European
Geothermal
Energy
Council

GEOTHERMAL HEATING & COOLING ACTION PLAN FOR EUROPE




European Geothermal Energy Council

Geothermal Heating and Cooling Action Plan

Summary and Introduction to the Geothermal Action Plan

This Action Plan for Geothermal Heat in Europe presents guidelines for the 5 key issues covered within the project K4RES-H (see following page):

1. Verifiable targets for geothermal heat: Market monitoring, statistics and methods for target setting

2. Quantifying the energy delivery of individual geothermal installations: Methods for measurement and calculation

3. Regulations: Best practice to promote geothermal energy, identification of regulations hampering geothermal usage

4. Financial incentives: Best practice to promote geothermal heating and cooling

5. Innovative geothermal Applications: Absorption cooling, CHP, Industrial applications and desalination

It will provide inputs for strong and coherent RES-H policies. It aims at providing stakeholders and policy makers with detailed information and clear guidelines based on the existing experience with policies to promote geothermal energy. This analysis of best practice policies should contribute to design new support schemes able to drive the EU beyond a doubling of the current renewable share of its heating and cooling supply. The Geothermal Action Plan provides information on the barriers to growth of geothermal heating & cooling markets, and it will try to help identify new instruments and policy initiatives, which address these barriers in an appropriate way.

Financial issues are presented in a first chapter to identify financial incentive schemes (FIS) for geothermal heating and cooling –provided they are managed well - as one decisive instrument to promote the use of geothermal energy. Principles of best practice for FIS for geo-H are being discussed.

The regulations are addressed in a chapter with the question how regulation schemes should be designed in order to best promote the uptake of geothermal heat. Best practice case studies for several Member States were prepared in order to provide assistance for the design of positive regulations.

A third chapter concerns innovative applications, such as geothermal heat for industrial processes, absorption cooling, desalination and Combined Heat and Power. This chapter lists the specific barriers to growth and consequently the best strategies to help overcome these barriers. Special attention is also paid to so-called flanking measures, which are important too for the development of geothermal technologies. One example is the dissemination of information in order to increase public knowledge and to raise understanding of geothermal energy and their benefits for private consumers as well as for the industry.

The setting of verifiable absolute targets for geothermal energy implies the solution of some statistical and methodological issues. This chapter on verifiable targets tries to identify these issues and recommendations for a methodology to set geothermal targets can be found here. Targets are a very important element in policy making for renewable energies.

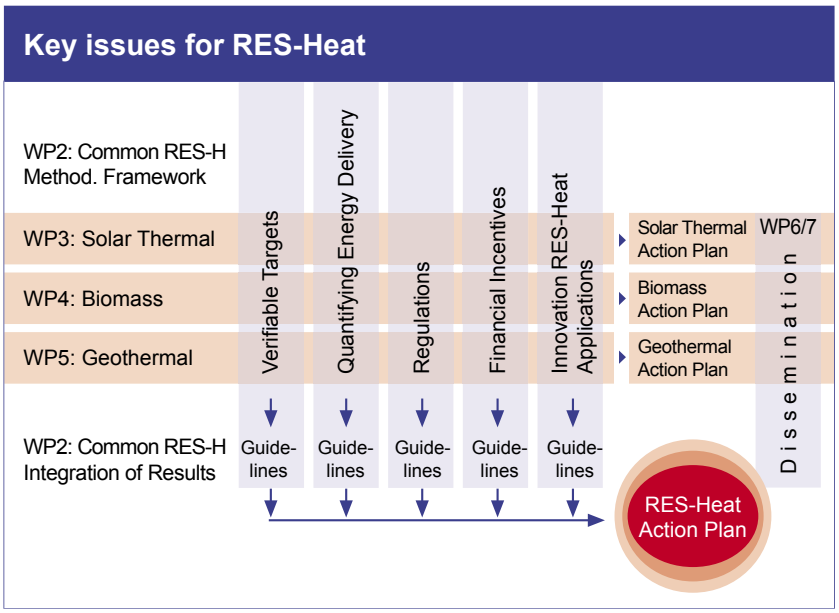
The energy delivery of geothermal installations is being discussed in a final chapter. The project developed guidelines for a widely agreed methodology to measure or calculate the energy delivery of individual geothermal installations. Such a methodology will enable policy makers to design policies to promote RES-H based on the desired result in terms of sustainable energy delivered.

Beyond EGEC, this Geothermal Action Plan was developed with the active collaboration of EREC, the EC-JRC (European Commission Joint Research Centre), and WIP-Renewable Energies.

Introduction to the K4RES-H Project

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

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 relative European trade associations ESTIF, AEBIOM and EGEC.

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

A Geothermal Europe

In pursuit of a sustainable energy supply, humanity has repeatedly lost its way in dead-end roads, or has perceived interim solutions as final ones. We are surrounded by inexhaustible energy resources that allow us to meet our energy needs and that of future generations without taking uncontrollable risks with the life and well-being of our planet. Now the development of modern technology enables us to make use of these energy sources on a scale that meets the requirements and demands of modern civilisation.

A single technology, a single renewable energy can never meet this demand alone. Each alternative has its specific advantages and disadvantages, and has to be applied intelligently and targeted in synergy in those places where it can deliver its optimum strength. Used in combination the renewable energy sources have a chance to meet the demand.

Our environment offers two completely different sources to cover our energy needs, the sun and the earth. The sun supplies energy directly or, as wind, hydropower and biomass, indirectly. The earth is stubborn, but reliable: Its potential is available at any time, it only has to be exploited by suitable technologies.

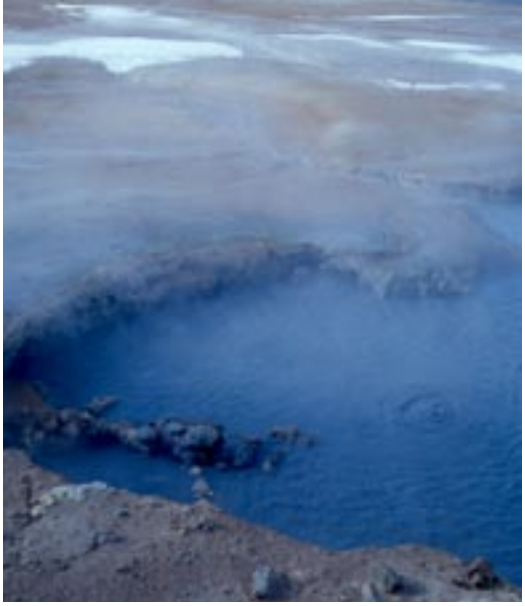
Therefore, success for the renewables is only possible, and a re-orientation of energy supply justified economically and socially, if both sources, sun and earth, can contribute. This statement is valid for our planet in its totality, as well as for our European continent in particular.

Geothermal power plant Krafla, Iceland

In the field of electrical power generation, geothermal energy already makes an important contribution on a world-wide scale. In recent years, significant advances have been achieved with enhanced geothermal systems (e.g. Hot Dry Rock). Great expectations are justified, of being able in the future to produce geothermal electricity independent of high-temperature resources of steam or hot water. Innovative power plants meanwhile permit the production of electricity using low thermal water temperatures in the order of 100 °C. A major advantage of geothermal energy is the availability of the resource all day, all year round. Using geothermal electricity, hydrogen may also be produced as a secondary energy carrier for automotive propulsion or use in fuel cells.

Drilling for shallow geothermal system in Wetzlar, Germany

Heat supply from geothermal energy in Europe is primarily done by using hot water from deep aquifers for district heating, etc., or in a large number of small to medium shallow geothermal plants. Shallow geothermal also supports the use of solar energy for heating, through underground storage of solar heat from summertime until its use in winter, and offers many other opportunities of long-term thermal energy storage.



In total, only a minuscule portion of the potential of geothermal energy is as yet explored and in use in Europe.

Thus a Directive to promote renewable heating and cooling will increase the use of geothermal energy towards our targets, in order to support the struggle for a sustainable, clean energy future in Europe. These targets can only be achieved, if all sectors, politics, science, and business, join forces.

Increasing the use of geothermal energy, and strengthening the geothermal industrial sector, will allow a substantial contribution to the reduction of CO_2 emissions, the saving of primary energy, and the creation and sustaining of many workplaces at various skill levels.

Geothermal energy :
A local answer, ecological and efficient, to reduce energy costs

A renewable energy :

- an energy resource nearly infinite, delivering heat and power 24 hours a day throughout the year, and available all over the world.
- friendly for the environment : large reduction in CO_2 emissions

- very low visual impact, and most of the infrastructure can be hidden beneath the ground.
- Heat-pump installations are unobtrusive and noise- and pollution-free on site

A safe and controlled technology :

- not dependent upon climatic conditions
- proven and reliable technically : drillings, heat pumps
- excellent feed back from leading countries

An energy adaptable with high performance :

- an answer to different energy needs : heating, cooling, hot water…
- modulated according to size and nature of equipments and in order to meet demands
- adaptable to old or new buildings

An energy economically sustainable :

- reduction of energy invoice from 40 to 80%
- not sensitive to conventional energy prices

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.

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

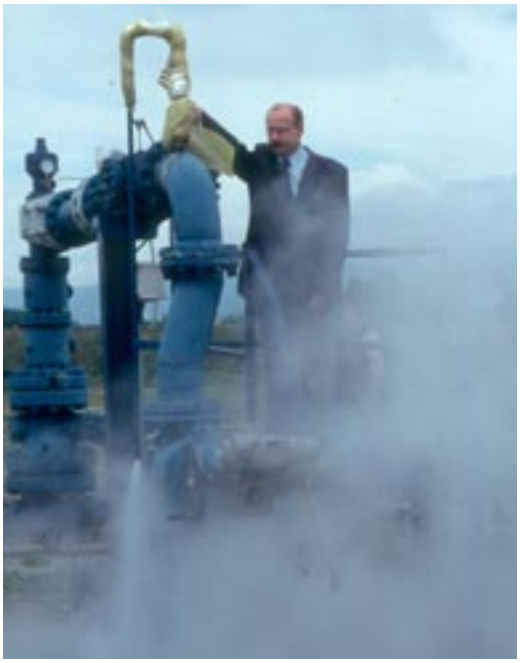
** equivalent full-time employment*

Market 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.



Geothermal well in Zakopane, Poland

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 MWth for GSHP of the almost 9000 MWth 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 kWth for residential use to large units of over 150 kWth for commercial and institution instal-

lation. 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 a 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:

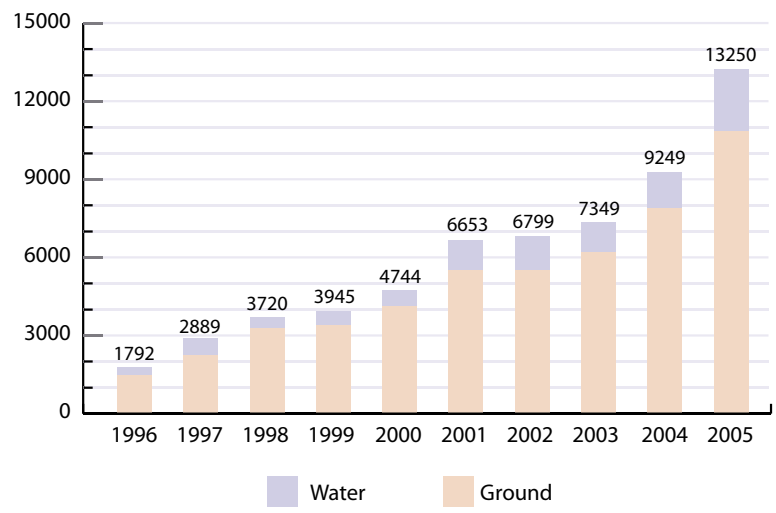
- Financial incentives
- Regulations
- Standards
- Awareness Raising
- Training
- R&D and Demonstration projects

The present document provides, for geothermal energy, an extensive analysis and proposals for guidelines on most of these issues.

Key Issue: Financial Incentives

There is a wide variety of economic instruments in the studied countries which either support or inhibit the enhanced use of geothermal energy in Europe.

Geothermal heat pump sales in Germany 1996-2005 (after data from BWP)



Success story of German federal scheme

The only direct support measure for geothermal heat pumps on the federal level in Germany was part of the Market Stimulation Programme. In the years 1995-98, a subsidy was paid per kWth of installed heating capacity. The programme was phased out in 1999. The subsidies where also subject to certain standards:

- achieve a minimum annual COP of 3.5, increasing up to 3.8 during the course of the scheme; to be certified in the design plans by an engineer
- use non-chlorinated refrigerants (to support early phase-out of ozone-depleting refrigerants)

The scheme had been developed and carried out by the Federal Ministry of Economics in close cooperation with the relevant associations for geothermal energy and for heat pumps.

The application was relatively easy, carried out by the Bundesamt für Wirtschaft (Federal Office of Economy) on a rather simple form. Acceptance was sufficiently quick to allow for waiting for the granting before starting the construction, as otherwise the support would be lost.

There was a good success of this programme, leading to a modest, but relatively stable market development. About 1000 new plants for geothermal applications (the scheme covered also other heat sources) have been supported each year, only a fraction of all new plants built. The market development, however, continued even after the end of that programme:

The few drawbacks of the programme can be summarized as follows:

- limited financial amount per year, as to the federal budget restrictions; in the fall of each year, typically no more money was available
- support had to be applied for and granted before start of construction, but construction had to end in the same fiscal year (calendar year); this led to certain problems when construction delays occurred
- At the end of the programme, the phase-out was too sudden. The market development continued, but mainly because only part of the projects had been financed, because some support schemes on state level took over, and because the economics of the systems had improved.

The latter was the main positive result of the programme. However, it also had to be accompanied by technical development, of which the relevant result is the guideline VDI 4640 “Thermal Use of the Underground”, issued first in 1998. This kind of technical advise and support was crucial to not only achieve increasing numbers, but also increasing efficiency and quality.

Way to success in Sweden

Governmental subsidies were given from the year 1981 to the year 1991. The form of subsidies has varied in type and size during the years : for single and multifamily housing facilities, for single family dwellings. Sweden has had the following types of subsidies over the years:

- Loans with special interest subventions for single and multifamily houses
- Cash contributions to multifamily housing installation, dependent on the number of installations
- Cash contributions to multifamily housing installation, dependent on the total costs of installation
- Income tax reduction for single house residents equivalent to a certain percentage of the total cost up to a fixed amount (renovation subsidy)

The different subsidies have had a different effect on the market. The first two types aimed to increase the number of heat pump installation while the third aimed to stimulate the conversion of direct electric heated buildings into water loop systems and the fourth subvention aimed to stimulate the overall building industry and was valid for any kind of investment concerning the building fabric or the heating system.

The subsidies contributed to an increase of heat pumps sales, but they had to be carefully drafted. If the subsidies in Sweden had been drafted with better judgement from the beginning, the effects could have been much more powerful and the establishment and growth of a functioning heat pump industry would have been faster.

Recommendations

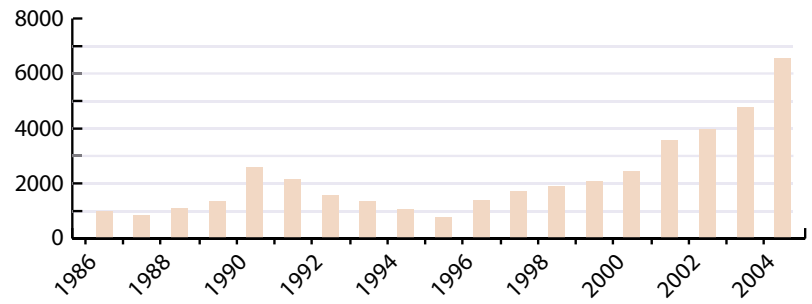
There are countries where the financial burden of fiscal nature (i.e. mining royalty, sewage penalty, groundwater use fee, environmental tax) are multiple, which breaches general taxation law.

The German example shows clearly how much these supportive tools can contribute to the high growth rate of renewables in a country with moderate natural setting.

The key lesson learned from the analysis within the project is that FIS can play an important role in promoting RES-H, if they are well designed, carefully managed and accompanied by appropriate flanking measures. If they are not, their positive effect is limited and can be even counter-productive in the medium and long term.

Therefore, continuity in time is the most important single element of a well designed and managed FIS for RES-H. A short-timed FIS may boost demand for a while, but does not create healthy market structures. On the contrary, such a situation may lead to a proliferation of “gold-diggers”, unserious companies with a short-term perspective that tend to install bad quality systems, leading to loss of reputation of the RES-H technologies.

Heat pump market development in Sweden 1986-2004 (Swedish Heat Pump Association 2005)



The key positive effects of well designed and managed financial incentive schemes are:

- Reduction of the upfront investment costs,
- Psychological effect: signal of the public authority to the potential users

Definitely more supportive governmental policies and efforts are needed to speed up the development of geothermal resources for direct use. Only by these means can their great potential be tapped and utilized.

Key Issue: Regulations

Legislation relevant to geothermal energy use was reviewed for selected countries. The compilation for Germany, France, Hungary, Poland, and Ireland reveals that the legal bases show great differences. Governmental policies to support geothermal development are focusing so far on power generation only. Serious efforts are needed to harmonize legislation and to simplify procedures as well as to establish and implement strong policies to boost geothermal heating and cooling.

The legislative and regulatory framework for geothermal energy is very diverse within the EU member states, and in some cases is a real barrier to geothermal energy use. There are countries with barriers of fiscal nature (i.e. mining royalty, sewage penalty, groundwater use fee, environmental tax), of licensing, etc. The different burdens within the EU are:

- Royalties e.g. in France, Hungary (2 % of turnover), Poland, Romania (2 % of turnover), Slovenia
- Groundwater exploitation / sewage fee in most countries, usually no fee when re-injected

For royalties, a distinction has to be made for thermal water and energy. There should be no or a very low royalty on the energy (there is also no solar or wind tax!).

The ownership of the resource has to be stated clearly in legal regulations.

Clear energy and environmental policies and regulations are of paramount importance for the development of renewable energy sources. The institutional framework, legislation and legal constraints are borderlines to delimit development, especially in view of environmental protection. Within these limits there should be unequivocal administration of law.

In reality, governments often lack clear energy policies and environmental policy does not address energy sources but rather the mitigation of their effects. Geothermal energy in general, and geothermal resources in particular, are usually not well defined in legal terms, and the regulation of their development and utilisation is correspondingly diffuse.

In many countries, the geothermal resources are dealt with in the Mining Law whereas the production of geothermal fluids from the subsurface is regulated by Water Protection legislation. This implies that responsibilities are assigned to different Ministries, with often limited cooperation and interaction between them.

Hotel Storforsen in Northern Sweden, heated by geothermal heat pumps

Umweltzentrum (Environment Centre) in Cottbus, Germany, heated by geothermal heat pump

For the geothermal sectors already established firmly on the market (mainly shallow geothermal), regulations also can act against the free competition and trade of goods and services.

Some actions recently have been started to look more closely into the existing situation, and to develop suggestions how to overcome the obvious problems.

Recommendations

Starting with a workshop in Kistelek, Hungary, in 2005, a process to achieve a suitable legal and regulatory framework for geothermal energy is ongoing. The relevant "Kistelek Declaration" can be found for download on the EGEC website. The process is carried forward in the new project GTR-H, supported by the IEEA (www.gtrh.eu).

Any regulatory framework for geothermal energy has to serve the following main purposes:

- Securing environmentally friendly use of geothermal energy, in particular concerning protection of underground drinking water resources, emissions, etc.
- Regulating competing uses and securing sustainable use of geothermal energy
- Granting to the investor a firm right to use geothermal energy in a given area and to a given extent, as the basis for business plans

The relevant national legislation is spread throughout the mining, energy, environmental, water management and geological acts, sometimes in a contradicting way, and the licensing authority framework for geothermal facilities is rather complex in most countries.

"A Community level communication shall foster Member States to adopt a coherent legislation system and to designate a rational framework of competent authorities in order to ease application for geothermal energy use." (from the Kistelek declaration, 2005)

The definition of geothermal energy is lacking in the acquis communautaire and the national practice is diverse - some authorities consider it as a type of energy carried by thermal waters exclusively -, which hampers the distribution of most up-to-date technologies using shallow depth reserves via heat pumps or deeper closed-circuit heat exchanger fluids.

Storage tanks in the Kistelek geothermal system, Hungary

"A broad sense legal definition of geothermal energy is needed in a relevant piece of Community legislation, e.g. the heating-cooling legislation in preparation." (from the Kistelek declaration, 2005)

The definition used by EGEC, being compatible with other definitions e.g. in guideline VDI 4640, reads:

"Geothermal Energy is the energy stored in form of heat beneath the surface of the solid earth"

Definitely more supportive governmental policies and efforts are needed to speed up the development of geothermal resources for direct use. Only by these means can their great potential be tapped and utilized.

Building codes and planning laws can have significant effect on the uptake of renewable heating technologies, positively or negatively. One problem with regulations for renewable energies can develop if certain technologies are exclusively required, limiting the choice and the adaptation to a certain building, location, and climate.

In general, simple and fair application and licensing procedures will help significantly in the development of RES-H.

Key Issue: Innovative Applications

Geothermal energy has been used since antique times for heating, and for more than 100 years also for electricity generation. The geothermal potential is inexhaustible in human terms, like that of the sun. Beside electric power generation, geothermal energy today is used for district heating, as well as for heating and cooling of individual buildings, including offices, shops, small residential houses, etc.

Meanwhile a number of new and innovative applications of geothermal energy has been developed, and some of those have already been demonstrated. The most promising topics are:

Desalination

One in three people in the world currently suffer from water shortage. Geothermal energy could be one of the technologies permitting to reduce this problem, in desalinating seawater. A demonstration project is ongoing in Greece.

Absorption Cooling

Geothermal energy has been used for cooling since a long time, in the form of reversible geothermal heat pumps or through direct cooling in shallow geothermal applications. A very good potential for larger systems (large individual buildings, district cooling) can be seen in geothermal absorption cooling.

Combined Heat & Power

Combined heat and power (CHP) plants are not a new use of energy, whether it be from conventional fossil fuels or geothermal. However, what has been happening recently in the geothermal arena is the use of low-temperature resources (down to 98 °C) in combination with binary power units.

Industrial Applications

Geothermal energy may be used in a number of ways in the industrial field : drying, process heating, evaporation, distillation, washing, chemical extraction for food processing, supermarkets, wastewater treatment, chemical recovery…

Snow melting and road de-icing

Geothermal energy can be used favourably to heat surfaces of walkways, roads, railway platforms, airport runways, etc., either by direct geothermal heat or by storing heat from solar radiation onto the surfaces during summer. Experiences with a roads on a bridge have been made in Switzerland, a railway platform recently has been equipped in the German Harz mountains, and many further applications can be expected.

Geothermal bridge heating near Interlaken, Switzerland

The current main barriers for these applications are common with most “early-stage technologies”:

- High upfront investment costs
- Lack of awareness amongst decision makers
- Lack of trained professionals
- Lack of mature and possibly standardised products

In order to overcome these barriers, the following recommendations have been produced:

- Funding for demonstration projects and awareness raising
- Increased funding for R&D on these applications
- Training of professionals (planners, installers)
- Inclusion of these applications in RES-H targets as well as in policy measures

Flanking Measures

Accompanying measures are particularly important for the development of RES-H technologies so as to provide comprehensive information, to introduce the appropriate technologies to the professional groups, which will be applying them, and to ensure quality standards.

Awareness raising

One particularly important flanking measure is the creation of public knowledge and understanding of geothermal energy technologies and their benefits for private consumers as well as for the professional groups concerned.

So at all levels a well-designed campaign about RES-H technologies, including training courses for professional groups could help developing the markets.

EU wide information campaigns, the allocation of support within the structural and cohesion funds for RES-H as well as an increased budget within the EU's research and development funds could help to promote RES-H.

Member States should ensure that the professional groups concerned are familiar with and master the appropriate technologies.

With leading by example the public sector could give priority to renewable heating and cooling installations as part of the procurement policy particularly when it comes to newly constructed buildings or buildings being renovated.

Training of professionals

Another very important measure is the education and training of relevant professionals: To date the lack of knowledge about RES-H technologies on the side of architects, planners and installers poses a serious burden for the broad market penetration of renewables in the heating and cooling markets. This would also ensure a high quality of the design and installation of the RES-H systems.

Standards

Standards already exist in a few countries for shallow geothermal systems (e.g. VDI 4640 and DIN 8901 in Germany). Also some CEN standards on heat pumps cover some geothermal aspects (e.g. EN 15450, currently as draft).

In general, components of geothermal systems have to comply to existing standards (e.g. pumps, compressors, heat pumps, pipes, controls, etc.). These standards have been developed or are under development within the relevant technology areas.

Specific standards for the geothermal systems will mainly have to deal with the exploration, design, and installation. This requires both some common standards for the whole EU, and specific regional aspects according to climate, geology, and traditions of the building sector. Experience e.g. with the development of EN 15450 shows this need for opening to regional practice and circumstances.

Past experience proved that the geothermal sector has to be included earlier into standards that are developed from the perspective of certain heating technologies (a very positive example, initiated from inside the geothermal sector already in 1994, is VDI 4640).

It is expected to first have an increasing need for standards on the shallow geothermal technology, and later on the deeper and larger systems (district heating). Shallow geothermal standards need to deal with, among other items:

- Drilling procedures for safety, efficiency and environmental protection (groundwater protection)
- Quality of borehole heat exchangers, manifolds, etc.
- Sizing and design guidelines securing systems for sustainable and efficient operation
- Specific components

Key Issue: Verifiable targets

Targets represent an important step in policy making. The rapid market development and technological advancement of the renewable energy sector in recent years ensured progress on the White Paper targets in the area of electricity and biofuels, where Directives have set concrete targets. Analogous targets for the heating and cooling sector will guide national and local policy makers in their decisions and send important signals to investors and the public.

Nevertheless, setting verifiable absolute targets for RES heating and cooling implies the solution of some statistical and methodological issues. The goal of a task of the project on verifiable targets was to tackle these issues and develop recommendations for a methodology to set RES-H targets and identify the improvements of the EU statistics.

In several countries, the "official" data (i.e. data published by national statistics offices, energy agencies, ministries etc.) is based on surveys of companies active in that country (Heat Pump manufacturers or importers, drillers…). Associations or governmental agencies often carry out these surveys. The accuracy of the data depends on the coverage of the market – e.g. have all relevant companies been identified? Have all of them answered the survey? – and the truthfulness with which the survey was answered.

Other statistics are based on the estimations of one or several market experts. The accuracy of those statistics then depends on the good knowledge and honest estimation of the expert.

An overall target for heating and cooling from renewable energy sources in the EU must be based on solid statistical data based on today's knowledge. According to Eurostat the share of renewable heating today is about 9%. This can easily be doubled by the year 2020 and with some ambition a share of 25% by 2020 is feasible. Such a target must be broken down into binding national targets for each Member State, taking into account their natural resources and the capacity already in operation.

Improve the overall data quality by

- more attention to RES-H statistics
- Improving data collection : harmonised concepts to collect data and development of inventories
- Agreeing on a methodology to discount old RES-H systems, which can be assumed to have reached the end of their life-time

Improve the comparability of statistics by

- Including all relevant geothermal system types in the statistics : deep and shallow energy
- Harmonising the definitions of geothermal energy used, of sources and production: a unified definition of geothermal energy, at national and European level, has to be adopted soon and will be used in each regulations, communications, statistical methodology, etc:
  Geothermal energy is the energy stored in the form of heat beneath the surface of the solid earth.
- Harmonising the conversion methodologies used in calculating the geothermal energy production, and hamonized concepts for calculation of capacity in operation.

These measures could significantly improve RES-H statistics in Europe. But even with the current state of statistics it is already possible to set and monitor verifiable targets. The EU should set an overall RES-H target, which shall be broken down into national binding RES-H targets for each Member State. Member States should then define sub-targets for each separate RES-H technology taking into account their natural resources and the

capacity already in operation. The clearer the target is formulated, the better

it will serve as a guideline for policy makers who design and implement suitable support strategies and evaluate their success. Technology specific targets set by each Member State will ensure that none of the technologies is easily forgotten.

In 2005 a total of approximately 2,1 Mtoe has been supplied by geothermal heating alone within EU 25, and more than 1 Mtoe in other European countries. Leading countries are Italy, Sweden, Greece, France, Germany inside the EU, and Turkey and Iceland for the rest of Europe

At the end of 2005, the installed thermal capacity (including heat pumps) amounted to almost 9000 MWth.

Unlike other renewable energy sectors, the geothermal sector has already outgrown the EU White Paper objectives outlined for 2010 (which were less ambitious, and did not account for the great success of geothermal heat pumps, and of the geothermal potential in the new member states).

Targets up to 2020

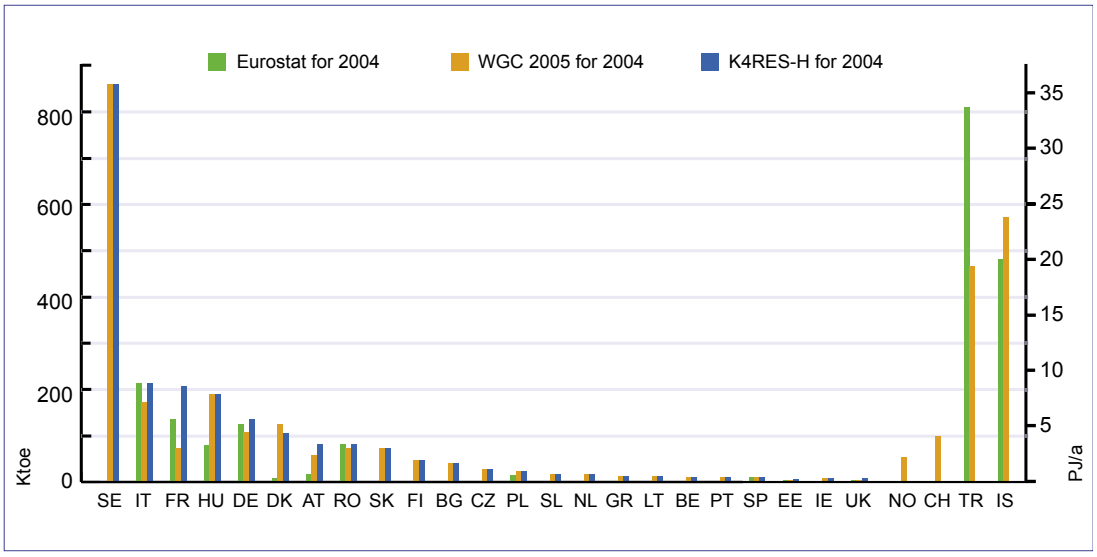
Geothermal heating & cooling	1995 Eurostat	2000 Eurostat	2004	White Paper Target 2010	Target 2020
White Paper Eurostat	0.56 Mtoe	0.66 Mtoe	1.5 Mtoe	2 Mtoe	
After projection EGEC			*2005: 2,1 Mtoe*	4 Mtoe	8 Mtoe

MW installed and future potential

Geothermal Heating & Cooling	2005	2010	2020
White Paper / Eurostat	8500 MW_{th}	10000 MW_{th}	
After projection EGEC	EU27 : 8750 MW_{th}	16000 MW_{th}	39000 MWth

Annual growth rates up to now and expected until 2020

Geothermal Heating & Cooling	Real growth 1995-2001	Real growth 2000-2004	AGR 1995-2005	AGR 2001-2010	AGR 2010-2020
White Paper / Eurostat	3,3 %	18 %		11,7 %	
After projection EGEC			14,2 %	19,7 %	8,0%



Key Issue: Quantifying energy delivery

In the heating sector, energy measurement is in general less common than in the electricity sector, as most EU citizens living in a multifamily-house with a central heating system know. In large renewable heating systems a direct measurement of the heat produced – and therefore of the conventional fuel saved – is a common feature. In small RES-H systems, this is not the case.

For this reasons, policies to promote RES-H, like financial incentives, are often not based on the energy effectively delivered, but on more rough parameters, like for instance Coefficient of Performance of the geothermal heat pump installed. Reliable and comparable statistics are necessary and a precondition for the purpose of verifying the progress towards national targets and a possible overall Community target.

The K4RES-H project developed guidelines for a widely agreed methodology to measure or calculate the energy delivery of individual installations for deep and shallow geothermal energy. Such a methodology will enable policy makers to design policies to promote RES-H based on the desired result in terms of sustainable energy delivered.

While part of the project focused on the macro level (national statistics), another part focused on the micro level (individual installation). The results of the two parts are complementary by defining a widely agreed methodology to convert statistical data (currently often available in term of capacity or of number of installations) into data for overall energy delivery of RES-H systems in a certain region or country.

For this purpose a clear definition for the production of RES-H is necessary.

The K4 RES-H project addresses the total amount of produced renewable and useful heat. This definition comprises the following specifications:

- The heat is measured directly after the conversion which means that all storage and transfer issues are neglected. Geothermal is measured after the heat exchanger (direct system) or after the heat pump.
- Auxiliary energy supply within the conversion process is only considered when being a considerable amount (suggestion for more than 5 %). It is expected that only Heat Pumps will find consideration as auxiliary systems.
- Geothermal Energy is energy stored in the form of heat beneath the surface of the solid earth.

As the detailed recommendations are rather technical, it is recommended to visit the K4RES-H website at http://www.erec.org/projects/proj_K4_RESH_homepage.htm to receive the full set of information.

Various heat uses

Renewable heating and cooling, including geothermal heat, has a far bigger potential than most conventional heating and cooling applications today. While the heating of the built environment (space heating, domestic hot water) will continue to be the most important market segment, other applications will grow to significant market shares.

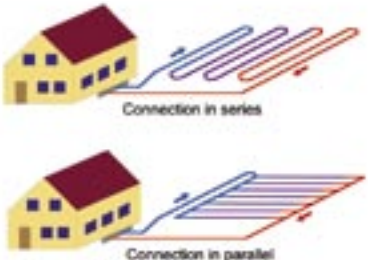
Deep geothermal energy

Deep geothermal energy can be used mainly in geological basins (France, Germany, Italy, Hungary, Poland, etc.), for district heating, for agricultural uses like greenhouses, for aquaculture (and also for power). The preferred method is the use of thermal water through well doublets, but recently also deep borehole heat exchangers have been demonstrated.

Shallow geothermal energy

With ground source heat pumps, geothermal applications can be present virtually everywhere and everytime… for heating and cooling

Groundwater heat pump(doublette)



Horizontal ground heat exchanger (European style)

Borehole heat exchangers (double-U-pipe)

Energy piles, cross-section of a pile with 3 loops

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K4RES-H

Key Issues for Renewable Heat in Europe

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Intelligent Energy Europe

Photo and graphical elements credits : EGEC, Franz Ewert, Polydynamics. Published in January 2007 - Design: ACG Brussels
Printed on ecologically friendly paper (chlorine-free paper)