Geothermal Energy in Scotland

A brief bibliography of key literature resources

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This short bibliography has been compiled at the request of Scottish Government to support the synthesis report provided in October 2016: *Geothermal Energy in Scotland: A synthesis report covering four feasibility studies.* The four feasibility studies were:

1. Aberdeen Exhibition and Conference Centre Deep Geothermal Single Well Project; Feasibility Report for the Low Carbon Infrastructure Transition Programme.

   Geothermal Engineering Ltd, University of St Andrews, Ove Arup and Partners. (2016) *Deep Geothermal Single Well report.* http://www.gov.scot/Resource/0049/00497878.pdf

2. Fortissat Community Minewater Geothermal Energy District Heating Network.

   James Hutton Institute. (2016) *Fortissat Community Minewater Geothermal Energy District Heating Network.* http://www.gov.scot/Resource/0049/00497924.pdf

3. Geothermal Energy Challenge; Guardbridge Geothermal Technology Demonstrator Project.

   University of St Andrews. (2016) *Geothermal Energy Challenge Fund: the Guardbridge Geothermal Technology Project.* http://www.gov.scot/Resource/0049/00497934.pdf

4. Hill of Banchory Geothermal Energy Project; Feasibility Study.

   Hill of Banchory Geothermal Energy Consortium. (2016) *Hill of Banchory Geothermal Energy Project Feasibility Study.* http://www.gov.scot/Resource/0049/00497700.pdf

The bibliography is in two sections. Firstly, some important textbooks and a review article covering geothermal energy in general are listed (the last of these is referenced by study 1 above). Secondly, key literature resources for geothermal energy in Scotland that have been used by and are referenced in the feasibility studies are listed.

Online access to the literature is indicated with links, some require purchase or an account. Open access versions are indicated in some cases, readers should check the copyright position before using these further.

It should be noted that the feasibility studies themselves now form key resources as examples for potential future studies. They also contain numerous other references, not picked out here, that have relevance to their specific locations or the technologies proposed.

Background textbooks and review

The following textbooks and review cover geothermal energy in general:

Gupta, H.K. & Roy, S. (2007) *Geothermal Energy: An Alternative Resource for the 21st Century*. Amsterdam, The Netherlands: Elsevier.

This gives good coverage of all aspects of geothermal energy resources and development.

Available online through Science Direct (account required): http://www.sciencedirect.com/science/book/9780444528759

Preview available online through Google Books:
https://books.google.co.uk/books/about/Geothermal_Energy.html?id=3sOyhcp5eZYC&redir_esc=y

Glassley, W.E. (2014) *Geothermal Energy: Renewable Energy and the Environment, Second Edition.* Boca Raton, Florida, USA: CRC Press.

An up to date general account of geothermal energy, including policy aspects, less technical.

Available online through CRCnetBASE (account required): http://www.crcnetbase.com/isbn/9781482221756

Preview available online through CRC Press: https://www.crcpress.com/Geothermal-Energy-Renewable-Energy-and-the-Environment-Second-Edition/Glassley/p/book/9781482221749

Lund, J.W. & Boyd, T.L. (2016) Direct utilization of geothermal energy 2015 worldwide review. *Geothermics*, 60, 66-93.

The latest in a periodic series of reviews of global geothermal energy use. Covers deployment by technology, application and country.

Available online through Science Direct (account required):
http://www.sciencedirect.com/science/article/pii/S037565051500156X

Pre-publication manuscript (not final version) available online here:
https://pangea.stanford.edu/ERE/db/WGC/papers/WGC/2015/01000.pdf

Beardsmore, G.R. & Cull, J.P. (2001) *Crustal Heat Flow: A Guide to Measurement and Modelling.* Cambridge: Cambridge University Press.

This book covers the fundamental concepts of heat flow in the Earth that give rise to the potential for geothermal energy exploitation.

Available to purchase through Cambridge University Press (preview available):
http://www.cambridge.org/us/academic/subjects/earth-and-environmental-science/solid-earth-geophysics/crustal-heat-flow-guide-measurement-and-modelling?format=PB&isbn=9780521797030

Key resources referenced by feasibility studies

The following works, referred to by one or more of the feasibility studies, are considered to be key literature resources for geothermal energy in Scotland:

Burley, A.J., Edmunds, W.M., & Gale, I.N. (1984) *Investigation of the geothermal potential of the UK: catalogue of geothermal data for the land area of the United Kingdom.*

Catalogue of fundamental geothermal data for the UK compiled during an eight-year programme of work by British Geological Survey (BGS); second revision, incorporating data up to 1984.

Available online here: http://nora.nerc.ac.uk/512272/

Downing, R.A. & Gray, D.A. (Eds.) (1986) *Geothermal energy: the potential in the United Kingdom*. London: H.M.S.O.

Report on the results of the programme of work by BGS, includes fundamental estimates of geothermal resources available in the UK that form the basis of later refinements.

Available online here: https://bookshop.europa.eu/en/geothermal-energy-pbCDNA09505/

AECOM. (2013) *Study into the Potential for Deep Geothermal Energy in Scotland. Volume 1 of 2.* Edinburgh: Scottish Government.

Gillespie, M.R., Crane, E.J., & Barron, H.F. (2013) *Deep geothermal energy potential in Scotland*. British Geological Survey Commissioned Report, CR/12/131. Published as: *Study into the Potential for Deep Geothermal Energy in Scotland. Volume 2 of 2.* Edinburgh: Scottish Government.

Study, reported in two volumes, to identify steps needed to commercialise geothermal energy in Scotland including an assessment of favourable areas based on existing geological data and suggestion of policy options and actions to encourage exploitation. Draws on data from BGS programme.

Available online here, Vol.1: http://www.gov.scot/resource/0043/00437977.pdf ;

Vol 2: http://www.gov.scot/Resource/0043/00437996.pdf

Westaway, R. & Younger, P.L. (2013) Accounting for palaeoclimate and topography: A rigorous approach to correction of the British geothermal dataset. *Geothermics*, 48, 31-51.

Methodology for correcting heat flow data for systematic underestimation in earlier works; referred to by, and corrections used in, two of the four 2016 feasibility studies (1 and 4 above).

Available online through Science Direct (account required):
http://www.sciencedirect.com/science/article/pii/S0375650513000266

Accepted manuscript version available online here: http://eprints.gla.ac.uk/81002/1/81002.pdf