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Geothermal Market Report for Europe

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ABSTRACT

EGEC publishes each year a market report to evaluate the development of the shallow and deep geothermal sector in Europe. The 2014 issue of this market report shows that interesting new projects have emerged. Some of the key findings are:

•Electricity: Eight new power plants became operational in 2014, increasing the installed capacity in Europe by 170 MWe. The total installed capacity in Europe is now more than 2000 MWe, producing some 12 TWh of electric power in 2013.

•District Heating: Eight new systems have been installed in four European countries this year, increasing the installed capacity by 76.2 MWth. The total installed capacity in Europe is now ca. 4500 MWth, with 13000 GWh th/year used for heating.

•Shallow Geothermal: For shallow geothermal energy (ground source heat pumps and Underground Thermal Energy Storage), the installation growth rate is spectacular; a capacity of at least 17, 700 MWth was achieved at end of 2013, distributed in over more than 1.3Mio installations.

Moreover, this report summarises the existing financial support schemes for geothermal electricity and heating & cooling in Europe.

In the whole debate, the potential of geothermal energy does not yet receive enough attention. We need a stronger focus on geothermal as a reliable contribution helping to reach Europe's climate and energy targets. With this market report, EGEC calls again for a level playing field, and the recognition of geothermal advantages: being a renewable, local, base load, and flexible source of energy.

1. INTRODUCTION

In 2011, EGEC published for the first time a market report to evaluate the development of the deep geothermal sector in Europe. We have witnessed within the last five years a resurgence of interest in geothermal power, after nearly a decade of only small development in capacity in the deep geothermal sector both for electricity and for direct uses (mainly district heating). A substantial number of projects have been developed throughout Europe, and geothermal energy is on its way to become a key player in the European energy market.

The 2014 issue of this market report shows that interesting new projects have emerged equally, unfortunately some other projects have been stopped for the time being. The reasons for not proceeding can be found primarily in changes in the relevant national policy framework. Some new plants, both for power and for heat, came on line this year. In this respect it should not be forgotten that the duration for project development, from the time the project is officially announced to the first heat or power delivered, is usually in the order of 4-7 years. It is for this reason that this report presents not only the plants in operation, but also those under development and others under investigation.

Some of the key findings are that:

•In geothermal electricity, the financial crisis has slowed down some development, and it is apparently a difficult time to attract the necessary investment. However, we can state the investigation into possible projects is happening in more countries than ever.

•For geothermal district heating, the need for thermal grid infrastructure is a key issue, both with new or renovated networks. Development must also pursue scalable solutions: capacities small or big, with low or high temperature, just to meet the demand.

2. ANALYSIS OF GEOTHERMAL ELECTRICITY MARKET IN EUROPE

The geothermal community celebrated in 2013 a century's worth of experience in operating geothermal power plants. It was therefore a special year to present the steps the sector has already taken, and to develop ideas on future technological trends (in this edition, especially in the turbine sector) and on the economic potential up to 2050. For the third edition of the Market Report, an update of the market trends was presented with a focus on market development in Germany, Italy and France.

In 1913, the first geothermal electricity plant started its operation in Larderello (Italy) and was composed of an alternator Ganz 250 kW, three-phase 50 Hz, with a voltage of 4500 volts coupled with a Tosi Parsons turbine of 350 hp.

Until the 1970s, only a few other plants were installed in Europe, i.e. in Italy and Iceland, followed by France (Guadalupe), and Turkey. And all of these were high temperature with flash/dry steam turbine technology. With the development of new turbine technologies i.e binary cycle (Kalina and Organic Rankine Cycle-ORC) for low and medium temperature, more countries (Austria, Germany, Portugal) have installed geothermal power plants in the last 40 years.

Against this background it is interesting to analyse the current and prospective development of turbine technology, which is why the market report 2014 put a particular focus on this sector.

There were, at the time of writing, 77 power plants in Europe representing a total installed capacity of more than 2000 MWe and a production of ca. 12000 GWh.

Geothermal plants are characterised by a high availability (amount of time that a plant is able to produce electricity over a certain period, typically a year, divided by the amount of the time in the period i.e. 8765-8766 hours) and net capacity factor (the ratio of the actual output of the geothermal plant over a period of time, to its potential output if it were possible for it to operate at full nameplate capacity indefinitely), typically in excess of 80%. Some geothermal plants operate at 100%.

51 geothermal electricity plants are located in the European Union. The total installed capacity in the EU-28 now amounts to around 945,96MWe, producing some 5,56 TWh of electric power yearly.

According to the projects under development, capacity on the continent will grow to around 3,500 MWe in 2018/2020, with this major increase linked to the rapid growth of the Turkish market.

On average, during the year 2012 the capacity factor was about 76%, because some power plants were commissioned in the later part of the year or were under repair (Bouillante in France) and therefore were only productive for a limited number of days. Additionally, the capacity factor of a number of (cogeneration) plants, e.g. in Austria, was lower because production in these cases is mainly driven by heat demand.

The geothermal power market is not developing as quickly as expected. There are 3 main reasons for this:

• Firstly, the vast geothermal potential is still underestimated and thereby there is an urgent need to increase awareness of its advantages especially for decision makers and investors

• Secondly, much more financial support should be brought to the geothermal sector. Support schemes are crucial tools of public policy for geothermal to compensate for market failures and to allow the technology to progress along its learning curve. Funding allocated to geothermal energy is negligible compared to that which is allocated to other technologies. Adequate financial support for low temperature plants and EGS is available only in France, Germany and Switzerland.

• Finally, beyond exploration, the bankability of a geothermal project is threatened by the geological risk. Risk insurance funds for the geological risk already exist in some European countries (France, Germany, Iceland, The Netherlands and Switzerland). The geological risk is a common issue all over Europe. Collaboration between Member States is desirable; it can allow them to save money and trigger the uptake of a valuable technology alike. For this reason the establishment of a Geothermal Risk Insurance Fund at the EU level is of the utmost importance for the deep geothermal sector in Europe.

3. ANALYSIS OF GEOTHERMAL DISTRICT HEATING MARKET IN EUROPE

District Heating (DH) is the geothermal sector currently with the most dynamic development and the most interesting perspective in the coming years. The renewed momentum since 2009 continues, with 5 countries installing new Geothermal DH systems in the past year. The technology is developing: in 2014, smaller systems, targeting shallower resources and assisted by large heat pump systems have been installed. In France, more triplet systems have been installed over the last 2 years.

The total installed capacity in Europe is now ca. 4500 MWth, with 13 terawatts-hours thermal per year (GWh th/y) used for heating. In total, installed capacity increased by 76.2MWth. Moreover, new triplet systems are installed in the Paris Basin in order to prolong the lifetime of the plants.

There are 247 Geothermal District heating plants (including cogeneration systems) in Europe. 162 geothermal DH plants are located in the European Union. The total installed capacity in the EU-28 now amounts to around 1.3 GWth, producing some 4256 GWh or of thermal power, i.e. 366 ktoe in 2012-13.

According to the more than 200 planned projects, the capacity is estimated to at least 6500 MWth in 2017/2018.

In 2014, the main GeoDH markets are still in France (45 systems), Iceland (32), Germany (25) and Hungary (21). The hot markets for the next years are also mainly in Germany (44 new systems being developed or upgraded), France (45), Hungary (19), Italy (13) and Denmark (10).

There is also a large production of other direct uses for heating and cooling from deep geothermal, but the lack of a strong statistical methodology to collect and treat data do not allow us to present data on installed capacity and production of other direct uses than geothermal District heating.

4. ANALYSIS OF SHALLOW GEOTHERMAL MARKET IN EUROPE

Shallow geothermal energy is available everywhere, and it is harnessed typically by ground source heat pump (GSHP) installations, using the heat pump to adjust the temperature of the heat extracted from the ground to the (higher) level needed in the building, or to adjust the temperature of heat coming from building cooling to the (lower) level required to inject it into the ground. The main technologies used to connect the underground heat to the building system comprise of:

• open-loop systems, with direct use of groundwater through wells

• closed-loop systems, with heat exchangers of several types in the underground; horizontal loops, borehole heat exchangers (BHE), compact forms of ground heat exchangers, thermo-active structures (pipes in any kind of building elements in contact with the ground), etc.

Shallow geothermal installations intended to change the underground temperature periodically (e.g. seasonally) fall under the term Underground Thermal Energy Storage (UTES). The delineation between GSHP and UTES is not sharp, and among the larger installations, only a minority are "pure UTES". Large GSHP plants in most cases have a high share of the annual energy turnover inside the BHE field or the aquifer, and not with the surrounding or underlying ground, and thus qualify for the term 'storage'. In all these large installations it is crucial to pursue a long-term balance of heat extracted from the ground and injected into the ground.

The different natural ground temperatures throughout Europe, from 2-3 °C near the polar circle to about 20°C in the very South of Europe, have a great influence on the options and design for shallow geothermal installations. Taking into consideration the building loads, the climatic zone the site is in, and the thermal and hydraulic parameters of the underground on site, the plant design has to guarantee that temperatures in the underground systems are kept within a given range in the long term. This temperature range is defined on one side by the technical (thermal) requirements of the building system, and on the other side by environmental considerations concerning the groundwater and ground at the specific site.

Often buildings have a rather unbalanced heating and cooling demand, either given by their climatic surroundings (very cold and warm climates), or by the specific use of the building (there are e.g. shopping malls even in Northern Europe that require virtually no heating, but a lot of cooling). In these cases, hybrid systems are designed to cover as much load as possible from the geothermal system, and to balance the heat in the underground by separate sources like cold air in winter or at night time, waste heat, solar heat, etc. Using all the different design options available to geothermal design allows for small and large, energy-efficient, economic, and reliable installations all over Europe. A nice example here is the case of the Swedish company IKEA. A growing number of stores from Sweden to Spain (and in the USA, too) are equipped with shallow geothermal technology of different types, and adapted to the respective geological and climatic situations.

For shallow geothermal energy (ground source heat pumps – GSHP and Underground Thermal Energy Storage – UTES), the installation growth rate is even more spectacular, and a capacity of at least 17'700 MWth was achieved by the end of 2013, distributed over more than 1.3 Mio GSHP installations. The countries with the highest amount of geothermal heat pumps are Sweden, Germany, France and Switzerland. These four countries alone account for ca 64 % of all installed capacity for shallow geothermal energy in Europe.

The GSHP market today is in difficulty nearly anywhere. While in some mature markets the situation still is rather stable, in others a decrease can be seen. In parts of Germany this can be attributed to continuously stricter regulation, causing delays and higher costs. Across Germany, and some other neighbouring countries, GSHP systems are becoming less competitive; as the cost of electricity (which is required to run the heat pump) increases, the use of fossil fuels such as natural gas for heating becomes more favourable financially. In developing markets, the growth rate is low, minus 20% sales in some countries, and juvenile markets are not really progressing. Here the aftermath of the economic crisis and the low rate of construction in some countries take their toll.

With an economic recovery, a new increase in the GSHP market can be expected. What are the main reasons for the current lull in the market?

A. Not enough awareness about this technology and its advantages. In particular, architects, the building sector, and local authorities need to be better informed.

B. Cost intensity is an issue, in particular for investment. Because of the drilling, geothermal heat pumps can be considered as a capital-intensive technology in comparison with other small scale applications.

C. Quite unfavourable competition with gas. Geothermal heat technologies are heading for competitiveness, but support is still needed in certain cases, notably in emerging markets and where a level playing field does not exist. In addition, there is a need for an in-depth analysis of the heat sector, including about the best practises to promote geothermal heat, the synergies between energy efficiency and renewable heating and cooling, and barriers to competitiveness. As Geothermal Heat Pumps can be considered a mature and competitive technology, a level playing field with fossil fuel heating systems will allow the phasing out of any subsidies for shallow geothermal in the heating sector.

D. Regulations need to be simplified (see specific chapter below)

E. Bad publicity from problematic projects in Germany and recently in France

5. CONCLUSIONS

We urgently need a stable political and regulatory framework to achieve the targets for 2020, 2030 and beyond!

For 2020, we need:

• more and dedicated support schemes for geothermal in several member States

• the establishment of a pan-European geological risk insurance scheme (like the proposal EGRIF)

• the removal of (mainly non-technological) barriers, in particular for shallow geothermal energy

• more competitiveness with fossil fuels (gas) in the heating sector and a strategy to switch from fossil fuels to renewables in order to improve security of supply.

For 2030, we need:

• A governance approach with ambitious measures, as drillers, developers, and equipment manufacturers need security for investment

• A market design promoting dispatchable renewable energy technologies.

• A competitive and fair playing field for heating and cooling, considering both fossil fuels and an unlimited and unjustified strategy to "electrify the heating market".
• Geothermal heat and cold becoming a standard practice in building renovation.

Energy prices for the end consumer of heat and cold are heavily influenced by taxes and subsidies, whether using fossil fuels, electric power, or also renewable energies. Thus the competitiveness of individual energy technologies is dependent on political decisions and actions. The strategies for electrifying the heating market currently under discussion could further limit the impact of renewable heating and cooling. Using renewable energies (and in particular geothermal energy) directly for providing heat or cold is much more effective than first producing electric power and then converting it again into thermal energy. Electricity should not have a greater share of the heating and cooling market than that which is necessary for the demand side management and storage of electricity in the form of heat. Geothermal heat pumps are not 'electric heating', as the amount of renewable, geothermal heat is much higher than the electricity input used for operating the machinery; with modern ground source heat pumps achieving SPF of more than 4, the geothermal heat is more than 3 times the amount of electricity in the heat supplied to the building.

REFERENCES

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