National Geothermal Centre

Our Geothermal Nation

A strategic roadmap for accelerating geothermal energy across the United Kingdom

Recommendations and actions for policymakers to accelerate the deployment of geothermal energy

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Key Ambition

By 2050, the UK could realise its untapped opportunity by delivering:

10 GW
Geothermal Heat

1.5 GW
Geothermal electricity

"The greatest risk to our energy security is from failing to decarbonise and continuing to be overly dependent on fossil fuels." *National Energy System Operator (NESO)*

Durham University

REECE FOUNDATION

Net Zero Technology Centre
Technology Driving Transition

shift GEOTHERMAL

Our Geothermal Nation

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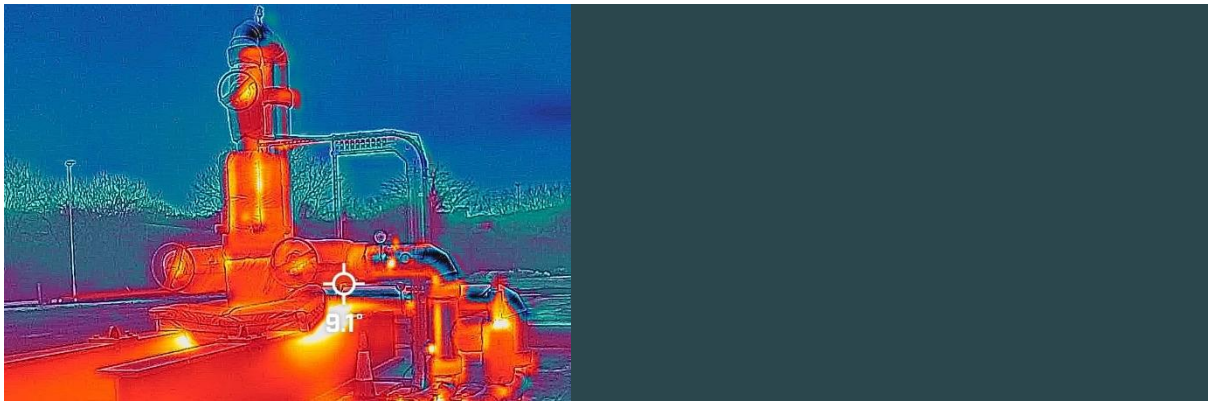


Strategic roadmap for accelerating our Geothermal Nation

Executive Summary

The National Geothermal Centre (NGC), established in 2024 by Durham University, the Reece Foundation, the Net Zero Technology Centre and Shift Geothermal is the UK's independent national focal point for geothermal, leading coordination across the sector. The NGC is supported by a group of 30 NGC Champions from across the sector working under our five thematic areas to gather evidence and accelerate our deployment ambitions. This roadmap sets out practical routes to position and recognise geothermal energy as a national resource of strategic importance for supporting UK energy security and economic growth. The NGC has set UK deployment targets of 10 gigawatt (GW) geothermal heat and 1.5 GW of geothermal electricity by 2050 (Figure 1).

The UK has proven, commercial scale geothermal deployments (including deep geothermal demonstrating electricity and lithium production, deep aquifers and shallower mine water and widespread open and closed loop ground-source heat schemes) highlighting huge potential to decarbonise our heat and electricity demands. Uptake remains limited and fragmented compared with European peers. Without coordinated action, geothermal will remain an underused domestic resource despite strong alignment with government missions and priorities: reliable low-carbon heat, selective opportunities for firm power, and long-lived infrastructure that significantly improves energy security by reducing reliance on imported fuels.

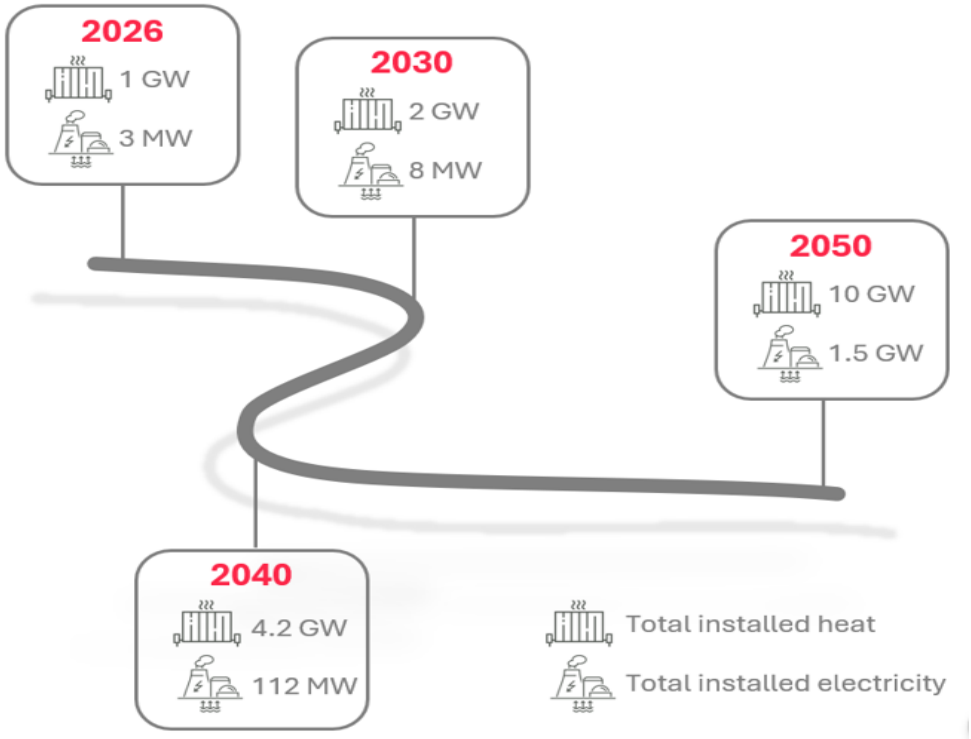


Figure 1 The NGC pathway to 2050

Increased geothermal uptake will help address three strategic and urgent priorities facing the UK:

Energy Security

Geothermal offers huge potential to decarbonise heating and reduce demands on electricity grids. It also offers price-stable, low-carbon heating and cooling for homes, public estates and industrial clusters. It would strengthen energy resilience by reducing reliance on gas imports especially liquefied natural gas (LNG) which is our most carbon-intensive and costly form of gas accounting for 46% of our emissions from burning gas[1]. The UK has been a net gas importer since 2004 and remains exposed to geopolitical shocks exacerbated by declining resources from both the UK Continental Shelf and Norway. Under NGC's illustrative 2050 10 GW heat scenario, geothermal could displace about 82 terawatt-hour (TWh) of gas input to 85% efficient boilers, equivalent to roughly 7.5 billion cubic metres of gas and around half of 2025 LNG inflows in energy terms. Following Russia's invasion of Ukraine in 2022, the UK spent £50 billion on gas imports. Increased geothermal uptake could therefore improve the UK's balance of payments and strengthen energy security.

Economic Growth

Geothermal also provides national and local opportunities for economic growth through supply-chain development, job security through redeployment of people currently leaving the UK oil and gas sector and job creation particularly in left-behind communities. This will help reduce the cost of living, shift people out of fuel poverty and improve lives alongside keeping businesses in the UK by reducing energy costs. The decline of UK oil and gas activity is happening at a rate of around 20,000 jobs per year, and the UK is losing highly skilled workers that currently contribute around £25 billion to the economy. Accelerating geothermal development could retain and redeploy these workers and facilitate the direct transfer of many existing engineering, drilling and subsurface capabilities into a growing low-carbon energy sector.

Heat Decarbonisation and Cost Reduction

Around half of the energy used in the UK is used to produce heat. With annual heat demand currently at around 600 TWh, geothermal currently produces around 2.1 TWh (0.3%). Geothermal is one of the few proven technologies capable of providing large-scale, low-carbon baseload heat and electricity. Increased uptake of geothermal heat aligns with government targets to deliver 20% of heat through heat networks by 2050 by providing a heat network compatible energy source. Geothermal heat networks may also offer more competitive and stable energy pricing. The UK's largest geothermal heat network at Gateshead provides heat to its customers at 5% below the equivalent market gas tariff.

[1] 2024 Emissions intensity of producing natural gas

The main constraints limiting geothermal uptake relate to the deployment environment rather than technical readiness, chiefly: the absence of an agreed national strategy and targets; complex, inconsistent permitting and licensing; limited mechanisms to de-risk the "first well"; and project pipeline visibility all contributing to insufficient investor confidence. International experience from countries with comparable resources and climate (notably Germany, France and the Netherlands) shows that geothermal markets and investor confidence grow rapidly when government provides clear policy support and governance, streamlined regulation, risk-sharing finance and transparent open-access data, alongside demand creation through heat networks and public-sector procurement. The experience of these countries has been used to inform the recommendations made in this roadmap.

Based upon what has been achieved in other European nations with comparable geothermal resources, this roadmap proposes ambitious yet achievable national deployment targets of 10 GW of geothermal heat (enough for 4 million homes) and 1.5 GW of geothermal electricity (enough for 3 million homes) by 2050. It builds upon recent and valuable UK reports which have either focused on specific resources[2,3,4], costs of geothermal energy production[5] or taken an in-depth view of work carried out to date and updated the resource and conditions and constraints surrounding its uptake[6]. Derived from numerous conversations, personal experience and long-standing collaborations between the NGC and numerous stakeholders across the geothermal sector, this roadmap proposes clear, actionable steps that recognise the limited resources available to the UK government and focus on immediate actions to accelerate the creation of a self-sustaining and economically viable geothermal sector. This roadmap proposes 16 recommendations across five challenge themes. They are described in this report and summarised in tables 2a, b and c. The NGC has started working on several recommendations. Three immediate asks of UK government are detailed below:

This strategy roadmap makes three immediate asks

1. **UK government to back the national delivery of geothermal**
   Recognise and resource the NGC to lead geothermal coordination, adopt this strategy and targets with accountable delivery arrangements.
2. **Unlock the first wave of investment**
   Commission a costed exploration-risk pilot, with eligibility, financial limits and evaluation criteria.
3. **Create demand and a credible pipeline**
   Assess geothermal for suitable heat network and public-estate projects; showing each project's development stage, opportunities and barriers.

[2] Mine heat White Paper
[3] Dig Deep June 2023.pdf
[4] Evidence report on deep geothermal energy opportunities in the UK released - British Geological Survey
[5] UK geothermal energy review
[6] projectinnerspace.org/resources/UK-Report/UK-Geothermal-Report.pdf

1. Introduction

1.1 UK Geological Overview

The United Kingdom has a diverse range of geothermal resources. Principal geothermal hosts include high heat producing granites, sedimentary basins, and a vast legacy of abandoned coal and metal mines distributed throughout the industrial heartlands of England, Scotland, Northern Ireland and Wales (Figure 2). Geothermal is proven in the UK. There are several commercially viable exemplar projects that showcase the main large-scale deployment types (Figure 3) and countless smaller GSHP projects, with a total installed capacity of around 1 GW.

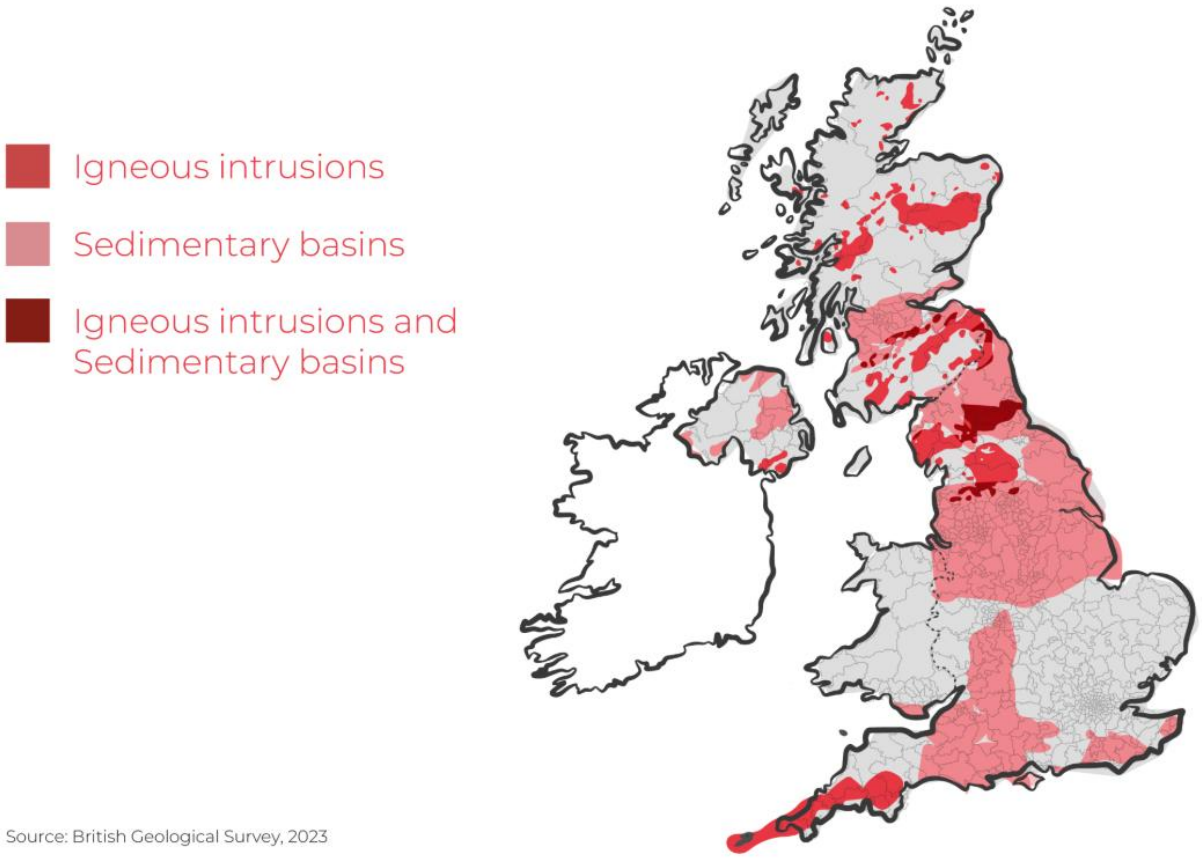


Figure 2 Geothermal potential map of United Kingdom - showing granite hot spots, major sedimentary basins, and urban clusters of viable mine water resources

A recipe for success

The UK has all the essential ingredients needed to become a leading geothermal nation: abundant resources, proven technology, world-class scientific expertise, an experienced energy workforce and growing demand for secure, low-carbon heat.

Summary of key UK projects and geothermal locations

- **Southampton Heat Network (Southampton)**: 1.8 km borehole in sandstone aquifer producing around 2 MW of heat, operational since the 1980s[7].
- **United Downs Deep Geothermal (Cornwall):** 5.3 km and 2.4 km boreholes in fractured granites, delivering 3 MW electricity, lithium production and substantial heat recovery[8].
- **Eden Project Geothermal (Cornwall):** 5.2 km borehole providing process heat for biomes, greenhouses, and business park infrastructure[9].
- **Kirby Misperton (Yorkshire):** Gas well repurposed for closed-loop demonstration, showcasing "plug and play" potential across the UK's legacy well stock[10].
- **Gateshead Energy Company (Tyne & Wear):** Minewater boreholes deliver up to 6 MW of heat to a local district heat network, serving homes, businesses, and public buildings[11].
- **Lanchester Wines (Tyne & Wear):** Minewater boreholes deliver up to 4 MW of heat to two bonded warehouses maintaining products at optimum temperature[12].
- **Seaham Garden Village:** Pumped minewater delivers up to 2.3 MW of heat to 750 affordable homes via a heat network.[13]

Geothermal gradients in the UK are generally modest compared with volcanically active regions; however, certain areas display locally elevated gradients, making them prospective for both heat and, in specific zones, electricity generation. These resources collectively position the UK to leverage a broad suite of geothermal technologies suited to different regions and local demand. The broad types of geothermal opportunity are summarised below and shown in Figure 2.

- **Cornwall:** Cornubian Granite (Rosemanowes Quarry, United Downs) – radiogenic granites with fracture permeability – potential for heat and electricity production and lithium extraction.
- **Weardale, County Durham:** Granite at shallow depth with confirmed high geothermal gradients and viable aquifers – potential for heat and electricity production and lithium extraction.
- **Northern England Basins (Cheshire, Yorkshire, Wessex):** Thick sedimentary successions; potential for deep hydrothermal systems – potential for heat production and thermal energy storage.
- **Wales, Scottish Borders:** Prospects for both deep sedimentary and mine water geothermal heat.
- **Abandoned Mines (Midlands, North-East, South Wales, Central Scotland):** Extensive opportunities for mine water heating, cooling and thermal energy storage.

[7] Our Networks - Bring Energy
[8] United Downs – GEL Energy
[9] About the Eden Geothermal Project – Eden Geothermal
[10] Our Solutions – CeraPhi Geothermal Development Company
[11] 2023 Gateshead Energy Company GEC_UK.pdf - Google Drive
[12] Wine giant uncorks clean energy future with mine water heat deal - GOV.UK
[13] Geothermal heat from mine water at Seaham Garden Village: The Mining Remediation Authority

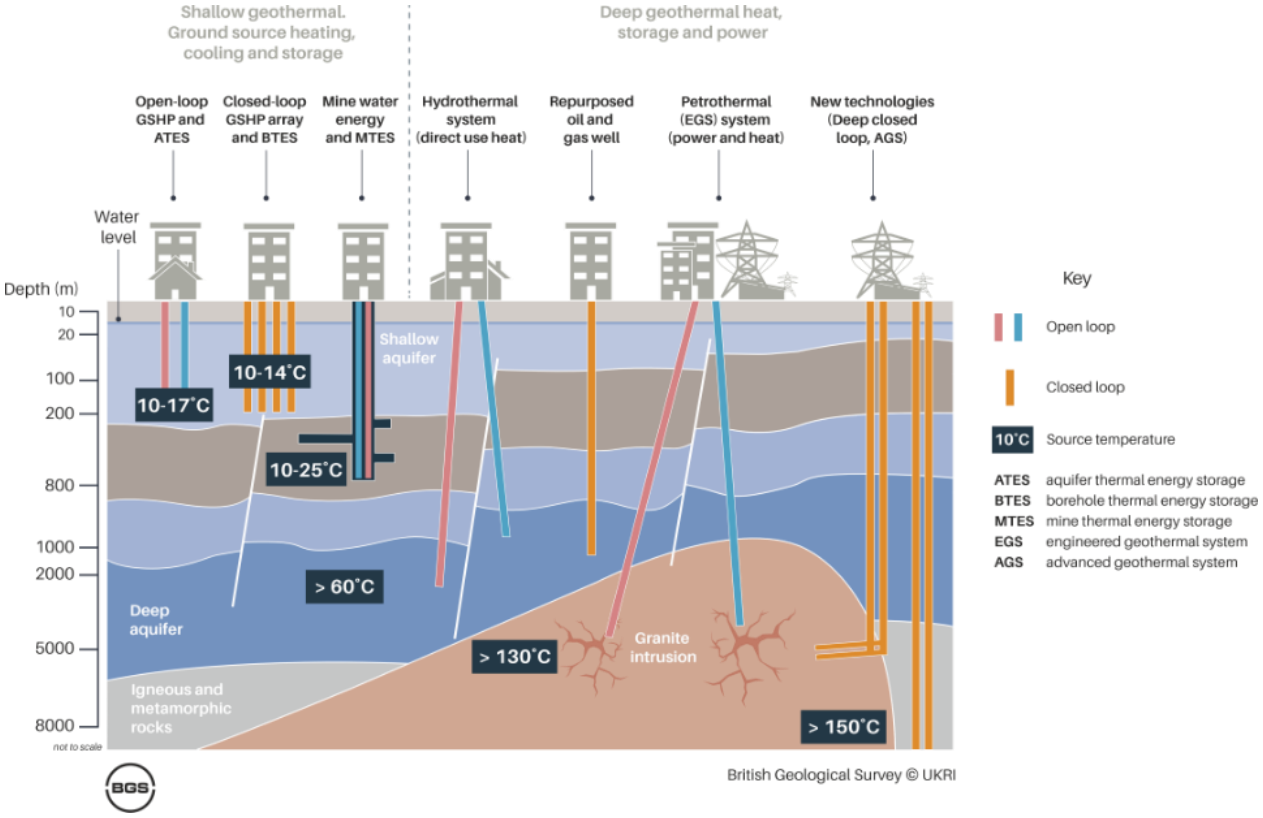


Figure 3 Summary of geothermal deployments (after BGS)

1.2 Background: Historic and Current UK Geothermal Initiatives

Despite limited development, the UK's geothermal resource is vast and estimated to be sufficient for the next century and beyond[14,15,16,17]. The UK Geothermal Platform recently launched by the British Geological Survey[18] is a valuable geothermal screening tool. It shows that most areas could access closed loop geothermal schemes and that there is potential for more than 55% of the population for gas boilers to be replaced with geothermal boreholes. Despite this, geothermal currently meets less than 0.3% of heat demand meaning that the size of this opportunity is huge (UK annual heat demand is around 600 TWh, geothermal currently produces around 2.1 TWh). New initiatives such as Heat Split highlight the value of increasing geothermal capacity to provide heating and cooling for the UK[19]. The UK's engagement with and knowledge base for geothermal resources extends back decades. Early pioneering work included the Hot Dry Rock (HDR) initiative at Rosemanowes Quarry, Cornwall, funded by the Department of Energy and led by the Camborne School of Mines[20] and the national aquifer drilling programme also funded by the Department of Energy in response to the 1970s oil crisis[21]. These projects, alongside the Weardale Granite exploration in County Durham during the 1960s[22], demonstrated both technical potential and the challenges of developing fractured granite systems

[14] ProjectInnerspace UK-Geothermal-Report
[15] The case for deep geothermal energy - unlocking investment at scale in the UK. A deep geothermal energy white paper
[16] Dig Deep June 2023.pdf
[17] Deep-Geothermal-Energy-Opportunities-for-the-UK.pdf
[18] UK Geothermal Platform
[19] UK HEAT SPLIT - Causeway Energies
[20] HDR Geothermal Energy Research at the Camborne School of Mines
[21] Geothermal energy : the potential in the United Kingdom - NERC Open Research Archive
[22] Terrestrial Heat Flow in North-east England

and aquifer systems. The Southampton aquifer geothermal scheme arose from these early explorations and has been operational since the 1980s.

1.3 Comparative Perspective

Globally, less than one percent of the estimated geothermal resource has been developed. The US is the largest producer of geothermal electricity and China is the largest producer of geothermal heat. Closer to home, while the UK has participated for decades in geothermal research and pilot activities, the deployment of geothermal is far more limited than in many European peers:

- **Germany and the Netherlands**: Both have advanced regulatory, risk-assurance, and investment mechanisms such as risk funds, insurance against drilling failure, and fit-for-purpose market incentives that have enabled rapid deployment of deep geothermal, especially for district heating.
- **France, Iceland, Italy, Croatia and Hungary:** These countries are supported by similar incentives and serve as leading examples in large-scale urban heat network deployment, hydrothermal exploitation and power generation.

The National Geothermal Centre's ambitions for the UK are to deliver at least 10 GW of heat and 1.5 GW of electricity from deep geothermal by 2050 (Figure 1), based on mature European market analogues and domestic resource mapping (see Recommendation 10). Accelerating UK geothermal uptake hinges on targeted policy and risk reduction measures proven in Europe; combined with an industrial legacy of wells and mines, the UK holds a distinct edge for city-scale mine water geothermal and repurposing existing infrastructure.

The following measures, commonly found in countries with more installed geothermal capacity than the UK, are set against the barriers that exist to UK acceleration in Table 1:

Table 1 Enablers and challenges to geothermal acceleration

Measures enabling success elsewhere	Current barriers to Geothermal in the UK
Geothermal forms part of national energy planning and policy	No national geothermal or wider energy strategy
Drilling de-risked through national funds or insurance pools	No drilling risk insurance
Subsidies paid for energy produced	Fragmented roles and policies between national and local entities
Uptake of heat networks is high	Weak heat demand aggregation
Stable permitting and regulatory frameworks	Oil and gas-oriented regulatory approaches
Open access to data	Awareness of geothermal and its potential contribution and piecemeal datasets

2. Developing Our Geothermal Nation

2.1 The Case for developing our geothermal nation

As of 2026, around a dozen European countries that have adopted a clear national geothermal strategy, roadmap or wider energy policy have more advanced geothermal sectors[23]. Notable examples include France[24], the Netherlands[25] and Germany[26]. The European Geothermal Energy Council (EGEC) has called on the European Commission to publish a dedicated European Geothermal Strategy and Action Plan during 2026.

The UK geothermal resource is underutilised and represents an asset of strategic national importance. The impetus for its development must be to reduce reliance on energy imports to achieve energy security whilst reducing costs for the UK and providing locally available and affordable low-carbon energy. The UK's geothermal resources are particularly attractive for heat decarbonisation, with sufficient resources identified to meet UK heat demand for at least a century.

The UK's geothermal resources are best suited to provide secure, low-carbon heat to homes and businesses the majority of which still rely heavily upon fossil fuels to meet their energy demands. In certain locations geothermal can also provide a source of continuous and dispatchable electricity. Geothermal plants, boreholes and energy centres generally occupy small footprints and have low visual impact. Geothermal systems are technologically mature and quick to deploy. They may also provide a source of critical minerals such as lithium. Lithium recovery has proven technical and early commercial viability at the Geothermal Engineering Ltd plant in Cornwall where globally significant lithium concentrations have been recorded in geothermal brines[27]. At scale, this high-grade resource could theoretically provide a large share of lithium for UK production of electric vehicle batteries[28]. The beauty of lithium recovery is that it uses the same wells and infrastructure as for geothermal energy recovery thereby adding a second revenue stream.

Geothermal offers continuity and security of energy supply, the global weighted capacity factor for geothermal electricity is high at around 80%[29] and for heat it will be higher. Global capacity factors for onshore wind and photovoltaics are 36–41% and 16% respectively[30].

Increased geothermal development will significantly improve UK energy security by:

Replacing costly and carbon-intensive LNG imports

Reducing reliance on imports of gas via pipeline

Replacing declining gas production from the UK Continental Shelf

Reducing demand on power grids through direct use of heat and heat pumps

[23] EGEC unveils 9 recommendations for the EU's Geothermal Strategy and Action Plan
[24] https://afpg-extranet.s3.amazonaws.com/media/2023/12/22/23003_DP_Plan-action-geothermie.pdf
[25] 108-LR_114337_EBN-Focus-Geothermal-Energy-ENG-V3.pdf
[26] Roadmap for Geothermal Energy in Germany
[27] Euopean Geothermal Congress 2025
[28] Geothermal first for Cornwall | Business Cornwall
[29] Geothermal Plant Capacity Factors - INL 2015
[30] A global dataset of onshore wind turbines with site-specific historical (1989–2018) and future (2030–2059) wind resources across 89 countries | Scientific Data

The NGC responded to the UK government gas consultation in February 2026 highlighting the key role of geothermal for increasing energy security. Currently, the UK's heavy reliance upon gas imports in the form of LNG and through pipelines exposes us to single points of vulnerability and failure and geopolitical shocks. LNG is expensive and carbon-intensive relative to pipeline gas chiefly because of the liquefaction and transport required. In 2024, LNG accounted for 15% of our gas imports, but was responsible for 46% of our carbon emissions associated with burning gas[31]. The UK government continuously competes with those of India, China and many other importers to secure ongoing LNG supplies for the UK. Additionally, LNG imports remain vulnerable to global geopolitical shocks as seen in 2022 when the invasion of Ukraine caused the cost of gas imports to more than double, costing the UK £50 billion[32] (Figure 4).

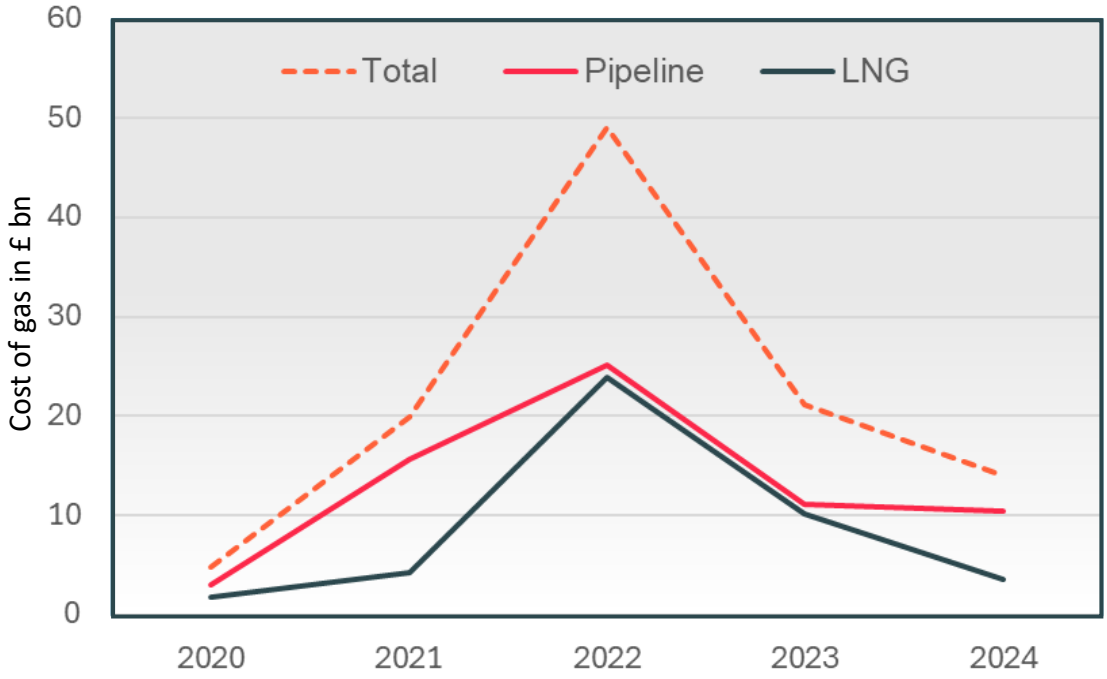


Figure 4 Cost of UK gas imports 2020-2024

The current conflict in Iran demonstrates that the stakes for UK energy security have never been higher. As UK continental shelf oil and gas production declines we need to find alternatives to offset gas imports or risk a severe energy crisis in as little as seven years. One part of the solution lies in the UK's vast geothermal resources which align well with the energy demand currently supplied by LNG imports including enough resources in place to meet heat demands for over a century. Geothermal energy can be developed almost anywhere, and most geothermal deployments have a high level of technology readiness (TRL) 8–9 compared with other large-scale low-carbon heat-generation options. For example, the TRL of green hydrogen has been rated at 6–7 and could be 10–20 years[33] away from the same level of readiness as geothermal. Compare this with geothermal systems, particularly those for heat security and decarbonisation, which could be deployed quickly (within five years) to reduce and rebalance demands on our energy system with remaining demands supplemented by less mature low-carbon technologies such as green hydrogen later.

[31] https://www.nstauthority.co.uk/media/nupk5sx1/emissions-intensity-of-producing-natural-gas-factsheet-sept-2025.pdf
[32] https://iea.blob.core.windows.net/assets/119378b2-8d56-49c7-9907-9ee7a516fddd/GasMarketReport-Q32025.pdf
[33] OEUK Hydrogen Insight Report

2.2 About this roadmap

The NGC geothermal roadmap is based around recommendations made under our five key challenge areas:

- **Challenge 1** Policy and regulation
- **Challenge 2** Market and finance
- **Challenge 3** Knowledge, education and skills
- **Challenge 4** Technology development, research and innovation
- **Challenge 5** Infrastructure integration

Delivering our geothermal nation demands coordinated action across all challenges. The NGC has proposed actions against each challenge alongside the responsibility for delivery including delivery timescales and expected impact (Tables 2a, b and c, the full version is also available as a separate file). 16 individual recommendations are spread across the challenge areas and further detail on each is included throughout the report. These challenges are not intended to be considered in isolation and should be actioned concurrently. Any strategy or roadmap should also integrate planning for infrastructure, development and transitioning of workforces, community engagement and long-term financing.

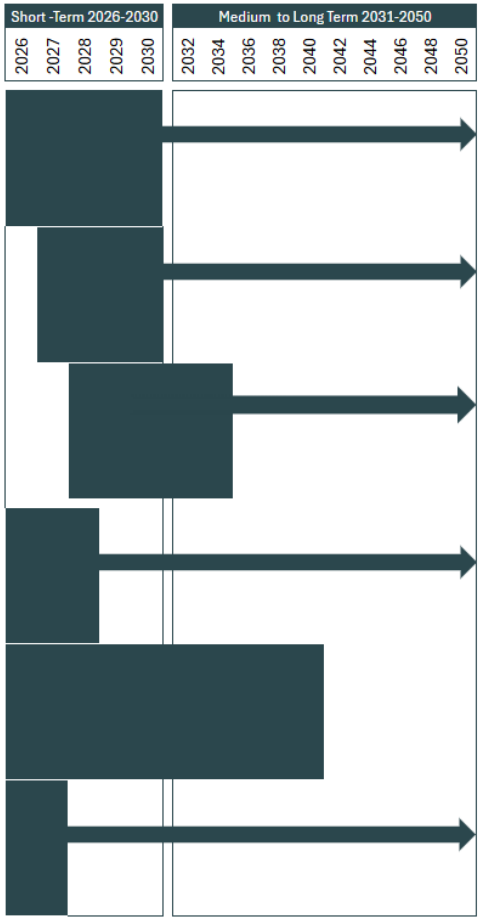
Table 2a Challenges 1 and 2

Recommendation		Actions	Expected Outcomes	Short -Term 2026-2030					Medium to Long Term 2031-2050									Responsibility
				2026	2027	2028	2029	2030	2032	2034	2036	2038	2040	2042	2044	2046	2048	2050	
1* **Recognise and resource the NGC as national delivery body**	Challenge 1 Policy and regulation	Form a working group to agree scope, nature and responsibilites of the national delivery body	Agreed delivery vehicle for the strategy and a "go to" for the industry																DESNZ, NGC, GBE, BGS, REA wider sector
2* **Adopt targets and strategy set by the NGC**		Consult more widely on this strategy to refine and share with government to adopt. Adopt proposed targets for heat, power generation, plus job creation and avoided CO_2 for 2030 and 2050	Commitment from geothermal to secure market and investor confidence. Clarifies the opportunity and helps establish UK as clean energy superpower																DESNZ, NGC, BGS, REA, wider sector
3* **Develop dedicated licensing and permitting routes**		Develop and coordinate geothermal specific licensing framework including standardised permitting pathways "one stop shop" including geothermal specific safety standards	Accelerated geothermal developments and clearer routes to market. Geothermal becomes the default choice for heating new developments																NGC, DEFRA, Regulatory Agencies (EA, NRW, SEPA), HSE, MRA, NSTA, Combined Authorities, Net Zero Hubs
4* **Create risk-sharing and development financing frameworks**	Challenge 2 Market and finance	For heat/ cooling and heat and power schemes - blended finance, heat CfD, tax breaks, upfront risk insurance stimulate market funding from private investment	Gaps and risk aspects not covered under existing support schemes are resloved. Additional private investment, unlocked blended finance to spread risks, improved market confidence and growth																DESNZ, NGC, NWF, GBE, Treasury, Private investors
5 Assess the national economic opportunity		Supply chain and skills transfer e.g. from oil and gas sector. UK supply chains strengths e.g. in propsecting, drilling and characterisation and wider opportunities for economic growth	Supported local economies in regions with high resource potential but low economic resilience																DBIST, NGC, DESNZ, OEUK
6 Develop and export strategy		Develop export strategy for services, tech, knowledge and digital data based on project success	New export opportunities identified. UK becomes a clean energy super																DBIST, NGC, DESNZ, NWF, GBE, Scottish Enterprise

*Key recommendation

Table 2b Challenges 3 and 4

Recommendation		Actions	Expected Outcomes	Responsibility
7* **Develop skills and transition programmes**	Challenge 3 Knowledge, education and skills	Complete an ssessment of skills and training needs. Training and reskilling programmes launched. Accelerated workforce retraining for oil, gas, and mining specialists moving into geothermal roles	An upskilled workforce, skills and expertise from UK oil and gas sector retained, geoenergy is a real and long term career opportunity	Trade associations, DESNZ, Scottish Enterprise, NGC, schools, FE colleges, universities, training providers
8 Establish regional centres of excellence		Regional sector hubs for skills, training, and knowledge transfer in high-potential regions. R&D calls focused on innovation and technology optimisation	Established centres of excellence where people can train and build capacity. A successful sector supporting up to 50,000 direct jobs by 2050	NGC, UKRI, Net Zero Hubs, combined authorities, industry
9 National awareness and engagement programme		Co-create projects with communities and authorities and undertake communication & education campaigns. High degree of community ownership and benefit-sharing	People know what geothermal is and ask for it thereby driving demand	NGC, BGS, DESNZ, Local Authorities
10 Create open access resource mapping	Challenge 4 Technology development, research and innovation	Map geothermal resource with heat demand, fill gaps in data using AI or additional data acquisition. Include greater open access to data	Improved resource estimates and reduced initial project risk	NGC, BGS, UKOGL, HNDU, Catapults
11 Establish a technology development fund		Geothermal delivery body will through fund technology development e.g. improvements in prospecting, drilling and energy recovery technologies	Reduced drilling times, reduced cost and more efficient topside energy recovery prodcuing more heat and electricity	DESNZ, GBE, NGC, BGS, NWF
12* **Create a national project pipeline**		Incorporate projects within NSTA project pathfinder tracks planned/ developing and commissioned projects	A transparent and investable geothermal market capable of attracting private capital. Project development and opportunities are tracked and highlighted	NGC, DESNZ, NSTA, BGS, Industry, Local Authorities



*Key recommendation

Table 2c Challenge 5

Recommendation		Actions	Expected Outcomes	Short -Term 2026-2030					Medium to Long Term 2031-2050									Responsibility
				2026	2027	2028	2029	2030	2032	2034	2036	2038	2040	2042	2044	2046	2048	2050	
13 Integrate geothermal with heat networks	Challenge 5 Infrastructure integration	Integrate geothermal into heat networks, complete feasibility mapping in zones. Connect new builds, retrofit exisitng, geothermal review for new and upgraded heat networks	Lower carbon and more efficient heat provision, large heat loads removed from gas and power grids, warmer safer decarbonised homes, reduced fuel costs and improved public health						→									Local authorities, network operators, untility companies, OFGEM
14 Electricity system integration		Connection and capacity studies, private wire connections, mapping demand with opportunity, quantification of geothermal potential to reduce grid demands	Public buildings and estates have adopted geothermal. Geothermal becomes a cors part of UK energy, industrial and digital infrastructure						→									NESO, OFGEM, GBE
15 Sustainable industry and food production		Couple geothermal with industrial processes, identify appropriate industries	Reduced costs retain businesses, food and energy security is improved						→									National government, Local authorities, network operators, trade associations
16 Data centre and AI growth		Align geothermal opportunities with AI zones	Heat supply, storage, electricity production and potential for geothermal fluids to meet AI cooling demands						→									Local authorities, utility companies, data centre providers, network operators

Challenge 1: Policy and Regulation

The UK's geothermal challenge is not a lack of resource or a lack of technology readiness. The key constraint is the deployment environment, primarily because geothermal projects have high upfront risk and CapEx but low OpEx once commissioned. Experience in countries such as the Netherlands, France, Hungary and Germany demonstrates that geothermal grows fastest where government combines clear policy support and direction, accessible subsurface data, predictable licensing, revenue support and mechanisms that share early geological risk. For example, the geothermal sector in the Netherlands grew by 50% in five years following implementation of its geothermal strategy and associated support measures[34]. This illustrates the transformative potential for the UK if similar enabling conditions are adopted.

Although the means of accessing geothermal energy is analogous to oil, gas and water extraction, a key difference is that geothermal energy extraction is generally non-consumptive, which makes the case that certain forms of geothermal should be licensed and regulated differently if at all. The ways of accessing different types of geothermal energy are technically quite different from each other with very differing risk–reward profiles. For the purposes of licensing, permitting, insurance and financing it is necessary to agree how geothermal schemes could be classified for example they could be split broadly by target depth and energy output as proposed:

- **0–500 m or heat pump based** – ground source heat, mine water, using heat pumps to boost temperatures [Closed loop]
- **0–500 m or heat pump based** – ground source heat, mine water, using heat pumps to boost temperatures [Open loop]
- **500–2,000 m or heat only** – direct use of heat from aquifers [Open loop]
- **2,000–5,000 m** power plants producing electricity and direct heat [Open loop]

Recommendations 1–3 lie within this challenge area and are described in the following sections.

Recommendation 1 – Recognise and resource the NGC as the national geothermal delivery body (timeline 2026–2027) KEY RECOMMENDATION

The UK government should demonstrate its commitment by establishing a joint task force to agree scope and delivery roles and resource the NGC as the delivery body for our geothermal nation with the remit for coordinating policy and licensing reform and overseeing investment and support programmes. This body would also adopt a geothermal strategy and set targets for delivering our geothermal nation. The broad remit would be to deliver the recommendations identified in this roadmap and could include:

- Annual reviews of roadmap delivery against targets, with public progress reports from the sector.
- Adaptive regulatory and funding mechanisms to respond to lessons from existing projects, market evolution, and emerging technologies.
- Ongoing engagement with devolved governments, local authorities, and industry groups to maintain stakeholder buy-in and regional relevance.

[34] Geothermal industry in the Netherlands has promising potential for strong growth

- Institutionalise public engagement, co-creation, and benefit-sharing for all major projects.
- Oversee annual deployment quota as number of connected GW per year increases, aligned to the targets and pipeline of developing projects.
- Biennial review points that would include progress reports, stakeholder consultations, regulatory adjustments, and innovation funding calls

Specialist capabilities would need to be resourced including:

- Geologists and drilling engineers
- Energy economists
- Planning and regulatory experts
- Competent persons for project approvals, evaluations and valuations

Robust processes should then be established for site identification and valuation and evaluation, environmental assessments, community engagement, and permitting to accelerate deployment while maintaining public trust. This should include independent reviews of larger projects by competent persons.

To achieve this, the NGC would collaborate across the sector to design or redesign market mechanisms and investment incentives to attract private sector participation. These could include risk sharing schemes for exploration drilling or long-term heat purchase agreements (see Challenge 2 – Market and Finance). Finally, a comprehensive research and innovation programme, developed with universities and industry, would help advance technologies, improve cost-effectiveness, and ensure the UK can build a competitive geothermal sector with exportable skills and knowledge for the long term.

Recommendation 2 – Adopt targets and strategy set by the NGC (timeline 2026–2027) KEY RECOMMENDATION

Other nations such as Germany, France, the Netherlands, Iceland, Indonesia, Turkey and the United States have implemented geothermal strategies, adopted targets and developed support mechanisms. Consequently, the development of their geothermal resources has accelerated.

The attributes of geothermal energy align well with several government missions including:

- **Strong foundations** - increasing UK energy security and reducing reliance on gas imports.
- **Kickstarting economic growth** - providing new business opportunities.
- **Positioning the UK as a clean energy superpower** - by displacing fossil fuel use/ imports.

The UK has a readily available and directly transferable skill set, supply chain and infrastructure from legacy energy industries (oil, gas and mining) that can all be redirected towards accelerating geothermal deployment.

Geothermal represents a major opportunity for the UK. With relatively modest investment, the UK could transition oil and gas capabilities into a new geothermal industry that supports growth and jobs and helps reduce the cost of living. However, there are few policy and financial support measures to offset early-stage costs and risks. This has slowed its uptake.

By adopting a national geothermal strategy, we can:

Recognise the crucial role geothermal could have in providing secure future energy supply.

Demonstrate UK government commitment to investors and the geothermal sector.

Support development of policies that support geothermal uptake.

Empower and motivate investors.

Promote collaboration and knowledge sharing

Currently, most of our geothermal heat (99%) is supplied by ground source heat installations that have been operating over many years. There is good potential to grow the installed capacity of larger MW-scale geothermal systems sourced from disused mining and oil and gas infrastructure, aquifers and granites. The UK should adopt a geothermal strategy that recognises geothermal as a strategic resource for heat, power and storage and pursue capacity targets of:

- 10 GW of geothermal heat by 2050 – this level of installed capacity operating at an illustrative 80% availability would deliver about 70 TWh a year or around one-eighth of the UK's modelled 2020 heat demand
- 1.5 GW of geothermal electricity by 2050 – at a 90% load factor this would generate about 11.8 TWh a year: roughly 3.7% of 2025 electricity demand and 40% of that year's net electricity imports

Achieving these targets would also:

- Create around 50,000 to 100,000 direct jobs, based on 5 to10 jobs per MW as seen in Germany[35]
- Avoid annual carbon emissions of 10 million tonnes
- Save between £0.8 and £1.6 billion in avoided CCS costs
- Improve local air quality
- Improve energy security

Table 3 shows potential growth across different types of geothermal deployment based on a 10% year-on-year growth in installed thermal capacity as seen in Germany.

Table 3 Potential installed capacity from different geothermal schemes up to 2050 (units are in MW)

Scheme Type	2026	2040	2050
Ground source heat (less than 100m)	1000	4000	10,000
Mine water (down to 500m)	11	45	120
Sedimentary aquifer (down to 2km)	2	9	24
Deep granite (down to 5km)	1.5	6	17

[35] The case for deep geothermal energy - unlocking investment at scale in the UK. A deep geothermal energy white paper

In reality, growth is unlikely to be equal across the different project types, smaller shallower ground source heat systems may reach a ceiling due to land availability and due to economies of scale for heat production and subsurface and topside advancements, mine water and aquifer schemes connected to heat networks may see more rapid growth. For the deeper schemes targeting granites, heat production will likely be a by-product of electricity generation and lithium recovery. More detailed work is required to assess the likely growth trajectories for each type of scheme.

Recommendation 3 – Create dedicated licensing and permitting routes (timeline 2026–2029) KEY RECOMMENDATION

Geothermal developments may have a range of impacts at different stages of the project for example, on local communities, ecology, flooding and pollution of watercourses, and ground movements associated with drilling and completion of boreholes, borehole testing and development and ultimately during scheme operation.

Geothermal remains in a regulatory grey zone: not fully defined as a mining, water, or renewables activity, which creates ambiguity and project delays. Project developers face high upfront costs and delays driven by regulatory uncertainty and the lack of specialised regulatory staff or fast-track approval routes for geothermal. The absence of a national risk-insurance or geothermal guarantee scheme amplifies the perceived "exploration risk," deterring private investment.

The recommendation is to recognise MW scale geothermal projects as nationally significant infrastructure that can then gain faster approvals and create a "one-stop shop" for geothermal licensing and permitting bringing together planning, environmental, health and safety, and mineral licensing in a single, fast-track process in line with German and Dutch streamlined permitting and sectoral authority approaches. For project consents, this involves bringing together the Environment Agency, mineral planning, health and safety, and energy regulators into a coordinated process. This mirrors approaches now used for offshore wind and large renewable schemes.

Legislating for geothermal as an energy resource helps to clarify its legal status and simplify licensing and property rights to encourage development.

- **Permitting and Licensing:** Geothermal developments typically require multiple consents such as groundwater abstraction and discharge, mining rights and planning permission. Environmental consents and requirements vary across the UK. While the legacy from oil and gas and groundwater licensing has sometimes been leveraged, geothermal is still not recognised as a separate energy resource that should have its own stand-alone regulation.
- **Heat as a Resource:** In the UK, heat is not formally treated as a proprietary resource. Subsurface heat is subject to different interpretations under property, mineral, and environmental law. Unlike water, for which abstraction rights and licensing are long-standing features, geothermal heat extraction (excluding mineral waters) does not have a clear national "ownership" framework. State ownership of heat is commonplace in other nations.
- **Environment and Safety:** Applicable health and safety laws include the Borehole Sites and Operations Regulations (BSOR), Construction Design and Management (CDM) Regulations and standard Environment Agency abstraction/discharge consents, these are currently required for open-loop systems.
- **Devolved Arrangements:** Policy and incentive coverage can differ across England, Scotland, Wales, and Northern Ireland, notably in the availability and terms of renewable heat support and planning guidance, clarification of what is required for each country or region in needed.

- **Update national planning guidance:** Geothermal energy to be assessed and, where unsuitable, explicitly ruled out as the energy source (particularly for heat) for any new developments before other energy options are considered (particularly fossil fuel) as local planning authorities have responsibility for permitting geothermal schemes and borehole drilling and set requirements for environmental impact and water resource assessments.
- **Reforms of planning and infrastructure legislation**: Speed up processes, establish a "one-stop shop" by limiting statutory consultees and make changes to the pre-application process (as recently adopted for onshore wind applications). Classify geothermal energy as an energy resource/ asset of strategic national importance.
- **Develop clear guidance:** Checklists or a matrix as guidance for the different geothermal deployments as to what regulation and licensing and permitting routes and consultees are required at every stage of each type of geothermal project. Recognise and constrain the elements of each stage. The NGC is currently developing such a matrix with its champions.
- **Boost local authority knowledge and capacity:** This links with Challenge 3 to develop greater in-house capacity and enable faster/ more informed decisions.

Expected Outcomes

The expected outcomes from implementing these recommendations include increased investor confidence, faster project delivery and improved coordination across government.

Challenge 2: Market and Finance

Recommendations in this section align with the UK government mission to Kickstart economic growth and break down barriers to opportunity. Looking longer-term, geothermal will be commercially viable and has the potential to be compatible with other forms of energy. Geothermal presents a significant opportunity for decarbonising our energy supply and could provide at least:

- 10 GW of heat and 1.5 GW of electricity by 2050
- Enough heat for over 4 million homes
- Enough electricity for 3 million homes

Potential markets include citywide heat networks, large industrial clusters, public-sector estates (hospitals, schools, prisons, councils), social housing, and commercial developments seeking resilient, low-carbon heat. Short-term finance measures are required to kickstart this revolution and unlock this potential:

- **Exploration risk:** Uncertainty over subsurface temperatures, flow rates or reservoir continuity can lead to unproductive wells. This risk is a key deterrent for lenders and investors.
- **First-well gap:** Upfront costs, uncertainty and risk are higher for the first well drilled.
- **Upfront capital requirements:** High initial costs must be financed before certainty of resource or returns, discouraging purely private investment.
- **Regulatory complexity:** including long timeframes for approvals (Recommendation 3)
- **Limited risk-sharing mechanisms:** Unlike more mature sectors (wind, solar), geothermal lacks comprehensive UK risk insurance schemes or public risk pools, which are standard in Germany, France, and the Netherlands.

Tailored support mechanisms, as seen in leading European markets, are essential for scaling up. Integration with heat networks is a key opportunity for the UK (see Recommendation 13) as network coverage expands and energy price and carbon reduction targets bite, high-load and continuous anchor heat loads suit the baseload supply profile offered by geothermal.

To address geothermal investment risks effectively, the UK should draw on both national sector insights and leading European models. Short-term support measures are essential to cover the initial risk and uncertainty gap: high upfront costs, geological uncertainty, and regulatory complexity that currently deter private investment. Below are strategic actions for the UK, informed by sector proposals and international best practice:

There are five schemes that have or could be used to leverage funding for geothermal projects

- **Contracts for Difference (CfD):** Deep geothermal electricity projects are eligible for the CfD scheme, which guarantees a strike price for power. However, the relatively high capital cost and exploration risk of geothermal mean few projects have yet achieved successful bids.

- **Green Heat Network Fund (GHNF):** This fund, supporting the transition to low-carbon district heat sources, covers geothermal as an eligible technology. It facilitates grants for projects using geothermal heat and can help cover first-well risk.
- **National Wealth Fund (NWF):** The risk profile and relatively small size of 5–10 MW geothermal projects has made it challenging to fund geothermal projects through this route and to attract matched private investment within the NWF timescales.
- **Great British Energy (GBE):** Its remit for local energy projects aligns well with heat network opportunities although heat is excluded with their initial focus being on electricity production.
- **British Business Bank (BBB):** Offers finance routes for smaller businesses.

The Public Sector Decarbonisation Scheme (PSDS) was also widely used by local authorities and regarded as a route for developing geothermal heat-network projects. The scheme is now dormant, and it is unclear whether it will be restarted.

Recommendation 4 – Create risk-sharing and development finance mechanisms (timeline 2026–2030) KEY RECOMMENDATION

Delivering geothermal at scale requires financing frameworks that reduce early-stage subsurface risk, provide bankable long-term revenues for heat and power, and create a repeatable route from feasibility to construction and operations. Without this, projects will continue to stall at the "first well" gap associated with high upfront capital costs before the resource is proven, combined with limited UK risk-sharing mechanisms and uncertain heat revenues.

International experience shows that deep geothermal markets scale fastest where governments tackle two issues in parallel: (1) drilling/resource risk (through guarantee funds or insurance pools) and (2) revenue certainty (through long-term tariffs, contracts or other offtake frameworks). The Netherlands, France and Germany provide established examples of public-backed risk mitigation mechanisms that reimburse a material share of eligible drilling costs when defined performance thresholds (e.g., temperature and flow) are not achieved, helping unlock private debt and equity.

Recommended components of a UK geothermal financing framework

- **National geothermal risk insurance / guarantee scheme (first-well de-risking):** Establish a UK mechanism that covers a defined share of eligible drilling and testing costs (limited to an agreed number of initial wells supported) where agreed resource performance criteria are not met. The scheme should be designed to (i) crowd in private capital, (ii) reduce risk premia, and (iii) build an underwriting track record that enables a transition to more commercial insurance over time.
- **Bankable revenue support for heat (and power where relevant):** Create long-term revenue certainty for geothermal heat through a heat tariff, a heat CfD-style instrument, or regulated heat offtake arrangements. Projects can then raise debt once subsurface risk is reduced. Maintain a stable, competitive route for geothermal electricity within power CfD auctions, with arrangements that reflect the different cost/risk profile of geothermal compared to more mature renewables.
- Development and construction funding to bridge feasibility to final investment decisions: Provide grants and/or concessional loans for early development activities (resource assessment, drilling design, permitting, front-end engineering, and heat-network integration

design). This can be delivered as a staged "development fund" that releases support as projects pass defined technical and commercial gates.

- **Standardisation and offtake frameworks:** Develop standard contract templates (e.g., heat offtake agreements for anchor loads; interface terms with heat network operators; monitoring and reporting templates) to reduce transaction costs, speed procurement, and improve lender confidence. Where appropriate, support aggregation of multiple smaller projects into investable programmes.
- **Public finance levers to crowd in private capital:** Align existing UK institutions and schemes e.g. Green Heat Network Fund, National Wealth Fund, Great British Energy, and the British Business Bank so they can support geothermal consistently across project stages (development, drilling, surface build, and early operations). This should include clarity on mandate, project and ticket sizes, timescales and eligible geothermal technologies.
- **Data, transparency, and learning to reduce the cost of capital:** Link public support to strong data capture and publication (with appropriate confidentiality periods) so each well reduces uncertainty for the next. Consistent reporting on drilling performance, subsurface outcomes, and operational availability will support insurer and lender confidence and progressively lower financing costs.

A dedicated geothermal development fund could be established to support early project stages that are difficult to finance commercially (screening, feasibility, permitting, front-end engineering, and mobilisation for drilling). This could come from a portion of the £8.3 billion of funds currently allocated to Great British Energy with the expectation that this could act as a catalyst to attract larger sums of private capital[36], their commitment to delivering local energy projects also aligns well with geothermal deployments. Support should be structured in stages, with clear gateways and deliverables, and should include strong data capture and sharing so that every publicly supported well improves the national evidence base. Funding could be provided through a combination of central government budgets, devolved/regional programmes, and (where policy allows) recycling of relevant fiscal receipts from legacy energy activities (e.g. enhanced profits levy) into geothermal risk reduction and delivery.

Additional financing routes can complement the core package above, particularly once early-stage subsurface risk is reduced:

- **Public-private partnerships (PPPs) and co-investment:** Use risk-sharing structures (e.g., co-investment, guarantees, convertible grants) to crowd in institutional capital, particularly for heat network-connected schemes and public sector estate decarbonisation.
- **Green bonds and programme finance:** Aggregate multiple geothermal and enabling infrastructure assets into investable programmes, enabling access to bond markets once revenues are stabilised.
- **Blended finance:** Combine grants, concessional loans and public guarantees to match support to risk by project stage (with greatest support weighted to exploration/first wells).
- **Support for data, R&D and demonstration:** Maintain targeted support for resource assessment, monitoring and performance validation, and demonstration of replicable models especially in urban and "hard to decarbonise" regions.

To widen the investor base and reduce the cost of capital, the UK should adopt a staged approach to geothermal project maturation (aligned with how other subsurface sectors value assets). This means defining clear technical and commercial milestones where uncertainty reduces and value increases (e.g. screened opportunity → permitted project → drilled and tested resource → constructed asset →

[36] Great British Energy: developer role and partnership with National Wealth Fund - GOV.UK

operating heat/power supply). Each stage can attract different investor types, improve price discovery, and support a more liquid "interim market" for geothermal development rights and projects. The NGC is working on this through its champions and wider international contacts.

- **Stage 1 – Exploration, drilling and testing:** Highest subsurface risk; typically requires public risk mitigation (guarantee/insurance) and/or staged development funding. Potential capital sources include specialist developers and higher-risk investors.
- **Stage 2 – Wellfield and surface infrastructure construction:** Risk reduces once the resource is proven; blended finance and co-investment can accelerate delivery of energy centres, heat networks and grid connections. Typical capital sources include project finance and private equity.
- **Stage 3 – Long-term operations:** With stable heat/power offtake and demonstrated performance, projects become suitable for long-duration, lower-risk capital (e.g., infrastructure funds and pension investors) and can be refinanced to recycle capital into new projects.

To support investment and comparability across projects, the UK should adopt a recognised reporting/assessment standard for geothermal resources and project performance and establish a credible route for independent technical assurance and valuation. This could be coordinated through the NGC (Recommendation 1) in collaboration with regulators, British Geological Survey and industry, enabling consistent due diligence and improving lender and insurer confidence. The United Nations has developed a framework for the classification of natural resources through the United Nations Framework Classification (UNFC[37]) which offers a standardised approach for cross-sector decision-making to promote sustainable and efficient resource use globally. Case studies demonstrate its successful application to geothermal energy resources which could be drawn upon as part of this recommendation.

Recommendation 5 – Assess the national economic opportunity (timeline 2030–2034)

The UK geothermal sector holds significant potential to drive domestic value creation, leveraging transferable expertise from oil and gas, civil engineering, and advanced manufacturing. Many workers will need to transfer existing skills rather than acquire entirely new ones. As a largely indigenous resource, the development of geothermal energy strengthens energy security, supports national decarbonisation, and offers business opportunities and socioeconomic benefits extending well beyond clean energy provision.

The geothermal industry value chain includes:

- Geological assessment, exploration, and subsurface modelling
- Drilling wells including development and completion (using adapted oil and gas or water well equipment and techniques)
- Planning of wells, power plants and energy centres, approvals and licensing, health and safety, procurement and community engagement
- Surface plant construction (heat distribution, power generation, direct use applications)
- System integration, monitoring, and controls
- Operations, maintenance, and scheduled workovers

[37] United Nations

Many of these activities directly utilise skills from the UK's oil and gas and wider energy workforce, particularly in drilling, reservoir engineering, and project management. This offers vital opportunities for reskilling as the fossil sector contracts, providing just transition roles in locations such as the north-east Scotland and north-east England, Midlands and south-west England. Reaching the 2050 targets proposed by the NGC could generate 50,000 to 100,000 direct jobs based on growth observed in the German geothermal sector. These jobs could be particularly concentrated in post-industrial and 'levelling-up' areas. For example, the Eden Geothermal project in Cornwall is estimated to have generated over 250 jobs throughout its lifecycle.

UK Supply Chain Strengths:

Significant domestic capability in drilling services, seismic and geophysical surveys, and mechanical/electrical engineering.

A ready pool of highly skilled workers, with 60–80% of the expertise required for low-carbon energy already present in the oil and gas supply chain.

Opportunities to develop local manufacturing for heat exchange equipment, well components, pumps, and digital OT systems.

Capability to repurpose existing hydrocarbon infrastructure (wells, rigs), reducing capital costs and lead times.

The establishment of a geothermal industry would also support local economies especially in regions with the highest resource potential and lowest economic resilience thereby reinforcing the UK's levelling up agenda. Assessing economic development potential in UK geothermal requires analysis of where heat and power are produced and where skills, services, intellectual property and regional value can accrue across the full lifecycle of projects. The NGC proposes a multistage assessment methodology that includes:

- Defining the value chain and how it is segmented during the end-to-end geothermal life cycle
- Quantifying the economic contribution and impact assessment of the geothermal value chain beyond individual projects
- Completing a market and system constraints analysis to understand critical dependencies and risks
- Assessing contribution of geothermal development to regional economic development ambitions
- Evaluating economic impacts for different development pathways/ scenarios
- Translating the findings into actionable policy, investment and delivery recommendations

Recommendation 6 – Develop an export strategy (timeline 2030–ongoing)

One of the UK government's missions is to become a clean energy superpower. The development of a UK geothermal sector represents more than a domestic opportunity and creates a pathway for the UK to export specialist capabilities, services and system expertise. There is potential for the UK to lead globally on geothermal in these areas:

- **Mine water geothermal** – the UK has the world's largest mine water resource with exportable knowledge in its management, treatment and development.
- **Advanced Geothermal (EGS)** - building on the Utah FORGE project and success in Cornwall, replicating this in other areas of the UK.
- **Industrial decarbonisation** – identifying industrial clusters.
- **Workforce and technology skills transfer** – redeployment of oil and gas expertise.

Unlike other low-carbon technologies, the primary export opportunity for UK geothermal lies not in mass manufacture of equipment, but in knowledge-intensive activities spanning subsurface expertise, system design, heat integration, project development, and public-sector delivery models. These capabilities closely align with established UK strengths in oil and gas, engineering consultancy, heat networks, and energy system governance.

UK exports will be most valuable where they can augment existing strengths e.g. within the petroleum sector, bring specialist subsurface knowledge, or expertise in accelerating heat network uptake. Implementing this strategy will also deliver a longer-term objective (2040–2050) by building the UK's ability to actively export UK skills, equipment, digital solutions, and project experience to global markets. With a maturing geothermal sector, UK engineering and technology firms can expect export opportunities for drilling technology, heat network design, geothermal project consultancy, and digital management tools. The experience gained in the North Sea energy sector is already in high demand internationally and positions UK firms as potential leaders in the global geothermal value chain with around 300 companies currently working in the oil and gas supply chain in Scotland undertaking geothermal projects outside the UK[38].

Export opportunities could be explored through the following activities in collaboration with the Department for Business, Innovation, Science and Trade and Scottish Enterprise:

- Identification of UK exportable capabilities
- Horizon scanning for global opportunities
- Identification and assessment of unique selling points and other differentiators
- Market access and risk analysis
- Identification of priorities and interventions

Expected Outcomes

The expected outcomes from adopting these recommendations include the potential to attract significant private capital investment alongside a significant opportunity to build a resilient, high-value UK supply chain whilst establishing international leadership in heat-led geothermal systems and strengthening the case for sustained domestic deployment and delivering regional regeneration.

[38] Scotland's Geothermal Supply Chain Analysis and Global Market Opportunities Study

Challenge 3: Knowledge, Education and Skills

The expansion of the UK geothermal sector presents a significant opportunity to build on the nation's existing subsurface expertise, particularly that developed through decades of oil and gas activity in the UK Continental Shelf and onshore. Many of the technical competencies required for geothermal development including subsurface characterisation, drilling and well design, reservoir management, geoscience, project delivery, health and safety, and regulatory compliance have parallels with those already embedded within the oil and gas workforce. Effective retention, transfer and adaptation of these skills will be critical to accelerating geothermal deployment while maintaining high standards of safety, performance and environmental stewardship.

As the oil and gas sector continues its managed transition, geothermal energy offers a valuable pathway for retaining skilled professionals within the UK energy system, supporting a just transition for workers and communities. However, while skills overlap is substantial, geothermal technologies and business models also present distinct differences, a key one being that geothermal systems are generally non-consumptive. Other considerations include the difference in value between oil and gas and geothermal fluids and the management of heat as a resource, lower temperature and pressure operation, integration with wider infrastructure such as heat networks and electricity grids and markets and navigating emerging regulatory and permitting frameworks. Addressing these differences will require targeted upskilling and retraining, alongside the development of geothermal-specific guidance, standards and best practice.

The UK also has a strong academic research base and many universities are now developing their own geothermal projects including Leeds, Durham, York, Aberdeen and Hull. NGC is also aware of around 25 Universities actively pursuing geothermal research which is high compared with our European counterparts however we estimate that a similar number of UK universities have removed, suspended, merged, or significantly reduced Earth science-related provision (e.g. geology, geophysics, applied/environmental geology, geohazards) since around 2015, with accelerating losses being observed since 2020. Action is required to halt this decline.

A coordinated approach to knowledge sharing, education and skills development will therefore be essential to accelerate UK geothermal. The recommendations in this section advocate for job creation in addition to job transition achieved by building upon partnerships between industry, academia, training providers and government to adapt existing oil and gas training pathways, develop specialist geothermal modules, and ensure that future workforce needs are anticipated across the full project lifecycle. Investing early in skills, education and knowledge transfer will help reduce project risk, drive down costs through learning and experience, and create a resilient talent base capable of supporting the long-term growth of geothermal energy in the UK.

Recommendation 7 – Develop skills and transition programmes (timeline2026–ongoing) KEY RECOMMENDATION

OEUK suggests that, as of 2024, around 154,000 people are employed in the oil and gas sector, contributing more than £25 billion annually to the UK economy. This figure is anticipated to decline to between 57,000 and 71,000 by the early 2030s[39]. The UK therefore risks losing skills at a rate of around 20,000 jobs per year. This needs to be reframed as an opportunity with career routes promoted as geoenergy careers rather than aligning with industries that may be viewed as dirty or declining by younger people entering the workforce.

Based on growth in the German and Dutch geothermal sectors, achieving the proposed UK target of 10 GW of geothermal heat by 2050 could create between 50,000 and 100,000 direct high-quality jobs, with an estimated ratio of 5–8 jobs per MW during the construction phase and 1.5–2 for ongoing operations. There are no formal data on how the oil and gas workforce is divided among vocational, corporate and academic roles. Using evidence gathered by Robert Gordon University as part of their UK Offshore Energy Workforce Transferability Review[40], the NGC has estimated the following split among job classifications which would also seem applicable for geothermal:

- Vocational, operational, technician and engineering roles 75–80%
- Corporate, project, commercial and supervisory roles 10–20%
- Academic and university-based 1–3%

Training is urgently required at all levels, Table 4 estimates the number of roles that could be created as geothermal development accelerates however there is further work to be done on how many roles are new roles and how many are transitioned roles i.e. we need to assess the "real" job creation potential.

Table 4 predicted roles required linked to geothermal heat growth targets (using 10 jobs per MW installed)

Job type	2030	2040	2050
Installed geothermal heat target (GW^{TH})	2	7	10
Vocational, operational, technician and engineering	16,000	56,000 i.e. 40,000 additional roles created over 10 years	80,000 i.e. 24,000 additional roles created over 10 years
Corporate, project, commercial and supervisory	3,600	12,600 i.e. 9,000 additional roles over 10 years	18,000 i.e. 5,400 additional roles created over 10 years
Academic, university-based	400	1,400 i.e. 1,000 additional roles created over 10 years	2000 i.e. 600 additional roles created over 10 years
Totals	**20,000**	**70,000**	**100,000**

[39] Economy & People Report 2024 | Offshore Energies UK (OEUK)
[40] UK Offshore Energy Workforce Transferability Review

Personal communication with the heat-network training provider HeatNet shows similar requirements for topside job creation for heat network installation. They estimate that around 10,000 people will need to be trained in heat network installation by 2032 to meet government 2050 targets for heat delivery via heat networks. The value chain for the geothermal and supporting topside sectors will include subsurface geologists, geophysicists, drillers, reservoir and process engineers, environmental consultants, project developers, commercial and legal experts, district heating engineers, digital operations, and customer relations representatives. A robust pipeline is needed from early development to operation. Skills in digital monitoring, regulatory compliance, and multidisciplinary collaboration (energy, construction, and digital) will grow in importance as district heating and geothermal networks expand. This presents a massive training opportunity particularly for further education colleges and for apprenticeships.

The maturity of UK oil and gas, particularly in the North Sea, makes available a considerable pool of skilled professionals with highly transferable skills (well design, geomodelling, risk management). National and regional reskilling initiatives can prioritise geothermal capacities for these workers, with modular, targeted training and recognised industry certification. The following education and training initiatives could be explored:

- Create targeted funding for workforce development including scholarships, reskilling grants, and innovation challenge funds.
- Launch of sector-specific course modules within university STEM programmes and Further Education Institutions (geothermal engineering, geoscience, sustainable energy systems).
- Fast-tracked, accredited conversion courses and on-the-job apprenticeships for drilling, plant engineering, and project management.
- Collaboration between industry groups (the National Geothermal Centre, Renewable Energy Association, industry consortia), government, and training institutions to develop standards, share best practices, and fund ‘train the trainer’ programmes.
- Establish regional centres of excellence (Recommendation 8) in high-potential areas (Cornwall, NE England, central Scotland), ensuring direct local benefit.
- National secondment programme to second staff from organisations transitioning into the geothermal sector into the geothermal delivery body, strengthening its capabilities and equipping the seconding organisation with new skills, knowledge and contacts from this sector.

Recommendation 8 – Establish regional centres of excellence (timeline 2027–ongoing)

The NGC would provide the hub for delivering governance and broader remit for a geothermal nation. The hub would manage core activities, such as strategic planning and direction to maximise national impact and keep the ‘spokes’ briefed on matters such as, national level legislation, news, initiatives elsewhere and funding opportunities. There is potential to establish several regional centres of excellence “spokes” that have demonstrated success in advancing geothermal over recent years. We may wish to load individual centres with a key area of responsibility. Examples could include: power generation, supply chain, drilling and more.

Regional centres of excellence (Table 5) would provide visible focal points and training facilities for capability building and delivery. Concentrating expertise and facilities in a small number of proven locations would accelerate learning-by-doing, enable faster replication of project models, and improve

quality assurance through shared standards, templates and lessons learned. Centres of excellence can also act as convenors for local authorities, communities, developers and supply chain organisations, making it easier to move from feasibility to delivery and to maintain a clear route for escalation and support via the national hub.

Table 5 Proposed regional centres of excellence

Area	Specialism
Northern Ireland	Engagement and awareness/ Social side of geothermal
Northeast Scotland	Oil and gas supply chain and transferable skills
Northeast England and North Yorkshire	Repurposing infrastructure/ mine heat and oil and gas infrastructure
Cornwall	Hardrock drilling/ granites/ Lithium production/ electricity production

The spokes would lead local operations and their defined areas of expertise. They carry a formal association with the hub that provides them with a level of authority and inform the hub of their activity request support as appropriate. The hub will act as the connector of knowledge (best practice) and processes between spokes. The spokes would not be dependent upon the hub but this would provide support. The NGC has been approached by and started to gather potential hub leaders and contributors.

In addition, the centres of excellence provide a practical mechanism for shared training opportunities across regions. This could include common curricula and accredited short courses, 'train-the-trainer' programmes, shared secondments and placements, and coordinated access to specialist equipment, technology testing and demonstration sites. A national training offer, delivered through the regional centres and coordinated by the NGC hub, would help scale workforce transition, reduce duplication, and ensure consistent competency standards across drilling, subsurface evaluation, heat network integration, operations and community engagement.

The hub and centres of excellence will both work with research councils and other funding bodies to inform future research funding calls, ensuring that priorities reflect delivery needs (e.g., drilling cost reduction, reservoir characterisation, monitoring and induced seismicity risk management, heat network integration, and social licence). The hub can coordinate evidence from the centres of excellence and the wider project pipeline to shape targeted programmes, stimulate cross-disciplinary consortia, and broker industrial and academic collaborations that accelerate commercial deployment and build UK intellectual property and exportable capability.

Recommendation 9 – National awareness and engagement programme (timeline 2028–ongoing)

Public awareness and trusted engagement are critical to scaling geothermal from a small number of exemplars to a geothermal nation. Even in countries with a much higher uptake of geothermal energy such as New Zealand, public awareness is still considered limited, perhaps because some of the most attractive attributes of geothermal such as its low visual impact and quiet, continuous energy supply, also make it less visible. Geothermal projects can involve drilling activity, construction works, and long-lived infrastructure in or near communities particularly where heat networks are developed. Effective

early engagement can reduce opposition and subsequent delays. Exemplars of this type of engagement have been demonstrated by Eden Geothermal[41] and Geothermal Engineering Ltd[42].

The national delivery body (hub) and regional centres of excellence (spokes; see Recommendation 8) would have a valuable role in raising awareness and promoting engagement. This should build on proven UK exemplars such as the Southampton heat network which offers longstanding proof of concept, Eden Project which is open to the public and grows coffee, bananas and lemongrass using geothermal heat. The United Downs project demonstrates how geothermal energy can be used to produce electricity (a UK first) whilst recovering the critical mineral lithium from the produced fluids and the Gateshead mine water heat scheme and Kirby Misperton KM8 demonstrator provide exemplars for repurposing legacy mining infrastructure for commercial scale heat supply. These projects all have the potential to communicate tangible benefits, normalise geothermal as a familiar local infrastructure project, and share replicable engagement materials (FAQs, visuals, construction timelines, monitoring dashboards and community benefit templates) that can be adapted by each locality. Approaches to awareness raising and engagement should include (Table 6 presents a proposed checklist for minimum engagement standard for all projects):

- **Audience-led communications:** Target messaging for (i) residents and community groups, (ii) local authorities and planners, (iii) investors and insurers, (iv) heat network operators and anchor customers (NHS, universities, councils), and (v) the supply chain. Tailor content to each group (e.g., safety and disruption for communities; bankability for investors; procurement and delivery confidence for public sector buyers).
- **Clear and consistent narrative:** Communicate geothermal as UK-made, secure, low-carbon baseload heat (and power in specific regions) that stabilises energy costs and energy security, creates skilled jobs, and supports local regeneration. Be explicit about where geothermal is most suitable (and where it is not) to protect credibility.
- **Transparent information on impacts and mitigations:** Provide plain-English explanations of drilling activity, traffic and noise management, water handling (for open-loop systems), induced seismicity risk management and monitoring, and environmental protections. Publish monitoring arrangements and escalation routes and commit to regular updates during construction and early operations.
- **Structured engagement process:** Start engagement pre-planning and maintain it throughout the project lifecycle. Use a mix of methods: public meetings, targeted stakeholder workshops, drop-in sessions, school and college outreach, site tours, and digital Q&A. Maintain a named local contact and a clear complaints and response process.
- **Community benefits and local value:** Establish clear, standardised options for community benefit (e.g., community heat tariff support for vulnerable customers where appropriate, local skills and apprenticeship commitments, community funds, local procurement targets, and transparency on job creation). Link benefits to measurable outcomes and local priorities.
- **Exemplar-led learning and independent evaluation:** Use operating UK projects as demonstration sites, publish independent evaluations, and make lessons learned transferable through national toolkits. Create opportunities for planners, councillors, community representatives and developers to visit sites and speak to operators.
- **Proactive PR and rapid response:** Maintain a single source of truth (hub-managed) for key facts, performance data and myth-busting, supported by spokes for local delivery. Prepare a

[41] Eden Geothermal Induced Seismicity Management Protocol
[42] Seismicity – GEL Energy

simple crisis communications plan (e.g., for felt seismic events, drilling delays, or misinformation) including agreed messages, spokespeople, and update cadence.

- **Digital Tools and Public Participation:** Leverage open-access data portals, digital twins, and citizen science initiatives to involve the public in monitoring, feedback, and stewardship of geothermal resources. Develop interactive resources and data transparency platforms (inspired by the European "GeoERA" hubs).
- **Legal and Regulatory Support:**
  Mandate public consultation in the permitting process. Strengthen legal requirements for community benefit and develop standardised frameworks for dispute resolution and ongoing engagement.

Table 6 Minimum engagement standard for all projects (checklist)

Before planning submission	• Identify stakeholders and decision-makers (community groups, local authority/planners, EA/SEPA, landowners, anchor heat users). • Publish plain-English project summary, indicative programme, and FAQs (including drilling, traffic/noise, water handling and seismicity monitoring where relevant). • Run at least one open public event and one targeted stakeholder workshop; log questions and responses. • Set out a draft community benefit approach and local jobs/skills commitments (proportionate to project scale).
During construction and testing	• Appoint a named community liaison contact and publish response times for enquiries/complaints. • Provide regular updates (e.g., weekly/fortnightly) on activities, disruption and next steps via agreed local channels. • Maintain transparent reporting of monitoring and mitigations; communicate any incidents and corrective actions promptly.
Operations (first 12 months)	• Publish a short "first year performance" update (outputs, reliability, emissions impact, and lessons learned). • Provide an accessible summary of ongoing monitoring results and governance (what is monitored, how often, and who reviews it). • Hold at least one community review session and document actions taken in response to feedback.

Expected Outcomes

The expected outcomes from adopting these recommendations include the delivery of high value, stable jobs, regional economic growth, wider public awareness and acceptance, and established regional centres of excellence that would help to concentrate skills, foster knowledge sharing, and catalyse local economic benefits.

Challenge 4: Technology Development, Research and Innovation

The UK has significant expertise and growing interest in geothermal, but relatively few commercial projects have reached delivery. Geothermal can be deployed at multiple scales for heat, electricity, cooling and thermal storage, making it a flexible and scalable option. However, the breadth of approaches can make it difficult for decision-makers to identify the most appropriate technology for a given location and use case. For example, geothermal systems can be dependent (open loop) or independent (closed loop) of the reservoir or rock formation they are drilled into. Independent closed loop systems are not tied to their underlying geology meaning that they can be sited anywhere and are less directly connected to the subsurface. The trade-off for this flexibility is that with current technology they generally provide lower heat outputs (typically an order of magnitude less for heat). Better understanding of the optimum deployment criteria required for each type of geothermal system will support better-informed future decision-making.

Technology development, research and innovation will determine how quickly geothermal can move from a handful of UK commercial-scale exemplars to a repeatable, investable national programme. While many geothermal applications particularly for heat are already high technology readiness, deployment is constrained by the deployment environment (Challenge 1), uneven subsurface evidence, limited standardisation and a lack of clarity over which technology is most appropriate in different locations. This challenge focuses on strengthening the national evidence base (resource mapping and open-access data), accelerating practical innovation that reduces cost and risk (drilling, monitoring, modelling and surface-system integration), and translating learning into a visible project pipeline. Together, Recommendations 10–12 set out how the UK can align resource understanding with heat demand, target technology development where it unlocks recoverable resource, and build confidence for investors, local authorities and the supply chain.

Recommendation 10 – Create open access resource mapping (timeline 2026–ongoing)

Understanding the UK's geothermal resource is a critical foundation for strategic deployment, but it is important to distinguish between resource in place and technically recoverable resource. The total thermal energy present in the subsurface can differ significantly from what can be technically, economically and sustainably extracted under current conditions. Assessing resource in place remains essential, because advances in technology can improve energy recovery. Improvements to drilling technology, reservoir engineering, data analytics and changes in surface heat infrastructure can increase the proportion of recoverable heat (reserves) over time. A national strategy must therefore include continued monitoring to ensure that the UK maximises its geothermal opportunity.

The UK already benefits from a substantial body of geological and subsurface information, with many reports highlighting where geothermal opportunities exist across deep sedimentary basins, fractured crystalline rocks, mine workings and sedimentary aquifers. The British Geological Survey (BGS) UK Geothermal Platform[43] has significantly improved access to geothermal-relevant data by consolidating and visualising existing datasets, helping to fill evidence gaps and enabling more systematic pre-screening of potential opportunities.

The UK Geothermal Platform summary layers, developed using British Geological Survey data and presented for four proven geothermal technologies, represent a major step forward in national-scale

[43] UK Geothermal Platform

assessment. These layers combine subsurface characteristics with levelised cost estimates commissioned by the Department for Energy Security and Net Zero (DESNZ) as part of Arup's review[44] of technical and cost assumptions for geothermal generation technologies. This integration of geological potential and indicative cost provides an important bridge between scientific understanding and commercial decision-making. The opportunity to resource BGS to further develop this platform should be explored.

Much of the underlying UK subsurface data were originally acquired for onshore and offshore fossil fuel (coal, oil, gas) exploration and production, rather than for geothermal development. As a result, there are gaps in coverage, uneven data quality, and limited resolution in areas that may be strategically important for geothermal heat, particularly outside historic hydrocarbon provinces. Data are also spread through a range of different platforms which may or may not be free to the end user.

As the geothermal market develops, there is a strong case for targeted public investment in new data acquisition, particularly in areas where geothermal potential aligns with high or strategic heat demand. "Popular" areas in this context should be defined as locations where multiple criteria coincide, for example:

- High and dense heat demand (e.g. urban centres, industrial clusters, public-sector estates)
- Geological settings judged to be favourable based on existing data
- Local authority or regional interest in heat network expansion
- Potential for early deployment and replication

While it is appropriate that developers bear responsibility for project-specific data acquisition, early-stage, area-wide datasets can substantially reduce exploration risk and lower barriers to entry, particularly for smaller developers and public sector-led schemes. International experience suggests that publicly funded, precompetitive data can unlock private investment rather than crowd it out.

There is also an opportunity to explore data sharing models that balance commercial incentives with long-term public value. For example, data acquired with private support could be made openly available after a defined confidentiality period (e.g. five years), reflecting approaches used in countries such as the Netherlands.

The Netherlands offers another relevant precedent. By mapping geothermal prospects against spatial heat demand through their "SCAN" project, Dutch authorities identified that around 80% of the areas with both high heat demand and favourable geology had limited subsurface data coverage[45,46]. This insight was used to justify targeted public funding for additional seismic and geological data acquisition to fill key gaps and de-risk development. A similar approach in the UK could help prioritise where limited public resources are best deployed, ensuring that mapping and data programmes directly support decarbonisation of heat rather than purely theoretical resource assessment.

New research is also exploring the potential of artificial intelligence and machine learning to extrapolate subsurface data and properties into areas where data are sparse or uneven. While such approaches cannot replace high-quality physical data, they help reduce uncertainties and can support early-stage screening, scenario analysis and strategic planning, particularly when combined with transparent uncertainty metrics.

[44] UK geothermal energy review
[45] Geothermal energy in the Netherlands: current state, challenges and future prospects
[46] English - SCAN aardwarmte

A national geothermal strategy should therefore encourage innovation in data analytics and modelling (linked to Recommendation 11), while maintaining clear standards for data quality, validation and use in decision-making.

To reduce exploration uncertainty and accelerate deployment, a coordinated approach to geothermal data is required. This strategy recommends the establishment of a national geothermal resource mapping and open-access data platform, building on and complementing the British Geological Survey Subsurface Platform. Key functions should include:

- National and regional geothermal resource maps aligned with heat demand
- Clear distinction between resource in place and recoverable resource, with assumptions transparently defined.
- Digital pre-screening tools to support local authorities, developers and investors.
- Managed data sharing arrangements that balance commercial confidentiality and public value.
- Integration with project pipeline data to link resource availability with delivery timelines.

By improving access to consistent, transparent and spatially relevant geothermal data, the UK can significantly reduce early-stage risk, enable better spatial planning for heat decarbonisation and signal long-term commitment to geothermal as part of the national energy system.

Recommendation 11 – Establish a technology development fund (timeline 2026–2035)

Geothermal is proven and, with current technology, can be developed almost anywhere. Crucially, most geothermal applications particularly for heat already demonstrate a high level of technology readiness (TRL 8–9), significantly higher than many other large-scale low-carbon heat options. By comparison, green hydrogen technologies are typically assessed at TRL 6–7, reflecting a greater degree of technical, commercial and system integration uncertainty.

This relatively advanced maturity means that with the right support geothermal heat systems could be deployed at pace, delivering consistent baseload, early decarbonisation benefits while reducing and rebalancing demands on the wider energy system. Residual and peak demand can then be progressively met by lower TRL technologies as they mature over time. In this context, geothermal represents a near-term, low-regret option that complements rather than competes with emerging solutions.

A technology development fund should therefore prioritise geothermal as an immediately deployable strategic technology, focusing public support where it is most effective: accelerating deployment, compressing learning curves, and reducing cost and risk for follow-on projects.

While geothermal is already deployment ready, this strategy also explicitly recognises the potential for technology innovation to accelerate geothermal development further, both by improving performance and by expanding the accessible resource base. Investment through a technology development fund should therefore support innovation across surface and subsurface domains. At the surface, this can be achieved through the development of more efficient heat exchangers and energy recovery systems, improved integration with heat networks and industrial heat demands and cascade and multi-use applications including underground energy storage to enhance efficiency and system economics. Subsurface innovation should be focused on faster, lower-cost drilling techniques, improved reservoir enhancement and stimulation techniques and advanced modelling and monitoring for prediction and optimisation of geothermal systems. Advances in these areas have great potential to unlock geothermal resources in settings previously considered uneconomic or technically challenging.

Recent international and domestic initiatives, including the US Department of Energy's FORGE programme[47] and emerging UK technologies such as FeTu[48] for electricity generation, demonstrate how focused public investment can rapidly accelerate learning and unlock new geothermal play types. The UK is well placed to benefit from and contribute to these advances.

Taken together, the high technology readiness of geothermal, combined with clear innovation pathways, supports a strong case for a Technology Development Fund that:

- Prioritises early deployment alongside targeted innovation, rather than extended basic research
- Focuses on cost reduction, risk mitigation and replication, not technology proof-of-concept
- Accelerates the transition from individual projects to a repeatable, scalable geothermal delivery model across the UK

The fund would be administered through the body proposed in recommendation 1. This would have strong technical capability and experience of innovation funding, working closely with regulators, devolved administrations and local authorities. It would bridge the gap between ambition and delivery, unlocking private investment, supporting a just transition, and building the skills and capability required for geothermal to play a meaningful role in the UK's net-zero future.

Recommendation 12 – Create a national project pipeline (timeline 2026–ongoing) KEY RECOMMENDATION

A visible pipeline of completed, developing and potential projects managed by a national delivery body is of strategic importance for supporting the creation of a UK geothermal market. There is currently a lack of clarity on the types, numbers and development timescales of geothermal projects making it difficult for supply-chain companies to invest in skills, equipment and grow a UK-based delivery capacity. This problem is already evident in the Scottish oil and gas supply chain. Work previously commissioned by Scottish Enterprise[49] has revealed that there are an estimated 300 companies based in Scotland that offer skills and services directly transferable to geothermal development, yet these companies are predominantly undertaking this work outside the UK. Stakeholders report that the UK is not perceived as a meaningful geothermal opportunity due to the lack of clear market and policy signals and a visible project pipeline.

The North Sea Transition Authority (NSTA) currently hosts a decommissioning dashboard[50] and Energy Projects Pathfinder that provide industry with forward visibility of upcoming projects. The dashboard aggregates data on the location, scale, indicative timelines and project status of offshore decommissioning activity, enabling supply chain companies to understand future demand and plan workforce, investment and partnerships accordingly. The NGC is working with NSTA to increase the number of geothermal projects included on the Pathfinder as this provides a useful, known existing platform through which a geothermal pipeline could be developed.

Stakeholders consistently report that this transparency has material value for business planning, reducing uncertainty and helping firms remain engaged in the UK market. A comparable approach for geothermal could be established relatively quickly and would represent a low-cost, high-impact intervention. This is something that the NGC is currently exploring with the NSTA.

[47] Utah FORGE | Frontier Observatory for Research in Geothermal Energy
[48] FeTu Roticulate
[49] Scotland's Geothermal Supply Chain Analysis and Global Market Opportunities Study
[50] Projects - Energy Pathfinder

For the pipeline to be meaningful, it should be linked with agreed targets (recommendation 2) with more detail provided on the number and type of projects envisaged each year, the indicative drilling depths and energy outputs and cumulative capital and investment and exposure profiles. This detail, which NGC is preparing, is important for engaging insurers and underwriters. Visibility on drilling activity, cumulative exposure and increased learning gained as more wells are drilled will be essential to reduce risk premiums and increase the availability of drilling insurance. A credible pipeline will also support licensing and permitting functions. Organisations such as the British Geological Survey and academic partners can play a critical role by aligning subsurface data, research outputs and demonstration activity with pipeline priorities.

The remits of the NGC with respect to the pipeline could include:

- Stewardship of the pipeline and associated data
- Convening industry, academia and local authorities around upcoming schemes; this links to Recommendation 9 and case studies and site visits as part of awareness raising
- Using the pipeline to inform sector needs including skills planning, standards and research priorities.

By making future projects visible and investable, a geothermal pipeline would help to:

- Retain and repurpose existing UK subsurface capability.
- Crowd in supply-chain investment and finance.
- Accelerate learning and cost reduction.
- Present geothermal as a credible, scalable component of the UK's net zero and heat decarbonisation strategies.

A UK geothermal pipeline would provide a market-creation mechanism that connects targets, delivery capacity and confidence across the geothermal ecosystem.

Expected Outcomes

The expected outcomes from adopting these recommendations include better identified areas of energy demand and gaps in subsurface data for the UK. This will support more efficient project screening and selection, improve project success rates while reducing project risks and uncertainty. This will create a transparent and investable geothermal market capable of attracting private capital at scale where project development and deployment are tracked.

Challenge 5: Infrastructure Integration

Expanding and modernising the UK's heat networks and access to electricity grid connections is critical for unlocking geothermal potential at scale. The UK has some of the longest lead times for electricity connections in Europe which increases investor uncertainty. To successfully deliver on energy security and decarbonisation goals, future heating infrastructure must enable the seamless integration of geothermal heat sources especially in densely populated urban and industrial areas, where district heating is most cost-effective.

As of 2026, heat networks account for the supply of just over 3% of UK heat demand but are targeted to supply 20% by 2050. The expansion of these networks through the Green Heat Network Fund (GHNF), Ofgem regulation, and local authority-led heat zoning is expected to catalyse demand for stable, low-carbon heat, including geothermal. Timescales for grid connections for geothermal projects must be reduced. The main infrastructure requirements include:

- **Connection Points:** Geothermal plants can interface with both high-temperature (as at Gateshead in the UK) and low-temperature (as at Heerlen in the Netherlands) heat grids. Flexible interface technologies are required to accommodate variable output temperatures and optimise system performance.
- **Network Resilience:** Integrating geothermal with short-term (buffer tanks) and long-term (seasonal aquifer or mine water) storage enhances system flexibility and security.
- **Grid Digitalisation:** Investment in digital twins, smart metering, and intelligent load management will be key to fully capturing the value and flexibility of geothermal within evolving, decarbonised heat network architectures.
- **Urban Integration:** Mine water schemes, open and closed-loop geothermal systems are well-suited for cities, offering opportunities to repurpose brownfield sites, existing infrastructure, and legacy pipework with minimal surface disruption.

Geothermal development can capitalise on the UK's legacy infrastructure, deriving value from stranded or disused assets:

- **Repurposed Wells:** Hundreds of former oil, gas, and mining wells present opportunities for rapid, low-cost deployment of closed-loop and mine water schemes (e.g. Kirby Misperton).
- **District Heating Retrofitting:** Existing gas or CHP-based networks can be progressively decarbonised using geothermal heat as baseload, minimising stranded asset risk and cost for consumers.
- **Urban Brownfield Redevelopment:** Brownfield sites, including former industrial estates and mines, can host geothermal plants and become centres for local heat network expansion and new commercial or residential developments.

Recommendation 13 – Integrate geothermal with heat networks (timeline 2026–ongoing)

Most UK homes are heated by gas[51], heating accounts for about half of the UK's energy use and about one third of greenhouse gas emissions. Building heating alone is responsible for around 37% of UK gas consumption (around 250 TWh). Total final heat demand for buildings, industry, and public sectors is historically around 500–600 TWh/year, though this varies with weather and efficiency trends. If heat networks were recognised as utilities, as water companies and power-network operators are, this would help to accelerate build-out.

Presently, the UK's heat market remains dominated by fossil fuels but heat from electricity is expected to see significant future growth because of policies to reduce gas and oil boiler installations in new homes and tightening building standards. The UK's ageing building stock presents a retrofit challenge, while new-build regulations drive adoption of low-carbon heating from the outset.

The UK government has set a target for 20% of heat to be delivered through heat networks by 2050[52]. Presently around 3% is supplied in this way. The UK currently has around 12,000 registered heat networks with an installed capacity of 17.4 GW; around half of these are less than 2 MW installed capacity. As of 2022 there were 57,668 connections of which 88% (50,857) are residential[53]. The government has also identified heat-network zones with strong potential. This work should be extended to assess the potential for geothermal to supply these zones and to retrofit existing schemes, as demonstrated at Gateshead and Southampton.

Current statutory and funding support aims to transform the market: the Green Heat Network Fund (£288M for 2022–2025), new zoning regulations, Ofgem regulation from 2025, and local authority-led strategy and delivery. In terms of market segmentation:

- **Residential:** Heat network uptake is expanding in new build and large refurbishment schemes, driven by planning and efficiency rules
- **Commercial/industrial:** Non-domestic heat networks are growing fastest, as commercial and industrial users seek to reduce energy costs and emissions and benefit from economies of scale
- **Public sector:** Central and local government, along with the NHS, are anchor users for many heat networks

In addition to the discrete markets identified above there are also opportunities for industrial symbiosis, whereby clusters can source process or low-grade heat from geothermal, improving competitiveness, reducing emissions, and opening pathways for hydrogen production and other clean industrial processes. Challenges to heat network growth include:

- High upfront infrastructure investment, with uncertainties around connection costs and guarantees, regulatory requirements, and load growth
- Retrofitting legacy heat networks to accommodate lower-temperature geothermal input may require upgrades to pipework, pumping systems, and customer interfaces

[51] English Housing Survey 2023 to 2024: low-carbon technologies in English homes - fact sheet - GOV.UK
[52] Heat networks - GOV.UK
[53] Heat Networks registered under the Heat Network (Metering and Billing) Regulations - GOV.UK

- Ensuring interoperability (standards, data protocols, flow/temperature controls) across a patchwork of local networks is essential for scaling national geothermal integration
- Balancing baseload supply from geothermal with the variable and distributed nature of other renewables and user demand requires sophisticated grid management

UK heat demand is large and dominated by gas (600 TWh p.a.). Heat networks and heat pumps will become increasingly important as regulation accelerates the shift to low-carbon heat. Geothermal can benefit from policy changes, network expansion and demand for secure baseload heat. Capturing urban and industrial opportunities will require technical innovation, effective risk reduction, appropriate finance and sustained public-sector leadership.

Geothermal scale-up depends on coordinated heat-network development, flexible thermal storage and smart digital operations. Retrofitting networks and repurposing legacy wells and mines could deliver rapid, cost-effective gains. Investment in digital tools and storage would help optimise baseload geothermal alongside variable renewables and changing demand. Policy should support integration, retrofits and cross-sector collaboration so that geothermal can become an important part of the UK's low-carbon heat transition. In addition to assessing the potential to retrofit geothermal to existing heat networks and use it as the energy source for new networks, there is also a need to commission standardised heat offtake and project documentation templates (anchor heat contracts, interface terms with heat network operators, monitoring and reporting) to support developers, operators and end users.

Recommendation 14 – Electricity system integration (timeline 2026–ongoing)

Most UK geothermal projects focus on heat, but they can offer several benefits to electricity networks, especially when combined with underground thermal energy storage. First, geothermal systems that use heat pumps to raise temperatures generally achieve higher coefficients of performance than air-source heat pumps, reducing the associated electricity demand. Cooling loads can also be met with far lower electricity demand than conventional chillers also avoiding the capital costs of chillers. Direct-use geothermal systems require still less electricity because the abstracted water is warm enough for use in a heat network without a heat pump to boost temperatures. Secondly, some deeper geothermal systems for example, the United Downs plant in Cornwall produce continuous, predictable and controllable electricity and increase the amount of low-carbon generation flowing through the electricity network, aligning with government ambitions to become a clean energy superpower and for green electricity by 2035. Geothermal systems also have the potential to reduce peak demand stress and can offer curtailment by counteracting variability elsewhere e.g. by storing excess wind energy as heat within the subsurface.

Recent Contracts for Difference (CfD) awards demonstrate that geothermal electricity can participate directly in national power markets. The United Downs project currently supplies 3 MW of electricity with the aim of ramping up to 10 MW[54]. It will supply continuous electricity to the national grid under a 15-year CfD contract. To provide context, meeting the NGC target of 1.5 GW by 2050 would require 150 such 10 MW schemes in place by 2050. Geothermal projects are eligible for CfD but the NGC is aware that grid connection issues may limit pace of development in some areas. A need has been identified to examine potential geothermal power projects and assess grid connection capacities and timelines accordingly[55]. As the UK power system becomes increasingly dominated by variable

[54] https://gel.energy/about/united-downs/
[55] https://www.neso.energy/industry-information/connections-reform

renewables, geothermal offers a rare combination of 24/7 availability, long asset life, and compatibility with both centralised and decentralised energy systems.

Recommendation 15 – Sustainable industry and food production (timeline 2026–ongoing)

Geothermal offers a suite of heat and power generation opportunities that align closely with industry needs particularly for low- and medium-temperature heat and is proposed as a direct replacement for burning gas to produce heat. Around 70% of UK industrial energy demand is for heat[56]. It is responsible for around 14% of UK CO_2 emissions and a complex sector to decarbonise. Most industrial heat is provided at temperatures below 150°C. Ideal industries for targeting geothermal include, food and drink processing, chemicals and pharmaceuticals, paper, packaging and printing, warehousing and logistics and industrial estates and industrial clusters.

Some of the projects that use mine water heat demonstrate direct benefits to industry. Lanchester Wines, one of the UK's leading suppliers of wines and spirits, has invested in several low-carbon energy projects as part of their ethos to achieve carbon neutrality for the company. Their warehouses have been heated by geothermal energy derived from historically abandoned mine workings beneath the site since 2008 saving more than 600 tonnes per year in CO_2. For similar reasons GB Lubricants have connected to the Gateshead mine water heat network that has been operational since 2023. Connection to the scheme allows them to produce products with a lower carbon footprint. This has improved their sustainability credentials which has allowed them to win new business contracts. The NGC is also aware of interest from multinational companies wanting to make their UK operations more competitive by reducing energy costs which can inform decisions about whether to maintain a UK presence. Switching to geothermal offers energy-price stability and independence from geopolitical shocks and low operating costs (once the wells are drilled).

Research into heat pumps that can efficiently produce steam, together with advances in power generation from lower-temperature sources, is creating more geothermal opportunities for industries that require steam or on-site electricity generation. The International Energy Agency acknowledges geothermal as a strategic resilience technology for energy-intensive sectors[57].

Around 60% of all food consumed in the UK is produced indigenously[58] with around 40–50% imported. Import dependence is high for fruit and vegetables which are climate-sensitive imports and important for health. Energy is a binding constraint for UK horticulture with UK glasshouse growers (particularly for tomatoes, cucumbers, peppers and salads) facing significantly higher prices than their competitors in the Netherlands. Accelerating uptake of UK geothermal has the potential to address three challenges to UK food production:

- Seasonality – baseload weather-independent heat
- Energy costs – reduce reliance on gas imports, secure energy pricing
- Climate risk – glasshouses directly mitigate weather-driven yield losses

Low to medium temperature geothermal heat (20–90°C) is well suited to greenhouse heating as it can provide continuous, weather-independent baseload heat. The Netherlands, Austria, France and Belgium are embracing the use of geothermal to heat glasshouses for producing vegetables at scale. Iceland grows around 90% of its tomatoes using geothermal heat despite having a much harsher climate than the UK. There is an opportunity to decarbonise some of our food production while

[56] pathways-to-industrial-heat-decarbonisation.pdf
[57] IEA Geothermal | International Energy Agency Geothermal
[58] United Kingdom Food Security Report 2024: Theme 2: UK Food Supply Sources - GOV.UK

increasing output. The University of Lincoln has been exploring this by using a geothermally heated glasshouse to grow strawberries[59].To achieve maximum economic benefit and return on investment from geothermal assets, growing projects should be co-located with heat networks, sources of industrial waste heat and food hubs or agri-clusters. This enables heat cascading: the geothermal source can serve high-temperature applications first, then glasshouse heating and food processing. Each use is matched to the temperature required by the next user.

Recommendation 16 – Data centres and AI growth (timeline 2026–ongoing)

The UK has the largest AI sector in Europe and one of the largest globally. During 2023–2024 this sector supported around 50,000 jobs and generated around £4 billion GVA[60]. Key constraints for this sector include power, land, cooling and grid capacity for data centres. Electricity supply is already limiting new AI projects particularly in London and the South East[61] and some developers are installing gas engines rather than wait for grid connection lead times. Geothermal can alleviate some of these challenges through production of electricity, provision of fluids for cooling, use of waste heat, potential for thermal storage and co-location of data centres with heat networks presenting symbiotic opportunities for heat supply and storage.

Data centres operate at high load factors commensurate with geothermal power systems which have higher capacity factors than wind or solar power systems. Cooling is also an important consideration accounting for 30–40% of total data-centre electricity demand[62]. Data centres produce substantial heat, meaning that geothermal systems can act as thermal bridges by capturing waste heat from AI facilities and exporting it to nearby heat networks, industry or greenhouses[63]. Elsewhere in Europe data centres are increasingly integrated into geothermal heating and cooling networks. For the UK this could link AI growth zones to local economic value and support place-based approaches to decarbonisation. Geothermal increasingly interests AI developers because of its low visual impact and potential to reduce surface-water demand for cooling.

In 2023, Fervo Energy successfully tested a 3.5 MW deep enhanced geothermal system that supplies local electricity grids and Google's data centres in Nevada, demonstrating the potential of geothermal for this application.[64] The UK geothermal electricity potential is more limited than the western US, learning from this project is being taken forward by Cornwall Council who see similar opportunities for their region and similar deep geothermal projects targeted near AI hubs could provide baseload power, help to de-risk grid connections and facilitate earlier rollout of AI infrastructure. Where geothermal electricity generation is not an option, geothermal cooling can work almost anywhere. Shallow geothermal sources and mine water are well suited to heat-rejection and cooling systems. Data centres may also offer long-term investments which could be well matched to geothermal.

Expected Outcomes

The expected outcomes from adopting recommendations within this challenge would position geothermal as a core part of UK energy, industrial and digital infrastructure contributing to both food and energy security with more homes, businesses and public estates connected. This would reduce business costs and improve business competitiveness.

[59] The Princess Royal Opens First-of-its-Kind Glasshouse to Grow the Future of UK Food | News and Press | University of Lincoln
[60] https://www.gov.uk/government/publications/artificial-intelligence-sector-study-2024/artificial-intelligence-sector-study-2024
[61] https://www.theguardian.com/technology/2026/feb/23/new-datacentres-risk-doubling-uk-electricity-use-ofgem-peak-demand
[62] https://www.iea.org/reports/energy-and-ai/energy-demand-from-ai
[63] https://www.opencompute.org/documents/2025-03-18-ocp-heatreuse-wp-referencedesigns-v0-1-pdf
[64] https://www.thinkgeoenergy.com/fervo-and-google-geothermal-power-facility-starts-grid-supply/

Key recommendations and conclusion

The UK has a significant opportunity to transform geothermal energy from a largely overlooked resource into a strategic national asset that strengthens energy security, supports economic growth, and accelerates the transition to heat and power decarbonisation. This roadmap demonstrates that the challenge facing geothermal development in the UK is not one of resource availability or technological readiness, but of policy, market, regulatory and delivery coordination. The UK possesses abundant geothermal resources, extensive transferable skills from the oil, gas and mining sectors, world-class research capability, and a growing number of successful commercial projects that prove geothermal can deliver reliable low-carbon heat and electricity now.

The case for action is compelling. Geothermal offers secure, indigenous, price-stable energy that can reduce dependence on imported fuels, particularly LNG, while supporting the decarbonisation of heat, industry, housing and public services. Unlike many emerging energy technologies, geothermal is deployment-ready and capable of providing continuous energy over decades. It complements other renewable technologies by supplying dependable baseload heat and power, reducing pressure on electricity networks and increasing the resilience of the wider energy system. At the same time, it presents a major opportunity to create jobs, retain critical engineering capability, regenerate industrial communities, and establish new export markets for UK expertise.

Drawing on lessons from leading geothermal nations such as Germany, France and the Netherlands, this strategy identifies five interconnected challenges for action: policy and regulation; market and finance; knowledge, education and skills; technology development and research innovation; and infrastructure integration. Progress across all five challenges must occur in parallel. No single intervention will unlock our geothermal nation. Success depends on creating a coordinated framework that reduces risk, builds investor confidence, develops markets, grows the workforce, and connects geothermal resources to the places where energy is most needed. Three immediate asks emerge as the most critical near-term actions:

1. **UK government to back the national delivery of geothermal**
   Recognise and resource the NGC to lead geothermal coordination, adopt this strategy and targets with accountable delivery arrangements.
2. **Unlock the first wave of investment**
   Commission a costed exploration-risk pilot, with eligibility, financial limits and evaluation criteria.
3. **Create demand and a credible pipeline**
   Assess geothermal for suitable heat network and public-estate projects; showing each project’s development stage, opportunities and barriers.

Progressing these recommendations would provide the foundations for a self-sustaining sector that would send a strong market signal that geothermal is a strategic component of the UK's future energy system and create the conditions necessary for private investment to flow at scale.

The ambition outlined in this roadmap is both substantial and achievable: delivering 10 GW of geothermal heat and 1.5 GW of geothermal electricity by 2050. Achieving this vision would provide low-carbon heat for millions of homes, strengthen national energy resilience, support tens of thousands of skilled jobs, reduce emissions, and create lasting economic value across every region of

the UK. Importantly, it would help secure a just transition by providing a future for workers and supply chains currently serving the oil and gas industry.

The next two years will be decisive. By taking practical action now to establish governance, de-risk early projects, improve regulatory clarity and build market confidence, The UK can move from isolated geothermal successes to a coordinated national programme. Most of the recommendations are short-term and we propose the actions in Table 7 take priority over the next 12–24 months.

Geothermal will not deliver the UK's energy transition alone, but it can become a vital part of the solution. The opportunity is clear, the resource is proven, and the tools required to accelerate deployment are well understood. The task now is to act with the urgency and coordination needed to make geothermal a cornerstone of a secure, affordable and sustainable UK energy future.

Table 7 Mini roadmap detailing actions for the next 12–24 months

UK actions in the next 12–24 months (mini-roadmap)

0–6 months

- Establish a joint task group (DESNZ, devolved administrations, NGC, GHNF, NWF/GBE/BBB representatives, insurers/lenders) to agree the scope and delivery roles for the NGC as a geothermal delivery body.
- Agree targets and consult on and adopt a national geothermal strategy
- Develop a clear matrix for licensing different types of geothermal and identify gaps/ non-essential requirements – questioning what we need to regulate and identify responsible bodies
- Gather information on projects underway and develop a pipeline using existing routes where possible e.g. NSTA Energy Pathfinder
- Ensure that public finance routes (GHNF/NWF/GBE/BBB and regional programmes) align with a consistent geothermal project pathway and publish an investor-facing pipeline of funded and investable projects.

6–12 months

- Explore options for a national geothermal risk insurance/guarantee scheme (eligibility, performance triggers, coverage %, underwriting, data requirements) and identify a pilot portfolio.
- Undertake UK skills and capabilities assessment in terms of drilling capacity and workforce capacity
- Propose a clear and bespoke licensing and permitting framework for different geothermal deployments
- Stand up a staged geothermal development fund with clear gateways (screening → feasibility → permitting/FEED → drilling readiness) and transparent appraisal criteria.
- Publish minimum data capture and reporting requirements for publicly supported wells (including confidentiality periods and release timetable).

12–24 months

- Launch a risk guarantee pilot and associated technical assurance process, aligned to a small number of “first wave” projects.
- Review and reassess training provision at all levels, identify training targets and develop new programmes to address gaps.
- Establish routes to crowd in commercial reinsurance as the portfolio grows.
- Agree a UK-wide data sharing/ reporting/assessment standard for geothermal resources and performance, with independent technical assurance and lender/insurer-aligned due diligence.