Executive Summary

Drilling into the United Kingdom's Geothermal Potential

Project InnerSpace

Geothermal energy can become a cornerstone of the United Kingdom's future energy system—yet it is often overlooked. With a growing pipeline of heat projects and a domestic resource for nationwide heating and cooling and selective electricity generation, the UK can mitigate exposure to future external shocks, and strengthen energy security, while creating tens of thousands of jobs, lowering bills, and meeting binding climate targets.

The United Kingdom is at an inflection point: After recent price shocks, the region needs clean, reliable energy that lowers bills, strengthens energy security, and supports industrial competitiveness while meeting binding climate targets. Geothermal energy can help deliver on all three needs, as the country sits above a major domestic geothermal resource that can be used for heating and cooling, storage, and even electricity generation.

The UK has benefitted from naturally heated groundwater for nearly two millennia—most famously via the Roman Baths, constructed at a hot spring in the town of Bath. Today, thanks to advancements in technology, geothermal can be used much more widely. In the United Kingdom, geothermal is primed to address one of the region's biggest and most overlooked energy demands: heat.

About 80% of the UK's household energy is used for space heating, water heating, and cooking,[1,2] and much of that energy comes from external fuel supplies. In 2024, net energy imports across the UK increased to more than 43% of all energy used.[3]

This figure indicates that across the United Kingdom, deploying more geothermal heat is central to protecting households and businesses from volatile fuel prices and to meeting climate goals. (See Chapter 2, "The Geothermal Opportunity in the United Kingdom," for more details.)

The opportunity for the UK is big. Project InnerSpace estimates that the UK has about 3,900 gigawatts of total technical potential for heating and cooling (down to 3.5 kilometres) and about 25 gigawatts of total technical potential for electricity (down to 5 kilometres). Those 3,900 gigawatts of heat are more than enough to meet the nation's entire heating demand for more than 1,000 years.[4] And the potential for 25 gigawatts of electricity equals about 75% of the electricity the UK uses each year.[5] Despite this potential, however, geothermal supplied only 0.3% of annual heat demand in 2021, primarily through residential ground source heat pumps and a handful of deep direct-use and minewater projects.[6] Chapter 3, "Where Is the Heat? Exploring the United Kingdom's Subsurface Geology," assesses the potential for various types of geothermal energy across the United Kingdom.

Ground source heat pumps are a great solution to the nation's energy needs, but the UK also has many other geothermal options (**Figure ES.1**). The Southampton District Energy Scheme has drawn geothermal heat from a deep well since the 1980s, demonstrating continuous performance in an urban setting, in addition to helping the area avoid an estimated 12,000 tonnes of carbon dioxide emissions and saving consumers £600,000 each year.[7] In Gateshead, a minewater-based heat system has been operational since March 2023 and currently serves more than 350 homes and a number of public and commercial buildings. These projects demonstrate how geothermal can deliver value for the UK today.

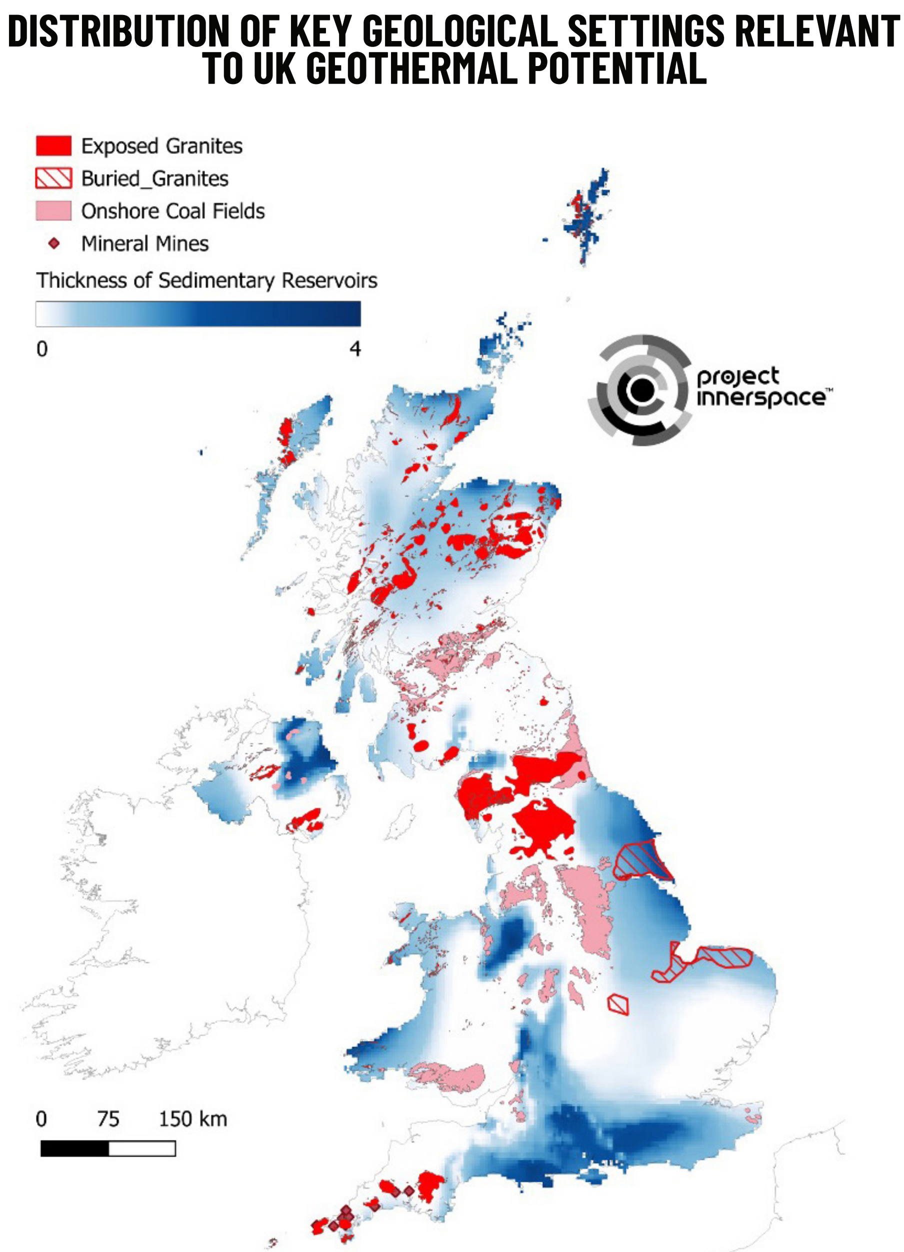

Figure ES.1: The map shows the extent and depth of sedimentary reservoirs, locations of exposed granites and buried granites, and areas of historic or active mining. In the southwest, red granite areas are the most likely option for electricity generation, while sedimentary aquifers have potential for heating and cooling, complemented by areas where former mines could be used for heating and cooling. Projection: OSGB36/British National Grid. Map created by Project InnerSpace. Data sources: Holdt et al. (2025). *Global sediment thickness (in preparation).* Project InnerSpace; ArcGIS Hub. (2025). Mineral mines. *UNESCO WHC sites dossiers elements core points;* Fleiter et al. (2020). *Documentation on excess heat potentials of industrial sites including open data file with selected potentials (Version 2).* Zenodo; British Geological Survey. (2020). *Coal resources for new technologies dataset;* British Geological Survey. (n.d.). *BGS Geology 625K;* Abesser et al. (2023). *Evidence report supporting the deep geothermal energy white paper:* The case for deep geothermal energy—unlocking investment at scale in the UK. British Geological Survey.

Expanding the use of geothermal systems across the country can accomplish the following:

- **Enhance energy security and resilience:** Geothermal is domestic, reliable, and not subject to fuel price shocks; it can provide baseload heat and (where feasible) electricity.
- **Lower costs over time:** Geothermal has lower operating costs and reduces consumer costs—particularly when it is deployed through networks and integrated planning.
- **Create environmental, economic, and energy-system benefits:** Geothermal deployment reduces emissions, supports high-quality jobs, eases peak electricity demand via the direct use of heat, and strengthens grid resilience through thermal storage and shifting demand away from peak times.

RECOMMENDED POLICIES TO EXPAND THE UK'S GEOTHERMAL INDUSTRY

The UK's geothermal sector is emerging within a regulatory system that was not designed for geothermal deployment at scale. There is no obvious national legal framework in place for the ownership, licensing, and management of geothermal heat in the UK. Improved government focus on geothermal would create regulatory clarity and allow this resource to scale. (See Chapter 6, "Who Owns the Heat? Navigating Subsurface Rights in the United Kingdom's Legal and Regulatory System.") Permitting and oversight processes are spread across various agencies and requirements, from local planning, environmental, and water and mineral exigencies to subsurface access, depending on the technology and location. This fragmentation increases transaction costs; lengthens development timelines; and raises uncertainty for developers, investors, and prospective heat and cooling customers.

Developing minewater geothermal means working with the institutions responsible for legacy mine infrastructure, while deep geothermal projects face other requirements related to drilling, reservoir management, monitoring, and long-term stewardship. No single body manages the end-to-end pathway, making it more difficult to standardise requirements, build institutional capability, and reduce timelines. To deploy geothermal resources in the UK, policy needs to keep pace with possibility.

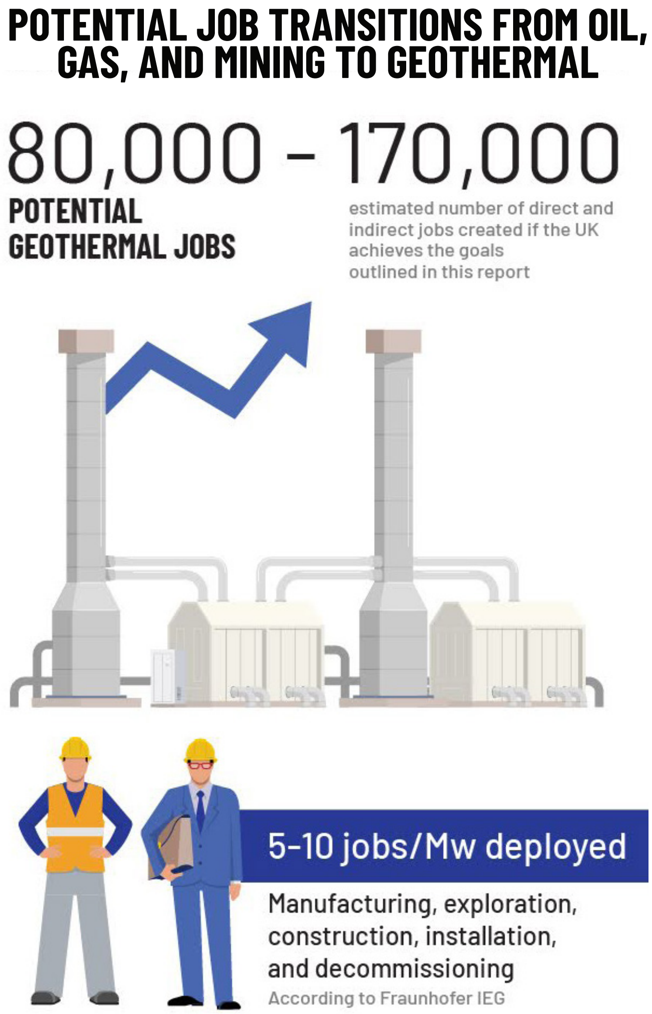

Figure ES.2: Potential job transitions from oil, gas, and mining to geothermal. Source: Bracke, R., & Huenges, E. (2022, February 2). *Shaping a successful energy transition* [Press release]. Fraunhofer IEG.

This report outlines an ambitious goal based on current technology and cost estimates: 15 gigawatts for heat and between 1.5 gigawattts and 2 gigawatts for electricity by 2050. Meeting this goal could create between 80,000 and 170,000 jobs.[8]

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POLICY MENU FOR ACCELERATED GEOTHERMAL DEVELOPMENT IN THE UK

Theme	Barrier or Challenge	Policy Solution or Recommendation	Responsible Party
Regulatory and Governance	Lack of national strategy or deployment targets, which undermines investor confidence. Fragmented regulation and unclear planning/permitting roles causing project delays.	**Policy Recommendation 1:** Publish a national geothermal strategy with explicit 2035/2050 heat and electricity goals. **Policy Recommendation 2:** Establish a "geothermal desk" for one-stop coordination between DESNZ and agencies with defined permit timelines; update national planning guidance to classify geothermal as a nationally significant, strategic, resilient, and renewable infrastructure.	DESNZ, Cabinet Office, HMT DESNZ; MHCLG; Environment Agency; Scottish government; Welsh government; Northern Ireland Executive; Mayoral Authorities
Financial and Investment	High up-front exploration and drilling risk that discourages private investors. Limited financial incentives compared with other renewables. Weak bankability of long-term heat offtake contracts.	**Policy Recommendation 3:** Create a geothermal resource insurance facility modelled on France and Germany. **Policy Recommendation 3:** Establish a geothermal exploration grant programme; include geothermal in Contract for Difference auctions; ring-fence funding in the GHNF. **Policy Recommendation 3:** Develop a geothermal financing framework using blended finance, tax breaks, and a contracts for heat regime with standardised heat purchasing agreements. Pair targeted capital support, loan guarantees, and resource insurance to reduce early drilling risk and unlock additional investment.	DBT, DESNZ, HMT Great British Energy, HMT, National Wealth Fund, DESNZ DESNZ, Ofgem, HNDU, local authorities
Market and Infrastructure	Low coverage of district heat networks, limiting viable demand.	**Policy Recommendation 4:** Introduce a public heat purchase obligation requiring public estate to procure low-carbon heat; designate geothermal opportunity zones within network areas.	Ministry of Defence, MHCLG, Cabinet Office, DESNZ, local authorities
Data, Coordination, and Integration	Incomplete or inaccessible subsurface data, which constrains exploration.	**Policy Recommendation 6:** Expand subsurface data resource mapping BGS Geothermal Data Map into a public National Geothermal Atlas; mandate open access to non-commercial well data.	BGS, DESNZ, GSNI
Skills and Awareness	Low awareness of technical skills and domestic capacity. Low public familiarity/ examples; confusion with hydraulic fracturing.	**Policy Recommendation 5:** Create a Geothermal Skills Transition Fund for oil and gas workforce retraining; incentivise UK manufacturing of drilling and heat-exchange components by establishing local-content rules. **Policy Recommendation 7:** Run a national geothermal awareness campaign; develop national guidance distinguishing geothermal from hydraulic fracturing; highlight success stories (such as Southampton).	DESNZ, DBT, OPITO DESNZ, local authorities, industry associations

ES3: BGS = British Geological Survey; DBT = Department for Business and Trade; DESNZ = Department for Energy Security and Net Zero; GHNF = Green Heat Network Fund; GSNI = Geological Survey of Northern Ireland; HMT = HM Treasury; HNDU = Heat Networks Delivery Unit; MHCLG = Ministry of Housing, Communities and Local Government; Ofgem = Office of Gas and Electricity Markets; OPITO = Offshore Petroleum Industry Training Organisation. Source: author.

The good news is that the UK does not have to invent new concepts from scratch. It has a number of companies developing geothermal applications across the region. It has an experienced oil and gas and mining workforce with skills that translate to many areas of geothermal development. And it has a growing pipeline of pilot projects and proof-of-concept programs in operation. But fully tapping into the UK's geothermal potential requires additional policies that clarify roles and responsibilities—streamlining permitting, de-risking early exploration, and making long-term heat and electricity offtake easier to finance (**Figure ES.3**).

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European and other international markets have successfully accelerated geothermal via many of the building blocks recommended in this report. (See Chapter 5, "Clearing the Runway: Policies and Regulations to Scale the United Kingdom's Geothermal Potential," for more details.) Countries such as Germany, France, and the Netherlands are already deploying new policy mechanisms that can be a model for the UK.

Some recommended policy actions can be implemented quickly (such as in the next one to three years): standardised guidance, clearer agency handoffs, and expedited pathways for proven project types. Others—such as durable revenue support and scaled risk-mitigation facilities—will take longer to take effect. Implemented well, this agenda turns geothermal from one-off demonstrations into a clean, financially attractive infrastructure asset that can help lower consumer bills,[9] among other benefits.

MINDING THE GAP

About 30 deep geothermal projects are already in development nationwide, a number of minewater heat and district heating projects are underway, and more than a dozen companies have secured private and public funding for geothermal projects.[10,11] In interviews with many of the leaders of these companies, however, a common constraint cited is that the UK's early-stage technology financing structures have companies struggling to accommodate subsurface risk, long lead times, and permitting complexity. (See Chapter 10, "A New Age of Innovation: The United Kingdom's Geothermal Start-up Scene," for more.) Early-stage development carries high up-front costs, especially for drilling and resource confirmation, that are difficult to finance under conventional infrastructure models. The most important near-term task, then, is turning geological promise into bankable assets that can attract capital and then grow. In other words, geothermal's biggest barrier is not a lack of demand; it is the gap between resource potential and investable projects.

IDEAS TO IMPROVE FINANCIAL INCENTIVES FOR GEOTHERMAL IN THE UK

- Include geothermal electricity in Contract for Difference (CfD) auctions with dedicated 200–500 megawatt allocation per round.
- Establish a first-well failure guarantee covering 50% to 70% of drilling costs, modelled on French/German schemes.
- Stand up the Geothermal Resource Insurance Facility + philanthropic first-loss package described to make exploration/appraisal bankable and reduce premiums over time.
- Publish model "Contracts for Heat" and reference them in Green Heat Network Fund (GHNF)/CfD guidance so combined heat and power projects can finance heat and electricity revenues together.
- Use a portfolio procurement approach for the first wave, then refinance and recycle public anchors via gilts/local climate bonds/reserves-based lending.
- Launch a £100–£200 million Exploration Grant Programme in high-potential basins (comparable in scale to GHNF) for pilot drilling and proving wells.
- Launch a national exploration and pilot drilling programme in priority basins, including reprocessing legacy data sets and targeted new seismic to refine reservoir models, with standardised appraisal/flow-test protocols.
- Taken together, these measures would bring geothermal to parity with wind, solar, biomass, and heat networks, aligning the sector with established UK support structures and unlocking significant private investment. Read more about financial instruments to accelerate the UK geothermal industry in Chapter 9.

Figure ES.4: Ideas to improve financial incentives for geothermal in the UK. Source: Chapter 9, "Minding the Gap: Financing Solutions to Advance Geothermal in the United Kingdom."

Geothermal's biggest barrier is not a lack of demand; it is the gap between resource potential and investable projects.

This report identifies a set of financial mechanisms designed to close this gap, particularly in the "first projects" phase, when uncertainty is highest and private capital is most cautious. (See Chapter 9, "Minding the Gap: Financing Solutions to Advance Geothermal in the United Kingdom.") These tools (such as targeted support for drilling, insurance, and heat offtake) are intended to work hand in hand with the policy solutions outlined in the report: clearer and faster permitting, defined responsibilities across regulators, stronger heat-network planning, and procurement and offtake structures that translate public ambition into investable demand.

One practical place to start is with the National Health Service estates. An analysis of geothermal resources in the Triassic sandstone reservoir beneath NHS facilities across the UK shows that there is substantial potential.

Expanding the use of geothermal also helps the UK move beyond today's largely bespoke model that treats every new project as a first of a kind. When multiple projects advance in the same region, geothermal becomes replicable: Regulators and planners build consistent pathways, and banks, insurers, lawyers, and contractors gain confidence through standardised templates and solid program track records. The result is faster timelines and lower costs.

TURNING UP THE HEAT

For geothermal to be widely deployed across in the UK, the most promising place to begin is with heating and cooling, which can be accessed fairly simply and fairly fast via ground source heat pumps (GSHPs), heat networks, and thermal storage.

The effectiveness of these systems, of course, depends on the subsurface temperatures that align with the heating needs above the surface. Fortunately, in the UK, thick sedimentary basins and legacy mining districts with heat resources sit beneath areas with significant heat demand.

One practical place to start is with the National Health Service (NHS) estates. An analysis of geothermal resources in the Triassic sandstone reservoir beneath NHS facilities across the UK shows there is substantial potential—an estimated 8,600 petajoules at or near 20°C; 3,250 petajoules at or near 40°C; and nearly 1,167 petajoules near 60°C—for low-carbon heating, cooling, and storage for these buildings. (See Chapter 4, "Geothermal Heating and Cooling: Applications for the United Kingdom's Industrial, Municipal, Residential, and Technology Sectors.") NHS sites around Belfast, Birmingham, Liverpool, Manchester, and Southampton could make particularly good fits for implementing early heat projects, accelerating repeatable delivery models, and creating a pipeline where learning-by-doing rapidly reduces costs and risks (**Figure ES.5**).

A number of different geothermal heat applications are currently being deployed across Europe. The Mijnwater project in the Netherlands has operated since 2008 and currently supplies heating and cooling to more than 400 homes and 250,000 square metres of commercial buildings, with plans to expand to 30,000 homes.[12]

The Dutch also lead on low-temperature aquifer thermal energy storage (LT-ATES) with more than 3,000 systems—about 85% of all of the ATES systems on Earth—at work today.[13] The policy framework in the Netherlands has been explicitly designed to tap into this resource.[14] The UK has analogous geology and infrastructure in many regions but lacks the coordinated planning, permitting clarity, and financing tools to move at comparable speed. Widespread deployment of aquifer thermal energy storage could supply roughly 61% of the UK's current heating demand and 79% of cooling demand.[15] (For more about the various examples of geothermal heat and how they can be scaled, see Chapter 4, "Geothermal Heating and Cooling: Applications for the United Kingdom's Industrial, Municipal, Residential, and Technology Sectors.")

NATIONAL HEALTH SERVICE FACILITIES OVER TRIASSIC AQUIFERS

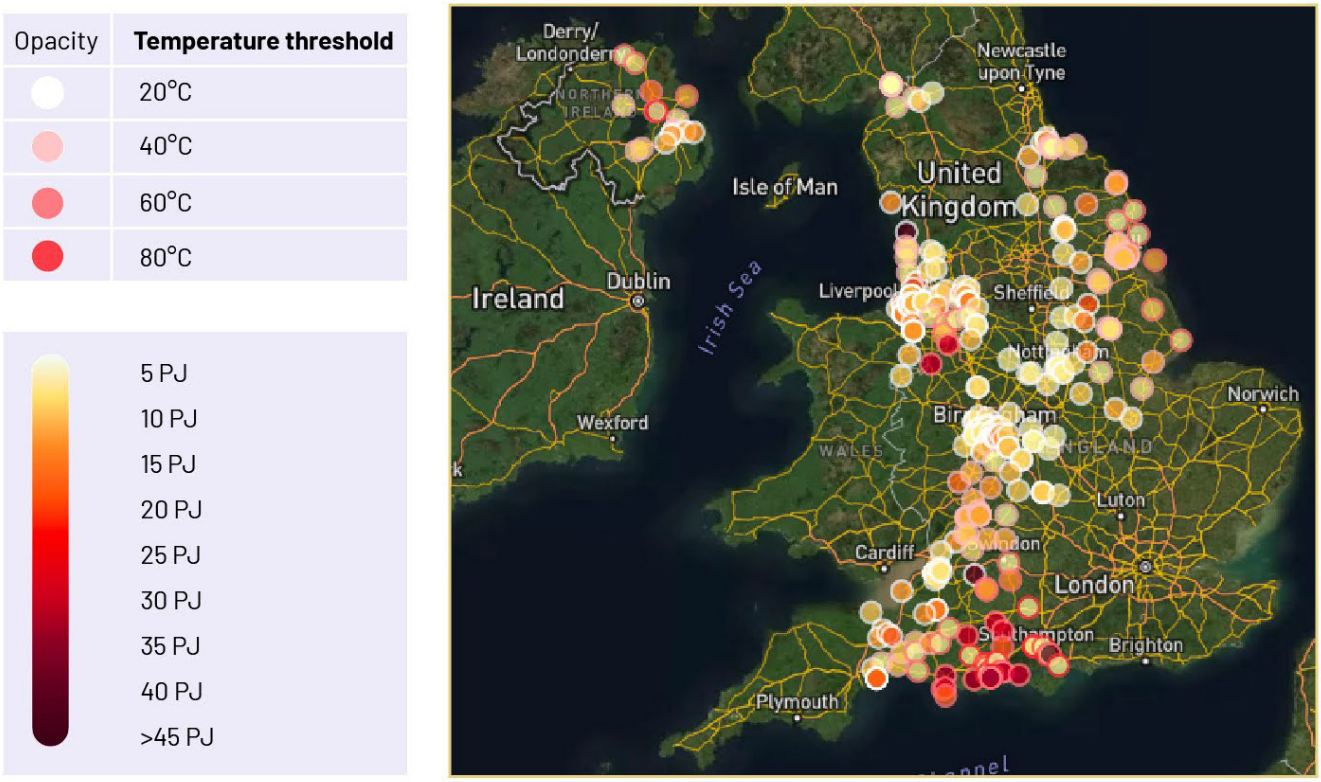

Figure ES.5: Project InnerSpace has mapped 301 National Health Service facilities that lie over Triassic aquifers, a suitable geothermal target. Hospitals that lie over sufficiently deep (and hot) and permeable aquifer units are considered to have the greatest geothermal potential. PJ = petajoules. Source: Project InnerSpace.

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ELECTRICITY GENERATION

While more limited than heat, the UK also has the subsurface resources to deploy geothermal electricity generation in select areas. As noted, Project InnerSpace estimates approximately 25 gigawatts of total technical potential for electricity (down to 5 kilometres).

The value of using geothermal for electricity is that it is an always-on, low-carbon resource. Geothermal can reliably operate near full output for most hours of the year. As a result, it can reduce reliance on fossil fuel-based energy generation during periods of peak demand and stand in when renewable output is low. It is also a resilient energy source, as it is largely unaffected by surface weather and can quickly return to operation after disruptions.

In the UK in 2024, the grid's inability to transport or store energy curtailed about 8.3 terawatt-hours of wind energy, enough to power more than 2 million homes per year. This cost consumers nearly £400 million.[16] Because geothermal can be located closer to demand centres than many wind and solar resources, its use can also reduce transmission losses and congestion. In some cases, geothermal can even serve as means of long-term energy storage.

In the near term, targeted geothermal projects can provide meaningful grid support, resilience, and decarbonisation benefits at the local level, building momentum towards broader national impact as deployments scale.

DATA CENTRES

The UK's rapid expansion in artificial intelligence (AI) and data centres is driving unprecedented energy demand. Cooling alone currently accounts for about 40% of a data centre's electricity use, and demand is projected to rise substantially as AI-related compute requirements grow.[17]

This expansion creates a strategic opening for geothermal-based cooling, seasonal thermal storage, and heating and cooling networks that can reduce both electricity demand and peak loads. Notably, two of the government's confirmed AI Growth Zones (AIGZs)—Culham in Oxfordshire and Northumberland and Cobalt Park in North Tyneside[18]—sit atop resources that could enable efficient, stable, and secure geothermal cooling.

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POTENTIAL AREAS FOR DATA CENTRE COOLING AND/OR STORAGE

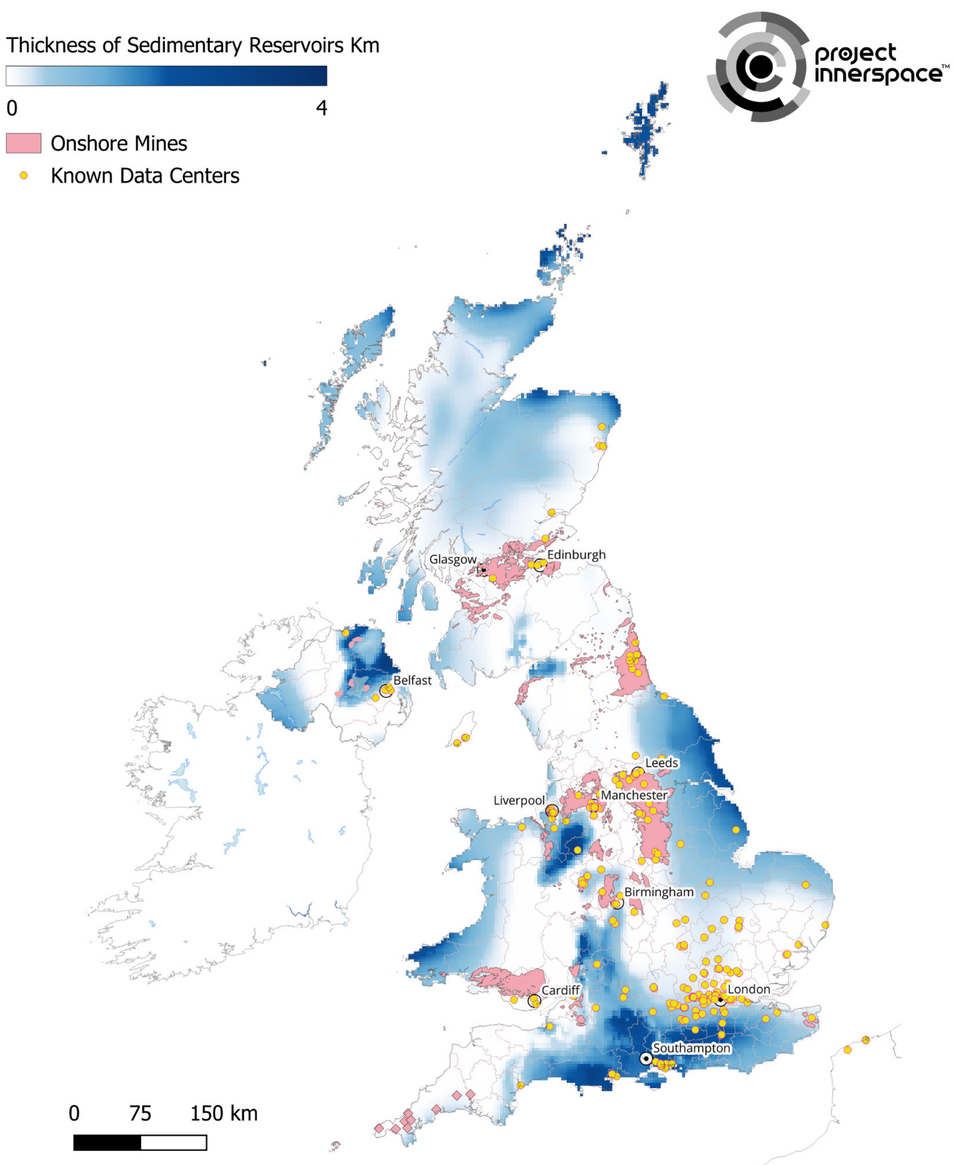

Figure ES.6: Thickness of sedimentary reservoirs across the UK. The overlap of thick aquifers, legacy mines, and digital infrastructure highlights priority zones for low-carbon cooling, thermal storage, and geothermal-ready AI Growth Zones. Sources: OSGB36/British National Grid. Map created by Project InnerSpace; Holdt et al. (2025). *Global sediment thickness* (in preparation). Project InnerSpace; ArcGIS Hub. (2025). Mineral mines. *UNESCO WHC sites dossiers elements core points;* Fleiter et al. (2020). *Documentation on excess heat potentials of industrial sites including open data file with selected potentials* (Version 2). Zenodo; British Geological Survey. (2020). Coal resources for new technologies dataset; British Geological Survey. (n.d.). *BGS Geology 625K*; Abesser et al. (2023). *Evidence report supporting the deep geothermal energy white paper:* The case for deep geothermal energy—unlocking investment at scale in the UK. British Geological Survey.

More than 200 regions across the UK are interested in hosting AIGZs. Many of them—including Scotland, northwest England, Yorkshire and the Humber, and North Lincolnshire—are in areas with major sedimentary basins or onshore mines. These resources give the regions strong opportunities to deploy storage and cooling systems to support AI and digital campuses. Geothermal cooling can also be paired with heat recovery and local heat networks, turning waste heat into a resource and improving overall system economics.

LEVERAGING EXISTING SKILLS AND SUPPLY CHAIN

Many of the skills needed to scale geothermal for both heat and electricity—safety management, subsurface modelling, construction, compliance, reservoir management, and more—overlap with the UK's existing oil and gas and mining workforces. (See in Chapter 8, "Beyond the North Sea: Leveraging the United Kingdom's Oil and Gas Expertise to Advance

TRANSFERABLE SKILL SETS FROM THE OIL AND GAS INDUSTRY

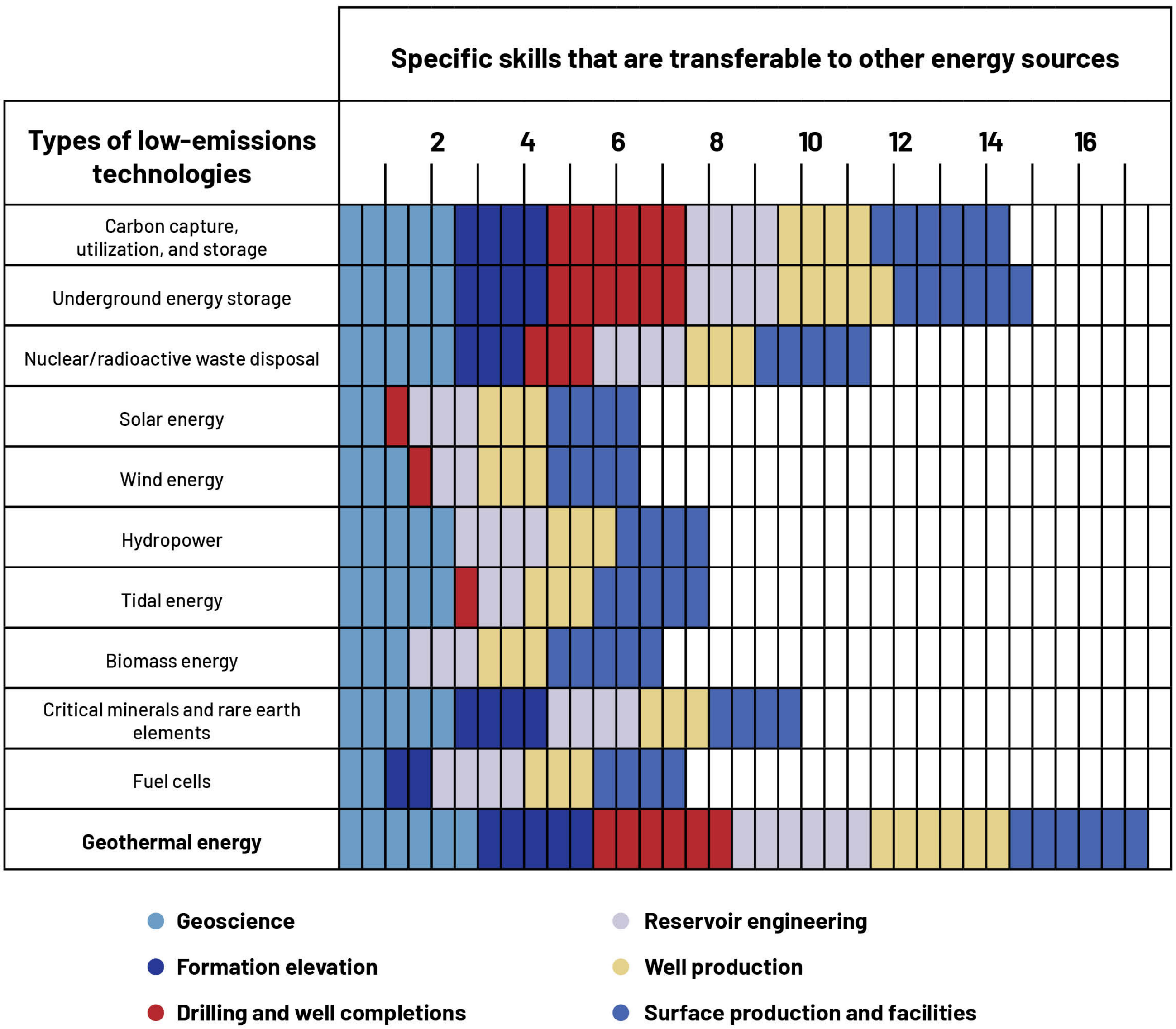

Figure ES.7: Geothermal requires the most skills from the oil and gas industry compared with all other clean energy production methods. Source: Tayyib, D., Ekeoma, P. I., Offor, C. P., Adetula, O., Okoroafor, J., Egbe, T. I., & Okoroafor, E. R. (2023). Oil and gas skills for low-carbon energy technologies. Society of Petroleum Engineers Annual Technical Conference and Exhibition, San Antonio, TX, United States.

Geothermal.") In addition, the UK's oil and gas supply chain (including manufacturers and service providers of drill bits, directional drilling tools, pumps, high-temperature wellhead equipment, and pipeline systems) is a ready-made infrastructure that can be adapted to geothermal development. By repurposing existing equipment, manufacturing capacity, and logistics networks, the supply chain can support both deep and shallow geothermal projects while also effectively training a new geothermal workforce in communities such as coal mining towns that have grappled with energy transitions. (See **Figure ES.7** for details on skills that can transfer to geothermal from oil and gas.)

GEOTHERMAL AND THE ENVIRONMENT

Geothermal can deliver substantial environmental benefits—especially when displacing fossil fuels. But it must be developed responsibly.

Reducing carbon dioxide (CO_2) emissions is one of the most significant environmental benefits of expanding geothermal energy.[19] In 2025, greenhouse gas emissions totaled roughly 371 million tonnes of CO_2-equivalent.[20] While national emissions have declined substantially over the past three decades, the UK is not on track to meet its 2030 climate targets, and the independent Climate Change Committee has called for accelerated deployment of low-carbon technologies across all sectors to close the gap.[21] With close to one-quarter of the UK's CO_2-equivalent emissions coming from fossil fuel combustion in building heating, decarbonising heat is essential to meeting the UK's legally binding climate targets.[22]

Geothermal operations also use the smallest land area of any renewable energy source.[23,24] Geothermal electricity plants typically use only 2.25% of the land that solar requires, 0.38% of the land needed for onshore wind, and 0.078% of the land needed by electricity plants that burn biomass for fuel (**Figure ES.8**). This small footprint makes geothermal particularly advantageous in space-constrained environments across the UK.[25]

As with any subsurface technology, geothermal development requires careful management of water, geochemistry, and ground conditions. These projects carry some known risks, including fluid migration and—when utilising hydraulic fracturing—induced seismicity. However, international and UK experience shows that such risks can be effectively managed. Modern geothermal systems are designed to reinject geothermal fluids, minimising surface impacts and supporting long-term reservoir sustainability, with plants capable of recovering up to 90% of the water they use.[26] Additional operational controls can further reduce the risk of contamination and environmental disturbance.[27]

In practice, the vast majority of UK geothermal projects will rely on low- to medium-enthalpy resources, which do not require hydraulic fracturing, for direct-use heating applications. In limited and highly controlled circumstances, however, geothermal hydraulic (primarily for electricity generation) should not be ruled out.

As explained in Chapter 7, "Environmental Stewardship in an Energy-Abundant Future: Considerations and Best Practices," with good site selection, baseline data, continuous seismic monitoring, and clear regulatory requirements and reporting, the UK can manage environmental risks. When developed well, geothermal can be a low-footprint, low-emissions contributor to the UK's clean heat, cooling, and resilience agenda.

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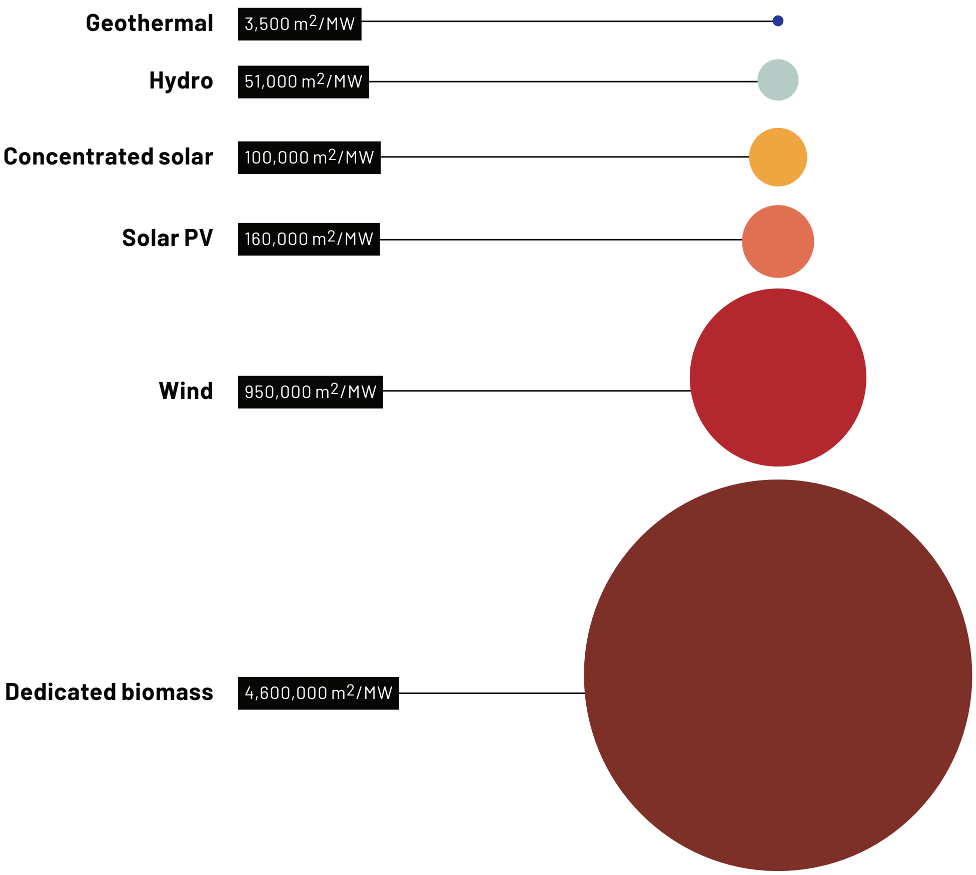
COMPARING SURFACE FOOTPRINT



Geothermal has the smallest footprint of any renewable energy source

Figure ES.8: The project surface footprint, acre for acre for 1 gigawatt of generating capacity, is smallest for geothermal compared with other renewables. PV = photovoltaic. Source: Lovering, J., Swain, M., Blomqvist, L., & Hernandez, R. R. (2022). Land-use intensity of electricity production and tomorrow's energy landscape. *PLOS ONE*, 17(7), e0270155; National Renewable Energy Laboratory (NREL). (2022). *Land use by system technology*.

CONCLUSION

The United Kingdom has the resources, ecosystem, and skills to become a geothermal leader. Tapping into even just a small portion of its geothermal resources increases the UK's energy security by reducing the need for imported energy. Yet, geothermal is often overlooked as a solution to the nation's energy challenges.

Geothermal can directly tackle volatility in heating costs—an issue that UK households feel acutely. Additionally, the UK cannot meet its long-term energy security and greenhouse gas emissions reduction goals without expanding its clean, reliable heating solutions.

Geothermal deployment at scale is achievable but not a given. Success depends on aligning three elements:

1. Clear rules and faster regulatory pathways—so geothermal projects can move through permitting and approvals with certainty.
2. Planned demand—through heat networks, zoning, and anchor customers such as hospitals, universities, and government estates.
3. Targeted financial tools—to bridge the early-stage risk gap, especially around drilling and subsurface uncertainty.

The payoff is multi-dimensional: lower bills, reduced reliance on imported fuels, durable local jobs, and a more resilient energy system that can support current and future demand such as data centre cooling and thermal storage. The UK's geothermal resource is domestic and dependable; turning it into a national industry is a strategic choice.

Keep calm. Geothermal is always on.

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