2021 United Kingdom Country Report

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July 2022

IEA Geothermal

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Corinna Abesser[1], and Melanie Jans-Singh [2], 2021 United Kingdom Country Report, IEA Geothermal, July 2022.

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National activities – United Kingdom 2021

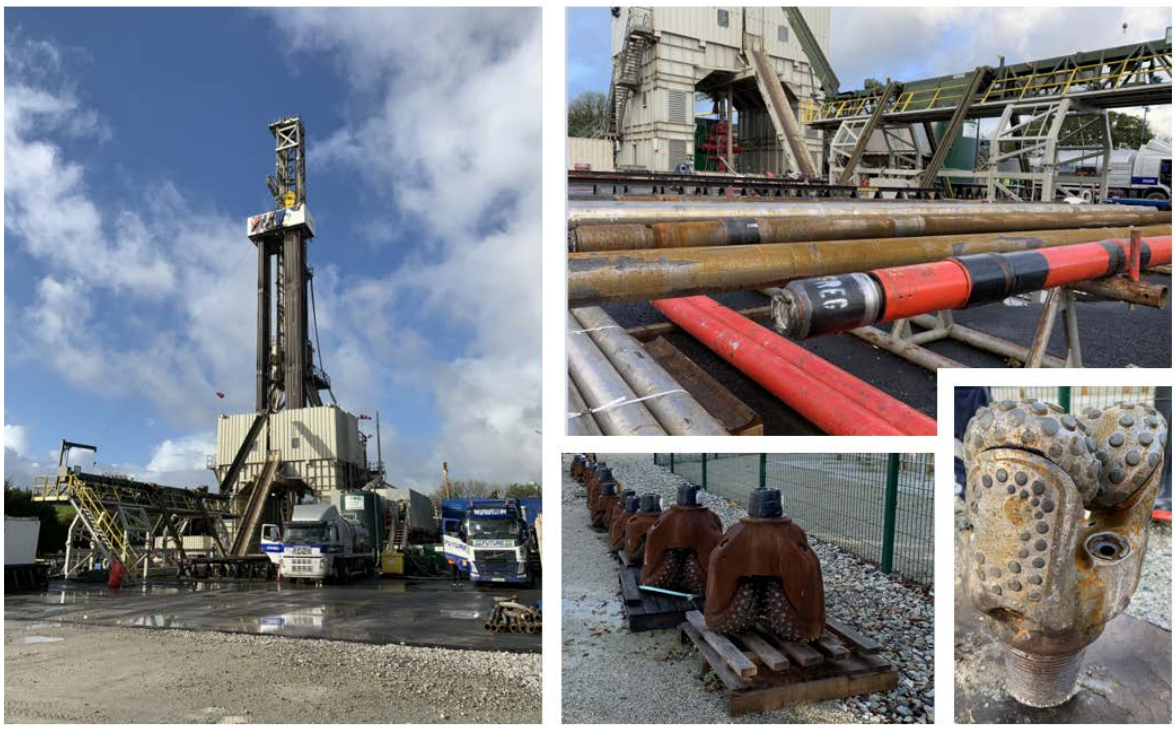

Figure 1.1 Drilling at Eden Geothermal Limited's site at the Eden Project in Cornwall (part funded by the European Regional Development Fund). Photo credit: Corinna Abesser

1. Introduction

This report summarises the national activities surrounding the development of geothermal energy systems between October 2020 and October 2021. The installed capacity of 787 MWth is from the estimated 43,700 installed ground source heat pumps. The total installed capacity in the UK from deep and mine water geothermal systems is ~8.1 MWth and 0 Mwe respectively. There are two geothermal power schemes currently being developed. Mine water geothermal systems are of increasing interest to the UK for their potential societal, economic and environmental benefits.

Table 1. Status of geothermal energy use for electric power generation, direct uses (excl. GSHP) and GSHP in the UK in October 2021.

Electricity	
New capacity installed in 2021 (MWe)	0
Total Installed Capacity (MWe)	0
Direct Use (incl. Mine energy schemes)	
New capacity installed in 2021 (MWth)	0
Total Installed Direct Use (MWth)	8.1
Ground source heat pumps	
New capacity installed in 2021 (MW)	35#
Total Installed Capacity for Heat Pumps (MW)	787#

Total Net Heat Pump Use [GWh/yr]	1316*

These data are forecasted based on market trends, expecting growth in GHSP sales of 18% in 2021

* In calculating the net GSHP 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 structure of the report is as follows. In section 2, the new and ongoing geothermal projects are presented, from deep geothermal, to district heating networks with mine water geothermal and large open/closed loop systems. In section 3, changes to policy supporting geothermal energy are reviewed. Research highlights, which include a new research centre and various research programmes are presented in Section 4. Various other activities are presented in section 5.

2. New and ongoing geothermal projects

2.1 Deep geothermal projects

The ***United Downs Deep Geothermal Power project*** (UDDGPP), led by Geothermal Engineering Ltd (GEL), is the first commercial project in the UK to develop deep geothermal for power generation. The project utilises the natural permeability of the Porthtowan Fault in the Carnmenellis granite in Cornwall. Drilling of two deviated wells started in November 2018 and was completed in 2019. The wells intersect the fault at two different depths in order to create a closed loop circulation system vertically along the fault. The first well, UD1, has a drilled depth of 5275 m (5057 m total vertical depth), encountering temperatures of nearly 200°C, and is the production well. The second well, UD2, has a drilled depth of 2393 m (2214 m total vertical depth) and will act as the injection well. Hydrotesting of the wells took place in July 2021. Production and injection of geothermal fluids was reported to be successful. Installation of the power plant is expected to be complete in 2022. The project plans to supply electricity for 6,000 homes and distribute 55MW heat to local users (including a Tropical Rum Distillery and a new housing estate). GEL has announced plans to develop four more projects in Cornwall by 2026.

In addition, GEL is planning a trial of a lithium extraction plant at the United Downs geothermal site, which was reported to have significant lithium concentrations (averaging around 220 mg/L) in the produced geothermal fluids. The pilot plant will use Direct Lithium Extraction (DLE) technology to recover lithium from the geothermal water and will be developed in collaboration with Cornish Lithium Ltd.

The second, deep geothermal project has started at the ***Eden project in Cornwall***. It is situated on the St Austell granite. The project is being developed by Eden Geothermal Ltd., which has shareholders comprising Eden Project Ltd., EGS Energy Ltd. and BESTEC (UK) Ltd. The project has funding of £9.9m from the European Regional Development Fund, £1.4m from Cornwall Council and £5.5m from institutional investors. The project is targeting a deep crustal fracture. Drilling of the well into the granite began in mid-May this year, and was completed ijn November 2021. The well, EG-1, has a vertical depth of 4,871m and its measured depth (actual drilled depth) is 5,277m, making it the longest geothermal well in the UK. The well has found its target fault structure and the early signs of high temperatures and good permeability at depth are promising. The well will be used to heat the Biomes, greenhouses and offices at the Eden Project. A second phase is planned to start next year, drilling a second well for power generation.

The only operating deep geothermal project is in the **City of Southampton** which contributes approximately 40 GWh heat to an inner-city district heating network. This scheme was under maintenance in 2020 but is understood to be back operating in 2021.

No further deep geothermal projects have been commissioned this year.

2.2 Mine water geothermal projects

Development of disused mine systems for utilisation of their waters for geothermal heating is progressing in the UK . Although in many cases the temperature of the water will be at normal ground water temperatures, the very high abstraction rates possible make disused mine systems ideal for large-scale open loop ground source heat pumps. Abandoned mines fall under the jurisdiction of The Coal Authority (CA) who are developing geothermal heating schemes at several of their sites. The CA estimated around 25% of UK homes are situated in the former coalfields, with potentially sufficient geothermal water to heat all the homes. The most advanced projects are:

- **Seaham Garden Village :** This is a new development of housing, a school, shops and medical and innovation centres that will have district heating supplied from the Dawdon treatment scheme. The pumped mine water is at a temperature of 18-20 °C and has a potential heating capacity of 6 MWth, supporting a district heat network of 1,500 new homes. The Dawdon green energy project will cost between £12 million and £15 million. It received £3.8m government support from the Heat Networks Investment Project (HNIP). It is hoped that the scheme will be a commercially viable sustainable energy demonstrator project that can be duplicated across UK coalfields.[1]
- **Hebburn Minewater District Network:** This development involves drilling into the former Hebburn colliery to extract heat for council owned buildings in the town. The Hebburn site, run by Dunelm Geotechnical, is currently drilling two 300-400 m deep boreholes, one abstraction well and one re-injection well, into the mine workings. Drilling is expected to complete in December, with pumping tests scheduled after Christmas.
- **Gateshead District Heat Network:** In Gateshead, an existing heat network is to be expanded and supplied from the groundwaters within disused mine workings beneath the town. A 6MW water source heat pump will recover heat and distribute via the heat network to up to 1,250 new private homes, a care home, Gateshead International Stadium and other Council-owned buildings. The development is being funded from a grant of £6M from the UK government's Heat Networks Investment Project (HNIP).

2.3 District heating networks using geothermal energy

District heating networks are not as common in the UK as in other European countries. However, there is an increasing recognition in the role these can play in reaching net zero targets. Consequently, government funding has been directed to these projects.

[1] Press release: https://tp-heatnetworks.org/innovative-low-carbon-projects-in-north-east-secure-hnip-funding/

- **Swaffham Prior Community Heat Network**: Funded with a £3.268m grant, sponsored by Cambridgeshire County Council in partnership with Swaffham Prior Community Land Trust, it is intended to help a village of some 300 homes to transition from oil to low carbon heating and serve as a model for other rural communities. The network will combine ground source heat and air source heat pumps to provide heating to homes within the village. Construction will consist of 130 boreholes drilled into the ground to a depth of around 200m to extract heat. The ground source pump will be supplemented by air source and both will be powered by solar panels.[2]

- In South Wales, Rhondda Cynon Taf County Borough Council has announced ***the Taff's Well Thermal Spring Heat Network Project***. The project plans to utilise Wales' only natural thermal spring, Taff's Well, as a source of low-carbon heat for the heating systems of the new school block and nearby pavilion. The spring emerges from the south Wales Coalfield and discharges to the river Taff at temperatures of 21-22C. The wider development is supported by a £1m investment from the Welsh Government.

3. Changes to Policy Supporting Geothermal Development

3.1 Interest in government

A Parliamentary Debate on ***Opportunities for geothermal energy extraction in the UK***[3] took place in the House of Commons on 15 September 2021.

In **Northern Ireland**, interest in geothermal energy saw a noticeable rise over the past year. Following on from a successful international conference in December 2020, the Geological Survey of Northern Ireland (GSNI), the Centre for Sustainability, Equality and Climate Action (SECA) at Queen's University Belfast and the Geothermal Association of Ireland have run a monthly webinar series that has been attended by over 1000 people to date.

A new ***Geothermal Advisory Committee (GAC)*** for Northern Ireland, chaired by the Geological Survey of Northern Ireland, was established in July (2021) which brings together a group of experts from industry, academia, public sector and professional organisations based in UK and Ireland. This group will provide independent advice to the DfE aimed at informing, supporting and developing public policy on geothermal energy as part of the new Energy Strategy for Northern Ireland.

The UK government's "Heat and Buildings strategy" was released in October 2021, which outlines "electrification of heat for buildings using hydronic (air-to-water or ground-to-water) heat pumps, heat networks and potentially switching the natural gas in the grid to low-carbon hydrogen" as the likely future for heating in the UK. The strategy targets at least 600,000 hydronic heat pumps per year by 2028. (Deep) geothermal energy has been recognised in the strategy as a low-carbon source for heat networks that the

[2] Press release: https://tp-heatnetworks.org/hnip-funding-awarded-to-first-community-renewable-heating-project/

[3] Debate pack. Number CDP 2021/0143: https://commonslibrary.parliament.uk/research-briefings/cdp-2021-0143/

government “will continue to monitor … (to) assess whether the technology provides a cost-effective option to help decarbonise heat.”

The new Energy Strategy for Northern Ireland was released in December 2021 following public consultation on policy options by the Department for Energy earlier that year.

The Electrification of Heat Demonstration Project (£14.6m) installed 750 innovative heat pump systems across a range of different housing types. The project will monitor these systems to demonstrate the feasibility of a large-scale roll-out of heat pumps in GB. The system installation phase was completed in 2021, monitoring will be undertaken for one year, finishing in 2022.

3.2 Government support & funding programmes

The Renewable Heat Incentive (RHI) is currently the principal mechanism to support geothermal heat installations in the UK. It provides a subsidy to applicants for every unit of renewable heat they produce. The scheme closed to non-domestic applicants in March 2021 but has been extended to March 2022 for domestic schemes.

A number of support schemes are available for heat networks. The Heat Network Delivery Unit (HNDU) provides support for local authorities in England and Wales for carrying out techno-economic feasibility studies and specialist consultancy work around provision of heat (including from geothermal sources) to heat networks. This fund was set up in 2013 and a total of £25.6m has been awarded to date.

A new scheme, the Boiler Upgrade Scheme (£450 million over three years), has been announced in the Government’s Heat and Building Strategy for domestic and small non-domestic installations, starting in April 2022. The scheme offers capital grants of £5,000 for air source heat pumps and biomass boilers, and £6,000 for GSHPs for schemes up to 45kW, including shared ground loops for non-social housing projects. Separate funding will be made available for social housing schemes, but details have yet to emerge.

A £270m Green Heat Network Fund (GHNF) scheme was announced in the budget of March 2020 and is currently being developed for England. The scheme supports all networks that meet its core eligibility criteria (which includes metrics on technology carbon intensity and minimum heat demand supplied by the network) irrespective of technology. Core eligibility metrics have yet to be confirmed for the GHNF full scheme which is planned to open in 2022 and close in 2025. The GHNF will be a capital grant support scheme which will provide targeted financial support for the decarbonisation of existing and development of new low carbon heat networks across England.

A £10 Million transition scheme was launched on 21st June (Green Heat Network Fund Transition Scheme), for networks with heat demands > 2GWh/year (urban) or > 100 connected dwellings (rural) which are more likely to be served by deep geothermal or mine energy sources instead of GSHPs. The Transition Scheme will provide grant funding to support projects through the commercialisation phase of development. This will enable them to be in a position to apply to the GHNF for construction funding when it opens.

Finally, in England and Wales, BEIS’s Heat Network Invest Project (HNIP) is investing £320m up to April 2022 to support the construction of heat networks and accelerate the

growth of the market across England and Wales. This fund was mentioned previously in this report, as it includes the grants to the North East mine water pump technology schemes.

In Scotland, several additional funding streams are available for geothermal energy technologies, including the Low Carbon Infrastructure Transition Programme (LCIPT) and the Community and Renewable Energy Scheme (CARES).

Geothermal energy continued to be eligible to compete in the Contracts for Difference under pot2 (less established technologies), though no projects have so far been successful. Contracts for Difference is a mechanism by which the government buys power from renewable technologies with 15-year contracts.

4. Research Highlights

4.1 Research centres

A second research site is currently being developed by the ***UK Geoenergy Observatories***, a £31m project funded by the 2014 UK Government Plan for Growth of Science and Innovation. The new site, UKGEOS Cheshire, will include infrastructure for research on GSHP systems, thermal storage in the Triassic Sherwood Sandstone and investigation of environmental impacts. The first research site, UKGEOS Glasgow, is now operational and available to third party researchers. The infrastructure comprises 12 wells drilled into an abandoned mine system equipped with high resolution monitoring technology. It will enable the UK science community to study the low temperature mine water geothermal environment at shallow depth.

4.2 Research programmes

UK geothermal research is broadening out, with an increasing number of funding calls supporting geothermal research. Overall, funding for geothermal research remains sparse with much research undertaken within / led by the Higher Education sector. A number of new projects have started in 2021.

NetZero Geothermal Research for District Infrastructure Engineering (NetZero GeoRDIE) project, led by Newcastle University, is a £1.6m academia/industry consortium which was launched earlier this year. The project will develop Newcastle 1.6km deep Helix's borehole into a state-of-the-art research facility. It is funded by the £8 Mill EPSRC[4] Programme to Decarbonise Heating and Cooling to support the UK's goal of achieving Net Zero emissions by 2050

A second call for an **£14.6 NERC[5]/EPSRC Programme to Decarbonise Heating and Cooling** was issued in 2020. Eleven projects were funded under this call, including three geothermal projects:

- Geothermal Energy from Mines and Solar-geothermal heat (GEMS) (£1.4 M), led by Durham University

[4] EPSRC – Environmental and Physical Sciences Research Council
[5] NERC – Natural Environment Research Council

- Sustainable, Flexible and Efficient Ground-source heating and cooling systems (SaFEGround) (£1.5 M), led by Imperial College
- Aquifer thermal energy storage for decarbonisation of heating and cooling: Overcoming technical, economic and societal barriers to UK deployment (1.5 M), led by Imperial College

The £8M ***UK Unconventional Hydrocarbons (UKUH) research programme*** (funded by NERC and ESRC[6]) made £400K funding available to fund a series of projects that address new research themes, which have emerged as the result of the changes to the shale gas landscape in the UK. Projects that received funding included

- Underground energy on-the-ground: risk perception, community engagement and lessons learned for geothermal energy in a post-shale energy landscape (£70K), led by Anglia Ruskin University which started in May 2021.
- Testing the limitations of empirical traffic light systems used to manage the hazard of fluid induced seismicity (£25K), led by Durham University
- Baseline seismic monitoring survey for UKGEOS Glasgow geothermal production using Distributed Acoustic Sensing (DAS) (£25K), led by University of Bristol
- Public engagements with induced seismicity: lessons for geothermal energy in the UK's net-zero transition(£25K), led by University of Birmingham
- Effective monitoring of the environment before, during and after sub-surface activities(£25K), led by the British Geological Survey

In Northern Ireland, funding announced for an innovative new partnership between academia and industry will harness Northern Ireland's natural geothermal resources, thermal energy that comes from the sub-surface of the earth to encourage the most efficient use of energy by industrial users, such as for data centres. It is funded through Invest NI's Competence Centre Programme and the Centre for Advanced Sustainable Energy (CASE).

4.3 Education

At COP26, a new education platform was launched: the UK Centre for Masters' Training in Energy Transition (CMT). The platform brings together UK universities with leading energy companies and industry training providers to facilitate access to resources and training for the next generation of geoscientists and engineers. Its remit covers a range of energy and renewable technologies, including geothermal energy and carbon capture and storage. Further details are available on the CMT website at https://www.energy-transition.ac.uk/ .

4.4 Selected publications

Abesser & Walker (2022) Geothermal Energy, *Parliamentary Office for Science and Technology (POST) researching briefing*, POSTbrief 46, https://post.parliament.uk/research-briefings/post-pb-0046/

Hinson & Sutherland (2021) Opportunities for geothermal energy extraction. *House of Commons Research Briefing*, September 2021. https://commonslibrary.parliament.uk/research-briefings/cdp-2021-0143/

[6] ESRC - Economic and Social Research Council

Jones, D (2021) Unlocking the deep geothermal energy potential of the Carboniferous Limestone Supergroup, *BGS Research Highlight*, https://www.bgs.ac.uk/news/unlocking-the-deep-geothermal-energy-potential-of-the-carboniferous-limestone-supergroup/

Narayan et al., (2021) Karstified and fractured Lower Carboniferous (Mississippian) limestones of the UK – A cryptic geothermal reservoir, *Zeitschrift der Deutschen Gesellschaft für Geo-wissenschaften*; DOI: 10.1127/zdgg/2021/0288

Pharaoh et al., (2021) Early Carboniferous limestones of southern and central Britain: Characterisation and preliminary assessment of deep geothermal prospectivity; *Zeitschrift der Deutschen Gesellschaft für Geowissenschaften;* DOI: 10.1127/zdgg/2021/0282

Raine & Reay (2021) Geothermal energy potential in Northern Ireland : summary and recommendations for the Geothermal Advisory Committee. Geological Survey of Northern Ireland, 27pp. http://nora.nerc.ac.uk/id/eprint/530934/

REA & ARUP (2021) Deep Geothermal Energy – Economic Decarbonisation Opportunities for the United Kingdon, Report by the Association for Renewable Energy and Clean Technology (REA) and Arup, May 2021. https://www.r-e-a.net/wp-content/uploads/2021/05/Deep-Geothermal-Energy-Opportunities-for-the-UK.pdf

5. Other National Activities

5.1 Geothermal Education

There are no specific higher education courses devoted to the exploration and utilisation of geothermal energy in the UK. However, earth science and renewable energy university courses increasingly offer modules on aspects of geothermal energy. There is also increased interest in renewable energy topics, including Geothermal Energy, in secondary school education. The 2021 Environmental Science Teacher Associations Annual General Meeting hosted a keynote lecture on Geothermal Energy in the UK (delivered by BGS).

5.2 Conferences

Build Back Better: Geothermal Energy for Norther Ireland virtual conference (virtual) 11th December 2020: Conference-Agenda-Building-Back-Better-A-future-for-Geothermal-Energy-in-Northern-Ireland.pdf (qub.ac.uk)

2021 Mine Water Geothermal Energy Symposium: Mine Water Heating and Cooling – A 21st Century Resource for Decarbonisation (virtual), organised by the BGS, BEIS and IEA Geothermal, 12 -13 April 2021. https://iea-gia.org/workshop-presentations/2021-mine-water-geothermal-energy-symposium/

8th London Geothermal Symposium (hybrid), 17th November 2021, https://www.geolsoc.org.uk/11-EG-Geothermal

5.3 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 continue to increase, but obtaining funding to develop projects remains challenging.

7. References

BSRIA 2021. Heat pumps market analysis 2021 - United Kingdom. Report number 102184/17

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