Considering the potential for clean, sustainable geothermal energy in Yorkshire

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Geothermal – direct vs indirect use

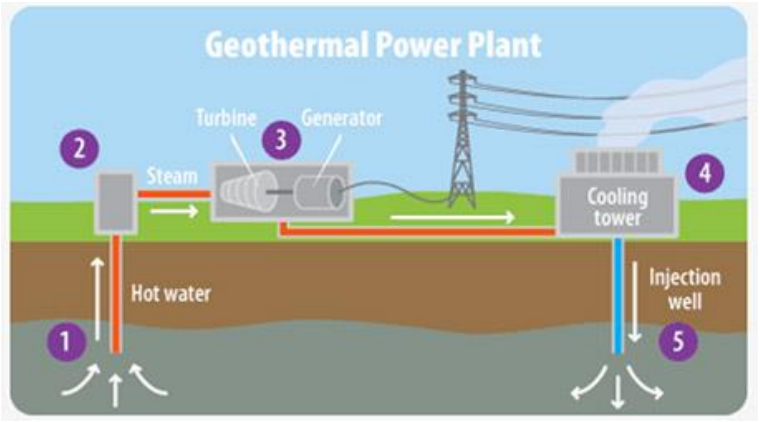
Direct vs indirect use geothermal:

direct use

- the geothermal energy is used directly e.g. for heating homes, swimming pools, greenhouses

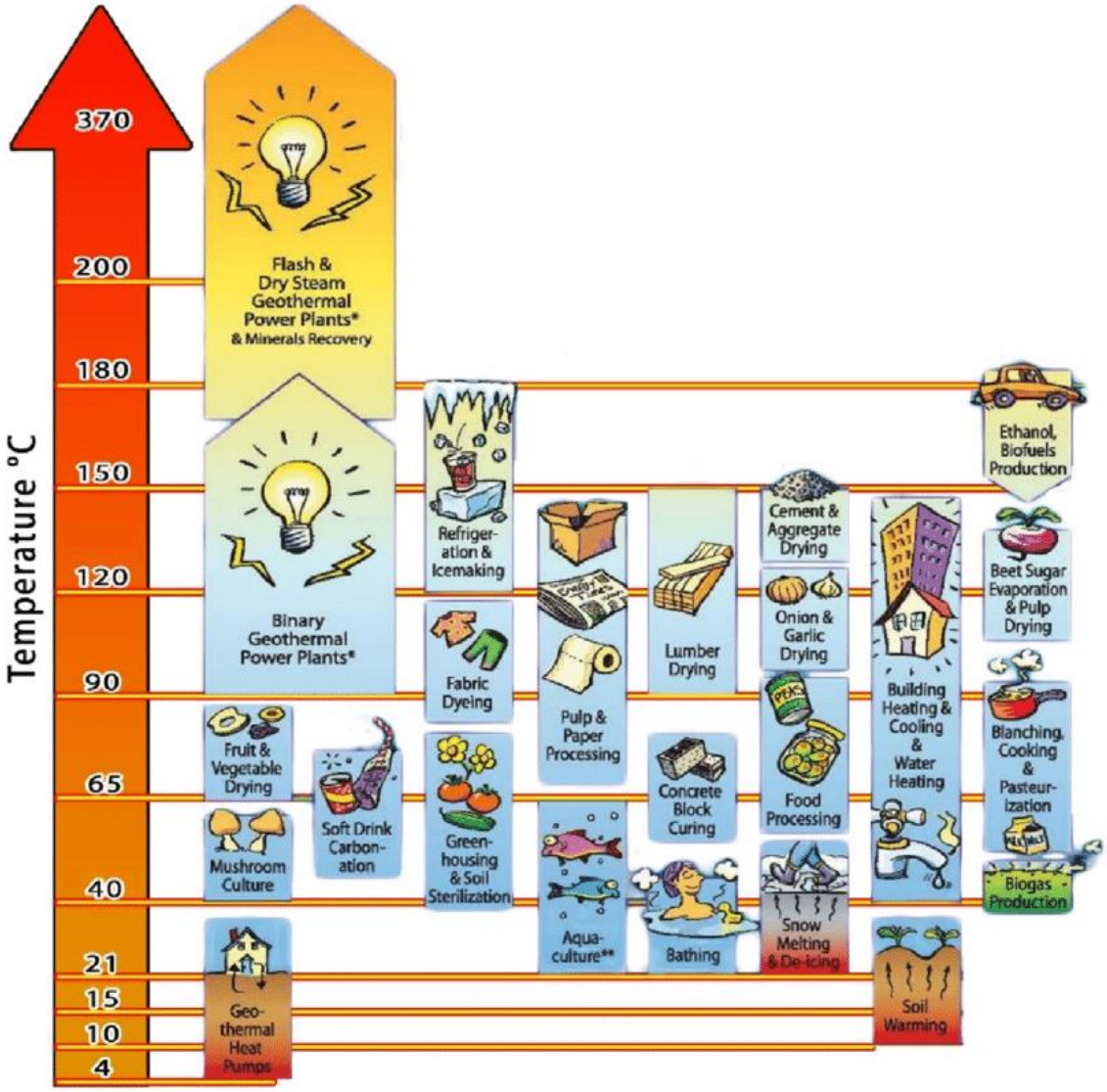
indirect use

- the geothermal energy is converted to electricity before using

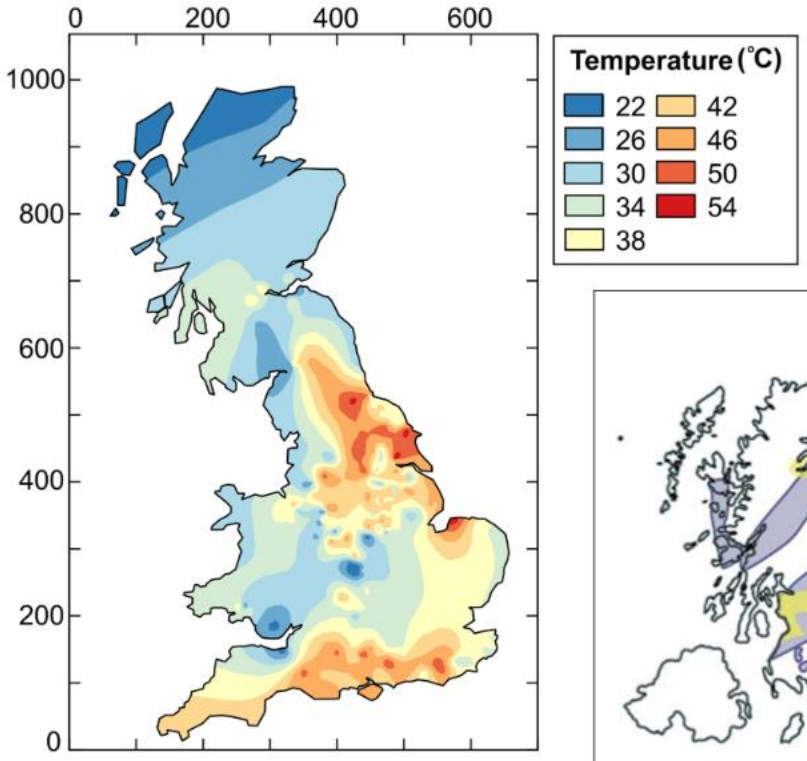


US EPA

Geothermal energy

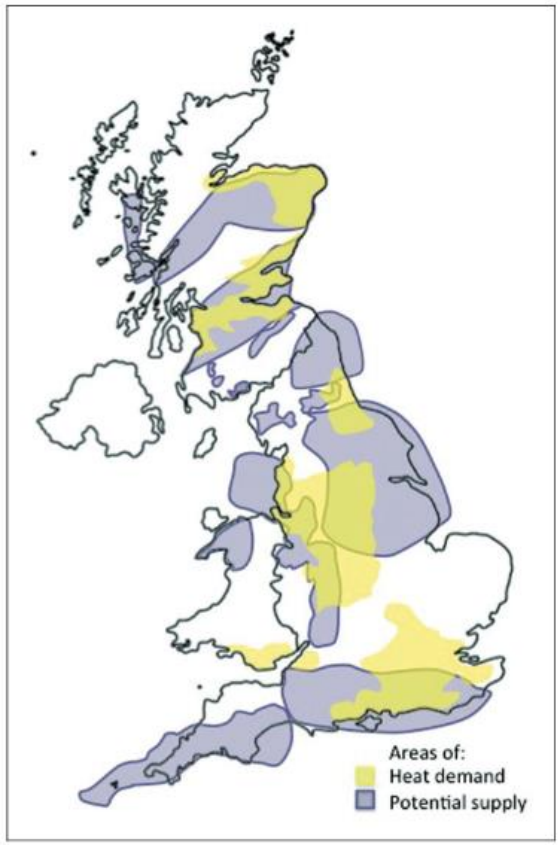


Geothermal – potential in Yorkshire



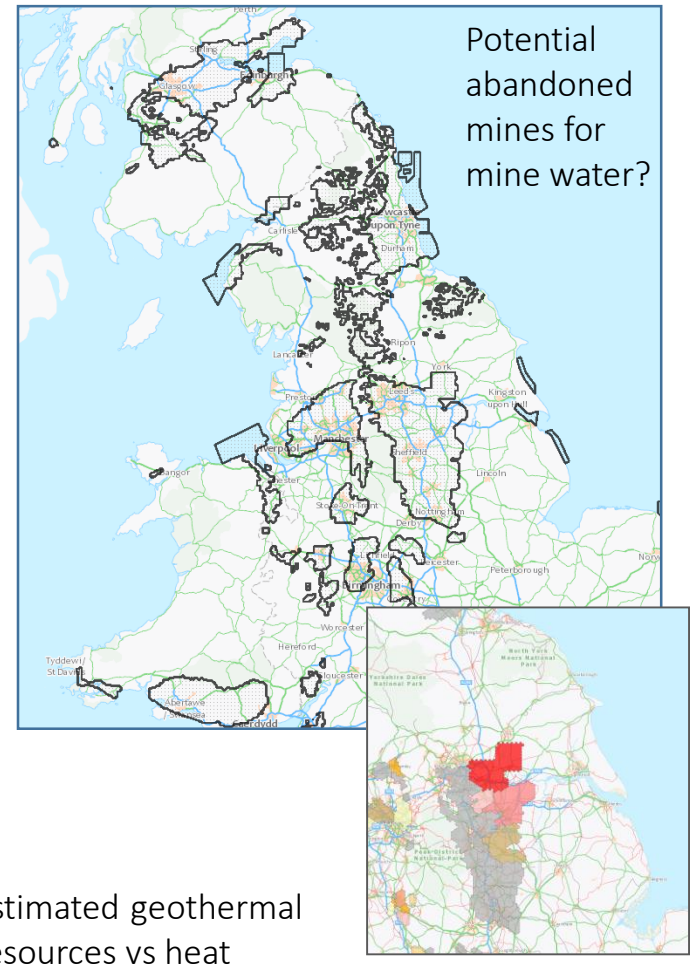
Regional temperature variation at 1 km depth across the UK

Watson et al., 2020



Estimated geothermal resources vs heat demand

Gluyas et al., 2018



Source: Interactive map, The Coal Authority

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Geothermal – potential in Yorkshire

A range of possibilities:

- shallow geothermal – ground source heat pumps (GSHP)
- mine water
- direct use of deeper hydrothermal system

- possible repurposing of legacy wells
- engineered solutions for low-mid enthalpy of deeper granite

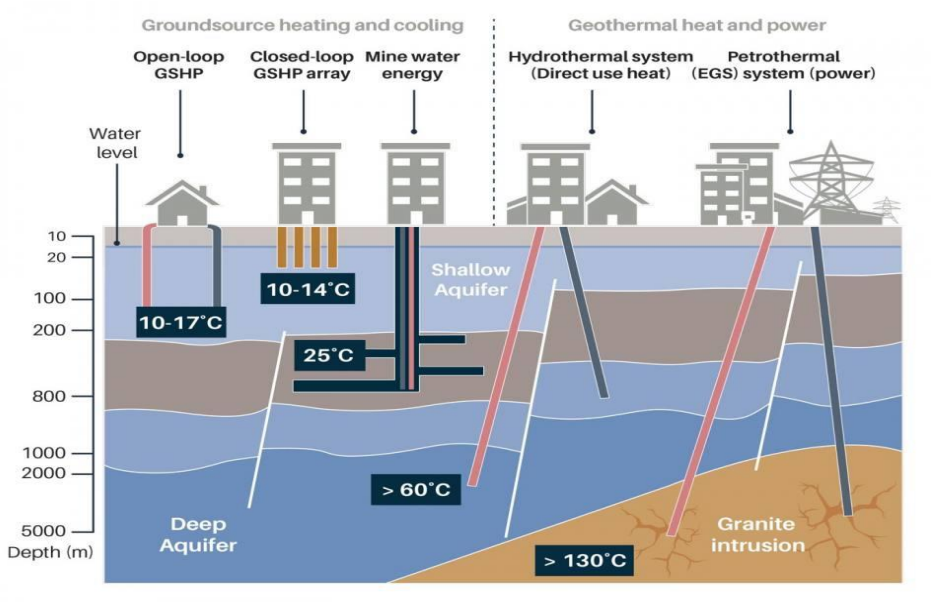
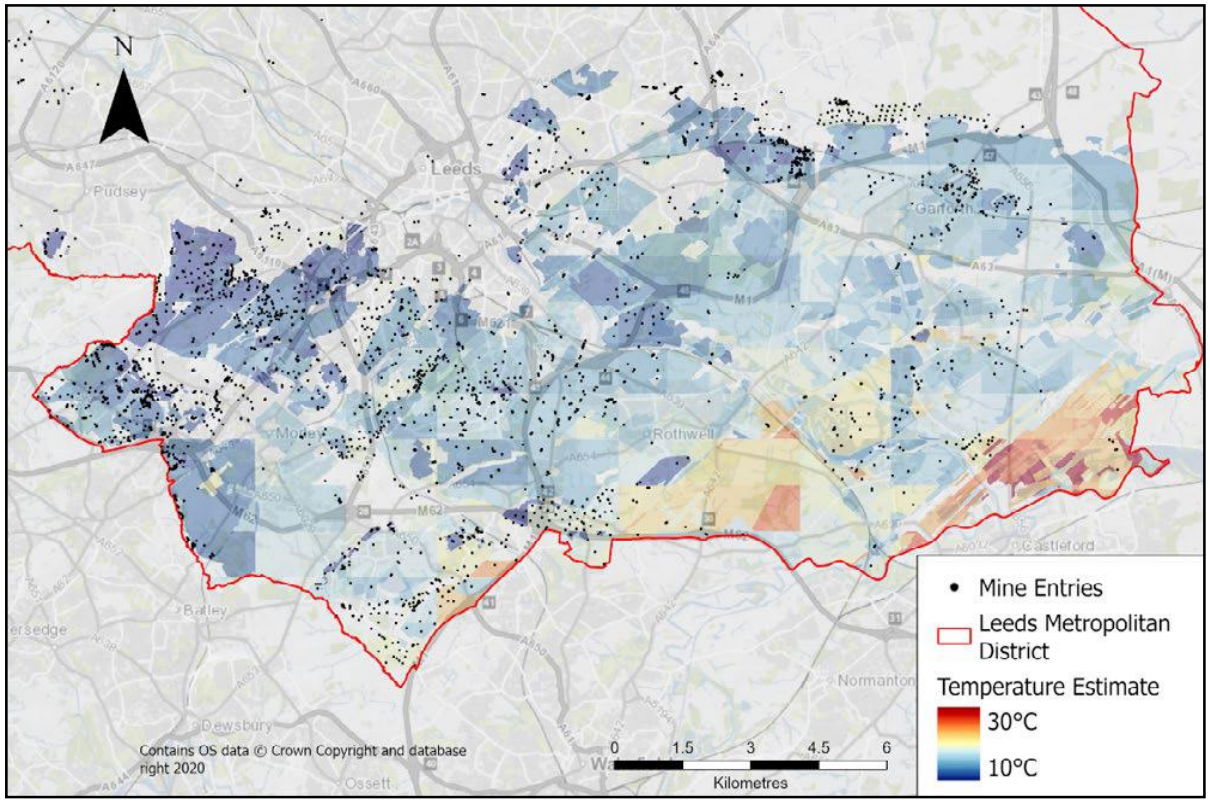


Image from BGS - UKRI

Geothermal – potential in Leeds



Geothermal mine water energy potential for food production
Sakai et al., Policy Brief, University of Leeds, 2022

Geothermal – potential in Yorkshire

Sustainable system:

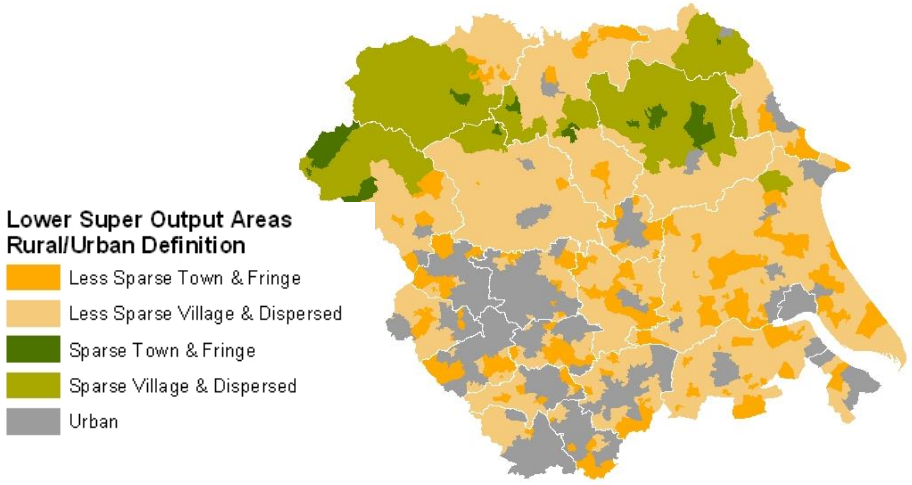
- **available energy** – heat in place - temperature gradient – heat flow
- **water/aquifer availability and reservoir quality** – subsurface geology, recharge of water and flow potential - permeability, pressure

Opportunities:

- **heating, cooling and energy storage** - district heating networks

End users:

- **end users** - industry, businesses, agriculture, residential – urban/rural



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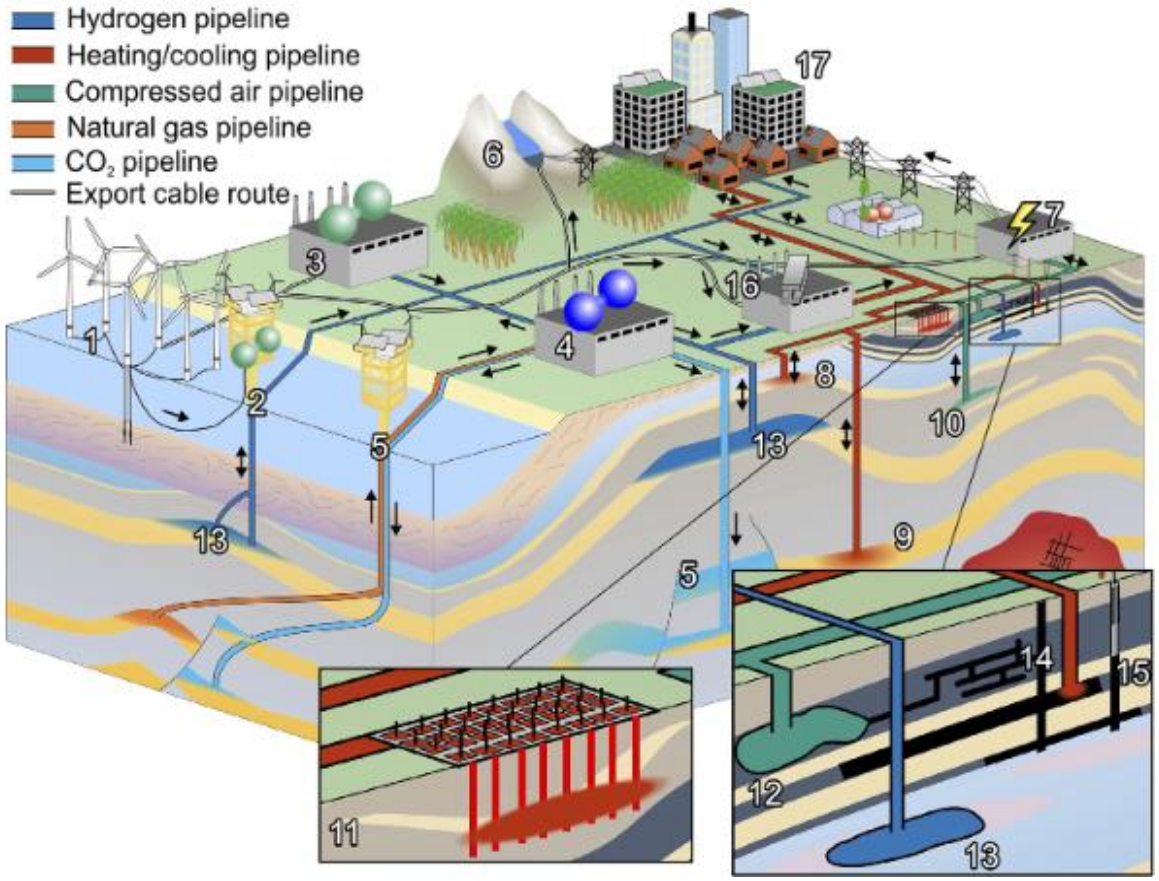
Estimated geothermal

Action – multi-faceted approach – circular economy

1. Offshore wind
2. Offshore green hydrogen production & storage
3. Green hydrogen production & storage
4. Blue hydrogen production with CCS
5. Natural gas production and Carbon Capture & Storage (CCS) site
6. Pumped Hydroelectric Energy Storage (PHS)
7. Electricity substation
8. Shallow aquifer thermal energy storage (ATES)
9. High-temperature aquifer thermal energy storage (HT-ATES)
10. Compressed air energy storage in aquifers (CAES-A)
11. Borehole thermal energy storage (BTES)
12. Compressed air energy storage in caverns (CAES-C)
13. Hydrogen storage in salt caverns and porous media
14. Minewater thermal energy storage (MTES)
15. Mineshaft gravity energy storage
16. Industry energy use
17. Commercial and residential energy use



Velenturf et al., 2021 – ES[3]

Action

Academia, industry and councils need to work together:

- Direct use geothermal tends to be a local energy solution
- Link research to solutions
- Form a strategic approach in Yorkshire that can influence government policy

Geothermal energy solutions should link up as part of the wider energy/resources solution:

- Levelling up of energy provision
- Reduction in energy dependence
- Resilience of energy networks provided by a range of solutions

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