

REVIEW OF ALL RESPONSES RECEIVED TO THE PUBLIC CONSULTATION ON GEOTHERMAL ENERGY IN IRELAND (3rd June – 8th August 2008)

Please note that the submissions are presented in random order with each number in the left hand column representing the same submission throughout the document. It will be noted that no answers are shown from some respondents to particular questions. This is because answers were not always given to all questions. This document is ready to print in A3 format.

Q1. Which of the following bases would most appropriately differentiate between the various categories of geothermal energy resources in Ireland: i. temperature and geothermal gradient ii. end-use iii. depth iv. other (please specify).		
No.	Category	Response
1.	Local govt.	temperature and geothermal gradient
2.	Consultant, Hydrogeology	End Use is the usual differentiator. The ground water exploitation method depends on the heating load. For 25kW to 50kW heating or cooling load then the closed loop system can be used. For anything over 50kW then an open system is required as the depth of the closed loop well becomes prohibitive. Large heating and cooling loads (>500kW) require permeable aquifers. There is a hybrid well which O'Neill Ground Water Engineering Ltd are developing which combines the efficiencies of the open system with the guaranteed heating of the closed loop. The end use i.e. heat or cooling load combined with the local hydrogeology dictates the approach taken.
3.	Consultant	The most appropriate method to differentiation between the various categories of geothermal energy is (A) Closed Loop Systems and (B) Open Loop Systems. This definition has already been defined in the regulations for planning exemptions for domestic dwellings.
4.	Professional Body	Other - type of system employed. Whether closed or open loop and whether groundwater is pumped from the aquifer for either recharge or discharge.
5.	Consultant	Geothermal resources need to be treated differently depending on the technology employed and effect on the resource. This can be attained through categories defined by a combination of depth and end use (defined by size/energy capacity of the system). The end use is defined by temperature and volume of water and therefore is an effective way of regulating the area. The depth cut-off between deep and shallow resources needs to be defined with a limit of between 300 and 500m.
6.	Energy Industry	Depth would most appropriately differentiate between the various categories of geothermal energy resources in Ireland. Geothermal resources below 300m would be termed deep geothermal resources and above 300m would be termed shallow geothermal energy resources.
7.	Consultant	Geothermal Energy requires to be distinguished between shallow and deep geothermal resources. This could be achieved by defining a depth cut off of 300m. Geothermal energy abstraction above 300m could be classed as shallow and below 300m as deep. However, consideration on end-use have to be made based on the potential environmental impacts associated with different systems. This distinction can provide a more flexible categorisation. Shallow geothermal systems used in the residential sector are likely to have limited environmental impact. Large commercial systems exploiting shallow resources (>30-40kW in size) are likely to have significant groundwater abstraction/re-injection requirements and/or subsurface temperature impacts for large closed loop collectors. These impacts are likely to vary based on the heating or cooling requirements of the proposed end user. Thus, the end-use of the system needs to be suited to the type of geological and hydrogeological conditions in the area with minimal impact to local ecosystems. Deep geothermal energy systems will typically require extensive resources for the production of heat or electricity exploited through large scale plants. These should be clearly stated to identify the correct regulatory instruments to be implemented.
8.	Consultant - Legal	We are not technical experts in geothermal development, and we would prefer to focus on the remainder of the questions in this questionnaire.
9.	Consultant	all required
10.	Energy Industry	end-use
11.	-	temperature and geothermal gradient
12.	Energy Industry	depth
13.	Potential Developer	other - recovery
14.	Landowner	end-use
15.	-	depth
16.	Private Person	temperature and geothermal gradient
17.	-	temperature and geothermal gradient
18.	-	temperature and geothermal gradient
19.	-	temperature and geothermal gradient
20.	Geology Graduate	temperature and geothermal gradient
21.	-	temperature and geothermal gradient
22.	Academic and Consultant	end-use
23.	Consultant	depth; shallow = heat pumps, deep = geothermal
24.	All-island representative body	Most appropriate – Depth; Secondly – Temperature; Thirdly - End Use (some examples are as follows) a. heating / cooling; b. district heating; c. tourism / health; d. agriculture; e. many, many more.
25.	Business representative body	depth
26.	Local Auth./Local Energy Agency	temperature and geothermal gradient, and depth
27.	Private Person	daft question
28.	Energy Industry	Depth would be a major factor in differentiating between categories. It raises the question of how we define geothermal energy. Shallow systems are generally based on ground source heat pumps and are really a means of using low grade solar heat stored in the ground. Deep geothermal energy comes from the earth's core. The responses below are directed at the latter i.e. deep geothermal.
29.	Private Person	I believe that the most appropriate way to differentiate between the various categories of geothermal energy resources in Ireland is depth. Most countries in Europe such as Germany, have modelled the regulation of geothermal on the depth of the resource exploited. As temperature and geothermal gradient are correlated to the depth drilled, they will be indirectly taken into consideration when using depth as the benchmark to differentiate between deep and shallow geothermal.
30.	Local Authority	Temperature and geothermal gradient, and the depth of the collector, (borehole, trench, vertical coil collector etc.) would be the most appropriate to differentiate various categories of geothermal energy resource in Ireland. On the end-use issue, the purpose of the geothermal development must be specified in terms of Heating or Cooling. The depth of the exploitation obviously needs to be specified, when it comes to assessing the various options. The civil works (drilling and other pipeworks) involved will be very much dependant on the depth of the exploitation. The temperature and geothermal gradient is another key issue. The temperature difference, or in the other words, different geothermal gradient, needs to be specified, for geothermal resource management and for the further development reference.
31.	Private Person - Consultant, Engineering	depth
32.	Consultant	depth

Q2. What are the most likely types and scale of any commercial exploitation of such resources that you consider are reasonably possible in Ireland? Please outline your reasoning:		
No.	Category	Response
1.	Local govt.	If a source can be developed the best sustainable solution is to supply heat energy to a group heating scheme, with the potential in due course, to interconnect with other group heating schemes fuelled by CHP, waste and/or biomass to form ultimately an integrated District Heating and Cooling system. A balanced heat demand profile, including (some of) leisure centres & swimming pools, residential and commercial developments, breweries and hospitals if in the vicinity would offer the most economically viable heat load. Commercial office blocks, IT facilities and conference centres could also benefit from group cooling systems, as summer and autumn temperatures in Ireland are likely to increase by 3 to 4 degrees C towards the end of the century.
2.	Consultant, Hydrogeology	O'Neill Ground Water Engineering Ltd have been involved in the use of ground water for space heating since 1986 and in particular the heating of buildings with low thermal inertia. In the last two years alone we have been involved in four projects where ground water has been used for both heating and cooling. The loads have been between 100kW for a small hotel to 750kW for a private hospital. In all cases the purpose was for heating and cooling. All the enquiries that we have is for heating and cooling and normally comes through mechanical and electrical engineering firms.
3.	Consultant	Horizontal Closed Loop Systems c300 to 400 per annum mainly for private houses and stand-alone systems for commercial premises. Vertical Closed Loop Systems c300 to 400 per annum mainly for private houses and stand-alone systems for commercial premises Energy Piles. Closed loop system where the collector pipes are enclosed in the foundations of buildings Office Blocks etc where ground conditions have poor load bearing capacity. None of these systems have been installed to-date and if promoted 5 to 10 per annum would be the probable number constructed. Open Loop Systems These can be divided into two categories- (A) shallow systems where groundwater is extracted from springs or wells up to a depth of 200 to 300M, the heat extracted and the cold water discarded. This system is used for private houses, swimming pools, small office blocks etc.c100 to 200 such systems are constructed each year (B) Deep Geothermal wells. These are wells that are drilled to depths of up to 1 – 2 KM and geothermal water at temperatures of c50c is extracted and used for heating and /or geothermal spa developments. In Europe only about 10% of these wells are used for heating only, economics dictates that they are used to supply a large spa hotel to get any sort of return on the investment. The number of potential developments in the country would be in the order of about 10 to 15 over the next ten years.
4.	Professional Body	Space heating in large buildings (schools, offices, museums etc.) appears to offer the most applicable use of geothermal energy especially where there is a continuous heating load. Water heating for swimming pools is another use but would represent only a small percentage of the available market compared to general space heating. District heating of e.g. housing estates/villages/towns could be achieved subject to definition of geothermal resource, thermal conductivity at depth (>1000m) and flow rates.
5.	Consultant	Shallow: With the currently available information the most likely commercial developments are at depths <300m as the potential and some of the possible applications for these resources has already been demonstrated. Deep: Current information also suggests potential for significant resources at deeper levels and with higher temperatures, however lack of resource information is hampering investment in these types of projects.
6.	Energy Industry	There are currently a substantial number of shallow geothermal systems in Ireland with the potential for thousands more and these will suit small scale developments. A CSA geothermal report prepared in 2004 suggests that there is a larger potential for the development of deep geothermal heat energy in Ireland. Produced through well doublet systems, it could meet and exceed current targets of heat energy from renewable sources of 5% by 2010 and 12% by 2020 whilst producing almost no greenhouse gases. There is potential for these plants to be located at multiple sites throughout Ireland. In the future, there are additional possibilities for the development of Enhanced Geothermal Systems which can produce electrical energy or the production of electricity from lower temperature energy from deep geothermal wells. These systems would require further exploration work and would require substantial research and development investment to ensure their commercial viability.
7.	Consultant	Geothermal exploitation in Ireland is predominantly limited to the development of shallow geothermal systems for space heating in the domestic sector and heating and cooling in the commercial sector. This is facilitated by a suitable climate and hydrogeological conditions to easily exploit these shallow resources. Deep geothermal resources in Ireland are currently perceived to be of medium to low enthalpy but these have historically not been sufficiently profiled. The main geothermal energy abstraction potential for deep reservoirs may be limited to the production of heat for space heating through district heating systems.
8.	Consultant - Legal	In the medium-term, the greatest potential for geothermal development in Ireland lies in the area of district heating. District heating distributes heat from a centralised source to end users, who may be located in a number of separate buildings. The method replaces traditional central heating systems powered by individual boilers, and is already used quite widely throughout Scandinavia and Central Europe, as well as in Southampton in the United Kingdom. Under certain circumstances, geothermal energy can be a suitable source of heat for such a scheme.
9.	Consultant	SHALLOW – CLOSED LOOP – Domestic, Offices, Horticultural, Pool heating, Ice melting 10 – 50 kWth SHALLOW - OPEN LOOP – Offices 20 – 300 kWth MEDIUM - District heating 0.5 – 4 MWth DEEP - Electricity 1 – 5 MWe
10.	Energy Industry	-
12.	Energy Industry	Deep borehole steam well for steam turbine electricity production. The reason is that it is not a centralised supply and losses would be limited to local distribution. It could also react to demand quickly. Deep borehole, sub 1609M would also not interact with other below ground activities such as water.
13.	Potential Developer	A. In the case of all refrigeration and air conditioning plants, the heat being discarded into the atmosphere could be recovered and used for space heating; B. Every village and town in the country has access to a river which should be used as a source of heat to be recovered by using a multiple heat pump system and the heat could be used in municipal buildings such as offices hospitals etc.; C. A further major source of heat could come from public water supplies as the pipe system is constantly collecting Geothermal heat from the ground.
14.	Landowner	Use in agriculture to heat for example, tomato houses.
15.	-	-
16.	Private Person	Site specific installations may prove a disadvantage. I am not sure but the bigger the better I suppose.
18.	-	It would seem (from what I have read mostly from SEI) that there is enough geothermal heat here to make it worth while to develop. If so, it would be better for those resources to be developed as they have done in Iceland, by the government and the heat is used for public housing and hospitals, schools, etc. This should NOT become another natural resource that is given away to some developer to squeeze profit from and then disappear. I also think it is not really suited to have every suburban J.R. with a well drilling apparatus in his backyard sinking a bore hole so he can heat his swimming pool. The amount and positioning of drilling should be controlled.
20.	Geology Graduate	Horizontal Closed loop collectors, vertical closed loop collectors and pumping of warm water from buried valleys. These can be used individually for smaller commercial projects, multiple use of the individual methods for larger/district heating or combinations of all 3 for larger/district heating.
22.	Academic and Consultant	Ground source heat pumps - Already a thriving business in Ireland and likely to remain so. No technical limit to number of units that can be installed. Direct use - For small industrial purposes such as aquaculture. Would remain localized to where warm water is easily accessible by shallow drilling. Engineered geothermal systems - Electricity and heat generation by accessing and enhancing the permeability of deep hot rocks. Technological advances are reducing the temperature at which power can be generated so the future potential may be much wider than presently thought.
23.	Consultant	Industries, factories, housing estates, swimming pools.
24.	All-island representative body	SHALLOW – CLOSED LOOP – Domestic, Offices, Horticultural, Pool heating, Ice melting 10 – 50 kWth SHALLOW - OPEN LOOP – Offices 20 – 300 kWth MEDIUM - District heating 0.5 – 4 MWth DEEP - Electricity 1 – 5 MWe
25.	Business representative body	We believe there is potential for deep geothermal heat energy and that there is the potential for deep heat geothermal to be located throughout Ireland.
26.	Local Auth./Local Energy Agency	Where possible to balance demand profiles, group heating schemes (leisure centres, residential and commercial developments, hospitals) and cooling schemes (Commercial office blocks, IT facilities, conference centres) would be most appropriate. Alternatively, single site developments employing geothermal for the heating or cooling may be more likely to proceed in practice in the short term.
27.	Private Person	local heating.
28.	Energy Industry	We would see geothermal energy as being suitable for commercial exploitation in district heating applications. As oil and gas prices increase the commercial potential of deep geothermal heating becomes more attractive. It is very difficult to estimate the scale of the commercial potential as there is insufficient experience in the field so far.
29.	Private Person	It appears to me that the most common form of commercial exploitation of geothermal resources will be in the form of shallow geothermal i.e. closed loop installations. Given the extra legal considerations involved with open loop i.e. discharge and pollution controls that pertain to open loop, I think that open loop development will be less common but nevertheless, it may be appropriate for larger scale developments such as at riparian offices, hotels and industrial developments or on premises suitably located on aquifers. As stated above I doubt that deep geothermal will be a very common type of exploitation in Ireland based on Ireland's geothermal resources. However, on a national and local level medium to deep geothermal development may be appropriate for town planning heating and cooling needs i.e. for district heating. I would expect that the use of geothermal for district heating may be utilised in conjunction with another energy source such as CHP. Less likely in fact seems to be the use of enhanced geothermal (popular in the USA) in Ireland.
30.	Local Authority	The most likely types and scale would be a single site developments looking to employ geothermal for the heating or cooling. (e.g. retail, office complex, hotel development).
31.	Private Person - Consultant, Engineering	No view.
32.	Consultant	Exploitation of naturally occurring higher temperature groundwaters.

Q3. What are the current barriers to the development of geothermal energy resources?		
No.	Category	Response
1.	Local govt.	Lack of information re: research into available quantities and properties, development costs and credibility in its performance.
2.	Consultant, Hydrogeology	The following would be OGE's perceived barriers: 3.1 Education of potential end user; 3.2 Overall cost; 3.3 Availability of grants; 3.4 Technical back up.
3.	Consultant	The current barriers to the development of geothermal energy resources are: <ul style="list-style-type: none"> • Capital Costs of installations; • Poor quality of some installations and bad publicity attributed to the technology from these; • Consumer caution regarding perceived new technology; • Pay back time for commercial installations; • For energy piles lack of knowledge of this technology and lack of expertise in design and installation in the country; • For shallow open loop systems risk involved in obtaining sufficient quantities of ground water and disposing of discharge water. Security of the supply of the groundwater i.e. other ground water users depleting the supply of water from the aquifer by drilling of further well locally; • For deep (1 to 2 Km) wells there are the same problems re locating a sufficient supply of water at a suitable temperature as for the shallow wells but on a much greater scale and also the same security of supply problem as for the shallow wells when the geothermal well is developed. In addition there is an almost complete lack of knowledge regarding deep geothermal aquifers, i.e. where production wells can be successfully developed, and no drilling or testing equipment or expertise regarding it. This has to be considered in the light of the cost of drilling and testing of these wells i.e. c €3,000,000.00 per well.
4.	Professional Body	A perceptual barrier exists that the geothermal resource in Ireland is sub-economical. If geothermal energy research & demonstration projects were to be incentivised through a suitable mechanism akin to the (REFIT) feed-in tariffs for large scale wind, offshore wind and wave resources, then perceptions of a viable economical resource could be strengthened through practical demonstrations. The lack of a clear regulatory regime for deep geothermal heat exploitation. A regulatory framework requires to be developed, with a transparent code on ownership, rights, liabilities and possibly royalties. The Irish climate lacks the temperature extremes experienced in continental Europe and so the cost of fossil fuel heating has (until now!) been readily affordable. The main barrier has been and will continue to be financial, i.e. capital versus payback timeframe. Less critical barriers would include lack of national experience, easily accessible demonstration projects, developers' unwillingness to embrace new technologies. Clarity on the interaction between the exploitation of geothermal energy and surface/ sub-surface property rights will also have to be addressed. Clearly the private sector would be very reluctant to invest extensively in this resource where there is any uncertainty regarding its ownership. A single case of a legal dispute could put the industry back a decade as it could potentially take that length of time for a judgement to be handed down by the Supreme Court, if it went that far.
5.	Consultant	Deep: Unavailability of adequate information on resources is completely stalling the development of deep geothermal resources. In the absence of more detailed resource information the clarification of rights of ownership of the resource would help to encourage this high risk investment. Deep and Shallow: The need for awareness of the possibilities with geothermal systems is also an issue in helping to increase the rate of installation of medium scale and larger systems (even with shallow resources).
6.	Energy Industry	The main barriers to the development of deep geothermal energy resources are: 1. Lack of geological knowledge; 2. Lack of regulation; 3. Lack of security for investor; 4. Lack of taxation/research and development funding incentivisation. Breaking down the above barriers will ensure investment in and development of this renewable energy resource in Ireland and ultimately will result in an effective commercial roll-out of this renewable energy resource.
7.	Consultant	Lack of specific regulation defining geothermal energy resources and their ownership; Lack of a licensing system to grant ownership of resources to potential investors; Lack of deep geological and geothermal resource profile data.
8.	Consultant - Legal	Lack of expertise, knowledge and incentives to explore and develop regions suitable for geothermal exploitation. The expense of exploration outlay makes it difficult to establish exactly what areas of Ireland are suitable for geothermal development. The development of extraction and distribution systems is capital intensive, which will limit the number of viable geothermal projects.
9.	Consultant	No security of sole access to the heat resource; No security of exploration and development; No required certification of Equipment, Designers, Drillers, Installers.
10.	Energy Industry	-
12.	Energy Industry	Research, Cost, Cohesion between industry and academia, (lack of energy clusters between industry and universities/institutes to drive R&D into commercial outcomes).
13.	Potential Developer	-
14.	Landowner	ESB preventing feed into grid from household excess.
15.	-	-
16.	Private Person	Probably the near non-existence of major active volcanic activity in Ireland.
18.	-	Oil is still too cheap and people are still refusing to change. NO one wants to give up their private oil tank and being able to heat their houses as they please. People should listen to some of our new settlers here from eastern europe and listen to the stories of communal heating...when it is NOT working well or the government is failing. Nevertheless, the way to use a resource like geothermal is in large city sized plannings, not individual houses or oven small estates.
20.	Geology Graduate	Funding into research into optimising and configuring the different methods so that maximum heat is extracted without having to use large area of land to extract the heat from as space is a problem in areas of commercial properties.
22.	Academic and Consultant	Economic. Steep up-front investment costs act as a barrier to substantial large-scale projects.
23.	Consultant	Ignorance, economics, technology, experience, low enthalpy, perceived risks, few companies offering turn key services.
24.	All-island representative body	SHALLOW & DEEP 1. No security of sole access to the heat resource (including zones of protection around domestic geothermal wells); 2. No security of exploration and development; 3. No required certification of Equipment, Designers, Drillers, Installers; 4. Lack of access to clean green electricity (to run heat pumps); 5. Relative lack of local expertise, especially with medium / deep drilling equipment.
25.	Business representative body	The main barriers to the development of geothermal energy resources are a combination of the following four factors: Lack of geological knowledge; Security for investors; Incentives for research/development; Lack of regulation.
26.	Local Auth./Local Energy Agency	Lack of geotechnical and hydrogeological knowledge on the available quantities and properties of geothermal sources; lack of geothermal project experience and performance analysis; high development costs and lack of support from national government.
27.	Private Person	lack of confidence in financial payback; feeling that technology is continuously evolving; feeling that advantages are borderline; environmental difficulties
28.	Energy Industry	Absence of a regulatory system is a primary barrier. Also high capital cost combined with a fair degree of risk. The precise geological conditions are not generally known so no guarantees of a return on investment. The absence of a developed district heating sector in Ireland means that higher investment will be required to connect to heat consumers
29.	Private Person	1. Lack of Investor and/or Developer Certainty <ul style="list-style-type: none"> a. No security of sole access to the heat resource (including zones of protection around domestic geothermal wells); b. Uncertainty of ownership of heat source i.e. groundwater rights; c. Uncertainty of where exclusivity to drill, explore or develop in a defined area exists; d. Additionally, uncertainty over the regulation of competing uses. i.e. if hydrocarbons encountered or other minerals in close proximity to geothermal resource; e. Concerns over having to deal with a multitude of regulatory bodies i.e. The Department of Communications, Energy and Natural Resources ("DCENR"), the Department of the Environment, Heritage and Local Government ("DEHLG"), the Environmental Protection Agency ("EPA"), local authorities and/or An Bord Pleanála ("ABP"). Where multi agencies are involved there may be a bureaucracy slowdown and communication breakdowns. Administration and transaction costs i.e. applications to multi disciplinary agencies; f. Low confidence in geothermal technology, equipment and domestic geothermal installers i.e. badly installed biomass burners damaged the reputation of that industry. 2. Geothermal in a sort of 'Legal Limbo'Lack of Legislative and Regulatory Uncertainty <ul style="list-style-type: none"> a. How to legislatively define geothermal? As sui generis or as form of mineral, water or hybrid. Different countries around Europe and the World categorize geothermal differently. Such categorization affects the legal issues involved. For example, under mining laws permits, licenses, state ownership and royalty issues will arise for consideration; b. Uncertainty over legal ownership of groundwater and aquifers for domestic and commercial use of geothermal. Most geothermal resources lie beneath groundwater so the groundwater laws are important considerations. A developer could find himself negotiating with a subsurface and surface owner of land resulting in uncertainty and a multiplicity of practical issues; c. No specific legislation or regulation for geothermal (whether found in entirely new specific legislation for geothermal or found in amendments to existing legislation); d. Need guidance on the status of re-injected water from geothermal installations – is it waste water or not? This consideration impacts a developer's environmental responsibilities and liabilities. 3. Lack of Certification, standards and expertise <ul style="list-style-type: none"> a. No required certification of geothermal equipment and installers; b. No centralized regulatory body for geothermal industry; c. Lack of knowledge and experience in local authorities of geothermal; d. No centralized database of geothermal resources or developments. I am aware that the Geological Survey have some form of database but perhaps a centralized database should be widely available such that for wind farms in Ireland. 4. Lack of financial incentives <ul style="list-style-type: none"> "Green Loans" i.e. low interest loans for green energy projects, grants for larger scale developments (as opposed to domestic geothermal installations), tax incentives. The promotion of inward investment for geothermal developments should also be given due consideration.
30.	Local Authority	The current barriers are: 1. lack of geotechnical and hydrogeological knowledge; 2. lack of relevant geothermal project experience; 3. not enough support from national government; 4. high initial capital investment and long term payback. 5. Reliance on grid-based fossil fuel electricity, which is leading to major increases in the unit cost of electricity in a volatile marketplace. Based on the success of the appliance labelling scheme and on the need to 'plug' geothermal energy into customer need the lack of an extensive, meaningful and practical labelling system has to be a significant barrier.
31.	Private Person - Consultant, Engineering	A major application would be domestic space heating, via district heating schemes for the PRIVATE sector. Two barriers to this are: <ul style="list-style-type: none"> a) the misuse of the term "geothermal" to cover ground-source heat pumps - legislation should ban this, as it causes confusion - and true geothermal systems might struggle to overcome the bad publicity beginning to accumulate re the running costs of heat pumps; b) the poor reputation of management companies in flat complexes - legislation should require price and service guarantees for householders - prices might be capped at x% of oil prices, with the cap subject to review by the Office of Energy Regulation. Applications in public housing should be covered too.
32.	Consultant	technical potential.

Q4. How can such barriers be overcome?		
No.	Category	Response
1.	Local govt.	Investment in pilot projects and promoting it in the appropriate journals. Provisions for hedging against the risks and inclusion in the budget of a provision for identification and follow-up management of teething problems will be valuable, at least in the early pilot projects.
2.	Consultant, Hydrogeology	These could be overcome by: A) Education 4.1 Case studies on SEI webpage; 4.2 Workshops; 4.3 Sessions at energy related conferences; 4.4 General dissemination of information. B) Overall Cost 4.5 Grants; 4.6 Tax relief; 4.7 Carbon credits. C) Availability of Grants 4.8 Clearer information on SEI webpage; 4.9 Educate promoters of such schemes. D) Technical Backup 4.10 Establish list of approved consultants with proven track record in developing ground water as a source of low enthalpy energy for heating and cooling. This would be done by public tender and interview; 4.11 Technical workshops for service providers; 4.12 Training of relevant SEI personal to provide well informed point of first contact.
3.	Consultant	Regarding the barriers listed in the response to question 3 I would suggest the following incentives: Extension of the existing grant aids; Training and certifying of designers and installers; Educational programme for potential consumers and installation of demonstration models to show that the systems work; Grant aid will reduce pay back time and also the increasing cost of fossil fuel. Scale of the grants could be related to fossil fuel costs; For energy piles the technology could be promoted and designers and installers obtained from Europe. The scale of the development would probably not justify the establishment of training courses for local designers and installers; For shallow ground water extractions there are sufficient hydrogeologists available in the country that could locate ground water supplies from shallow aquifers and also trained drillers. The security of supply problem can be overcome by use of the planning acts by the Planning Authorities. They can employ specialist expertise when required. For deep geothermal wells it is important to keep in mind the scale of the potential development i.e. 10 to 15 developments over the next 10 to 15 years, and the cost of the wells not to mention the investment in the developments that these wells would support Using highly experienced European professional and technical expertise the success rate of deep geothermal wells is about 50% in hard rock hosted geothermal aquifers. Grant aid for these wells is essential or a special insurance scheme, which would cover some of the losses in the event of the necessary geothermal water not being obtained. Such a grant scheme operated in Bavaria and is now replaced by an insurance scheme. Security of supply could be handled by the planning acts as for the shallow open loop systems. The developer would have to satisfy the planning authority that the proposed well would not impact on any existing well or spring and that the discharge water would not pollute any aquifer of surface water or eco system contained therein. With the small number of possible developments the necessary professional and technical expertise should be imported for each project as required.
4.	Professional Body	Clarity on ownership, planning and regulatory framework. Acquisition by the State of the subsurface as a source of geothermal energy? Numerous and diversified demonstration projects easily accessible to building designers, engineers and the wider public. A concerted effort to inform the building industry in particular about the range of applications possible. The establishment of a dedicated unit within the Geological Survey to provide a single point of contact on geothermal energy. The experience of the very successful Groundwater Division of the Survey could be used as the template for the new Geothermal Division.
5.	Consultant	Deep: Resource evaluation is required through the investment in drilling, testing and monitoring. The development of a licensing scheme for deep resources is required in order to ensure ownership for those undertaking evaluation projects with large investment. The provision of resource information centrally or locally is required either through the licensing authority or some other agency in order to build up a national database in the sector.
6.	Energy Industry	The barriers to the development of geothermal energy resources can be overcome by introducing a licensing system as follows: 1. Adopt the general international understanding that no-one owns the heat energy in the earth's core. Geothermal heat energy is not a mineral but is a unique energy resource category. Geothermal energy resources can be defined as naturally occurring heat in the earth which flows through the earth and is independent of individual land owners. 2. In accordance with the Irish Constitution, all natural resources including the air and all forms of potential energy within the jurisdiction of the Government belong to the State subject to all estates and interests therein. There are no estates or interests in geothermal energy. It is a unique resource and can be compared to wind and solar energy. 3. The heat energy located under Ireland would be administered by the Government of Ireland. 4. A licensing system similar to the current mining and hydrocarbon licensing system should be adopted for geothermal licensing. A. An exploration company who can prove they are suitably qualified to carry out exploration for geothermal energy resources with evidence of technical capability and financial viability, can apply for an exploration licence in certain areas of interest; b. This exploration licence should be issued for a period of five years. Within this five year period, exploration work must take place. The exploration licence can be extended for a further period of 5 years if it can be shown that the exploration company are in the process of carrying out exploration works at the end of the original 5 year period; c. The new geothermal exploration and production licence system must allow for the exploration of geothermal resources under any third party lands below 300 meters within the licence area subject to a public notification two weeks in advance; d. Currently exploration works directly beneath land appear to be exempt from planning as per Class 45 of the Planning and Development Regulations 2001. http://www.irishstatutebook.ie/2001/en/si/0600.html "Any drilling or excavation for the purpose of surveying land or examining the depth and nature of the subsoil, other than drilling or excavation for the purposes of minerals prospecting"; e. In Ireland, given the current lack of geological knowledge, it may be necessary to issue exploration licences for large exploration areas of, for example, 30km by 30km; f. If the exploration company identify suitable geothermal resources and wish to develop a production plant or plants within the licence area, a production licence must automatically be granted for a period of, for example, 50 years with the right to renew. The geothermal energy resource once harnessed becomes the property of the production company; g. The production licence area can cover a smaller area of for example 10km by 10km. The license area granted would be determined by the applicant and should be Subject to sound geological reasoning; h. No compensation would be payable to landowners for the value of any geothermal resource as it is not owned by them. They would, in theory, be entitled to compensation for any damage to their lands which results in a loss and is proven to be as a result of the geothermal operation; i. It is important that a nominal licensing fee is imposed so as to promote geothermal energy as it is a beneficial, renewable, indigenous and practically carbon neutral energy source; and j. These licenses should be capable of overlapping mineral licenses affecting the same area. 5. This licensing system should be administered by the Department of Energy, Communications and Natural Resources. 6. On commencement of the issuing of exploration licences, priority for an exploration licence, in a given area, should be given to those exploration companies who already are actively investigating or have plans in place to investigate, prior to the commencement of the submission process.
7.	Consultant	Barriers to the development of the sector can be achieved by including geothermal energy as a resource in national primary legislation and granting the power to a government department to issue licenses to private sector investments. The regulation needs to clearly define categories of geothermal energy and comply with secondary legislations in the groundwater, environmental and planning sector. A national data gathering programme by the government agencies appointed as being in charge of the promotion and development of geothermal energy in Ireland needs to be implemented. These should be aimed at obtaining data to better profile the shallow potential by re-interpretation of existing data and to acquire deep geological information to promote investment in the deep geothermal potential in Ireland.
8.	Consultant – Legal	The provision of a regulatory regime would go some way to providing a firm legal basis from which incentives could be provided for exploration and possible development of commercially viable geothermal schemes.
9.	Consultant	Protection of sole access to the heat resource; Protection of exploration and development; Certification of Equipment, Designers, Drillers, Installers.
12.	Energy Industry	Spreading investment through a cluster approach will share knowledge quickly and deliver solutions faster, potentially leading to a number of Irish company's creating export lead activities. The investment should be channelled into academics through industry otherwise research will not be commercialised fast enough (if at all). Industry is hungry to participate but there are no energy clusters to engage and deliver cutting edge R&D. If company's do it all on their own then International players will be first out of the blocks with 2 nd generation technologies.
14.	Landowner	Encourage and facilitate competition.
16.	Private Person	Go nuclear.
18.	-	Government has to lead. (Pause for outbreak of laughter). It will probably take some NGOs and hippy types to build the first one and PROVE it works, then the govt could safely get involved. I'm not sure about public / private partnership. Seems to me that the private part makes all the money and the public part just keeps paying out. I see no benefit. I think the government should keep control of large projects like this and be responsible for and accountable for them. We need to have people who have power to make sure these jobs are run correctly.
20.	Geology Graduate	More funding for this topic to masters/pHd research students.
22.	Academic and Consultant	Government assistance with co-funding capital-intensive, high risk drilling programs.
23.	Consultant	Larger projects bringing economics of scale and joint business ventures between hydrogeologists & geothermal engineers.
24.	All-island representative body	SHALLOW & DEEP 1. Protection of sole access to the heat resource; 2. Protection of exploration and development; 3. Certification of Equipment, Designers, Drillers, Installers.
25.	Business representative body	The key to addressing barriers is the introduction of an effective licensing system. This could be based on the current mining system.
26.	Local Auth./Local Energy Agency	Strengthen the surveying capacity of GSI and others for independent public good research. Funding assistance for capital expenditure for pilot projects. Full funding for independent public good analysis of projects.
27.	Private Person	state incentives.
28.	Energy Industry	Establishment of a licensing system would be a first step. Also, if the technology could be demonstrated on a reference site it would provide information and valuable experience.
29.	Private Person	For both shallow and deep geothermal a good policy should raise the profile of geothermal and increase incentives to invest in and develop geothermal resources in Ireland, lower the risks connected with investing in geothermal by reducing investment costs and uncertainties and increase the technical performance and reliability of geothermal. Overall a good policy must provide stable framework conditions. Targets and indicators of achievement should be put in place, monitored and updated as necessary. 1. Investor and/or Developer Certainty: a. Security of tenure – sole access to explore or develop the heat resource (including zones of protection around domestic geothermal wells). Additionally, uncertainty over the regulation of competing uses of land i.e. if hydrocarbons encountered or other minerals in close proximity to geothermal resource. Ownership of sub surface heat source should also be clarified i.e. water rights. B. Slim-lined and user friendly process with designated procedures and lines for communications between regulatory bodies who are implicated by geothermal developments. c. Develop centralized expertise in government – whether in the Exploration and Mining Division or Petroleum Affairs Division, An Bord Pleanála, DEHLG and/or EPA etc. d. Promotion of the benefits of geothermal. 2. Legislative and Regulatory Certainty: a. Define geothermal based on informed decision from this and later consultations, reviews of best practice in EU (such as from the GTR-H project), legislative analysis of Irish, EU and International law etc. b. Clarify the legal ownership of groundwater and aquifers. C. Development of legislation or regulation for geothermal (whether found in entirely new specific legislation for geothermal or found in amendments to existing legislation) d. Early implementation of E.U. Directives i.e. RES Directive. E. Protection of sole access to heat source and rights of exploration and development. 3. Certification, standards and expertise: a. Mandatory certification of equipment, drillers and installers. B. Dedicated and centralized government division for geothermal established as the key reference point for the geothermal industry available for advice and assistance, source of policy development, regulation and permitting. C. Publication of guidelines and best practice. D. Access to information 4. Financial incentives to offset high up front costs of domestic geothermal installations, drilling and exploration for medium/large scale geothermal developments. i.e. tax incentives, grants, green loans and the promotion of inward investment for geothermal developments.
30.	Local Authority	1. Lack of geotechnical and hydrogeological knowledge: The Geological Survey of Ireland (GSI) should get more funding to develop its geotechnical and hydrogeological data base to facilitate geothermal project development. All the developers should log their site survey analysis with GSI and they should provide all valuable geological, geotechnical and hydrogeological data to them. Government should invest and promote research to strengthen the basic knowledge of geothermal energy. A certification/labelling system should be introduced. 2. Lack of relevant geothermal project experience: Geothermal project experience and expertise in Ireland is limited. Most successful stories are on the continent, Austria, Germany, Switzerland. 3. Not enough support from national government: Government should provide funding for training, research and international collaboration. Government support should be made available for research drilling in strategic locations. 4. High initial capital investment and long term payback: The initial investment for a geothermal project is very high, deep borehole drilling is expensive, and the risk of failure is high. 5. Reliance on grid-based fossil fuel electricity: On-site generation of electricity would minimise the cost of electricity to the customer. Government policy should focus on district heating and combined heat & Power (CHP) centralised plants for large scale development in particular. There are a number of projects on the continent where geothermal systems could be integrated into these systems. For example, the power generated from the turbine in a CHP system could be utilised to run all the pumps including the heatpump in a district heating scheme.
31.	Private Person - Consultant, Engineering	Legislation and regulation.
32.	Consultant	Continuing R&D.

Q5. How adequate do you consider the current geothermal knowledge base to be?		
No.	Category	Response
1.	Local govt.	While I am sure people have been working on it and I am aware of the Newcastle Geothermal Project in South Dublin, there has been no appreciable dissemination of the information in the public domain. This is particularly obvious when you compare the amount of media coverage other forms of renewable energy receive. As a result it is very difficult for me to quantify the extent and depth of knowledge available in the Country. I am aware that it can be developed for one off houses but whether the capacity is available for large scale development and where are the locations is not known to me.
2.	Consultant, Hydrogeology	Some individuals and companies have a very good working knowledge of ground water as source of geothermal energy. However it would be the opinion of OGE that ignorance on the part of mech/elec engineers maybe acting as a barrier to the development of geothermal energy. The mech/elec engineers seem to be the first point of contact when developers are deciding on which heating and cooling system to use. The engineers do not know enough about the resource to be able to sell it properly to their clients. The engineers do not have an obvious database to consult for technical help and advice. We, as ground water consultants, would be brought in quite late in the project development when a lot of key building design decisions have been made making the development of geothermal more expensive and less attractive. A good example is the building footprint and layout has been decided leaving very little opportunity to locate the borehole in the optimum position.
3.	Consultant	Horizontal and vertical closed loop systems - Knowledge level is adequate; Shallow open loop system - Knowledge level is adequate; Energy Piles - Knowledge level almost non-existent; Deep open loop systems - Knowledge level almost non-existent.
4.	Professional Body	Good within the geothermal industry but wholly inadequate within the general population. Knowledge of the deep geothermal resource is in a fledgling state, where considerable research and demonstration projects are required to define that resource at modelled 'hot-spots' and zones of higher geothermal gradient around the country.
5.	Consultant	Deep: General guidelines only are available. The knowledge base for shallow resources is increasing in the sector but there is a requirement for more reliable assessment of deep potential. Shallow: Expertise in the use of shallow geothermal resources is developing especially as seen in some of the developments in the Cork City area. However Ireland is lagging behind in some of the more complex applications especially regarding the integration of geothermal energy systems with other renewable options.
6.	Energy Industry	The majority of the knowledge in this sector is confined to shallow geothermal applications where a rapidly growing sector over the last three years has stimulated a better understanding of the subsurface for the deployment of mainly ground source heat pump systems. The knowledge of the deep geothermal sector in Ireland is quite limited. Basic and minimal deep geological and hydro-geological information has been obtained from previous deep mineral and oil and gas drilling projects. However, these are sparse and in the case of mineral exploration are limited to specific lithologies often above potential geothermal targets, providing a very limited knowledge of deep geological conditions of potential geothermal energy reservoirs. Lack of knowledge of petrological and thermodynamic parameters of key potential geothermal target formations in Ireland currently increase the risk of development of new deep geothermal energy projects.
7.	Consultant	Geothermal knowledge base in Ireland is currently limited. A number of training programmes have focussed on standards for installation of shallow geothermal systems. Some of the potential for shallow resources can be inferred by using existing GSI, Teagasc and other datasets. In the case of deep geothermal resources only one study completed in 2004 has profiled temperature maps at different depths based on available and measured deep borehole data. Key shallow and deep geothermal reservoir parameters such as porosity values, thermal conductivity and transmissivity remain unknown. Additional geological, geophysical and petrological parameters should be outlined to better profile the suitability of Irish geological conditions for the extraction of geothermal resources. Where this data is not available a data gathering programme should be undertaken.
8.	Consultant - Legal	There are currently over a thousand domestic ground source heat pump units installed in Ireland. These primarily use shallow bore-holes and larger systems heat a number of civic buildings, university buildings and office blocks. Notwithstanding this, there is no large scale development of geothermal energy in Ireland which would suggest that the knowledge base is quite low.
9.	Consultant	SHALLOW Well established on ad hoc basis, but no official planning or support for the process, apart from installation grant aid; DEEP Developing fast, but no good deep data base. Also no official planning or support for the process, needs official support.
10.	Energy Industry	-
12.	Energy Industry	Imported Heat pumps for domestic use with a dodgy reputation to date. Confusion as to their effectiveness has been caused by poor installation, overselling and a huge learning curve.
13.	Potential Developer	It can easily be expanded for the national benefit.
14.	Landowner	Poor at best. Though information is available it needs to be more easily mined.
15.	-	-
16.	Private Person	If I am an average citizen it would be very limited.
18.	-	I think most people are only aware of it from programmes like Duncan Stewart. There is a lot of information available on line.
20.	Geology Graduate	There is a lot of unknown variables to get the maximum/optimum heat return from the geothermal collectors, where a lot of further research needs to be undertaken.
22.	Academic and Consultant	Inadequate for accurate prediction of temperature at several kilometres depth. The missing data are thermal conductivity measurements of relevant geological formations required to constrain robust predictive models of temperature distribution.
23.	Consultant	Inadequate compared to other European countries.
24.	All-island representative body	SHALLOW 1. Developing fast, but no official planning or support for the process, apart from ad hoc grant aiding; DEEP 2. Insufficient data on deep resources.
25.	Business representative body	I consider there are weaknesses in our geographical knowledge pertaining to geographical knowledge. In particular, knowledge of deep geothermal geology is quite limited.
26.	Local Auth./Local Energy Agency	Despite the fact that there have been a number of demonstration projects, there has been very little public dissemination of these experiences compared to other forms of renewable energy.
27.	Private Person	Poor.
28.	Energy Industry	The knowledge base appears to be poor.
29.	Private Person	I find that the knowledge base for geothermal exists mainly amongst geologists and hydro-geologists who have first hand experience with geothermal developments, similarly, amongst geophysicists. Certain engineers from experience and increasingly more academics are gaining knowledge with geothermal through research and analysis.
30.	Local Authority	Although there are a number of sites and developments deploying geothermal systems, it is a relatively new technology to Ireland. The earliest development of geothermal in Ireland was in 1987 at the Mallow swimming pool complex. At present GSI Ireland have some geothermal information available online. The Department of Communications, Energy & Natural Resources and SEI recently published Geothermal Energy Resource Map of Ireland. In addition, there are a number of organizations existing besides GSI Ireland, namely the Geothermal Association Ireland (GAI), the International Association of Hydrogeologists. There has also been a geothermal forum formed in Cork due to the increase in geothermal exploitation of the Lee Valley Aquifer. The membership consists of developers, consultants and the two local authorities. It is hoped that a set of guidelines will be developed to assist in the orderly uptake of the technology on the Lee Valley resource in the future. Good expertise exists between researchers in UCC and a privately owned GSHP company in Cork. Individuals are Dr. Alistair Allen and Dr. Paul Sakora. Specific and thorough expertise exists in the Centre for Sustainable Technologies, University of Ulster under the tutelage of Dr. Neil Hewitt. Unfortunately their knowledge is not disseminated to any great extent and the market at the client level is weak in knowledge.
31.	Private Person - Consultant, Engineering	To a few specialists - I don't know. To the vast majority of the population - grossly inadequate.
32.	Consultant	Limited.

Q6. What needs to be done to strengthen the knowledge base? By whom?		
No.	Category	Response
1.	Local govt.	While the private sector will promote particular products, some of which may be very good, it is really the Government or one of its agencies who has to educate the public on what the specs should state and whether it is worth the effort of installing. After all it will have to be maintained by the owner with the resultant ongoing costs. Dissemination of information from "Official" sources gives credibility to the knowledge base and assists the public in forming their opinion, otherwise they are dependant on media reports and TV programmes which inevitably will be biased in some shape or form.
2.	Consultant, Hydrogeology	6.1 Education of mech/elec engineers and architects; 6.2 Education of developers; 6.3 Develop on-line database of bona fide consultants who can provide real advice to potential users of geothermal energy. 6.4 The best people to do this would be SEI through IEI, IGI and other professional organisations.
3.	Consultant	The Knowledge base for horizontal and vertical closed loop systems could be improved by refresher courses for installers and designers who have had already completed the basic courses. These could be organised by FAS or FAS/SEI. The first step in improving the knowledge base for energy piles is to promote the concept to designers, architects, heating engineers etc. The Geothermal Association of Ireland has already commenced this. For shallow open loop systems it is important that the designers are made aware of the necessity of having hydrogeologists source and test their water supply to ensure that it is sustainable and does not interfere with other water supplies in the neighbourhood of the development. For deep open loop systems it is important that the use of this resource be published and its development is very specialised and that expert professionals and technicians be employed, at present only available in mainland Europe.
4.	Professional Body	Establish a technical unit dealing with the subsurface aspects of geothermal energy within the Geological Survey. The systems information would be best left to the industry with SEI playing a certification role. Incentivisation of collaborative RD&D projects with researchers in universities, geological surveys and energy practitioners. SEI and GSI/GSNI could be drivers of this mechanism to define the all-island geothermal resource.
5.	Consultant	Deep: Deep drilling and testing - Where feasible this should be carried out by government agencies, but otherwise by full or part-funding of private demonstration projects.
6.	Energy Industry	Research and development funding through grant aid and other forms of State or EU funding need to be made available to the private sector as the exploration and exploitation of this energy resource is extremely capital intensive. An additional key driver in the future of geothermal energy in Ireland is the establishment of a close working relationship between the private sector and third level educational institutions. Funding needs to be made available to educational institutions to enable further research and development of geothermal energy in Ireland. This funding and cooperation could allow Ireland to become a leader in specific geothermal research and development fields. The lack of knowledge of the potential geothermal resources in Ireland is a major barrier to the development of this resource as a renewable energy source. Funding also needs to be made available for the mapping of geothermal resources in Ireland.
7.	Consultant	Existing geological data and available core samples from representative parts of Ireland should be used to profile currently unavailable geothermal reservoir parameters. This should be achieved by a network of key national government agencies involved in different environmental and natural resource sectors.
8.	Consultant - Legal	The distribution of information would be a useful first step. In this context, it may be useful to liaise with the European Geothermal Energy Council to produce information packs to be made available to interested parties. Given the obvious relationship with the matters dealt with by the Exploration and Mining Division of the Department of Communications, Energy and Natural Resources, a section dedicated to the development of geothermal energy could be established within this division.
9.	Consultant	A programme of deep drilling to provide reliable data, organised and/or carried out by the Geological Survey of Ireland. Support for academic research and training schemes, without the horrendous bureaucracy of the Skillnets system.
10.	Energy Industry	-
12.	Energy Industry	No one entity can reliably renewable information. The position on knowledge needs to be agreed by a number of parties, both industry and academia and placed into the market in a considered approach. Clusters again would address this.
13.	Potential Developer	A suitable study group (without commercial interests) should be appointed to look at all the existing international achievements in this field and make recommendations for use in domestic and commercial situations.
14.	Landowner	Industry experts should compile the information and the government should promote access to this knowledge. Universities should fund research projects to enhance the knowledge base.
15.	-	-
16.	Private Person	Government controlled private partnership with penalty clauses for politicians who promise and don't deliver.
18.	-	Maybe more programmes on TV and radio, to try and reach more people. As I said above, there is loads available on the internet, if you are interested enough to look. I think the interest will increase as do oil prices...
20.	Geology Graduate	Further post graduate research.
22.	Academic and Consultant	A role for government - simple pre-competitive data collection.
23.	Consultant	Field trips, workshops, worked and published case studies. GAI or DCENR.
24.	All-island representative body	SHALLOW & DEEP 1. Support for training schemes; 2. Academic research; 3. Encourage private investment in geothermal projects - see European examples; 4. Collaboration between Industry and DCENR, etc.
25.	Business representative body	The private sector could be incentivised to engage in research development. This, coupled with a close working relationship with third level educational institutes, would create a very positive dynamic in furthering our knowledge.
26.	Local Auth./Local Energy Agency	Research and demonstration projects need to be carried out with the involvement of independent bodies such as GSI, Universities/ITs and disseminated through the National and Local Energy Agencies.
27.	Private Person	more widespread discussion/info; funding for companies to do R&D.
28.	Energy Industry	As suggested above, a demonstration site would expand the knowledge base. A trial borehole would be very useful, targeting the Blackrock to Rathcoole fault. Some level of grant support for a demonstration project should come from government, probably through SEI.
29.	Private Person	1. Centralized government department/ agency to promote and inform the public about geothermal. This should be a key reference point for the geothermal industry available for advice and assistance, source of policy development, regulation and permitting. The work of the Geothermal Association of Ireland should be supported by government. 2. Support for training schemes would ensure that geothermal developments and installations are successful. Training schemes should aim to accredit participants with an appropriate certification so that consistency exists between private and public training facilities. 3. Support for and conduct of Academic research i.e. University projects and research. 4. Encouragement and support for GAI.
30.	Local Authority	The government department should strengthen the knowledge base through the universities and public bodies like GSI and SEI. A national centralised database under the auspices of the GSI should be established.
31.	Private Person - Consultant, Engineering	SEI should consider some educational publications.
32.	Consultant	R&D guided by GSI.

Q7. Which of the following legislative regimes would provide the most suitable form of regulation for the exploration for and development of geothermal energy? I. as minerals; II. as hydrocarbons; III. planning laws only; IV. Groundwater; V. other; VI. no regulatory system needed.		
No.	Category	Response
1.	Local govt.	While I do not have a great knowledge or experience of some of the legislation above I would propose the groundwater legislation. The reason for my selection is that the Water Framework Legislation covers all issues that deal with water. This can be incorporated into the same system of maintaining the quality and any impacts on the environment. In addition the personnel dealing with the overall picture can decide on the merits of permitting it or not. It would also minimise conflicts between different departments.
2.	Consultant, Hydrogeology	i. as minerals a) Minerals normally requires the drilling of boreholes. The primary information gathered is to do with geology. However that same hole can provide information on hydrochemistry, temperature, and water flows as they vary with depth. In addition to submitting mandatory information to the GSI on the mineral value of the hole, the additional data on hydrochemistry, temperature and flow could also be provided mandatorily. ii. as hydrocarbons a) Hydrocarbons normally requires the drilling of very deep boreholes. The primary information gathered is to do with geology. However that same hole can provide information on hydrochemistry, temperature, and water flows as they vary with depth. In addition to submitting mandatory information to the GSI on the mineral value of the hole, the additional data on hydrochemistry, temperature and flow could also be provided mandatorily. iii. planning laws only a) Exploration wells and site investigations are exempted under planning law. Should the opportunity arise as part of a planning process, conditions could be attached requiring certain information to be gathered and submitted. b) Where ground water is an integral part of the planning application such as a source of potable water, or a receptor for treated effluent, then all the investigation data should be submitted to the GSI for inclusion in the national ground water database by law. iv. Groundwater a) Ground water is protected by the Water Framework Directive (WFD) [2000/60/EC] and the Ground Water Daughter Directive (GWDD) [2006/118/EC] in terms of quality and quantity. Article 11, 3(j), mentions specifically the management of ground water in the context on geothermal but only to protect the quality of the water. There is no mention of geothermal in the GWDD. b) Any legislation with respect to ground water should be about the proper management and development of ground water as a source of energy. It should be encouraging the sustainable development of ground water for geothermal use in keeping with the spirit of both the WFD and GWDD. v. other a) Any government agency or semi state agency (e.g. SEI) responsible for providing assistance for the development of ground water as a source of geothermal energy should be obliged by law to have all the investigation data submitted to the GSI for inclusion in the national ground water database. vi. no regulatory system needed. a) I would respectively suggest that there should be controls be they mandatory requirements of voluntary guidelines to prevent the over development or exploitation of ground water in general and as a source of geothermal energy in particular. It would ensure that the developments are sustainable. It would also prevent unscrupulous people from taking advantage of peoples ignorance and resulting in the industry getting a bad name.
3.	Consultant	Planning Laws only as they already address the matter and the passing of new laws would only be an additional barrier to the development of our geothermal resources.
4.	Professional Body	An adaptation of the Minerals and/or the Hydrocarbons licensing systems would be favoured, given the history in dealing with deeper sub-surface resource regimes. The planning system seems appropriate with some changes to the EIS Regulations to incorporate a threshold for the assessment of environmental impacts associated with geothermal systems. Clarity would also be required regarding the application of the Discharge Regulations under the Water Pollution Act where pumped groundwater is either recharged into the aquifer or discharged to a surface stream.
5.	Consultant	Deep: The system of licensing of deep geothermal energy may refer as necessary to a number of legislation regimes. Whether there should be a separate Geothermal Act or whether amendments can be made to existing Acts is a matter for debate. In the partner states of the GTR-H project the natural fit for the regulation is unique for each country emerges rapidly from the existing approach to legislation of natural resources. In Ireland minerals legislation may provide a template for an effective administrative process. Hydrocarbon legislation may provide the approach for the definition of the area of the licence and the regulation of the drilling and development (as many of the issues that apply to deep drilling for hydrocarbons will apply to deep geothermal). Planning laws currently provide some effective regulation for surface installations and groundwater abstraction and will be amended in future to reflect adoption of the groundwater directive. Shallow: General opinion seems to suggest that only minor regulation is required for domestic shallow geothermal systems (up to a capacity of 30 kW or other limit) with some restrictions in the use of closed loop systems in areas of vulnerable aquifers.
6.	Energy Industry	A mixture of the above legislative regimes is needed. 1. Legislation dealing with the development of geothermal energy should follow legislation from other common law governed countries such as Canada and Australia. It should be contained in standalone legislation or alternatively included in Petroleum or Mineral Legislation. 2. Consideration should be given to the use of abstraction licenses under European groundwater legislation and also current Environmental Protection Agency guidelines for the protection of groundwater in Ireland. 3. Planning for geothermal energy exploration is exempt as per Class 45 of the Planning and Development Regulations 2001 as described above. 4. The issuing of a production licence from the Minister/Department of Communications, Energy and Natural Resources gives the right to drill the production boreholes, subject to an agreed standard. 5. Planning for surface works and the deployment of geothermal energy is subject to current planning guidelines and is administered by the local authorities.
7.	Consultant	The structure of the minerals legislation provides a suitable basis for legislating deep geothermal energy. The currently established license areas for exploration in the minerals sector as, clear guidelines on environmental issues as well as temporary exemptions from planning regulation for the purpose of exploration provide a stable platform to encourage investment in the sector and increase the understanding of deep geology in Ireland. Shallow geothermal energy, however, could be more effectively licensed under the planning laws ensuring that the requirements of other groundwater, environmental legislation are observed.
8.	Consultant - Legal	The geothermal exploitation techniques being used (e.g. extraction of heated water, as opposed to heating water by passing it through hot subterranean rocks) should influence the regulatory treatment. Planning laws would have to be taken into account when building above ground installations. The Planning and Development (Strategic Infrastructure) Act 2006 (the "SID Act") may be applicable in the case of major geothermal developments. When drafting legislation, it will be necessary to take into account any conflicts that may occur between mining rights and geothermal development rights. It is noteworthy in Queensland that mining activities may not be carried out if such activity adversely affects geothermal exploration (S6 Geothermal Exploration Act 2004, Queensland). In other jurisdictions, developments below a certain de minimis threshold (mainly relating to depth of boreholes and if the energy produced is for private use) do not need the permission of the relevant regulator.
9.	Consultant	SHALLOW, mostly through current Planning Laws and Groundwater Regulations; DEEP, mineral administration, hydrocarbon for deep drilling regulation, then as for Shallow.
10.	Energy Industry	No regulatory system needed.
11.	Energy Industry	Planning laws only.
12.	Potential Developer	No regulatory system needed.
13.	Potential Developer	No regulatory system needed.
14.	Landowner	No regulatory system needed.
15.	Landowner	No regulatory system needed.
16.	Private Person	As hydrocarbons.
17.	Private Person	As hydrocarbons.
18.	-	Im not sure, but environmental concerns should be foremost, and of the highest concern. Protection of ground water is vital.
19.	Geology Graduate	Groundwater.
20.	Geology Graduate	Groundwater.
21.	Academic and Consultant	Groundwater.
22.	Academic and Consultant	Groundwater.
23.	Consultant	planning laws only; groundwater
24.	All-island representative body	SHALLOW 1. planning laws; 2. groundwater, through Water Framework Directive (when it is in place). DEEP Minerals for administration, but hydrocarbons where areas have similar technical problems.
25.	Business representative body	A mixture would be necessary to provide the most suitable form of regulation.
26.	Local Auth./Local Energy Agency	Groundwater legislation.
27.	Private Person	Groundwater.
28.	Energy Industry	Possibly minerals or hydrocarbons – not really sure.
29.	Private Person	Geothermal developments fall under the ambit of many pieces of legislation such as land, planning, water, environmental laws. As analogies admittedly do exist to the mining for minerals or hydrocarbons and geothermal exploration and drilling, the potential exists for geothermal to be subsumed into mining laws. It is common in other member states for geothermal developments to fall under the mining regime. However, consensus amongst those currently involved with geothermal developments in Ireland suggests that the application of mining law is unnecessary (in particular for shallow developments) and would deter commercial exploitation of geothermal. In comparison to scale of and return from shallow geothermal developments the burden and cost of administrative compliance and other associated hurdles found in the minerals legislative regime (such as the imposition of royalty payments potentially making investment unattractive. As such I do not believe that geothermal resources should be considered analogous to minerals or hydrocarbons for the purpose of regulation. Most notable is the extant application of the planning and environmental law regime to geothermal developments. The experience of many developers i.e. engineers is that these laws suffice at present. I agree to some extent but believe that appropriate amendments ought to be made, particularly in the planning regime. Planning For shallow geothermal, the planning legislative regime would provide the most suitable form of regulation for the exploration for and development of geothermal energy because the Planning and Development Acts (as amended) provide the statutory basis for sustainable development and protecting the environment and our natural and architectural heritage where development works such as excavation or building are carried out in, on, above or under land. The planning regime is user friendly and has the benefit of being familiar to many developers and investors and also for the average person who may use geothermal in their homes or on their land. The planning regime has proved flexible to allow for amendments such as the recent Planning Development Regulations 2007 (Statutory instrument ("S.I."). 83 of 2007) which provides an exemption for certain domestic heat pumps from Part 1 of Schedule 2 of the Planning and Development Regulations 2001 (S.I. 600 of 2001). The Planning and Development Regulations 2008 (S.I. 235 of 2008) amends Schedule 2 of the Planning and Development Regulations 2001 (S.I. 600 of 2001) with regard to the installation of heat pumps in industrial buildings or business premises. The regime takes into account the proper planning and sustainable development of the area (e.g. appropriate land use (zoning), road safety, development density, size, location, adherence to established planning and development practices), the locality's own development plan, Government policy, Special Areas of Conservation, Special Protection Areas, submissions and observations made by members of the public on the application. The planning regime might provide for investor certainty in that assessment of applications could take into account existing geothermal developments and the impact that a new concurrent and proximate development might have on the extant project. The planning regime might provide that due to the risk of depletion of the resource it is inappropriate for the second in time development to be allowed take place. This would give developers certainty of exclusivity in their defined area. Overall my experience with the planning process is that with geothermal specific amendments to the extant regulations, the planning law regime should best regulate geothermal developments. It can be noted that in the U.S.A where a conflict occurs i.e. parcel of land has minerals and geothermal resources then a cooperative agreement is entered so that the geothermal and mining resources are concurrently developed and exploited. In this instance then each developer should be under a duty not to unreasonably interfere with the development rights of the other. Deep geothermal development cannot but fall under the planning law regime as a major infrastructural project which would make a material (i.e. significant) change of use of land under the Planning and Development (Strategic Infrastructure) Act 2006. Schedule 7 of the also needs to be considered regarding deep geothermal developments which may or may not fall under the provision for "A thermal power station" i.e. where geothermal is combined with CHP such as in Southampton or alternatively under the provision for "an industrial installation for the production of electricity, steam or hot water with a heat output of 300 megawatts or more." Clarification is needed as to whether non electricity producing deep geothermal developments could appropriately be considered by ABP under the Strategic Infrastructure Act. If so, then the Strategic Infrastructure Act will need amendment. Overall, further studies must be done in order to ensure that the development of geothermal resources could appropriately and expressly be dealt with under the planning laws in Ireland. Mining On the other hand, for deep geothermal developments perhaps the minerals legislative regime would provide a suitable form of additional regulation for the exploration for and development of geothermal energy based on the similarity of scale and geological considerations in deep drilling involved in exploiting deep geothermal resources. I am sure that the following paragraphs may be to the chagrin of many developers who have undertaken deep drilling projects in search of geothermal resources, but it is still worth consideration of the application of the minerals regime. It appears that the definition of minerals under the 1940 and 1979 Mineral Development Acts (as amended) does not cover geothermal resources and as such in order to come under the minerals legislative regime amendments will have to be made to section 3. However, it cannot be ignored that the essential distinction between geothermal resources and minerals is that the geothermal resource is not finite. With proper re-injection and adherence to environmental considerations the resource can be maintained indefinitely. As such any State mining facility's duration would have to be for a considerable amount of time i.e. 50 years. If the minerals legislative regime was to be utilized for geothermal then a similar series of permits and licenses could be arranged for the development of deep geothermal resources i.e. prospecting licenses and state mining facilities. Again, as with minerals development, planning permission and an Integrated Pollution Prevention and Control License and an Environmental Impact Statement should be obtained for deep geothermal developments as is necessary under the minerals legislative regime. The State Mining Facility provisions and conditions (such as those for mine closure plan inclusive of a bond to secure financing of mine closure and a long-term maintenance and monitoring plan) could be adapted and made applicable to the grant of a geothermal resource development permit and exploitation facility. However, as set out above the negative implications of the minerals regime such as the potential imposition of royalties, administrative costs and delays etc. may not be suitable as proving to be a deterrent to commercial exploitation of geothermal resources. Water Law The hydrological implications of any geothermal development cannot be ignored. It is common in other European member states such as Germany and Lithuania to treat geothermal according to the heat carrier i.e. where appropriate regulation as water source or alternatively through mining law. In Ireland it seems that both legislative regimes will be implicated by exploration and development of deep geothermal resources. Both deep and shallow geothermal developments (in particular deep geothermal) will likely encounter both geological formations and groundwater issues where thermal waters are developed. The EPA found that most bedrock aquifers in Ireland are unconfined and a geothermal development will have to take account of this. Over abstraction must also be addressed in a legislative regime i.e. planning & development regulations. Any legislative regime will have to be cognisant of the EU Groundwater directive which will be applicable to open loop discharge. A discharge license will be required from the appropriate body especially where deep systems produce brines. As groundwater is the main source of drinking water the existing laws may need to be clarified for developments (and amended if studies show it necessary) in relation to geothermal so that geothermal developments do not affect groundwater quality. Pollution of groundwater will detrimentally affect the public profile of geothermal and also to maintain investor certainty as clean up operations could incur significant costs or risk closure of the geothermal development. The environmental and water quality standards set out in the various water pollution acts and regulations should be made expressly applicable to geothermal developments or referenced in a geothermal legislative regime. Guidance should be given to local authorities on how they should deal with queries and licensing relating to discharge from geothermal installations. Clarity on the issues and risks of water pollution from geothermal activities is key in order to prevent instances of pollution. All involved should be aware of their respective duties, responsibilities and liabilities so that they can properly provide for avoidance and mitigation of risks to the environment. A study of the application of the Water Framework Directive ("WFD") (to be fully implemented by 2015) is vital as the WFD drives water policy. Analysis of the implications of the WFD to geothermal developments is also necessary. A challenge to address in advance of a legislative regime for geothermal is that currently not all waters in Ireland currently meet the 'good status' objective of the Water Framework Directive. Discharge licenses should also be considered in any legislative regime as well as the mandatory requirement where the exploitation of geothermal involves re-injection.
30.	Local Authority	Groundwater protection in terms of pollution (thermal and chemical) should be the main basis of control.
31.	Private Person - Consultant, Engineering	Groundwater
32.	Consultant	Groundwater

Q8. If a permitting regime is required for exploration for geothermal resources: i. Is it appropriate to have a system similar to that for minerals or hydrocarbons with exclusive rights to exploration in defined areas? Yes / No ii. If yes, how should the areas of licences be defined?		
No.	Category	Response
1.	Local govt.	NO. Each exploration regime should require a permit system. If at present a planning permission is required for a "change of use" in a building which is obvious to the majority of people in passing, how more important it is that we know what someone may be doing to the unseen resources beneath the ground. In any case in the future it will be necessary for us to quantify everything that is abstracted or inputted into the ground (e.g. carbon storage) and the impacts that the particular operation will have on the surrounding environment.
2.	Consultant, Hydrogeology	a) There should be a differentiation between low enthalpy and high enthalpy geothermal energy. I would not agree that there should be any spatial restriction to the development of low enthalpy geothermal resources by individuals or companies. The development of geothermal resources tends to be on a development by development basis for space heating or cooling. The viability of such projects depends on the local availability of ground water in the top 50m to 150m. b) High enthalpy energy would be targeting ground water at depths of at least 700m (25°C) to 1450m (40°) or deeper. This would require a considerable financial investment of many hundreds, if not millions, of Euro. Such costs could only be justified on the basis of a large commercially viable end user. This could be very large commercial developments, hospitals, or residential district heating schemes. Where such an investment was being made then I would consider that the developer be afforded some protection for their investment. This could be in the form of a licensing system whereby the developer is allocated the exploitation rights. c) The country is now divided into ground water bodies. These are based on aquifer types. A licensing system could allocate licence areas for the exploitation of deep high enthalpy geothermal ground water on a ground water by ground water basis. This would provide some scientific basis to the delineation of licence areas.
3.	Consultant	NO. Licences would be another barrier and the planning act should handle this. With the small number of deep open loop systems is it worth the effort to set up a licensing system and the shallow open loop system have been developed for years without any licence being needed without any problems that I have heard of.
4.	Professional Body	i. Clarity on ownership is required. If State own rights to geothermal energy then a permitting system is required, if not, the planning system should suffice. Yes, it is appropriate – ownership can be retained by the state, but security of tenure for operators, based on a licensing system akin to exploration for minerals/ hydrocarbons is favoured; otherwise will not be able to stimulate commercial scale exploration and development. ii. Clarity on ownership will determine whether a geothermal system can take energy located beneath a neighbouring property with or without the owner's approval. Exploration licences can be defined in exactly the same way as for minerals/ hydrocarbons.
5.	Consultant	i. Deep: Yes these areas of legislation may provide a template for the licensing of exploration for deep systems as the investment for both is large and not risk free. Shallow: No for shallow systems. ii. Deep: As mentioned above the area of the licence could be defined in some way similar to how hydrocarbons licences are defined. Initially by the applicant (up to an area limit) but based on hydro-geothermal parameters and negotiated by the licensing authority based on their technical assessment of the request. With shallow systems there may need to be some limit on the distance to a geothermal or water abstraction borehole of neighbouring systems.
6.	Energy Industry	Yes, similar to the current mineral and hydrocarbon licensing system but with nominal licensing fees to ensure the successful uptake of the exploration of geothermal energy and the licence area granted should be determined by the applicant and should be subject to sound geological reasoning.
7.	Consultant	i. Yes, for deep geothermal systems. ii. Shallow geothermal exploration should not be the subject of any licensing as no current legislation covers the completion of boreholes for the purpose of groundwater or site investigation (Class 45, Exempt Developments . General, Planning and Development Regulation, 2001, SI 600). Deep geothermal exploration license area should be defined based on a set of defined exploration licenses for deep geothermal energy. Exploration should be exempt from current planning conditions similarly to minerals and hydrocarbon exploration as per Class 5, Part 3, Exempt Developments . Rural, Planning and Development Regulation, 2001, SI 600.
8.	Consultant - Legal	Other jurisdictions, primarily Australian, that have legislated for geothermal exploration / exploitation have based their licensing regime on dividing areas into blocks and issuing exploration and exploitation licences accordingly. This would be the most convenient method as the system is familiar from minerals and hydrocarbons licensing regimes. This is also a feature of European permitting regimes, such as that in place in Germany under the Bundesberggesetz. Retention Leases are also a feature of a number of Australian jurisdictions' legislation – these allow an exploration licence holder to retain rights to a discovery that may become commercially viable within a certain period. Provision in legislation for a retention period would add further incentive to explore and develop potential geothermal resources.
9.	Consultant	i. SHALLOW mostly NO, though some systems may need more exploration and hence protection, DEEP YES ii. Similar to Mineral Exploration Licences
10.	Energy Industry	-
12.	Energy Industry	No
13.	Potential Developer	No
14.	Landowner	No
15.	-	-
16.	Private Person	No
18.	-	Yes. I really haven't any experience of this area. I would think that the licences should be geographically defined. Limited as to area and depth that the licensee can drill. Have to keep expert records of what they do and find. Post a large bond to prove they are not cowboys. Put surface back as it was before they started. Report their findings to government (like SEI) to increase knowledge of geothermal.
20.	Geology Graduate	No
22.	Academic and Consultant	Yes. By over-the-counter applications for grid-referenced areas capped at a maximum area. 5 year work programs submitted, with first two years committed.
23.	Consultant	i. Yes, some rights i.e. water can be shared, but first come first served; ii. Defined by zone of influence of abstraction/ recharge and data on plume migration from similar systems where aquifer behaviour is understood.
24.	All-island representative body	i. For SHALLOW - NO, For DEEP – Yes; ii. For SHALLOW -Through Planning Laws, Discharge Licences, etc.; For DEEP -Through Planning Laws, Discharge Licences, etc.
25.	Business representative body	A regime similar to the current mineral licensing system.
26.	Local Auth./Local Energy Agency	No. Licences should be granted on the basis of groundwater abstraction and its effects on surrounding aquifer similar to current groundwater legislation.
27.	Private Person	Yes. Use existing PL system.
28.	Energy Industry	Yes, Probably a grid reference system of some sort
29.	Private Person	(See my thoughts above at answer no.7)
30.	Local Authority	No. Licences shall be obtained on the basis of groundwater abstraction and their effect on the existing aquifer. The permitting regime should be required for development of geothermal resources, but it should not be similar to that for minerals or hydrocarbons.
31.	Private Person - Consultant, Engineering	Yes. It would make sense to follow geological divisions and watersheds.
32.	Consultant	-

Q9. If a permitting regime is required for development of geothermal resources:		
i. Is it appropriate to have a system similar to that for minerals or hydrocarbons with exclusive rights to exploitation in defined areas? Yes / No		
ii. If yes, how should they be defined?		
No.	Category	Response
1.	Local govt.	I do not know the system used for hydrocarbons but I would expect that it would be based on the standard main criteria but would also include the environmental impact caused and the mitigation measures necessary to minimise damage to the environment. The assessment should also include a long term view based the principles of sustainability, climate change and the loss of the asset to future generations.
2.	Consultant, Hydrogeology	See Above for Item 8.
3.	Consultant	Same answer as to 8 above.
4.	Professional Body	i. Clarity on ownership is required. If State own rights to geothermal energy then a permitting system is required, if not the planning system should suffice. Yes, it is appropriate – ownership can be retained by the state, but security of tenure for operators, based on a licensing system akin to mining/ extraction of minerals/ hydrocarbons is favoured; otherwise will not be able to stimulate commercial scale operations. ii. If owned by the State it would be incumbent on the Applicant to define the extent of the systems radius of influence and its potential impact on other systems. Development licences can be defined in exactly the same way as minerals/ hydrocarbons.
5.	Consultant	i. Deep: Yes for deep resources. Shallow: No for shallow resources. ii. Deep: For deep geothermal resources hydrocarbons and ground water (currently in the Planning and Groundwater Pollution Acts) regulations could be used to provide a template for a permitting regime or in fact to directly regulate geothermal resources by amendment of the current hydrocarbon and groundwater/planning legislation.
6.	Energy Industry	Yes, similar to the current mineral and hydrocarbon licensing system but with nominal licensing fees to ensure the economic viability of the exploitation of geothermal energy and the licence area granted should be defined by the applicant and should be subject to sound geological reasoning.
7.	Consultant	i. Yes for commercial systems over a certain size only. ii. The exploitation or development licenses areas should be defined based on the radius of influence (deep geothermal well doublet, open loop ground source heat pump or closed loop) during the lifetime production of the system. This should be presented by the applicant upon the application of the license, reviewed by an expert group and corroborated with some obligatory monitoring during the course of production. Existing Irish regulation shows the model of onshore hydrocarbon licensing structure may be appropriate to define geothermal exploitation licenses. Larger, shallow geothermal commercial systems over a certain output power rating (eg: 30kW) should be regulated based on a submitted production model. This would have to outline the impact on aquifers for open loop systems and the effect of subsurface temperatures based on a given production period as part of the requirements of an EIS for new developments. These could define a given license area and provide investor security. Existing systems should also be permitted based on presentation of similar production models and existing monitored operating parameters. Residential shallow geothermal users should have an obligation of reporting the installation of systems with limited or no licensing requirement if no discharge to surface waters occurs. A national standard on borehole completion (for both open-loop and closed-loop system) should be established similarly to those currently available for the groundwater sector. A simple submission detailing the type of system installed should be implemented through local authorities or government agency with the responsibility for geothermal energy development.
8.	Consultant - Legal	As above in item 8.
9.	Consultant	i. SHALLOW some systems may need protection, especially as density of development increases; DEEP YES ii. Similar to mineral licences, but based on the system being installed with a good buffer zone.
10.	Energy Industry	No.
12.	Energy Industry	No.
13.	Potential Developer	No.
14.	Landowner	No.
15.	-	-
16.	Private Person	No.
18.	-	Yes.
20.	Geology Graduate	No.
22.	Academic and Consultant	Yes. Long time frame, large enough to encompass all the defined resource or all the resource that will be exploited over the time-frame of the development licence.
23.	Consultant	Same answer as to 8 above.
24.	All-island representative body	i. For SHALLOW - NO, For DEEP – Yes; ii. For Deep - Based on production models of system by applicant, with a reasonable buffer zone. Require re-injection for deep open wells.
25.	Business representative body	A regime similar to the current mineral licensing system.
26.	Local Auth./Local Energy Agency	No. Licences should be granted on the basis of groundwater abstraction and its effects on surrounding aquifer.
27.	Private Person	Yes, geographic areas.
28.	Energy Industry	Yes, same answer as to 8 above.
29.	Private Person	Yes – in that exclusive rights to explore and exploit defined areas but this may be more appropriately dealt with by the planning regime i.e. require demonstration of no impact to existing development. (See my thoughts above) No – in that as set out above, I believe the mining regime would be too onerous for shallow developers to comply. Also, the mining regime might be inappropriate for deep geothermal developments as making investment commercially unattractive.
30.	Local Authority	No. Licences shall be obtained on the basis of groundwater abstraction and their effect on the existing aquifer.
31.	Private Person - Consultant, Engineering	Yes. This qn seems to be a repeat - like the previous one.
32.	Consultant	-

Q10. How could a permitting regime provide security to private investors seeking to develop geothermal energy? For example should 'Zones of Influence' be considered?		
No.	Category	Response
1.	Local govt.	Yes, Zones of influence should be considered. The strains that the environment will be subjected to over the next 50 to 100 years makes it essential that we know as accurately as possible what the impact and extent of any exercise that we carry out will have. We can no longer proceed, with what is now known as reckless behaviour, in harvesting an asset in an uncontrolled manner as we have done with most natural resources to date. I suppose it is called "good husbandry" of our resources.
2.	Consultant, Hydrogeology	a) I would discriminate between low enthalpy and high enthalpy energy. Low enthalpy geothermal sources develop near surface (within 150m of the surface) ground water. The law as it stands allocates all water on a first come first served basis as long as it not contrary to the common good. On this basis the development of near surface ground water can be controlled as part of the planning process and the current legal framework. Third parties would have an opportunity to review the application and make objections as appropriate. Controlling ground water as part of the planning process would require the management of ground water data from previous applications. This is not currently happening. b) As I indicated above the development of deep high enthalpy geothermal ground water could be controlled by licensing on a ground water body basis. This would protect the investment. Such licensing would have conditions and a review procedure.
3.	Consultant	By using the planning acts; no permitting regime is required – a permitting regime would at this time be a barrier to development. Zone of influence should of course be considered but only in the context of a planning application.
4.	Professional Body	Potentially yes but the onus would have to be on the Applicant to define the extent of its zone of influence and any potential impacts on other geothermal systems and groundwater abstractions. Zones of influence could be considered, but the grounds by which such zones could be exploited/ shared would have to be very clearly defined in the regulatory regime. What would happen for instance at the zone of influence of the zone of influence if further resources were defined within?
5.	Consultant	Deep: By giving exclusive rights to exploit the resource/extract heat in a defined area this gives security of investment as with other resources licensing schemes and will encourage the sector. Zones of influence or other means of ensuring that the resources are free from competition should therefore be considered. Consideration could be on a case by case basis by the licensing authority and would therefore require geothermal and hydro geological expertise either within the licensing authority/agency or sub-contracted to that agency.
6.	Energy Industry	A permitting regime could provide security to private investors seeking to develop geothermal energy by providing security of tenure in a very speculative sector in specific areas throughout Ireland. It is difficult to envisage how investment would be made without this permitting regime. In addition, zones of influence must be considered which are determined by the applicant and based on sound geological reasoning as this would eliminate any third party conflict and would prevent the positioning of geothermal plants too close together. Zones of influence would ensure a more commercially viable project and thus reduce the risk to private investors seeking to develop geothermal energy.
7.	Consultant	Yes, zones of influence need to be considered to characterise the impact and extent of any type of geothermal energy abstraction system. Large commercial, shallow or deep geothermal systems are likely to broader environmental impact. Production models should be calculated based on the proposed production rates over the expected lifetime of any given system by a license applicant. Subsequent to review this should define an influence zone in which no other developments of a similar size to the licensed ones should be permitted. A provision for the inclusion of shallow geothermal systems in these areas should be made as these are not likely to interfere with deep geothermal energy abstraction. Environmental Impact Assessments for these projects should help determine these 'Zones of Influence'. Environmental Impact Assessment Regulation, 1999 (SI 93/1999, Part 2, Art.2 Extractive Industry, makes reference to: 'All geothermal drilling ... other than test drilling, .. Where the expected supply would exceed 2 million cubic metres per annum.' Article 3 of SI93/1999 makes reference to the Energy Industry, stating in part (a) that: 'any industrial installation for the production of electricity, steam and hot water...where the heat output is greater than 300MW...and in part (b) that: ...transmission of electrical energy by overhead cables...where the voltage is 200kV or more.' Possible amendments to this regulation could be made to cover the potential impact of large scale geothermal systems. The outlined water abstraction figures, installation ratings and electrical production may be beyond the reach of most geothermal power plants in Ireland. Ireland is considered to have medium to low enthalpy geothermal resources. These values may not be achieved easily in these geological conditions.
8.	Consultant - Legal	As mentioned above, the incorporation of a 'retention period' would allow investors to hold onto exploration/exploitation licences that may become commercially viable due to factors such as improved technology or higher returns on investment. It will be important to establish ownership of the resource, i.e., should geothermal energy be treated like any other mineral resource and remain the property of the state (and thus allow for the payment of royalties etc.), or should any geothermal resource be the property of the landowner. It is interesting to note that in Germany all geothermal energy is the property of the Federal administration and that in Victoria, Australia, any geothermal energy is the property of the Crown until it is exploited in accordance with the Geothermal Energy Resources Act 2005 (Victoria), upon which time it becomes the property of the person extracting the resource.
9.	Consultant	Similar to the granting of a mining license, but with individual case scrutiny based on an EIS.
10.	Energy Industry	-
12.	Energy Industry	Planning laws specific to this area could be drafted. A free for all is not needed but community's should be facilitated in a way wind farms were not, i.e. there should be scales of burden. (these figures are just for descriptive purposes only) 1) Anything under 500kw could be low burden (community's/individuals rather than commercial). 2) Anything under 10 MW could be medium burden (with 49% ownership being "offered" to community's in the area of situation) 3) Anything over 10MW could be high burden (large scale commercial).
13.	Potential Developer	Not if proper legislation protecting the rights of the individual were introduced.
14.	Landowner	No. Zones of Influence should not be considered. Open and accountable granting of Permission is all the security needed.
15.	-	-
16.	Private Person	No, a simple tax relief or % of the resource delivered to market on target.
20.	Geology Graduate	-
22.	Academic and Consultant	Long time frames. Certainty on issues such as royalty levels. Large enough areas to encompass adequate resource for extended growth and exploitation. "Zones of influence", if the issue ever arises, should be dealt with in the same manner as the petroleum industry: i.e. unitisation.
23.	Consultant	Need to consider how the rest of Europe does this but consider protection zones used for groundwater source protection and monitoring boreholes to define zone of influence for open loop systems.
24.	All-island representative body	SHALLOW & DEEP EIS / Planning application to require demonstration of No Impact on existing geothermal or water schemes, where appropriate.
25.	Business representative body	A permitting regime could provide security to private investors seeking to develop geothermal energy by providing security of tenure in a very speculative sector in specific areas throughout Ireland. In addition this regime would allow for clearly defined geographical areas and as a result would eliminate third party conflict and would prevent the positioning of geothermal plants too close together.
26.	Local Auth./Local Energy Agency	Each Development should be treated on its own merits, including consideration of Zones of Influence of the development.
27.	Private Person	don't know.
28.	Energy Industry	-
29.	Private Person	(See my thoughts above at answer no.7)
30.	Local Authority	Each Development should be treated on its own merits.
31.	Private Person - Consultant, Engineering	No view.
32.	Consultant	See 17 below for response to this and Q 8,9 & 11.

Q11. What ancillary rights are required in order to provide for the orderly development of geothermal resources?		
No.	Category	Response
1.	Local govt.	While I have very little knowledge of such rights I do believe that the overriding one should be the "rights of the greater community" as compared with the rights of an individual or company. Following this the minimisation of impact on surrounding areas is essential
2.	Consultant, Hydrogeology	Abstraction of geothermal water normally requires its reinjection to ground or its disposal to surface water. Ancillary rights might include the assurance to the developer that they will be permitted to continue such discharges even though it may result in other third parties not being able to undertake their own developments.
3.	Consultant	No ancillary rights are required for the orderly development of the geothermal resource.
4.	Professional Body	Clarity on ownership. Royalties to the State could be considered for deeper, larger resources.
5.	Consultant	Shallow and Deep: Groundwater issues such as rights to reinject or discharge (clean water) and also the reinjection of mineral rich formational water (which may be defined as contaminated by the current Groundwater Pollution Act) may need to be reconsidered in order to allow reinjection to maintain aquifer pressure and therefore protect the geothermal and potentially the groundwater resource. Planning guidelines may also need to include issues relating to large heatpump systems and district heating systems.
6.	Energy Industry	Ancillary rights required in order to provide for the orderly development of geothermal resources include the following: 1. The right to explore exclusively in an exploration licence area for a given period of time; 2. The right to develop a commercial production plant(s) and energy centre(s) exclusively in the given exploration licence area; 3. The right to drill and explore under third party land pursuant to public notice two weeks in advance; 4. The right to exemption from planning permission for exploratory works pursuant to Class 45 of the Planning and Development Regulations 2001; 5. Support in planning and roll-out of heat deployment and district heating infrastructure; 6. Recognition that energy plants may need to be constructed in built-up urban areas; 7. By the nature of the construction process of geothermal plants which may need to be located in urban areas, special temporary concessions need to be considered for the development of geothermal plants for the better good of the environment and the local communities; 8. The implementation of financial support through feed-in tariffs, other price support, grants, taxation incentives etc to assist in the speedy roll-out of geothermal plants; and 9. The right to have prior exploration work and commercial agreements which have commenced prior to the implementation of legislation recognised and prioritised when exploration licences are being issued.
7.	Consultant	Rights of exclusivity to a given geothermal license area should ensure that no other subsurface resource licensing be issue over an existing geothermal license area where the proposed operation is likely to interfere with the security of a shallow or deep geothermal abstraction. (eg: Carbon Capture and Storage in areas of operating deep geothermal well doublets or a development of large quarrying operations in the vicinity of large commercial open loop systems.)
8.	Consultant - Legal	The ancillary rights that will be required (or at least desired) by geothermal developers will include rights to access property and to carry out preliminary works and works related to exploration. So that development is "orderly", there must, however, be limits on the extent to which developers can access land for exploratory works without the consent of private landowners. Consideration should also be given to the use and enjoyment of adjoining or neighbouring landowners in relation to properties/land over which rights of entry and rights to carry out work are exercised. The subsequent exploitation of a project deemed to be viable could be a matter for commercial agreement with landowners, and there would not appear to be a strong case for the creation of additional statutory development rights for the later stages of a project. As was referred to in response to question 10, the ownership of any geothermal resource must be established by legislation.
9.	Consultant	Protection of utilisation of the resource.
10.	Energy Industry	-
12.	Energy Industry	No idea...needs careful review of all stakeholders.
13.	Potential Developer	rights for who ????????
14.	Landowner	A lot need to be considered. Access, pollution, infringement on area's of conservation.
15.	-	-
16.	Private Person	Pay the land owner the same terms as the developer. If it is state owned site the state should take the same deal as the developer for tax revenue. By the way question 8 and 9 are the same.
20.	Geology Graduate	-
22.	Academic and Consultant	Right to access freehold land (with due compensation)
23.	Consultant	Right to resource below land, protection of environmentally sensitive areas, protection of drinking water sources.
24.	All-island representative body	SHALLOW NONE; DEEP Multi-licensing issues to be considered. Problems of conflict of interest between e.g. deep geothermal and carbon capture and storage. Consider requiring re-injection for deep open schemes.
25.	Business representative body	Ancillary rights required in order to provide for the orderly development of geothermal resources include the following: 1. The right to develop a commercial production plant or plants and energy centre exclusively in the given exploration licence area; 2. The right to exemption from planning permission for exploratory works pursuant to Class 45 of the Planning & Development Regulations 2001; 3. The right to explore exclusively in an exploration licence area for a given period of time; 4. The right to drill and explore under third party land pursuant to public notice; 5. Recognition that energy plants will need to be constructed in built-up urban areas; 6. Support in planning and roll-out of heat deployment and district heating infrastructure.
26.	Local Auth./Local Energy Agency	-
27.	Private Person	Environmental problem areas clarified; how heat relates to water sources.
28.	Energy Industry	The right to develop heat distribution networks under public space, subject to the normal planning process and the right to be registered as a utility provider to customers.
29.	Private Person	See my thoughts above at answer no.7. Regulation of development of geothermal resources involves considerations of the applicability of land, environmental, water and mining laws. Orderly development requires regulatory certainty.
30.	Local Authority	Existing developments must have superior rights over proposed developments.
31.	Private Person - Consultant, Engineering	No view.
32.	Consultant	See 17 below.

Q12. Is there a need to protect existing (and future?) groundwater abstractions from interference by geothermal resource developments? If so, how could this be achieved?		
No.	Category	Response
1.	Local govt.	Yes, it is critical that a priority between water abstractions and geothermal needs are stated. This is one of the areas where the "larger community" needs may be more important. Who owns the water in the first place? It is for this reason that locating the permitting system in the area of Water Framework Dept will somewhat assist in resolving such issues. The impact of climate change in 50 to 100 years time will be determined by such decisions made in the present era.
2.	Consultant, Hydrogeology	a) All ground waters by law require to be protected. There are already registers of drinking water abstractions (which are not kept up to date). There are Drinking Water Protected Areas and Ground Water Safe Guard Zones delineated as part of the WFD. These will be part of the River Basin Management Plans. Therefore safe guards for existing drinking water sources are already available if they are policed. b) The planning authorities have an opportunity to protect ground water as part of the planning process.
3.	Consultant (Chairperson of the Geothermal Association of Ireland)	By applying the planning acts and requesting the developer to demonstrate that his/her open loop abstraction will not impact on existing groundwater abstractions or impact on the aquifer in such a way to prevent the further development of the aquifer.
4.	Professional Body	Yes. Best done under existing planning regulations together with amendments to EIS Regulations. Requiring all non-domestic geothermal systems to submit to the EIS process would ensure an open and public debate on potential impacts. Yes – a Strategic Environmental Assessment (SEA) approach could also be adopted.
5.	Consultant	Shallow and Deep: Geothermal resources need to be developed in a way which allows parallel development of groundwater resources where possible in the same area. They should be managed in the same way that groundwater resources are currently managed with some additional guidelines and recommendations that are more specific to geothermal projects (for ex. reinjecting issues - see section 11 above).
6.	Energy Industry	There is a need to protect existing (and future) groundwater abstractions from interference by geothermal resource developments. This can be done in a number of ways such as: 1. By following the European Directive 2006/118/EC on the Protection of Groundwater against Pollution and Deterioration and European Directive 2000/60/EC Establishing a Framework for Community Action in the Field of Water Policy. 2. By following current EPA guidelines on the non contamination of ground water; and 3. By the Department appointing a body of recognised experts to establish a detailed code of ethics, a best practice model and guidelines to be employed by geothermal energy exploration companies. It is envisaged that potable ground water aquifers should never be interfered with and should be protected at all times. In addition, any fluids from deep aquifers must be re-injected to maintain pressure balance and to ensure a continuous future supply of geothermal energy. Directive 2000/60/EC establishing a framework for community action in the field of water policy specifically provides at Article 11 (j) for member states to authorise the reinjection into the aquifer of water used for geothermal purposes.
7.	Consultant	Yes. The development of any large commercial geothermal abstraction facility (shallow or deep) should be subject to parts of the planning regulation. These will require the submission of an EIS. As part of this process an applicant should be able to determine the impact of the proposed production on groundwater resources. Amendments to the current EIS Regulations may be required to include geothermal energy.
8.	Consultant - Legal	The protection of abstraction rights will be required only where the holders of the threatened rights are not the same persons as those whose consent will be required for the development of a geothermal project – as parties in the latter category will be able to resolve contractually any conflict between their various water uses. Under a permit-based regime, conditions could be attached to any exploration/development licences, among which could be included requirements to prevent interference with already existing groundwater abstractions, or delimiting the extent to which some interference may take place. Alternatively, such conditions could be set out in legislation.
9.	Consultant	Yes. Demonstration in the application by EIS that there will be no undesired impact on any existing or planned abstractions
10.	Energy Industry	-
12.	Energy Industry	Deep deep borehole only where the temperature is high enough, by going for only one typical depth layer, it will substantially bring the bore cost down.
13.	Potential Developer	By first studying the legislation in Sweden.
14.	Landowner	Yes.
15.	-	-
16.	Private Person	YES, Do not allow any development where the abstraction problem is identified, or is seriously suspected after a survey is completed.
20.	Geology Graduate	over pumping from wells which extract heated water from buried valleys can lead to the progression of the seawater/fresh water interface further in land causing salt water contamination.
22.	Academic and Consultant	Yes. Access to known aquifers should be tightly regulated. Drilling through known aquifers should require cementing off and sealing of the aquifer to limit pollution. Wherever possible, water should be reinjected after the geothermal energy has been extracted.
23.	Consultant	Licensing of groundwater abstractions.
24.	All-island representative body	SHALLOW & DEEP YES. Use current planning regulations.
25.	Business representative body	There is a need to protect existing (and future) groundwater abstractions from interference by geothermal resource developments. This can be done by the Department appointing a body of experts to establish a detailed code of ethics, a best practice model and guidelines to be employed by geothermal energy exploration companies including: 1. that potable ground water aquifers should never be interfered with and should be protected at all times; 2. that any fluids from deep aquifers must be re-injected to maintain pressure balance and to ensure a continuous future supply of geothermal energy; 3. by following EPA guidelines on the non-contamination of ground water.
26.	Local Auth./Local Energy Agency	Yes, A detailed pumping test on the proposed abstraction well needs to be carried out prior to the development of the groundwater source geothermal project. The drawdown, recovery time, the scale of the cone of depression, the yield and the quality of the groundwater should be included in the pumping test report, which should be compulsory to carry out and made available to the permitting authority and the regulator.
27.	Private Person	yes - don't know.
28.	Energy Industry	Protection of existing and future groundwater abstractions from contamination would be very important. Codes of practice and monitoring procedures would be required, possibly under control of the EPA.
29.	Private Person	Yes, using the environmental considerations that form part of the planning law regime i.e. environmental impact statements and assessments. See my thoughts above.
30.	Local Authority	Yes, this is especially applicable to groundwater wells near coastal regions, which is very likely to be interfered by large amount of water abstraction for the geothermal development without reinjection. Large abstractions could result in saline intrusion. Also the large amount of abstraction might potentially have a negative impact on the yield of the well nearby, which depends on the property and characteristic of the aquifer (e.g. hydraulic conductivity, transmissivity, storativity etc). A detailed pumping test on the proposed abstraction well needs to be carried out prior to the development of the groundwater source geothermal project. The drawdown, recovery time, the scale of the cone of depression, the yield and the quality of the groundwater should be included in the pumping test report, which should be compulsory to carry out and made available to the permitting authority and the regulator.
31.	Private Person - Consultant, Engineering	Yes, there is a need. Meet by a regulatory system integrated with that for groundwater.
32.	Consultant	Yes; by provision of EIS for projects above a certain size.

Q13. How might geothermal developments impact on groundwater-dependent surface waters/ecosystems?		
No.	Category	Response
1.	Local govt.	The fact that we intrude into the depths with manmade equipment will by its very nature increase the risk of pollution or changes to the ecosystem. Information on the role of aquifers, particularly the deep ones has not been researched in Ireland. As a result it is very difficult to predict what will occur. While the GSI have carried out a great amount of work on our aquifers (refer to Ireland at Risk Paper, May 2007) the interaction of the aquifers and the surface water systems is not fully understood. It is therefore essential that before any geothermal work is commenced that the holistic picture of the water resources is fully understood.
2.	Consultant, Hydrogeology	a) Near surface, low enthalpy geothermal systems have the potential to impact on GWDTE in exactly the same way as any current or proposed ground water abstractions e.g. drinking water supplies, quarries and mines. The controls are already in place or will be in the very near future be in place as part of the River Basin Management Plans to protect GWDTE. In my opinion the potential controls are already available. b) Deep geothermal ground water sources, given their depth, are unlikely to ever impact directly on GWDTE. Such developments may impact on GWDTE indirectly in terms of surface works and discharges. The River Basin Management Plans, the planning process and an IPPC licence can already be used to control such developments. c) There maybe geothermal springs such as Louisa Bridge, St. Gorman's Spring or Kilbrook Spring that support GWDTE. These are the surface expressions of very deep sources of ground water. This water is moving upwards along very deep fault systems. Where such deep fault systems are being targeted for exploitation, then the investigative work must demonstrate that the abstraction of deep ground water has no negative impact on the GWDTE that the warm spring is supporting. This would be normal for any development that might potentially impact on GWDTE.
3.	Consultant	Groundwater developments of the open loop type could impact on groundwater – dependent surface water ecosystems by lowering the water table and restricting the natural flow to the receiving waters.
4.	Professional Body	Depends on type of system installed, its proximity to an ecosystem and the sensitivity of ecosystem. Systems that involve the removal of groundwater would likely have the greatest potential for impacts.
5.	Consultant	Shallow: For small systems with correct guidelines and monitoring zero impact would be the aim. The issues that may cause problems are undersizing of shallow systems (with the impact of freezing of the surface), incomplete reinjection in deep open systems and necessity to dispose of surplus groundwater after heat extraction. For shallow systems accreditation of all installers and drillers is required to eliminate any chance of leakage of closed geothermal systems. Reinjection parameters may need to be set in any new groundwater regulations. Proposed future IGI guidelines on the drilling of geothermal wells and the installation of are scheduled for completion in late 2008 (?) and will provide a useful guide for shallow and deep drilling. Shallow and Deep: For large systems (shallow or deep) surface installations can be regulated as for any planning application for surface developments and restrictions can be imposed on the use and impacts in the geothermal reservoir or groundwater body on a case by case basis to minimise aquifer impact. . it is not envisaged that general guidelines can be drawn up for this at least until more is understood about the parameters of the deeper resources.
6.	Energy Industry	During production there will be no impact on groundwater-dependent surface water/ecosystems. During construction there is potential for geothermal developments to impact on groundwater-dependent surface water/ecosystems. Deep geothermal projects have the potential for using high temperature saline water that may have a potential of being dissipated to other shallow fresh water aquifers if not mitigated correctly at the borehole construction stage. The saline water can be expected to be mildly acidic and highly mineralised and could have a potentially damaging impact on any surface or shallow groundwater ecosystems if not carefully protected. It is believed that by the clear adoptions of the current EPA guidelines and in addition, by implementing a best practice model and guidelines such as the "Guidelines for Good Environmental Practice in Mineral Exploration", deep geothermal water will not be allowed to interfere with surface or shallow groundwater ecosystems and geothermal developments will not impact on groundwater-dependent surface water/ecosystems. High priority should be placed on the establishment of the best practice model, guidelines and the code of ethics.
7.	Consultant	The impact to local ecosystems and surface waters will be entirely dependant on the proposed size/type of the systems to be installed and the sensitivity of the local ecosystems. Residential systems are likely to have a limited impact on local ecosystems irrespective if these are open-loop or closed-loop collector systems if these are less than 20-30kW in size. Larger, shallow geothermal commercial systems are likely to impact on subsurface and groundwater temperatures during the course of production. In the case of open-loop systems groundwater budgets are likely to also be affected. In high vulnerability areas open-loop systems with re-injection should be encouraged and monitoring of re-injection temperatures should be a requirement under license conditions and the imposition of a minimum re-injection temperature in high vulnerability zones could be imposed upon granting of the license. Single well open-loop systems with surface water discharge should probably not be encouraged in highly sensitive areas and an imposition of minimum discharge temperature in accordance with the national water discharge regulation should be imposed. Shallow closed loop commercial systems extracting heat through a borehole array are likely to have an impact of local subsurface temperatures. During the installation of these larger systems thermal response tests are carried to accurately size the collector area. These provide the necessary information to characterise the impact on subsurface temperature from a single well in the array and should be used to outline the potential impact of the entire collector area over a period of time. Deep geothermal abstraction systems need to be licensed only if re-injection it to take place. Stimulation and testing during the production phase needs to be able to demonstrate that no impact to shallower groundwater systems will occur as a result of production.
8.	Consultant - Legal	While we are not experts in the field, we understand that a certain risk does arise should heated water escape from the geothermal system into the water table and ultimately into surface waters/ecosystems. The effect of such an escape will depend on the temperature of the water released and the fragility of certain ecosystems to an increase or decrease in water temperature. The escape into any watercourse of any solution used in the heating process may also cause damage to surface waters/ecosystems by, for example, increasing the salinity of a body of water. It must also be recognised that drilling and general exploratory activities have the potential to adversely affect ecosystems.
9.	Consultant	SHALLOW & DEEP Improper well completion can lead to aquifer contamination; Uncontrolled extraction can impact on groundwater regimes. Which may cause springs to dry up. DEEP Reinjection to be required for deep open schemes.
10.	Energy Industry	-
12.	Energy Industry	Deep borehole should not impact.
13.	Potential Developer	It should not have any detrimental effect if properly designed.
14.	Landowner	not sure
15.	-	-
16.	Private Person	That's what the surveys would or should establish.
20.	Geology Graduate	-
22.	Academic and Consultant	Unregulated extraction of groundwater could lead to lowering of water tables with subsequent serious damage to ecosystems, and maybe tourism.
23.	Consultant	Potential long term impacts on quantity of groundwater available to ecosystems and impacts on quality if plume of hotter/ colder moves towards ecosystem.
24.	All-island representative body	SHALLOW & DEEP 1. Some negative impacts can be envisaged through improper well completion leading to aquifer, contamination; 2. Uncontrolled discharge can lead to aquifer contamination.
25.	Business representative body	During production there should be no impact on groundwater-dependent surface water / ecosystems. During construction there is potential for geothermal developments to impact on groundwater-dependent surface water / ecosystems. Through the adoption of the current EPA guidelines and in addition, by implementing a best practice model and guidelines such as the "Guidelines for Good Environmental Practice in Mineral Exploration", deep geothermal water should not interfere with surface or shallow groundwater ecosystems. High priority should be placed on the establishment of the best practice model, guidelines and the code of ethics.
26.	Local Auth./Local Energy Agency	Large volume water abstraction may increase the risk of pollution or changes to the ecosystem as well as reducing the yield of existing wells. Re-injection of low temperature reject water can minimise impacts on groundwater-dependent surface waters/ecosystems.
27.	Private Person	don't know
28.	Energy Industry	With deep geothermal systems there is the potential for acidic or caustic water to contaminate groundwater sources. Codes and standards would be required to ensure water from deep aquifers is contained within the system.
29.	Private Person	As with any drilling activity affecting the subsurface and ground water, contamination is a very real risk. Environmental and planning law can best provide the incentive to minimize any risk of contamination i.e. by the imposition of penalties and liability. (See my thoughts above at answer no.7)
30.	Local Authority	Over pumping can reduce the yield of existing wells. Re-injection of low temperature reject water can prevent impacts on groundwater-dependent surface waters/ecosystems.
31.	Private Person - Consultant, Engineering	Hard to predict.
32.	Consultant	See 12 above.

Q14. How can the impacts be prevented or mitigated?		
No.	Category	Response
1.	Local govt.	If a holistic picture of the initial water system is understood then the impacts on the ecosystems will be understood. Each area will be different, some more resilient than others. Thus the main criteria will have to be set out at government level with the micro managed at a local level. In this way the mitigation measures can be tailored to each location. This is another reason why it is essential that official bodies are promoting knowledge so that reasonable solutions are worked out at a local level.
2.	Consultant, Hydrogeology	Any potential impacts on ground water from any geothermal development would be mitigated in exactly the same as such impacts on ground water are currently impacted. For example a diminution in resource is mitigated by alternative supplies, surface water augmentation and conditioning of discharges.
3.	Consultant	This impact can be mitigated by making it a condition of planning that it does not happen and asking the developer to prove this prior to granting of planning permission.
4.	Professional Body	Requiring all non-domestic geothermal systems to be subjected to an EIS would identify the range of potential impacts and the appropriate means of mitigating those projected impacts. It may be that the nature and/or scale of potential impact would rule out the geothermal project.
5.	Consultant	Shallow and Deep: Current planning guidelines and the Groundwater Pollution Act cover many aspects of this area at present with the successful development of mining projects requiring dewatering being a testament to this in recent times. However it is understood that changes will also arise under future groundwater regulations and these should take into account geothermal energy as another possible use of our groundwater resources. Shallow: In clean water abstraction it is recommended that maximum utilization of the geothermal/groundwater resource is encouraged in the design of the installation. This could mean for instance that a cascade system to include the use of the abstracted water as drinking water/process water or other innovative approach is considered after heat extraction (this is especially pertinent in certain counties where a large proportion of the municipal water supply comes from borehole sources).
6.	Energy Industry	In addition to the EPA guidelines, best practice model and guidelines, and code of ethics for exploration and drilling as detailed above, and Environmental Impact Statement should be prepared during the development phase that will detail the following: 1. Agreed well completion standards; 2. An agreed programme of well infrastructure maintenance; 3. Included in the project construction plan, details of actions for spillage and clean-up from geothermal fluids of working fluids used in geothermal plants.
7.	Consultant	For shallow extraction systems: Submit models showing impact on groundwater budgets to aquifers to be reviewed by independent experts; Submit models showing the impact to subsurface temperatures of closed loop collectors to be reviewed by independent experts; Where ecosystem sensitivity is too high, discourage use of open loop systems with no re-injection; Impose a minimum and maximum temperature that water can be re-injected or discharged to minimise ecosystem impacts in accordance with Discharge regulation and the Water Pollution Act; For deep geothermal systems impose monitoring at the exploration stage to show that re-injection tests have no impact on shallower groundwater regimes. A continued monitoring programme should be imposed during the course of the production life of the doublet. This will require independent review and assessment by an expert panel.
8.	Consultant - Legal	Existing environmental legislation provides a significant incentive for developers to minimise the chances of adverse environmental impacts arising – for example, causing pollution to watercourses is already a strict liability offence. Conditions may also be attached to licences granted by the Minister requiring that certain preventative measures should be carried out during both exploration and development phases.
9.	Consultant	Licensing of drillers and installers; Inspection by Council hydrogeologists if indicated.
10.	Energy Industry	-
12.	Energy Industry	...
13.	Potential Developer	By introducing a correct system of control and inspection.
14.	Landowner	Detailed planning, examination of existing cases
15.	-	-
16.	Private Person	This is getting tedious, I assume the relevant government dept., would know or should find out.
20.	Geology Graduate	prevent overpumping of wells. pumping tests need to be carried out before system is fitted to determine whether there is sufficient replenishment of the freshwater into the buried valley as to prevent the progression of the salt/fresh water interface further inland.
22.	Academic and Consultant	Require "baseline" studies prior to any development, and ongoing monitoring of the impact of geothermal activities on water table levels and groundwater quality.
23.	Consultant	Monitoring, modelling of potential impacts, delineate protection/ buffer zones.
24.	All-island representative body	SHALLOW & DEEP 1. Licensing of drillers and installers; 2. Assessment of the applications for deep development by the agency empowered to grant; licences and agreement on appropriate monitoring plans and development constraints. 3. Supervision by regulating body.
25.	Business representative body	In addition to the EPA guidelines, best practice model and guidelines, and code of ethics as detailed above, an Environmental Impact Statement should be prepared during the development phase that will detail how groundwater, dependent surface water and ecosystems will be protected.
26.	Local Auth./Local Energy Agency	By treating each development on its own merits and mitigation measures tailored to suit each location. Basic criteria should be set out at a national level by e.g. GSI/DEHLG and compliance managed at a local level by Regional/Local Authorities.
27.	Private Person	don't know
28.	Energy Industry	See our answers to questions above – licence to extract groundwater should be subject to strict regulation and controls. Geothermal developments should be subject to the Environmental Impact Assessments.
29.	Private Person	1. Licensing of drillers and installers; 2. Environmental impact statements and assessments carried out at the planning stage ; 3. Supervision by regulating body.
30.	Local Authority	By treating each development on its own merits. (see Q11)
31.	Private Person - Consultant, Engineering	No view.
32.	Consultant	See 12 above.

Q15. What are the implications for Local Authorities in the development of geothermal resources?		
No.	Category	Response
1.	Local govt.	The growth in population to possibly an island of 8 million people in 2100 means that anything which impacts on the water cycle will have major implications for the local authorities, who are the guardians of the water supply and the local environment. In this context the sustainability of any proposal will have to be balanced with future needs. In addition the growth in affluence with the corresponding growth in leisure activities particularly associated with water means that the surface water abstractions are under increasing threat of pollution and increased supply demands by LA's are contested vigorously by these competing forces. This means that groundwater sources will play an increasing role in future supplies and any other demand (e.g. geothermal) that uses this resource will have to be carefully studied. In some areas where water is abundant the local authority may be used to promote geothermal energy as an alternative source. In this situation the LA acts as a pilot experiment and provides the credibility and local knowledge previously mentioned to assist in the growth of thermal energy.
2.	Consultant, Hydrogeology	There should be no particular implications to Local Authorities in the development of geothermal resources over and above any impacts that are currently anticipated to ground water from the current types of developments. In my opinion the controls are already available. There would probably a deficit of internal expertise in geothermal energy which should be addressed through education of the regulators.
3.	Consultant	The Local Authorities will not be involved in a large amount of extra work in applying the planning act to open loop geothermal wells. Some of them already do this for shallow wells, both for geothermal and water supply use. For the deeper geothermal wells there will be very little impact due to the small number of projects – probably one per year for the country.
4.	Professional Body	If regulated under existing process additional expertise knowledge base required in order to be able to assess potential implication of such developments. Need for discharge licensing in open systems. If the development of geothermal systems is handled within the normal planning system and required to have an EIS then the role of the Local Authority will be no different than now where it might have to evaluate a major industry or quarry. The Local Authority can always seek additional technical advice as they did from the Geological Survey in relation to groundwater abstractions.
5.	Consultant	Deep: There may need to be expertise within the geothermal licence issuing agency for assessing applications for deep geothermal resources and devise boundaries, usage and monitoring plans. As stated above multiple uses of the existing water supplies to maximise and protect water and energy resources need to be encouraged.
6.	Energy Industry	The Minister of Communications, Energy and Natural Resources has a remit for policy formation as regards planning in the area of natural resources. The implications for Local Authorities in the development of geothermal resources should be minimal if the following procedures are followed: 1. Incorporated in the production licence issued by the Minister is the permission to drill production boreholes at the location previously explored; and 2. The Local Authorities to give permission for the construction of any surface works for the processing and deployment of geothermal energy under existing planning rules. The above procedures are believed to be the most efficient and effective for the Local Authorities as it would be unreasonable to expect every Local Authority to have the detailed expertise necessary to issue permission for the production drilling for geothermal resources. It is envisaged that the framework for geothermal licensing should not necessitate huge time and resources from each Local Authority. In addition to the above, the Local Authority should: 1. Give special consideration to geothermal projects as a form of renewable energy; 2. Promote the benefits of geothermal energy in the local community as per Local Authority's strategy to promote alternative renewable energy sources; and 3. Take into consideration the availability of geothermal resources in the preparation of future development plans in their area.
7.	Consultant	If the exploitation of geothermal energy by large commercial users is to be licensed in Ireland, irrespective of what licensing instrument is used, the national planning laws should be applicable to these developments. These will require, like any other or as part of any large scale developments, an EIS to be submitted. The role of the local authority will be no different to its existing role where it has to evaluate these for any large development. Additional technical information should be sought by the local authority through a national expert working group (to include GSI, EPA etc) and an approved network of independent experts.
8.	Consultant - Legal	Local Authorities will need to be mindful of the potential development of geothermal infrastructure within their administrative area when drafting Development Plans and when considering planning and zoning issues. Should geothermal developments be of a sufficiently large scale, it is possible that they may come within the auspices of the SID Act.
9.	Consultant	SHALLOW Planning regulations are core; DEEP Planning again is central, but needs special expertise not normally available at county level.
10.	Energy Industry	-
12.	Energy Industry	Changes to the planning process for low impact, regulatory input from CER into large scale electricity production. Deep Bore Geothermal should not be used for heat and it would require a new district heating infrastructure. The grid is already in place.
13.	Potential Developer	They should be the leaders in exploiting the use of all the existing 'geothermal resources under their control and thereby indicate to private individuals how to exploit resources at their disposal.
14.	Landowner	Major.
15.	-	-
16.	Private Person	It's an opportunity to help citizens develop green attitudes.
20.	Geology Graduate	In the case of district heating they would have to spend a lot of money on the purchase of land and the design and fitting of these systems.
22.	Academic and Consultant	Increased local employment prospects. Injection into the local economy during development.
23.	Consultant	Management of licensing of abstractions and monitoring.
24.	All-island representative body	SHALLOW & DEEP Currently the planning system provides the vital control for all developments including the ancillary aspects of developing geothermal resources, though this may need review in order to comply with any new geothermal legislation.
25.	Business representative body	Geothermal Energy is very positive for local authorities in addressing a key social/community/business issue, namely energy. The local authority should: 1. Give special consideration to geothermal projects as a form of renewable energy; 2. Promote the benefits of geothermal energy in the local community as per Local Authority's strategy to promote alternative renewable energy sources; 3. Take into consideration the availability of geothermal resources in the preparation of future development plans in their area. The implications for Local Authorities in the development of geothermal resources should be minimal if the following procedures are followed: 1. Incorporated in the production licence issued by the Minister is the permission to drill production boreholes at the location previously explored; and 2. The Local Authorities to give permission for the construction of any surface works for the processing and deployment of geothermal energy.
26.	Local Auth./Local Energy Agency	As Local Authorities have primary responsibility for water supply, any impacts on the volume/quality of fresh water supply will have implications for Local Authorities. In this context the sustainability of any proposal will have to be balanced with future needs as aquifers become increasingly important as a source of water supply to meet growing population needs. As the planning authority, the Local Authority should assess the risk to the aquifer and existing geothermal developments.
27.	Private Person	don't know
28.	Energy Industry	Geothermal developments will need to be carefully regulated. Obviously protection of the public water supply would be of major concern to Local Authorities. In their role as the planning authority they would set down requirements for environmental impact studies. They would also need to approve plans for the building of geothermal facilities and heat distribution networks.
29.	Private Person	Currently the planning system at local authority level provides the necessary order and control for all developments. Review and analysis of the extant planning regime as being applied to geothermal development is required. Also training needs to be provided to planning application assessors so that they fully understand geothermal resources and developments.
30.	Local Authority	As planning authority, the Local Authority should assess the risk to the aquifer and existing geothermal Developments.
31.	Private Person - Consultant, Engineering	No view.
32.	Consultant	None that Planning Acts cannot cover.

Q16. Which of the following do you consider would be the most appropriate regulatory agency for geothermal energy?		
	i.	Department of Communications, Energy & Natural Resources
	ii.	Department of Environment, Heritage & Local Government
	iii.	Commission for Energy Regulation
	iv.	EPA
	v.	Local Authority
	vi.	A combination of the above
	vii.	Other (please specify).
No.	Category	Response
1.	Local govt.	On a macro level the Dept of Environment, Heritage & Local Government should be in charge and the on a micro level the Local Authority will be responsible for giving the planning permission. The regulation part could be provided by SEI.
2.	Consultant, Hydrogeology	a) The control of deep geothermal sources could be controlled in the exact same way that mine developments are controlled. The Local Authority controls the planning issues, the EPA controls the IPPC aspects and the DCENR controls the actual exploitation of the resource (as happens with mines). b) Low enthalpy sources of geothermal ground water could be controlled primarily by the Local Authority as part of the planning process and their own environmental sections. i. Department of Communications, Energy & Natural Resources For deep (>500m) ground water sources for the permitting, monitoring etc as currently happens with the issuing of mine licences. iv. EPA For deep (>500m) ground water sources for the IPPC licencing as currently happens with the mines. v. Local Authority Planning issues in all cases; For the control of the development in terms of surface works etc and any discharges to surface waters. vi. A combination of the above See Above.
3.	Consultant	Local Authorities
4.	Professional Body	Local Authority. If a licensing system akin to Minerals/Hydrocarbons regime is adopted for exploitation of deep geothermal resources, then the DCENR is the best option.
5.	Consultant	Shallow and Deep: Predominantly the Department of Communications, Energy & Natural Resources with geothermal resources also mentioned as an instance of application of other regulations as appropriate, e.g. planning regulations etc. Deep: CER may also have a role if the development of a heat market in order to encourage CHP and the use of district heating schemes expands into Ireland.
6.	Energy Industry	Department of Communications, Energy and Natural Resources for deep geothermal resources and the Local Authority through planning laws for shallow geothermal resources.
7.	Consultant	Deep Geothermal - Department of Communications, Energy & Natural Resources; Shallow Geothermal- Department of Environment, Heritage & Local Government.
8.	Consultant - Legal	Licensing: Department of Communications, Energy & Natural Resources (perhaps with Department of Environment and EPA input re environmental protection requirements) The Commission for Energy Regulation will, by virtue of existing legislation, have an input should any exploration lead to the development of a source of electricity. Local Authority / An Bord Pleanála in relation to development of generation plants (Again, SID Act may be applicable).
9.	Consultant	SHALLOW, Initially Local Authority with others as necessary. DEEP, Should be lead by DCENR, with input by the others as required.
10.	Energy Industry	Department of Communications, Energy & Natural Resources
12.	Energy Industry	Commission for Energy Regulation.
13.	Potential Developer	A combination of the above.
14.	Landowner	Department of Environment, Heritage & Local Government
15.	-	-
16.	Private Person	Other: a dedicated supplier like the ESB but not a government department.
20.	Geology Graduate	A combination of the above.
22.	Academic and Consultant	Department of Communications, Energy & Natural Resources.
23.	Consultant	Department of Environment, Heritage & Local Government for planning; EPA for licencing; Local Authority for licencing.
24.	All-island representative body	SHALLOW Firstly through the Local Authority and Secondly through the EPA; DEEP DCENR.
25.	Business representative body	Department of Communications, Energy and Natural Resources.
26.	Local Auth./Local Energy Agency	On a National level, the Dept of Environment, Heritage & Local Government should determine regulations, which should be implemented at the local level the Local Authority.
27.	Private Person	Department of Communications, Energy & Natural Resources.
28.	Energy Industry	DCENR should control the licencing system. Local Authority would oversee planning process. EPA probably best positioned to deal with environmental impact issues.
29.	Private Person	1. Department of Environment, Heritage & Local Government ; 2. EPA ; 3. Local Authority ; 4. DCENR.
30.	Local Authority	Local Authority.
31.	Private Person - Consultant, Engineering	-
32.	Consultant	EPA

Q17. Any other comments?		
No.	Category	Response
1.	Local govt.	All resources are now limited, even those not yet developed, so the implications of developing new ones have to be studied in detail to ensure that we are getting the optimum use with the minimum of impact and not compromising the needs of future generations. There is a place for geothermal energy but the available capacity needs to be defined and then the rules placed in legislation.
2.	Consultant, Hydrogeology	-
3.	Consultant	It is important to remember that geothermal energy is a relatively new development and any new regulations should be to support the development in particular the deep open loop system. The planning acts with perhaps some new ministerial regulation is sufficient to regulate the development of geothermal water.
4.	Professional Body	Geothermal systems could be readily regulated within the planning system as long as additional environmental studies had to be presented as part of the planning application. Ideally those studies should be carried out by a Competent Person with appropriate experience and qualifications.
5.	Consultant	Deep: It is recognised at this early stage of the development of a deep geothermal market that there may be a need to support the geothermal area through similar mechanisms to those used in the minerals and hydrocarbons sectors to encourage the exploration and development of geothermal resources. Similar issues of high risk for investment exist in this fledgling sector especially where there is so little available information. Promotional activities for licensing opportunities and exploration incentives as used in other resources sectors maybe a possible approach. Tax incentives for the renewable energy sector in general as well as more specific mechanisms such as risk insurance funds for deep exploratory (and in some cases development have been found to be successful in other jurisdictions. It is also pointed out here that the debate for the best approach to the regulation sector needs to be widened out to incorporate the experience in the EU where there has been experience of deep geothermal developments as it present experience in Ireland is mostly limited to the Shallow geothermal sector.
6.	Energy Industry	There are many reasons why geothermal energy is important to the Irish economy and Irish environment such as: 1. It is an indigenous natural resource which will reduce Ireland's reliance on price volatile fossil fuels such as oil and gas and on renewable energy fuels such as wood chip pellets. This will improve Ireland's energy security of supply. 2. It has practically zero carbon and other green house gas emissions. 3. The roll-out of commercial geothermal plants will assist the government in achieving their difficult Kyoto and European directive targets for energy and emissions such as the target to source 5% of heating from renewable resources by 2010 and 12% by 2020. 4. Unlike solar or wind or ocean, geothermal plants are unaffected by changing weather conditions and can operate almost 100% of the time. 5. The energy produced is highly efficient if distributed properly with only 0.3% of a degree of heat loss for every kilometre travelled. 6. There is huge future potential through enhanced geothermal systems to produce electricity from the geothermal energy available in Ireland and with further research and development; Ireland could become a market leader in this field. 7. Future skilled and semi-skilled employment through the development and operation of geothermal plants throughout Ireland. In addition, the use of district heating systems is a highly efficient method of space heating. The key benefits are: 1. It is 66% more efficient than privately heating each building via oil, gas or coal. 2. It allows for increased buying power to the members of the connected network as the fuel source only needs to be changed at one point on the network. 3. There is a reduced space requirement compared to oil or bio-fuel storage. 4. Individual building's heat usage can be monitored and controlled from one central computer at the energy centre to allow for increased efficiency. Due to the key benefits of the district heating system, Geothermal Energy Ltd believes that in addition to the support for planning and roll-out of a district heating system as mentioned above, financial support should be made available to private residents and businesses to convert from their current heating system and to join an available district heating network. As can be clearly seen from the benefits above, the establishment of an exploration and production licensing regime for deep geothermal energy in Ireland should be recognised as a high priority by the current Government. The current situation of no licensing policy is resulting in the hold-up of a highly efficient energy resource which will benefit both the Irish economy and Irish environment.
7.	Consultant	-
8.	Consultant - Legal	-
9.	Consultant	SHALLOW Geothermal resources when planned correctly tend to be entirely renewable and sustainable. DEEP Geothermal resources tend to be sustainable in the short term e.g. 40 years and renewable over the long term e.g. 100 years or more. Since this is a renewable resource, the term mining is inappropriate.
10.	Energy Industry	-
12.	Energy Industry	We as an Irish company involved in R&D want to participate in the developments in this area.
13.	Potential Developer	-
14.	Landowner	Any development should be Irish driven, maintained and consumed.
15.	-	-
16.	Private Person	Set up this new business in the private sector under government control with a minister for energy to include all other energy producing and supplying providers exclusively under this New minister.
20.	Geology Graduate	-
22.	Academic and Consultant	In Australia (where I am writing from) we have travelled this path several times as the individual states wrestle with how to regulate geothermal development. The general consensus is that South Australia "got it right". SA regulates GE under the Petroleum and Geothermal Act. early stage exploration is treated similar to minerals exploration, whereas deep drilling is handled like petroleum. Over the counter applications has allowed over two dozen companies to secure exploration permits based on a wide range of exploration ideas. Licence "auctions" do not give the same impetus to exploration because they a) rely on under-resourced governments identifying prospective areas and b) do not account for novel exploration concepts. The states of Victoria and Queensland have suffered from this mistake. SA has also made the cost of application affordable and the regulator has been an enthusiastic promoter of GE. New South Wales has imposed high fees for licences and stifled interest in that state. SA has also limited the size of licence areas to smallish blocks (although in the Irish context 500km2 may not be that small). Tasmania allowed one company to peg half the state and effectively kill any competition!
23.	Consultant	Need to examine Scandinavian and British experience and their legislative development and make results available publicly.
24.	All-island representative body	SHALLOW & DEEP Identification of the key stakeholders is required for the development of the industry; Information dissemination is necessary through placing details on relevant websites, such as DCENR, SEI, geothermists, hydrogeologists, engineers; DEEP The provision of schemes such as Risk Insurance for the exploratory drilling through a central fund has been found to be effective at encouraging the development of deep geothermal projects in Germany and elsewhere in the EU.
25.	Business representative body	The establishment of an exploration and production licensing regime in Ireland should be recognised as a high priority by the Government as it will assist Ireland in achieving a reduction in greenhouse gas emissions under the Kyoto Protocol.
26.	Local Auth./Local Energy Agency	-
27.	Private Person	-
28.	Energy Industry	Geothermal energy has potential to contribute to National CO2 reduction targets and commitments and so should be facilitated and encouraged. A pilot deep borehole could be developed while the necessary regulatory framework is being put in place so that the knowledge base would be extended in parallel with the regulatory system. UCD Buildings Dept is planning to issue a request for proposals from companies with knowledge of or experience in deep geothermal exploitation to carry out a Deep geothermal Resource Evaluation for the Belfield Campus. Depending on the response we would hope to carry out tests, possibly including a trial borehole, to determine the scale of the resource and the feasibility of its development. We would hope that SEI would provide grant support for this initiative.
29.	Private Person	Geothermal power stands out as a potentially invaluable untapped natural resource in Ireland. It becomes particularly attractive in this age of growing consciousness of environmental hazards and increasing awareness of the necessity to develop new resources to help meet Ireland's future energy requirements. Potential exists to utilize shallow and deep geothermal for the reallocate resources from conventional fossil fuelled heating/cooling technologies to renewable energy technologies in the following areas, which the GAI aim to aggressively promote through their activities i.e. talks, field trips and conferences: Agriculture i.e. dairy farming heating and cooling – pasteurisation and temperature control; Food/ Horticulture i.e. providing heat for green houses growing tropical plants, vegetables and fruits; Food Industry i.e the heating and cooling functions of geothermal can be utilized for food drying i.e. evaporated milk, dehydrated vegetables, tinned goods; Beverage Industry i.e. brewing processes; Leisure – balneology, spas; Commercial – heating and cooling to replace energy inefficient air conditioning; District Heating – often used in conjunction with other forms of renewable energy and fossil fuels. (this is not intended to be an exhaustive list) Ireland's geothermal resources promise to be a relatively pollution-free source of energy, and their development should be encouraged through a clear and supportive government policy vital for future development of geothermal. Overall, a legislative regime for geothermal requires long term continuity in a strategy which allows implementation of a comprehensive and coherent policy communicating a long term target to the public and establish a stable framework for investors, developers etc.
30.	Local Authority	-
31.	Private Person - Consultant, Engineering	None.
32.	Consultant	Establish a review of best practice in jurisdictions that have substantial geothermal energy production eg California, New Zealand.
33.*	Private Person	General Observation The development of shallow geothermal energy is being carried out throughout the country without the enactment of specific national regulation. However, developing deep geothermal needs an enabling regulation process. Deep geothermal energy offers scope for large scale heat and or power projects – such projects need risk finance to fund the exploration and debt finance to fund the capital programme. The provision of these funds will only come about when the project promoters can produce title to the deep geothermal resources. Clear title can take a number of forms. However because there are many legal issues around the ownership of deep geothermal energy, clear title can best be facilitated through a state administered exploration licence system coupled with a state administered deep geothermal extraction permitting system. The primary purpose of the exploration licence system and the extraction permitting system is to facilitate the development of deep geothermal energy. As such they should be designed to stimulate the process of attracting the risk and development finance with as little regulation as is necessary to confirm title. They should not be seen as means of generating revenue for the state. The consultation process should provide useful background data upon which to base the regulation process. However the underlying requirement is to produce an investor friendly process that will transform Irelands energy supply with sustainable deep geothermal energy resources long into the future.

* This answer was originally not part of the questionnaire, but was submitted as a general observation and the author has agreed to include it in this section.

Q18. To which of the following categories do you belong:

- i. Landowner
- ii. Academic
- iii. Regulator
- iv. Consultant
- v. Energy industry
- vi. Potential developer
- vii. Other (please specify).

No.	Category	Response
1.	Local govt.	Answer in previous column
2.	Consultant, Hydrogeology	
3.	Consultant	
4.	Professional Body	
5.	Consultant in the resources and Energy industry	
6.	Energy Industry	
7.	Consultant	
8.	Consultant - Legal	
9.	Consultant	
10.	Energy Industry	
11.	-	
12.	Energy Industry	
13.	Potential Developer	
14.	Landowner	
15.	-	
16.	Private Person	
17.	-	
18.	-	
19.	-	
20.	Geology Graduate	
21.	-	
22.	Academic and Consultant	
23.	Consultant	
24.	All-island representative body	
25.	Business representative body	
26.	Local Authority/Local Energy Agency	
27.	Private Person (Mining Company)	
28.	Energy Industry	
29.	Private Person; Individual training energy and environmental law and involved with GAI	
30.	Local Authority – Energy Agency	
31.	Private Person - Consultant, Engineering	
32.	Consultant, Engineering	