Geothermal Energy for heating and cooling – a roadmap to 2020 (EU-project K4RES-H)

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Keywords: Ground source heat pump, thermal conductivity, borehole heat exchanger, thermal response test

ABSTRACT

The promotion of geothermal energy on the European level until now was only considered for electricity, within the EC Directive for the promotion of electricity from renewable sources from the year 2001. Geothermal heating and cooling received little political attention, in spite of its considerable potential.

In the framework of activities to increase the use of renewable energies on the heating and cooling sector, also geothermal energy received new attention as one of the most reliable sources of renewable energy. The goal of the current EU policy is to increase market deployment in all relevant energy sectors: electric power, transport, and heating/cooling. While transport for geothermal energy only is an option via secondary energy carriers like electricity or hydrogen, both the sectors of electric power generation and heat/cold-supply are now in the focus for support measures.

WHAT IS THE PROJECT K4RES-H ABOUT?

In December 2005, the European Commission announced that it would work towards a Directive to promote heating and cooling from renewable sources. The European Parliament's report for a Directive on the promotion of renewable heating and cooling by rapporteur M. Rothe (1 February 2006) with recommendations to the Commission on renewable heating and cooling sent a strong signal to the European Commission, and to the Member States too. The Parliament clearly asked the Commission to table a Directive proposal.

This development was welcome and necessary. However, due to the traditional lack of attention for RES-H policies, there is a strong need for clear analyses of the existing experience and possible guidelines.

In the coming months and years it will be the task of the Member States to implement strong and concrete measures in their own countries, in order to help the RES-H sector towards reaching its full potential.

The Key Issues for Renewable Heat in Europe (K4RES-H) project plan was developed in early 2004, in expectation of these political developments. The project aims to support the discussion on RES-H policies (geothermal, solar heating and biomass) with a comprehensive Action Plan for RES-H in Europe.

There is an urgent need for increasing information and awareness about the RES-H sector, which is essential for reaching the EU target of 12% RES contribution to the gross inland energy consumption. It has become apparent that knowledge about the most suitable support policies for RES-H is still scarce. Support policies for RES-H tend to be weak and fragmented. A comprehensive approach to support RES-H does not exist yet.

An Action Plan for Renewable Heat in Europe is complemented by three sectoral Action Plans: for geothermal energy, biomass and solar thermal.

K4RES-H is built around the analyses of five Key Issues setting verifiable targets for RES-H; quantifying energy delivery of individual systems; regulations; financial incentives; policies for innovative applications.

These Key Issues were analysed separately for each of the three main RES-H technologies (solar thermal, bioheat and geothermal heat), under the leadership of the respective European trade associations ESTIF, AEBIOM and EGEC.

For more information and for the download of the material published, please visit :

http://www.erec-renewables.org/

(go to “projects”)

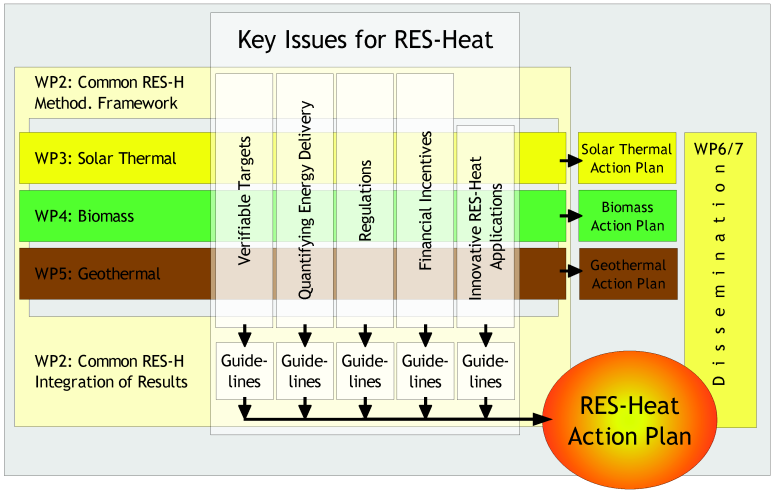

Figure 1: Schematic of the K4RES-H project plan

GEOTHERMAL ENERGY FOR HEATING IN EUROPE

Geothermal energy is in line with an overall strategy of sustainable development. It helps to reduce dependency on energy imports, thereby ensuring a sustainable security of supply. Geothermal sources are particularly suitable to be used in decentralised generation systems.

Furthermore geothermal energy can help to improve the competitiveness of industries, at least in the long run, and can have a positive impact on regional development and employment.

Using renewable energy technology creates employment at much higher rates than many other energy technologies. There are economic opportunities for new industries and new industrial and craft jobs through production, installation and maintenance of renewable energy systems.

Renewable heating and cooling in general and geothermal energy in particular has several benefits for society, including: positive externalities of private investments, reduction of CO_2 and other emissions, security of energy supply, local economic development, contribution to the creation of economies of scale and thus to cost reductions in the medium and long term.

By saving conventional fuels, RES-H systems have lower running costs but usually higher investment costs than a conventional heating system. With rising oil, gas and electricity prices, the timeframe for a positive return on investment is becoming shorter. In many cases, it is already well below the average lifetime of the equipment.

In table 1, some key figures for geothermal energy are reported. They have been published in the Geothermal Heating and Cooling Action Plan, which is for download from the site http://www.egec.org .

Costs and forecasts

	2005	2010	2020
Geothermal Electricity	50-150 €/MWh	40-100 €/MWh	40-80 €/MWh
Geothermal Heating & Cooling	4-10 €/toe	3-8 €/toe	3-6 €/toe

Investments

	2001-2010	2011-2020	2001-2020
In billion €	6	15	21

Employment

	2010	2020
Jobs FTE *	30 000	70 000

* equivalent full-time employment

Table 1: Key figures for geothermal energy from the Geothermal Heating and Cooling Action Plan, 2007

Figure 2: Principle of Ground Source Heat Pump System

MARKETS AND BARRIERS

The market situation is very different in the various countries and with the different geothermal technologies, according to natural resources and influenced by political issues.

Deep geothermal

The largest geothermal district heating systems within Europe can be found in the Paris area in France, with Austria, Germany, Hungary, Italy, Poland, Slovakia and others showing a substantial number of interesting geothermal district heating systems.

In most countries, geothermal district heating needs some investment support, reduced interest loans, etc. to become economic.

Cascade uses (district heating, industry, agriculture, and other) improves economy, but usually are very difficult to achieve due to business obstacles, distances, etc.

The main financial obstacle in geothermal heating plants is the heat distribution network. For heat distribution, Eastern European countries may have an advantage due to existing networks.

There are some distortions to be mentioned that impact certain national markets. In France e.g., heat from geothermal district heating carries the full VAT, natural gas only a reduced value. Competition from conventional sources (in particular natural gas) even uses dumping prices to keep costumers.

On the other hand, projects in some countries are affected by not adequate mining law, many taxes, fees and royalties. These expenses are too high compared to the annual heat sales, even in the biggest plant. Expenses comprise e.g. in Poland:

– Concession fee
– Mining royalty
– Fee for geological information
– Tax for surface installations

And there is even a new parliamentary initiative for tax on geothermal water.

Shallow Geothermal

For shallow geothermal systems, in several countries a market-driven economy exists. This will be further boosted by the expected oil price development.

Geothermal (ground-source) heat pumps have the largest installed capacity, accounting for about 50% of the europe-wide use and capacity. The installed capacity is ca. 4500 MW_{th} for GSHP of the almost 9000 MW_{th} for total geothermal heat capacity. Almost all of the installations are located in North and Central Europe.

The size of individual units ranges from about 5 kW_{th} for residential use to large units of over 150 kW_{th} for commercial and institution installation. In Europe, most units are sized for the heating load and are often designed to provide the base load with peaking by fossil fuel in larger installations. As a result, these units may operate from 2,000 to 6,000 full-load hours per year (capacity factor of 0.23 to 0.68).

Sweden, Switzerland, Germany and Austria are the leading countries in terms of market for geothermal heat pumps in Europe.

A transition is underway of Ground Source Heat Pump (GSHP) technology into some new areas:

- Southern Europe and the Mediterranean, with an emphasis on cooling and heating
- Eastern and South-eastern Europe, where slowly a demand for more comfort in houses is growing, and a group of people who can afford it.
- In United Kingdom and Ireland, meanwhile interest grows, and some prestigious plants have been built. The number of systems is rising, however, the technology used typically is under some US-influence.

Barriers

New policy initiatives in this field will need to address the barriers which currently hamper the rapid expansion of the RES-H market. These barriers include:

- Geothermal energy offers much lower operation costs, but investment costs are usually higher. In the short term, consistent and reliable support programmes, including those which promote innovative financing mechanisms, must help to overcome this barrier. In the mid- and long-term, economies of scale are expected to significantly decrease investment costs;
- In many countries and regions in Europe, information and awareness levels about the different RES-H technologies, and in particular about geothermal energy, are still quite low. Clear market signals, such as RES-H targets, as well as awareness campaigns proactively targeting suppliers (especially installers) can help to overcome this obstacle;
- Similar to energy efficiency, increased RES-H requires changed investment behaviour of millions of energy consumers. For majority of them - be they homeowner or business or public bodies - RES-H is still "exotic". Even if they are aware of the existence and know that many of them are mature technologies, mostly they are not considered when an investment decision, e.g. for a new heating system, is being taken.
- Insufficient data base: Presently, statistics on the heating sector and inventories of the geothermal resources in general are weak. A speedy establishment of robust market data and reliable statistics that allow the establishment of a baseline as well as progress monitoring is essential;

Recommendations

The main instruments to achieve a sustainable growth of RES-H are:

- Financial incentives
- Regulations
- Standards
- Awareness Raising
- Training
- R&D and Demonstration projects

More details on the different key issues (Verifiable targets, Quantifying energy delivery, Regulations, Financial incentives, Innovative applications, and in addition Flanking measures) can be found in the Action Plan and in the published reports of the project on the EREC website (http://www.erec-renewables.org)

On the following page, some statistics and targets developed within the project results are presented.

ACKNOWLEDGEMENTS

The project was support by the EU through IEEA in the ALTENER program. The responsibility for the content of the publication, however, is with the authors only.

Targets up to 2020

	1995 Eurostat	2000 Eurostat	2005 EGEC	White Paper target 2010	Target 2020
Geothermal heating & cooling	0.56 Mtoe	0.66 Mtoe	2.1 Mtoe	2 Mtoe	4 Mtoe
after projection EGEC				4 Mtoe	8 Mtoe

MW installed and future potential

	2005	2010	2020
Geothermal Heating & Cooling	8500 MW_{th}	10000 MW_{th}	25000 MW_{th}
	EU27 : 8750 MW_{th}	16000 MW_{th} *	39000 MW_{th} *

* after projection EGEC

Annual growth rates up to now and expected until 2020

	Real growth 1995-2001	AGR 2001-2010 (to meet WP)	AGR 2010-2020 (straight)	AGR 2010-2020 (accumulated)
Geothermal Heating & Cooling	3,3 %	11,7 %	15,0 % (14,4 %)*	9,7 % (9,3 %)*

* after projection EGEC

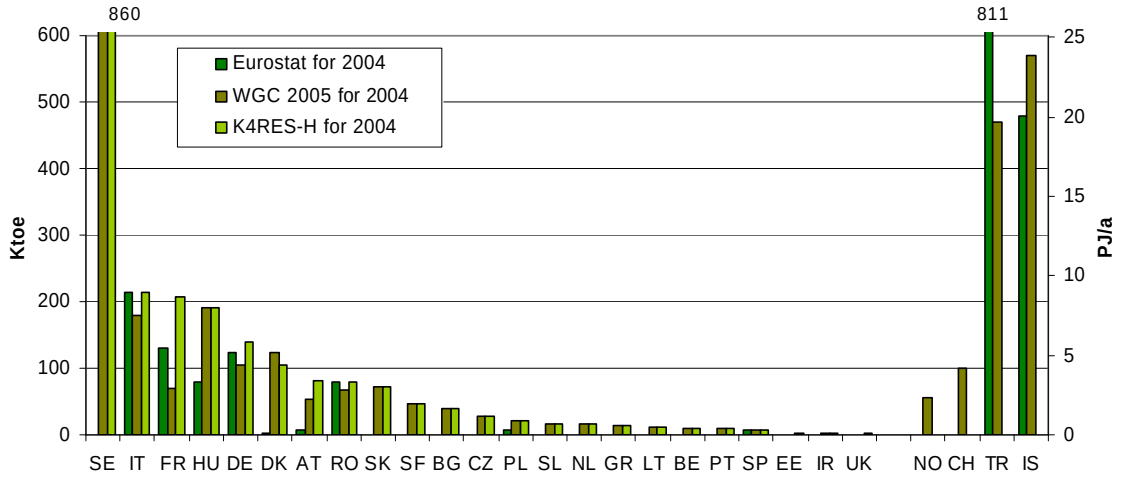

Figure 3: Comparison of different statistics for geothermal heat in Europe