National Geothermal Centre

Our Geothermal Nation

A strategic roadmap for accelerating geothermal energy across the United Kingdom

Recommendations and actions to accelerate the deployment of geothermal energy

Prepared by

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The National Geothermal Centre, 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 over 30 NGC champions from across the sector working under our thematic areas to gather evidence and accelerate our deployment ambitions.

Durham University · REECE FOUNDATION · Net Zero Technology Centre · shift GEOTHERMAL

Key ambition

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

10 GW

Geothermal heat

Enough to supply the equivalent of around 4 million homes.

1.5 GW

Geothermal electricity

Enough to supply the equivalent of around 3 million homes.

"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)

Executive summary

The UK hosts significant geothermal resources capable of supporting both heat supply and power generation, alongside cooling and energy storage opportunities. The National Geothermal Centre (NGC) roadmap sets out a delivery programme comprising 16 recommendations within five thematic areas. The NGC proposes three immediate asks to kickstart our geothermal nation. With commercial-scale projects already operating across varied UK geologies, geothermal is proven and ready to scale, has a technology readiness level (TRL) of 8–9 and offers:

- Secure, home-grown heat, cooling and electricity, reducing reliance on imported gas.
- Continuous, predictable energy with high availability and long asset lifetimes.
- Stable long-term prices with minimal land take and visual impact.
- A practical route to decarbonise heat for industry, buildings and public estates.
- Regional growth, workforce transition and up to 50,000 direct and 125,000 indirect jobs supported by the sector by 2050.
- Improved balance of payments and export potential through avoided gas imports and UK supply chain expertise.

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

Energy security

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 gigawatt (GW) heat scenario, geothermal could displace about 82 terawatt-hours (TWh) of gas input to 85% efficient boilers, equivalent to roughly 7.5 billion cubic metres and around half of 2025 LNG inflows in energy terms. Following Russia's invasion of Ukraine in 2022, the UK spent around £50 bn on gas imports*. Increased geothermal uptake could therefore improve the UK's balance of payments and strengthen energy security.

Economic growth

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 from an industry that contributes around £25 bn a year 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 produces around 2.1 TWh (0.3%). Geothermal is one of the few proven technologies capable of providing large-scale, low-carbon baseload heat. The UK's largest geothermal heat network at Gateshead provides heat to its customers at a price at least 5% below the equivalent market gas tariff.

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; publish a pipeline showing each project's development stage, opportunities and barriers.

Why the NGC?

- NGC is an independent, not-for-profit organisation working across all four nations of the UK.
- NGC has strong founding partners with long-standing expertise in innovation and the energy transition.
- NGC has developed this strategy drawing on experience, conversations and collaborations across the sector spanning several decades.
- NGC is supporting the delivery of live geothermal projects including the universities of York, Aberdeen and Durham and Auckland Castle.
- With support, NGC will deliver a geothermal development plan for the UK within a year of the strategy launch.

Sources: * Energy and Climate Intelligence Unit (ECIU): eciu.net · ** The OEUK Economy & People Report 2024: oeuk.org.uk/product/economy-people-report-2024 · *** Digest of UK Energy Statistics (DUKES): gov.uk/government/collections/digest-of-uk-energy-statistics-dukes

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 linked with geothermal projects having high upfront risk and CapEx but low OpEx once commissioned. International experience shows 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. Current UK geothermal installed capacity is around 1 GW for heat, mostly from shallow ground-source heat projects, and 3 MW for electricity. This represents less than 0.5% of the estimated resource in place, yet geothermal could heat and power millions of homes. The following actions could reduce uncertainty and delays that discourage investment:

- Explicit government commitment to or recognition of geothermal potential by adopting a national strategy and agreeing deployment targets
- Creation of a skilled workforce and supply chain capable of delivery at scale from vocational to professional roles
- Accelerated deployment by streamlining project approvals and recognising geothermal projects as national infrastructure projects
- Crowding in private investment by sharing early-stage geological risk and improving revenue confidence
- Supporting local communities, public estates and industrial users to benefit from the secure, affordable and low-carbon energy provided by geothermal heat

> "The UK has geothermal resources of national significance. It is a proven, ready technology and market demand is growing. The challenge is not its technical feasibility – rather its deployment environment."

National Geothermal Centre

Recommendations

01

Recognise and resource NGC as the national geothermal delivery body

With an appropriate mandate and resources, NGC would:

- Coordinate policy and licensing reform
- Oversee investment and support programmes
- Undertake due diligence on proposed projects
- Track delivery and maintain sector reporting

02

Adopt a national geothermal strategy and deployment targets

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 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 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

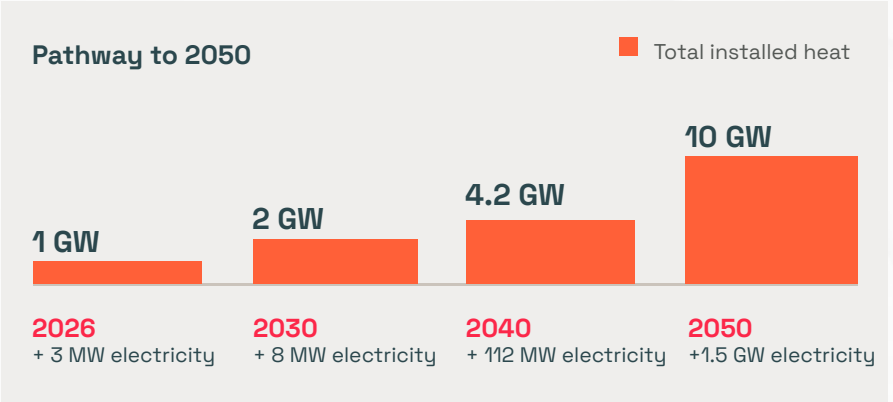
A roadmap is also required that integrates geothermal with heat networks including annual progress reporting linked to the project pipeline.

03

Create dedicated licensing and permitting routes

Explore the costs and benefits of introducing:

- A coordinated route through existing permissions, with clear guidance and timescales
- Clarity on subsurface rights and protection of investment
- Requirements proportionate to project size and risk
- Contractor competence, monitoring and environmental safeguards



Expected outcomes

Greater investor confidence

Faster project delivery

Improved coordination across government

Challenge 2

Market and finance

One of the UK Government's missions is to kickstart economic growth. Geothermal can be commercially viable and competitive with other renewable technologies. Gateshead Energy Company provides 6 MW of geothermal heat to its customers at a price at least 5% below the equivalent market gas tariff.

The highest risk and cost phase of many geothermal projects is drilling and proving the resource, especially at the first well. Government should design a portfolio-based exploration-risk mechanism, potentially combining stage-based recoverable grants, contingent loans, guarantees or insurance. Finance should be aligned with existing public investment routes, including the Green Heat Network Fund, the National Wealth Fund and Great British Energy. The principal barriers to geothermal uptake are not resource availability or technological readiness. Investors lack confidence because of:

- High upfront drilling costs
- Geological uncertainty
- Limited risk-sharing and licensing mechanisms
- Uncertain long-term revenues

National Geothermal Centre

Recommendations

04

Create risk-sharing and development finance mechanisms

The UK should explore:

- **Geothermal risk insurance –** to reduce first-well risk through government-backed guarantees
- **Revenue support –** to develop heat market mechanisms that create predictable revenues
- **Development funding –** to agree where finance is most needed e.g. resource assessment and data acquisition, permitting, commercialisation, front-end and topside engineering
- **Technical and commercial milestones –** for different project stages aligning these with investor needs

Public finance alignment

Review, coordinate and align geothermal projects to maximise support from existing initiatives such as:

- **Great British Energy –** extend its remit to include geothermal heat projects
- **National Wealth Fund –** develop portfolios of projects to spread risk and increase ticket size
- **Green Heat Network Fund –** ensure alignment with geothermal as an energy source
- **Contracts for Difference –** ensure that the scheme reflects the characteristics of geothermal electricity projects

05

Assess national economic opportunity

In order to highlight the economic value of our geothermal nation and to convince government and investors the UK should:

- Evaluate potential for jobs created and retained (both direct and indirect per MW installed)
- Estimate supply chain value
- Calculate gross value added
- Highlight and promote regional and local benefits

06

Develop an export strategy

As part of UK aspirations to become a clean energy superpower, geothermal can take advantage of the UK's extensive subsurface skills and knowledge to position the UK as a leader in:

- Mine water geothermal
- Heat network integration
- Geothermal plus oil and gas supply chain consulting and services
- Geothermal drilling

Expected outcomes

Significant private capital investment

New UK export opportunities

Regional regeneration

Challenge 3

Knowledge, education and skills

Expansion of the UK's geothermal sector aligns with government missions to break down barriers to opportunity and be a clean energy superpower. The UK risks losing thousands of experienced energy-sector workers during the energy transition and needs to attract young and early-career people to the sector, particularly for vocational roles that are estimated to account for 75-80% of the workforce. Geothermal provides one of the strongest opportunities for retaining transferable skills as our oil and gas sector transitions. It also creates a need to train additional skilled people to deliver the topside infrastructure, particularly for heat networks.

50,000

Direct jobs supported by 2050

Recommendations

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07 Develop skills and transition programmes

Building a geothermal sector presents a clear opportunity to retain skills developed through the UK's long association with energy innovation, particularly in north-east Scotland. Based on comparable analysis of the petroleum sector, NGC estimates that the geothermal workforce could comprise approximately:

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

To realise this opportunity, we now need:

- Accredited conversion training
- Apprenticeships
- University modules
- National secondment programmes
- Professional certification schemes

09 National awareness and engagement programme

Build public awareness through:

- **Project case studies**
- **Community engagement**
- **Education campaigns**
- **Industry showcases**

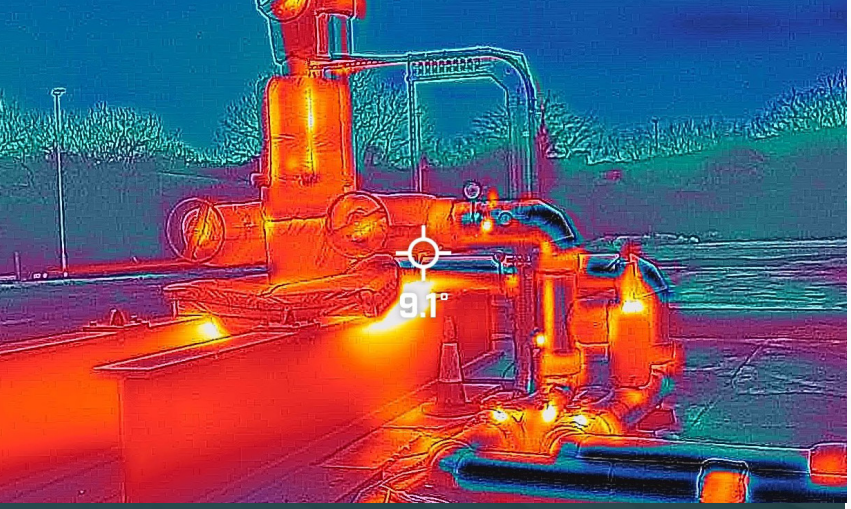
08 Establish regional centres of excellence

The NGC plans to support regional centres of excellence, selected for their areas of expertise. The centres of excellence 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, support innovation, enable faster replication of project models, and improve quality assurance through shared standards, templates and lessons learned. The table below shows an illustrative list of potential regional centres:

Region	Focus
Cornwall	Deep geothermal drilling, lithium recovery, power generation
North East England and North Yorkshire	Former mining and petroleum infrastructure reuse
Scotland	Supply chain and workforce transition and technology testing
Northern Ireland	Engagement and awareness and licensing and regulation

Expected outcomes

- **A successful geothermal sector that supports up to 50,000 direct jobs by 2050**
- **Securing long-term opportunities for workers transitioning from traditional energy sectors**
- **Increased demand for geothermal and improved public acceptance and understanding**
- **Established centres of excellence where people can train and build capacity**



Challenge 4

Technology development, research and innovation

The UK possesses a longstanding and strong research, innovation and technology development capability but relatively few commercial geothermal projects. Innovation must now focus on deployment and scale. Most geothermal applications have already reached a high level of technological readiness (TRL 8–9). However, deployment is constrained by the investment environment, uneven availability of subsurface data, limited standardisation and difficulties in selecting the most appropriate geothermal technology. Better data does not remove all geological risk, but it can reduce uncertainty and improve the quality of early decisions. The following recommendations would strengthen the national evidence base, reduce uncertainty and increase investor, operator and user confidence.

Recommendations

National Geothermal Centre

10
Create open access resource mapping

Build on and open up existing datasets to:

- Undertake a gap analysis and identify data-acquisition requirements, including the use of AI
- Develop domestic and commercial heat demand overlays
- Enhance screening tools such as the BGS UK Geothermal platform
- Promote open data access, building on successful practice in the Netherlands

11
Establish a technology development fund

Although most geothermal deployments have relatively high technology readiness (TRL 8-9), it is important to optimise and enhance existing practice including:

- Lower-cost and faster drilling
- Reservoir enhancement techniques
- Advanced real-time monitoring and feedback
- Heat network integration and optimisation
- Thermal storage and cascade use of geothermal
- Priority should be given to deployment ready technologies that will help build investor confidence and grow the market.

12
Create a national project pipeline

There are several commercial-scale geothermal projects operating across the UK, with many more in development. A visible project pipeline not only supports business planning by highlighting the size of the market but is also essential for:

Investors & Insurers

Supply chains

Local authorities

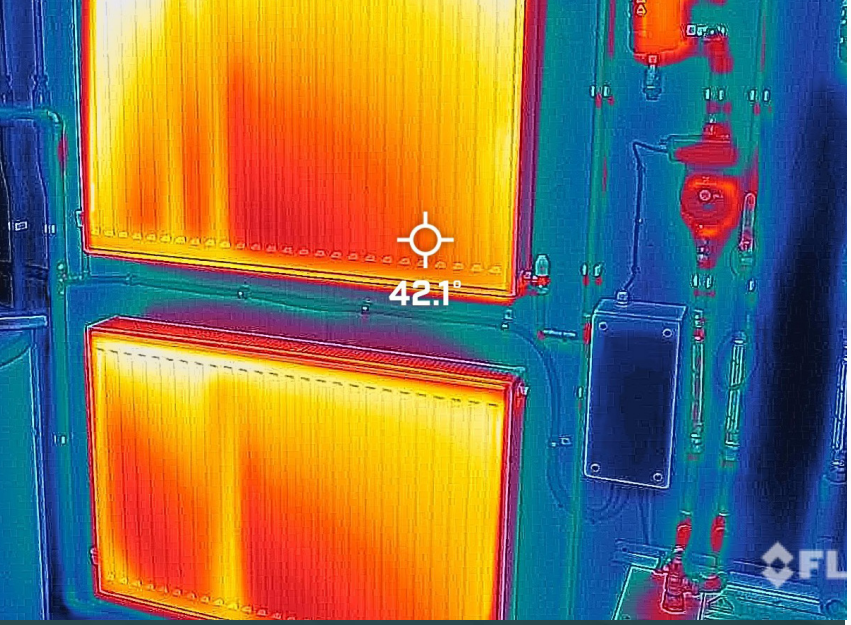
Expected outcomes

Areas of demand identified and gaps in data elucidated

Enhanced project screening and selection reduces risk and uncertainty, improving project success rates

A transparent and investable geothermal market capable of attracting private capital at scale

Project development and deployment are tracked to highlight opportunities and progress



Challenge 5

Infrastructure integration

Geothermal can only scale if connected effectively to heat and power infrastructure.

20%

UK government target for heat supplied via heat networks by 2050

2030

The UK's target year for delivering a clean power system

Recommendations

13
Integrate geothermal with heat networks

Geothermal will scale fastest where there is strong local heat demand. Heat networks are therefore central to geothermal deployment, particularly in dense urban areas, public estates, hospitals, universities, social housing, industrial parks and new developments. This opportunity aligns with UK government targets to supply 20% of heat via heat networks by 2050.

Priority markets to be explored include:

- Residential developments
- NHS estates
- Universities
- Local authorities
- Social housing
- Industrial parks

14
Electricity system integration

The UK aims to deliver a clean power system by 2030. Geothermal electricity could support this ambition by providing:

- Consistent, low-carbon energy at stable prices
- Grid resilience
- Reduced peak demand
- Thermal storage opportunities

15
Sustainable industry and food production

Explore how geothermal can help industry to produce products more sustainably using lower-carbon, stably priced energy across the following sectors:

- Manufacturing
- Warehousing
- Commercial horticulture
- Chemicals
- Food processing

16
Data centres and AI growth

AI is a fast-growing sector in the UK and will require new data centres. The potential for geothermal to support these facilities should be evaluated, including through:

- Cooling
- Power generation
- Heat recovery
- Thermal storage

Expected outcomes

Reduced business costs and improved business competitiveness

Geothermal becomes a core part of UK energy, industrial and digital infrastructure

Geothermal contributes to food and energy security

Public buildings and estates have adopted geothermal

More homes connected to geothermal heat networks

Key recommendations and conclusion

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.

The case for action is compelling. Geothermal offers secure, indigenous, price-stable energy that can reduce dependence on imported fuels, while supporting the decarbonisation of heat, industry, housing and public services. 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.

The missing component is the development and coordination of a supportive and investable deployment environment.

This strategy roadmap provides a practical, affordable and achievable pathway to unlock geothermal at scale. The proposed deployment of 10 GW of geothermal heat and 1.5 GW of geothermal electricity by 2050 would strengthen national energy security, attract investment, support economic growth and create tens of thousands of skilled jobs across the country. We propose the following actions to progress the three immediate asks and begin delivering the 16 recommendations over the next 24 months:

0–6 months

- Establish a geothermal task group to agree and form NGC as a delivery body
- Agree NGC's mandate and national delivery arrangements
- Evaluate a risk guarantee scheme and technology fund

6–12 months

- Launch first-well guarantee pilot and technology development fund
- Publish national reporting standards
- Create standardised project documentation

12–24 months

- Scale support programmes
- Align public finance programmes
- Design workforce training at all levels
- Publish investor-facing project pipeline

The National Geothermal Centre is already acting as the UK's focal point for geothermal knowledge, evidence, stakeholder engagement and project development. With the appropriate mandate and support, the NGC is ready to lead the national geothermal delivery function, coordinating many of the actions outlined in this roadmap and accelerating progress towards a secure, affordable and resilient energy future.

The resource is proven. The technology is ready. The need to increase energy security is pressing. The time to build our geothermal nation is now.