Proceedings World Geothermal Congress 2015
Melbourne, Australia, 19-25 April 2015

GeoDH: Promote Geothermal District Heating Systems in Europe

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Keywords: Geothermal District heating, Europe, potential, finance, regulations, training

ABSTRACT

The objective of the GeoDH project is to accelerate the uptake of geothermal district heating (geoDH) in Europe, for ensuring security of supply and substitution of fossil fuels. Today, geothermal district heating technology is under developed although deep geothermal potential is significant and competitive. To reverse this situation it is necessary to identify and address the current barriers affecting the development of geothermal district heating. GeoDH project aims to remove administrative and financial barriers and to work alongside decision makers to facilitate the adoption of the right framework. The GeoDH project focuses on developing geothermal district heating systems in Eastern and Central Europe (Bulgaria, Czech republic, Hungary, Poland, Romania, Slovenia) and in other EU countries with ambitious 2020 target (Netherlands, Germany, Italy, France) or with geothermal DH projects under development (Denmark, United Kingdom, Ireland). Recommendations (administrative, legal, financial and managerial) have been drafted to address the identified barriers and to contribute accelerating the market penetration of this technology. The sharing of best practices on technologies and on the implementation and delivery mechanisms was achieved through targeted workshops within regional and local authorities within the 14 target countries. The results of the project is reported and analysed together with the expected impact they will have on the market.

1. INTRODUCTION

In Europe, there are over 5,000 district heating systems installed in 2014 (including 247 geoDH systems), and the market share of district heat is about 10% of the heating market.. However, as suggested in several National Renewable Energy Action Plans for 2020-NREAPs (Hungary, Poland, Slovakia) the geoDH potential is much larger. The challenge now is to remove administrative and financial barriers in order to facilitate the penetration of geoDH systems. In some Eastern and Central European countries (Bulgaria, Czech Republic, Slovenia) there is both the need to convince decision makers and to adopt the right regulatory framework but also to establish the market conditions for a development of the geoDH market.

Moreover, several Western European countries have 2020 targets for geothermal DH of which Germany, France and Italy are the most ambitious. In order to reach these targets, simplification of procedures is needed and more financing required.

Finally, a third group of EU countries includes those Member States currently developing their first geothermal DH systems, such as the Netherlands, UK, Ireland and Denmark. For this third group of countries, there is no tradition of geoDH so there is a need to establish the market conditions (regulatory, financial, etc.) for its development.

The GeoDH consortium is working on these 3 different groups of countries (with juvenile, in transition and developing markets) with 14 countries covered in total, in order for the activities to be replicated after the project in all Europe.

The specific objectives of GeoDH project are to:

- Propose the removal of regulatory barriers in order to promote the best circumstances and to simplify the procedures for operators and public authorities.
- Develop innovative financial models for geoDH in order to overcome the current financial crisis which is hampering the financing of geothermal projects which are capital intensive.
- Train technicians and decision-makers of regional and local authorities in order to provide the technical background necessary to approve and support projects.

The GeoDH project will result in increased awareness of the potential applications and benefits of DH with geothermal energy, with a set of recommendations for removing barriers and improving regulatory frameworks, a better understanding of related technologies, costs and financing, as well as with a transfer of best practices to national and local authorities.

2. GEOTHERMAL DH POTENTIAL IN EUROPE

One part of the project aimed at identifying possible areas for the use of geothermal energy for district heating and cooling in 14 European countries, to present the geothermal potential in these regions, and finally to propose recommendations for the NREAPs in these countries.

One important barrier for the development of deep geothermal is that decision-makers at national, regional, and local levels do not have a clear picture about the geothermal potential and its advantages and therefore do not always feel the need to establish regulations and support schemes.

2.1 Geothermal potential

A compilation of geological data were prepared for each region. The geological data relevant for geothermal DH could already be found in several publications:

- The 2002 European Geothermal Atlas: Heat-flow density, Temperature at 1000 m depth & Temperature at 2000 m depth.
- The GEOELEC project has compiles, putting together and analysing the "raw" geological data for electricity production (temperature > 100°C). It will be relevant for combined heat & power systems
- TRANSENERGY project data for some countries in Central Europe (Austria, Hungary, Slovenia & Slovakia)
- Other sources e.g. national geological surveys as governmental organisations storing country-wide geoscientific data which is publicly available and should be freely accessed, the country papers submitted at the World Geothermal Congress

The GeoDH projectprovided additional information in order to transform this geological data into a technical potential in terms of percentage (%) of the EU population living in areas directly suitable for Geothermal District Heating. The objective was to use all the existing maps and data, and to extrapolate them in order to estimate, for the first time, geothermal DH potential in 14 countries in Europe.

2.2 DH potential for geothermal resources

A compilation of data on heat demand in the selected regions for best locations was assessed from previous step. This work was performed through:

- compilation of data from current heat loads and existing heat maps obtained from DH associations, Energy Ministries Energy Agencies, members of the AC, etc
- results of other projects used and updated where necessary, e.g Ecoheatcool, SDHtake-off.
- survey and investigation to assess accessible heat market through district heating construction/extensions (large building space heating / space cooling though absorption chillers).
- study of the parameters on urban density (population density in NUTS 3: inhabitants /Km²). Data from Eurostat and EEA on urban density in the EU will be used.

The objective was to briefly present 14 regional heat maps using the European heating index (EHI) in a contour map.

Special attention was paid on the future evolution of the heat demand in cities with more efficient buildings, and on the role DH can have in this new situation.

2.3 Geothermal District Heating has the potential to alleviate Europe's energy security crisis

The GeoDH interactive web-map viewer (developed as part of the GeoDH project) presents the geothermal resource assessment carried out in the countries covered by this Project and highlights the areas where potential for geothermal district heating exists. Based on currently available information in terms of geological data, already operational district heating systems, and heat demand, it shows the respective potential in the 14 project countries: Bulgaria, Czech Republic, Denmark, France, Germany, Hungary, Ireland, Italy, the Netherlands, Poland, Romania, Slovakia, Slovenia, and the United Kingdom. The geothermal potential is presented down to the depths of 2 km below ground level. In some countries prospective resources are located also at greater depths (e.g. Poland), in such cases relevant specific information is available by contacting GeoDH partners in the respective countries.

The viewer is available online. For information on how the system works, the manual provides all details. An example of GeoDH Web GIS screenshot in given on Figure 1 below.

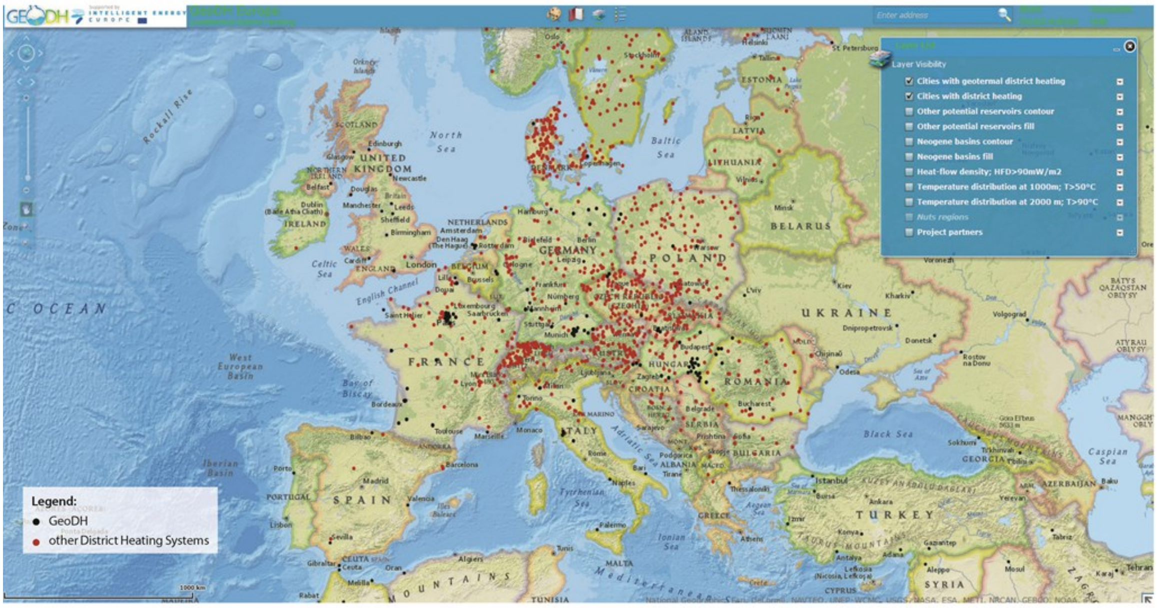

Figure 1: An example of GeoDH Web GIS screen shot (www.geodh.eu)

In addition to showing areas which are potential for geoDH developments due to their favorable geological and geothermal conditions, the web-map indicates the existing DH systems, including geoDH systems in Europe. The interactive nature of the web-map viewer makes possible to perform more in-depth search, i.e. to show areas where temperature distribution is higher than 50°C at 1000 m deep, higher than 90°C at 2000 m deep, heat-flow density is above 90 mW/m2 , all these combined with prosperous geological environments.

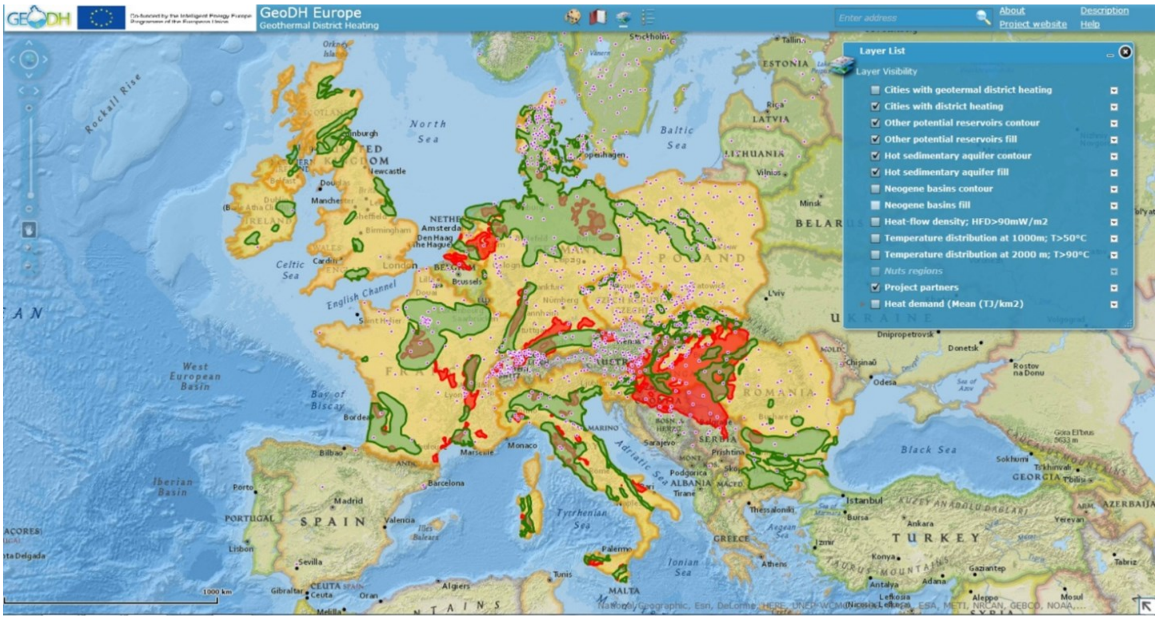

Figure 2: Map of geothermal potential of European Union

From the map, limited to the 14 project countries, we can note that:

- geoDH can be developed in all countries
- The potential for geoDH development by 2020 is much higher than the forecasts of Member States in their NREAPs (see below)
- The Paris and Munich basins are the two main regions today in terms of number of geoDH systems in operation.
- The Pannonian basin is of particular interest when looking at potential development in is Central and Eastern Europe countries.
- The extensive European Lowlands (covering significant areas in several countries: Denmark, Germany, Poland) offer good conditions to develop geoDH systems in many localities;
- The enthalpy (temperature) is not the only selection criteria; other key factors are sufficient flow-rate on the supply side, and the heat users (urban density) on the demand side.

According to Eurostat, about one third of the EU's total crude oil (34.5%) and natural gas (31.5%) imports in 2010 originated from Russia. Of this, 75% of the gas is used for heating (2/3 in households and 1/3 in the industry). Geothermal DH technology has the potential to replace a significant part of that fuel.

Over 25% of the EU population lives in areas directly suitable for Geothermal District Heating. Geothermal district heating is a valuable and immediate option for the alleviation of Europe's energy dependency.

3. RECOMMENDATIONS ON LOCAL REGULATIONS OF GEOTHERMAL DH SYSTEMS

Not only are a sound mining codes and national legislation required for the development of geothermal DH systems, but also favorable regional geothermal regulatory frameworks and a local planning is necessary. Both regional and local authorities are deeply involved in the licensing process.

3.1 Background and objectives of the Regulatory Framework

Despite the significant potential of deep geothermal energy in several states geothermal DH systems have been poorly developed so far. This is mainly due to the lack of adequate national and regional policies and legislation concerning geothermal district heating systems; there is no comprehensive set of regulatory acts related to the geothermal sector which would create a proper longterm environment for the development of geothermal projects. Only a solid legal framework, continuity and predictability of legal, administrative and incentive provisions will create a proper background allowing strategic decisions in both the DH and geothermal heat sectors to be taken.

Against this background, GeoDH project has made proposals for the removal of regulatory barriers in order to promote the best regulatory environment and the simplify of procedures for geothermal district heating system operators and policy makers. The report “Regulatory Framework for Geothermal District Heating Systems in Europe” makes recommendations for decision makers on ways to optimise and simplify the regulations by translating the best rules into local and regional regulatory systems. Key stakeholders were consulted on the Framework and it was endorsed by relevant authorities in the 14 European countries involved in the GeoDH Project.

The “Regulatory Framework for Geothermal District Heating in Europe” report provides legal and administrative recommendations which should facilitate the introduction of complementary and cohesive legal and regulatory provisions essential to creating a long-term stable system for the development of geothermal district heating in Europe.

Developing geothermal district heating requires an enabling framework beginning with clear and consistent national / regional strategies from the public authorities. From the project developer’s point of view, realising a geothermal project requires several authorisations and the compliance with a number of national and local regulations.

The main requirements / permits that may be required for a geothermal district heating project development are the following:

- Water, mineral, and mining rights,
- Exploration permits,
- Well construction permit,
- Development rights,
- Payment of royalties,
- Environmental impact assessment (EIA),
- Environmental permit,
- Building permit for the plant/distribution network,
- Dismantling permit,

Regulatory barriers and long-administrative procedures can result in additional costs. It is therefore crucial that a fair, transparent and not too burdensome regulatory framework for geothermal and district heating is in place.

Building on the feedback received in several national workshops organised within the project, the GeoDH consortium has gone beyond the mere analysis of legislation. An accurate assessment was carried out to understand the practical implementation of regulations and the overall conditions influencing the development of the technology. The main good practises and barriers are reported, country by country, in a dedicated report.

Such an assessment shows how regulatory and market conditions widely vary across the 14 GeoDH countries. However, it is still possible to observe that - regardless of the market maturity- some practice is perceived as being pre-requisite or very favourable to the development of geothermal district heating technology. This is the case, for instance, where:

- Geological data are freely available to project developers (e.g. after a five year period in the Netherlands);
- A public risk insurance scheme is in place (i.e. in France and the Netherlands);
- There is a clear definition of procedures and licensing authorities (e.g. France, Poland and Denmark)
- Adequate national and regional strategies (Bulgaria) integrated with some form of financial support (e.g. Hungary, Italy, and, Netherlands, and the UK).

Contrariwise, a persisting number of barriers are perceived to be detrimental to any further market development of geothermal / district heating:

- Market sometimes closed to new entrants (e.g. in Slovenia);
- Long and burdensome administrative procedures (e.g. in Italy, Slovenia, and Hungary),
- Serious regulatory gaps such as a lack of dedicated licencing system for deep geothermal and unregulated right to use the geothermal resources (e.g. in Ireland , UK, and Czech Republic),
- Lack of support (e.g. in Ireland, Poland and Slovakia), and
- Lack of a level-playing field (e.g. in Bulgaria, Czech Republic, Slovenia, Poland, Hungary and the Netherlands where gas prices are regulated and connection to the gas grid is sometimes mandatory).

3.2 Key recommendations

In this context, it is worth highlighting that in some countries the presence of some good practises may be largely offset by the persistence of barriers. It is therefore crucial to have a consistent enabling framework from start to finish.

Other three interesting aspects have emerged during the project:

• Assessing the implementation of key articles of the EU RES Directive (e.g. articles 13 and 14) is not an easy task and should be properly carried out by the European Commission. In the target countries, it is generally observed that the EU 20-20-20 framework has indeed attracted some new interest in the sector. However, dedicated legislation and simplification of administrative procedures, when observed, were not stemming from the RES Directive but rather linked to reforms for the mining and oil & gas sectors. This issue should be addressed in the review of the relevant EU legislation.

• Particularly in emerging markets there is shortage of qualified specialists and the industry, mainly composed of local SMEs, is not organised in a structured national association. The result is weak lobbying advocacy power and inability to remove persisting market failures against conventional competitors. In this case, it is advised to policy-makers to create the initial conditions to attract investments and specialists from close fields such the mining and gas sectors;

• Not only lack of information is detrimental. In certain cases misinformation over deep geothermal between policy-makers and citizens may bring about confusion and social opposition. While it is important to deal with communication at the very beginning of project development, it is still equally critical to launch large awareness and educational campaigns to improve the general knowledge about geothermal energy.

In order to remove the regulatory barriers and promote the best practices identified in the project countries and presented in this report, the GeoDH consortium has developed a set of recommendations collected in an ideal 'Regulatory Framework'.

This regulatory framework is primarily addressed to regional public authorities in charge of regulations and local development, since they are deeply involved in licensing and other procedures related to geothermal energy exploration, development, and management.

These proposals should lead to regional and local regulations favourable to geothermal DH development in Europe. The key recommendations are provided below :

• National and local rules must include a definition of geothermal energy resources and related terms, in line with Directive 2009/28/EC;

• Ownership rights should be guaranteed ;

• In line with Article 13 of Directive 2009/28/EC, administrative procedures for geothermal licensing have to be fit to purpose - they should be streamlined wherever possible and the burden on the applicant should reflect the complexity, cost and potential impacts of the proposed geothermal energy development;

• The rules concerning the authorisation and licensing procedures must be proportionate and simplified, and transferred to regional (or local if appropriate) administration level.

The administrative process must be reduced;

• Rules for district heating should be as decentralised as possible in order to be adaptable to the local context, and stipulate a mandatory minimum level of energy from renewable sources, in line with Article 13 §3 of Directive 2009/28/EC

• A unique geothermal licensing authority should be set up;

• Information on geothermal resources suitable for geoDH systems should be available and easily accessible;

• GeoDH should be included in national, regional and local energy planning and strategies;

• Policy-makers and civil servants should be well informed about geothermal;

• Technicians and Energy Service Companies should be trained in geothermal technologies;

• The public should be informed and consulted about Geothermal DH project development in order to support public acceptance;

• Legislation should aim to protect the environment and set priorities for the use of underground: geothermal energy should be given priority over other uses such as for unconventional fossil fuels, CCS, and nuclear waste deposits.

4. FINANCING SOLUTIONS AND PROJECT MANAGEMENT

Geothermal space and district heating systems are capital intensive. The main costs are initial investment costs, for production and injection wells, down-hole and transmission pumps, pipelines and distribution networks, monitoring and control equipment, peaking stations and storage tanks. Operating expenses, however, are much lower than in conventional systems and consist of pumping power, system maintenance, operation and control.

To a certain extent the generally higher upfront-costs of geoDHapplications can be compensated by lower or less fluctuating fuel prices or lower running costs (if in the latter case no fuel costs are to pay respectively). Therefore, innovative solutions for financing projects have to be found to overcome this obstacle. Such solutions have been studied in detail and are presented below.

4.1 Business models on geothermal DH systems

In order to define the business model of a geoDH project, the heat customers are a key element. The presence of one large heat consumer helps the economy of a project greatly. Local DH utilities with a need for renewable and flexible heat supply, and building owners with a need of heat supply are two interesting customer segments.

Generally geoDH offers the heat consumer the following:

• Stabile secure heat supply

• Fixed, long term prices (for production and depreciation)

• Lower need for maintenance (compared to other conventional heat sources)

• Lower risks (when in operation)

• Ease and comfort for the end-user

GeoDH technology is quite a mature one, in use for 50 years, and geoDH installations are competitive. There are three frequently used financing models:

1. Firstly, public investment undertaken by the local or regional authority (usually at municipal level)

2. secondly, private sector investment which in turn is granted the opportunity to sell the heat directly to the grid-connected subscribers over long duration (20 to 30 years contracts)

3. finally a ‘mixed’ solution, which entails the creation of companies dedicated to the development of the geothermal with capital investment shared by both public and private entities.

The first model (public scheme) has been developed mainly in Austria, Germany, and Denmark. The second (private DH utilities) is today used in France and the UK, among others. The third model, (a Public private Partnership) applies elsewhere and is gaining popularity in several European countries.

Two business models can be given as an example:

1. The case of a DH company decarbonising its heat supply in close cooperation with ESCOs. Here the main marketing strategy would be to combine sustainable heat supply (possibly with use of labels or certificates) and energy saving services so as to widen the scope of activity, and reducing the impact of the inevitable reduction in energy consumption.

2. The second case would concern a geoDH project developer (public or private) aiming at proposing a new DH system supplied by geothermal. The objective would be to convince heat users of the value of renewable energy sources which are stable and competitive.

Finally, specific attention should be paid to cascade uses. It is sometimes presented as an obvious solution for improving the economy of (notably) CHP, but it seems less and less easy to develop them. Today few examples exist all over Europe. The managerial issue is not the only one preventing the deployment of this technology, the difficulty to find adapted consumers.

4.2 Project management of cascade uses and cooling applications

Geothermal energy can provide heat for DH, and multi-purpose uses improve the economical performance significantly. However, the number of applications for geothermal ‘cascade uses’ is rather limited in Europe. The main problem today for its development is the difficulty of managing the contractual relationship between the different heat users.

One of the most important issues in design of geothermal systems is the management of the project, which comprises planning, organization, motivation and the engagement of controlling resources. This document provides basic information on management tasks, which have to be accomplished for a particular geothermal system. Without those, the risk of technical or the potential economic failure is too high, therefore the proposed steps in this document are highly recommended for future geoDH systems.

The starting point of management is usually based on feasibility study and the preliminary design of the system. In geothermal district heating/cooling systems, these two activities must not consider only the geothermal system, but should represent broader analyses, related to the development of the specific area and its characteristics. It is namely well known that the geothermal heat should be brought to the lowest possible enthalpy before the reinjection. This means, that planning of the geothermal source and its utilization must consider a multipurpose use of energy. This further depends on potential customers and related demand, as well as the future development of certain surrounding area.

Good urban planning of geothermal district energy system includes the use of heat in a multipurpose system, by utilizing the most of the geothermal potential. Therefore it is very important that urban planners, municipalities, policy makers as well as the investors perform a comprehensive analysis on possibilities not only to use the geothermal energy at different temperature sources, but also to expand the possibilities of its use with regard to new business opportunities.

The district heating pipeline can cover a large variety of different industrial needs. Furthermore, it enables use of hot water to drive sorption chillers. The return temperature of such pipeline is in many cases sufficient to be applied as the secondary supply pipeline.

New types of low temperature district heating systems will certainly apply low temperatures of supply and return. This is also in accordance with use of different renewable energy source and waste heat.

4.3 Financial models

Geothermal heat may be competitive for district heating where a resource with sufficiently high temperatures is available and, preferably, an adaptable district heating system is in place. Geothermal heat may also be competitive for industrial and agriculture applications (i.e. greenhouses).

Geothermal space and district heating systems are capital (CAPEX) intensive. The main costs are generated by initial investments for production and injection wells, down-hole and surface feed pumps, pipelines and distribution grids, monitoring and control equipment, peaking stations, and storage tanks. Operating expenses (OPEX), nevertheless, are much lower than in conventional systems, consisting of pumping power, system maintenance, operation and control. The financial performance of the system depends on the thermal load density, or the heat demand per unit area.

Generating costs and selling prices are usually around 60 €/MWh thermal, within a range of 20 to 80€/MWh thermal. This depends on local geothermal settings (high/low heat flows, shallow/deep seated sources), socio-economic conditions and pricing policies (kWh thermal or m3 of hot water). In addition, district heating networks achieve an important share of the total costs for a GeoDH system expenditure: around 1 Mio €/ Km for the grid and the substations. One considerable challenge in the current economic crisis concerns the financing and the development of new heat grid infrastructures. Retrofitting is an alternative for developing the GeoDH market. Oradea, in Western Romania, is an example of the insertion of a geothermal heating system into the existing city: a coal fired/back pressure system typical of historical Central/Eastern Europe district heating practice was adapted for a combined heat and power (CHP) network.

With regards to financing, with levels of investment varying between 3 and 12 M € related to capacities between 2 and 10 MWth (1,200 to 1,500 €/MWth installed), there are three frequently mobilised financing modes. Firstly, public investment undertaken by the local or regional authority (usually at municipal level); secondly, private sector investment which in turn is granted the opportunity to sell the heat directly to grid connected subscribers over long duration (20 to 30 years contracts) and finally a "mixed" solution, which entails the creation of companies dedicated to the exploitation of the geothermal network with capital investment shared by both public and private entities.

The first model (public scheme) has been developed mainly in Austria, Germany, Denmark and others. The second (private DH utilities) is today used in France and the UK, amongst others. The third model (a public private partnership, PPP) applies elsewhere and is gaining popularity in several European countries.

Today, market conditions in the EU heat sector prevent geothermal from fully competing with conventional technologies developed historically under protected, monopolistic market structures where costs reduction and risks were borne by consumers rather than by plant suppliers and operators.

Support measures for geothermal technologies are therefore needed in some cases to favour the progress towards cost-competitiveness of a key source in the future European energy mix and to compensate for current market-failures. In the geothermal heating sector, there is a predominance of investment grants, in certain cases accompanied with or substituted by zero interest loans. Operational aid similar to a feed-in tariff system is now beginning to be explored in some Member States (RHI in the UK, SDE+ in the Netherlands…), partly because of the inclusion of the sector into the European regulatory framework and therefore its relevance in achieving the 20% RES target.

4.4 Risk insurance

Any industrial project is exposed to risks, even if these risks do not ultimately materialise. Nevertheless, unlike any common project, a geothermal DH project has an additional and particular risk that lies in the geological characteristic of the geothermal resource. This risk, known as the geological risk, is an inherent part of any geothermal project. The geological risk covers:

- The short-term risk of not finding a sufficient geothermal resource (temperature and flow rate) during the drilling phase for an economically sustainable project to take place,

- The long-term risk of the geothermal resource depleting over time rendering the whole project economically unprofitable once operation of the geothermal plant has taken place.

Analyses of investment costs and risks underline that the financing of the exploration phase of a geothermal project is an important, even if not the most important barrier (Figure 4). During the exploration phase, the risk is high while the costs are already significant as e.g. seismic data has to be purchased or seismic investigations have to be conducted. One of the largest obstacles for investment in deep geothermal systems is that the presence and quality of the resource is not proven until the first exploration well is drilled. On the other hand exploration wells have a relatively high success rate (80-90%) in developed regions and low success rate (20-60%) in not yet explored areas. To establish a comparison, in oil and gas exploration a success ratio of 20% is considered as rather good, taking into account the geophysical campaign carried out before(with associated huge cost) allows for a much better prognosis of geological conditions which is not the case in geothermal exploration. In consequence, only if the flow rate and temperature fulfil the expectations of the investor (e.g. profitability), it can be determined that the project achieves its objectives.

The reduction of the risk coming from limited geological information can be in some cases covered by government through geological exploration (drilling, seismic profiles, etc.) funded by the state. Unsuccessful drilling is an important risk that has to be taken and to be paid. Drilling costs are significant and can represent a non-negligible part of the overall project costs, however have to be financed somehow. Regardless of the accuracy of the exploration phase that takes place, the short term geological risk can only be fully removed when drilling confirms the expected temperature and flow rate. In spite of the geothermal plant being operational, there is no guarantee that original conditions remain over time and that the original temperature and flow rate will not decline.

When considering the geological risk, the whole financing of the geothermal DH project is at stake. Geothermal projects require high upfront investments that will never be available unless the geological risk is adequately handled. This can only be achieved by obtaining an insurance policy for the geological risk. There are different insurance designs in existence in Europe to cover the geological risk. Apart from Germany, where the private insurance sector engaged in providing market-based insurance policies for geothermal projects, insurance is usually made available from national insurance funds that have been set up at the initiative of governments willing to support geothermal development. Some countries also propose repayable grants for drilling the first well. In this respect, national funds may either offer a post-damage guarantee for the geological risk (for example in France, The Netherlands, Switzerland) or a guaranteed loan, which is forgiven in case the risk materialises (e.g. Germany, Iceland). Both insurance concepts offer pros and cons. However, they undoubtedly contribute to the strengthening of confidence in the geothermal sector.

In this context, insurance is of such significant importance for geothermal development that it is in the interest of all European policy makers and investors to give some consideration to the establishment of a European insurance fund to cover the geological risk at European level.

5. CONCLUSIONS

Three main factors are driving geothermal DH development in Europe:

Firstly, there is a lack of awareness of decision-makers and investors concerning the importance of the heating sector, the benefits of DH systems and the advantages of geothermal energy.

Secondly, more financing is needed to develop DH infrastructure all over Europe, and in particular in dense urban areas where it is a highly competitive option.

Finally, responsive policy makers in focal countries have to set adequate incentives that provide help to develop markets (geological risk insurance, financing for drilling), reduce prices and raise investors' awareness of the technology.

So where lies the future of geothermal DH development? With more than 200 new geothermal DH plants likely to be installed by 2018, the forecasts are promising. However, in the heating sector, as with the electricity sector, fair competition is crucially needed because conventional technologies still receive more financial support from governments and their external costs are not integrated to their market prices. Some technological improvement could help to foster this development, as lowering the temperature of the networks will be the key point for development of smaller scale projects.

The future of the geothermal market remains bright in the EU and the rest of Europe. Many projects will be announced in the coming years in all European regions, representing an ever increasing market share for geothermal.

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