UKERC

UKERC ENERGY RESEARCH LANDSCAPE: GEOTHERMAL ENERGY

Prepared by Lesley Wright, STFC Rutherford Appleton Laboratory and Paul Younger, University of Glasgow
Last Update: 13 December 2012

1. Overview

Return to Top

Characterisation of the field

Geothermal Energy is defined as the energy available as heat contained in, or discharged from the Earth's crust. The amount of heat available is largely determined by local geology, and thus exploitable energy is distributed very unevenly, both globally and locally. Extractable heat can be used to produce electricity directly or indirectly, and/or provide heating / cooling (using, for instance, absorption chillers) for industrial processes or buildings.

The term "Geothermal Energy" covers a wide spectrum of geological settings from volcanic sources, through "hot rocks", hot sedimentary aquifers (HSA), oil-geothermal co-production, and the exploitation of warm mine waters using heat pumps. Although normally described as geothermal, Ground Source Heat Pumps (GSHP) exploit stored solar radiation and virtually none of the heat is derived from the Earth's interior. Thus GSHP technically do not utilise geothermal energy but the International Energy Agency (IEA) nonetheless includes GSHP as a form of Geothermal Energy. GSHP therefore will be covered in the "Other Renewables" UKERC Research Landscape rather than in this document.

Geothermal Energy is usually regarded as a renewable resource, although this depends on the rate of recharge of the resources being exploited. In geothermally active areas of the world associated with volcanoes, such as Iceland and New Zealand, the reservoirs of heat are large compared with demand and resources may also be regularly replenished, so such geothermal energy can be regarded as renewable. In the UK, where active volcanism is not present, the rate of recharge of crustal heat tends to be slow. When the rate of exploitation exceeds the rate of replenishment then heat is essentially being mined. In general, a practical level of replenishment (e.g. 95%) will occur on time scales of the same order as the lifetime of the geothermal production systems (Rybach and Mongillo 2006). It is likely that the main contribution of geothermal energy in the UK will be to local area heating, although the potential for power generation exists especially in hot rocks such as the granites of Cornwall, northern England and eastern Scotland.

Some of the attractive characteristics of Geothermal Energy are that it can provide a steady base power load, with no seasonal, weather or climate-change related variation, and that both of its outputs (electricity and heat) are easily exploited. On the other hand, the short history of deployment means that there is a lack of experience and awareness of the technology, safety issues and environmental impacts, which coupled with the high capital cost of installation makes investing in the deepest hot rock geothermal resources a high risk strategy in the UK, although shallower resources, especially mine waters, represent a lesser risk. A detailed review of hot rock and aquifer resources in the UK was published by Downing and Gray (1986) whereas a more recent perspective can be found in Younger et al. (2012).

Each type of Geothermal Energy and associated exploitation has its own specific characteristics, risks and benefits.

Hot Rocks:

Temperature increases with depth at about 26°C per kilometre on average in the UK but in certain areas where granite rocks have concentrated radiothermal elements (notably U, Th and K) much higher gradients may be found. Thus at depths of 4-5 kilometres rock temperatures in favourable locations may be well in excess of 150°C. Extracting this heat usually requires drilling boreholes into the rock and creating an artificial reservoir by hydraulic fracturing, a process known as stimulation leading to the creation of an Engineered (or Enhanced) Geothermal System (EGS). An important exception is the Weardale granite in Co.Durham where very high natural permeability obviates the need for stimulation (Younger and Manning 2010). Extracting the heat typically involves a doublet closed loop system for pumping cold water down into the reservoir and recovering steam or hot water under pressure. Steam may be used to drive turbines for power generation – usually via a heat exchange stage as geothermal waters are usually corrosive to turbine components. Cooler waste water is then returned to the reservoir. The process of stimulation can lead to small amounts of seismic activity locally, and a hot rock development at Basel (Switzerland) in an ill-judged tectonically-active location has been halted. It should be noted that the stimulation process is not the same as the "fracking" process used in shale gas exploitation. An international protocol has been developed to address these concerns, but the technology is still being developed and there remain critics of this form of exploitation. In the past, subsidence has also occurred causing concern at a few high temperature developments; but with modern closed-loop systems, where fluid pumped up is balanced by fluid pumped down, this is now much less of a problem. The UK has some good hot rock prospects among the granites of Cornwall, the North of England, and in the Eastern Grampian Highlands of Scotland, all in relatively stable tectonic settings. Readers should be aware that there is also some confusion of terminology: Hot rock sources are sometimes referred to as Hot Dry Rock (HDR) or Hot Fractured Rock (HFR) whereas Enhanced (or Engineered) Geothermal System (EGS) has been defined as "engineered reservoirs that have been created to extract economical amounts of heat from low permeability and/or porosity geothermal resources" (MIT 2006). EGS technology may be applied to any deep geothermal system including hot sedimentary aquifers (see below) but it should be noted that all the above terms are often used interchangeably.

Volcanic Geothermal:
This is "classical" Geothermal Energy exploitation as practiced in the volcanically active areas of the world. Here magma lies sufficiently close to the surface to heat natural groundwater and convert it into superheated steam, which can then be exploited to drive turbines, with residual heat being used for district heating. This utilises the same phenomenon as geysers, and it is commercially exploited in the same volcanic areas. There are few risks with this technology although a borehole into an active magma chamber in Iceland resulted in a short-lived ash eruption near a geothermal power plant. There is no active volcanic activity in the UK, ruling out this source of geothermal energy for *in situ* exploitation, although certain UK Overseas Territories, currently most notably in Montserrat, have potential to exploit volcanic geothermal sources (Younger 2010)

Hot Sedimentary Aquifers (HSA):
An aquifer is a body of saturated rock which stores and transmits significant quantities of water. At depth, trapped water may reach useful temperatures and providing the host rocks are sufficiently porous and permeable adequate flow rates may be achieved to efficiently extract the thermal resource. As with some hot rock sources the water is usually not sufficiently hot to flash to steam and drive turbines directly but may be exploited for both heat and electricity by utilising binary power units. These employ working fluids (usually organic) that have lower boiling temperatures than water. The rate of hot water replenishment is an important factor, and for the resource to be sustainable either a balance must be achieved between extraction rate and replenishment rate, or a system of rotation between active wells and recovering wells must be implemented. The UK has some good potential HSA resources, most notably in Permian and Triassic rocks of England and Northern Ireland, and Lower Carboniferous and Upper Devonian rocks of the Midland Valley of Scotland and northern England. Warm waters in the Sherwood Sandstone aquifer of the Wessex Basin have been exploited at about 1800 metres depth in a geothermal development that has provided heat and power to the city centre in Southampton for over 20 years. The Science Central borehole in Newcastle reaches a similar depth and also aims to support city centre heat demands.

Oil-Geothermal co-production:
Each barrel of oil extracted from an oilfield may be accompanied by some 10-20 barrels of hot water, especially towards the end of the oilfield's life. As this water has to be separated from the oil and reinjected or disposed into the environment, it requires little

additional technology to extract its available heat. In the USA, research is underway with small retrofitted binary power modules to convert this heat to power for the purposes of driving the rig itself and thus offsetting some of the running costs. In addition, there is some interest in drilling regions such as the Gulf States of the USA in pumping in and recovering fluid cyclically to exploit the increased temperatures at oil reservoir depths – a way to make continued use of oil rigs and extraction systems after oil reservoirs are exhausted. A significant factor is that the major costs of rig construction, installation and drilling the oil well have been offset by the hydrocarbon activities. Most of the UK's oil is recovered from the North Sea, far distant from power grids and centres of population, and any co-produced geothermal energy will need to be used *in situ*. This is useful, as many platforms ironically become energy-scarce late in the productive life of a field, and, furthermore, if current plans for carbon capture and storage are to come to fruition, a local energy source above the undersea injection zones would be extremely useful.

Warm Mine Waters:
In deep mines, including those used for coal production, temperatures can be sufficiently elevated to heat naturally occurring groundwater. Once pumping ceases, mines tend to fill with this warm water that can then be extracted and used for heating, usually in combination with a heat pump. This type of resource is generally used to support district heating schemes, especially in new build projects close to disused collieries. A few small schemes exist in the UK. On a larger scale warm mine waters may serve as the rationale for urban regeneration projects, such as at Heerlen in the Netherlands (Veld et al., 2010).

Research Challenges

The exploitation of geothermal energy is largely dependent on geology. The UK has an enormously varied geology for such a small land area, although its lack of active volcanism means that geothermal energy still has a low profile among so-called renewables. Intense research during the 1980s culminated in a focus on the geothermal potential of some Cornish granite masses, but until recently there had been little subsequent research in the UK. New models of geothermal resources have recently been developed and there is now a need to reassess the UK's geothermal resources. With the development of more efficient methods of utilising lower grade geothermal resources so it is likely that larger scale and commercially viable geothermal resources will soon be identified and developed in the UK, although it is difficult to predict the rate of uptake. Research that would help bring this about includes:

- *Geology:*
    - developing more accurate geological and geothermal models for well established deep resources such as HSA in the sedimentary basins of Cheshire, Wessex, Worcester, Lincolnshire, Northern Ireland and the Midland Valley of Scotland, and HDR in Cornwall, North of England and the East Grampians Scotland
    - devising and testing novel geological models such as exceptionally permeable hot granites and geothermal fluids associated with large regional faults
    - understanding local effects such as the stress regime and its influence on the stimulation of reservoirs, and the effect on heat flow of the last glaciation (evidence from northern Europe and Canada suggests that the HDR potential of Scotland and Northern England may have been significantly underestimated by extrapolation from shallow boreholes)
    - extend the scope of geochemical "geothermometer" models to accommodate highly saline waters such as those recently found in deep drilling in northern England
    - improved geophysical sounding techniques for identifying deep fractures in relatively homogenous granite
- *Engineering:*
    - evaluating the extent to which oil-geothermal co-production using retrofitted binary plant generators can contribute to extending the productive life of

North Sea oilfields, and whether the concept has any value in onshore oilfields
    - improving drilling technologies with the objective of reducing the cost of exploration and exploitation of geothermal resources in hard rocks where drilling may account for more than half the total cost
    - improve hydraulic and other techniques for fracture stimulation in granites and highly compacted sandstones under high lithostatic loading
    - improved methods for borehole completion and operation for purposes of reinjection of spent fluids
    - improving pumps, valves etc. that need to function reliably in extreme environments of temperature and high dissolved solute loads
    - identifying new materials and process routes for better and lower cost heat-exchange processes involving highly saline geothermal fluids
    - extend the temperature range of cost-effective binary plant operation, so that lower temperature waters can also be used to generate electricity
- *General:*
    - combining all available research in databases to facilitate the exploitation of shallow, intermediate and deep geothermal resources in the UK
    - identifying where social factors such as urban regeneration, and environmental factors associated with exploitation represent opportunities (or threats) to utilising geothermal resources
    - explore the economic viability of deep geothermal energy under currently anticipated Renewable Heat Incentive and ROCs regimes.

Geothermal energy is plentiful beneath the UK, although it is not readily accessible currently except in specific locations. Unlike many geological resources, anomalous heat is not easily detected at the surface, indeed the best resources will be insulated by rocks of low thermal conductivity. Furthermore heat resources at depth are not easily detected remotely using geophysics, although associated features such as aquifer fluids might be discernible. The subsurface of the North Sea is much better characterised than the subsurface of mainland UK, and a new focus on the few kilometres beneath the onshore surface veneer might result in the discovery of significant amounts of exploitable geothermal energy.

Useful Resources:

- "The Potential for Exploiting Geothermal Energy in Scotland" - Ed Stephens, University of St Andrews, June 2011 (http://www.st-andrews.ac.uk/~wes/research/Geothermal_overview.html)
- "Low Temperature Geothermal Energy Modelling the Potential Resource in the UK" – Keith Rollin, British Geological Survey (http://www.bgs.ac.uk/downloads/start.cfm?id=353)
- "Geothermal Energy Application Experience and Development in Europe" - The Newsletter of the ENeRG Network, Issue 19, June 2009 (http://www.energnet.eu/system/files/newsletter/newsletter-19.pdf)

References

Downing RA and Gray DA (1986) Geothermal Energy – The Potential in the United Kingdom. British Geological Survey, Nottingham, UK/Her Majesty's Stationery Office (HMSO), London, UK.

MIT (2006) The future of geothermal energy: Impact of Enhanced Geothermal Systems (EGS) on the United States in the 21st century. Massachusetts Institute of Technology (ISBN 0615134386)

Rybach L, Mongillo M. (2006) Geothermal Sustainability - A Review with Identified Research Needs. *GRC (Geothermal Resources Council) Transactions* **30:** 1083-90.

Veld, P.O, Malolepszy, Z., Bojadgieva, K., Vertsek, J. (2010). Geothermal Development of Low Temperature Resources in European Coal Mining Fields in practice: the EC REMINING-lowex project. *Proceedings World Geothermal Congress* 2010 Bali, Indonesia.

Younger, P.L., & Manning, D.A.C., (2010), Hyper-permeable granite: lessons from test-pumping in the Eastgate Geothermal Borehole, Weardale, UK. *Quarterly Journal of Engineering Geology and Hydrogeology* **43**: 5 – 10. (doi:10.1144/1470-9236/08-085)

Younger, P.L., (2010) Reconnaissance assessment of the prospects for development of high-enthalpy geothermal energy resources, Montserrat. *Quarterly Journal of Engineering Geology and Hydrogeology* **43**: 11 – 22. (doi: 1144/1470-9236/08-083)

Younger, P.L., Stephens, W.E. and Gluyas, J.G. (2012). Development of deep geothermal energy resources in the UK. *Energy (Proc. I.C.E.)* **164**: 1–14.

2. Capabilities Assessment

Return to Top

New geothermal concepts mean that this type of energy resource is no longer confined to volcanically active areas and many countries well away from plate margins, such as the UK, may host useful resources. This creates a much larger market for relevant skills and technologies.

The UK has little capacity in developing technologies for Geothermal Energy exploitation – most of the equipment used is of Japanese, American and especially German manufacture. However, our experience in oil/gas exploration means that we may well have technologies and experience that can be effectively transferred from the North Sea to onshore prospects. In particular drilling technologies, seismic and structural investigations, basin and thermal modelling, and reservoir stimulation are central to both oilfield and geothermal field development.

It is likely that low-grade resources associated with abandoned coal mines and deep aquifers will be those most easily exploited in the UK, and it is a convenient consequence of this nation's geology that the host basins were historically often the loci for urbanisation. Unfortunately many of these have become economically deprived regions in need of regeneration, and access to clean energy resources may in some cases provide the necessary catalyst for development. Making it happen will require cross-disciplinary research involving geologists, engineers and others, and engagement with industry and planners.

National capacity to exploit geothermal energy on any significant scale is currently meagre and skills shortages may limit the rate of such exploitation. A report prepared in May 2012 by the Renewable Energy Association (http://www.r-e-a.net/news/deep-geothermal-resource-has-potential-to-produce-up-to-20-of-uk-electricity-and-heat-for-millions) which showed that geothermal energy could meet up to a fifth of the UK's energy needs, it receives a relatively low level of subsidy - less than that offered to wave and tidal power, and less than that offered in rival countries such as Germany and Switzerland. Despite this, geothermal energy was omitted from the UK Government's "Banding Review for the Renewables Obligation" published in July 2012.

Ironically, during 2012, the UK government approached Iceland to discuss connecting the UK to Icelandic geothermally-generated electricity supplies via the proposed multi-million pound Europe-wide energy supergrid.

There are some signs the UK industry is interested in making use of the UK's resource: a UK Deep Geothermal Symposium took place in October 2012, for companies in this fledgling area to exchange information about their current projects. This indicates that there is a perceived market resource in the UK. As an example, in May 2012, GT Energy revealed plans to build the UK's biggest commercial deep-geothermal heat plant in Manchester.

Table 2.1 UK Capabilities

UK Capability	Area	Market potential
High	• Drilling technology derived from the oil/gas industry • Associated technical services and consultancy	• Global: Medium Now
Medium	• Development of better geological and geophysical survey methods for identifying potential deep geothermal resources	• UK: High 1-2 years • Global: High 5+ years

3. Basic and applied strategic research

Return to Top

In the 1980s major research projects into the national geothermal resource were undertaken by a consortium of the BGS, Imperial College, Camborne School of Mines and the Open University. Research in this area then largely ceased but is now slowly reviving elsewhere. NERC is funding some CASE Studentships, and the Scottish Government is commissioning research to take forward the commercial exploitation of deep geothermal heat. ONE North East funded the first deep geothermal exploration borehole in the UK in more than 20 years at Eastgate (Weardale, Co Durham) in 2004, and the Deep Geothermal Challenge Fund of the UIK Department of Energy and Climate Change funded a further borehole at Eastgate in 2010 and a new 1821m borehole in central Newcastle upon Tyne in 2011.

4. Applied Research and Development

Return to Top

There is no dedicated applied research and development funding for geothermal energy currently available in the UK – all funding is for commercial or near-commercial projects.

Several universities do provide applied research and development opportunities (listed below)

Table 4.2: Key Research Providers

Name	Description	Sub-topics covered	No of staff	Sector
Renewables and Energy Security - British Geological Survey	BGS is investigating ways in which the UK can utilise cleaner forms of energy. The UK benefits from a number of renewable energy options including geothermal and our coal reserves are beginning to be exploited in a carbon free manner. We are involved in research and development to improve our understanding of the UK's geothermal resources and how these can be utilised in the UK's energy mix. • distribution of sub-surface temperature in the depth range down to 1 km • potential of disused mine workings as a geothermal resource in urban areas • geothermal potential resulting from the blanketing effect of sedimentary rocks over hot, deeper rocks • GIS of the distribution, depth and nature of the UK's geothermal resources	• Geological surveying • Hot Sedimentary Aquifers (HSA)	?	Earth Sciences

Durham Energy Institute - Durham University	The Centre for Research into Earth Energy Systems (CeREES) is a Geo-Energy research centre, founded in 2006, which is a part of the Durham Energy Institute. Since it began, CeREES has attracted £1.3M research income per annum. Collaborators on the Newcastle Science City borehole, which is a DECC and BGS funded project to drill a geothermal borehole in Newcastle.	• Hot Sedimentary Aquifers (HSA) • Geothermal use of co-produced waters in oil and gas fields • optimising the process for generation of heat and electricity from low temperature resources.	22	Earth Sciences
Rankine Chair of Engineering, Systems, Power and Energy Division, School of Engineering – University of Glasgow	The Rankine Chair is working in the following areas: • deep geothermal heat recovery linked to radiothermal granites, deep sedimentary aquifers and fault-related reservoirs; • practical experience of sinking deep boreholes geothermal (to 2 km), including improving the accuracy and efficiency of directional drilling technology; • improved techniques for using geothermal energy for district heating, binary plant power production and ground source heat pumps • storage and recovery of industrial heat; • modelling of geothermal reservoirs Industrial collaboration includes a Non-Executive Directorship of Cluff Geothermal Ltd, which is developing geothermal prospects in northern England, Kenya and Ethiopia	• Geothermal reservoir exploration • Geochemistry of geothermal fluids • Geothermal reservoir modelling • Geothermal district heating networks • Ground-coupled heat-pump systems • Volcanogenic geothermal energy in the Caribbean and East Africa	7	Engineering and applied Earth Sciences
Sir Joseph Swan Centre for Energy Research	The Centre is working in the following areas:	• Radiothermal granite sources, particularly	14	Earth Sciences Engineering

- Newcastle University	• deep geothermal heat recovery linked to radiothermal granite; • expertise in hydrothermal structures; • practical experience of sinking deep boreholes (to 2 km); • improving directional drilling technology; • improved techniques for using geothermal energy for CHP; • storage and recovery of industrial heat; • binary power plants and ground source heat pumps – improving their efficiency; • developing translational research into clean energy, including the Geotrainet European training course Leading the Newcastle Science City borehole project, which is a DECC and BGS funded project to drill a geothermal borehole in Newcastle to heat the Science City on the former Newcastle Brewery site. Drilled the existing Eastgate Boreholes, and active partners with Lafarge plc and Cluff Geothermal Ltd in the development of the Eastgate resource.	targeting naturally high permeability at depth;		
Department of Earth Sciences - St Andrews University	CERSA (Centre for Earth Resources at St Andrews) focuses on the geology and geophysics of a wide range of Earth resources, including geothermal, in collaboration with industry. The focus of geothermal research is currently in Scotland but collaborative research with other countries is also	• Hot Sedimentary Aquifers (HSA) • Hot Dry Rocks (HDR) • Mine waters	16	Earth Sciences

	undertaken			
Geotechnical Group, Department of Engineering, Cambridge University	An EPSRC funded Industrial Case PhD Studentship Award to conduct research in the field of geotechnical engineering. The award is sponsored by Arup (www.arup.com) for developing a "deep geomechanics" thermo-hydro-mechanical simulator coupled with micro-seismic geophysical analysis. It is proposed to extend the analytical/numerical models of conventional deep geothermal wells to a generalized model for enhanced geothermal system and the newly developed model will be validated by laboratory model test data and field data.			Civil Engineering

5. Demonstration Funding

Return to Top

All the current UK installations are aimed at producing usable amounts of heat and power. There are currently no demonstration projects as such, but funding is available for developing live systems.

Hot Rocks: Three projects are currently underway in Co.Durham and Cornwall. The DECC-funded Eastgate Geothermal Exploration Project in Weardale, Durham, ran from 2003-2006 and was very successful, and is now scheduled for commercial exploitation. Geothermal Engineering Ltd has been granted outline planning permission for a commercial geothermal power plant at Redruth in Cornwall; this is expected to produce 10MW of electricity for the National Grid and 55MW of renewable heat energy for the local community although as yet it is unclear where this will be used. EGS Energy is building a geothermal power plant at the Eden Project, which is expected to produce 4MW to run Eden, with surplus going into the National Grid. Both of these projects secured funding from the DECC Deep Geothermal Challenge Fund.

Hot Sedimentary Aquifers: The successful combined heat and power plant in Southampton city centre that uses water at 76°C extracted from 1.8 km depth in an aquifer below the city. It has been operating continuously for more than twenty years (http://www.discoversouthampton.co.uk/sections/southampton%20geothermal.aspx).

The Newcastle Science City borehole project is a DECC and BGS funded project to drill a geothermal borehole in Newcastle to heat the Science City on the former Newcastle Brewery site, accessing fault-hosted geothermal fluids. Keele University was awarded DECC funding for a 1200m borehole to be drilled to provide geothermal heat for their new sustainable campus, but this project is currently on hold.

Warm Mine Waters: At Shettleston (Glasgow) a borehole of 100 metres depth has been used since 1999 to extract water at 12°C from flooded coal mine workings. This water is increased to 55°C using a heat pump and circulated to 16 homes. A similar scheme at Lumphinnans in Fife using a 172 metre borehole ran successfully from 2000 to 2005 until it was vandalised.

With the end of the DECC Deep Geothermal Challenge Fund, no major source of UK-wide funding is currently available. Scottish Enterprise is procuring a feasibility study and implementation plan for the design, build and operation of a Geothermal Technology Demonstrator, possibly within the Energetica Corridor between Aberdeen and Peterhead.

Table 5.1 Development and Demonstration Funding

Name	Funding Agency	Description	Committed Funds	Period	Representative Annual Spend
Eastgate Geothermal Project	One North East	Phase 1: Drilling of 1000m borehole in 2004 Phase 2: test-pumping exercise in 2006 (Phase 3 (2010) was funded by Deep Geothermal Challenge Fund of DECC) 1 project	£550K	2004 - 2010	~ £150K
Deep Geothermal Challenge Fund	DECC	Projects whose ultimate object is deep geothermal energy exploitation in England, Scotland, Wales and Northern Ireland are eligible to bid to the fund. The challenge fund forms part of the Low Carbon Investment Fund (LCIF). 3 projects funded in Round 1; 3 projects funded in Round 2 in December 2010	£6 M disbursed in two rounds of £4M and £2M	2009-2010	~£3M
Geothermal Technology Demonstrators	Scottish Enterprise	To provide a feasibility study and implementation plan for the design, build and operation of a Geothermal Technology Demonstrator, possibly within the Energetica Corridor between Aberdeen and Peterhead. 1 project	£40-57K	November 2011-March 2012	~£50K

6. Research Facilities and Other Assets

Return to Top

There are currently no dedicated research facilities for geothermal energy in the UK, though work on component technologies (e.g. binary cycle systems) is underway in existing thermo-mechanical laboratories in Newcastle University and elsewhere. The installations that do exist are functional rather than for research. However, with the recent completion of the Science Central borehole in Newcastle upon Tyne, there are plans to develop this borehole as a shared research resource between the project leaders Newcastle University, the British Geological Survey and Durham University.

7. Networks

Return to Top

The Geothermal Group is a sector of the Renewable Energy Association which serves the geothermal energy producers and others interested in this sector within the UK.

The first national EGS symposium was held on September 27th 2011 and a second event was held in October 2012. Both were well-attended.

Table 7.1 Networks

Network	Date Established	Description	Membership Profile	Activities
Geothermal Group of the Renewable Energy Association		The Renewable Energy Association represents the UK's renewable energy industry, covering all renewable power, heat and fuels. The Geothermal Group covers the extraction of heat from deep beneath the ground which can be used to provide heating for homes and to generate electricity.	Geothermal energy developers in the UK	• Organising events to highlight deep geothermal for government and other opinion makers • Commenting to the Press on specific geothermal-based news items
UK – Iceland Geothermal Technology Network	Nov 2011	An initiative of the Icelandic Ambassador to the UK in collaboration with Newcastle University. Exchange of project information and technology capabilities.	Main deep geothermal energy developers in the UK and the principal geothermal contracting and consulting companies of Iceland.	• Initial forum 17th Nov 2011, London • Not yet clear whether further meetings will be held

8. UK Participation in EU Activities

Return to Top

The UK does not apparently participate in major European programs such as the EERA Joint Programme in Geothermal Energy.

Individuals and institutions are actively involved in the European Geothermal Energy Council (EGEC) and in the recently-launched EU Intelligent Energy project "GEOELEC".

A UK-led consortium (Glasgow, BGS) recently applied for FP7 funding under a call relating to geothermal reservoir exploration, the outcome of which will be known in Spring 2013.

9. International Initiatives
Return to Top

In September 2011 the UK became a member of the IEA Geothermal Implementing Agreement (http://thinkgeoenergy.com/archives/8770)

Table 9.1: International Activities

Name	Type	Description	UK Contact Point
IEA Implementing Agreement for a Cooperative Programme on Geothermal Energy Research and Technology, or Geothermal Implementing Agreement (GIA)	IEA Implementing Agreement	The GIA came into effect in 1997, being renewed each five years after. It provides a framework for international cooperation on geothermal issues, bringing together national and industry programmes for exploration, development and utilisation of geothermal resources by establishing direct cooperative links between experts in participating countries and industries.	Roy Baria MIL-TECH UK Ltd roybaria@onetel.com