2016 United Kingdom Country Report

Jon Busby

Alison Auld

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IEA Geothermal

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[1] Team Leader Renewables & Energy Storage, British Geological Survey, Keyworth, Nottingham, NG12 5GG, UK. Email: jpbu@bgs.ac.uk

[2] Science and Innovation, Department for Business, Energy and Industrial Strategy (BEIS), 1 Victoria Street, London, SW1H 0ET, UK.
Email: Alison.Auld@beis.gov.uk

Figure 1. Well head at the Southampton geothermal site.

1. Introduction

2016 was another year when interest and awareness of geothermal in the UK increased and a number of projects were progressed but no new capacity was added. There is currently no power generation and direct use is restricted to a total capacity of about 3.14 MW. It comprises 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. However, this scheme has been under maintenance while a new electric pump is fitted but is expected to be at a higher capacity by 2017. There is also 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 February, the results of the Scottish Government's Geothermal Energy Challenge Fund were published. The 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 £185,235 funded four projects as follows;

- Aberdeen Exhibition and Conference Centre was a study undertaken by Geothermal Engineering Ltd to install a Deep Geothermal Single Well (DGSW) to supply heat to a low temperature heat network and to a commercial development. Peak outputs from the well were estimated between 400 and 600 kW and the estimated costs are £2.3M. The DGSW is considered as an alternative geothermal heat source in regions where low permeability rocks are found at depth.

- The Guardbridge geothermal technology demonstrator project investigated the potential of a faulted Devonian sandstone as a Hot Sedimentary Aquifer (HSA) to supply heat to a local network. The study, led by the University of St Andrews, predicted flow rates of 5 to 20 l/s at a temperature of 25 ◦C. Capacity was estimated as 0.42 MW, to supply 2,867 MWh of heat per annum at a development cost (including the heat network) of ~£2M. The project has moved forward to a development stage with the collection of 3 lines of seismic reflection data in the autumn.

- The Fortissat Community minewater geothermal energy district heating network was 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, led by the JHI. The estimated heat supply was between 5,500-20,000 MWh per annum with development costs between £5M-£10M depending on the size and capacity of the heat network and geothermal system.

- The Hill of Banchory geothermal energy project was conducted by the Hill of Banchory Geothermal Energy Consortium. It assessed the deep geothermal potential at Banchory, Aberdeenshire from a pair of deep boreholes drilled into the Hill of Fare Granite. The heat-only project estimated temperatures of 75-90 ◦C between depths of 2.2-3.8 km, depending on the geothermal gradient, and considered flow scenarios between 5-50 l/s.

In February, the UK Department for Communities and Local Government announced a European Regional Development Fund call of £10.6M to develop a scheme incorporating Enhanced Geothermal System (EGS) demonstration wells in the southwest of England.

Electricity		Direct Use	
Total Installed Capacity (MW_e)	0	Total Installed Capacity (MW_{th})	3.14
New Installed Capacity (MW_e)	0	New Installed Capacity (MW_{th})	0
		Total Heat Used (TJ/yr) [GWh/yr]	55.3 [14.8]+
		Total Installed Capacity Heat Pumps (MW_{th})	598
		New capacity installed in 2015 (MW)	63#
		Total Net Heat Pump Use [GWh/yr]	952*

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

These are data from 2015 as the 2016 data were not available at the time of submission of the report.

* 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. Changes to Policy Supporting Geothermal Development

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. The strike price for geothermal in 2016 was set at £145/MWh.

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 2016.

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 2016 were as follows;

- Non-domestic GSHP has a 2 tiered tariff comprising 8.95 p/kWh for the first 1314 hours of use (tier 1) and 2.67 p/kWh thereafter (tier 2)
- Domestic GSHP tariff is 19.33 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 5.14 p/kWh.

3. Geothermal Project Development

3.1 Projects Commissioned

No new projects were commissioned in 2016

3.2 Projects Operational

The only operating deep geothermal project is in the City of Southampton which contributes heat to an inner city district heating network. This scheme has been under maintenance, and therefore at reduced capacity, whilst a new electric pump is fitted.

4. Research Highlights

UK geothermal research is largely concentrated on developing the potential of less conventional resources as deep hot sedimentary aquifers are only found in a few regions and often not in regions of high heat demand. Much research is undertaken within the Higher Education sector, usually as part of PhD programs, as follows;

- Investigating the potential for hydrocarbon wells or shale gas wells for direct use geothermal. This could involve the exploitation of co-produced water or the potential refurbishment of the well after the production of hydrocarbons has ceased. (Durham University, Glasgow University).
- Exploiting the permeability of deep fracture systems as viable geothermal resources. (Glasgow University).
- Exploring the extent of palaeokarst within the buried Carboniferous Limestone and its geothermal potential (Durham University).
- Quantifying the potential of the thermal resource within disused mine systems in the UK (Newcastle University, Glasgow University, British Geological Survey).

5. Other National Activities

5.1 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.

5.2 Conferences

The principal UK geothermal energy conference was the 5th London Geothermal Symposium, held on the 25th October 2016 at The Geological Society. Jointly organised by BritGeothermal (Charlotte Adams), EGS Energy Ltd. (Guy Macpherson-Grant) and Town Rock Energy Ltd. (David Townsend), it was attended by around 80 delegates who listened to 16 presentations.

5.3 Publications

Bailey. M. T., Gandy, C. J., Watson, I.A., Wyatt, L.M. & Jarvis A.P. 2016. Heat recovery potential of mine water treatment systems in Great Britain. International Journal of Coal Geology, 164, 77-84.

Beamish, D. & Busby J. 2016. The Cornubian geothermal province: heat production and flow in SW England: estimates from boreholes and airborne gamma-ray measurements. Geothermal Energy, pp 25, DOI 10.1186/s40517-016-0046-8.

Burnside, N. M., Banks, D. & Boyce, A. J. 2016. Sustainability of thermal energy production at the flooded mine workings of the former Caphouse Colliery, Yorkshire, United Kingdom. International Journal of Coal Geology, 164, 85-91.

Burnside, N. M., Banks, D., Boyce, A. J. & Athresh, A. 2016. Hydrochemistry and stable isotopes as tools for understanding the sustainability of minewater geothermal energy production from a 'standing column' heat pump system: Markham Colliery, Bolsover, Derbyshire, UK. International Journal of Coal Geology, 165, 223-230.

Busby, J. 2016. Thermal conductivity and diffusivity estimations for shallow geothermal systems. Quarterly Journal of Engineering Geology and Hydrogeology, 49, 138-146.

Farr, G., Sadasivam, S., Manju, Watson, I. A., Thomas, H. R., Tucker, D. 2016. Low enthalpy heat recovery potential from coal mine discharges in the South Wales Coalfield. International Journal of Coal Geology, 164, 92-103.

Taylor, K, Banks, D. & Watson, I. 2016. Heat as a natural, low-cost tracer in mine water systems: The attenuation and retardation of thermal signals in a Reducing and Alkalinity Producing Treatment System (RAPS). International Journal of Coal Geology, 164, 48-57.

Westaway, R. 2016. Repurposing of disused shale gas wells for subsurface heat storage: preliminary analysis concerning UK issues. Quarterly Journal of Engineering Geology and Hydrogeology, 49, 213-227.

Westaway, R. & Younger P. L. 2016. Unravelling the relative contributions of climate change and ground disturbance to subsurface temperature perturbations: Case studies from Tyneside, UK. Geothermics, 64, 490-515.

Younger, P. L., Manning, D. A. C., Millward, D., Busby, J. P., Jones, C. R. C. & Gluyas. J. G. 2016. Geothermal exploration in the Fell Sandstone Formation (Mississippian) beneath the city centre of Newcastle upon Tyne, UK: the Newcastle Science Central Deep Geothermal Borehole Quarterly Journal of Engineering Geology and Hydrogeology, 49, 350-363.

5.4 Useful Websites

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/

6. Future Activity

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

The project to develop EGS demonstration wells in the southwest of England with part funding from a European Regional Development Fund grant of £10.6M was given the go-ahead in late 2016 with a start-date of March 2017. It is the intention that the funding will kick-start a geothermal combined heat and power industry in Cornwall.

The city of Stoke-on-Trent are investing in a District Heat Network and have conducted feasibility studies to enable private sector investment in a deep geothermal heat source for the scheme.

A deep geothermal single well will be drilled in 2017 to supply the heat for an outdoor swimming pool (the Jubilee Pool) at Penzance in Cornwall, southwest England.

There is continued interest in mine waters as a source of low carbon heat. The Coal Authority are looking to develop existing mine water treatment schemes for their heat and 5 opportunities are currently underway.

In 2014 the UK Government allocated £31M to establish new research centres called the Energy Security & Innovation Observing System for the Subsurface (ESIOS) project. It is expected that this project will set up two centres, with work beginning in 2017, the second of which will be focussed on geothermal energy research.

7. References

BSIRA 2016. Heat pump market; United Kingdom. Report 59122/11

IEA Geothermal

Executive Secretary
IEA Geothermal
C/ - GNS Science
Wairakei Research Centre
Ph: +64 7 374 8211
E: iea-giasec@gns.cri.nz