INNOVATION & RESEARCH CAUCUS

UNLOCKING THE UK'S CRITICAL MINERALS POTENTIAL:

Identifying and overcoming non-technical barriers in the domestic critical mineral sector

IRC Report No: 047

REPORT PREPARED BY

Laura Smith
Sustainability Research Institute, University of Leeds

Alice Owen
Sustainability Research Institute, University of Leeds

Taija Torvela
Institute of Applied Geology, University of Leeds

James Van Alstine
Sustainability Research Institute, University of Leeds

Delivered with ESRC and Innovate UK

Authors

The core members of the research team for this project were as follows:

- Laura Smith - Sustainability Research Institute, University of Leeds
- Alice Owen - Sustainability Research Institute, University of Leeds
- Taija Torvela - Institute of Applied Geology, University of Leeds
- James Van Alstine - Sustainability Research Institute, University of Leeds

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Executive Summary

Critical minerals such as lithium, tin and nickel are essential to the UK's transition to net zero and to the production of low-carbon technologies including electric vehicles, renewable energy systems and energy storage. While the UK has geological potential and a long history of mining, it currently produces none of the critical minerals it relies on. This study finds that the primary constraints on domestic production are not technical, but are institutional, regulatory, social and economic. Unlocking the UK's critical mineral capacity therefore requires an innovation ecosystem in which governance, regulation, finance, skills, infrastructure, communities and environmental safeguards are aligned to support responsible development and long-term investment.

The research identified **eight interconnected non-technical barriers** that shape and constrain domestic critical minerals exploration and production:

- **Mineral rights complexity and land access** – fragmented and often unregistered mineral rights increase the cost, time and uncertainty of assembling exploration land packages, while companies must negotiate multiple land access agreements even where rights are secured.

- **Fragmented and ambiguous regulatory landscape** – developers must navigate multiple regulators and poorly coordinated permitting processes, while inconsistent interpretation of permitted development (GPDO) rules creates uncertainty around regulatory pathways.

- **Planning bottlenecks and uncertainties** - mineral planning authorities are under-resourced and often lack specialist expertise, leading to unpredictable timelines and uncertainty in planning decisions.

- **Infrastructure, energy costs and processing limitations** – the UK lacks domestic refining and processing capacity, while high electricity costs and constraints in grid, transport, housing and other infrastructure limit project competitiveness and regional preparedness.

- **Finance, investment and market risk** – early-stage exploration faces funding gaps, while regulatory uncertainty and high operating costs reduce the attractiveness of the UK as an investment jurisdiction.

- **Skills and capacity gaps** - shortages of mining engineers, geologists, mineral planners and regulatory specialists persist, and small firms lack capacity to train apprentices.
- **Community opposition and social licence to operate** – community support for exploration and mining projects varies significantly, and misunderstandings about modern mining and legacy impacts can generate opposition.
- **Environmental regulatory uncertainty and long-term obligations** – existing environmental frameworks are not always well aligned with modern mining techniques, creating uncertainty around waste management, closure and long-term environmental responsibilities.

These findings are drawn from in-depth qualitative evidence from three critical mineral industries – tin, geothermal lithium and nickel – and across two regions and governance systems – Cornwall (England) and Aberdeenshire (Scotland).

The report identifies the following **priority areas for action**, synthesised from the mitigation actions presented in Section 7.

- **Develop a national framework for critical minerals** to improve policy coherence, clarify regulatory responsibilities and reduce investor uncertainty.
- **Improve transparency and accessibility of mineral rights ownership**, including exploring options for a national mineral rights register and mechanisms to encourage or require registration, reducing the cost and time burden of assembling exploration land packages.
- **Strengthen planning and regulatory capacity and technical expertise** within local authorities and regulators.
- **Clarify regulatory pathways for emerging technologies** including geothermal lithium and modern tin mining.
- **Provide targeted support for early-stage exploration** to reduce financial risk, support projects to progress and improve competitiveness.

- **Ensure access to cost-competitive, low-carbon electricity for critical minerals extraction and processing**, recognising that high UK energy costs undermine the viability of energy-intensive mining and processing activities.
- **Invest in infrastructure and domestic processing capacity** to address midstream gaps, support regional preparedness and strengthen UK critical minerals supply chain resilience.
- **Strengthen social licence and enhance community engagement** through transparent, consistent and meaningful two-way engagement practices that ensure local people's voices are heard.

Progress across these areas will require coordinated commitment from national and local government, regulators, industry bodies, skills providers and local communities.

The findings and recommendations for mitigation actions provide evidence-based insights which can support delivery of the UK Government's Critical Minerals Strategy 2025. By addressing non-technical risks while strengthening social and environmental safeguards, the report demonstrates that ambitions for UK critical minerals supply resilience can be realised alongside responsible development, public trust and long-term economic value.

Interactive Insights

Findings from this report have been brought to life in an interactive tool. This visualises the eight non-technical barriers using a dynamic chart, showing how each barrier manifests across different metals and regions and indicating relative risk levels from low to high. Click on each barrier to explore detailed insights. You can also explore the mining project lifecycle for each metal, with insights into how risks evolve at different stages and the mitigation actions that can support project development.

Explore the interactive model.

1. Introduction

Critical minerals - such as lithium, cobalt, nickel and tin - are integral to modern life, from powering the technologies we are reliant on, to advancing innovation in the transition away from fossil fuels towards clean sources of energy. The UK's Net Zero 2050 framework commits us to shift to renewable and low-carbon technologies, accelerating production of wind turbines, solar panels, electric vehicles and energy storage, all which need significant mineral and metal inputs (Blondeel et al., 2021). As the UK and other economies transition to low-carbon technologies, demand for critical minerals is increasing, with, for example, the UK's demand for lithium is predicted to grow by 1,100% in the next ten years (UK government, 2025). The EIA Global Critical Minerals Outlook 2025 showed that demand for key minerals is set to increase rapidly across all scenarios, with the largest source of growth in demand coming from the energy sector.

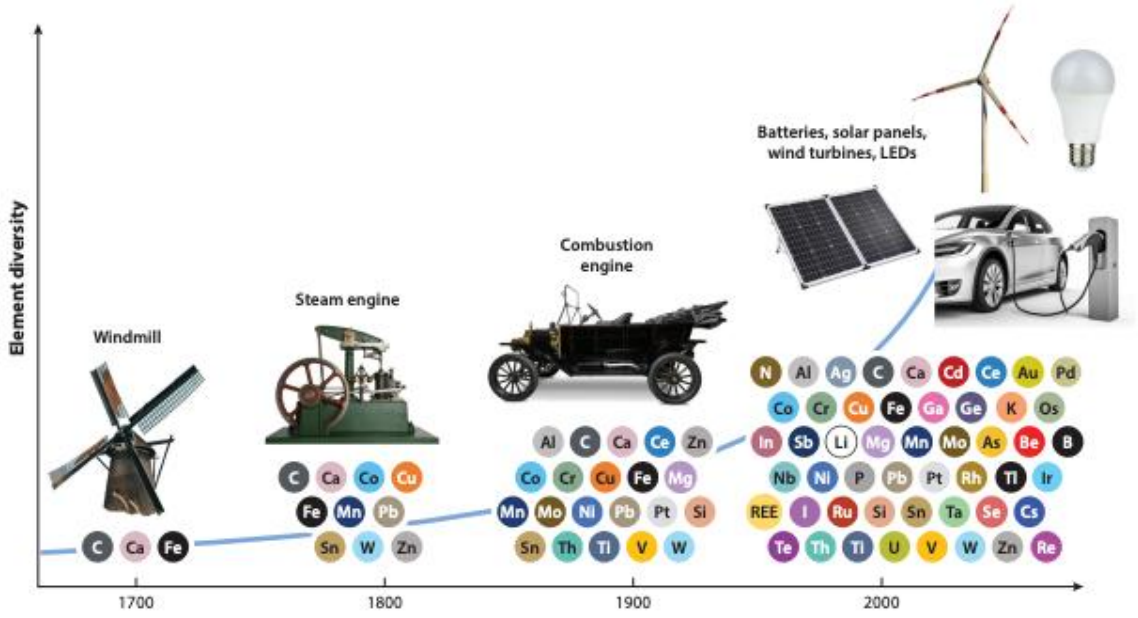

Figure 1 from Reich and Simon (2025) captures the evolution of energy technologies and the material diversity needed for advancing energy systems as we transition away from a reliance on fossil fuels. (REE refers to Rare Earth Elements).

These "critical minerals" or "critical materials" are defined by the UK as: "The minerals and metals with the greatest economic importance and the highest risk of supply disruption" (Mudd et al 2024: vi). The number of minerals and metals considered critical to the UK has

grown significantly in the last five years, with the most recent criticality assessment listing 82, up from 26 in 2021 (Critical Mineral Intelligence Centre, 2024).
At present, none of the critical minerals the UK relies on are produced in the UK; they are sourced from mines around the world, many of which are concentrated in geographical locations where geopolitical tensions can threaten supply chain security, and where there are often poor environmental and human rights standards. For example, 87% of the world's cobalt (a key material for smart phones and EV batteries) is located in the Democratic Republic of Congo, where miners work in life-threatening conditions (Bazan Lopes, 2025). In the 'Lithium Triangle' in South America (Chile, Argentina, Bolivia) indigenous livelihoods are under threat from the sector's environmental impacts (Souza et al. 2025). Furthermore, Chinese companies control nearly half of global lithium production and 60% of electric battery production capacity (Heredia, 2020). Chinese dominance in critical minerals production has raised concerns about supply chain vulnerability, with countries such as the UK, USA and the EU focusing on building resilient supply chains and increasing domestic critical mineral capacities.

The UK government's ***Vision 2035: Critical Minerals Strategy*** (the principal national policy document for critical minerals development over the next decade) sets out a long-term ambition to secure critical minerals supply and reinforces the role of domestic production, stating: "To reduce our vulnerability, the UK will make strategic use of its own available mineral resources and capabilities" (Department for Business and Trade, 2025: n.p.). A key policy objective of the strategy is to optimise domestic production where it works for the environment and communities. Specifically, the UK's ambition is to produce at least 10% of annual UK demand for critical minerals domestically, including at least 50,000 tonnes of lithium (or lithium carbonate equivalent) by 2035 (UK government, 2025).

This research project is therefore timely. Although the technical challenges of building the UK's domestic capabilities in this vital area are largely known, the other elements of a healthy innovation ecosystem for critical minerals are less understood. While the UK has an extensive mining history and geologically has the potential to be prospective for many critical minerals, the UK is considered a challenging jurisdiction for minerals exploration (Colman, 2019). Drawing on in-depth qualitative evidence from across industry, local government, regulatory agencies and other key stakeholders, we shed light on the real-world experiences and challenges faced by industry in this sector. By exploring the non-technical challenges –

regulatory, environmental and social – we aim to improve understanding of these issues and identify ways to address them to strengthen the sector.

This report seeks to address three questions:

1. What are the non-technical constraints and risks in the UK domestic critical metals sector?

2. In what ways do these constraints and risks impact UK industry stakeholders for three exemplar metals: tin, lithium (geothermal) and nickel.

3. How can these non-technical constraints and risks be addressed to create an enabling environment for existing industry and for new investment in critical minerals production?

2. Approach

The findings and recommendations in this report are drawn from research carried out between February and July 2025. Following a desk review of academic and grey literature which mapped out the regulatory and planning context for critical minerals in the UK, we conducted field visits to Cornwall and Aberdeenshire. We carried out in-depth semi-structured interviews and group interviews with 17 participants across five critical mineral exploration companies, as well as local authorities, regulatory agencies, industry consultants and third sector organisations. Interviewees were selected through existing connections (e.g. industry stakeholders), and through convenience and snowball sampling. We chose case studies of mineral exploration in England and Scotland because the differences in legislative frameworks and planning systems allowed us to compare the UK mineral exploration landscape. Mineral exploration is at varying stages of development across the two regions, giving us the opportunity to understand challenges at different points in the exploration timeline. Cornwall has several exploration companies operating there, leading the media to claim there is a Cornish critical minerals 'rush' (Channel 4 news, 2024). In contrast, exploration in Aberdeenshire is at a much earlier stage. Three critical minerals that are on the UK critical minerals list are being actively explored for and / or developed by the companies in the study: tin, lithium (geothermal) and nickel.

Most interviews took place in person in the two field sites between May and July 2025 and lasted between 60 and 90 minutes. Three interviews were held online via Microsoft Teams. Interviews were transcribed and anonymised to protect identities and then analysed and coded.

Our thematic analysis distilled eight barriers which generate constraints and risk for the sector. We then developed risk profiles for each mineral and used the mining project lifecycle to highlight the most salient risks at different points in time.

The eight barriers are:

- **Mineral rights complexity and land access** – fragmented and often unregistered mineral rights increase the cost, time and uncertainty of assembling exploration land packages, while companies must negotiate multiple land access agreements even where rights are secured.

- **Fragmented and ambiguous regulatory landscape** – developers must navigate multiple regulators and poorly coordinated permitting processes, while inconsistent interpretation of permitted development (GPDO) rules creates uncertainty around regulatory pathways.

- **Planning bottlenecks and uncertainties** - mineral planning authorities are under-resourced and often lack specialist expertise, leading to unpredictable timelines and uncertainty in planning decisions.

- **Infrastructure, energy costs and processing limitations** – the UK lacks domestic refining and processing capacity, while high electricity costs and constraints in grid, transport, housing and other infrastructure limit project competitiveness and regional preparedness.

- **Finance, investment and market risk** – early-stage exploration faces funding gaps, while regulatory uncertainty and high operating costs reduce the attractiveness of the UK as an investment jurisdiction.

- **Skills and capacity gaps** - shortages of mining engineers, geologists, mineral planners and regulatory specialists persist, and small firms lack capacity to train apprentices.

- **Community opposition and social licence to operate** – community support for exploration and mining projects varies significantly, and misunderstandings about modern mining and legacy impacts can generate opposition.

- **Environmental regulatory uncertainty and long-term obligations** – existing environmental frameworks are not always well aligned with modern mining techniques,

creating uncertainty around waste management, closure and long-term environmental responsibilities.

Section 5 of this report is structured around these eight non-technical barriers. Rather than treating the barriers as isolated challenges, the analysis recognises that they are interconnected and often reinforce one another as projects progress. To highlight this, the report uses the mining lifecycle approach to map how the barriers manifest and present risks at different stages of the project cycle, as presented in Figure 2. For example, regulatory ambiguity may be a greater risk in the early stages of the project cycle (during early exploration) while infrastructure constraints and skills gaps become more salient in the development and operations stage of the project cycle.

Figure 2. The mining lifecycle showing where risks typically peak

Our analysis highlights the ways in which risks can vary across commodities and geographies. For example, tin, geothermal lithium and nickel projects face distinct regulatory, environmental and social challenges that are shaped by factors such as legacy mining, processing requirements and public perception. Regional contexts similarly influence how these barriers manifest and are managed in practice. This approach allows for clearer identification of where policy intervention, regulatory reform or institutional capacity building might be targeted to reduce risk most effectively and to facilitate investment into the sector while strengthening environmental and social safeguards.

3. Case selection

3.1 Regional focus of the study

Aberdeenshire

For the Scottish case study, Aberdeenshire was selected due to the team's awareness of nickel exploration currently taking place and existing contacts within the industry. According to the British Geological Survey, Aberdeenshire is one of the priority areas for mineral exploration and further investigation (Deady et al, 2023), with known nickel deposits and some indications of lithium and titanium deposits (Colman, 2019). In the 1970s, major mining companies Rio Tinto and Consolidated Goldfields undertook joint exploratory work (mapping and drilling) in the region but spent half of their £1 million exploration budget on legal costs due to the challenges of securing land access (Ibid.). After this initial activity the area lay dormant for thirty years (Ibid.). Industry stakeholders claim that only 10% of the area has been explored, leaving significant untapped potential (Mining Network Online, 2024).

Figure 3: Map showing fieldwork sites

Cornwall

Cornwall was selected as a case study site due to the significant increase in critical minerals exploration activity since the early 2000s, and some existing contacts within the industry. Mineral exploration and development builds on a long history of mining in the region, especially Cornish tin mining which established Britain as a supplier of metal across the ancient world (Bloodworth, 2012). Cornwall's rich mineral wealth is due to its geology; a granite mass with fissures allowing mineral-rich molten rock to solidify and create rich veins of metals. In addition to tin, other valuable metals mined in Cornwall included copper, silver, lead, zinc and, more recently, tungsten and lithium. Industrial materials such as arsenic, kaolin (China clay) and slate also positioned Cornwall as an important mining region. The development of post-mining Cornwall into a 'heritage' site, and a popular place for second home ownership presents the possibility for tensions with the modern era of mining

4. UK context for critical mineral exploration

4.1 A new era of mineral exploration

The current wave of mineral exploration in the UK gained pace in the early 2000s, with the upturn in global commodity prices and growing resource security concerns. As Tim Colman (2019) outlines in his account of UK mineral exploration over the last sixty years, there has been significant recent exploration activity, as the following list indicates:

- 2004 - mineral exploration companies restarted prospecting for nickel in Aberdeenshire
- 2007 - an Australian mineral exploration company recommenced exploration for tungsten in Devon;
- 2012 - an Australian company restarted a project in Redmoor in Cornwall to explore for tin and copper, and other exploration companies, encouraged by rising tin prices, began to acquire mineral rights for tin prospecting in other parts of the region
- 2017 - exploration for lithium from geothermal brines began in Cornwall and in the Northeast near Durham;
- 2018 - Lithium exploration from hard rock began in Cornwall;

- 2019 - in Cornwall, a Canadian company gained significant investment to restart South Crofty tin mine, after multiple failed attempts by different companies since 1998 (Colman 2019).

Technological innovation has played an important role in identifying new domestic resources and opened possibilities for extraction, yet the contemporary environmental and social context presents challenges (Bloodworth, 2014). In this report we focus on understanding these challenges in relation to three critical minerals; tin, lithium (geothermal) and nickel.

4.2 Critical minerals in the study

Mineral	Role as critical material	Value & demand profile	Geography & geopolitics	UK projects
Tin - "Critical technology enabler" On UK and USA criticality lists, but not EU	Unique properties as solder and in advanced technology materials, including circuit boards, renewable energy systems, EV manufacturing, energy storage, advanced computing technologies and telecommunications.	Tin value risen from 5,000 USD/metric ton in the 1990s to over 40,000 USD per metric ton in 2025. Global demand is predicted to double in the next twenty years.	Tin is geographically concentrated within China (30%), Indonesia (25%), and Myanmar (15%), with China - the world's largest producer and consumer of refined tin - controlling approximately 70% of global production.	400 years of tin mining in Cornwall ended in 1998 with closure of South Crofty. New projects in Cornwall include reviving old tin mines and prospecting for new mines. No UK tin smelters remain, therefore tin ore will need to be exported for processing.
Lithium (Geothermal) "Rising demand and insecurity of supply" On UK, USA and EU criticality lists	Important for lithium-ion battery technology and energy storage systems. Two main source forms: brines or 'hard rock', with brines representing more than 50 per cent of the global identified reserves.	Lithium prices peaked in 2022 at 83000 USD/ metric ton and dropped to 8500 USD/ metric ton in 2025. Global demand expected to increase to 2-3x from 2024 levels by 2030.	Lithium reserves are concentrated in the 'Lithium Triangle' in South America, and in Australia and China. Australia, Chile, and China account for 94% of the world's lithium production, and 80% of world's lithium refinery infrastructure is in China (Chaudary, 2025).	Cornwall's lithium potential been known of since the 1980s. New projects include lithium from hard rock (former china clay pits), and from brine. Brine projects are targeting lithium from geothermal waters using novel Direct Lithium Extraction.

Mineral	Role as critical material	Value & demand profile	Geography & geopolitics	UK projects
Nickel "Highly versatile metal" Added to UK criticality list in 2024, and on USA and EU criticality lists.	Important as an alloying agent due to strength and corrosion resistance. Maintains structural integrity in extreme heat and is 100% recyclable. Essential use in electric vehicle (EV) batteries, wind turbines, and solar panels.	Nickel prices dropped in 2025 to 15000 USD/ metric from a peak of over 30000 UDS/mt in 2022 due to oversupply. Global demand expected to triple by 2030 with batteries accounting for 36% of demand.	50% of global nickel production located in Indonesia, with Chinese companies dominating production. China holds just under 87% of the Indonesian mining rights and 60% of the world's refining capacity.	Aberdeenshire exploration has confirmed both high-grade and extensive low-grade resources. There are no smelting facilities in UK therefore nickel ore will need to be exported for processing. The Vale-owned nickel refinery in Wales processes imported nickel matte (a semi-refined product) from Canada and Indonesia.

Table 1: Summary information of critical minerals examined in this research.

Sources: CMI, 2024; Corssins-Smith, 2024; Greitemeier, 2025; Gunn and Deady, 2022; Nickel Institute, 2022; EIA, 2024; US Geological Survey (about lithium reserves) .

4.3 Legislative and regulatory context for critical minerals

Unlike other jurisdictions, such as Australia or Canada, the UK does not have a single mining code or legislative framework. The UK's mining law has developed over many centuries and the government has treated mineral development as a form of industrial development (Colman, 2019). Mining in the UK is therefore governed by a complex system of local planning legislation, health and safety laws, and environmental regulations (ICLG, 2025). The rules also differ depending on what is being mined, for example, the Crown owns gold, silver, oil and gas; coal is owned by the Coal Authority; and other minerals are in private ownership (BGS, 2026). Devolved powers in the UK mean that Scotland, Wales and Northern Ireland have their own specific planning and environmental rules.

With no national licensing system for exploration and extraction of privately owned minerals,, permissions and consent must be sought from multiple sources. For critical minerals exploration in Great Britain (England, Scotland and Wales), the explorer must obtain mineral rights from the private owner, through purchase or lease. Mineral exploration requires planning permission from a mineral planning authority (MPA), with exploration considered "temporary development" under the Town and Country Planning Act 1990 and Town and Country Planning (General Permitted Development) (England) Order 2015 (GPDO). Exploration activity may generate environmental impacts and may also require an environmental permit from either the Environment Agency (England), Natural Resources Wales (NRW)or SEPA (Scotland). Explorers are also required to submit notifications to the Health and Safety Executive.

In the absence of a national licencing system, Great Britain is perceived as being extremely difficult to carry out exploration, with the initial step of acquiring legal tenure of mineral rights often a considerable challenge (Colman, 2019). The situation is different in Northern Ireland where the Mineral Development Act (Northern Ireland) 1969 reserved all minerals (apart from gold and silver already with the Crown) to the Ministry of Commerce (now Department for the Economy). In Northern Ireland, exploration companies acquire a licence from Department for the Economy (DfE) upon payment of a fee, and the exploration licence can be turned into a mining licence after going through the planning process (Ibid.) and obtaining the necessary permits environmental permits from NIEA (Northern Ireland Environment Agency).

Plans for Great Britain to develop a system along the same lines as Northern Ireland did not come to fruition. The long and complex history of land ownership, large population and small

land area presents further difficulties for mineral exploration, with many deposits located in the north or west where there are national parks, designated Areas of Outstanding Beauty and Sites of Special Scientific Interest (SSSIs) (Colman, 2019). Mineral safeguarding, which is intended to ensure that non-mineral development does not prevent future mineral development, does not guarantee that planning permission for minerals exploitation will be approved where there are competing considerations (Cavoski, Ahuja and Lee, 2024).

4.4 Non-technical barriers and risk

Risk is a multifaceted concept that is defined in different ways in different contexts. ISO 31000, the international standard for risk management published by the International Organization for Standardization (ISO) defines risk as "the effect of uncertainty on objectives". Risk therefore combines uncertainty, likelihood and impact. In mining projects non-technical risks can be defined as "those risks arising from interactions between business and external stakeholders with the potential to create future negative impacts on society and the environment" (Fraser, 2023: 711).

While understanding technical risks, relating to the success of specific processes of extraction in specific locations, are part of a mining exploration company's core concern and competence, non-technical risks can be overlooked, although they deal with important potential negative impacts on society and the environment. In terms of the barriers to the UK developing domestic capabilities in critical minerals extraction and refining, dealing with these non-technical risks requires different capabilities in the mining sector, and in the application of policy and regulation. Because companies and investors in the mining sector must navigate an extremely complex UK regulatory landscape that has no single mining code or legislative framework, these non-technical constraints can become significant risks which can lead to projects delayed, stalled or simply failing to raise investment capital.

In the findings section below, we present empirical evidence of how some of the realties and challenges of the UK system discussed in section 4.3 manifest and impact a range of stakeholders in the case study regions across different metals. Our findings also demonstrate how stakeholders navigate these challenges to progress projects.

5. Findings

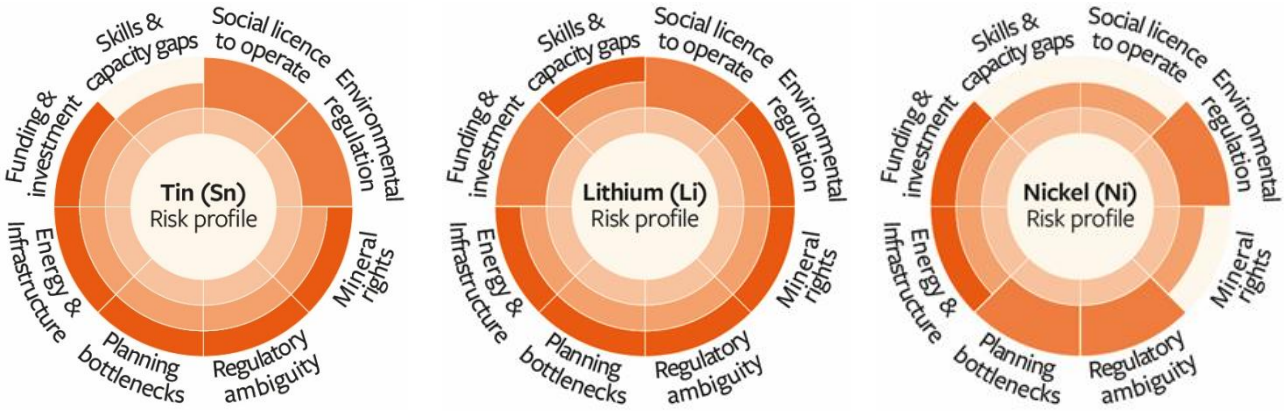

Figure 4. Risk profiles of Tin, Lithium (geothermal) and Nickel

5.1 Mineral rights complexity and land access

- Mineral rights can be owned separately to surface rights in the UK meaning that companies must negotiate with owners of mineral rights and the landowner before any exploration can be carried out
- It can be challenging to identify mineral rights holders due to fragmented historical ownership and unregistered rights
- Even where mineral rights and surface rights are together, companies have multiple land access agreements to negotiate and manage.

Fragmented mineral rights ownership

Great Britain's mineral rights ownership system presents considerable barriers to mineral exploration companies. In parts of England, Scotland and Wales the mineral rights have been 'severed' from surface rights, meaning that the land providing access to the mineral resource and the mineral rights beneath that land, are owned separately. This pattern dates back to feudal times where large estates sold off parcels of land but retained mineral rights which over time were split between families, or won, or lost over generations. In Cornwall, in historical mining areas, the legacy of fragmented mineral rights ownership requires explorers to first understand and identify mineral rights ownership going back hundreds of years. Companies described a complex and bewildering process to trace mineral rights owners and 'assemble'

mineral rights packages. The success in leasing or purchasing mineral rights involves a multi-year, costly process of accessing historical records, establishing relationships with large estates, tracing family members and sometimes "*luck*".

One company described nine-years of effort, drawing on publicly available and private historical data to put together "*probably the largest portfolio of mineral rights access*". Indeed, one challenge for explorers is that there is no national register of mineral rights and registration is not compulsory. Because mineral rights often remain unregistered, with some owners unaware of ownership, they sometimes cannot – or do not want to – be found. Interviewees explained that some owners wish to remain hidden and some may fear acquiring historical liabilities (such as hazards or legal disputes) if they register.

> *"You're having to engage with multiple mineral rights holders across different aspects of the mine. There's not just one owner, it's lots of different owners, and then they've all got different agreement levels for each different package" (Company 1).*

Where owners can be traced, they are sometimes unwilling to make a deal, leaving gaps in the "land package" that can further complicate and delay exploration.

> *"Ultimately new developers not knowing how to get in to understand the mineral rights problem are going to struggle with investment" (Company 2).*

There is no standard licencing agreement, so companies must negotiate on a case-by-case basis. Sometimes this is with large estates such as the Duchy of Cornwall, and sometimes it is with several rights owners across a prospective area. There is considerable financial outlay involved; explorers must engage land agents and solicitors to negotiate the rights lease or purchase with each owner. Negotiations can get bogged down in legal complications and become protracted which further raises costs and risk and has a knock-on effect on a company's ability to raise capital. Past exploration companies have been known to spend over half of their budget on legal fees running into the hundreds of thousands of pounds (Colman, 2019).

> *"It's just that barrier to entry of land agents, lawyers, the cost. So, a cost of 50 or 60,000 pounds just to get the license signed" (Company 3).*

Interviewees were not confident that a solution to the mineral rights challenge will be presented any time soon, due to the complexities and political sensitivities of the issues involved. Government-funded studies have yielded little enthusiasm for an overhaul, with a recent report

suggesting some changes but concluding that mineral rights are "not a barrier" (Knights PLC, 2022). While our data shows that the case study companies in Cornwall are indeed "*showing that licencing works*" through the deals they have established, this is after years of effort and tens of thousands spent which suggests a significant barrier. All industry interviewees agreed that without guidance and support to understand and overcome the mineral rights challenge, this crucial aspect of minerals exploration in the UK will remain a barrier to new entrants and deter investors, thus limiting our ability to meet the high demand for these materials.

In Aberdeenshire, mineral rights are in private ownership but tend to be with the landowner and not separated from surface rights. In the case of nickel exploration, explorers note that identifying mineral rights is much easier than in Cornwall because companies can access records in the land registry to identify the landowner. Once the landowner is identified, companies can then negotiate the lease of mineral rights directly. As one explorer explained, "*treat the landowner with respect, it's very easy to do*".

> *"There isn't a long history of mining [in Aberdeenshire] …the mineral rights are generally owned by the landowner, so you just need to do a deal with the landowner". (Company 5).*

However, it is not guaranteed that landowners want to make a deal. As in Cornwall, negotiations in Scotland can also become protracted and run up high legal costs. In cases where there are legacy issues due to previous companies having been unable to reach a deal or where relationships have soured, it can take years for new companies to re-build relationships. Therefore, while the level of complexity facing exploration companies differs between Cornwall and Aberdeenshire (and indeed other parts of Great Britain), all exploration companies face uncertainty on acquiring mineral rights.

Securing land access for exploration

Exploration companies must secure both mineral rights and land access before exploration can begin. In Aberdeenshire, because the mineral rights owner is usually also the landowner, access agreements can be structured with an option for a future minerals lease. One interviewee described a two-step process in which an initial "*exclusivity agreement*" allows developers to access land to undertake basic survey work, but not drilling, enabling both parties to "*get to know the landowner, and vice versa*." This is followed by a more formal "prospecting agreement", through which companies can "*lock in the terms of an eventual lease agreement*" should exploration results prove favourable. While this staged approach allows developers and

landowners to build trust over time, it also requires negotiating multiple agreements as projects progress, increasing costs and administrative burden for exploration companies.

Because rights ownership is fragmented across hundreds of farms, a considerable effort is needed to contact, negotiate and enter into land access agreements with multiple individual landowners across a prospective area. One explorer has established "*56 land access agreements covering just over 8000 hectares*" in the last few years.

> *"Primarily we're dealing with individual farms…a full range of guys who own multiple farms with 1000s of acres, and some smaller landowners. So, it was really a significant effort to put together that number of agreements". (Company 4).*

In Cornwall, where mineral rights are secured separately, companies must also negotiate land access agreements with owners of surface rights. For geothermal lithium, where drill sites are dispersed, land access agreements are a crucial next step before any exploration can begin. Companies locate the landowner, negotiate access to work the mineral rights and come to an agreement about access and compensation. The risk in both Cornwall and Aberdeenshire is that the company is unable to establish a deal with every landowner, sometimes "*because the person who has that land just hasn't been interested in signing an agreement with us*". This means there can remain gaps in the land package, even when due diligence on mineral rights has been done. Interviewees involved in nickel exploration noted that early-stage exploration often requires different forms of land access at different stages, such as reconnaissance followed by drilling, meaning companies must negotiate multiple agreements with landowners as projects progress.

While the companies in both regions negotiated land access successfully in most cases, this is a labour-intensive process that can be unpredictable and there is no statutory guidance. In Cornwall, the access agreement feeds into the planning application, but any financial compensation for land access is at the company's discretion; some companies pay, and some companies may not, depending on how well landowners negotiate. Successful agreements often depend on relationships that must be nurtured and maintained over time. As one company respondent pointed out, "*people skills*" are a competitive advantage in early-stage

> *"Those kind of connections with the local community are absolutely crucial...and once you've built up a little bit of credibility amongst that core landowner group, then other people get to know who you are" (Company 4).*

exploration, where knocking on someone's door and being able to chat over a cup of tea is a way to progress projects.

5.2 Ambiguous and complex regulatory landscape

- The growing complexity of permitted development rules in England adds increased burden and cost for companies outside Scotland
- There is a misalignment between permitted development and operational needs in both regions
- The lack of a unified regulatory pathway for critical minerals mining means companies are learning, and relearning, by trial and error

Ambiguity in permitted development rules

In the UK, critical minerals exploration can be carried out as 'permitted development', which defines activities that can proceed without planning permission. These rights are set out in the *Town and Country Planning (General Permitted Development) (England) Order 2015* and the *Town and Country Planning (General Permitted Development) (Scotland) Order 1992*, both referred to as the GPDO.

> *"They don't allow rolling… you can't then say, 'I want to do another one'. You're well within your six-month time frame [but] you have to have a period of break… the ground doesn't change, the environment doesn't change, but the council want this." (Company 2).*

Inconsistencies and ambiguities within planning guidance mean that permitted development rules are interpreted differently across the case study regions. In Cornwall, interviewees reported increasing requirements associated with GPDO applications, while the boundary between permitted development and full planning permission remains unclear to exploration firms. Industry interviewees noted that GPDO applications have therefore become increasingly burdensome. Explorers described requirements for various surveys and reports, including bat surveys, archaeology assessments and, more recently, private water supply studies, even though "*there is no evidence that any of this is needed*." Because companies have interpreted GPDO rules differently in the past, local planning authorities have introduced additional requirements, leading industry interviewees to perceive that the GPDO process has "*ballooned into something it didn't need to b*e." The growing complexity of a GPDO means that companies are spending considerable time and

cost to put the information required together, with some interviewees noting up to 4 months of work and £10,000 spent for 6 months of access. A further challenge is that because the GPDO covers temporary development on one site only, each site requires a separate GPDO. When developers are exploratory drilling on several sites, as in the case of geothermal lithium, the requirement for repeated applications pushes up costs and stretches timelines.

> *"Class 53 allows drilling less than 28 days… Class 54 allows four months… but we haven't explored what the planning consent would look like if we needed longer… There's no legislation in place for longer drilling campaigns." (Company 5).*

Requirements for permitted development in Cornwall contrasts considerably with the situation in Aberdeenshire. Here, permitted development allows for up to four months with no requirements for surveys or public consultation, only a simple notification to the Council, referring to the development as "Class 53 or Class 54" (https://www.mygov.scot/perm-development-works). While this light touch approach is quicker for explorers, it means there is nothing visible to the public on the planning portal, which has the potential to contribute to perceptions of secrecy (see section 5.7). Industry interviewees in Aberdeenshire also explained that there is confusion about when permitted development ceases to apply and a full planning application is needed, and no guidance about requirements for lengthier periods of drilling exists.

Industry interviewees in Aberdeenshire also highlighted ambiguity in how certain drilling regulations are interpreted in practice. Consultants involved in exploration drilling described uncertainty around how regulatory limits on borehole depth should be measured, for example whether the limit refers to vertical depth from the surface or the total length of the drilled borehole. In sloping terrain these interpretations can produce different measurements, leaving operators to adopt an interpretation that may later need to be justified if challenged.

As a result of these ambiguities in permitted development rules and drilling regulations, companies in both regions described adopting practical workarounds, either by applying for more drill holes than needed to carry through to the next round of drilling (Aberdeenshire) or squeezing as much drilling as possible into the time frame (Cornwall) to avoid the need for a full planning application. These ambiguities in permitted development and planning make early and advanced exploration unpredictable, adding avoidable cost and delay.

Poorly coordinated multi-agency regulatory oversight

Exploration companies must navigate a complex landscape of regulators to progress mineral exploration projects. These agencies operate with their own processes, requirements and timeframes and there is no framework coordinating their activities. Across the case study regions, planning authorities, the Environment Agency (EA), Scottish Environment Protection Agency (SEPA), World Heritage Site (WHS), the Health and Safety Executive (HSE), Natural England and the British Geological Survey (BGS) may all be involved at different stages of the mining project cycle. As a result, companies must engage with multiple agencies without a clear understanding of what is required.

Interviewees described situations where agencies issue conflicting opinions. In Cornwall, for example, archaeologists within local planning authorities approved drill sites that were subsequently contested by WHS representatives based on historic maps, requiring companies to spend additional time liaising between agencies to resolve the issue.

> *"So the archaeologist could be like "you're not going to cause an issue"... and the WHS could be like… "you can't drill there". They don't always mesh" (Company 1).*

> *"There've been a few [companies] that have come to us and asked about permitted development or not even known about it, and just said, 'we've done some non-intrusive works, been able to do some boreholes. What do we need at that point'? (Industry consultant 3).*

The lack of clear guidance also creates compliance challenges for exploration companies. Consultants noted that some firms are unaware of permitted development requirements or when additional regulatory notifications are needed. In these cases, companies often rely on consultants to interpret planning rules and regulatory obligations. One company in our study reported being unaware that statutory drilling notifications needed to be submitted to both the Health and Safety Executive and the British Geological Survey, in addition to planning notifications. Such duplication of requirements increases the administrative burden on exploration companies and can raise project costs.

> *"Companies are designing the mine and what to do with water and what to do with the waste facility and the lining, and they need technical support and advice…. all from different people and none are talking to each other" (Regulator).*

In England and Wales, companies must also deal with multiple points of contact within the Environment Agency. Because mining projects do not fit neatly within existing regulatory regimes, permitting requirements may fall across several frameworks, including installations, waste, water and discharge, each handled by different teams. Companies therefore engage with multiple EA specialists who may not coordinate with one another. Interviewees suggested that limited familiarity with mining within some permitting teams can lead to delays, with requests for additional information or inconsistent interpretation of requirements (see Section 5.3).

> *"I mean, for the regulator having the mine is something new for them as well…So it's kind of learning path for both us and the regulator" (Company 2).*

Across tin, geothermal lithium and nickel projects, interviewees described the absence of a clear regulatory pathway for mineral development. Companies often reported having to "*figure it out*" as they go along, relying on consultants and learning through trial and error. In Cornwall, where projects have progressed into advanced exploration and feasibility stages, interviewees described a situation in which regulators and industry must "*learn lessons from other industries*" as projects move forward.

Poor regulatory fit for new critical mineral extraction technologies

> *"Permitting is a real challenge in terms of how you define mining waste, how they are regulated, how they're disposed of... I mean, the information required, in some cases, will take a couple of years to obtain and then model, and then depending on the complexity of the waste in the sites, years to get a permit" (Industry consultant 1).*

New critical mineral projects – in particular geothermal lithium, modern tin operations and nickel exploration in hard rock as explored in this research - do not fit within the UK's existing regulatory architecture, adding uncertainty for developers and regulators. Interviewees across the case study regions noted the salient challenge of how to manage mine waste in the absence of any existing regulations, especially to deal with novel waste streams from Direct Lithium Extraction techniques. Furthermore, because existing frameworks for dealing with waste from hard rock lithium extraction are not appropriate, there is uncertainty over how to classify and regulate the treatment of geothermal brines (water that

is pumped into rock to dissolve and carry minerals). Existing water abstraction rules and installations regimes are not sufficient.

> *"[This] is very unusual for us to do in the exploration industry; as soon as we've drilled the hole backfill it so we can't go back down there again. But we've done it, yeah, we've just done what we had to do to comply" (Company 5).*

Explorers explained that applying existing regulations means that such regulation is working against the realities of modern exploration techniques which hinders project progress. Interviewees explained that for nickel exploration drilling, SEPA applies groundwater protection rules and requires boreholes to be backfilled with cement within 14 days, despite hard rock drilling carrying limited risk to groundwater. Industry interviewees note that although these rules prevent re-entry for geophysical surveys and "*don't reflect the geology*", they must comply in order to build a track record of compliance.

> *"We haven't done lithium mining in this country before, the techniques to do that, the processes involved, it's all new" (Regulator).*

What we have therefore is an industry and regulator figuring out the new sector as they go along, which adds pressure, lengthens timelines and increases risk. The regulator is proceeding cautiously, knowing from Cornwall's mining legacy "*what can happen when it goes wrong or when things aren't properly considered in advance, you know what kind of legacy you can be left with*".

5.3 Planning system bottlenecks and uncertainties

- Local Planning Authority teams are under resourced and stretched, with high caseloads covering all types of development
- Decision making by committees of local elected representatives is unpredictable and may not follow planning officer recommendations
- The lack of statutory planning response and decision timelines in the UK adds further unpredictability to planning applications

Under resourced mineral planning teams

The planning system was frequently cited as a key non-technical barrier across tin and geothermal lithium projects in Cornwall and nickel projects in Aberdeenshire. Mining projects in the UK require planning permission from the relevant local authority (Minerals Planning Authority). In England the relevant policy framework is the National Planning Framework, and in Scotland this is the National Planning Framework 4.

Across Cornwall and Aberdeenshire, planning teams are under resourced and stretched, having been subject to funding cuts over the last decades. Interviewees explained that planning fees have increased but are not ring-fenced income, meaning departments remain underfunded despite rising workloads. High caseloads and the lack of mining specific knowledge within planning departments (see section 5.2) can delay decision making. One interviewee explained that if a challenging issue is raised by a statutory consultee, it can easily fall into the "*too difficult pile*" while the planning officer moves to deal with something equally pressing but less challenging. Planners are trained to make decisions on housing and commercial projects, not on complex mining projects. As such, planners' reliance on external consultees for specialist knowledge can further delay decision making.

> "*The [planners] case load is very busy; I mean they might be dealing with a porch extension one day and a lithium mine project the next" (Industry consultant 2)*

> *"[Developers] are quite often talking to an officer who doesn't understand their business, doesn't understand the financial elements, and all the environment elements" (Industry consultant 2)*

The mining sector in Cornwall is competing with other developments – especially housing projects - that have in some cases led to mineral deposits being 'sterilised', effectively taken out of potential extraction, due to weak mineral safeguarding. There is only one mineral planner in the whole of Cornwall, who is also a planning officer. This under resourcing within the mineral planning authority (MPA) means that the 2018 minerals safeguarding document has not been updated to accurately reflect areas of current and future exploration. Explorers are therefore struggling with space to access mineral rights workings, and must find innovative, new techniques which further raises costs.

> *"We just don't have any accessible areas because they've all been developed on… even though we have the mineral rights." (company 1)*

Developers in Cornwall acknowledge that the planning authorities are supportive of minerals projects, but in the absence of any minerals-specific guidance, pre-application advice can be inconsistent. In the case of both tin and geothermal lithium, the developers note that they must "*educate the planners*" which further slows determinations. While positive relationships between companies and the MPA have developed through pre-application consultations, 'learning by doing' happens on a case-by-case basis and the barrier to entry for new developers remains high.

> *"If you're coming in as a fresh mineral developer… you'd have to find this all yourself. It's not particularly helpful for people coming into it." (Company 3).*

In Aberdeenshire, where projects are not yet at planning stage, planners acknowledge their limited awareness of critical minerals exploration in the region and the steep learning curve ahead. While there is no precedent for nickel mine planning, one respondent referred to Scotland's mining heritage to suggest that planning authorities will generally understand and support mining.

> *"We need the planners to understand they're a crucial part of it…everything's subject to planning." (Company 5).*

Indeed, exploration companies discussed the crucial role that planners will play in developing the sector and pointed to the successful permitting of Scotland's quarries as a positive sign. Planning authorities also highlighted the parallels with quarrying, although cautioned that there is little tolerance for new quarries in the region, meaning public concerns about noise and traffic are also likely to translate to issues that applications for critical minerals mining must also address.

> *"I think because Scotland has this heritage, particularly coal mining and lead mining and so on, I think there is an understanding of what it entails so that it does tend to get reasonable support at planning authority level". (Industry consultant 2).*

Long planning timelines without decision-making deadlines

Another risk associated with the planning system is that planning committees, made up of locally elected representatives, sometimes make decisions that diverge from planning officer recommendations based on policy. Even technically sound planning applications with the strong support of mineral planning authorities can

> *"The unknown is the fact that those bigger decisions will go to planning committee and then that is difficult…the planners can make recommendations but that doesn't mean the committee will take that on or acknowledge it" (Council 1).*

be refused due to political issues or planning committee dynamics. Interviewees across both case study regions referred to cases elsewhere in the UK where community objections held up planning applications for several years, and where political pressures led to applications being rejected despite community support. Conversely, the case of gold mining in a National Park in Scotland was used to highlight that political priorities can override local objections when employment is brought to a deprived area. These examples further highlight the prevailing uncertainties of the UK planning system.

> *"And you know, mineral planning permissions tend to come with a lot of conditions... you're quite often running into your 100 on a mineral planning consent these days. And that's, you know, before you put a spade in the ground". (Industry consultant 1).*

The planning system's statutory deadlines are frequently missed adding a further layer of unpredictability to planning applications. One interviewee contrasted the UK system with other jurisdictions that are obliged to respond within three months, whereas UK planning applications can take years before they come back with issues to be addressed, once again raising costs and uncertainty for developers and investors.

5.4 Infrastructure, energy costs and processing limitations

- Critical minerals processing is located overseas which undermines the potential for a wholly UK product
- High electricity costs undermine the competitiveness of energy-intensive critical minerals extraction and processing in the UK.
- Transport, grid and housing infrastructure constraints mean the UK is not yet ready to support the simultaneous development of multiple critical minerals projects.

No domestic processing capacity in the UK

Infrastructure, energy costs and processing limitations present significant barriers across critical minerals projects in the UK. While mineral resources may be geologically viable, the absence of midstream processing and refining capacity undermines the development of a secure domestic sector. For example, tin extracted in Cornwall will need to be shipped overseas, probably to southeast Asia, for smelting. Nickel extracted in Aberdeenshire will also need to be shipped overseas for processing, either to Scandinavia or southeast Asia. The dependency on overseas refining undermines value capture and the economic rationale for

domestic production. Furthermore, in Cornwall, where producing a "Cornish product" is important for ongoing local acceptance of industry, the need to process tin overseas presents a risk. Similarly, interviewees in Aberdeenshire emphasised the importance of producing "UK Nickel" with strong sustainability credentials to compete in international markets.

While there are plans for lithium processing in the UK, this relies on novel and unproven routes rather than established facilities. Interviewees emphasised the importance of government support for the midstream sector, including for retrofitting or repurposing existing refineries and smelters in the UK. An example is the Clydach Nickel Refinery in South Wales owned by Brazilian mining firm Vale which produces high-purity nickel products from nickel ore sourced from Canada.

"We've got a refinery in Wales… that could be re-tasked to become a smelter for nickel…you've got steel up the road, you've got all these things...[with] state sponsored intervention you could have your own nickel production facility in South Wales…They've got ethical standards higher than most places, right? It's about security supply...the UK can subsidise it and maybe sell it to other European countries". (Company 5).

Energy, transport and housing infrastructure challenges

"So if we wanted to keep Cornish tin in Cornwall, we would need a smelter in Cornwall, but a smelter takes a huge amount of energy and you're going to need that energy from somewhere". (Company 5).

Mining and mineral processing were repeatedly described as highly energy-intensive activities, and interviewees noted that UK electricity prices are significantly higher than in many competing jurisdictions. High energy costs therefore represent a major competitiveness challenge for domestic extraction and processing projects. At the same time, energy infrastructure – particularly electricity distribution and grid capacity – was identified as a constraint. This issue is especially pressing in Cornwall given the potential development of several projects simultaneously. Even where companies are willing to invest in renewable energy, limited grid capacity can restrict the ability to connect new projects.

"There either needs to be some dispensation, acknowledgement that this is for the greater good, or we need to address some of those tax issues so they can do some kind of work around, like an offshore wind turbine... some of those wind turbines, they don't run because the grid, it's not upgraded enough that it could accept all the electric that all the wind turbines will generate if they're all at the same time" (Regulator).

Transport and site access were also raised as constraints. Geothermal lithium sites are dispersed across rural areas accessed by narrow roads and lanes, while tin exploration projects in areas of historic mining now face limitations due to housing and commercial development on mineral safeguarding areas. In Cornwall, many prospective sites are located near designated landscapes or within mining heritage areas, requiring more complex and costly engineering solutions such as underground access and waste storage. In Aberdeenshire, although some areas benefit from legacy industrial infrastructure, similar grid and transport limitations were reported.

Infrastructure constraints also extend to housing, where interviewees in Cornwall raised concerns about housing shortages and strains on existing services. The construction phase could require thousands of workers, many of whom would need to relocate from outside Cornwall. Temporary accommodation solutions were viewed as bringing little local benefit and potentially causing disruption, with interviewees suggesting that industry would need to take the lead in addressing local housing needs and local workforce development. These issues point to wider gaps in infrastructure and regional planning that are not yet ready to support the development of multiple critical minerals projects.

> "*If you've got a couple of projects in a small region needing construction for three years at an overlapping time, you might need 1000s of construction workers, they've got to live somewhere...so that already has the potential to lead to disharmony in communities…I don't think it would fall to the council to look at it, the companies need to provide a solution" (Industry consultant 1).*

5.5 Finance, investment and market risk

- Finance availability for revenue as well as capital costs is a cross-cutting barrier that significantly impacts project timelines
- The UK lacks effective funding mechanisms to support the exploration phase of the critical minerals sector
- UK projects may struggle to compete with projects in countries with weaker environmental and social standards and lower energy costs

Financing gaps for early-stage projects

Financing for projects was raised as a dominant barrier across both case study regions, particularly impacting early exploration through to feasibility stages. Interviewees developing nickel and tin projects emphasised that "*finance, finance, finance*" was the ultimate constraint, explaining that other barriers such as mineral rights and planning were surmountable with enough persistence. Both industry and non-industry interviewees were clear that capital constraints fundamentally shaped project timelines to the extent they can become "*open ended*". Projects are mostly reliant on private capital or subsidies from a parent company to finance exploration and struggles to access finance often hold projects back when they are unable to mobilise capital for the next project phase. One interviewee described a project sitting for several years "*doing very little background exploration activities until they could unlock [capital]*".

Industry interviewees described how the UK lacks effective mechanisms to support the high-risk, exploration phase, with grant funding largely targeting R&D or downstream processing, leaving a significant "*gap in between...where exploration sits*". Any grant funding available is limited and has proven challenging to access. Interviewees reported their frustration with being either rejected from grant schemes or spending considerable time and effort applying for grants whose amounts dwindle throughout the application process (with the majority of funds going to academic institutions perceived to be "*safer*").

> *"I think most of the projects have proven that if there's government backing, they can more than match that backing with their own investments. They just need the government backing" (Company 5).*

The National Wealth Fund was seen to not match the realities of some projects because its minimum threshold (£50 million) is above typical scoping or pre-feasibility budgets. This creates a catch-22 situation where projects must advance to be eligible for funding but are unable to advance without finance. Industry interviewees highlighted the importance of being able to access smaller pots of funding or benefit from exploration incentives that are seen in other jurisdictions. The UK was repeatedly contrasted with Australia and Canada where tax incentives, flow-through shares and co-funded drilling "*keep the wheels*

> *"You have to have a project that's already ready to spend 50 million to get access to funding, which obviously, as an early stage exploration project you're not spending that…..so we're not eligible for those schemes, any of them" (Company 3)*

moving". Government financial support – of an appropriate kind - was therefore seen as crucial to stimulate investment in UK projects.

However, one interviewee stressed that ultimately, being able to demonstrate that it was possible to get projects off the ground in the UK without becoming stuck in a "*legislative nightmare*" was crucial for addressing the UK's poor reputation. Successful projects would in turn attract more investment interest.

> *"the more times you can show that projects are advancing and investments actually are going in the ground, not just paying for legislative issues…[that] projects are getting permitted… the more people will take note and invest". (Company 3).*

Market competitiveness and UK cost disadvantage

Beyond access to capital, interviewees highlighted the high operating cost environment in the UK as a major barrier to competitiveness for critical minerals projects. One interviewee stressed that UK projects operate on a "*total unlevel playing field*", dealing with regulatory compliance costs, high electricity prices and investor expectations around ESG, while competing with Chinese and Indonesian producers who can undercut prices through state-subsidised production and weaker environmental and social standards. Interviewees emphasised that government backing is crucial to compensate for this competitive disadvantage, or to ensure "*there is a premium for metals produced here locally*".

> "*In order for us to put something in promotion, it needs to be bigger and better than anywhere else, and that's difficult" (Company 5).*

However, the idea of a premium UK product with high sustainability credentials is currently undermined by the lack of processing facilities (see section 5.4). Interviewees considered this continued reliance on countries in Asia to process tin and nickel ores to be short-sighted and a missed opportunity for the UK to develop secure and resilient critical minerals supply chains.

5.6 Skills and capacity gaps

- The UK has a shortage of trained mineral planners, mineral surveyors, geologists, and mining engineers
- Regulators have limited mining expertise and insufficient capacity to support and regulate the sector
- Exploration companies do not have the capacity to take on and train apprentices

Lack of specialist mining expertise and limited institutional capacity

Across all three case studies, a consistent barrier identified by interviewees was a shortage of specialist skills and lack of institutional capacity, both within public authorities and across the wider mining and minerals ecosystem.

A recurring theme was the lack of specialist mineral expertise within the planning teams and the relevant regulator, particularly at the local level. Planning officers tend to be generalists and therefore lack the specialist skills to assess complex proposals for mining. In Cornwall the loss of the mineral planner from the local authority has left a knowledge and skills gap that has been filled by the planning officer, rather than a specialist minerals planner (see section 5.3).

Regulators also lack mining expertise and specialists. Interviewees in regulators described a "*steep learning curve*" to be able to understand the processes and support the companies to do what they need to get their permits, as well as to work out what is needed to be able to regulate the industry. As one interviewee in Cornwall explained, "*we haven't done lithium mining in this country before, the techniques to do that, the processes involved, it's all new*". That regulator is aware the mining sector is "*coming in the pipeline*" and they are not prepared for it, which impedes their ability to "*provide a good service*".

> *"We've got tungsten, lithium, we've got tin coming back… you've got all this mining activity and we're missing the structure that we need to get the support we need". (Regulator).*

Lacking the necessary regulatory expertise, the teams are drawing on knowledge from other industries in the UK such as chemical processing, metal plating, and acid manufacture to try to learn lessons. The regulator is therefore proceeding cautiously, alert to the risk of "*getting it wrong*". This is particularly the case with geothermal lithium which generates novel processing or waste management routes where regulators are having to interpret existing frameworks in the absence of any tailored guidance. Other sectors have a formal structure with dedicated specialists and feedback mechanism for industry engagement. While the teams in Cornwall recognise the importance of the pre-application service to strengthen applications, there is no funding to be able to develop and offer such a service.

> *"We're trying to learn...it's all based on expertise that we pull from other sectors…So trying to work out all that without the funding to do so… it's the technical nature of it, the amount of time it takes because of the scale and complexity". (Regulator)*

However, the funded role of 'mining regulatory specialist' was created at the Environment Agency in summer 2025 as a first step in addressing the capacity gap, signalling to interviewees that the government is beginning to take the sector seriously. It is hoped that this individual will act as a coordination point at the regulator for England and Wales so the companies can liaise with one person for pre-application advice rather than several.

Limited domestic skills base in the UK

The skills gap extends into the wider mining ecosystem. Interviewees across tin, geothermal and nickel projects emphasised that the UK's long period without active mining has reduced professional capacity in this sector, with much of the skills and knowledge going overseas. As one interviewee claimed; "*we are trying to rebuild something that hasn't been here for 50 years*".

Industry interviewees across both case study regions highlighted that the lack of training in applied geology and mining engineering means that graduates are not ready to do the operational work required by the sector. Small exploration companies with limited staff do not have the manpower to train graduates, nor do they have capacity to support apprentices. As one interviewee stated: "*far too often the government thinks that giving money to the universities is going to do the job when it's actually the other way round".*

> *"That's great if you've got somewhere you can slot a mining engineer in. But for a company our size, we don't have the ability. We don't have a mining engineer who can train apprentices" (Company 3)*

Interviewees pointed out that there are no undergraduate courses for mineral surveying in the UK and limited courses in mining engineering. While the Camborne School of Mines reinstated its mining engineering programme in 2024, there is some concern that there will not be a skilled workforce in time to meet the demands of the sector. In Cornwall, the development of several mining projects simultaneously means that there is increasing competition for a limited pool of talent. The possibility that industry may have to import skilled workers presents an additional challenge to companies that are promising to recruit their workforce locally.

> *"Colleges aren't going to [create programmes] if there's nowhere to send those people, nowhere to train them and send them out to work. Far too often the government thinks that giving money to the universities is going to do the job when its actually the other way round" (Company 3).*

A council interviewee expressed concern that while there were demands for jobs in the sector, the return of mining in Cornwall is being "*romanticised*" and the reality of working in a mine may not be compatible with the modern era. However, one company claimed that they received hundreds of applications for 13 mining jobs and that many applicants had transferable skills from other sectors. Council interviewees in Aberdeenshire also discussed the potential for skills to transfer from the oil and gas sector. One industry interviewee suggested that to deal with the skills gap the government should "*find as many people as it can who actually know anything about exploration and get them back to mining*".

5.7 Community Opposition and social licence risk

- The unpredictability of community support is one of the main uncertainties for critical minerals projects
- Misperceptions about critical mineral exploration shapes community attitudes and the 'false starts' of many projects has eroded trust
- Exploration firms must balance early engagement with not building unrealistic expectations

Unpredictable community support

> *"I think all the other bits are resolvable, but the community is so unpredictable… it just adds a layer of complete unknown to it" (company 2).*

One of the most significant non-technical barriers exploration companies face lies in their relationships with communities living in and around the exploration area. While not unique to exploration projects in the UK, interviewees across both case study regions acknowledged that one of the main uncertainties for their projects is the unpredictability of community support.

> *"they remember as a child that mine up and running.. their grandfathers or their fathers worked in the mine.. they've got their stories to tell how good it was" (Company 1).*

In Cornwall community responses to the sector vary depending on location. As several interviewees noted, there tends to be less support in areas with high second home ownership, or in designated conservation or landscape areas where visual impacts are likely to be an issue. Industry interviewees noted that support for new mining projects tends to be stronger in former mining areas where there is family history of mining or memories of when the mines were open. However, enthusiasm for mining in these areas is tempered by the false starts of previous projects with other companies which has eroded trust. One explorer described information fatigue and a perception that "*nothing's going to happen anyway*". Furthermore, while Cornwall's mining heritage is celebrated, in some areas legacy pollution from hundreds of years of mining increases concerns about mining's revival.

> *"One of the challenges was actually changing the community mindset from something of its never going to happen, because you are the sixth company now to try… it's a lot of false hopes, false starts" (Company 1).*

Industry interviewees in Cornwall emphasised that community engagement methods must be flexible given the diversity of views and expectations they encounter. This is especially the case for geothermal lithium where drill sites are dispersed, and community responses and expectations can vary from site to site.

Industry interviewees discussed the challenge of local people misunderstanding what mineral exploration, development and production entails. For instance, companies struggle to get across that mining projects are dependent on feasibility economics and "*not like building a*

> *"Benefits always come up, everyone says 'what are we going to get out of it'.. you're just going to extract money for shareholders" (Company 2).*

public road with public money" or a supermarket where a set number of jobs can be predicted. Companies are unable to make firm promises on jobs, and this inability to make commitments to community benefits can feed into mistrust and perceptions that "*outsiders*" will benefit from the industry.

> *"It's a difficult balance, the amount of disclosure and engagement when you don't know yourselves yet if its viable. And people are always going to jump to the worst conclusions, I mean, because you would, wouldn't you?" (Industry consultant 1).*

Interviewees across both regions emphasised that companies have a responsibility to educate the general public about mining. For example, misunderstandings about geothermal lithium might be tackled by educating communities on the role of lithium in everyday life and in a low-carbon future. In Aberdeenshire, where comparisons to quarries can make people fear noise and dust, it will be important for companies to educate communities on what nickel mining will entail (i.e. one truck per day from a mine rather than hundreds from a quarry). However, it was stressed that companies must find a balance between avoiding sowing seeds of doubt and not raising unrealistic expectations. One third sector organisation interviewee speaking about the sector in general emphasised that it will be crucial for local people to continue to have their voices heard by industry and government, especially as the UK's new critical minerals strategy comes into effect.

5.8 Environmental regulatory uncertainty and long-term obligations

- Frameworks designed for other sectors are being applied to mining without considering their effectiveness
- Companies must address legacy pollution issues to build support from communities
- Commitments to remediation, biodiversity enhancement and long-term monitoring raise additional investment challenges for companies

Misalignment between environmental frameworks and modern mining

Environmental sustainability expectations or obligations are a cross-cutting barrier for critical mineral development in the UK, not because of opposition from industry, but because existing UK frameworks do not offer clarity on what projects should achieve. As a result, environmental sustainability objectives can translate into uncertainty, cost and risk for project developers.

One challenge is that environmental regulations have not kept pace with modern mineral extraction technologies. As noted in section 5.2, environmental sustainability requirements for issues such as waste management are not yet clear at the permitting stage, and lithium brines and modern mining techniques do not fit existing regimes.

> *"You've got a high value to offset and you don't own the land, so you can't deliver that offset on the land at the end of the project which means you have to deliver it elsewhere, which means you have to buy land or buy credits... and its very expensive". (Industry consultant 1)*

Developers also highlighted cases where environmental frameworks designed for housing or conventional industrial development are being applied to mining activities. This is particularly evident in relation to biodiversity net gain (BNG) requirements, which mandate a minimum 10% gain in biodiversity value as part of development. Interviewees in Cornwall raised this as a significant challenge where mining sites have limited physical space to deliver biodiversity improvement through habitat restoration or enhancement on site.

While mining operations may deliver ecological improvements following site closure, the requirement to demonstrate net gain at the development stage creates both financial and practical difficulties. Several projects face significant 'biodiversity offset' costs because historically disturbed or previously mined land is often classified as high-value habitat. Developers may therefore be required to purchase biodiversity credits or secure off-site mitigation, sometimes involving multi-million-pound commitments over 30-year periods. As one interviewee noted, this level of uncertainty makes financial modelling difficult at early project stages.

Environmental legacy, public sensitivities and long-term obligations

Environmental sensitivities are heightened in both case study regions due to the legacy of historical mining. In Cornwall, while there is some cultural attachment to the region's mining heritage, the continued presence of heavy metals in water and sediment means that new projects must demonstrate high standards of environmental monitoring and management to maintain public confidence. In Scotland, interviewees noted that companies often seek to distance themselves from historic mining practices, particularly in areas affected by abandoned open-cast coal mining.

> *"The [mining] legacy is extremely tarnished because of the collapse of the opencast coal industry in Scotland, where lots of sites were left unrestored". (Council 2)*

Across all metals studied, interviewees also highlighted the long-term nature and cost of environmental obligations associated with mining projects. Environmental standards in the UK can result in a large number of regulatory conditions, with one project reporting over 70 environmental conditions attached to its planning permission. Operators must demonstrate high environmental standards during operations and commit to remediation, biodiversity enhancement and environmental monitoring for decades after closure. For example, tin projects may be required to maintain mine water treatment systems, manage tailings facilities and undertake water monitoring for many years after operations cease. Interviewees noted that uncertainty around the scope and duration of these commitments can complicate investment decisions. At the same time, regulators and local authorities expressed concern about ensuring that operators have the financial capacity to meet long-term environmental obligations.

> *"what we don't want this time is for the mine to get the minerals out of the ground until it's no longer viable... to go bust and then there's polluted water going into the rivers again, because we've been there… what we need to do is to work out site aftercare" (Regulator).*

More broadly, several interviewees highlighted the tension between the environmental impacts of mining and wider sustainability goals. While critical minerals are essential for the low-carbon transition, the extraction and processing of these materials can be energy and carbon-intensive, raising questions about how projects align with regional sustainability and climate objectives.

Overall, strengthened environmental regulations that are specifically tailored to the needs and impacts of modern mining are crucial to support the long-term viability of projects and build and maintain public trust.

6. Summary of metal and region-specific risk profiles

6.1 Comparison table Tin, Lithium and Nickel

Table 2 summarises how the various challenges described in section 5 are salient for different metals, in different locations, at different points of the project life cycle. This is complex, but these points of difference are important in designing interventions that reduce barriers in constructive ways at the right points in time. The following three short sections of this report set out a slice of this complexity, as seen by each critical minerals represented in our data collection.

Table 2. Comparison table for Tin, Lithium and Nickel

Metal / region	Salient Non-Technical Risk	How the Risk Manifests	Impact on Projects
Tin in Cornwall	Mineral rights uncertainty Burdensome permitted development Planning bottlenecks & uncertainty Fragmented and complex regulation Finance gaps in early exploration phase Space constraints High cost of short and long-term environmental compliance	Legal uncertainty, time and cost burden to secure mineral rights Planning unpredictability & political sensitivity at committee stage Permitting across multiple regimes causes delay Capital constraints extends timelines Surface access constrained by housing and population density	Time commitment to assemble and manage land packages Delays to exploration and development Increased project costs and uncertainty Difficulties raising capital to move the timeline forward Costly innovative solutions to develop underground access
Geothermal Lithium in Cornwall	Mineral rights uncertainty and land access Permitted development misfit	Legal uncertainty, time and cost burden to secure mineral rights	Time commitment to assemble and manage land packages Delays to exploration

Metal / region	Salient Non-Technical Risk	How the Risk Manifests	Impact on Projects
	Regulatory ambiguity Novelty of technology High upfront finance costs	Multiple land access agreements required for multiple sites GPDO not compatible with drilling needs Does not fit neatly into EA regimes (water, waste, installations) Planners and regulators lack experience and expertise Community misunderstanding of lithium extraction Engagement needed across multiple sites	Long permitting timelines Disproportionate risk on pioneer developers Increased community engagement requirements Uncertainty for investors
Nickel in Aberdeenshire	Land access across multiple farms Regulatory ambiguity for advanced drilling High energy costs & lack of mid-stream processing Planning uncertainty at committee stage	Negotiating and managing multiple land access agreements Planning unpredictability & political sensitivity at committee stage UK projects struggle to compete with low cost production, high volume production	Time commitment for landowner relationship management Difficultly attracting capital Viable projects delayed or paused

6.1 Tin (Cornwall)

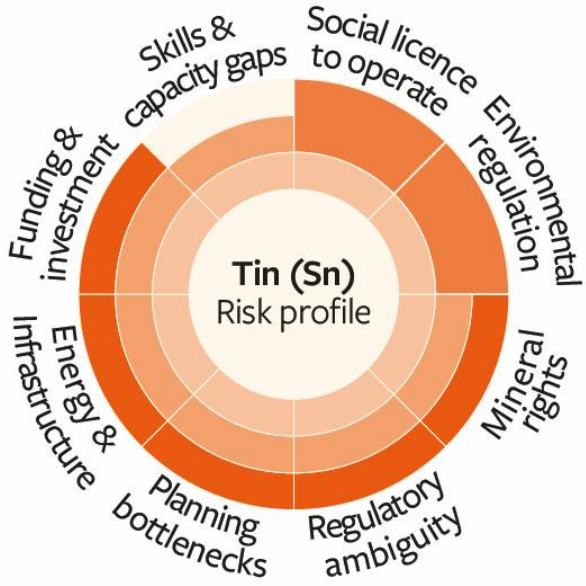

Figure 5: Tin risk profile

Tin mining in Cornwall has a high non-technical risk profile largely due to institutional, regulatory and socio-environmental constraints that manifest across the mining project lifecycle. While Cornwall benefits from a strong mining heritage and an increasingly supportive narrative around critical minerals for the energy transition, there remain key non-technical risks in practice.

Planning and regulatory risk is the dominant constraint for tin in Cornwall. Interviewees consistently pointed to the planning system as the most significant cause of uncertainty, delay and cost escalation. Ambiguity in planning rules and burgeoning requirements means that permitted development does not work with exploration timelines and project needs. Decision-making is perceived as untimely, unpredictable, and sensitive to political pressures. Well-prepared applications that are supported by the mineral planning authority can be delayed or refused at committee stage. Planners' limited understanding of business and project needs can have a knock-on effect on companies' ability to raise capital.

Regulatory complexity adds to the risk. Tin mining sits across multiple regulatory regimes with each administered by a different team with no coordination between teams and potential duplication of information and efforts. Although interviewees note that engagement with the

regulator is positive and constructive (helped by the new post of regulatory specialist) projects are slowed by long permitting timelines, unclear requirements, and the need to bring understandings of mine waste and water treatment to meet modern standards. This is particularly the case for historic mines being redeveloped. This challenge is compounded by lack of expertise and technical skills within the regulator and planning authorities, and under resourcing.

Mineral rights complexity is an ongoing early-stage risk across Cornwall. Cornwall's fragmented and opaque mineral rights system contributes significant legal, financial and timeline uncertainty during exploration. Ensuring due diligence on mineral rights often requires extensive historical archives research, negotiations with multiple rights owners, landowners and multiple bespoke agreements across a prospective area. While this risk has proven to be manageable by companies that are willing and able to dedicate time and effort, mineral rights complexity represents a high upfront risk that is a barrier to new entrants to the sector and can deter early-stage financing.

Financing is a risk across the tin project lifecycle. The exploration and development stages of projects face gaps due to the absence of UK mechanisms to incentivise exploration as in other jurisdictions. Listed UK companies cannot access schemes such as EIS, and public funding mechanisms. As a result, projects advance in incremental phases which extends timelines that are further compounded by planning and regulatory timelines that are out of sync with project needs. The lack of earlier-stage public financing means that viable tin projects remain capital constrained.

While Cornwall has a comparatively positive attitude towards mining, especially in former mining areas, **community-related social licence risk** increases as projects move from exploration to development. Public concerns focus on future impacts such as traffic, noise, visual impacts, housing constraints or devaluing house prices. In densely developed areas, competing land uses have already sterilised some of the mineral resource base, and combined with surface access constraints, have caused projects to develop more costly indirect or underground approaches.

6.2 Geothermal Lithium (Cornwall)

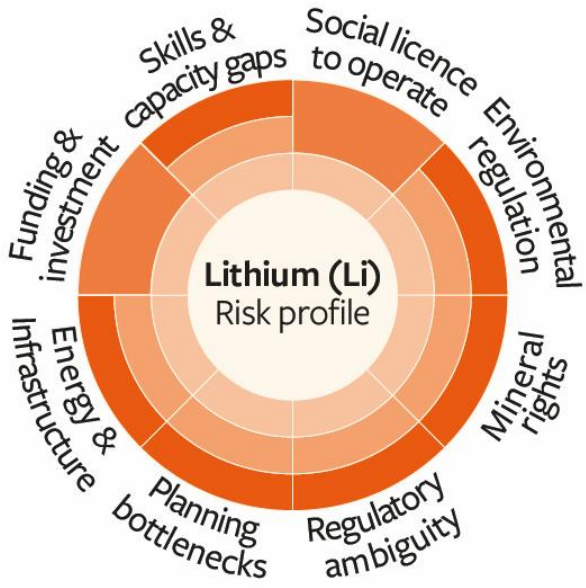

Figure 6: Lithium (geothermal) risk profile

Geothermal lithium projects in Cornwall have a distinct non-technical risk profile due to the **novelty of the extraction technology** and the challenges this presents for planning and regulation. While lithium as a material has strong strategic support from the government and is framed as a low-impact, future-essential technology aligned with Net Zero objectives, its hybrid nature sitting between mining, energy and water abstraction and use, creates significant **regulatory and planning uncertainty**.

Regulatory ambiguity is the most significant non-technical risk for geothermal lithium in Cornwall. The activity does not fit within existing environmental regulation regimes governing waste, water abstraction, discharge or industrial installations. The regulator is cautious that everything must be right, however the lack of expertise on lithium means that the regulator is learning on the job and drawing from other sectors and jurisdictions to be able to understand and effectively regulate this new sector. Developers must engage with multiple regimes (i.e. waste, water, installations) that were not designed for extracting metals from fluids meaning there are significant gaps as well as duplication of efforts. Early-stage geothermal lithium has relied on permitted development (GPDO) which is intended for temporary and low risk activities. The dispersed nature of sites creates an additional constraint, and no roll over for

permissions to allow for drilling over longer durations does not fit with project realities and timelines.

The novelty and unproven nature of the technology create the **potential for community mistrust.** Lack of understandings around geothermal drilling can lead to comparisons to 'fracking' and concerns about groundwater contamination and increased seismic activity. There is need for engagement tailored to each site to listen to and inform local people and counter any misinformation.

There is high uncertainty and apprehension about how risks will be assessed and which standards will apply, with the regulator concerned to strike a balance between supporting the sector and protecting communities and the environment. Because the companies and regulator are learning as they go along, there is disproportionate risk on the pioneer developers in this sector. As with tin, geothermal lithium in Cornwall faces challenges due to **mineral rights complexities** which presents an early-stage barrier. Geothermal lithium's dispersed sites means that explorers are negotiating with multiple rights owners and must enter into and manage multiple negotiations and land access agreements.

6.3 Nickel (Aberdeenshire)

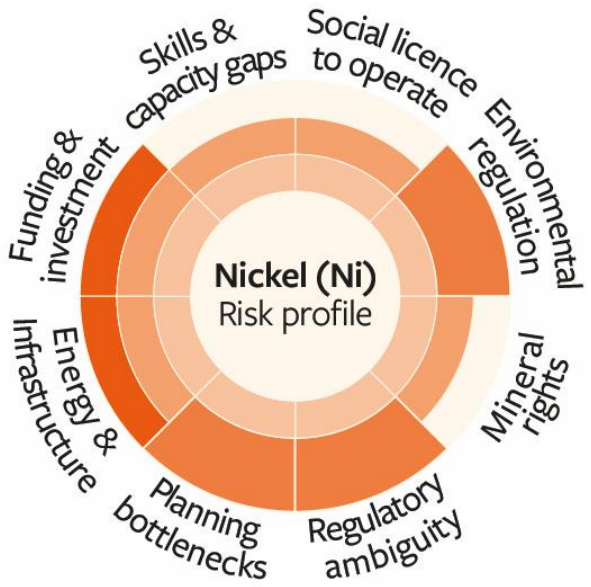

Figure 7: Nickel risk profile

Nickel projects in Aberdeenshire face a distinct non-technical risk profile dominated by **finance and investment constraints** that are shaped by **global market conditions, high electricity prices in the UK, and the absence of downstream processing capacity**. While the planning system in Scotland is generally viewed as more navigable than in England, **economic viability and investment risk** are salient constraints across the mining project cycle. Interviewees emphasised that nickel projects struggle to compete in the global marketplace due to low cost, high volume production in China and Indonesia. While developers welcome high environmental and social standards for UK nickel, projects must compete against nickel producers operating under lower regulatory, labour and environmental standards. There is the perception among investors therefore, that UK nickel projects will be uncompetitive unless projects are 'premium' either through high grade nickel, or nickel that is government supported. While developers claim that investors recognise the ethical advantage of UK production, they will be unwilling to factor this into investment decisions without government intervention or subsidy. **Commodity price volatility** further compounds this risk, as depressed nickel prices have led to mining suspended in some jurisdictions and increased investor caution.

Regulatory pathways for nickel exploration remain opaque, particularly for projects seeking continuous drilling or scaling up exploration. Scottish planning authorities have a working understanding of extractive industries where projects can be compared to quarrying or underground mining with limited surface impact. However, investment risk is closely tied to planning uncertainty at planning committee stage and applications remain vulnerable to refusal by elected members responding to public pressures that take priority over planner or consultee recommendations.

7. Risk Mitigation Actions

In this section we present a framework for action to reduce the risk of the non-technical barriers highlighted in the report's empirical findings (some of which are summarised in the interactive graphic on page 6). We have organised these by the stakeholder that we recommend should take ownership of the action.

Government

Risk – Ambiguous and complex regulatory landscape with no clear roles, responsibilities and regulatory pathways (**Tin, Geothermal Lithium, Nickel)**	**Mitigation –** Develop a national framework for critical minerals to clarify regulatory roles, responsibilities and permitting pathways across government and regulators.
Risk – Fragmented and poorly documented mineral rights ownership increases the cost, time and uncertainty of assembling exploration land packages due to historic severance and the absence of a registration requirement **(Tin, Geothermal Lithium, Nickel).**	**Mitigation –** Improve transparency of mineral rights ownership through a national mineral rights register that consolidates existing records and historic ownership data and explore mechanisms to encourage or require registration over time.
Risk – Lack of coordination across agencies involved in critical minerals exploration and development leaves companies navigating multiple authorities without a clear pathway for engagement or guidance **(Tin, Geothermal Lithium, Nickel).**	**Mitigation –** Establish a **Critical Minerals Coordination Office** as a central point for guidance, inter-agency coordination and information sharing across relevant authorities.
Risk – Inconsistent interpretation of permitted development rights under the General Permitted Development Order (GPDO) requirements across authorities increases exploration costs and can delay drilling programmes where permissions cannot roll between drilling	**Mitigation –** Standardise GPDO requirements for exploration and allow rolling permissions for low-impact drilling across multiple nearby sites, subject to environmental screening and public notification.

campaigns **(Tin, Geothermal Lithium, Nickel).**	
Risk – Regulatory ambiguity around novel geothermal lithium extraction technologies creates uncertainty in planning and permitting processes **(Geothermal Lithium)**	**Mitigation –** Develop and publish national guidance for geothermal lithium projects, clarifying regulatory expectations for exploration, extraction and environmental management.
Risk – Lack of funding mechanisms for high-risk exploration projects **(Tin, Geothermal Lithium, Nickel)**	**Mitigation –** Introduce targeted public risk-sharing mechanisms for early-stage critical mineral exploration to reduce financial risk and attract private investment.
Risk – Limited domestic processing capacity and infrastructure constraints weaken the viability of UK critical minerals supply chains, as most processing occurs overseas and regional energy, transport and housing constraints limit project development (**Tin, Geothermal Lithium, Nickel).**	**Mitigation –** Invest in infrastructure, energy and processing capacity to address midstream gaps and support regional preparedness for critical minerals projects by addressing transport, grid and local infrastructure constraints.
Risk – High electricity costs undermine the competitiveness and economic viability of energy-intensive critical minerals extraction and processing in the UK compared with other jurisdictions **(Tin, Geothermal Lithium, Nickel).**	**Mitigation –** Develop mechanisms to ensure the sector can access reliable, cost-competitive, low-carbon electricity for critical minerals extraction and processing.

Industry

Risk – Low awareness, misperceptions about critical minerals exploration projects combined with previous 'false starts' can	**Mitigation –** Establish an early local presence and provide clear, consistent communication about exploration activities and the mining lifecycle, highlighting the

undermine community mistrust (**Tin, Geothermal Lithium, Nickel)**	differences between exploration drilling and mining operations.
Risk – Ongoing community concerns about environmental impacts, visual impacts, noise, benefit sharing can generate opposition to projects (**Tin, Geothermal Lithium, Nickel)**	**Mitigation –** Maintain ongoing engagement with communities on environmental mitigation measures, monitoring results and project impacts, supported by independent third-party briefings and transparent discussions on community benefits and local employment opportunities.
Risk - Dispersed exploration sites with varied local expectations and engagement challenges (**Geothermal Lithium with some relevance for Tin and Nickel)**	**Mitigation –** Develop site specific early engagement plans that include stakeholder mapping, outreach approaches and feedback mechanisms.

MPA / LA

Risk – Early-stage exploration requires negotiating multiple land access agreements with different landowners, creating delays, legal complexity and inconsistent arrangements across projects **(Tin, Geothermal Lithium, Nickel).**	**Mitigation -** Develop model two-stage land access templates for exploration (e.g. exclusivity agreements for survey work followed by prospecting agreements for drilling) to reduce negotiation time and provide clearer expectations for landowners and developers.
Risk – Mineral Planning Authorities are **u**nder-resourced and often lack mining expertise & guidance (**Tin, Geothermal Lithium, Nickel)**	**Mitigation –** Provide resources for specialist mineral planners and enhanced pre-application support for exploration projects.
Risk - Planning system bottlenecks and overlapping responsibilities between agencies extends planning timelines (**Tin & Geothermal Lithium)**	**Mitigation –** Introduce coordinated pre-application scoping between MPAs and key consultees and ring-fence mineral planning fee income to address capacity constraints.

Risk – Mineral sterilisation and spatial constraints restrict access to mineral resources and increase project costs (**Tin & Geothermal Lithium)**	**Mitigation –** Ensure mineral safeguarding document are regularly updated and allow industry representatives to provide input into safeguarding reviews.
Risk – Planning committee decisions can diverge from planning officer recommendations, increasing uncertainty for developers (**Tin, Geothermal Lithium, Nickel)**	**Mitigation –** Provide training for planning committee members on critical minerals lifecycles, environmental safeguards and policy frameworks to support informed decision making.

EA / SEPA

Risk - Lack of a coordinated permitting pathway and limited regulatory expertise and capacity increase uncertainty and delay project approvals (**Tin, Geothermal Lithium, Nickel)**	**Mitigation –** Establish an integrated and coordinated permitting pathway for critical minerals projects, create a sector working group for regulators and continue funding the role of mining regulatory specialist.
Risk – Ambiguity in how regulatory thresholds for exploration drilling are measured and interpreted creates uncertainty for operators and increases compliance risk **(Nickel).**	**Mitigation –** Develop and publish guidance clarifying how drilling depth thresholds should be measured and applied (e.g. vertical depth versus borehole length) to ensure consistent regulatory interpretation.
Risk – Existing regulatory frameworks do not align well with modern mining techniques creating uncertainty around waste management and water regulation (**Tin, Geothermal Lithium, Nickel)**	**Mitigation -** Develop guidance on exploration drilling, mine waste classification and water management for modern mining operations.
Risk – Regulatory uncertainty around novel geothermal lithium extraction technologies delays permitting decisions **(Geothermal Lithium)**	**Mitigation –** Develop mineral-specific guidance for geothermal lithium and Direct Lithium Extraction (DLE) clarifying waste

	streams, water abstraction and installations regulatory interfaces.
Risk – Lack of clear frameworks for mine closure, including groundwater protection, soil contamination and long-term waste management and monitoring (**Tin, Geothermal Lithium, Nickel)**	**Mitigation –** Establish mine-specific closure guidelines and long-term monitoring frameworks coordinated between regulators, planning authorities and industry.

8. Conclusion

As demand for critical minerals continues to accelerate amid geopolitical uncertainties, the UK aims to secure a supply of critical minerals to support the clean energy transition and meet Net Zero and national security goals. The 2025 Critical Minerals Strategy, released in November 2025, emphasises the importance of the UK developing its own domestic capacity and confirms the importance of this research. Our study examined the non-technical barriers shaping the viability of domestic critical mineral exploration and development in the UK, drawing on in-depth qualitative evidence from tin, geothermal lithium and nickel projects in Cornwall and Aberdeenshire. While the UK possesses geological potential and increasing industry activity, the findings show that the current innovation ecosystem is not yet able to support the sector at scale. Fragmented governance, regulatory ambiguity, limited institutional capacity and social licence risks increase uncertainty, raise costs and extends timelines in the early stages of exploration projects when investor confidence is weakest.

Across the case studies we identified eight non-technical barriers including mineral rights complexity, planning system bottlenecks, skills and capacity gaps, infrastructure and processing constraints, challenges around community engagement, finance and environmental regulation. These barriers do not operate in isolation, but rather accumulate and reinforce each other across the project lifecycle. Understanding and mitigating against these non-technical risks is therefore key to whether projects progress, stall, or fail to get off the ground.

The priority areas for action synthesised from the mitigation actions are:

- **Develop a national framework for critical minerals** to improve policy coherence, clarify regulatory responsibilities and reduce investor uncertainty.

- **Improve transparency and accessibility of mineral rights ownership**, including exploring options for a national mineral rights register and mechanisms to encourage or require registration, reducing the cost and time burden of assembling exploration land packages.
- **Strengthen planning and regulatory capacity and technical expertise** within local authorities and regulators.
- **Clarify regulatory pathways for emerging technologies** including geothermal lithium and modern tin mining.
- **Provide targeted support for early-stage exploration** to reduce financial risk, support projects to progress and improve competitiveness.
- **Ensure access to cost-competitive, low-carbon electricity for critical minerals extraction and processing**, recognising that high UK energy costs undermine the viability of energy-intensive mining and processing activities.
- **Invest in infrastructure and domestic processing capacity** to address midstream gaps, support regional preparedness and strengthen UK critical minerals supply chain resilience.
- **Strengthen social licence and enhance community engagement** through transparent, consistent and meaningful two-way engagement practices that ensure local people's voices are heard.

Progress across these areas will require coordinated commitment from national and local government, regulator, industry bodies, skills providers and local communities. The analysis demonstrates that social and environment constraints are essential conditions for the long-term viability of critical mineral projects. While the assessment draws primarily on industry and institutional perspectives, it highlights the importance of complementing this evidence with further research that captures the experiences and perspectives of local communities affected by mineral exploration and development. Uncertain regulatory pathways, under-resourcing within planning and regulatory authorities and inconsistent approaches to community engagement increase misunderstandings, delays and loss of trust. Clearer guidance, better coordination between agencies, as well as early, transparent and meaningful two-way engagement with communities can improve outcomes for all stakeholders. High environmental

standards and strong public accountability emerge therefore as critical enablers of responsible critical minerals development. In this context, the findings and mitigation actions in this report provide practical and evidence-based insights to support delivery of the UK Government's critical mineral strategy 2025.

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