



Affordable, secure and clean energy: The case for geothermal

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The UK's Clean Power mission aims to deliver lower bills and greater energy security alongside decarbonisation. Utilising shallow geothermal beneath UK towns and cities can reduce peak electricity demand and strain on the grid, and cut reliance on volatile fossil fuels. Evidence from Leeds shows that there is substantial potential for shallow geothermal energy to contribute to Clean Power but that current energy planning frameworks overlook this resource.

Overview

- **Shallow geothermal is an untapped energy resource under many UK urban areas.**
- **Shallow geothermal could contribute to lowering energy bills and increasing energy security as part of the Clean Energy Mission.**
- **Research at Leeds finds reservoirs under the city centre could heat 350,000 homes**
- **Current energy planning frameworks do not account for geothermal resources and so overlook economically viable opportunities.**

Reducing energy bills, improving energy security and ensuring a fair transition are central challenges for the Clean Power 2030 mission. Meeting them requires solutions which work across the whole energy system, not within individual silos. Fortunately, the UK has an underutilised resource which could help on all three fronts. Shallow geothermal aquifers – water-bearing rocks at less than 500m depth – are located beneath many UK towns and cities, and can be coupled with heat pumps and heat networks to deliver reliable and efficient, low-carbon heating and cooling. They can also act as energy stores, smoothing out supply and demand, and reducing the strain on the system overall. This brief draws on research from Leeds to indicate the scale of the opportunity and the current barriers to deployment.



The evidence base

This brief draws on interdisciplinary research by Geosolutions Leeds, including the Ofgem-funded GeoGrid project¹, which combines geological assessment, seasonal storage modelling, system optimisation and grid integration analysis, alongside geothermal resource quantification and policy analysis of heat network zoning outcomes. The research focuses on shallow geothermal for heating and cooling (see Figure 1). There are exciting opportunities for deep geothermal in the UK, including for electricity generation, but shallow geothermal is more widely available, with lower upfront costs and uncertainties.

Lower energy bills through smarter system design

Clean Power by 2030 targets the electricity system, but growing electrification will increase demands on that system. If electrification proceeds without sufficient flexibility and storage, it risks locking in higher system costs for decades. Shallow geothermal offers a way to reduce these costs.

Unlike individual electric heating systems, geothermal heat networks can provide stable, baseload heat supply and incorporate seasonal storage in aquifers². This reduces reliance on gas-fired generation during cold, low-wind periods when electricity demand peaks and wholesale prices are highest. They can also provide cooling and use stored waste heat to provide heating more efficiently.

System-level benefits include:

- Reduced peak electricity demand, lowering the need for gas-fired top-up generation.
- More frequent price-setting by low-cost renewables, helping stabilise wholesale electricity prices.
- Avoided grid reinforcement, reducing network costs that are ultimately passed on to all consumers.
- Lower operating costs for heat networks, particularly where renewable electricity is abundant.

The potential system savings are significant. Around £58 billion is expected to be required to upgrade the GB power system by 2035³. Independent analysis suggests that a well-developed flexibility market could deliver over £40 billion in savings by 2050⁴. Integrating subsurface geothermal storage into energy planning can contribute to this flexibility, helping to reduce overall system expenditure and protect consumers from unnecessary cost escalation.

In short, geothermal is not only a heat technology, it is a system cost-control asset.

Strong UK energy security

The UK's energy transition must reduce exposure to volatile international fossil fuel markets. Whilst renewable electricity deployment has accelerated, gas-fired generation has continued to drive wholesale prices during periods of low wind and high demand^{5,6}. The recent government

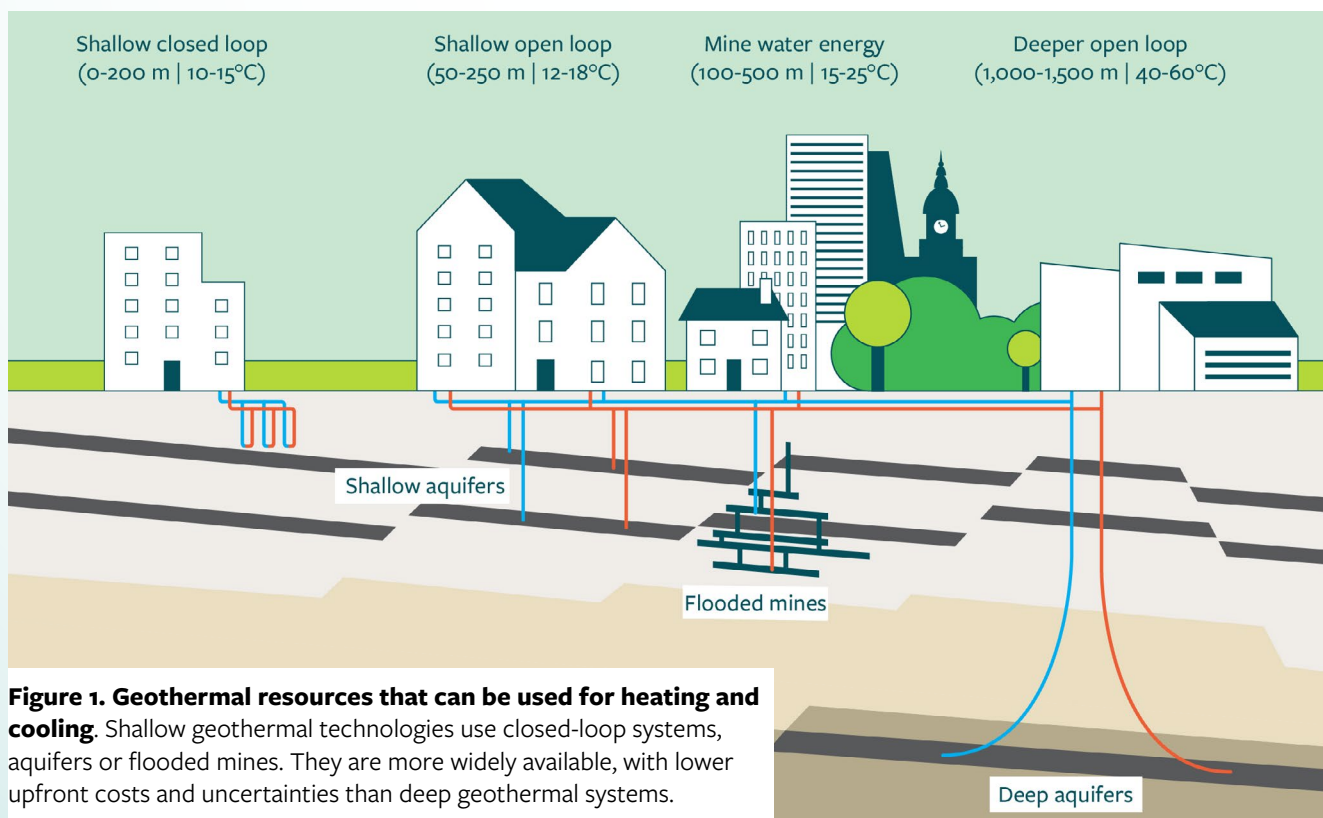
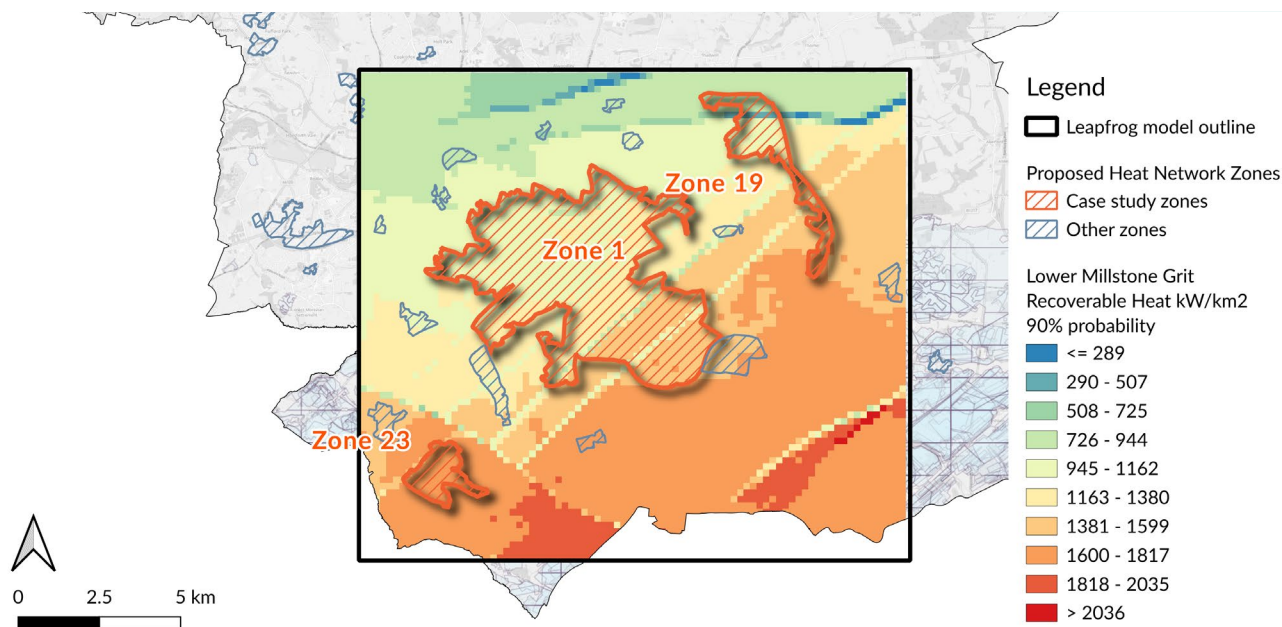


Figure 1. Geothermal resources that can be used for heating and cooling. Shallow geothermal technologies use closed-loop systems, aquifers or flooded mines. They are more widely available, with lower upfront costs and uncertainties than deep geothermal systems.

Figure 2. Mapping of geothermal heat under central Leeds. The map shows potential recoverable heat from one of the four aquifer layers modelled, the Lower Millstone Grit, with blue indicating regions of lower availability through to red indicating higher availability areas. The current designated heat network zone (Zone 1) and two additional case study zones (Zones 19 and 23) are shown.



announcement of measures to reduce the influence of gas on wholesale electricity prices is welcome, but decoupling prices alone will not deliver the system flexibility and storage capacity needed for a resilient clean energy transition ⁷.

Shallow geothermal is a domestic, weather-independent energy resource located beneath many UK towns and cities.

When deployed at scale through heat networks, it can:

- Reduce reliance on imported gas during peak winter demand.
- Provide long-duration thermal storage to smooth seasonal imbalances.
- Lower stress on electricity networks during cold spells.
- Improve resilience against supply disruptions and price shocks.

Unlike short-duration battery storage, geothermal aquifers can store energy over weeks or months, providing flexibility across seasons rather than hours. This capability becomes increasingly valuable as electrification expands. By diversifying the UK's low-carbon heat sources, geothermal enhances energy security whilst supporting Clean Power objectives.

Evidence from Leeds: a domestic opportunity

Research by Geosolutions Leeds demonstrates the scale of this opportunity⁸. In central Leeds alone, modelling identified

approximately 460 MW of recoverable heat from shallow aquifers⁹. Equivalent to 350,000 homes, this is sufficient to meet most of the heat demand within designated heat network areas.

The study examined how heat, electricity and subsurface planning frameworks interact in practice, using Leeds heat network zones as a case study (see Figure 2). It assessed whether current planning processes provide opportunities for subsurface resource data to inform heat network development, grid investment and local energy planning.

Geothermal resources missed from planning

Current energy and planning frameworks do not systematically account for subsurface resources¹⁰. Heat network zoning focuses primarily on surface-level demand indicators. Electricity system planning models future demand growth without fully considering subsurface thermal storage. Environmental permitting and energy planning proceed largely independently.

As a result of this disjointed planning, economically viable geothermal opportunities risk being overlooked, while grid reinforcement decisions are taken without full visibility of geothermal storage potential. The consequence is not only missed decarbonisation potential – it is higher long-term system costs and avoidable exposure to energy price volatility.



Policy opportunity

Decisions being taken now on heat electrification and grid upgrades will shape UK energy bills and security for decades. Integrating shallow geothermal into mainstream planning can reduce system costs, enhance resilience and ensure that the Clean Power transition delivers both affordability and security.

Unlocking cost and security benefits

To capture the benefits of shallow geothermal resources for the UK Clean Energy Mission three shifts are required:

1. Make the subsurface visible in energy planning

Integrate geothermal resource screening into heat network zoning and Regional Energy Strategic Plans (RESP) to ensure domestic storage potential informs infrastructure investment decisions. Action for: Department of Energy Security and Net Zero (DESNZ), National Energy System Operator (NESO), and the British Geological Survey (BGS).

2. Align heat, electricity and grid planning

Require joint assessment of heat demand, grid capacity and subsurface storage within Local Area Energy Planning and RESP processes, reducing duplicated infrastructure investment. Action for: DESNZ, NESO, and Local Authorities.

3. Enable geothermal to capture flexibility value

Develop market mechanisms to incentivise inter-seasonal storage. Action for: DESNZ and Ofgem.

Develop a geothermal heat ownership model which aligns with industry and investor risk profiles around long-term system performance. Action for: DESNZ.

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Geosolutions Leeds is an interdisciplinary research centre at the University of Leeds, bringing together world-class experts in geology, engineering, social sciences, and creative industries to lead the way towards a clean-energy future. Read more on [Geosolutions geothermal research](#).

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