Proceedings World Geothermal Congress 2005
Antalya, Turkey, 24-29 April 2005

The Netherlands Country Update on Geothermal Energy

E. Victor van Heekeren, Aart L. Snijders, Hilke J. Harms

Stichting Platform Geothermie, Jan van Nassaustraat 81, 2596 BR Den Haag, The Netherlands, Telephone : +31 703244043

E-mail : heekeren@heekeren.nl

Keywords: Netherlands, heat pumps

ABSTRACT

At the initiative of NOVEM, the Dutch Agency for Energy and Environment, a Platform for Geothermal Energy was established at the end of 2002. The objective is to stimulate the development of geothermal activities in The Netherlands and to disseminate know how in this field.

As the geological conditions in The Netherlands are not so very much different from the situation in the surrounding countries it is actually a bit surprising that the level of geothermal activities (in the sense of utilizing the energy in deeper layers of the earth) is currently so modest. This situation might, however, improve. At the moment of the writing of the article there are four initiatives to investigate the possibilities for use of Geothermal energy from deeper layers (feasibility studies for specific applications). It is expected that other new initiatives will be developed in the coming period by the newly established Platform.

A different story is the market development of the utilization of Ground Source Heat Pumps (GSHP's). GSHP's are obviously still being improved and optimized but are nowadays firmly established as an option to be considered for a wide variety of building projects.

1. GEOTHERMAL ENERGY IN THE NETHERLANDS

At the initiative of NOVEM, the Dutch Agency for Energy and Environment, a Platform for Geothermal Energy was established at the end of 2002. The board of the Foundation Platform Geothermie is formed by a number of key players in the field of geothermal energy in The Netherlands and the Platform is open to all organizations – both commercial and non-profit – and individual persons. The objective is to stimulate the development of geothermal activities in The Netherlands and to disseminate know how in this field. A bureau was established to support the Board of the Platform with the implementation of the work programme and to form a focal point both for questions from market actors and government organizations. A kick off workshop was organized in January 2004 in Utrecht at TNO/NITG (Netherlands Institute of Applied Geoscience) and a second event is planned for the beginning of 2005.

The current situation in The Netherlands is a very modest use of hot water for balneology (hot water baths or thermal baths) and an established and developing market for Ground Source Heat Pumps and seasonal storage of energy. Until now no (deep) geothermal energy is utilised for heating or electricity. This country update will deal with the new initiatives for deep geothermal energy as well as the emerging market for shallower depth geothermal energy. The situation with respect to balneology is unchanged and the contributions are expected to remain modest.

2. GROUND SOURCE HEAT PUMPS

2.1 General

In the Netherlands, the use of the shallow underground for extraction and storage of thermal energy started in the early 80ties. In first instance, the objective was to store solar energy for space heating in winter. Later on, the scope of application broadened to the storage of thermal energy (both heat and cold) from other sources than solar and to geothermal heat pumps. Because of the facts that in the 80ties the R&D efforts were focused on larger scale applications (building applications instead of individual houses), and that in the Netherlands aquifers can be found almost everywhere, almost all early projects are using groundwater wells to store and extract thermal energy. In the late 90ties, borehole heat exchangers started to play a more important role in geothermal heat pump applications.

2.2 Geothermal heat pump applications.

By the end of 2004, most of the geothermal heat pump projects are using vertical borehole heat exchangers. Over 1.100 of this type of geothermal projects are in operation, mainly for small scale applications like single family houses and small size office buildings and commercial buildings. In the housing sector, most of the heat pumps are used for heating only purposes. In the building sector, however, the geothermal heat pumps are applied for both heating and cooling in most situations, using the underground both as a heat source and a heat sink.

The situation with respect to geothermal heat pump projects using groundwater is somewhat different. The number of applications for individual houses is very limited. The small scale applications are found in office buildings and commercial buildings. The heat pump capacity is in the range 50 - 100 kWt, limiting the groundwater flow rate to 10 m³/h. Up to this groundwater flow rate, no groundwater permit is required for the project. Comparable with the application of borehole heat exchangers for small scale buildings, the underground (aquifer) is used for both heat extraction and heat rejection. Because of the limited groundwater flow rate involved, many aquifers allow for a single well to abstract and inject the groundwater. In this situation, the well has two screened zones in top of each other.

The most important application, not by number but by annual thermal energy flows, are the medium to large scale projects applying geothermal heat pumps combined with groundwater wells. By the end of 2004, about 300 projects of this type were in operation. The typical heat pump capacity for these projects is about 750 kWt. The heating capacity provided by heat pumps ranges between 200 kWt and 20.000 kWt for these projects. Most of the applications are found in the field of office buildings and commercial buildings. Due to the involvements of energy utilities, offering their clients heating and cooling, an increasing number of applications is found in the areas of building parks, industrial zones and housing developments, which are equipped with a district heating and cooling system. The 20.000 kWt project mentioned before, relates to a University Campus with a district heating and cooling system, supplying cooling and low temperature heat for the heat pumps to the buildings on the campus site.

A common characteristic of the medium to large scale geothermal heat pump projects is the application of direct groundwater cooling. The heat pump is using the groundwater as a low temperature heat source, thus lowering the temperature in the aquifer to 5 - 7ºC in wintertime. This low temperature groundwater is extracted in summertime and used for direct cooling of the building, i.e. without running the heat pump in chiller mode or running the heat pump in chiller mode at cooling peak load conditions only. Using groundwater for a medium to large scale geothermal heat pump project, will require a groundwater permit. One of the most important requirements to obtain a groundwater permit, is that the amounts of thermal energy extracted from and recharged to the aquifer will balance each other over a longer period of time (several years). This requirement is aiming at a sustainable groundwater use and can be met by allowing for flexibility in the operation of the geothermal heat pump system.

3. GEOTHERMAL ENERGY FROM DEEPER LAYERS

3.1 Potential.

The theoretical potential for geothermal energy use in The Netherlands is substantial. TNO/NITG estimates this potential at approximately 90.000 Peta Joule. Even at very modest utilisation levels of 1%, the technical potential is a very substantial 900 PetaJoule. The forecasts (Third Energy Report Scenarios) indicate a level of 2 PetaJoule (roughly 10 to 20 installations) in the year 2020. There are some important aquifers to be found in The Netherlands – at depths which are common to normal oil and gas producing operations.

The geological risks involved with the implementation of a geothermal project are believed to be modest and are mainly related to the permeability of the aquifers (influencing the volumes of water produced). This risk of low or zero water production is statistically found to be less than 15% - if the geological conditions are well known as in the case of The Netherlands. These statistics are derived from the experiences in the Paris basin.

Since the publication of the Third Energy Report, a number of external developments occurred, which may affect the application potential. The most important change is the adoption of the new Mining Law as from January 2003. The crucial difference is that all drilling and seismic data become public domain after ten years. This implies that vast information resources on the geological conditions in practically all Dutch regions are accessible for users.

Other changes are more on the technical level. An external development is the general trend in building and construction towards the use of lower temperature ranges for heating (e.g. floor heating) in new or renovated buildings. This allows the use of lower temperature ranges of the geothermal source, which in its turn increases the potential of suitable geothermal aquifers (including aquifers at lesser depths). Another external development is in the field of cost reduction of drilling and installing pipes accessing the aquifers. As drilling is the main cost factor for the implementation of a geothermal project, the combination of shallower depth and reduced drilling costs will enhance its technical and economic viability and thus its application potential.

The perception is consequently that these developments may substantially contribute to the economics and application potential of geothermal projects. The experience in Germany – with generally similar geological conditions – is a relevant example for The Netherlands. The German example has shown, that a substantial contribution from geothermal energy can be expected, given the right framework (a comparable incentive level - level playing field - with other forms of sustainable energy).

3.2 Constraints

The current situation in The Netherlands is that until now no (deep) geothermal energy is utilised for heating. When analysing the reasons, various causes and aspects become apparent. Geothermal projects are complex in the sense that a variety of disciplines are needed for successful implementation. Fossil energy based systems are quicker and easier to install. But this aspect is also true for various other forms of sustainable/renewable energy. So this should not necessarily discriminate against geothermal activities.

Another point raised in the discussions is that early action is required. At the early stages of decision forming on energy supply steps must be made to keep the option of a sustainable alternative open. For instance the costs of a geothermal project can be drastically lower (or at least partly compensated) in those applications where no natural gas infrastructure is installed. If the natural gas infrastructure is installed in every building/glasshouse etc., all costs for geothermal energy are additional costs. The same goes for the heating system in buildings. Once the choice for low temperature heating in buildings is made, the option for geothermal heating is kept open, without preventing other forms of energy sources (including heat pumps). Though not particularly difficult, this requires a positive or at least open mind of the owner/developer of the building, the municipality or other key actors involved. Though nobody will deny the complexity of these processes it must again be concluded that the same goes for other forms of low temperature – e.g. ground source heat pumps.

The size of a geothermal installation has implications for its scope of application. The capacity of a geothermal doublet, being usually in the range of between 3,5 and 12 MWth, requires a demand for heat which is equivalent to between 500 and 2000 houses. These numbers are obviously subjected to type and size of the houses (old/new, stand alone/flats, small/large etcetera) but nevertheless they give an indication of the minimum size of the demand. As water should not be transported over too long distances (as energy efficiency suffers by transport), this implies that the application potential is focused on new urban development projects (residential, commercial buildings), district heating grids and greenhouses. The latter consume rather substantial amounts of heat, but also require CO2. Optimal conditions for horticulture can be expected if there is also a source of CO2 that can be utilized.

A typical Dutch constraint is the generally rather low prices for natural gas. Natural gas prices may well increase in coming years, whereas the costs of geothermal energy, once installed and running, are practically negligible. It might be argued that geothermal energy shares this problem with other forms of renewable energy. However, there is a difference here. Financial instruments are in place for practically all forms of renewable energy. A very important instrument is the financial incentive (MEP subsidy) on green electricity produced in The Netherlands. This greatly encourages renewable energy based electricity production. The problem is that the temperature ranges of the Dutch geothermal reservoirs seem to favor heat production rather than electricity production. This implies that for geothermal energy there is no comparable subsidy for the production of green heat. In other words: no level playing field compared to renewable electricity. So even in spite of the advantages of zero nuisance levels, geothermal energy tends to lose the financial competition with options such as wind and solar energy. Calculations indicate, that, given the same support, geothermal energy economics would end up anywhere in between Wind and Solar – or better.

3.3 Key issues to be addressed

Nowadays an increasing awareness of the advantages of geothermal energy is evident. In articles and meetings it is pointed out that also for the Dutch scene geothermal energy could offer a clean source of energy with practically no emissions of carbon dioxides and a complete lack of other emissions either to air, water and land (no waste production). The noise levels are negligible and there is no creation of visual nuisance. Important from the demand point of view: it is easy to control and regulate in terms of capacity and without too many limiting outside factors. The production obviously depends on the permeability of the aquifer, but within its site specific range the volumes can be controlled and regulated and the capacity is totally independent of any seasonal fluctuation, weather conditions, etcetera.

Therefore, the promotion of a level playing field for geothermal energy (compared with other forms of renewable energy) is an important issue to be addressed. Further analysis of the financial aspects is desired and the results should be published and used in discussions with the Dutch Government authorities. The aim of this effort is to promote the creation of a comparable instrument (comparable to the MEP subsidy for the renewable electricity sector) for green heat production. This would also fall in line with recent initiatives at the EU level to develop a Green Heat Directive.

The question whether this would really help was addressed by the introduction of a financial scheme dealing with electricity from geothermal energy in Germany. The developments in Germany show a drastic increase in interest in geothermal activities once the German government instated a regulation creating contributions for electricity from geothermal energy.

Another lesson from the German scene is the need for strong and continued public relations. Without support from political powers and the public opinion, the chances of broader market deployment are modest. The role of the German association (Geothermische Vereinigung) has been crucial for the dissemination of information on the benefits of geothermal technology to decision makers and the public at large. Continuous lobbying at all levels, from local to supranational, has to be done to ensure the political backing of geothermal energy use. The current success in Germany could not be imagined without the perseverance of the Geothermische Vereiniging in lobbying over more than a decade.

The main tasks for the newborn Dutch Platform for geothermal energy are:

- To analyse the financial position of geothermal projects in comparison with other forms of renewable energy;
- To provide information on the benefits of geothermal energy to decision makers and the public at large.
- To promote the creation of a financial instrument for green heat, and
- To bring together consortia of actors around potential geothermal projects.

The second half of 2004 will be dedicated to these priorities. It is envisaged that during this period three feasibility studies will be carried out. Each study will focus on a specific type of application. At the time of the writing of this article it is envisaged that one study addresses the application in greenhouses, one study addresses the potential for new urban development projects and a third study focuses on the integration with an existing district heating grid. The objective is to present the results of these feasibility studies in the beginning of 2005 during a symposium dedicated to geothermal energy in The Netherlands.

TABLE 1. GEOTHERMAL (GROUND-SOURCE) HEAT PUMPS AS OF 31 DECEMBER 2004

Application	Ground or water temp. (^{o}C)	Typical Heat Pump Rating or Capacity (kW)	Number of Units	Type	COP	Heating Equivalent Full Load Hr/Year	Thermal Energy Used (TJ/yr)	Cooling Energy (TJ/yr)
Houses individual	11	6	1000	V	3.5	1150	17.8	0
Buildings small	11	75	150	V	3.5	1000	28.9	15.0
Buildings small	11	75	150	W	4.0	1000	30.4	15.0
Buildings large + houses collective	11	750	300	W	4.0	1000	608	550
TOTAL			1600				685	590