



**British
Geological Survey**

NATURAL ENVIRONMENT RESEARCH COUNCIL



**Durham
University**



**University
of Glasgow**



**Newcastle
University**

BritGeothermal

Plumbing the Depths

Dr Charlotte Adams

Research Manager BritGeothermal

Sustainable Exploitation of the Subsurface 21-21st May 2015



Geothermal Energy

- Sourced from Earth's Core
 - Volcanic High T >150°C
 - UK Low T <150°C
-
- Harnessed at surface or by drilling into target formation
 - Used for direct heat and for power generation



Why Geothermal?

Pros

Predictability

Energy Security

Offset heat demands

Low Carbon Resource

Proven

Cons

Drilling Costs

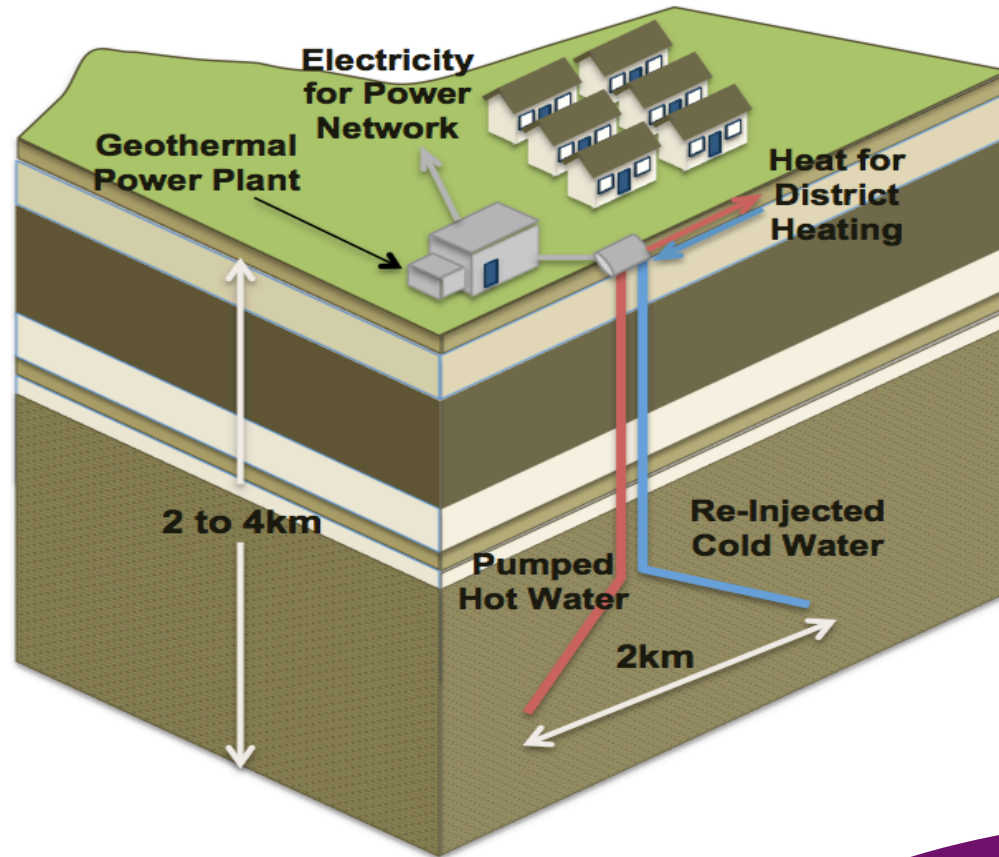
Economics

Infrastructure

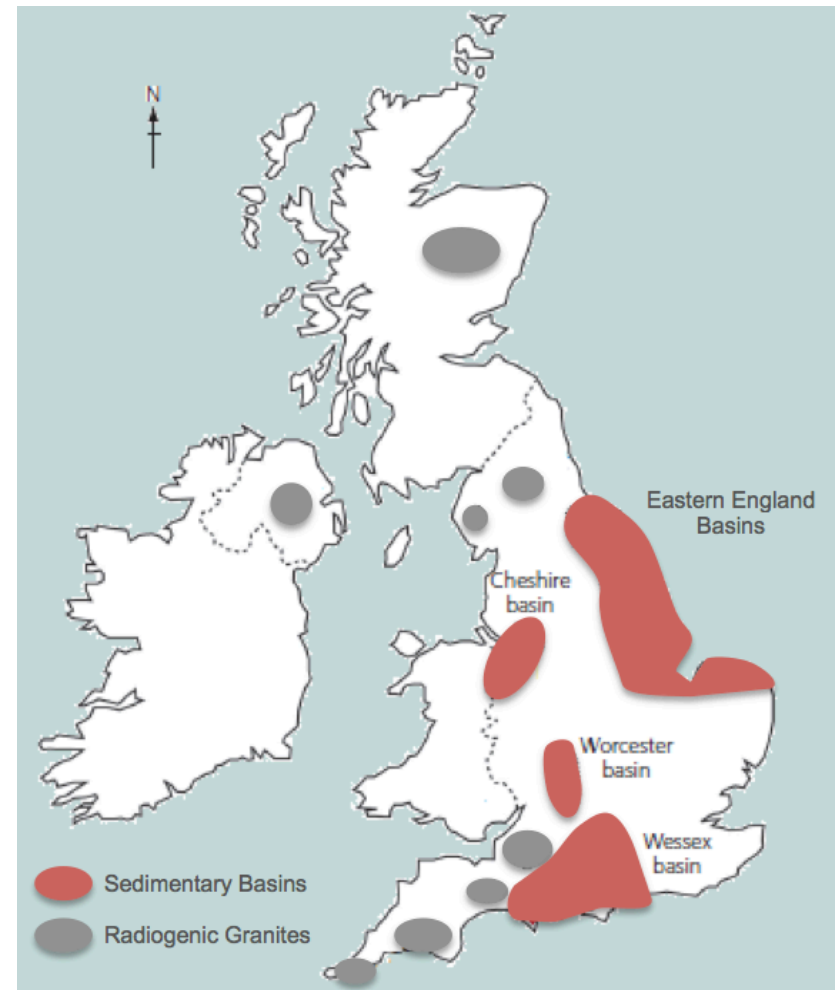
Social change



How is it exploited?



Key Message 1: You don't need volcanoes

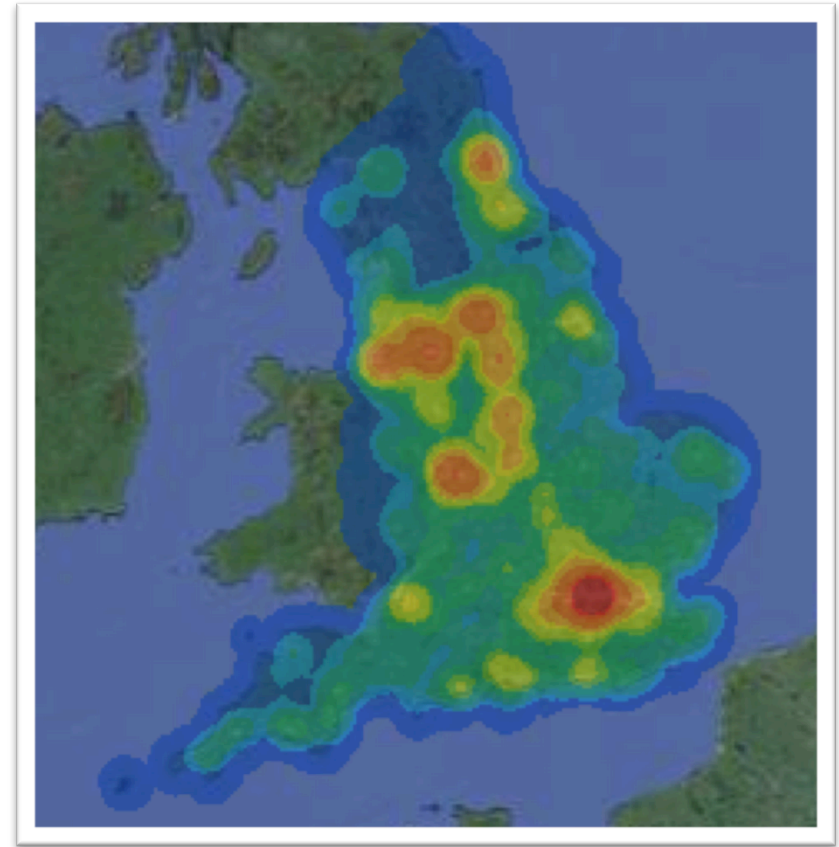


Potential UK Geothermal Targets



Key Message 2: Heat is as important as electricity

- Half of the energy consumed in the UK is used for the production of heat
- Two thirds of this can be assigned to the domestic sector
- 83% is used for space and water heating
- Deep geothermal resources could provide over 100GW of heat



Source: DECC



Key Message 3: Geothermal energy technology is not new

- Geothermal energy has been used for millennia
- Globally China and the USA are the largest producers of geothermal heat and power respectively
- Less than 1% of the Earth's geothermal potential is currently exploited
- Technology advancements mean that most regions of the globe could access geothermal resources
- Several geothermal plants have been operational on the scale of decades



Objectives

Centre for Deep Geothermal Energy Research

- Formally launched at the 4th London Geothermal Symposium Oct 2014
- Expertise gained from drilling 3 most recent deep boreholes in the UK

Objectives

- Create a virtual geothermal research centre
- Actively collaborate and cooperate in geothermal research
- Share experiences and expertise and promote knowledge exchange
- Seek out new sources of funding for geothermal research
- Promote geothermal energy to government and commerce



Key Skills

- Microseismicity
- Hydrogeochemistry
- Minerals geothermometry
- Hydrogeology
- Petroleum geology
- Structural geology

Research

- Research on projects identified by the consortium or in response to industry needs. Supervision by both academic and industry staff

Outputs

- Journal Papers and Geothermal Book
- Visited DECC to discuss UK geothermal - Feb 2014
- Responded to DECC Consultation on underground access - Aug 2014
- Invited to brief Lord Jenkin on geothermal - Oct 2014



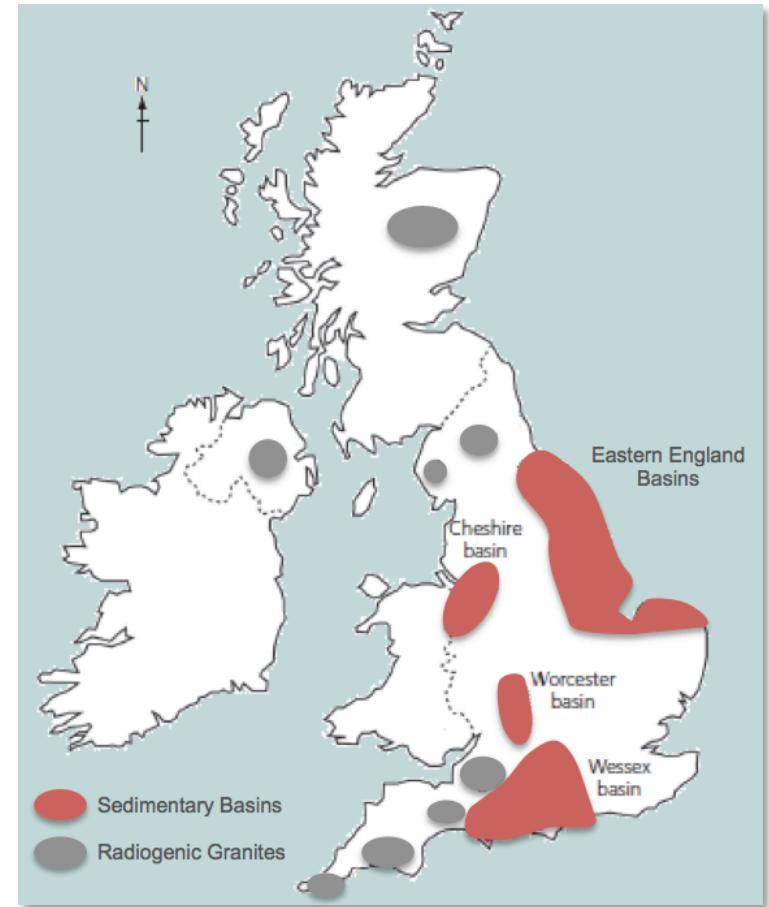
Science Central Borehole



UK Geothermal Interests

BritGeothermal research themes within the UK:

- Hot sedimentary aquifers
e.g. Cheshire and Wessex Basins
- Radiothermal granites and fault systems
e.g. NE England and Cornwall
- Oilfields
e.g. E Midlands, Wytch Farm and North Sea
- Abandoned flooded mineworkings
e.g. UK coalfields
- Colonising abandoned/planned wells
e.g. Abandoned exploration and shale gas wells



Potential UK Geothermal Targets



Radiothermal Granites

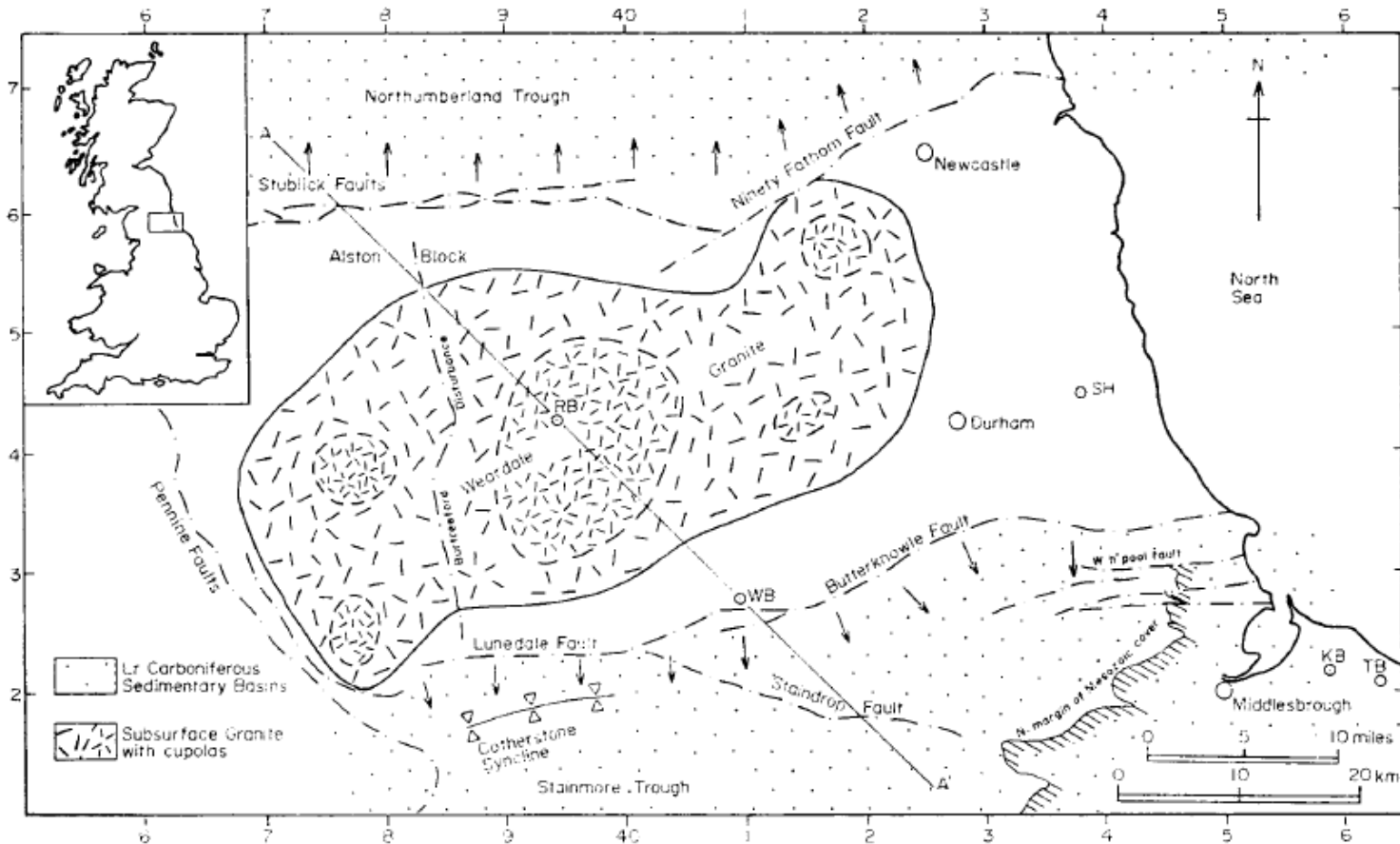


FIG. 1. Map showing the heat flow determinations in County Durham and north Yorkshire and the deep geological structure of the region. Lower Carboniferous hinge-belts are marked by arrows which indicate the direction of thickening. A-A' is line of section shown in Fig. 2. RB—Rookhope boring, WB—Woodland boring, SH—South Hetton boring, KB—Kirkleatham boring, TB—Tocketts boring.

Eastgate - Granite

- Drilled in 2004 to a depth of 998m
- Drilled into Weardale Granite to intercept fractures associated with Slitt Vein
- Temperature 46°C at bottom of well
- Well doublet created
- Plans for testing



Science Central - Faults



- Drilled 2011 in central Newcastle upon Tyne
- Drilled to connect with 90 fathom fault which feeds thermal fluids from the Weardale Granite
- 73°C measured at 1,821m gradient >35°C/km
- Intercepts Fell Sandstone aquifer
- Well tests planned



Hot Aquifer Systems

- Buried thick sedimentary basin sequences
- Aquifer Depths 2-5km – convective flow
- Heat only
- Temperature typically 60°C or above

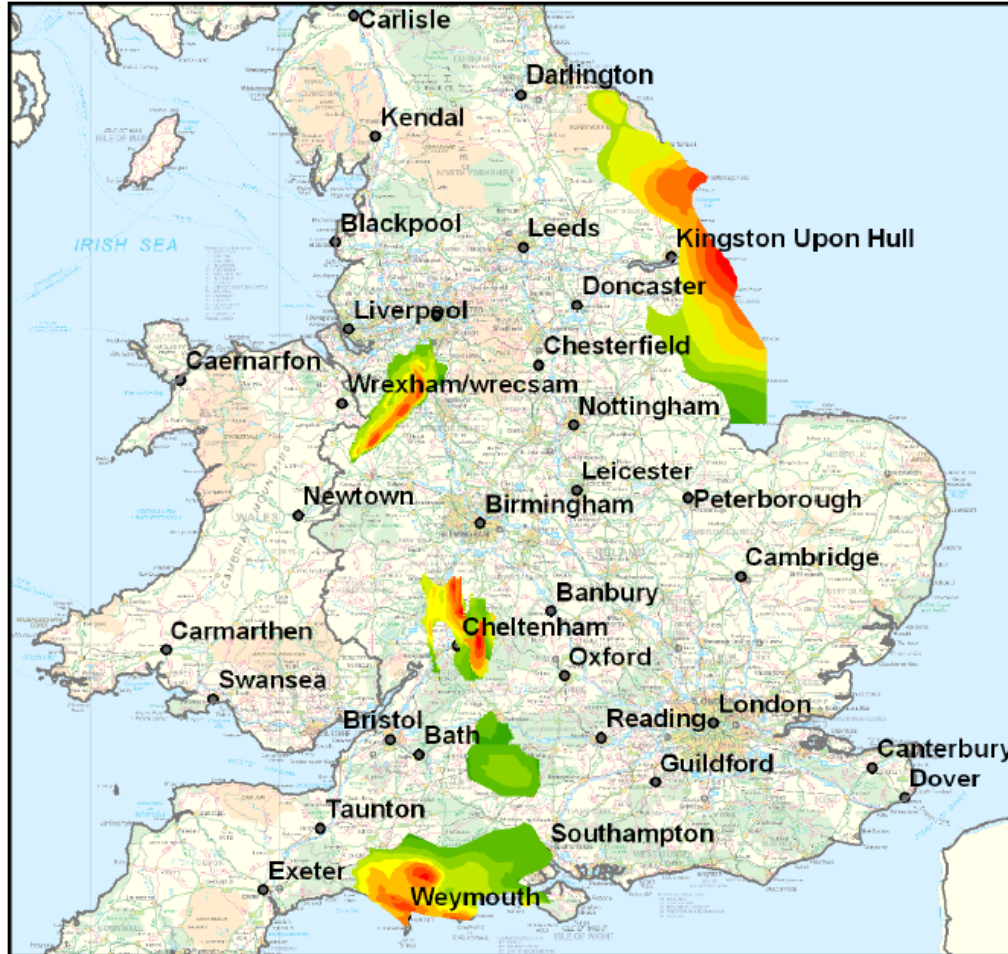


UK Warm Water Deep Basin Potential

- Southampton District Energy Scheme
 - Single borehole to 2km into Triassic Sherwood Sandstone
 - Start-up 1986
 - Rate 15-20 lsec⁻¹ (\equiv 39,500-52,600 m³month⁻¹)
 - Temp ~75°C
 - Heat ~ 1.7MW

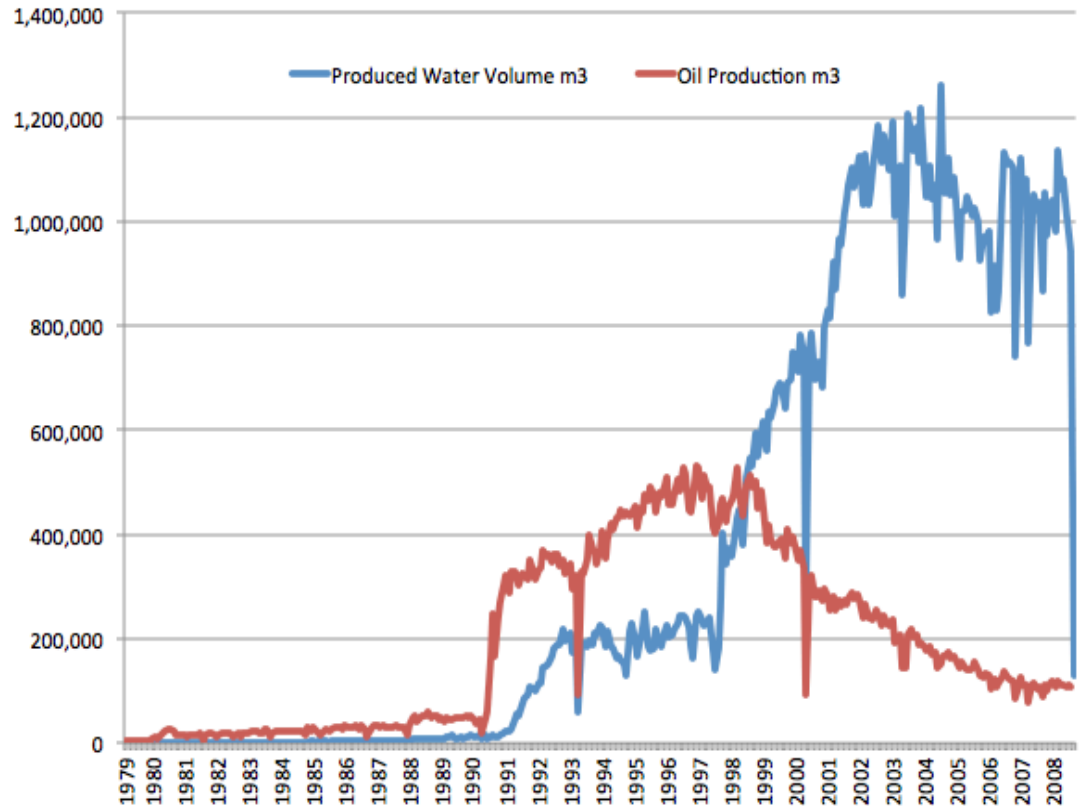


Geothermal Basins in England

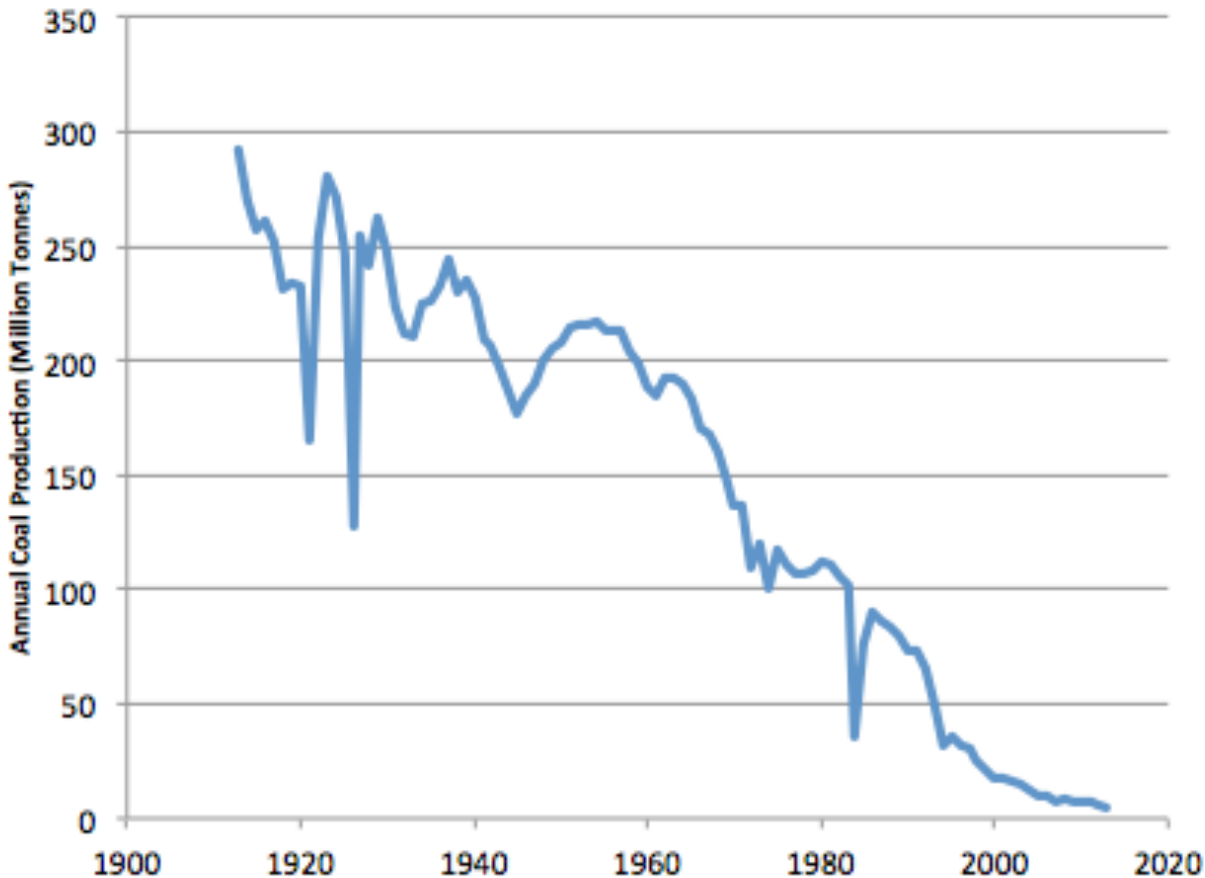


Wytch Farm Oilfield

- Potential to reduce CO₂ emissions in the Poole area by 85,000 tonnes
- Potential heat and power output of 35MW and 1.3MW
- Opportunities for replication at other sites



Abandoned Mines

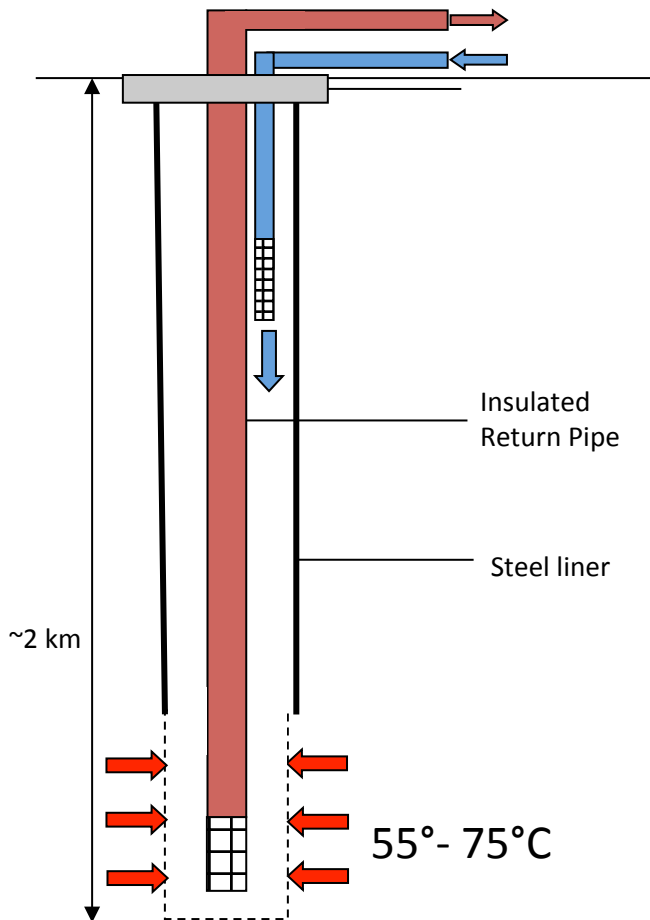


- 15bn tonnes of coal from deep mines
- 2bn m³ of water within flooded workings in the UK
- 38,500TJ of heat*
- Good underlap with population centres

* At ΔT 4°C



Single Well Systems



- Colonise existing wells
- Independent of geology
- Lower heat outputs suitable for clusters of dwellings or larger single buildings
- Reduces project risk and cost when using existing wells

Adapted from schematic by
Geothermal Engineering Ltd



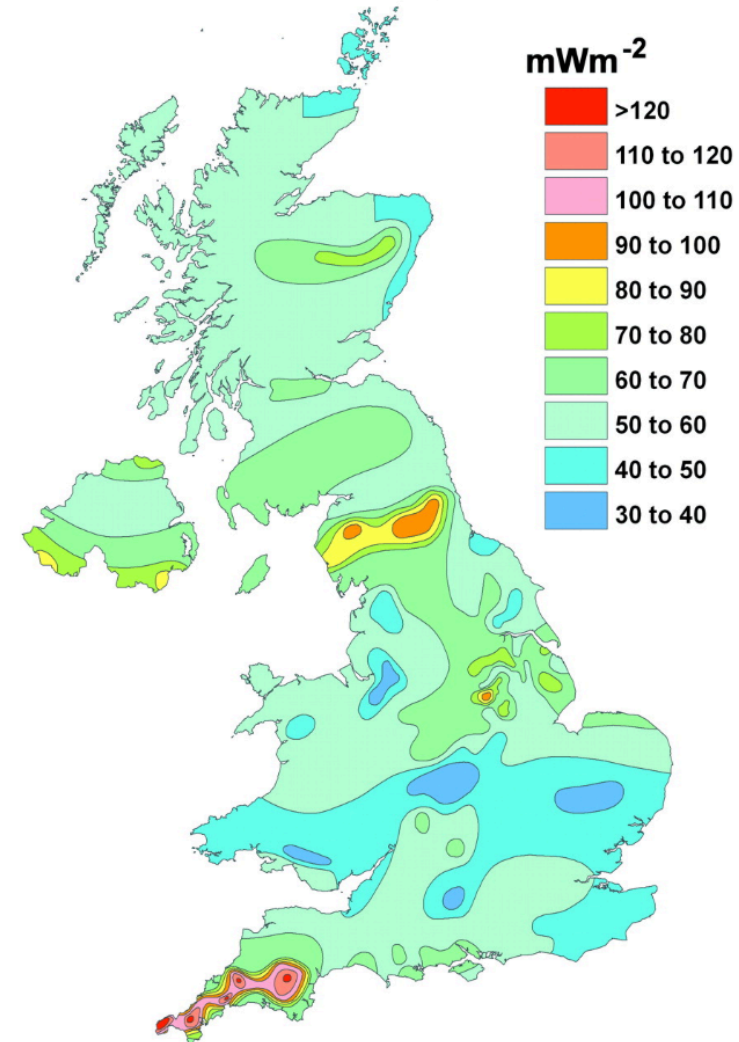
Looking to the Future...

- Offsetting gas consumption for heat production
- Lowering minimum temperatures for power production
- Reducing risk by enhancing survey techniques
- Increase in heat network uptake



To conclude...

- The UK has a wide variety of geothermal resources
- There are opportunities to reuse existing subsurface infrastructure
- Need to know more about the deep subsurface to reduce risk and increase investor confidence





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BritGeothermal

Research Partnership

Thank you

c.a.adams@durham.ac.uk

www.britgeothermal.org



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