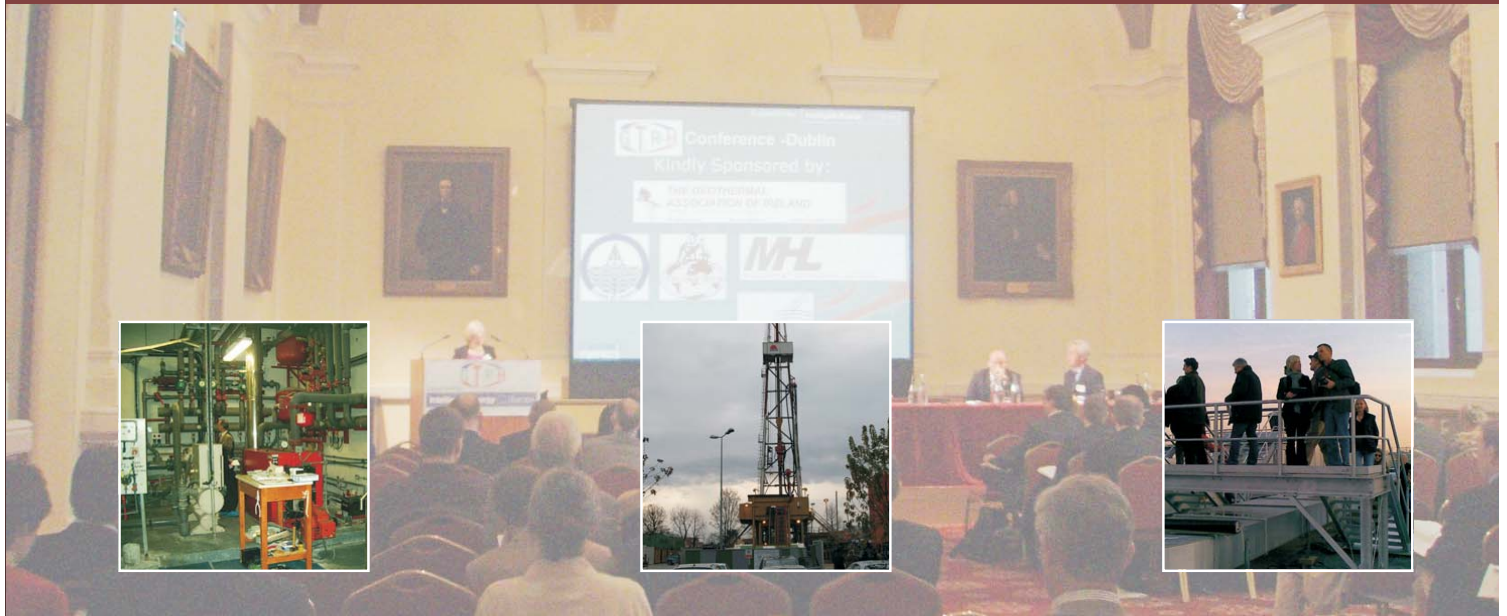




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# Geothermal Regulation Framework



**G E O T H E R M A L R E G U L A T I O N - H E A T**



GEOTHERMISCHE VEREINIGUNG E.V.  
BUNDESVERBAND GEOTHERMIE

The GTR-H project was funded by the IEE/Altener Programme. It set out to review and establish the regulatory barriers and deficiencies in the geothermal sector through a process of discussion and consultation with key target actors and stakeholders at a national level in Hungary, Ireland, Northern Ireland and Poland. A review was carried out of best practice in geothermal regulatory frameworks in France, Germany and the Netherlands, to provide the necessary input to design a possible framework for the implementation of geothermal regulations.

The project has produced a framework document as presented here, aimed at increasing overall sectoral investment in geothermal energy for the exploration and exploitation of heat across the EU.

### **Acknowledgements**

The project consortium would like to thank the geothermal experts throughout Europe who provided input and comment during this project. This report has been prepared through the collaborative team efforts of the consortium member companies and in particular the following geoscientists, engineers and geothermal experts:

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We trust that the presented framework will progress the wide development of geothermal energy in a dynamic and sustainable way across Europe.



This project was supported by Intelligent Energy Europe



# GEOHERMAL REGULATION FRAMEWORK

Final version November 2009

Project Partners:





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## TEMPLATE FOR A GEOTHERMAL ENERGY REGULATORY FRAMEWORK

### CONTENTS

#### A. LEGAL GUIDELINES:

- A.1 Definition and Classification of geothermal energy
- A.2 Geothermal resource ownership
- A.3 Geothermal energy licensing system
- A.4 Simplify regulations and administrative procedures
- A.5 Geothermal Energy Licensing Authority
- A.6 Geothermal Resources inventory & statistics

#### B. FINANCIAL INCENTIVES GUIDELINES:

- B.1 Regulatory Costs/ Licence Fees/ Royalties
- B.2 Develop Financial Incentive Schemes
- B.3 Notes on Financial Incentive Parameters

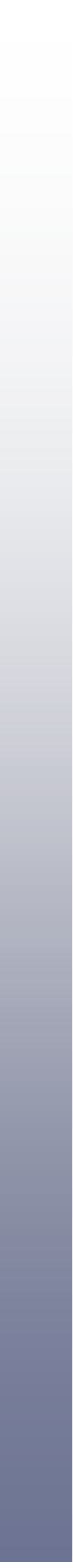
#### C. GENERAL GUIDELINES FOR FLANKING/SUPPORTING MEASURES:

- C.1 Education, Training and Certification
- C.2 Promotion of Geothermal Energy
- C.3 Standards & Codes
- C.4 Research & Development



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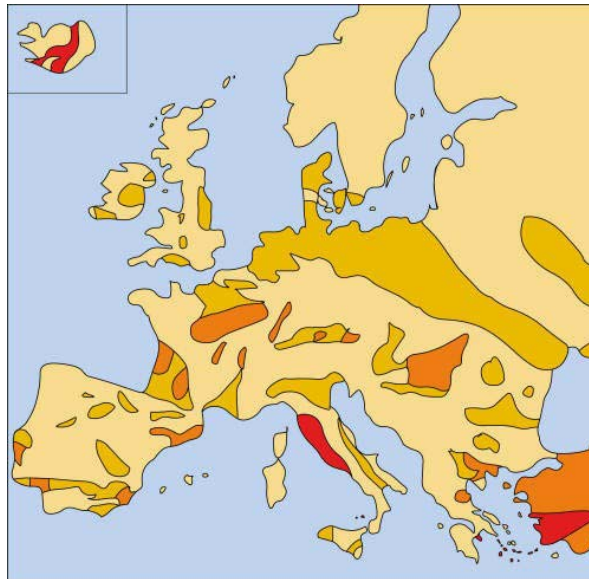


## INTRODUCTION

Geothermal energy is a widely available low carbon, sustainable, strategic resource capable of producing continuous baseload energy. It has the potential for much more widespread use and to make a significant contribution to the 2020 renewable energy targets established in the European Union. The current use of geothermal energy resources varies between countries but it has been established that suitable regulatory, financial and technical regimes are important positive factors in the development of the geothermal energy sector.

The GeoThermal Regulation—Heat (GTR-H) project is concerned with the regulation of geothermal energy for heat in the EU. An analysis of the existing regulatory frameworks for geothermal energy in Member States has confirmed that the effective regulation of geothermal energy needs a sound legislative basis. This may be achieved through new policies, the modification of existing legislation, the introduction of new legislation or a combination of all. Existing legislation for natural resources, hydrocarbons, mining, geology, groundwater or planning may cover aspects of geothermal energy exploration or development, or legislation specifically for geothermal energy may be made. The choice will depend on the scope of existing legislation or may be a matter of national policy.

The reviews and consultations carried out in the GTR-H project have identified factors that should be addressed in any regulatory system for geothermal energy and these essential elements are described below in the template for a geothermal energy regulatory framework.



Non-technical issues identified as requiring inclusion in the regulation framework for geothermal energy have been grouped into the following categories in the template:

- A. **Legal**
- B. **Financial**
- C. **Other supporting or flanking measures (including education, training, standards and promotional strategy)**

Detailed recommendations are made in this framework as to what should be included under each heading in any regulation for geothermal energy.



## TEMPLATE FOR A GEOTHERMAL ENERGY REGULATORY FRAMEWORK

The following sections set out the main areas for consideration in geothermal legislation under each of the headings of Legal, Financial and Other Supporting or Flanking Measures.

### A. LEGAL GUIDELINES

Of primary importance is the clear definition of geothermal energy and the ownership of geothermal resources. Based on these definitions appropriate regulation must be adopted through natural resources, hydrocarbons, mining, geological, groundwater or planning laws or alternatively be contained in a separate geothermal act.



#### A.1 DEFINITION AND CLASSIFICATION OF GEOTHERMAL ENERGY

A clear definition of geothermal energy should be included in the legislation.

A.1.1. "Geothermal Energy" is the energy stored in the form of heat beneath the surface of the solid Earth" (as defined by the RES Directive 2009/28/EC). Currently different terms exist in legal and regulatory acts referring to the geothermal sector. It is recommended to unify the basic terminology using only the term 'geothermal energy', with a view to introducing transferable clear solutions and incentives from country to country and across the EU as a whole.

Classification of the geothermal energy resource and its mode of extraction may be made using a variety of parameters. Such a classification would allow the appropriate level of regulation to be applied to the different classes of geothermal energy systems.

A.1.2. Parameters describing the potential geothermal energy available for production could be used to further define the resource and mode of extraction. Depth, water temperature, flow rates, pressure, end use, installed thermal capacity (in both heating and cooling mode) can be used to guide the



permitting process through which shallow and deep geothermal energy exploitation should be regulated in each country. The defined parameters should comply with existing natural resource regulations.

These parameters can be used to distinguish between shallow and deep resources. It is proposed that a single depth limit be used to accurately define and differentiate shallow and deep geothermal resources depending on country specific geological or hydrological conditions. Possible cut-offs can be chosen from the following:

Shallow geothermal resources can be defined as occurring above depths of 200m to 500m.

Deep geothermal resources can be defined as occurring below depths of 200m to 500m.

## A.2 GEOTHERMAL RESOURCE OWNERSHIP

- A.2.1. Legislation needs to clearly define the ownership of the resource at a national level.
- A.2.2. The state ownership of geothermal energy resources must be defined in legislation similarly to other natural resources (eg: minerals, hydrocarbons, groundwater or thermal waters).
- A.2.3. Legislation should give the state the right to use the resource and to grant licences for the exploration, development and production of geothermal energy.



## A.3 GEOTHERMAL ENERGY LICENSING SYSTEM

A system of licensing for exploration and exploitation of geothermal energy resources should be in place as a primary requirement to develop and regulate the national geothermal sector.

- A.3.1. Existing national natural resource, geological, water abstraction/exploitation, environmental, planning and building legislation can be used, with modifications if necessary, to regulate the shallow and deep geothermal sectors. However, the regulatory burden for shallow systems should be

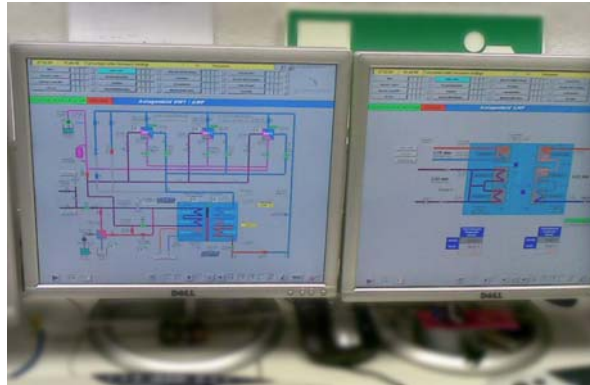
minimised; for example, it is recommended that small, closed loop, domestic heat pump systems should be the subject of a simple notification rather than licensing process.

- A.3.2. Geothermal resources definition and regulation under existing legislation (such as minerals, mining, hydrocarbons, water or planning) could be followed by a new Geothermal Act to address any hortfalls identified in the legislation once the licensing system has been in operation for several years.
- A.3.3. Shallow geothermal energy exploration and development for large scale systems could be regulated through local planning laws where the local government body could be the licensing authority.
- A.3.4. The licensing authority for exploration and development of deep geothermal resources could be the government department responsible for licensing mineral or other resources in consultation with relevant local authorities.
- A.3.5. The geothermal licensing system should grant a licensee the exclusive rights to exploration and exploitation/development of geothermal resources over a defined area and for a specified period of time. The area and the duration of the licence should be appropriate for the size and type of geothermal energy development, and the potential capital investment.
- A.3.6. The geothermal licensee must be protected from other external parties depleting or damaging the geothermal resource available within their licence area. The licensing authority will be required to take into consideration other existing natural resource licences (eg: mining, hydrocarbons, carbon capture and storage, quarrying, groundwater abstraction) before issuing geothermal exploration and development licences, as interaction between various resources may occur.



- A.3.7. The legislation should set priorities among natural resource use taking into account the following: potable water use, water for agriculture, renewable energy, balneological, conventional energy and auxiliary uses of the underground, sports & recreational water use.
- A.3.8. The geothermal licensing authority should be responsible (with the other licensing authorities) for ensuring that there are no conflicting rights relating to overlap of geothermal licences with other resources or licences.

- A.3.9. There is an obvious potential for competition between onshore carbon storage and geothermal energy projects because they may target the same deep aquifers, or the same areas within sedimentary basins. Geothermal energy may also be produced from rocks below the depth range for potential carbon storage sites. Carbon capture and storage is essentially a bridging technology whereas geothermal energy is a sustainable energy resource. Areas of deep geothermal energy resources should be identified and priority given to geothermal energy over carbon storage exploration licences.
- A.3.10. The geothermal resource (as per the parameters defined in section A.1.2) being made available to the license holder must be clearly defined by the licensing authority as part of the license award process. Legal conditions attached to the licence (such as ownership, rights of access, multiple resource licensing) need also to be specified in the process.
- A.3.11. Specific guidelines on the application procedure for deep geothermal exploration and exploitation licences should be developed. These should outline the legislation regarding the granting of rights of ownership and of access to geothermal resources, nominate the relevant licensing authorities and describe the application process and guidelines for technical inputs, work programmes and reporting requirements. These guidelines should help streamline the application process.



- A.3.12. The administrative process for the granting of deep geothermal exploration or development licences should not exceed an overall period of six months.
- A.3.13. The duration of a geothermal exploration licence should not exceed six years. There should be an agreed exploration work programme and expenditure, against which the performance of the licensee would be monitored by the licensing authority.
- A.3.14. An application for a geothermal development licence should be accompanied by a development plan supported by exploration results, technical and financial models. These data should fulfil all requirements of the legislation for natural resources, planning, protection of the environment and groundwater in accordance with relevant EU Directives.
- A.3.15. Deep Geothermal Energy development licences should have a duration appropriate to the normal minimal lifetime of the exploitation\development wells. A renewal option for a defined period should be made available to the licence holder. The licence extension should be subject to a review of the production rates and their associated impacts on the geothermal reservoir and other natural resources as well as the economics of the project, by the licensing authority.
- A.3.16. Requirements for the submission of monitoring and production data for development licences should include energy production (in both the heating and cooling mode where applicable), temperature of the carrier fluid at surface, flow rates, pressure, temperature of the injected fluid and chemistry of the produced and injected waters. These will be submitted to the licensing authority on a regular basis as set out in the licence.

- A.3.17. Conditions for release of all submitted data associated with licensed geothermal exploitation operations should be specified in the legislation as for other strategic natural resources. Any confidentiality clauses should clarify the length of time for which the resource and production data are confidential.
- A.3.18. Groundwater abstraction/exploitation permitting for geothermal energy production should be based on the national groundwater abstraction/exploitation and pollution control regulations. Large-scale shallow and deep geothermal exploitation systems should have a minimum target for net water abstraction/exploitation from an aquifer or geothermal reservoir to ensure sustainable use of the resource.
- A.3.19. Cascade systems using low temperature geothermal waters where re-injection is not used (balneology, thermal spas) should follow surface water discharge licensing requirements with relevant local authorities. Minimal environmental impact of the proposed system and sustainability of the resource must be demonstrated.
- A.3.20. The cost of geothermal exploration licences should be set lower than the petroleum and mineral exploration licensing costs to reflect the comparatively lower economic return potential and to promote geothermal energy development as part of the national renewable energy action plans (NREAPs, RES Directive-2009/28/EC).



#### A.4 SIMPLIFY REGULATIONS AND ADMINISTRATIVE PROCEDURES

Administrative procedures for geothermal licensing should be fit for purpose – they should be streamlined wherever possible and the burden on the applicant should reflect the complexity, cost and potential impacts of the proposed geothermal energy development.

- A.4.1. National rules concerning the authorisation and licensing procedures must be proportionate and adopted only if necessary. Procedures must be simplified and the administrative process for the granting of authorisation must be reduced.
- A.4.2. The degree of regulation of shallow geothermal energy usage should be appropriate to the scale of use. 'Large scale systems' could be regulated through existing local planning laws when necessary. In the case of open loop geothermal systems, a groundwater pumping flow rate threshold could be used to define projects requiring a groundwater abstraction/exploitation licence in accordance with national legislation. A capacity threshold could be applied in the case of large multiple borehole collector arrays. The licensing authority could set minimum and maximum water temperatures for re-injection from geothermal systems for geothermal and aquifer management purposes.

- A.4.3. It is recommended that small sized closed loop domestic systems should be registered through a simple information submission form to a nominated government agency. These systems should require no exploration licences or planning permission.
- A.4.4. Registration of these systems should ensure suitable monitoring at national level in relation to resource usage and protection especially in vulnerable areas.
- A.4.5. Deep geothermal energy production should comply with the Groundwater Framework Directive-2000/60/EC, and national groundwater abstraction/exploitation legislation where implemented including the requirement for the use of re-injection or closed circuit systems.
- A.4.6. Appropriate exemptions from the national planning regulation and environmental impact assessment regulations should be considered for geothermal energy projects in order to assist in the development of the sector.
- A.4.7. A reference guide to national legislation for geothermal energy exploration and development, outlining the regulations with respect to licensing, taxation and fiscal conditions, should be provided for stakeholders.
- A.4.8. The provision of one government e-portal for deep geothermal exploration licence applications and legislative guidelines is recommended.

## **A.5 GEOTHERMAL ENERGY LICENSING AUTHORITY**

- A.5.1. It is recommended that there should be an organisation with responsibility for the promotion and development of the geothermal energy sector. This could be the regional or national licensing authority or independent expert body (competent professional body or cooperative network of competent authorities).
- A.5.2. The geothermal authority should have the necessary level of expertise in geothermal energy, and adopt geothermal industry best practice standards.
- A.5.3. The administrative structures and organisation, the respective responsibilities of national, regional and local administrative bodies for geothermal procedures must be coordinated and clearly defined.







- A.5.4. This geothermal authority will be responsible for the issuing of licences for exploration and development of geothermal resources, reviewing and awarding the licences on a case specific basis, as well as facilitating and monitoring the geothermal licence application system.
- A.5.5. Where no licensing system currently exists, the licensing authority to be considered could be a department already responsible for natural resource exploration licensing. For example, the local authority could administer the permit procedures for shallow geothermal systems.
- A.5.6. Where possible the same authority should be responsible for both granting the licence and monitoring the activities carried out under the license. However, where the monitoring and licensing authorities are different, the authority responsible for monitoring should advise the authority responsible for licensing.

## **A.6 GEOTHERMAL RESOURCES INVENTORY & STATISTICS**

- A.6.1. The national authorities should adopt a national strategy to assess geothermal energy potential, identify targets and increase the public awareness of geothermal energy.
- A.6.2. Geological data should be easily available, free and if possible presented through an e-portal (Inspire Directive and the OneGeology initiative).
- A.6.3. Current statistics on the heating sector and inventories of geothermal resources in Europe are incomplete. More comprehensive compilation of geothermal, heating and cooling market data and reliable statistics are required to profile baseline market data and as well as forecasting future sector growth.
- A.6.4. Borehole completion information, production parameters and yearly monitoring data from large commercial systems (shallow and deep) should be submitted to a central geothermal database. These data will be used for the purpose of planning, exploration or exploitation\development licence granting by the appointed national government agencies and local authorities. This will help the implementation of a successful national geothermal energy development strategy.
- A.6.5. Monitoring data from surface production facilities such as the heat or power plant efficiencies, heat output, electrical power output and fouling of heat exchangers should be included. Templates should be developed to ensure full reporting.
- A.6.6. Monitoring data should be made publicly available subject to the set confidentiality period of exploration and development licences. Domestic systems should be exempt from this.

## B. FINANCIAL INCENTIVES GUIDELINES:

Financial Incentives Schemes (FIS) play an essential role in promoting the development of national shallow and deep geothermal energy sectors for heating and cooling. National Government financial incentives in Europe have significantly facilitated the growth and development of national geothermal sectors, resulting in the uptake of both shallow and deep geothermal activities. An important element in the design of financial incentives for renewable energies is that a “level playing field” is achieved between the various RES options. This implies that geothermal energy should receive incentives similar to the support received by other renewable energy sources in the form of financial assistance for initial feasibility studies, grants, low interest rate loans, risk insurance, preferential VAT rate, feed in tariffs or certificates for geothermal heat units produced/installed.

It is important that the FIS are adequately designed and implemented in the medium and long term. The management of Financial Incentive Schemes should be accompanied by adequate flanking/supporting measures in areas of training, standards and information availability.

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

- Reduction of the upfront investment costs and risks to users
- Changed perception of geothermal energy systems by consumers and local authorities and a resultant shift to increased uptake of these systems

### B.1 REGULATORY COSTS/ LICENCE FEES/ ROYALTIES

Licence fees and royalties for the use of geothermal energy should be kept to a minimum. The level of fees should take account of the lower return on investment from geothermal energy systems, when compared with, say, hydrocarbons and mining, and the beneficial characteristics of geothermal energy as a low carbon, sustainable energy resource.

B.1.1. Any fees for exploration licences should be kept to a minimum. There should be no other fees applied to specific activities (such as drilling) carried out as part of an exploration programme during the licence period.

B.1.2. Fees or charges should not be applied on the production of energy by geothermal systems (shallow or deep) as the geothermal heat resource is continuously replenished (renewable) and therefore not “mined” in the conventional sense if used sustainably.





- B.1.3. Royalty fees should not be applied to deep geothermal energy production plants especially where national legislation promotes the use of reinjection systems on the basis that geothermal energy is renewable and contributes to fulfilling the RES targets set out in the national renewable energy action plans (NREAPs) to be defined in every EU state.
- B.1.4. Groundwater abstraction/exploitation fees should be based only on the net water abstraction rate from shallow and deep systems and these should be waived where this is below a specified threshold. Where re-injection of produced geothermal waters does not occur, national groundwater abstraction/exploitation and surface water regulations should apply.
- B.1.5. The cost of national drilling permits (where applicable) should be waived or reduced for the completion of geothermal energy boreholes. This should be considered for a period of 15 – 20 years until the sector is established.
- B.1.6. Where applicable there should be a waiver or reduction on the cost of acquiring released natural resource data to enable a licence applicant to review relevant geothermal energy data prior to application submission.

## B.2 DEVELOP FINANCIAL INCENTIVE SCHEMES

- B.2.1. A Geothermal Insurance Guarantee and Risk Fund for deep geothermal exploration and/or development drilling should be made available. This type of fund typically covers the risk associated with exploration drilling and assessment of the resource. The geological risk exists especially at sites with only partially known subsurface conditions: the geothermal resource may be below expectations or, the flow rate insufficient etc. Risk coverage schemes should aim to cover the reimbursement of an adequate percentage of the initial investments.
- B.2.2. National taxation law should be designed to promote increased capital investment in geothermal energy (e.g.: renewable energy tax incentives, preferential VAT rates for heat sales). Other renewable energy resources are actively incentivised by national governments in Europe. Incentives for delivering heat from renewable energy sources such as geothermal energy should be encouraged through low



VAT rates and/or 'green certificates' to geothermal and renewable energy system heat producers (such as heat feed-in tariffs) based on units of renewable energy (RE) heat produced and installed geothermal capacity. Consideration should be given to calculating the renewable heat production over the life of a geothermal system and applying the resulting financial incentive 'up front', to offset the relatively high initial capital costs associated with geothermal energy systems.

- B.2.3. Grants or other financial support schemes should be available for the installation of small scale geothermal systems.
- B.2.4. Incentives for large scale geothermal energy systems should be made available on a case by case basis subject to a review by the relevant national authority of projected energy production and energy efficiency of the system. Cascading uses and integrated systems should be encouraged by means of appropriate financial incentives.
- B.2.5. Small sized domestic sector funding support schemes should be awarded subsequent to the notification of satisfactory drilling specifications and/or system installation parameters being submitted to the relevant national or local government agency.
- B.2.6. Project assessments for financial incentives have to be based on market accepted resource definition parameters and on long term geothermal energy production data. These incentives should be made available after initial production data have been submitted to the relevant national agency.
- B.2.7. Administrative procedures for applications to Financial Incentive Schemes should be as simple as possible.



- B.2.8. National, regional and local government authorities should promote deep geothermal energy project development by making financial incentives available for the project development phase of large scale geothermal projects.
- B.2.9. National research and development funding schemes should target geothermal energy research, with demonstration projects and spin-off activities amongst the priority objectives.

- B.2.10. Preferential VAT rates for heat sales from operating geothermal power plants should be below the higher current rates of 16%, 19%, 21.5%, 22% and 22.5% applicable in some Member States. The lower VAT rates should be designed to encourage fossil fuels substitution and provide a competitive price for geothermal energy based on national domestic and commercial energy rates.
- B.2.11. A geothermal heat pump Guarantee Fund for large systems (e.g. >30kW) and exploitation of shallow aquifers should be considered.
- B.2.12. Specific agreements on preferential electricity consumption tariffs favouring the utilisation of ground source heat pumps should be encouraged.

### **B.3 NOTES ON FINANCIAL INCENTIVE PARAMETERS**

- B.3.1. Any technical parameter used to assess eligibility for a Financial Incentive Scheme should adhere to any European standards and certifications in place.
- B.3.2. Incentives could be based on the net CO<sub>2</sub> emissions avoidance from operating geothermal plants and/ or a set of agreed heat feed-in tariffs based on a national feed-in tariff strategy for renewable heat and electricity.
- B.3.3. The development of a CO<sub>2</sub> emissions credit system (green certificates) for the operation of geothermal energy projects should be encouraged at national level to incentivise sector investment. For small installations a simplified procedure should be established.
- B.3.4. Geothermal energy should receive incentives similar to the support received by other renewable energy sources in the form of financial assistance for initial feasibility studies, grants, low interest rate loans, risk insurance, preferential VAT rate, feed in tariffs or certificates for geothermal heat units produced/installed.



## C. GENERAL GUIDELINES FOR FLANKING/SUPPORTING MEASURES:

A number of indirect accompanying measures are important for the development of the geothermal energy sector. These should include the provision of comprehensive information on geothermal energy and the introduction of the appropriate technologies to professionals groups. Efforts should focus on adequately meeting existing national market demands in the geothermal area and ensuring the implementation of appropriate quality standards. A national consultative body (preferably a cooperative network of stakeholders and competent authorities) is recommended to have the responsibility for the development of targets, policies & instruments as well as awareness campaigns and the monitoring of the geothermal energy sector.

Aspects of these measures are elaborated as follows:

### C.1 EDUCATION, TRAINING AND CERTIFICATION

C.1.1. Educational strategies about geothermal energy for students, academia and professional bodies and institutions involved in the implementation of geothermal energy projects should be devised by national geothermal experts in consultation with NGOs and private sector companies. This should include the introduction of geothermal energy courses and qualifications in tertiary level (post-school) education.

C.1.2. An education national committee should be established to oversee the training of shallow geothermal designers, installers and drillers. It should also implement an agreed code of practice for professionals in the geothermal sector.

C.1.3. A certification scheme must be proposed for shallow geothermal installers and drillers. The accreditation process should differentiate between the design and installation of shallow and deep geothermal systems, and ensure that the type and level of accreditation is appropriate for the experience and competence acquired.

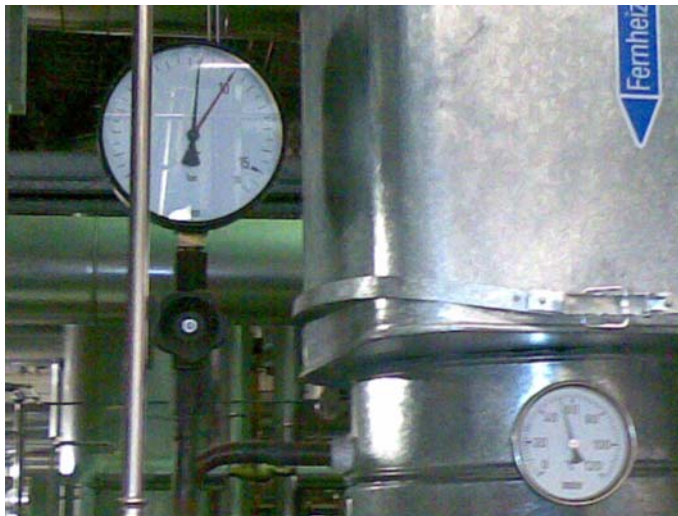
C.1.4. It is acknowledged that certification schemes for geothermal professionals are at an early stage but professional competence specifically in the geothermal area should be a prerequisite.





## C.2 PROMOTION OF GEOTHERMAL ENERGY

- C.2.1. A national geothermal strategy (based on the national renewable energy action plans (NREAPs) defining the goals and targets for geothermal energy as a contribution to the national renewable energy mix is required in order to meet the European renewable energy targets of 20% by the year 2020. The national strategy should include projections on the target contributions of shallow and deep geothermal energy developments. The strategy will provide a stable implementation platform for geothermal regulation over a defined period of time.
- C.2.2. The national strategy should be accompanied by a set of government measures to achieve the targets, such as the inclusion in the priority development fields eligible for special funding (e.g. from the EU 2007-2013 financial schemes).
- C.2.3. The mapping and assessment of geothermal resources needs to be included as part of the NREAPs to understand the potential contributions from the geothermal energy sector.
- C.2.4. The development of National Heat Markets and national strategies for future heating and cooling demand need to be addressed. The heating and cooling markets in Europe are poorly defined. The demands of both residential and commercial sectors are currently being largely met by fossil fuels. Geothermal energy deployment has the potential to significantly contribute to the current status of the European Heat Market. In order for this to be achieved, coherent European and national strategies for heat markets are required.
- C.2.5. Awareness campaigns for Renewable Heating and Cooling technologies and in particular for geothermal energy which proactively target professionals (engineers, architects, installers) need to be undertaken in many countries and regions in Europe.
- C.2.6. Information and economic benefits of Renewable Heating and Cooling need to be further disseminated to encourage change in investment behaviour of energy consumers.
- C.2.7. District heating schemes are an effective application of geothermal energy and a parallel review of the legislation and planning laws relating to the implementation of such schemes may need to be considered in order to provide better access to this cost effective application of geothermal energy.



### C.3 STANDARDS & CODES

Standards on the deployment of geothermal technologies need to be prioritised and implemented. Development and implementation of 'Best Practice Guidelines' in geothermal development should be based on or linked to existing construction best practice guidelines and regulations in the different member states.

C.3.1. Shallow geothermal standards need to include the following in order to address the extensive European market.

- Drilling safety procedures
- Drilling equipment efficiency
- Borehole completion standards
- Environmental protection (groundwater protection)
- Quality of borehole heat exchanger completion
- Manifolds and installation of surface equipment
- Sizing and design guidelines to ensure the sustainable and efficient operation of the system
- Standards for individual system components

C.3.2. Longer term implementation standards for large deep geothermal systems (including aspects of district heating) are also required to facilitate the growth of this sector.

C.3.3. Standards already exist in a few countries for shallow geothermal systems. Individual components of geothermal systems have to comply with 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 and regulation can be used to ensure the application of these standards.

C.3.4. A European or national guideline for definition of efficiencies and utilisation coefficients for power and heat generation from deep geothermal energy should be developed.



## C.4 RESEARCH & DEVELOPMENT

Funds should be made available, as part of a national geothermal (or wider renewable) energy strategy, for research and development into the assessment and methods of exploitation of geothermal energy resources.

National research and development strategies should preferably be aligned with the emerging Strategic Research Agenda and objectives of the Geothermal Panel of the European Technology Platform for Renewable Heating and Cooling. European Technology Platforms are instruments created by the European Commission to bring together stakeholders in technology to strengthen Europe's leading position in certain technological fields. European Technology Platforms are expected to have a decisive influence on European R&D policies. One of the tasks for the Renewable Heating and Cooling Platform will be to elaborate detailed research strategies for geothermal energy development. The current position of the ETP-RHC Geothermal Panel is as follows:

C.4.1. The general technological objectives of the sector are:

- increasing the knowledge about the usable geothermal potential, amongst the various stake holders: end-users, advisers, authorities, etc
- for direct uses: improving plant efficiency, and decreasing installation and operational cost
- for Geothermal Heat Pumps: decreasing installation cost, and increasing Seasonal Performance Factor (SPF), optimization of the system (ground heat source/heat pump/distribution)

At present, direct use of geothermal is subject to the availability of existing resources. The key challenge for the widespread direct use of geothermal heat will be the ability to reliably engineer the subsurface heat exchangers (EGS) in a reproducible way to harvest the heat flux at the required temperature.

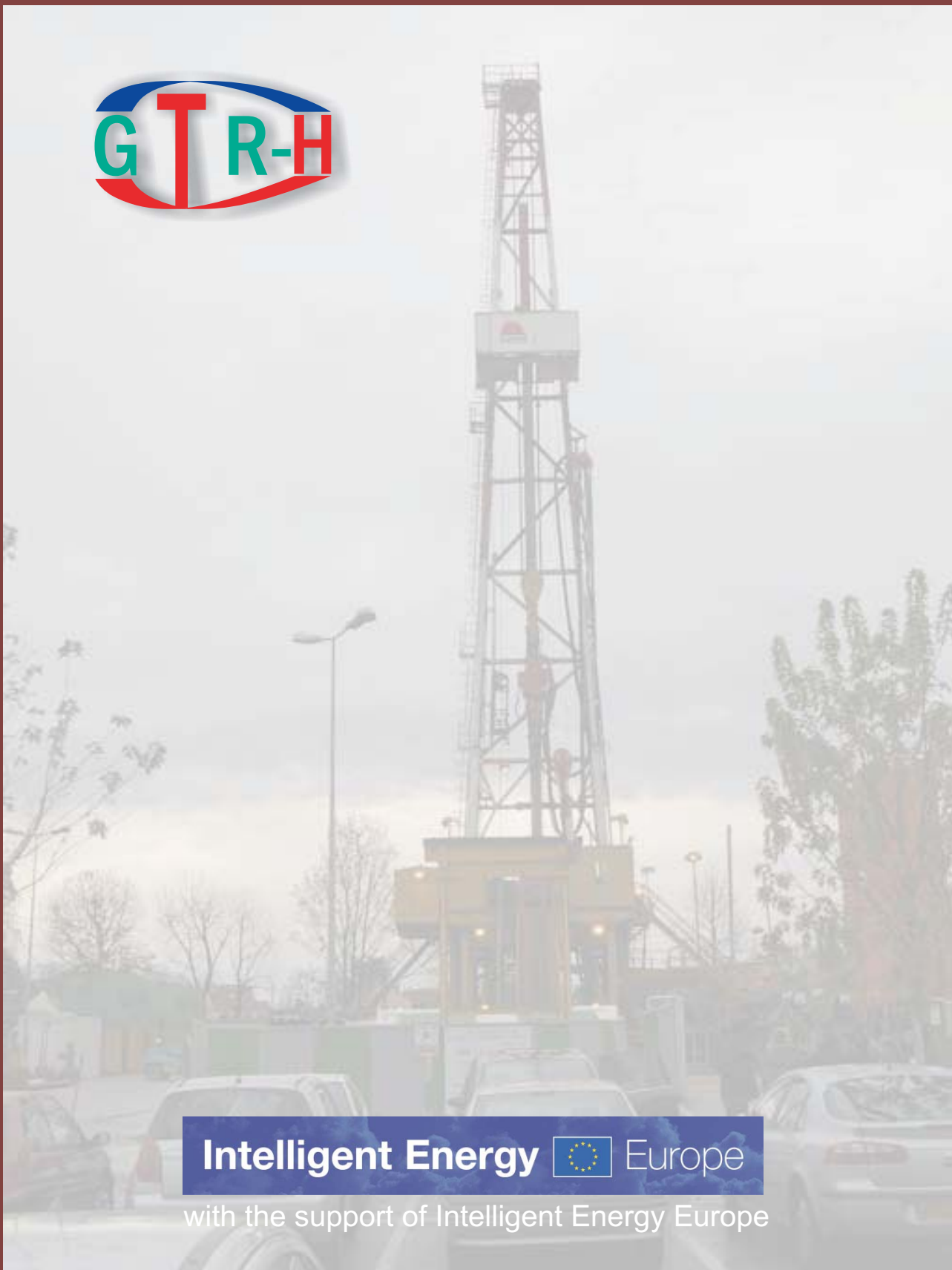
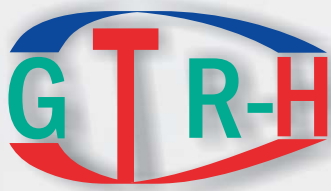
C.4.2. The main research priorities for geothermal heating and cooling are to:

- a) Improve resource identification, including low temperature resources connected to geothermal heat pumps, through assessment and characterization using innovative geological and geophysical methods adapted from the oil and gas industry.
- b) Improve access to the resource through improved drilling technologies especially for hard rocks but also at high pressure and high temperature, again using techniques adapted from the oil and gas industry. Development of lower cost drilling for the exploitation of shallow resources.
- c) Improve well production to reduce unit heat cost through the transfer and development of high temperature equipment, well stimulation technologies, monitoring, modelling, etc .
- d) For Geothermal Heat Pumps: develop new components, improve performance, research on design and hybrid heating & cooling systems, intensify research in the use of the underground to store heat/cold, and for high temperature heat storage from waste heat.
- e) For Combined Heat and Power: cogeneration with Enhanced Geothermal Systems and low temperature power plants, to allow project optimization in spite of seasonal demand variation in heating and cooling.





*Final conference and presentation of the GTR-H Framework,  
Royal College of Physicians, Dublin, Ireland,  
September 30th - October 1st 2009.*



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