Innovation
in
Municipal Geothermal Networks

Project proposal for the Innovation Fund
Issued by PORCI Co. Ltd., Hungary

Project partners

Municipality of Veresegyház

Municipality of Bóly

Municipality of Túrkeve
Innovation in Municipal Geothermal Networks - Project proposal for the Innovation Fund

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Introduction
Characteristics of the geothermal utilisation in Hungary

- **Abundance** of low temperature **geothermal resources** in the country
- **1878**, Budapest: finishing a 970 m deep thermal well - **world record drilling**
- **1929**, Szolnok: heating with thermal water; removal of the accompany gases; combined heat and power production – **pioneer innovation**
- **1958**, Szentes: drilling of the hospital well – start of the **geothermal boost**
Introduction
Municipal geothermal networks

• How to define the ‘municipal geothermal network’?
  • Owned and operated by local governments (municipalities).
  • Based on the local geothermal resources right under a settlement or nearby.
  • Aimed at supplying with geothermal energy mostly public buildings or larger industrial or agricultural consumers.
  • Detached houses are still excluded from the geothermal heat supply.
  • Implementation of long transmission and distribution piping system is crucial part of the projects.
  • The subsurface water is the carrier media of geothermal energy.

• Success story for over 30 years.
  • Quite a number of systems are available countrywide.
  • The best example for real democracy: local communities enjoy the benefit from the local energy source.

  • Systems are sufficiently mature in terms of planning, business model and financial and legal structure.
Innovation in Municipal Geothermal Networks - Project proposal for the Innovation Fund

Introduction
Sites (towns) chosen for geothermal innovation

Three Hungarian small towns are willing to participate the innovation project.
1. Veresegyház (20.000)
2. Bóly (4.500)
3. Túrkeve (8.500)

In each town there are one or more geothermal wells in operation. Yet, they differ from each other quite significantly regarding
• the type of the geothermal aquifer,
• the quality of geothermal brine,
• the wellhead temperature and the exploited yield,
• the overall technical level of the utilisation, and
• the problems to be solved.

It is reasonable to involve all the three sites in the project.
Introduction
Site maps of the projects

**Veresegyház**
- Geothermal wells: 2pcs
- Piping: 7 750m
- Heat station: 4 pcs
- Civil works: 3 pcs

**Bóly**
- Geothermal wells: 1pcs
- Piping: 11 500m
- Heat station: 3 pcs
- Civil works: 2 pcs

**Túrkeve**
- Geothermal wells: 2pcs
- Piping: 6 500m
- Heat station: 16 pcs
- Civil works: 3 pcs
Innovative elements of the project

1. Piping (which may otherwise kill geothermal projects)

Settlements, where no district heating infrastructure is available have to establish extended networks to connect the source of geothermal energy and the consumers. The lack of this kind of piping system causes, in most cases, tremendous amount of investment cost and, therefore, serious financing problem to the investor.


So, reducing piping costs is crucial for all the three municipalities.

2. Scaling

Scaling is the most significant problem in Túrkeve where hydrochloric acid is used in three-day frequency (!) to remove encrustment has deposited in the heat exchangers.

3. Utilisation of accompanying gases

Even though equipment for burning of accompanying gases in gas motors and thus producing electricity was installed in Túrkeve many years ago, for various reasons it has been out of operation for long.

4. Improvement of small capacity geothermal substation

Rethink the idea and the construction of the prototype assembled in 2009 in Veresegyház. If the cost of an equipment is kept low the range of the use geothermal energy will dramatically increase.
Innovative elements of the project

5. Providing geothermal for energy intensive industry

Appearance of new heat energy consumers in the industrial park of Bóly:

- Egg farming company „Prophyl” – 2.8 MW

  Construction of hen houses has already started. Start up with the first two units will be in February, 2020. The architectural design results the extremely low heat transfer coefficient of 0.19W/m²K (while 0.24W/m²K is allowed).

  Since there are no more options to reduce the transmission heat loss of the buildings the only way to lower CO₂ emission is to replace natural gas with geothermal.

- Tile producing company „Terrán” – 1,0 MW

  Construction is expected to start in 2020.

Arial view of the egg farming plant
Layer structures of hen houses: wall and footing
Financial issues
Estimation of implementation costs

<table>
<thead>
<tr>
<th>Project elements</th>
<th>Veres</th>
<th>Bóly</th>
<th>Túrkeve</th>
<th>Quantity</th>
<th>Veres</th>
<th>Bóly</th>
<th>Túrkeve</th>
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<tbody>
<tr>
<td>Geothermal wells</td>
<td></td>
<td></td>
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<td>Production well drilling</td>
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<td>1,0 pcs</td>
<td>1,0 pcs</td>
<td>2,0 pcs</td>
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<td>Reinjection technology</td>
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<td>Piping</td>
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<td>Insulated, large diameter</td>
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<td>Roads, fences, etc.</td>
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<td>1 pcs</td>
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<td>Improvement of secondary heating loops</td>
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<td>9 pcs</td>
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<td>Automation, remote control</td>
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<td>21 pcs</td>
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<td>184 300 €</td>
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<td>2 976 300 €</td>
<td>3 987 500 €</td>
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<td>GRAND TOTAL</td>
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<td>10 962 100 €</td>
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# Financial issues

## Benefits over 10 years

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<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
<th>Year 6</th>
<th>Year 7</th>
<th>Year 8</th>
<th>Year 9</th>
<th>Year 10</th>
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<tr>
<td><strong>Capital expenditure [€]</strong></td>
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<td></td>
<td></td>
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<tr>
<td>Veresegyház</td>
<td>3 998 300</td>
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<td>-</td>
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<td>-</td>
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<tr>
<td>Bóly</td>
<td>2 976 300</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Türkeve</td>
<td>3 987 500</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td><strong>Total implementation costs [€]</strong></td>
<td>10 962 100</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td><strong>Operational costs [€]</strong></td>
<td>0</td>
<td>39 451</td>
<td>81 348</td>
<td>83 870</td>
<td>86 386</td>
<td>88 891</td>
<td>91 558</td>
<td>94 488</td>
<td>97 417</td>
<td>100 340</td>
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<tr>
<td>Veresegyház</td>
<td>-</td>
<td>27 172</td>
<td>56 029</td>
<td>57 765</td>
<td>59 498</td>
<td>61 224</td>
<td>63 061</td>
<td>65 079</td>
<td>67 096</td>
<td>69 109</td>
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<tr>
<td>Bóly</td>
<td>-</td>
<td>10 105</td>
<td>20 837</td>
<td>21 483</td>
<td>22 127</td>
<td>22 769</td>
<td>23 452</td>
<td>24 203</td>
<td>24 953</td>
<td>25 701</td>
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<tr>
<td>Türkeve</td>
<td>-</td>
<td>2 174</td>
<td>4 483</td>
<td>4 622</td>
<td>4 760</td>
<td>4 899</td>
<td>5 046</td>
<td>5 207</td>
<td>5 368</td>
<td>5 529</td>
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<tr>
<td><strong>Income [€]</strong></td>
<td>276 923</td>
<td>571 015</td>
<td>588 717</td>
<td>606 378</td>
<td>623 963</td>
<td>642 682</td>
<td>663 248</td>
<td>683 809</td>
<td>704 323</td>
<td></td>
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<tr>
<td>Veresegyház</td>
<td>-</td>
<td>141 538</td>
<td>291 852</td>
<td>300 900</td>
<td>309 927</td>
<td>318 915</td>
<td>328 482</td>
<td>338 993</td>
<td>349 502</td>
<td>359 987</td>
</tr>
<tr>
<td>Bóly</td>
<td>-</td>
<td>115 385</td>
<td>237 923</td>
<td>245 299</td>
<td>252 658</td>
<td>259 985</td>
<td>267 784</td>
<td>276 353</td>
<td>284 920</td>
<td>293 468</td>
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<tr>
<td>Türkeve</td>
<td>-</td>
<td>20 000</td>
<td>41 240</td>
<td>42 518</td>
<td>43 794</td>
<td>45 064</td>
<td>46 416</td>
<td>47 901</td>
<td>49 386</td>
<td>50 868</td>
</tr>
<tr>
<td><strong>Benefits [€]</strong></td>
<td>0</td>
<td>237 472</td>
<td>489 667</td>
<td>504 847</td>
<td>519 992</td>
<td>535 072</td>
<td>551 124</td>
<td>568 760</td>
<td>586 392</td>
<td>603 983</td>
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<tr>
<td><strong>Accumulated benefits [€]</strong></td>
<td>237 472</td>
<td>727 139</td>
<td>1 231 986</td>
<td>1 751 978</td>
<td>2 287 050</td>
<td>2 838 174</td>
<td>3 406 934</td>
<td>3 993 325</td>
<td>4 597 309</td>
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</tbody>
</table>

1. **Level of certainty:**
   - Capital expenditures: very high
   - Benefits: high
2. **Key variables:** Price of fossil fuels, price of electricity, taxation
3. **Financing gap:** Only the city of Türkeve will need some local grant addition to innovation reward.
Reduction of GHG emission

<table>
<thead>
<tr>
<th></th>
<th>Veresegyház</th>
<th>Bóly</th>
<th>Túrkeve</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase of geothermal capacity [MW]</td>
<td>4,5</td>
<td>3,9</td>
<td>0,85</td>
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<tr>
<td>Geothermal energy produced in a year [MWh]</td>
<td>12 778</td>
<td>10 417</td>
<td>1 806</td>
</tr>
<tr>
<td>GHG originated from natural gas replacement [t CO2 eq per year]</td>
<td>2 610</td>
<td>2 128</td>
<td>369</td>
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<tr>
<td>GHG emission due to auxiliary energy consumption [t CO2 eq per year]</td>
<td>218</td>
<td>60</td>
<td>13</td>
</tr>
<tr>
<td>Reduction in GHG emission [t CO2 eq per year]</td>
<td>2 392</td>
<td>2 068</td>
<td>356</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>4 816 t/year CO2eq</strong></td>
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</table>

Due to the energy consumption produced from geothermal resources in a year can easily be measured, monitoring, reporting and verification (MRV) of the GHG emission will be fulfilled.
The potential market for the product

Approximately 2/3rd of the area of Hungary is suitable to exploit geothermal water with the temperature above 60°C. The number of settlements in that area with the population over 5,000 is about 50.
Neither the project as a whole nor any of its part are dependent from any other projects, development of infrastructure or adaptation of EU or national regulation.
Selection criteria

1. Effectiveness of GHG avoidance
   - The existing MRV requirements can be applicable to the project. No further guidance is needed.
   - The role of LCA is marginal since the expected lifetime of geothermal projects is quite long (min 30 years.)

2. Degree of innovation
   - Considering the innovative elements of the project the degree of innovation is high.

3. Project maturity
   - All the criteria such as business plan, financial background, societal acceptance, legal issues and stage of project development clearly prove the maturity of the project.
   - Evaluation of the project within 4 years can easily be fulfilled.
   - The main barrier to implementation would be the failure of this application.

4. Wide-spread application
   - Market statistics are not available. The potential market should therefore be indicated by the project at European level.

5. Relevant cost calculation
   - There are no specific issues of the relevant cost and, production costs are easy to estimate.
   - The main key variable factor determining the financial gap is taxation.
   - Providing own financial resources may be slightly risky mostly in the case of Túrkeve.
Milestones

Since this project proposal consists of three geographically separate sub-projects, it would be convenient to have a four-step disbursement for each of the sub-projects linked to the milestones shown below.

\[
\begin{array}{|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|}
\hline
\text{Implementation phase} & \text{month} & 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 & 10 & 11 & 12 & 13 & 14 & 15 & 16 & 17 & 18 \\
\hline
\text{Technology} & & & & & & & & & & & & & & & & & & & & \\
\text{Civil works} & & & & & & & & & & & & & & & & & & & & \\
\text{Electrical works} & & & & & & & & & & & & & & & & & & & & \\
\text{Automation} & & & & & & & & & & & & & & & & & & & & \\
\hline
\end{array}
\]
Project development assistance

1. **Will PDA be useful?**
   - Yes. Porció Ltd. has so far served as a PDA when launching the idea of this project. Furthermore, geothermal projects require technical, economic and legal expertise during the realization.

2. **What would be the level of amount to PDA?**
   - As a maximum it will be 3,5% of the total costs of investment

3. **Is there request to publish of results of studies done with PDA?**
   - No.

4. **How FEED studies will be financed?**
   - In case of Veresegyház the FEED study is currently being prepared and financed by the local municipality.
   - In case of Bóly and Túrkeve FEED studies will be financed after successful application.
Knowledge-sharing

1. Useful information to be shared
   • It is anticipated that all information related to the economic, project management, regulatory and permitting (licensing) issues will be shared with other projects from the sector.
   • Most of the technical information emerged from the project evaluation will also be open for discussion.

2. Knowledge-sharing activities
   • Workshops will be organised both during the implementation phase and when the projects will have been working for over a year.

3. Knowledge-sharing tools
   • Articles to the Ground Heat Newsletter issued by the Hungarian Geothermal Association
   • Special occasions to be organised for policy and decision makers and representatives of public authorities.
Importance of the Innovation Fund

Needless to say, how much the acceptance of this project proposal would impress on the utilisation of geothermal energy in Hungary. It would be both acknowledgement of the results in the past and encouragement for the future efforts.

Once the projects described above are implemented they will serve as reference sites for other municipalities. Hopefully, policy makers will also pick up on the success. It is obvious that projects which enjoy support from a European level fund weigh more than if only local source are used.

Due to the huge geothermal resources in Hungary the success of the project proposal may lead to dozens of new systems to establish.

✓ Good for the climate.
✓ Good for the energy security.
✓ Good for the democracy.
Thank you for your attention!

Gábor Szita  
man. director  

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