



IEA GEOTHERMAL

IEA Geothermal Implementing Agreement

United Kingdom Country Report 2014

United Kingdom



Figure 1 The first, new, deep geothermal heat produced in the UK for 25 years from a single standing column well at Rosemanowes Quarry in Cornwall, October 2014.
(Photo courtesy of Geothermal Engineering Ltd.)

1.1 Introduction and overview

No additional geothermal power generation or direct use from deep sedimentary aquifers was added during 2014 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 of 0.14 MW [geothermal contribution]).

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 of grant funding had been made available to 82 local authorities. There are no figures as to what percentage of these funds was used for geothermal feasibility studies, but 9 authorities expressed an interest in deep geothermal or mine water heat recovery.

A fourth round of funding ran from 16th October to 27th November 2014 resulting in additional grant funding of £2,983,369, to be spent in 2015. Stoke-on-Trent City Council were awarded £20.2M UK government funding through the City Deal initiative to develop an energy network across the city, comprising a district heat network fed by deep geothermal energy. A

geothermal feasibility desktop study was commissioned by the council in late 2014 and a recommendation for new seismic reflection data acquisition is being followed up. In June 2014, Cheshire East Council launched the Crewe Deep Geothermal Energy Project with the aim of creating a district heating scheme for Crewe supplied by geothermal energy from the Mesozoic Cheshire sedimentary basin.

Table 1 Status of geothermal energy use in the UK for 2014.

Electricity	
New installed capacity (MWe)	0
Total installed capacity (MWe)	0
Direct Use	
New installed capacity (MW _{th})	0
Total installed direct use (MW _{th})	3.0
Total Heat Used (TJ/yr) [GWh/yr]	55.3 [14.8]+
Ground source heat pumps	
New capacity installed (MW)	56
Total Installed Capacity for Heat Pumps (MW)	478
Total Net Heat Pump Use [GWh/yr]	767*

+ 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.

During the year, Geothermal Engineering Ltd. successfully trialled a single standing column well in a project funded with an £800k grant from the DECC. Water was heated up to 60 °C in one of the old Hot Dry Rock boreholes at Rosemanowes in Cornwall. It is hoped that further wells with capacities of up to 0.5 MW can be drilled across the country to meet the heating requirements of apartment blocks and public buildings. The Science Central Borehole in the centre of Newcastle upon

Tyne, which was first drilled in 2011, was cleaned out and secured to a depth of ~1800 m. An air lift pump test on the Fell Sandstone target reservoir was disappointing as only a low, geothermally uneconomic, flow rate was achieved. It was not possible to discern if the low porosity/permeability is a property of the sandstone or is due to precipitation of mud from the drilling fluids.

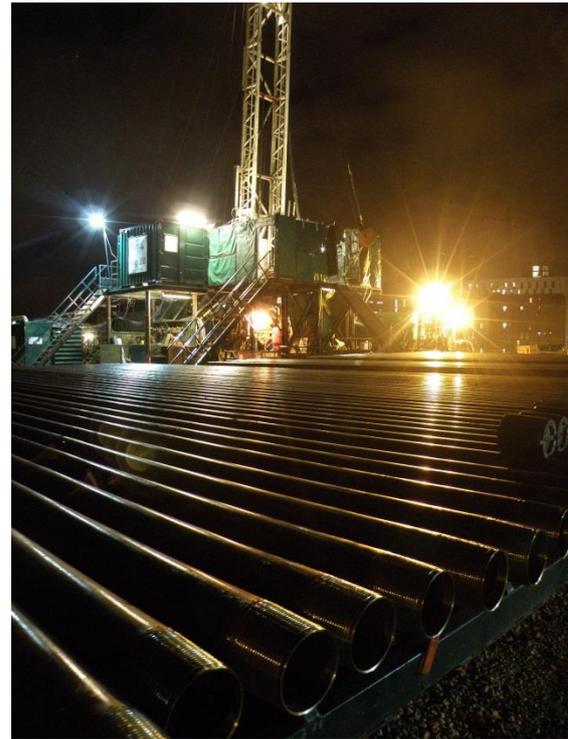


Figure 2 Securing of the Science Central borehole in the centre of Newcastle upon Tyne, March 2014

1.2 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 (GSHP). 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).

1.2.1 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 2014/15 was set at £145/MWh. It has not yet been decided how CfDs for 'less established' technologies (including deep geothermal) will be allocated.

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 2014.

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 are 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 held a consultation 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.

1.2.2 Progress towards national targets

- By the end of 2014 there were 196 accredited non-domestic ground source heat pump installations receiving the RHI with a combined installed capacity of 10.5 MW_{th}. Eligible heat generated was 17,256 MWh_{th}.
- The domestic RHI was introduced in April 2014, but any installations commissioned since July 2009 are eligible. By December 2014 there were 2,922 accredited domestic ground source heat pump installations receiving the RHI. Heat paid for under the domestic scheme was 9,481 MWh_{th}.

1.2.3 Government support/Incentives for R&D

- Geothermal Engineering Ltd was awarded a grant of £800,000 from the DECC Energy Entrepreneurs Fund in November 2013. A successful trial of a single standing column well was performed in one of the old HDR project boreholes at Rosemanowes in Cornwall, SW England, during 2014. A fourth phase of the Energy Entrepreneurs Fund was launched on the 27th November 2014.

1.3 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. There are a number of direct use projects at an advanced stage of planning, most notably Auckland Castle Trust (advised by Cluff Geothermal) in Bishop Auckland, County Durham; Manchester (led by GT energy); North Tyneside (led by Cluff Geothermal)

and Stoke-on-Trent, where 2D seismic reflection data are about to be collected.

Cornwall Council is very supportive of developing geothermal within the county, particularly combined heat and power from enhanced geothermal systems (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.

1.4 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.

1.4.1 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 following projects were funded in 2014, 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	

National Activities – United Kingdom

Glasgow University		Geothermal reservoir modelling: high-enthalpy systems in eastern Africa.	East Africa geothermal	
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
Southampton University		Foundations as an energy source	Energy piles performance	EPSRC/RAERF
Cardiff University		SEREN – Ground Source Heat	Improve the performance and uptake of GSHP	WEFO
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 engineering	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	Hydro-geothermal	

EPSRC – Engineering and Physical Sciences Research Council

NERC – Natural Environment Research Council

RAERF – Royal Academy of Engineering Research Fellowship

WEFO – Welsh European Funding Office

1.5 Geothermal Education

There are no specific higher education courses 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.

1.6 Future Outlook

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

A Heat Network Innovation Demonstration Small Business Research Initiative (SBRI) was kicked off in early 2015 by DECC, which initially funded a number of feasibility studies for innovations in heat networks. A number of these included ground source heat pumps and geothermal heat sources. After this initial phase, seven projects were funded for a demonstration phase. This included one project for a single borehole geothermal system providing heat to communal buildings.

In 2015, the Scottish Government launched a Geothermal Energy Challenge Fund of

£250,000 to fund 5 feasibility studies, as follows;

- **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, Fife:** to explore the geothermal potential under a brownfield site to provide heat to on-site industries and the local community.
- **Polkemmet, West Lothian:** to establish the feasibility of geothermal heat from mineworkings, which will heat proposed new social housing in the area.
- **Hartwood, North Lanarkshire:** to develop a fully operational minewater geothermal district heating system which could act as an exemplar of how to transform farm economics and transfer benefits to local communities.
- **Hill of Banchory, Aberdeenshire:** to explore the viability of adding geothermal energy from hot dry and hot wet rocks to the existing renewable heat network that is already serving the local communities.

In addition the Scottish Government also announced support from the Low Carbon Infrastructure Transition Programme (LCITP) for 4 projects, as follows;

- **Shawfair, Edinburgh and Midlothian:** to explore the technical and economic feasibility of a minewater geothermal heating scheme for the new development at Shawfair, building on the experience of the minewater project in Heerlen.
- **Clackmannanshire Energy Hub:** to investigate commercially viable business models to exploit identified geothermal resources (from minewater, hot sedimentary aquifers and hot dry rocks) within the area. The geothermal energy will be used to supply small

businesses, public buildings and housing.

- **Coleburn Distillery, Elgin, Moray:** to assess the potential for a district heat network supplied from the hot dry rock geothermal resource believed to be under the site of the former distillery (a very large mass of contiguous granite intrusions, parts of which are known to have High Heat Production capacity) to meet the commercial and residential heat demands of the planned development.
- **Clyde Gateway, Dalmarnock and Shawfield:** to evaluate the thermogeological resource and heat storage potential of abandoned mineworkings beneath the area of Clyde Gateway in the east end of Glasgow. This work will build on a study commissioned by Clyde Gateway in 2012 which highlighted the potential that district heating offers the area in terms of economic benefits and addressing fuel poverty.

Cornwall Council has declared its intention to use part of an ERDF (European Regional Development Fund) grant to co-fund an initial borehole in Cornwall to investigate the EGS resource. It is hoped that a consortium of public sector institutes/universities will manage the project and raise the required co-funding.

1.7 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
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
www.r-e-a.net/member/deep-geothermal

Ground Source Heat Pump Association
www.gshp.org.uk/

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