IEA GEOTHERMAL

United Kingdom Country Report 2012

IEA Geothermal Implementing Agreement

National Activities

Chapter 21 of Draft 2012 GIA Annual Report

United Kingdom

Figure 21.1 Geothermal drilling in the city of Bath.
(Photo courtesy of Drilcorp)

21.0 Introduction and Overview

The exploitation of geothermal resources in the UK remains minimal even when compared with other countries in a similar, non-volcanic, setting. The best EGS prospects for power generation are the radiogenic granites in the southwest and northeast of England. Proven temperatures of 100 °C were measured at a depth of 2.6 km during the UK Hot Dry Rock (HDR) programme in Cornwall (Parker, 1999) and 46.2 °C at a depth of 995 m in the Eastgate borehole drilled into the North Pennine batholith (Weardale granite) in northeast England (Manning et al., 2007). Two EGS projects are in development: EGS Energy Limited is developing a 4 MW_e

deep geothermal energy plant at the Eden Project, St Austell, Cornwall. This will comprise two wells drilled to a nominal depth of 4,500 m in granite, to obtain a downhole temperature of at least 175 °C. Primarily this plant will supply the electricity and heat demand of the facilities at Eden and have additional capacity to supply future development and local use. Geothermal Engineering Limited (GEL) proposes to develop a deep geothermal power project at the United Downs Industrial Estate near Redruth in Cornwall, located a few kilometres from Rosemanowes Quarry, the test site for the UK's HDR programme in the 1980s and 1990s. The proposed binary power plant will generate 10 MW_e of electricity and up to 55 MW_{th} of renewable heat for local use, utilising three wells (two production and one injection) drilled to approximately 4,500 m. At this depth the temperature of the granite host rock is expected to be approaching 200 °C. (Curtis et al., 2013). In 2010 these two projects were both given government grant aid from the Deep Geothermal Challenge Fund of £2.01M and £1.49 M respectively.

Table 21.1 Status of geothermal energy use in the UK for 2012.

Electricity	
New capacity installed in 2012 (MW_e)	0
Total Installed Capacity (MW_e)	0
Direct Use	
New capacity installed in 2012 (MW_{th})	0
Total Installed Direct Use (MW_{th})	2.6
Total Heat Used (TJ/yr) [GWh/yr]	44.3 [12.3]+
Ground Source Heat Pumps	
New capacity installed in 2012 (MW)	60
Total Installed Capacity for Heat Pumps (MW)	355
Total Net Heat Pump Use [GWh/yr]	578*

+ Note this is lower than previous years due to maintenance of the plant at Southampton.

* In calculating the net heat pump use it has been assumed that the hrs/year heating equivalent full load is 1800 hrs/year for domestic systems and 1500 hrs/year for commercial systems.

The Mesozoic sedimentary basins are the best prospects for heat only applications. Five basins have been investigated where basal Permo-Triassic sandstones have measured temperatures up to 80 °C that could reach 100 °C in the deepest parts of some of the basins. Porosity and permeability data from depth are limited, but values high enough to allow adequate yields have been measured. Productive sandstones vary from a few tens of metres to hundreds of metres thick resulting in productive transmissivities. The estimated heat in place (Inferred Geothermal Resource) has been calculated between 201 to 328 x 10^{18} J. To date, the only geothermal district heating scheme is in the City of Southampton where a 2 MW capacity installation extracts brine at 76 °C from a Triassic sandstone aquifer at a depth of 1.8 km, although the scheme was not operational in 2012 while a new electric pump was fitted. In 2011 an 1821 m deep borehole was drilled into the Carboniferous Fell Sandstone in the City of Newcastle. A shale bridge blocked the hole at 969 m depth and in 2012 the blockage was removed and a bottom hole temperature of 73 °C was measured at a depth of 1770 m. At the city of Bath, where the hot springs have been exploited since Roman times, a borehole was drilled in 2012 to intercept the hot artesian water (Chapter Figure; Figure 21.1). The water will be used to safeguard the Thermae Bath Spa and to supply a new hotel.

21.1 National Programme

The UK Renewable Energy Strategy was launched in 2009 with a target of 15% of energy from renewables by 2020. It also aims to reduce the UK's carbon dioxide emissions by over 750 million tonnes by 2030. The lead scenario envisages more than 30% of electricity generated, 12% of heat generated and 10% of transport energy from renewables. Most of this will be wind, biomass, biofuels and electric vehicles, but with a significant input to domestic heating from ground source heat pumps. Geothermal electricity is expected to have a minor role.

The UK Renewable Energy Roadmap was published in 2011 and identified 8 technologies that have the greatest potential for the UK to meet its renewable energy targets. One of those identified was ground source and air source heat pumps. Incentives introduced included the Renewable Heat Incentive for non domestic ground source heat pumps and the Renewable Heat Premium Payment (grant aid) for eligible domestic scale ground source heat pumps.

21.1.1 Legislation and Regulation

As explained in the 2011 UK country update, the Renewables Obligation (RO) is currently the main financial mechanism by which the UK Government incentivises the deployment of large-scale renewable electricity generation. Generators sell Renewables Obligation Certificates (ROCs) to suppliers or traders which allow them to receive a premium in addition to the wholesale electricity price. Geothermal electricity was eligible for 2 ROCs per MWh in 2011, but in 2012 the banding levels for renewable technologies were reassessed. The geothermal industry lobbied for an increase to 5 ROCs per MWh for geothermal electricity which would have brought support levels up to those in Germany. However, support remained at 2 ROCs

per MWh in 2013-15, falling to 1.8 ROCs per MWh by 2016-17.

The Feed-in Tariffs (FITs) scheme was introduced on 1 April 2010. Through the use of FITs, the Department for Energy and Climate Change (DECC) hopes to encourage deployment of additional small-scale (less than 5MW) low-carbon electricity generation. There was no geothermal electricity generation in 2012.

The Renewable Heat Incentive (RHI) was introduced in July 2011 and pays a tariff for renewable heat for non-domestic installations. This includes deep geothermal heat as well non-domestic ground source heat pumps. In 2012 the tariff paid was 4.8 p/kWh$_{th}$ for projects < 100 kWth and 3.5 p/kWh$_{th}$ for projects > 100 kWth. There is a considerable imbalance in the RHI tariff for GSHPs vs other heat technologies which caused market distortion, to the detriment of non-domestic GSHP installation rates.

Domestic scale ground source heat pumps are eligible for a Renewable Heat Premium Payment (RHPP) of £1250 to help cover the purchase price. The scheme was set up to support private householders, social housing providers and community groups to install renewable heat measures, including ground-source heat pumps, biomass boilers and solar thermal. The scheme was particularly orientated towards off-gas grid properties. The overall budget was £25million, with £10 million for the social housing scheme, £7 million for private householders and £8 million for community groups. A domestic RHI is expected to be introduced in early 2014.

In March 2012, the Government published a strategic framework for low carbon heat (see: Heat - Department of Energy and Climate Change). There is an increasing awareness of deep geothermal heat and its potential for district and agricultural heating. The strategic framework set out the Government's vision for heating homes, businesses and industry in the decades ahead and considers the possible ways in which the supply of heat can be decarbonised to meet the UK's renewables and emissions reduction targets. Heat networks which can be supplied by deep geothermal heat form a key element of the strategic framework.

Also in March 2012, the Government published a heat demand map. It consists of series of electronic maps showing heat demand from buildings across England. The intention is to help developers and planners identify priority areas for low carbon heat projects. The map displays the heat demand density in kWh m^{-2} year^{-1} for all sectors and building types. It is possible to zoom and sub-select for residential, commercial, industrial and public buildings.

21.1.2 Progress towards National Targets

- By the end of 2012 there were 37 accredited ground source heat pump installations receiving the RHI with a combined installed capacity of 1.0 MWth. Eligible heat generated (since July 2011) was 853 MWhth.
- Between August 2011 and November 2012, 1251 (13 MWth) ground source heat pump installations received the Renewable Heat Premium Payment.

21.1.3 Government Support /Initiatives for R&D

- The Engineering and Physical Sciences Research Council is funding 4 research projects into ground engineering and heat and mass transfer. The total budget is £1,000,000.
- The British Geological Survey received £71,000 in 2012 from the Natural Environment Research Council to conduct geothermal research.

21.2 Industry Status and Market Development

Two companies (EGS Energy Ltd and Geothermal Engineering Ltd) are pursuing the development of EGS combined heat and power projects in the southwest of England. Both projects have the necessary planning permission and environmental consents to commence drilling. During 2012 efforts continued to raise the funding for the first well of each project. The local, Cornwall, Council is keen to develop and promote its renewable energy agenda and both the Council and the Local Enterprise Partnership actively support the development of deep geothermal energy.

Two major initiatives are proceeding for direct use. GT Energy Ltd. announced in July 2012 that it was working with a major utility to develop a geothermal heat project in the city of Manchester. In December 2012 the Manchester project received its Ground Investigation Consent (GIC) from the Environment Agency (EA) which was followed by the granting of a 24 year water abstraction licence in January. Cluff Geothermal Ltd. is proposing to drill at Shiremoor, located to the north of Newcastle upon Tyne in the northeast of England. The heat would supply a new office and housing development.

In May 2012 the Deep Geothermal Group of the Renewable Energy Association released a commissioned report on the geothermal potential of the UK (SKM, 2012). It concluded that deep geothermal resources could eventually provide 9.5 GW of base load electricity and 100 GW of heat, equivalent to 20% of the UK's annual average electricity generation capacity and the total heat consumption of the UK. However, it also concluded that subsidy levels would need to be substantially increased for any significant geothermal development.

21.3 Research, Development and Demonstration/Deployment

Geothermal research in the UK is at a low level when compared to research into other renewable technologies. The government has been supporting technologies such as wave and tide where it sees the UK can develop a commercial advantage that can be exported. The majority of UK geothermal research is largely related to resource estimations and utilisation of the resource.

21.3.1 Government Funded

Government funding for early stage research is distributed through the Research Councils. Additional funding may also be available from the European Commission and is included here. The following projects were funded in 2012, but this is not an exhaustive list (Table 21.2 below).

The Scottish government funded a study into the 'Potential for Deep Geothermal Energy in Scotland' the lead contractor for which was AECOM.

21.3.2 Industry Funded

Funding from industry is not always publicised as it may be commercial-in-confidence. The following projects are being undertaken within the university sector (not an exhaustive list) (Table 21.3 below).

21.4 Geothermal Education

There are no specific higher education course devoted to the exploration and exploitation of geothermal energy in the UK. However, earth science and renewable energy university courses will often have modules on aspects of geothermal energy.

In October 2012, the Ground-Source Heat Pump Association published new standards for thermal pile design and installation.

In June and November 2012 the British Drilling Association held two seminars on 'Driving Quality' in London and Leeds respectively. A third in this series was held in Glasgow in April 2013.

Since the social housing market is an important driver for the take up of heat pumps, DECC subsidised a set of roadshows to explain the recent MCS (Microgeneration Certification Scheme) guidance for installation of heat pumps (both air-source and ground-source) to social housing providers. A webinar was also developed.

21.5 Future Outlook

Little progress was made in 2012 in raising the funding for the first deep EGS boreholes. At a deep geothermal energy symposium organised by EGS Energy Ltd. in October, the Minister of State Greg Barker committed the Government to reconsider whether there is a case to provide further support to the deep geothermal power sector. As a result DECC have commissioned another study into the potential for geothermal electricity generation (awarded to Atkins) which will report in mid-2013. In spring 2013, £6M of UK Regional Development Fund aid was surrendered by Geothermal Engineering Ltd. as matched funding from a private investor was not secured.

The UK government Early Tariff Review Consultation in 2013 has proposed raising the RHI tariff for non-domestic GSHP to 7.2-8.2 p per kWh and the tariff for deep geothermal heat will be set at 5p per kWh. Both tariffs should incentivise the geothermal heat sector although they will not be introduced until 2014. Following the publication on the 'Future of Heating' in 2012 the UK government has announced substantial grant aid for the creation of heat networks.

21.6 References and Websites

Curtis, R, Ledingham P, Law R and Bennett T. 2013. Geothermal Energy Use, Country Update for the United Kingdom, European Geothermal Congress 2013, Pisa, Italy, 3-7 June 2013.

Manning, D. A. C., Younger, P. L., Smith, F. W., Jones, J. M., Dufton D. J. and Diskin, S. 2007. A deep geothermal exploration well at Eastgate, Weardale: a novel exploration concept for low-enthalpy resources. *Journal of the Geological Society, London*, **164**, 371-382.

Parker, R. H. 1999.The Rosemanowes HDR Project 1983-1991. *Geothermics*, **28**, 603-615.

Sinclair Knight Merz (SKM), 2012. Geothermal Energy Potential: Great Britain and Northern Ireland, (May 2012).

Renewables Obligation:

- www.ofgem.gov.uk/Sustainability/Environment/RenewablObl/Pages/RenewablObl.aspx

Renewable Heat Incentive:

- www.decc.gov.uk/en/content/cms/meeting_energy/renewable_ener/incentive/incentive.aspx
- www.energysavingtrust.org.uk/Professional-resources/Funding-and-finance/Renewable-Heat-Incentive

Renewable Energy Association Deep Geothermal Group:

- www.r-e-a.net/member/deep-geothermal

Ground Source Heat Pump Association:

- www.gshp.org.uk/

Table 21.2 Government funded projects in 2012 (not exhaustive list).

Institute	Industrial partner	Project title	Subject area	Funder
Cambridge University	Arup	Numerical modelling of EGS reservoir development	Deep geomechanics	EPSRC
Newcastle University	Cluff Geothermal Ltd	A conceptual hydrogeological model for fault-related geothermal energy resources in northern England	Geothermal potential of northeast England	NERC
Reading University		Ground coupled heat pumps: mitigation potential for current and future climate predictions	Impact of climate change on horizontal GSHP	NERC
Southampton University		Performance of ground energy systems installed in foundations	Energy piles performance	EPSRC
Cardiff University		SEREN – Ground Source Heat	Improve the performance and uptake of GSHP	WEFO

EPSRC – Engineering and Physical Sciences Research Council
NERC – Natural Environment Research Council
WEFO – Welsh European Funding Office

Table 21.3 Projects funded within the university sector in 2012 (not exhaustive list).

Institute	Project title
Durham University	Multiphysics simulation of geothermal engineering
Durham University	Geothermal potential of low enthalpy deep sedimentary basins

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