United Kingdom Country Report

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IEA Geothermal

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1. Introduction and overview

A number of direct use geothermal proposals continued to be evaluated during 2015, however no additional geothermal power generation or direct use from deep sedimentary aquifers was added during the year in the UK. There is currently no power generation and direct use is restricted to; a district heating scheme 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 it is not known if the scheme is currently operating while a new electric pump is fitted; a thermal spa in the City of Bath (1.0 MW), and five, small, mine water schemes (total geothermal contribution of 0.14 MW).

The Scottish Government approved five feasibility projects funded out of the Geothermal Energy Challenge Fund. The Challenge Fund was established to support feasibility studies exploring the capacity of Scotland's geothermal resources to meet the energy needs of local communities. Grants totalling £234,025 were offered to five projects, but only four took up the offer resulting in £185,235 total grant funding. The four projects, which reported in February 2016, were;

- Aberdeen Exhibition and Conference Centre: to conduct a feasibility study for the installation of a deep geothermal single well system to provide heat to the new centre and associated buildings.

- Guardbridge geothermal technology demonstrator project: to conduct a feasibility study to investigate whether a geothermal district heating system, accessing a Hot Sedimentary Aquifer (HSA) underlying a brownfield site at Guardbridge in northeast Fife, can be developed in a cost-effective manner.

- Fortissat Community minewater geothermal energy district heating network: a feasibility assessment for a potential minewater geothermal energy system in the vicinity of the James Hutton Institute's (JHI) Hartwood Home Farm, North Lanarkshire.

- Hill of Banchory geothermal energy project: a feasibility study to explore the deep geothermal potential at Banchory, Aberdeenshire from at least one pair of deep boreholes drilled into the Hill of Fare Granite.

Geothermal Engineering Ltd were awarded £858,060 from the UK Government's Heat Network Small Business Research Initiative competition to part fund the development of a deep geothermal single well heat system at the Crewe campus of Manchester Metropolitan University. Elsewhere, additional geophysical data were collected as part of a feasibility study for direct use geothermal at Auckland Castle, county Durham.

In 2013 the Department of Energy and Climate Change (DECC) established the Heat Networks Delivery Unit (HNDU) to support local authorities in England and Wales in exploring heat network opportunities. Grant funding is available to meet up to 67% of the estimated eligible external costs of heat mapping, energy master planning, feasibility studies and detailed project development. Feasibility studies can cover the sources of heat supply including renewable options such as geothermal. By the end of 2014, £6,403,249 grant funding had been made available to 82 local authorities and additional grant funding of £2,983,369 was made available in 2015, although there are no figures on the extent of geothermal feasibility studies.

Table 1 Status of geothermal energy use in the UK for 2015.

Electricity		Direct Use		Geothermal / Ground source heat pumps	
New capacity installed in 2015 (MWe)	0	New capacity installed in 2015 (MWth)	0	New capacity installed in 2015 (MW)	57
Total Installed Capacity (MWe)	0	Total Installed Direct Use (MWth)	3.0	Total Installed Capacity for Heat Pumps (MW)	535
		Total Heat Used (TJ/yr) [GWh/yr]	55.3 [14.8]+	Total Net Heat Pump Use [GWh/yr]	855*

+ 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.

2. 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 that, after consultation in 2013, covers domestic and non-domestic ground source heat pumps and deep geothermal heat (see below for the tariff rates). Prior to March 2014 an interim grant fund was in place which targeted social housing providers, known as the Renewable Heat Premium Payment (RHPP).

2.1 Legislation and regulation

The UK Government's Electricity Market Reform (EMR) programme will replace the Renewables Obligation (RO) incentives for large scale renewable electricity generation by 2017. The new mechanism is known as Contracts for Difference (CfD). Each renewable technology has a 'strike price' in £/MWh of renewable electricity generated. When the market price of the electricity is below the strike price the generator receives a payment equivalent to the difference between the strike price and the market price. However, if the market price is above the strike price the generator has to pay back the difference between the two prices. This variable top-up is designed to reduce the risk and increase the level of certainty for renewable generation. In December 2013 the strike price for geothermal for 2015/16 was set at £145/MWh. It has not yet been decided how CfDs for 'less established' technologies (that includes deep geothermal) will be allocated.

A Feed-in Tariffs (FITs) scheme was introduced on 1 April 2010. Through the use of FITs, the Department for Energy and Climate Change (DECC) seeks to encourage deployment of additional small-scale (less than 5MW) low-carbon electricity generation. There was no geothermal electricity generation in 2015.

The Renewable Heat Incentive (RHI) was introduced in July 2011 and pays a tariff for renewable heat. After consultation in 2013 the scheme (from April 2014) covers, amongst other technologies, domestic and non-domestic GSHP and deep geothermal heat. The rates in 2015 were as follows;

- Non-domestic GSHP has a 2 tiered tariff comprising 8.7 p/kWh for the first 1314 hours of use (tier 1) and 2.9 p/kWh thereafter (tier 2)

- Domestic GSHP tariff is 18.8 p/kWh payable for 7 years, but note that new build properties other than self-build are not eligible

- Deep geothermal (defined as from a minimum depth of 500 m) tariff of 5.0 p/kWh.

In the summer of 2014 the UK government consulted on underground drilling access for onshore oil and gas and deep geothermal. Under existing regulations permissions had to be obtained from all land owners under whose land the drilling may have extended. For projects involving deviated or horizontal drilling, the large number of permissions led to lengthy delays in project starts. Under the new proposals, land owner permissions will not be required where the underground access is 300 m below ground level. These proposals became law as part of the Infrastructure Act 2015.

2.2 Progress towards national targets

By the end of 2015 there were 409 accredited non-domestic ground source heat pump installations receiving the RHI with a combined capacity of 32.5 MWth. This represents percentage increases of 109% in accredited installations and 210% in capacity over 2014 levels. Eligible heat generated was 53 GWhth.

The domestic RHI was introduced in April 2014, but installations commissioned since July 2009 are eligible. By December 2015 there were 6522 accredited domestic ground source heat pump installations receiving the RHI, an increase of 123% over 2014 levels. Heat paid for under the domestic scheme was 91,582 MWhth.

2.3 Government support/Incentives for R&D

Geothermal Engineering Ltd were awarded £858,060 from the UK Government's Heat Network Small Business Research Initiative competition to part fund the development of a deep geothermal single well heat system at the Crewe campus, Manchester Metropolitan University. The Scottish Government approved grant funding of £185,235 for four geothermal feasibility studies.

3. Industry status and market development

Despite an upturn of interest in direct geothermal for district heating, taking projects forward to the development stage is still proving challenging in the UK. There is no publicly funded drilling

insurance scheme and the perceived risk associated with deep drilling has meant it is very difficult to raise private sector finance.

Seismic reflection data were collected in Stoke-on-Trent as part of ongoing investigations for a deep geothermal option for a district heating scheme.

Cornwall Council are very supportive of developing geothermal within the county, particularly CHP from EGS. Two companies, EGS Energy Ltd and Geothermal Engineering Ltd, continue to work towards developing EGS and have the necessary planning permissions and environmental consents in place.

4. 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.

4.1 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 projects tabulated below were funded in 2015, but this is not an exhaustive list.

Institute	Industrial partner	Project title	Subject area	Funder
Cambridge University	BP	City-scale modelling of geothermal energy	GSHPs	Schlumberger
Cambridge University	Arup	Numerical modelling of EGS reservoir development	Deep geomechanics	EPSRC
Glasgow University	Cluff Geothermal Ltd	A conceptual hydrogeological model for fault-related geothermal energy resources in northern England	Geothermal potential of northeast England	NERC
Glasgow University	Parsons Brinckerhoff	Optimisation of groundwater-based cooling systems for large public buildings in London and other cities	Open loop GSHP	
Glasgow University		Geothermal reservoir modelling: high-enthalpy systems in eastern Africa.	East Africa geothermal	

Institute	Industrial partner	Project title	Subject area	Funder
Glasgow University		Conceptual hydrogeological model for caldera-associated high-enthalpy geothermal reservoirs in eastern Africa	East Africa geothermal	
Glasgow University		Deep geothermal resources associated with major faults in northern England and Scotland	Deep fault permeability	NERC
Glasgow University		The scope for deep geothermal energy to combat fuel poverty in Greater Glasgow	Hot sedimentary aquifer	
Southampton University		Foundations as an energy source	Energy piles performance	EPSRC/ RAERF
Durham University	BP	Assessing the UK's low enthalpy geothermal resources with specific focus on deep sedimentary basins	Hot sedimentary aquifers	
Durham University		Multiphysics simulation of geothermal enginnering	Fracture systems in crystalline rocks	
Durham University		The geological characterisation and permeability measurements of surface and subsurface fractures in the southern Negros geothermal production field, Negros Oriental, Philippines	Hydrogeothermal	

EPSRC – Engineering and Physical Sciences Research Council
NERC – Natural Environment Research Council
RAERF – Royal Academy of Engineering Research Fellowship

5. 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.

6. Future Outlook

Interest and awareness in geothermal continues to increase, but funding to develop projects remains challenging.

In late 2015 Cornwall and Isles of Scilly Local Enterprise Partnership announced their intention to open a call in early 2016 for a European Regional Development Fund grant of up to £10.6M. The call will only be open to proposals that include the drilling of enhanced geothermal system demonstration well(s). These should be consistent with 'first' well/s that would be required for an enhanced geothermal system (electricity generation from an enhanced or engineered geothermal resource, created by increasing the permeability of the hot rocks at depth). It is the intention that the funding will kick-start a geothermal CHP industry in Cornwall.

7. References and Websites

Batchelor T., Curtis R, Ledingham P. and Law R. 2015. Country update for the United Kingdom. Proceedings World Geothermal Congress 2015, Melbourne, Australia, 19-25 April 2015.

Contracts for Difference
https://www.gov.uk/government/policies/maintaining-uk-energy-security--2/supporting-pages/electricity-market-reform

Renewable Heat Incentive
http://www.decc.gov.uk/en/content/cms/meeting_energy/renewable_ener/incentive/incentive.aspx

http://www.energysavingtrust.org.uk/scotland/Generating-energy/Getting-money-back/Renewable-Heat-Incentive-RHI2

Renewable Energy Association Deep Geothermal Group - http://www.r-e-a.net/member/deep-geothermal

Ground Source Heat Pump Association - http://www.gshp.org.uk/

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