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How to Make the Economy of Geothermal District Heating Projects Better?

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ABSTRACT

Similarly to other types of renewable energy geothermal also faces with low density of energy and relatively high cost of investment. Thus profitability of projects aiming at using renewables is mostly insufficient for commercial financing. In order to fulfill the goal for extending the use of renewables and reducing emission of greenhouse gases, governments, at least in Europe, need to provide financial support either in a form of contribution to the costs of investments, or ensuring feed-in-tariffs for renewable energy producers. Spending tax payers' money for subsidies will work as long as social acceptance of renewable energy is high. Obviously, it will not last forever. Stakeholders in renewable industry need to be prepared for the time when state funds dry up. After 2020, according to some nonpublic news, the Hungarian government intends to reduce subsidies for renewables drastically. The main user of geothermal energy in Hungary is, behind agriculture, the district heating. In the last 8-10 years, due to supports, about one and a half dozens of new geothermal district heating systems have been built in the country. By examining cost structure of some of these new projects it shows that a significant proportion of the investment costs were spent for the transmission and distribution network of geothermal heat. These investment elements cannot be avoided if district heating network does not exist. Due to the lack of heat supply infrastructure, geothermal developments thus faced to additional expenses. Such infrastructure type elements can be recognized in almost every geothermal projects, the financial share of which reached in some cases up to half of the total investment cost. This is a serious competitive disadvantage for geothermal energy, which, furthermore, does not occur with the other forms of renewable energy sources. If such non-geothermal-related costs are detached from the budget for renewables and financed by a separate source, uncommon opportunities will expand for geothermal energy, and dependence on state aid will also be abolished.

1. INTRODUCTION

To answer the question raised in the title, namely how to make the profitability of geothermal heating systems better, does not require any qualification in economics. Everyone knows that by raising the incomings and reducing the operation costs the profitability improves. But this is of course too trivial to be the topic of this paper. The actual reason of writing this study is the experience that at the geothermal projects in the last 10 years in Hungary the way of heat transportation and distribution has to be planned and constructed and not the geothermal technology. For this you do not really need any expertise in geothermal. The question is then why these two items are still parts of geothermal investments.

Comparing geothermal energy with other renewable energy sources, a similar question may arise. Regarding solar energy and biomass, e.g., utilization mainly occurs at the site of energy production, therefore there is no cost of transport and the size of the project can be adjust to the consumer's demand. Contrary to them, at deep geothermal projects it is a very rare case when only one institute or building is supplied with geothermal energy. Geothermal based heating can be provided typically to several hundreds, sometimes even thousands of apartments or whole districts. In this case heat transport and distribution have a main role.

2. SUBSIDIES FOR RENEWABLE ENERGY IN HUNGARY

Renewable energy subsidies are quite new in Hungary. The first inviting applications for renewable energy came out after joining to the European Union. They meant to create calculable conditions and notable financial source for investors.

It is worth mentioning that 30 years ago, at the time of the socialist planned economy a still unprecedentedly big scale geothermal program started. The aim of this program was then, however, not promoting geothermal energy but revitalize the recessive economy through state orders. Although the desired result could not been reached and the socialism collapsed in 5 years, those geothermal projects proved to be very successful and enduring: 7 from the 8 systems built at that time are still in operation, mostly widened and modernized since then.

After 1990 renewable energy sources did not get any support but loans with favorable interest rates were provided for replacing fossil energy.

The main point of the current subsidy system is that the state takes over some part of the investments costs, that is, the investor gets a non-refundable subsidy. The subsidy rate depends on the profitability of the projects but there are limits of supportability. A comprehensive feasibility study with a defined formula has to be prepared for the application of any state subsidy. The study has to show the extant energy production and utilization, the planned technical completion of the renewable energy use with the needed equipment and machineries, and the detailed budget of the project confirmed by tenders. Operational cost of renewable energy use and savings due to fossil energy redemption have to be determined. Based on a dynamic financial analysis, support entitlement of the project has to be proven and with a defined algorithm the support claim has to be laid down.

An application cannot be supported if the profitability of the project is too good or too bad (Figure 1). The profitability count as too good if the payback time is lower than 7 years. It is, however, too bad if the payback time is longer than

- 20 years in the case of budgetary institutions,

- 15 years in the case of companies.

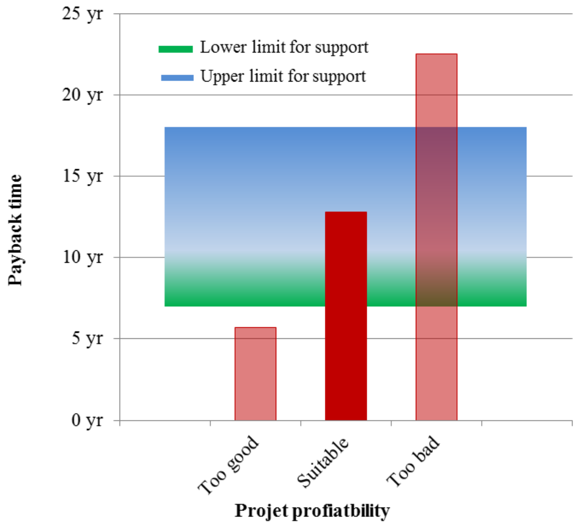

Figure 1 Projects suitable or not suitable for support

This criterion can be easily understood, since a project with a very good rate of return does not need a support, and, on the other part, the state does not want to waste money on almost non-viable projects.

3. COST ANALYSIS OF GEOTHERMAL PROJECTS

It is an ideal case for geothermal energy use when the geothermal reservoir can be reached at any point of the settlement with a minimal risk and a district heating network already provides heat for the buildings. In this case it is enough to conduct the geothermal water to the heating station of the district heating system and transmit its heat with a central heat exchanger (Figure 2). After that only the water disposal has to be solved. Consequently, the geothermal system consists of the production well, the water treatment and transmitting equipment, the heat exchanger and the water disposal unit (injection well, surface channel, cooling and storage ponds, etc.). Besides these the isolated or non isolated pipes are added to the system joining the units at different locations. The length of the pipeline varies in a wide range from 10 m to 10 km. (From this point of view one of the most fortunate location is Szeged-Felsőváros where the production and injection well were deepened next to the district heating station and the distance needed between the production and re-injection was not reached by building surface pipelines but by directional drilling.) The main units, their relative position and the system scopes of a geothermal utilization scheme based on an existing district heating system are shown in Figure 1. This was the principle of the geothermal energy utilization systems built in the 80-ies in Szentes, Csongrád, Hódmezővásárhely, Makó, Kapuvár, Mosonmagyaróvár and Nagyatád, then of the Szeged-Felsőváros system mentioned above in 1995 and a small capacity geothermal district heating in Vasvár.

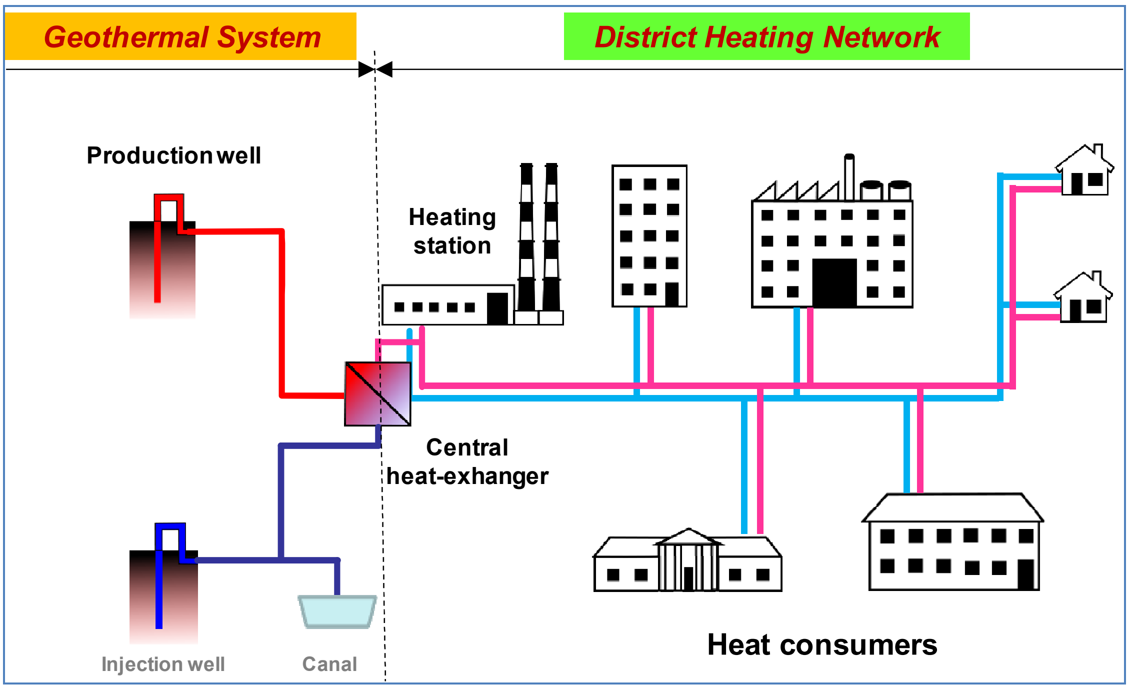

Figure 2 Scheme of geothermal based district heating

Also during the 80-ies there was a large geothermal space heating program, the part of which was the drilling of two geothermal wells in Szarvas where district heating had (and still has) not existed. This was the situation also in Jászkisér. In both towns a long pipeline network had to be laid from the wells to the buildings – mainly public institutions – heated by geothermal energy. The range of these 'geothermal public utilities' has extended significantly since then: Veresegyház, Szolnok, Kistelek, Bóly, Gárdony, Mórahalom, Orosháza, Mezőberény, Törökszentmiklós and Barcs are now on the list. The scheme of this kind of geothermal energy utilization is shown in Figure 3. Transport, distribution and transfer of heat are not detached from the geothermal system but parts of that.

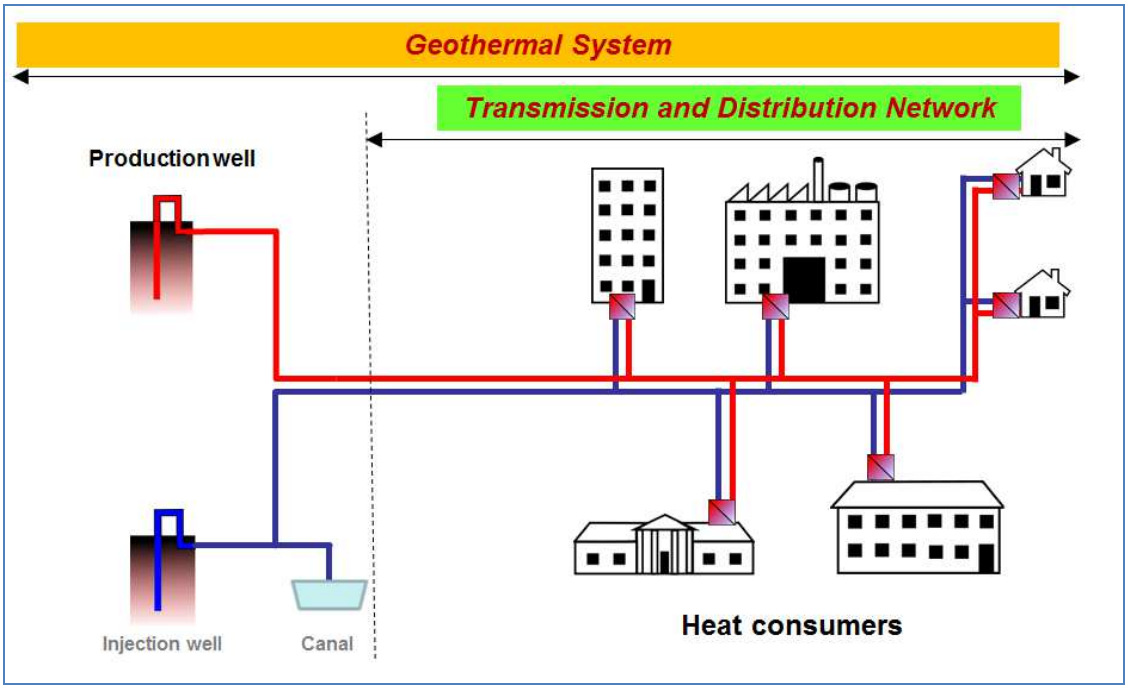

Figure 3 Scheme of geothermal public utilities

This is of course under the pressure of necessity. The use of geothermal energy cannot be realized without the heat transportation, distribution and transferring infrastructure. The investors in these cases cannot decide whether building an extended pipeline network and geothermal substations or not; they have to take on the investment costs of these project parts if they want to come in for a share in environmentally sound and relatively cheap geothermal energy.

It is worth investigating what are the main costs in a geothermal project for space heating in general. In Figure 1 the details of the part 'Geothermal System' are the followings:

1. Drilling
2. General engineering
   - submersible pumping
   - degassing, storage
   - water transfer, pressurizing
   - heating station (heat exchanger)
   - water disposal technology
3. Laying pipelines
   - isolated primary pipes
   - (non-isolated) return pipes
4. Masonry
5. Electrical installations
6. Remote control system

Comparing Figures 1 and 2, it may be seen that the item 'heating station' from the general engineering group is missing from Figure 2. It does not mean, however, that at the direct geothermal network version no heating stations have to be built. On the contrary, because you need a heat exchanger in every building, the price and installation cost of several small capacity units can be significantly higher than those of only one central heat exchanger of the same global capacity. The installation of heat transportation, distribution and transferring certainly causes extra expenses in these fields:

1. General engineering
2. Laying pipelines
3. Electrical installations
4. Remote control system

The next task is to determine the cost of non-geothermal works and to divide from the straight geothermal investment costs. This cannot be done in general, only for certain projects with detailed budget or estimate.

Figure 4 Location of geothermal projects for cost analysis

For an accurate reflection I have analyzed 15 geothermal project applications in 12 Hungarian settlements all around the country (see the map on Figure 4) for European Union subsidies between 2005 and 2013. The method to detach the non-geothermal investment costs was as follows:

1. From the costs of laying the pipelines I rated to the geothermal system that had to be (or should have been) inevitably built between the sides of geothermal water production and disposal (re-injection). All other pipelines were considered as part of the heat transfer and distribution system.
2. Costs of heating stations, electrical installations and remote control systems were divided between the geothermal system and the heat transmitting side.
3. After dividing up the costs the following statements can be done:
4. Every geothermal investment has a district heating type part.
5. The share of this varies in a wide range, between 7 to 94 % in the 15 projects analysed.

The above statements are well demonstrated in Figure 5. The explanation of the two projects with end values: in the one with 7 % two geothermal wells had to be drilled for a relatively concentrated heat demand, in the other one with 94 % the plan was to provide heat from an underutilized well to a residential area.

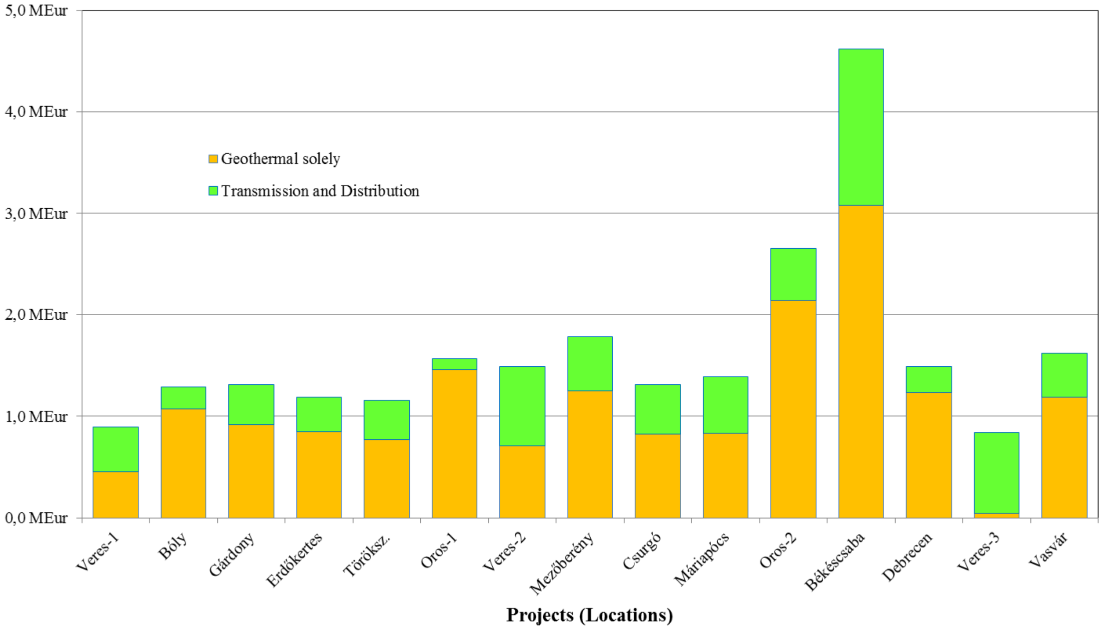

Figure 5 Composition of the total costs of investment of geothermal projects

The profitability of an investment is of course highly affected when the annual results are projected only to geothermal investment costs instead of the total cost. From the results shown in Figure 6 it can be stated that

a. The payback time is significantly influenced by accounting the district heating type costs.

b. Profitability of the above geothermal investments could have been much better if the heat transportation, distribution and transferring infrastructure had been already available. Three projects would not have even reached the lower limit of supportability.

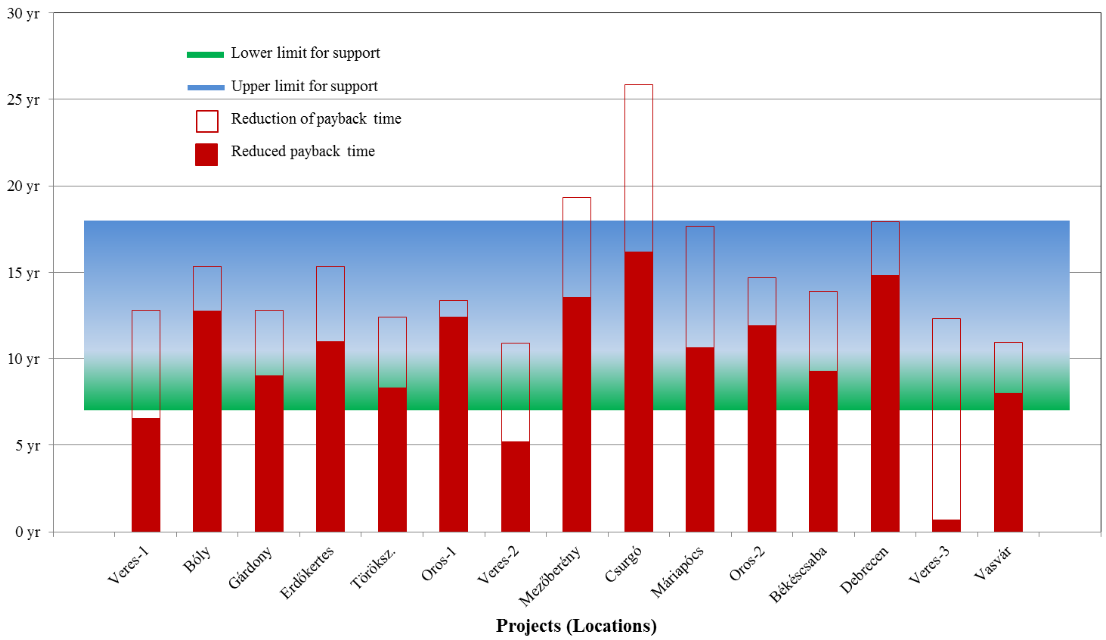

Figure 6 Reduction of payback time of geothermal projects

4. CONCLUSIONS

The aim of this paper is not to exactly answer the question raised in the title, since this could be done either in a very easy way or in the frame of a very comprehensive study. The real aim was to point out the current approach of the Hungarian renewable energy subsidy system disadvantageous for geothermal energy use and to prepare geothermal stakeholders for the time without subsidy.

Dividing clearly geothermal and other investment items responsible for heat transportation and distribution it has been apparently shown that geothermal heating project subsidies provided in last few years were applied for realizing more or less, or sometimes even in a significant measure not geothermal but infrastructure type elements. This is an unequivocal source depletion from the support frame for renewable energy sources and geothermal energy and it lessens the opportunity of investments.

State subsidies help only when all applicants can get supports. In the reality, however, rightful claims usually exceed the possibilities. Therefore it would be favorable to unload the restraint of being dependent of support. (This would be a good way also for extinguish the aspiration of dishonest profiteering, by the way.) Purely market based financing should be the goal of geothermal investors, which could be reached if the state took over the cost of non-geothermal investment elements.

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