

EIE06/007 GeoThermal Regulation for Heat (GTR-H)

Questionnaire Feedback Report

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May 2007

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INTRODUCTION

This report describes the results from a questionnaire circulated among geothermal energy sector stakeholders from Northern Ireland as part of the GTR-H geothermal energy project. The questionnaire is one element of the process to review and establish the regulatory and other barriers to the use of geothermal energy in Northern Ireland.

The GTR-H project will provide a national framework document in four target countries aimed at increasing overall sectoral investment in geothermal energy for the exploration and exploitation of heat across the EU. This will also build on previous projects such as K4RES-H in the renewable energy sector. In addition to the national framework documents, guidelines for the establishment of geothermal regulation in other EU countries will be provided and disseminated to a broader international audience.

Northern Ireland, together with the rest of the United Kingdom, is one of the target countries where the legislation for geothermal energy is inadequate and the market is immature. The Geological Survey of Northern Ireland is the partner responsible for assessing the current situation, primarily in Northern Ireland but also taking an overview of Great Britain.

The questionnaire was handed out at the end of the Belfast Roundtable discussion and had a near 100% completion rate. Subsequently additional questionnaires were e-mailed to other stakeholders unable to attend the meeting, including all the accredited Ground Source Heat Pump installers on the Action Renewables list. Only three additional responses were received.

2. QUESTIONNAIRE FORMS

2.1 Purpose of the Questionnaire

The stakeholder questionnaire was designed by the project co-ordinators, CSA, in consultation with the other partners to discover the major barriers to the uptake of geothermal energy perceived or experienced by the stakeholder communities.

The questionnaire listed eleven factors that the partners believe have the potential to inhibit the development of geothermal energy resources in the target countries. The purpose of the questionnaire was to establish the relative importance of these factors in the view of the stakeholder communities in each country. Respondents were also encouraged to add any other factors that they felt were important but not mentioned on the questionnaire. The barriers were then assessed in the context of the maturity of the geothermal energy market, the availability of geothermal resources, the legislative and regulatory framework, and government energy strategy and support for geothermal energy in a particular country. These parameters and the questionnaire results could then be compared across the target countries and the similarities or differences between them identified.

2.2 Questionnaire Presentation and Submission

The questionnaire form (see Appendix 2) comprises two components – information about the respondent for stakeholder analysis and follow-up, and the main body of the questionnaire where the respondent is asked to rate the importance of the listed barriers and to add any additional barriers or comments.

The relative importance of the barriers is rated from 1 (minor barrier) to 5 (significant barrier) on the questionnaires. The eleven listed barriers can be grouped into a smaller number of categories as follows:

Legislative and regulatory framework

Lack of specific geothermal legislation
Inadequate regulation
Lack of clarity

Information on geothermal energy resources and technology

Access to geological data
Information on proven resource and resource risk data
Information on geothermal exploitation systems*

Fiscal and economic factors

Geothermal taxes
Lack of incentives
Cost of royalties and geological information
Cost of Environmental Impact Assessments

Industry standards

Lack of professional code of practice
Information on geothermal exploitation systems*

*This barrier could be interpreted as a lack of specified standards.

The questionnaire was distributed to the stakeholders who attended the roundtable discussion held in Belfast on 26th March 2006. It was completed and collected at the end of the open discussion following a series of presentations on aspects of the geothermal energy market, resources and regulation in Northern Ireland, Ireland and the Netherlands. Subsequently questionnaire forms were distributed to a number of stakeholders unable to attend the meeting, and a small number of additional replies received.

3. QUESTIONNAIRE RESULTS AND DISCUSSION

All attendees to the Roundtable discussion held in Belfast, Northern Ireland, on the 26th March 2007, with the exception of the organisers and invited speakers, returned completed questionnaires. Questionnaires were also sent out to a number of stakeholders unable to attend the meeting and a small number of replies received. The results are summarised in Appendix 3.

3.1. National Barriers to the Geothermal Sector

The questionnaire results revealed a good degree of agreement between the respondents on many of the barriers to geothermal resource development in Northern Ireland, although specific comments reflected stakeholder interests. It should be noted that the geothermal market in Northern Ireland is currently almost exclusively comprised of shallow domestic, closed loop, geothermal ground source heat pump (GSHP) systems. Numerically, larger installations in commercial, educational and public buildings are relatively scarce and often consist of several closed loop borehole heat exchangers. Deep geothermal energy systems are non-existent. It is the operation of this dominant GSHP market that concerns the respondents and the questionnaire replies accurately reflect this bias.

The results for each of the barriers listed on the questionnaire are listed below together with additional comments received.

Lack of specific law/regulation related to geothermal resources

	1	Barrier weighting (low to high)				5
No. of responses	4	5	5	6	0	

Mean weighting: 2.7

There is no specific geothermal energy legislation in either Northern Ireland or the rest of the United Kingdom. Environmental, water, planning and building regulations cover some aspects but there is no systematic treatment of geothermal resource evaluation and exploitation in the existing legislation.

The questionnaire responses show a spread across the range of weightings and this appears to reflect the business interest of the respondent and the suitability of existing legislation to this.

Stakeholders concerned primarily with shallow depth GSHP and space heating-cooling systems and working within the existing legislative framework rated tended to rate this barrier towards the lower end of the scale. The design and installation of ground source heat pumps are already covered, to some extent, by recent water, environmental, planning and building regulations in Northern Ireland.

Respondents with an interest in deeper geothermal energy resources, or with a regulatory role, perceived the lack of specific legislation related to geothermal resources to be of greater importance. There is no legislation to properly cover the more extensive (and expensive) exploration and development programmes required to develop medium or high enthalpy geothermal energy resources for either deep basin aquifers or 'hot dry rocks'. Deep drilling operations are covered from geological, health & safety and environmental aspects but the existing legislation does not confer any ownership rights to the geothermal resource. Equally, the water legislation deals with the protection of groundwater aquifers and surface waters as well as licensing water abstractions and discharges, but is not designed specifically to deal with systems where there may be no 'net' abstraction or for deeper aquifers where there are unlikely to be other competing uses.

Inadequate Regulation

	1	Barrier weighting (low to high)				5
No. of responses	4	6	2	6	1	

Mean weighting: 2.7

This barrier relates to the perceived suitability of the existing regulations and the responses show a marked bi-polar distribution. As with the previous question this reflects a split between the GSHP industry (installers and contractors) and those interested in deeper geothermal energy resources or with a regulatory responsibility for geothermal resource utilisation.

In general, those involved with the industry have worked within the existing regulations and therefore do not perceive them to present a major barrier to the uptake of GSHP technology. On the contrary, those respondents with an interest in deeper resources recognise the inadequacy of the regulations, as described above. There was also a reservation about the adequacy of existing regulations with regard to monitoring the quality of design and installation of GSHP systems. The lack of a comprehensive database of GSHP installations and the future potential for heat pollution and interference between neighbouring systems were also considered to be factors leading to higher weightings for this barrier.

Access to geological information on geothermal resources

	1	Barrier weighting (low to high)			5
No. of responses	1	2	7	10	2

Mean weighting: 3.8

The responses to this question show that access to geological information is considered to be a considerable barrier to the uptake of geothermal technology. This may reflect both the availability of geological information on geothermal resources and the 'visibility' of such information.

In Great Britain the Carbon Trust provided co-funding for the British Geological Survey (BGS) to produce automated geothermal site reports. BGS now offer two types of geothermal site characterisation reports on their website – a low cost basic report and a higher cost detailed report for users, installers and designers of GSHP systems. Such reports are not available for Northern Ireland – there is probably sufficient geological information to produce the basic reports for the whole of Northern Ireland but insufficient to produce the detailed reports, except in selected areas.

The Geological Survey of Northern Ireland (GSNI) is the primary repository of geological information in Northern Ireland, and all drillers and developers are required by law to inform GSNI of their intentions to drill boreholes greater than 15 metres deep and also to supply the drilling data to GSNI. The Geological Survey has established an extensive borehole and site investigation database over the years but, in practice, much drilling activity is not reported to GSNI and valuable geological data is therefore not yet available. Temperature data is recorded in only a small percentage of the boreholes drilled in Northern Ireland.

As far as medium and high enthalpy geothermal resources are concerned there have been only a very limited number of deep boreholes drilled in Northern Ireland, and many of these have only non-equilibrated bottom hole temperatures at most.

Availability of proven geothermal resource/ resource risk data

	1	Barrier weighting (low to high)			5
No. of responses	0	2	6	9	3

Mean weighting: 4.0

As above respondents feel that there is insufficient data on proven geothermal resources and the risks involved with the exploration for, and development of, such resources. This arises from both a real lack of information on basic subsurface geological conditions and the suitability of these for the development of geothermal energy resources. The geological risk assumes a greater importance as a barrier to the exploration for deeper geothermal energy resources where drilling costs may be substantial.

Much of Northern Ireland is suitable for GSHP systems whereas aquifers for geothermal energy storage systems are more restricted although they are located in the most populated Greater Belfast area.

Access to information on geothermal exploitation systems

	1	Barrier weighting (low to high)			5
No. of responses	0	1	8	7	2

Mean weighting: 3.6

Inadequate access to information on geothermal technologies and their suitability to geological conditions and output requirements is considered to be a significant barrier to the uptake of this technology.

Geothermal taxes

	1	Barrier weighting (low to high)			5
No. of responses	5	5	2	1	1

Mean weighting: 1.5

There are no specific geothermal taxes in Northern Ireland and the rest of the United Kingdom, although geothermal businesses are subject to the same fiscal regime as other industries. Indeed, the taxation system contains financial incentives such as Enhanced Capital Allowances (ECAs) for the installation of low carbon technologies such those derived from geothermal energy. The questionnaire results reflect this with a low rating for this barrier.

Higher ratings may reflect concerns associated with possible future charges for water abstraction and discharge licences that could be applied to open loop systems. The Department of the Environment plans to consult on proposals to introduce a scheme of fees and charges based on "cost recovery" later in 2007. It is likely that there will be an application fee and annual maintenance charge for licences although there will probably be no charges where abstraction is less than 20m³ per day.

Lack of Incentives

	1	Barrier weighting (low to high)			5
No. of responses	1	4	1	13	1

Mean weighting: 3.3

The lack of incentives produced a slightly bi-polar distribution in the responses. This barrier recorded the highest modal score of any barrier with 13 respondents rating it at 4 but a significant minority gave it a low weighting. The majority view shows that even the existing grant schemes (Reconnect, Low Carbon Buildings Programme) and other financial incentives such as ECAs are not considered sufficient to stimulate rapid investment in geothermal energy in the United Kingdom.

The high rating may, however, relate more to the low uptake of the technology among the business and public sector than the domestic sector where the Reconnect grant scheme has proved attractive. Similarly, the incentives available for the exploitation of medium and high enthalpy geothermal resources for both heating and electricity generation are considered to be too low relative to the commercial (and geological) risks involved.

Lack of clarity on legal and regulation requirements

	1	Barrier weighting (low to high)			5
No. of responses	3	2	9	3	1

Mean weighting: 2.8

Respondents consider this barrier to be fairly significant. The medium rating probably reflects the fact that the regulations for GSHP systems are fairly well established in the planning and building regulations. Information about these is made readily available by Action Renewables both in the course of grant

applications and on their website. There may be some lack of clarity on regulation requirements because the Water Abstraction & Impoundment (Licensing) Regulations (Northern Ireland) 2006 only came into operation on 1st February 2007 and procedures may be subject to revision.

The absence of a legislative framework for deeper geothermal systems produced a high rating for the smaller number of attendees who are interested in this sector.

Lack of professional code of practice

	1	Barrier weighting (low to high)			5
No. of responses	2	1	4	9	3

Mean weighting: 3.6

The lack of a professional code of practice in the United Kingdom is seen as a major barrier to the development of geothermal energy resources. Most respondents are concerned that in an emerging market a small number of 'bad' customer experiences can have a disproportionately large negative effect on the uptake of the technology. Poor design, installation and maintenance of ground heat source pump systems are seen as major risks. It is notable that this view as expressed by all the industry attendees, although they may be a self-selecting group who are particularly committed to the successful adoption of geothermal energy technologies in Northern Ireland. The establishment of industry associations and schemes of accreditation in Ireland and Great Britain are seen as welcome developments.

High cost of licence/royalty (including geological information fee)

	1	Barrier weighting (low to high)			5
No. of responses	3	8	2	2	0

Mean weighting: 2.2

There are currently no charges for water abstraction & impoundment licences and there are no royalties on the production of geothermal energy. There are modest charges for some of the geological information but these are relatively minor. The low rating for this barrier reflects the low cost involved.

Cost of Environmental Impact Assessment (EIA)

	1	Barrier weighting (low to high)			5
No. of responses	2	6	3	5	1

Mean weighting: 2.8

The responses for the cost of environmental impact assessments tend to be either low (2) or high (4). This outcome can be explained by the fact that many respondents are only concerned with domestic GSHP systems which are unlikely to require an expensive EIA whereas others are considering larger open loop systems that would require an EIA. However, even for low-cost GSHP systems any requirement for an EIA could represent a significant additional cost that would significantly increase the 'pay-back' period.

Other barriers

Respondents identified several barriers to the development of geothermal energy resources in Northern Ireland that were not included in the questionnaire. The most frequently mentioned barrier was insufficient promotion of, and publicity for, geothermal energy. High capital investment costs were seen as a deterrent for the development of larger medium and high enthalpy geothermal resources. An additional concern was inadequate design leading to higher than expected consumption of electricity and operation at unfavourable electricity tariffs.

3.2. Discussion on the direct impacts of each barrier on the national sector

The barriers on the questionnaire can be grouped together for the purposes of the discussions

Lack of specific law/regulation related to geothermal resources/ Inadequate Regulation/ Lack of clarity on legal and regulation requirements

There is no current legislation with regards to the regulation of ground source geothermal systems but there is basic licensing for water extraction and discharge consent in Northern Ireland. Jon Busby (BGS) said that, without a licensing or registration system, in Great Britain it was difficult to know how many GSHP systems had been installed and where they were. At the moment this may not be a problem but it is desirable to have a comprehensive database of installed systems to help monitor and improve performance, to anticipate potential interference between neighbouring systems and potential heat pollution problems that might arise as the density of installations increases. Similarly an accurate record of installations would be beneficial to future system maintenance, replacement or removal, or prior to re-development of sites.

However, several speakers (particularly from the industry and user representatives) stressed that any regulation needs to be simple and inexpensive – otherwise it could act as a significant barrier to the adoption of ground source heat pump technology, in particular. In Northern Ireland, currently, new GSHP installations do not require planning permission but are subject to building regulations. When GSHPs are included as part of new-build housing applications they are routinely passed from Planning Service to the Environment & Heritage Service for assessment in terms of environmental impact and the water regulations. However, at least for small domestic systems, the regulatory system was not regarded as too onerous. The perception at the meeting was that the system should be kept simple, with a single point of contact with the regulatory authorities for the user or developer. The efficiency of the current system could be improved by capturing **all** the required information once and giving shared access to relevant data to the different regulatory bodies.

The Environment and Heritage Service (EHS), of the Department of the Environment for Northern Ireland, is responsible for the introduction and administration of environmental legislation in Northern Ireland. In his presentation to the meeting Peter McConvey (GSNI) outlined the environmental and water legislation that is relevant to geothermal energy in Northern Ireland. Water legislation covers water abstractions and discharges although the situation of open loop shallow geothermal systems where there is no net abstraction or discharge is not specifically dealt with in the Northern Ireland regulations.

The situation is different for the development of deeper medium or high enthalpy geothermal energy resources where current Northern Ireland legislation is completely inadequate. There is no licensing system for exploration and development of deep geothermal resources. Many of the exploration methods are similar to those used for mineral and petroleum exploration but the existing Northern Ireland legislation for the minerals or petroleum does not cover geothermal energy. Robin Taggart, who represented potential investors in this market sector, argued that a lack of exclusive exploration licence and no demonstrable legal ownership to a geothermal resource in a particular area would prove a total barrier to investment. Investors would want some sort of legal title to the resource before committing funds to these major capital projects.

Access to geological information on geothermal resources/ Availability of proven geothermal resource/ resource risk data

Derek Reay (GSNI) outlined the current state of knowledge about the geothermal resources of Northern Ireland which had been summarised in a report by Dublin consultants, CSA. The Geological Survey is the official repository of geological information in Northern Ireland and holds most of the available relevant geological data. GSNI make this data publicly available, except where it is subject to confidentiality provisions, although there may be some modest charges for data supply. There was some discussion about making geological information more easily available. BGS have developed a system where the public in Great Britain can input their postcodes on a website and get an assessment of the geological characteristics of the ground around their property relevant to the design and installation of shallow ground source heat pump systems.

Suitable conditions for closed loop GSHP systems are widespread throughout Northern Ireland. However, the potential for open loop heating-cooling GSHP systems and larger district heating or power generation developments is less well-defined. Petroleum exploration has been limited in scope and groundwater has provided c5% of water supplies in Northern Ireland, so the density of borehole overage is poor and the sub-surface geological information is sparse. Additionally, GSNI receives a relatively low proportion of the water-well drilling results to which it is legally entitled so a significant amount of the data is not available for the modelling of the shallow (<250m deep) sub-surface geology. The limited deep borehole information indicates that there is deep geothermal energy potential in Permo-Triassic and Carboniferous aquifers in the Rathlin, Larne and Lough Neagh sedimentary basins. Hot dry rock geothermal potential may exist in buried granites within the sedimentary basins, and in the concealed parts of the potassium-rich granites of the Mourne Mountains where high heat flow measurements have been obtained from shallow boreholes.

However, it was agreed that the lack of proven geothermal resource data and, consequently, the associated risk data, are both substantial barriers to the development of deeper medium or high enthalpy geothermal energy resources.

Access to information on geothermal exploitation systems/ Insufficient promotion and publicity

A number of attendees felt that the access to information on geothermal exploitation systems to be a significant barrier to the widespread adoption of geothermal energy technologies. A couple of end-users mentioned that their GSHP systems did not meet the expected performance targets, and it emerged that there was some variation in the knowledge of recent technological developments amongst the consultants and installers in Northern Ireland. There was a general consensus amongst delegates that the growth of the sector could be seriously affected by the experiences of early users – negative publicity should be avoided by good practice and ready access to up-to-date technical information.

A recurrent theme in the questionnaire responses was that of insufficient promotion and publicity. In discussion Stephen Butler (Action Renewables, AR) outlined the roll-out of the Re-Connect grant scheme for domestic users, a forthcoming programme of advertisements and the new AR website. However, many delegates felt that geothermal energy had a low profile compared to other forms of renewable energy such as wind power. A number of people expressed support for one or more demonstration projects preferably at new or existing landmark public sites. Such projects would require some public funding, although public-private partnerships might be possible. Dan Sinton (DETI Energy Division) said that some funds might be available for this type of project from the Environment and Renewable Energy Fund (EREF).

Geothermal taxes

This topic was not discussed other than the abstraction/discharge licence fees discussed by EHS and mentioned below. There are no specific geothermal taxes.

Lack of Incentives

Many respondents cited this as a major barrier to the use of geothermal energy in Northern Ireland. However, through the EREF the Department of Enterprise, Trade and Investment have made £8 million available for the installation of renewable energy technologies in private households. Action Renewables are managing this via the Reconnect grant programme for householders with a grant of £3000 towards the costs of GSHP installations (up to a maximum of 40%). Currently 10% of the grants issued have been for GSHP systems. However, there is a worry about what will happen to the domestic GSHP sector when this tranche of funding ends in June 2008.

In the commercial and public sectors the financial assistance is by means of low-cost loans and enhanced tax allowances which is seen to be insufficient to significantly develop the geothermal space heating market without additional drivers.

The high capital costs of drilling deep boreholes was considered to be a major barrier to the exploration for potential medium to high enthalpy geothermal energy resources in Northern Ireland and the UK. Some attendees argued that there needed to be a more pro-active approach to this sector, in terms of government support.

Lack of professional code of practice/ quality control

This topic received animated discussion at the roundtable, with representatives from industry (practitioners, consultants and associations) and regulatory bodies agreeing that good quality control was essential for the continuing growth of the GSHP market in Northern Ireland.

There is an EU-funded joint initiative between Action Renewables and Sustainable Energy Ireland to provide an examined heat pump installation course that is required for all Reconnect-accredited installers. This course may be extended to cover engineers and architects to ensure that they are adequately trained. This course covers aspects of design and the equipment also has to be on an approved list. However, there was concern that not all installers, architects and engineers were fully conversant with recent technological developments and that poorly designed systems could lead to adverse consumer experience.

All new GSHP installations need Building Control approval and proposed systems must meet specified performance criteria, but this is a paper exercise only. Installations assisted by Reconnect grants are inspected on behalf of Action Renewables – however, concern was expressed that there were no specified standards for installation or quality control bar the accreditation training scheme. Inspections performed on any installations not grant-aided would not necessarily be performed to a specified standard. Darren McCamphill (Belfast City Building Control) suggested that Building Control could provide an inspection service to ensure that adequate standards of design, installation and maintenance were adhered to, if their remit was expanded to cover this.

High cost of licence/royalty (including geological information fee)

According to Environment & Heritage Service (Dept. of Environment NI) there will be a consultation in the autumn with regards to the fees and charges and the current option is possibly to combine fees and charges for extraction and discharge. For open geothermal systems, where there is no net abstraction, the issue of charges for extraction and discharge will be critical to the economics of the project. In terms of ground source heat pump systems there will be no taxation issues, just soft regulation issues dealing with environmental risk. Environmental risk will be the basis of the fees.

The cost of geological information is mentioned above but is not considered to be a major obstacle.

Cost of Environmental Impact Assessment (EIA)

The cost of EIAs was not discussed in detail at the roundtable although Tony Cluskey (EHS) stated that the Environment & Heritage Service would probably take a 'soft regulation' approach to closed loop GSHP systems and most small open loop systems, based on environmental risk. Larger geothermal energy projects and those which pose a greater risk in terms of pollution or negative impact on water bodies, and the environment generally, would obviously require more detailed environmental impact assessment.

4. COMPARISON WITH THE BEST PRACTICE COUNTRIES

4.1. Potential Solutions to the Barriers from Discussion and Interviews

Licensing and regulations

The depth factor may be a consideration in terms of legislation as a deep borehole is quite a complicated system whereas a shallow system is simpler to design and faster to install. Separate legislative or regulatory systems according to depth may be appropriate. In the Netherlands, up to a depth of 500m open-loop heating and cooling systems are regulated by groundwater legislation, and deeper than this the Mining Act is the legislative regime for deep geothermal exploration and production.

In the Netherlands there has been a rapid development in the use of underground thermal energy storage (UTES), using groundwater in aquifers. UTES schemes are essentially abstraction/re-injection well doublets using groundwater in aquifers at depths up to c200 metres. The first storage system for cooling was completed in 1987 since when approximately 600 projects have been carried out. Provincial governments in the Netherlands monitor the use of groundwater according to The Groundwater Act, 1981, which protects the groundwater resource. Abstraction above a certain volume requires a licence and there are a series of conditions attached to the licence that must be fulfilled by the UTE scheme before and during operation.

In the Netherlands closed loop ground source heat pump systems are not regulated by the Groundwater Act and the total number of installed systems are unknown. By contrast, in Germany the design, manufacture and installation of GSHP systems including borehole heat exchangers and the connection to the building are all governed by specified guidelines. In Germany this more stringent regulation and quality control was probably partly a consequence of the earlier heat pump market crash caused by consumer reaction to poor (unregulated) installations in the 1980s. There is a great range of types and size of GSHP installations in Germany and the geology is probably more comparable to Northern Ireland than that of the Netherlands, at least in terms of its variability. The German model for regulation of closed loop GSHP systems is probably more appropriate to Northern Ireland. In Northern Ireland the most obvious regulatory authority would be Planning Service, with system parameters specified through Building Regulations and operational duties conducted by Building Control.

Deeper geothermal energy exploration shares many of the technological characteristics of that used in the oil and gas industry, and geothermal energy can be considered to be a resource similar to minerals or hydrocarbons. In several countries, therefore, minerals, mining or petroleum legislation has been extended or modified to include geothermal energy. Alternatively, several Australian states, for example, have introduced new legislation specifically to regulate the exploration and production of deep source geothermal energy. The model used may depend on the suitability of existing legislation – in Northern Ireland the existing minerals, mining and petroleum legislation are inadequate to cover geothermal energy but updated minerals and petroleum legislation is currently scheduled for introduction in June 2009. However, DETI have also proposed the introduction of a new geothermal energy bill within a similar timescale. None of these policies are set in stone and this project should have significant influence over the legislative framework proposed for geothermal energy in Northern Ireland.

‘Joined-up’ government is essential to reduce bureaucratic obstacles particularly to the growth of the GSHP market. Working groups should be established and the regulations should be formulated such that information is collected only once but shared as needed amongst the various agencies and departments. The stakeholder communities, including those not yet involved in the project, should be encouraged to participate to ensure that the new legislative framework is fit for purpose.

In summary, three different types of regulation are proposed for geothermal energy in Northern Ireland.

Closed loop ground source heat pump systems, including borehole heat exchangers, should be subject to specified standards of design, manufacture and installation. Such installations would be controlled by planning permission and building regulations, and inspected by Building Control as for other elements of building construction. Fees would be small and the permissions would be via a relatively simple system.

Open loop systems, including underground thermal energy storage, would be regulated under existing groundwater legislation. Regulations specific to geothermal energy may be needed to cover aspects such as the heat budget within the aquifer and potential impacts on other users. Abstraction fees would take into account net abstraction rather than total abstraction to reflect re-injection into the aquifer.

The exploration and development of geothermal energy resources below a specified depth (e.g. 500m) would be regulated under a more typical earth resource legislative framework - modification or extension of existing mining, minerals or petroleum legislation or the development of bespoke geothermal legislation. This legislation would reflect the more complex reality of medium and high enthalpy geothermal energy systems and the exploration techniques involved. It would protect the investment of the licensee by conferring ownership of a defined geothermal resource and it would attach environmental, and health and safety responsibilities to the licence and the licensee.

Geological and geothermal resource information

For ground source heat pump systems the local near surface geological conditions can be a significant factor affecting the design and installation of an efficient system. Digital map data covering soil type, superficial deposits and bedrock geology is available for much of Northern Ireland, derived from original maps produced at a scale of 1:50,000. This information could be made available via a web-based report service, similar to that run by BGS for Great Britain. Funding would be required to capture all the data in the required format and to set up the system.

Information about the aquifers in Northern Ireland comes mainly from boreholes drilled for public and private water supplies. The data from the public supplies is routinely deposited with GSNI but a large percentage of the data on private water well drilling is not supplied by the drillers. A pro-active programme of data collection by GSNI geologists could improve this situation but additional staff resources need to be identified for this task.

The deeper geology is known only from a small number of deep boreholes, drilled mainly for mineral and hydrocarbons exploration. Out of a data archive of over 24000 borehole records and 2500 site investigations there are only 34 boreholes with a total depth greater than 500 metres, of which 18 reach 1000 metres depth. This is supplemented by a small amount of seismic reflection data which may aid depth and thickness modelling of the major aquifers in the main sedimentary basins.

Total depth of borehole (metres)	Number of borehole logs
>50	c1000
>100	508
>200	171
>500	34
>1000	18

Table 1 Total depths of boreholes in the GSNI borehole database

A modest programme of targeted drilling would yield further useful subsurface geological information.

It is also essential that any future geothermal legislation or regulations make provision for the reporting of geological information to GSNI.

Quality control and professional standards

Quality control would appear to be best managed by a combination of standards incorporated into the regulatory framework, and a robust system of professional accreditation.

A substantial amount of research has been carried out in Europe into optimum technical characteristics of GSHP systems and standards have been specified in several countries (e.g. Germany VDI 4640). Additionally, further research has led to country-specific recommendations applicable to the wide range of geological conditions found in the UK. Most of the geological units found in Northern Ireland are also found

in Scotland and the north of England, and the climates are also similar so a common set of standards should apply.

In the United Kingdom GSHPs come under the Building Regulations and these could be modified to include, or refer to, the more comprehensive technical standards proposed. Building Control officers could ensure that the standards were adhered to, by adding GSHP site inspections to their current schedule of inspections.

Approved training and accreditation for architects, engineers and installers is probably the best way to establish and maintain the appropriate professional standards. The courses currently run by the Renewable Energy Installer Academy could form the basis for the training in Northern Ireland. Accreditation should become mandatory for all installers, not just those working on projects funded under the current government-sponsored Reconnect and Low Carbon Buildings schemes. Industry associations can play a vital part in this process and although the Northern Ireland industry is too small to support its own independent organisation there are well-established Irish, UK or European organisations.

Quality control and professional standards for the more complex deep geothermal energy projects can be regulated under the proposed new legislation. Some of the activities associated with this type of project, such as deep drilling, would already be controlled under existing exploration or health & safety legislation.

Promotion and publicity

Action Renewables (AR) have run a successful radio, TV and static advertising campaign to promote the Reconnect scheme but there is plenty of scope to raise the profile of geothermal energy in Northern Ireland. Many of the delegates to the roundtable suggested that demonstration projects, for both ground source heat pump and deeper geothermal systems, could play an important role in bringing geothermal energy to a wider audience. Obviously in Northern Ireland the geothermal market is in its infancy, with only closed loop GSHPs installed in any significant numbers, so existing case studies are small in number. The possible availability of funding for such a demonstration project from the EREF should be followed up. AR are letting a contract with the aim of identifying locations of the juxtaposition potential deep geothermal resource and potential market.

There is potential for the active participation of the geothermal energy industry to increase promotion and customer awareness of the technology via demonstration installations, brochures, videos and roadshows. This type of activity could be carried out in conjunction with Action Renewables

Influencing government strategy – in UK government has accepted the benefits of GSHP as low carbon technology and wishes to promote this. However, their view of the deeper geothermal energy potential is still coloured by the outcome/conclusion of the geothermal energy research programme carried out in the 1980s. Some work is needed to bring government up to date with subsequent developments in the development of geothermal CHP/heating technology. In Northern Ireland the potential for deep geothermal energy was recognised by the allocation of funds for research and development in EREF.

Involvement of other stakeholder groups

All the stakeholder groups represented at the roundtable discussion made valuable contributions to the process identifying barriers to the development of geothermal energy, and shortcomings of the existing legislative and regulatory framework. However, it was significant that some potential stakeholder groups were not represented at all – the legal profession, banks, commercial users, housing associations, builders and developers. Invitations were made to organisations in these sectors but they were declined in some cases or it proved difficult to find the 'right people'. Some of this is probably due to the immature state of the geothermal energy market, and the lack of large projects requiring high capital investment.

Further efforts should be made to involve these sectors, in particular, the social housing sector including the Northern Ireland Housing Executive and housing associations. The latter, in Great Britain, have been among the early adopters of GSHP technology both for new build and for retrofit installations.

There is also potential to work with planners and developers to encourage the incorporation of geothermal energy into future large housing developments.

Incentives and minimisation of cost/risk barriers

The current Reconnect scheme of grants for householders is aimed at increasing the number of domestic renewable energy installations in Northern Ireland tenfold to 4000 by June 2008. Ground source heat pumps currently form 10% of installations under this scheme and a total of approximately 400 GSHP systems might be expected when the current funding is all allocated. This is probably too few to establish a healthy growing shallow geothermal heat market and the extension of the current grant schemes is probably vital to its continued development. Reductions in stamp duty payable on new homes that have a 'zero carbon rating' should also provide an incentive to use GSHP technology.

For commercial users, public bodies, charitable institutions and housing associations there is a range of financial and fiscal incentives administered by the Carbon Trust or under the LowCarbonBuildings fund. It is important that these schemes continue until the non-domestic geothermal heat market is well established. However, these are not very attractive to housing developers because the benefits are only realised by the house buyers over a number of years and the additional installation costs are not easy to pass on in the selling price. In the case of commercial organisations, which may produce significant amounts of carbon dioxide, geothermal energy offers an attractive means of enhancing their 'green' credentials, reducing their CO₂ output and trading in the carbon credits market.

Government policy on increased energy efficiency in buildings, as manifested in current and future Building Regulations, will act as a driver towards the increased use of renewable energy technologies. Although all renewable energy technologies will benefit from the reducing carbon targets in new buildings shallow geothermal energy, particularly GSHP systems, should be especially attractive because of its widespread availability.

One of the major barriers to the exploitation of medium and high enthalpy geothermal energy resources in Northern Ireland and the rest of the United Kingdom is the risk associated with lack of information about the subsurface geology. Over the medium to long term this situation can be improved by improved capture and availability of borehole data but there will remain a substantial risk associated with the initial drilling of a geothermal prospect. In several other countries the existence of insurance to manage the risk of unsuccessful drilling has proved to be an important factor in reducing the effect of this barrier. In the Paris Basin the initial development of the geothermal district heating schemes was assisted by a publicly funded drilling insurance scheme, and in the Netherlands the Government runs a guarantee scheme to cover geological risk. In Germany, where the market is more mature and the geological and drilling risks are more quantifiable, commercial companies offer insurance policies. However, even here the Ministry of the Environment is discussing the suitability of a pool solution to cover geological risk.

The use of geothermal energy for electricity generation and as input into Combined Heat and Power plants could also be stimulated by the introduction of geothermal feed-in tariffs (higher than those paid for electricity generated from conventional hydrocarbon fuels) such as those available in Germany.

4.2. Recommendations for Inclusion of Future Questionnaires

Further questionnaires should canvas the opinions of stakeholders on the range of options identified as possible solutions to the problems or barriers currently limiting the development of geothermal energy resources in Northern Ireland and Great Britain.

5. DISSEMINATION OF RESULTS

The results from the questionnaire and roundtable discussions will be made available on the GTR-H website at www.gtrh.eu. The reports will also be distributed to roundtable attendees and questionnaire respondents by e-mail.

Follow-up workshops will be arranged for stakeholder groups to allow further discussion of the proposals for a new or revised legislative and regulatory framework for geothermal energy in Northern Ireland arising out of this review.

Posters and presentations will be submitted to relevant future conferences and meetings – for example, the Tellus conference being held in Belfast on 17-18 October 2007.

Appendix 1 Glossary

Abbreviations used within the text are listed below:

AR	Action Renewables
BGS	British Geological Survey
CSA	CSA Ltd.
DETI	Department of Enterprise, Trade and Investment
EHS	Environment and Heritage Service
EIA	Environmental Impact Assessment
EREF	Environment and Renewable Energy Fund
EU	European Union
GB	Great Britain
GSHP	Ground Source Heat Pump
GSNI	Geological Survey of Northern Ireland
GTH-R	Geothermal Regulation – Heat project
NI	Northern Ireland
UK	United Kingdom (of Great Britain and Northern Ireland)
UTES	Underground Thermal Energy Storage

Appendix 2 Questionnaire Form

GEOTHERMAL DEVELOPMENT NEEDS QUESTIONNAIRE

OPTIONAL*

1. *Surname _____ First Name _____

2. *Company name _____

3. *E-mail address. _____ Web address _____

4. Organization Type (please tick)

National Government

Government Agency/Regional Authority (Water, Energy, Environment, Planning or natural Resources or other); Please specify _____

Trade and Industry Association

Banking and Financial Institution

Legal Institution

Industry & Technical Service Company

Investor

Geothermal Education Facility or Association

Geothermal Exploration and Resource Assessment Consultant

Geothermal Construction, Component Manufacturers, Drillers

Geothermal Energy User

NGO

Other (please specify) _____

5. Barriers to Geothermal Energy Development

*(please tick as many as required and rate between 1 & 5 where: 1 = Minor barrier and 5 = Total barrier)*Lack of specific law/regulation related to geothermal resources ☐1 ☐2 ☐3 ☐4 ☐5Inadequate regulation ☐1 ☐2 ☐3 ☐4 ☐5Access to geological information on geothermal resources ☐1 ☐2 ☐3 ☐4 ☐5Availability of proven geothermal resource / resource risk data ☐1 ☐2 ☐3 ☐4 ☐5Access to information on geothermal exploitation systems ☐1 ☐2 ☐3 ☐4 ☐5Geothermal taxes ☐1 ☐2 ☐3 ☐4 ☐5Lack of incentives ☐1 ☐2 ☐3 ☐4 ☐5Lack of clarity on legal and regulation requirements ☐1 ☐2 ☐3 ☐4 ☐5Lack of Professional code of practice ☐1 ☐2 ☐3 ☐4 ☐5High cost of license/royalty (including geological information fee) ☐1 ☐2 ☐3 ☐4 ☐5Cost of Environmental Impact Assessment (EIA) ☐1 ☐2 ☐3 ☐4 ☐5Other (please specify) _____ ☐1 ☐2 ☐3 ☐4 ☐5 PTO

6. Do you have any additional comments that will assist us in the development of a European framework for regulation of geothermal heat?

Please indicate if you would like to be contacted for further discussion on the framework for geothermal regulation;

YES____ NO____

NB. If YES please ensure sections 1, 2 and 3 are filled out

THANK YOU FOR YOUR COOPERATION
