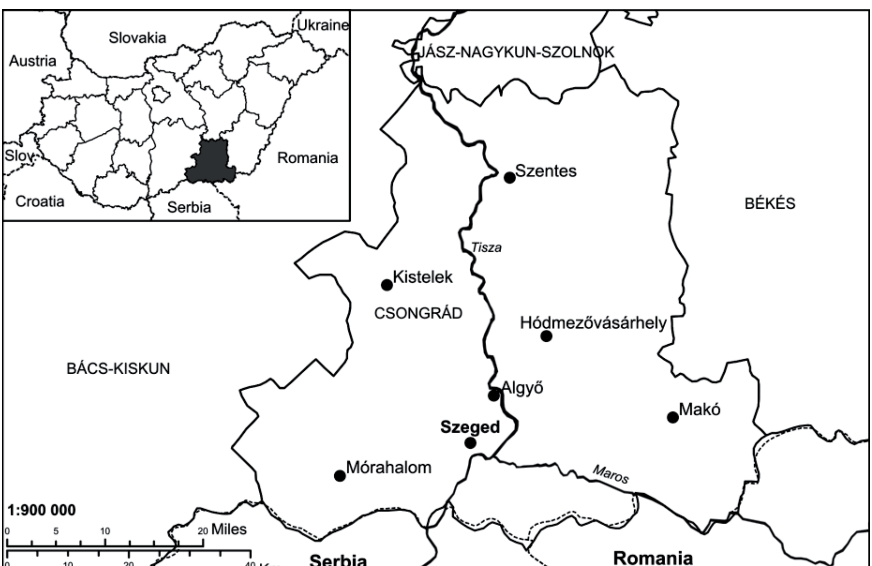

Figure 1 – Major 'geothermal settlements' of Csongrád County
Edited by SZELESI, T. (2013)

a. Roughly one-third of the exploited thermal waters are used in agriculture for local horticultures and animal farms acting as major users. The annual usage of this agglomeration ranges between 8–10 million m^3 (282–353 ft^3/1 m^3~1000 litres) of waters with temperatures between 70–100°C (150–212°F). Two major centres are known in *Szentes* and *Szeged*, where the heat transferred from thermal waters is used for heating greenhouses, animal farms as well as for servicing communal buildings. The *ÁRPÁD-AGRÁR Horticultural PLC.* of the city of *Szentes* is one of the largest complexes in *Europe* using such renewable energy resource. Its predecessor, the *Árpád Horticultural Cooperative* started exploiting this resource as early as from 1960. Today, 20 producing wells ensure heating supply of 60 ha for greenhouse complexes and plastic foil tents. In addition, the gained energy is also used for heating poultry farms and concomitant service buildings. Greenhouse and plastic foil tents provide the growth of various off-season vegetables and groceries such as green peppers, tomatoes, cabbages, lettuce, and cucumbers. The other company, the *FLORATOM Ltd.*, established in 1992 in *Szeged* uses the same type of energy for heating 22 ha of greenhouse complexes which primarily produce peppers and tomatoes. 15% of the total capacities are used in floral industries with gerbera being the main type of flowers grown. The company' predecessor, the Liberation Cooperative, has exploited this energy source from 1959 onwards.
b. Balneological and therapeutic utilisation of thermal waters is long-standing in our study region. 24% of total thermal water production goes to spas and thermal baths. The first wells, yielding waters of 30–50°C (86–122°F), were established during the last century, many of which were granted the status of therapeutic waters. A 944 m (3,097 ft) deep well established in the vicinity of the public steam bath in *Szeged* in 1927 yielded waters of 49°C (120.2°F). The thermal spring of the Anna well was granted therapeutic status in 1929 and 1967, respectively. The

recently renovated *Anna Thermal Bath and Spa* complex is one of the largest and most visited wellness complexes of the city of *Szeged*, offering a wide-range of wellness and therapeutic services. The *Napfényfürdő Aquapolis Spa Complex* opened in 2009 on the other side of the *Tisza River* is the other such highlight of the town. In addition, several modern spa complexes have been opened in the region including the ones of *Algyő*, *Mórahalom* and *Makó*. The key importance of these complexes in local tourism industries is well known. The most recently established spa complexes of *Hódmezővásárhely* and *Csongrád* act as end users of the newly established geothermal cascade systems, where the produced waters after an initial heat transfer and cooling to 30–40°C (86–104°F) are used for balneological purposes.

c. Only 6% of the referred energy types are used in public heating. They are mainly concentrated in the area of *Csongrád* County. The first such measures were taken in *Szeged* and *Szentes* in the 1960s.

3. Potential uses of thermal waters for public heating in Szeged

Geothermal energy for public heating of trade and service providers as well as local citizens was first used in the *Odessa district* of the city. The first thermal water well with a depth of 1,900 m (6,233 ft) yielding waters of 90.5°C (194.9°F) was also established there in 1962. The gained heat was initially used for heating local daycares, preschools as well as various communal buildings in addition to 196 public apartments. Within two years, another 800 users were introduced into the system. So far, the cooled waters have been driven to the *Tisza River*. From 2013, however, the used water must be injected back to the reservoir (Kothencz, T. 2012).

The first complex of a production and injection well in the city of *Szeged* was established in 1983 by the courtesy of the *Central Mining Development Institute*. After a long intermission, a new, high productive compressor was installed in 1994–1995 from *PHARE* subsidies. This well system provided the heating and hot water demands for

3,300 apartments in the residential complex of *Szeged-Felsőváros* between 1995 and 1998. In that year, due to the unfavourable running conditions, the injection was shut down. Today, the producing well yields 50,000 m^3 (1,765 thousand ft^3/1 m^3~1000 litres) thermal water for heating (KOTHENCZ, T. 2012).

Learning from the problems of the past uses, today there are two possibilities for thermal water utilisation in public heating. One is the updating of the available infrastructure and the other is the establishment of the multi-step heat transfer cascade systems. The establishment of the latter is profitable only in those areas where there are substantial market demands. The enormous public buildings of the downtown area as well as the condos of the adjacent residential complexes would be most suitable for such establishment. Numerous pros are present, including a local presence of the energy source granting independence from imported energy as well as being perceived as a long-term stable supply. Moreover, this would also result in reduced pollution and heating costs. In the long run, the system offers ca. 60% savings compared to systems based on gas burning.

In 2007, an extensive study conducted by the *Geothermal Coordination and Innovation Foundation of the Department of Mineralogy and Geochemistry*, *University of Szeged* as part of an *INTERREG II. Project*, was assessing the potential uses of geothermal energy in the buildings of the university. Proposals were made for the establishment of two cascade systems. The first is located in the downtown area and composes a producing well of 2,200 m (7,217 ft) depth yielding waters of 90°C (194°F) where two concomitant injection wells would provide for the heating of 9 downtown university buildings. The second, made up of a producing injection well, established in *Újszeged*, would provide the heating of 6 university building complexes in addition to the city's stadium and public pool. The expected turnover period of the investments with substantial state subsidies is 9 years. However, once this plan is realised, heating costs would be reduced to roughly half of the present value.

While *Szeged* is still stuck in the phase of planning, some nearby cities have decided to move on providing functioning examples of such systems. The geothermal public utility system of *Hódmezővásárhely* was inaugurated in 1998, after five years of construction. The system is made up of two subunits, a producing and a heating unit. Two producing wells with a depth of 1,300 m (4,265 ft) provide hot water for 2,800 apartments and 10 public buildings. The heating subunit is composed of three producing and two injection wells with the depth of 2,000 m (6,561 ft) and water of 80–86°C (176–186.8°F). Two insulated heating pipe circles were established of 6,500 m (21,325 ft) total length transporting hot water to the apartments. The end user of the cascade system is the public bath, where the cooled waters with the temperature of 27–30°C (80.6–86°F) are injected back into the reservoir. The producing cost of 1 m^3 (35.3 ft^3/1 m^3~1000 litres) of hot water for public use in the traditional system was ca. 1.60 EUR (1.35 GBP), now it is only ca. 20 euro cents (0.17 GBP). In case of heating, the costs were cut back to one third of the original (Ágoston, B. *et al.* 2008). The system is being continuously extended by the adding of new public buildings. A significant achievement, besides its greenness, is complete independence from imported energy.

Learning from the example of *Hódmezővásárhely*, more and more settlements have realised the benefits offered by this new type of energy. The city of *Mórahalom* inaugurated its own cascade system in 2010 following two years of construction using *EU* subsidy, as well. The system is composed of a single pair of producing and injection wells and accessory pipes with heat transfer centres. The gained energy is primarily used in public buildings for heating and will surely cut back running costs besides offering a lesser degree of dependence on fossil fuels. The geothermal cascade system of *Csongrád* was reopened in 2012 following a substantial expansion and update of the previously shut down system. The rejuvenated producing well with a depth of 2,000 m (6,561 ft) yields waters of 82°C (179.6°F) provides heating for the most important public buildings and facilities (schools, healthcare centre) in addition to 500 apartments and the public bath as the end user of the system.

4. Summary and discussion

The utilisation of geothermal energy has several advantages with respect to the technology, the outstanding economic value and importance. These are rooted in several factors, such as the independence from price increases of other energy resources like fossil fuels, the mass of potentially available resources and environmentally friendly usage. Thermal waters have been widely exploited for ca. 50 years in the area of the *Great Hungarian Plain* for not only balneological purposes, but also industrial and agricultural usage, as well as public heating. The use of geothermal energy for heating has been more and more widely propagated. An economic run can be achieved only in case of larger public buildings as well as residential complexes.

The geothermal public utility system in the city of *Hódmezővásárhely* dates almost a decade back and as such offers sufficient information on the potential pitfalls of such systems in public heating for other cities. Acknowledging these experiences, more and more towns decided to introduce it into their own system of public utilities. Classical examples are the towns of *Makó*, *Csongrád*, *Szentes*, *Kistelek* or *Mórahalom*. Thermal waters are used as a renewable energy source since the excess heat is utilised with used waters pumped back into the original reservoir. The region has a good potential of know-how in the field of geothermal energy exploitation based at the University of *Szeged*. The presently ongoing projects are aimed to evaluate the benefits and pitfalls of establishing a geothermal cascade system in the city of *Szeged*. The leading expert in the field, *János Szanyi* considers the establishment of 5–6 subsystems to be necessary for meeting the heating demands of public buildings and residential complexes in the town. With this, approximately one third of the total usage of natural gas for heating could be substituted following a full payback of investment in 10–12 years (Dobai, T. 2012).

References

ÁGOSTON, B. – KOZÁK, P. – TÖRÖK, J. (2008). *A termálenergia hasznosítási lehetőségei a dél-alföldi régió területén XXVI.* – Hidrogeológiai Vándorgyűlés Miskolc ATIKÖVIZIG

BOBOK, E. – TÓTH, A. (2010). *A geotermikus energia helyzete és perspektívái.* – Magyar Tudomány 2010/8., pp. 926–937.

SZANYI, J. – KOVÁCS, B. – SCHAREK, P. (2009). *Geothermal Energy in Hungary: potentials and barriers.* – European Geologist, 27, pp. 15–19.

SZANYI, J. – KOVÁCS, B. (2010). *Utilization of Geothermal Systems in South-East Hungary.* – Geothermics, 39, pp. 357–364.

SZANYI, J. – KOVÁCS, B. (2011). *A geotermikus energia hasznosítási lehetőségei az Alföldön.* In: RAKONCZAI, J. (ed.) *Környezeti változások és az Alföld.* – Nagyalföld Alapítvány 7., Békéscsaba, pp. 373–378.

Electronic sources

DOBAI, T. (2012). *Meg lehet spórolni a gázfelhasználás harmadát.* Delmagyar.hu [Online]. 18 December 2012. Available at: <http://www.delmagyar.hu/szeged_hirek/meg_lehet_sporolni_a_gazfelhasznalas_harmadat/2311880/> [Accessed 13 January 2013]