CHALLENGES AND SOLUTIONS FOR MINERAL EXPLORATION IN EUROPE

A TECHNICAL REPORT

European Investment Bank | Group

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Technical report: challenges and solutions for mineral exploration in Europe.

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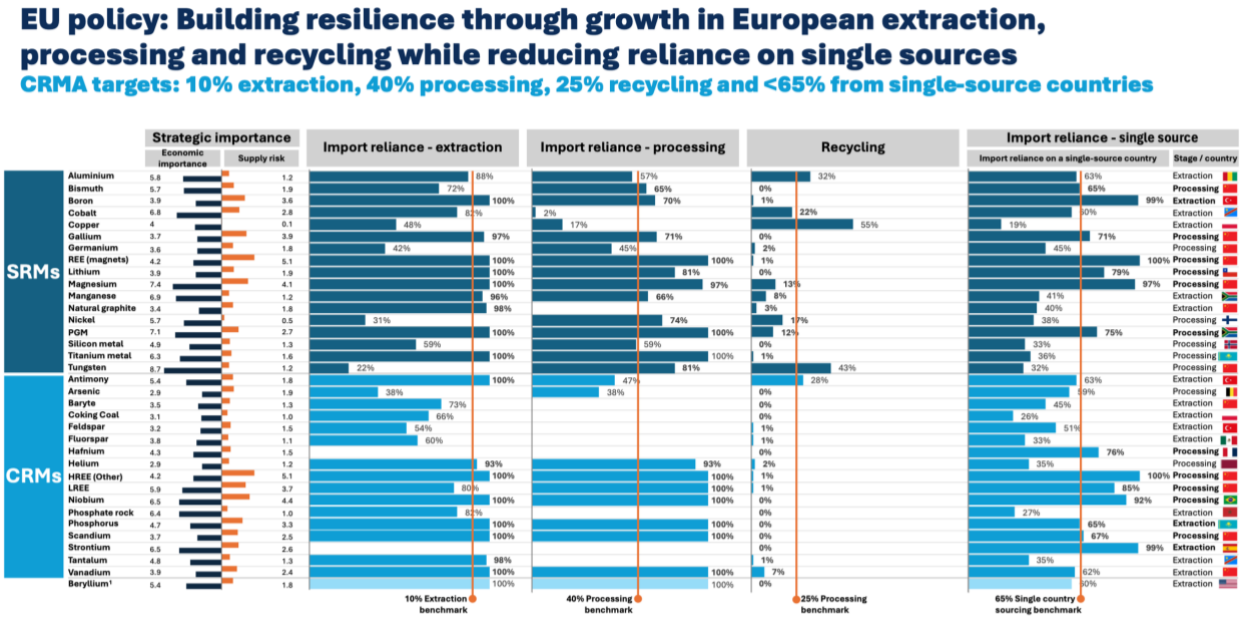
EXECUTIVE SUMMARY

Raw materials are indispensable for the European Union's future and mark the very beginning of industrial value chains. The European Commission assess 34 non-energy, non-agricultural raw materials as critical. The Commission's assessment is based on objective criteria, including economic importance and risk of supply disruptions, a factor that has shot up in importance since the COVID-19 pandemic and the recent increase in trade tensions.

Although critical raw materials are mostly produced and used in relatively small quantities, all have special characteristics that make them essential components for products in strategic areas such as renewable energy, digitalisation, aerospace and defence technologies. Well-known examples include rare earth elements found in the permanent magnets used to manufacture wind turbine generators, lithium used for batteries and silicon used for semiconductors.

In light of these applications, critical raw materials are key to the economic competitiveness of European industries and to many of the European Union's climate, energy, digital, defence and strategic autonomy goals.

Figure 1: EU policy goals for mining critical raw materials



Source: European Critical Raw Materials Act, *Supply chain analysis and material demand forecast in strategic technologies and sectors in the EU – A foresight study*, *Study on the critical raw materials for the EU 2023*.

Note: SRM stands for strategic raw materials, while CRM stands for critical raw materials. Materials marked with a 1 are not defined as a critical raw materials by the European Union, but are one of 12 critical raw materials defined by NATO.

Given their importance, the European Union has embarked on a strategy to secure access to critical raw materials by diversifying import sources, promoting recycling and substitution, and increasing domestic extraction and production.

This report focuses on domestic extraction and production. The European Investment Bank worked with Aurum Exploration Limited to prepare this technical report on the challenges and solutions for mineral exploration investment across the European Union's 27 countries. The study compares the European Union with leading mining

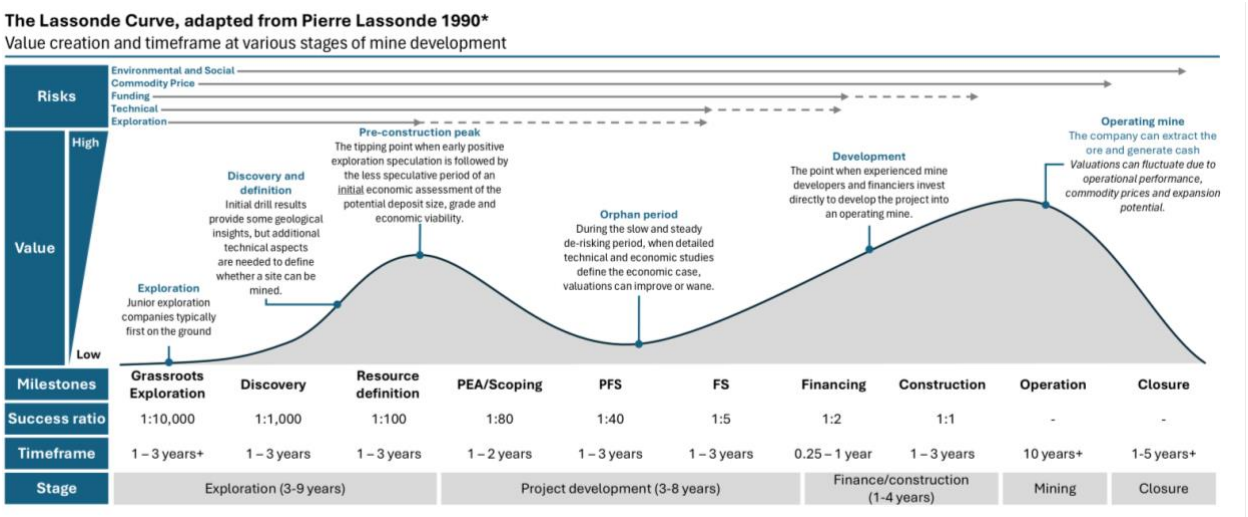
jurisdictions worldwide – including Canada, Australia, the United States, Chile, Japan and Ireland – to identify best practices that could catalyse exploration activity in Europe.

The European Union's Critical Raw Materials Act (CRMA), adopted on 23 May 2024, establishes ambitious targets for domestic sourcing of critical and strategic raw materials, including a goal of meeting 10% of the European Union's demand from domestic mining by 2030. However, policy ambition currently outpaces real-world capacity for exploration, technological and economic assessment and permitting. Decades of underinvestment in mineral exploration across the European Union have created a significant shortage of "shovel ready" mining construction projects. This study provides an industry perspective on factors inhibiting investment and identifies pathways to address these gaps.

Key findings

Early-stage exploration projects have a very high failure rate, approximately one out of every 10 000 projects succeed in the grassroots phase and one out of 1 000 projects in the discovery stage. Figure 2 uses the well-known Lassonde Curve, together with data from the Prospectors and Developers Association of Canada (PDAC) supplemented by industry experience, to identify ten distinct stages of mine development, with exploration comprising the first three stages that typically span three to nine years.

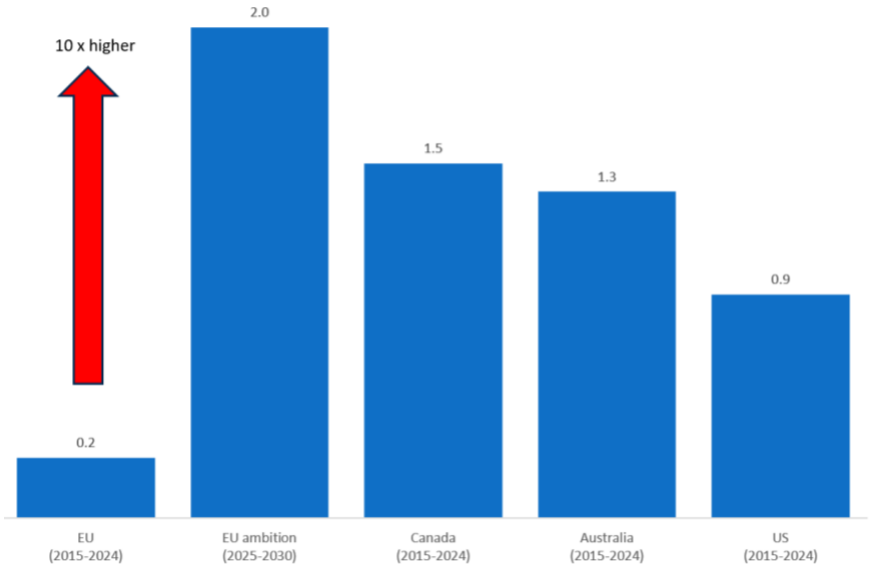
Figure 2: The Lassonde Curve: Ten stages of mine development



Source: The Lassonde Curve was first introduced by Pierre Lassonde in The Gold Book (1990), it was elaborated by Visual Capitalist and further expanded for this study by V. Williams of Aurum Exploration and J. Allott of the European Investment Bank.
Note: The Lassonde Curve outlines the company life stages, beginning with exploration and ending at production. It also shows the perceived value that investors broadly assign to each stage.

To meet targets laid out under the Critical Raw Materials Act, exploration expenditure would need to increase tenfold. Achieving the European Union's critical raw material sovereignty goals and the act's targets for domestic extraction will require approximately €2 billion per year in mineral exploration over the next five years – a tenfold increase over current expenditure of approximately €0.2 billion per year. This figure, derived from both top-down and bottom-up estimation methods, is elaborated in Section 2.3 of the full report. At the required level, expenditure would exceed current comparable expenditures for Canada (€1.5 billion per year) and Australia (€1.3 billion per year) and would be double that of the United States (€0.9 billion per year) (Figure 3).

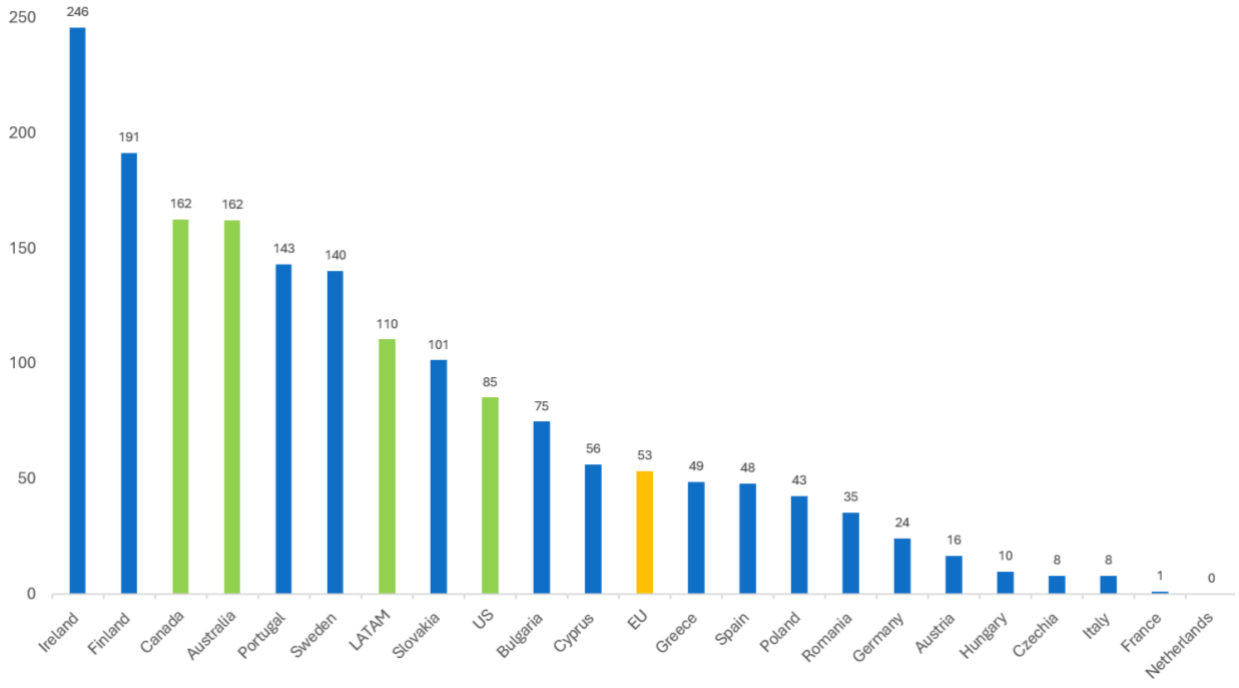
Figure 3: Annual exploration expenditure (€ billion)**, by jurisdiction**



Source: S&P Capital IQ benchmarking, Aurum historical exploration database
Note: 1 Due to project development timelines of 7-20 years mines will start several years after initial discovery.

The European Union lags global leaders in exploration investment by a factor of six to seven. An analysis of exploration budgets shows the European Union consistently underperforms benchmark countries on investment per capita and per square kilometre (Figure 4). In 2024, Canada accounted for 20% of the total global exploration budget, Australia for 16%, while the European Union represented only 3%. However, some bright spots exist in individual EU members: Finland, Sweden and, to a lesser extent, Ireland, Portugal and Bulgaria demonstrate spending levels per square kilometre comparable to Canada and Australia.

Figure 4: Exploration budget intensity (per km^2)**, European Union vs. benchmark countries, 1997-2024**



Source: S&P Capital IQ Pro.

Key challenges:

- Regulatory complexity and permitting delays extend exploration licence approval to two to seven years vs. one to two years in benchmark jurisdictions;
- Each EU country decides its own permitting rules, timelines and environmental frameworks, which results in fragmented regulations across the European Union;
- Limited public awareness of the importance of raw materials can heighten challenges and public opposition to projects;
- Underfunded national geological surveys produce incomplete or outdated geological mapping;
- Europe's junior mining sector remains poorly developed compared to Canada, Australia and the United States;
- EU countries offer few tangible incentives, such as tax credits, grants or fast-tracking of early stage exploration projects;
- Complex public funding mechanisms fail to address the specific needs of high-risk exploration activities.

Leading jurisdictions employ coordinated strategies to attract exploration capital. Canada and Australia stand out as benchmark countries, with Canada's flow-through share system[1] consistently accounting for 65% to 70% of capital raised on Canadian exchanges for exploration companies. This mechanism shifts tax incentives to investors, spurring substantial grassroots and critical mineral exploration activity. Both countries combine investor support mechanisms with robust geological survey programmes, streamlined permitting processes and clear regulatory frameworks.

Four EU members account for 75% of EU exploration drilling activity. Sweden, Finland, Spain and Ireland dominate current exploration efforts, clearly demonstrating significant untapped potential across the remaining EU countries.

EU-based sources provide minimal funding for early-stage exploration. Only 2% of junior exploration (small) companies' global expenditure and 3% of major mining company budgets flow to projects across the European Union. Early stage exploration is funded largely by a combination of a few European junior (small) exploration companies and a handful of major companies conducting brownfield exploration, supported by Canadian or Australian junior and mid-tier companies.

[1] Canada's flow-through share system allows mining exploration companies to "renounce" eligible exploration expenses to investors, who can then claim those expenses (and sometimes additional tax credits) against their own taxes, thereby lowering the effective cost of investment and channelling private capital into high-risk mineral exploration.

Recommendations

The study identifies two overarching themes subdivided into five strategic pillars, further broken down into 13 levers that could be used to improve exploration (Figure 5). Successful implementation requires EU governance to champion the overarching vision and importance of boosting exploration, providing clear direction and concrete support for EU countries to roll out coordinated frameworks.

Figure 5: The five pillars of action for EU countries and institutions

The fundamentals of EU exploration need to be addressed before capital can be effectively deployed at the scale envisaged

Theme	Strategies	Levers	Actions for EU countries	Actions for European institutions
Fix the fundamentals	Enable responsible exploration	Streamline and integrate permitting	Implement EU-wide improvements to permitting, reduce long lead times and overlapping ESG requirements, strengthen legal support.	European Commission mandates maximum deadline for permitting decisions. Provide technical assistance to EU countries and make use of existing Commission and EIB Group advisory programs, such as JASPERS.
		Enable land access and tenure	Educate public and land-owners about the Critical Raw Materials Act and rights and obligations to third parties when exploration and mineral rights have been granted.	
		Develop Infrastructure for field access	Consider providing either a) infrastructure (water, power or roads) or b) funding support to exploration companies to aid access in remote areas.	Provide complementary EU budgetary funding to national funding programs. The EIB Group can provide loans to EU countries, regions and public agencies
	Execute and promote the Critical Raw Materials Act	Implement the critical raw materials strategy	Develop national critical raw materials strategy, building on the European act, taking into account national specificities, reserves and industrial needs	European Commission selects strategic projects for streamlined development.
		Boost government-led promotion	National promotion of critical raw materials, visible support of exploration, regional events to share knowledge across regions (Nordics, Iberian, West Tethyan)	Elevate the EU RM Week into a major industry event with global footprint, like Indaba or PDAC. Attract more exploration companies and investment groups
		Educate to build capacity and awareness	Identify national skills-gap in critical raw materials, promote vocational and higher education. Raise the profile of mining through awareness campaigns.	Provide complementary EU budgetary funding to national funding programmes. EIB public-sector debt products already available can support national programmes.
	Fuel discovery with public geoscience	Supercharge national critical raw materials geoscience	Build/beef up national geoscience programs, focus on national critical raw material potential. Make public remote sensing, geology, geochemistry and geophysics.	Provide complementary EU budgetary funding to national funding programs, such as: - small states joint programs - negotiation of drilling cost EIB public-sector debt products already provide support national programmes. EU countries' target definition strategies and associated data could make investment more attractive.,
		Public-funded drilling	Consider public drilling programmes in high-potential or under explored regions, using national funds to catalyse private investment.	
		Designate Strategic zones/regions	Based on results of geoscience and other public data (historic mining areas) establish strategic zones with additional benefits for mineral explorers	
Fund the front-runners	Amplify exploration capital	Provide exploration incentives	Give tax incentives to exploration companies designed to top up or refund exploration expenditure for critical raw materials, Careful definition of implied costs.	European commission could complement national tax incentives with additional grants.
		Build investor support structures	Establish national exploration (and eventually mining) investment funds to provide equity injections to promising discoveries	Establish a financial instrument to de-risk and provide additional EU exploration funding
	Foster mining innovation ecosystems	Promote use of AI and targeting tools	Promote AI and other targeting tools by research institutions and companies though publicly available data (historic mine records/geoscience data)	Leverage existing EU support - e.g. Horizon Europe grant. EIB loans for corporate RDI or venture debt (aimed at start/scale-ups). EC led harmonisation of geological date.
		Nurture innovation for novel processing	Identify mining waste and/or geological deposits with processing challenges and promote public/private technology innovation to extract them economically.	As above leverage Horizon Europe grant and EIB corporate RDI or venture debt loans. EC could act as match-maker between technologies and deposits

Source: Prepared by Aurum Exploration.

Theme 1: Fix the fundamentals addresses the broader investment landscape through streamlining permitting frameworks, implementing the Critical Raw Materials Act and modernising public geoscience. **Theme 2: Fund the front-runners** addresses financial incentives needed to encourage exploration companies to commence operations in the European Union. EU countries must address Theme 1 for the investment landscape to become sufficiently attractive for investors to engage under Theme 2. Poor sequencing or partial completion of these actions will waste public investment, as the private sector will show limited appetite to participate without addressing fundamental issues.

The Five Strategic Pillars

Pillar 1: Enable responsible exploration

EU member governments should grant regional administrations authority to issue exploration licence applications and oversee compliance, while supporting companies through the environmental and social engagement processes. Clear public messaging on critical raw materials and the necessity for exploration will build consensus while reassuring communities about responsible practices. Educational initiatives should extend to secondary schools, where currently little to no information on exploration, mining or critical raw materials is featured in school curriculum.

Pillar 2: Execute and promote the Critical Raw Materials Act

The European Commission has established a robust and actionable CRMA framework. The Critical Raw Materials Act now tasks all EU countries with implementing practical ground-level actions that encourage exploration, requiring strong guidance and support from EU institutions. Promotion across all countries must place the act's objectives in the collective public consciousness, clearly articulating the risks of inaction and the need for secure EU supply chains.

Pillar 3: Fuel discovery with public geoscience

Article 19 of the act legally mandates that each EU country draws up a national programme for general exploration by 24 May 2025, including measures to increase information on mineral occurrences through mapping, geochemical campaigns, geoscientific surveys and data processing. National geological surveys provide the mechanism to achieve this. However, many suffer from significant underfunding and understaffing. Amalgamation of government departments once tasked with overseeing critical natural resources into broader departments has undermined capacity. EU countries should designate areas underlain by known mineral belts – including the Iberian Pyrite Belt, the Tethyan Arc, the Fennoscandian Shield and others – as strategic zones with specific incentives for critical raw materials exploration.

Pillar 4: Amplify exploration capital

Once EU countries establish fundamentals under Pillars 1-3, they should implement financial incentivisation mechanisms, drawing inspiration from successful benchmark countries. The European Union should examine mechanisms such as Canada's flow-through share system and other approaches successfully deployed in mineral exploration jurisdictions. The Junior Mining Programme (JUMP) – a €150 million framework facility for equity and quasi-equity investments in early-stage mining companies that is funded by the European Commission and implemented by the European Bank for Reconstruction and Development (EBRD) – provides a starting point. Currently, JUMP covers only 12 EU countries (27% of lands in the European Union). Establishing a JUMP-like facility for the remaining 15 countries – covering 73% of EU land area and including the entire top five states for current exploration spend – would enable a holistic EU response. Such a fund would require approximately €300 million to €500 million per year, based on the €2 billion exploration funding gap, the 73% land coverage and the capital mobilisation ratio (one to three or five times) that public investment typically catalyses.

Pillar 5: Foster mining innovation

Advanced remote sensing technologies, satellite systems, and algorithmic processing are now standard for regional exploration targeting. The evolution of 3D and 4D subsurface geological modelling, driven by artificial intelligence (AI) and machine learning, requires sustained funding to accelerate new deposit discovery. Europe's extensive mining history and research infrastructure position it to lead this technological innovation.

A critical opportunity lies in reassessing historic mining waste and challenging geological deposits. Funding research to unlock these resources could significantly impact CRMA timelines. Historical mine waste – including dumps and tailings – can contain multiple critical raw materials not previously extracted, now accessible through modern technologies. However, economic viability remains a key challenge, as many sites may prove marginally profitable or unprofitable.

Additional measures

Effective coordination between EU institutions, countries and private industry, combined with robust monitoring mechanisms, will maximise returns on public and private funding. Regular assessment of progress against targets will enable timely adjustments to strategy and implementation.

EU members should consider further incentivising exploration through tax relief on exploration funding, emulating the Canadian model. This would reduce the effective cost per metre of exploration for early-stage projects. Given extremely low current exploration levels in most EU countries, such measures would not result in a significant loss of tax revenue but could effectively boost exploration activity.

Conclusions

The European Union possesses significant untapped mineral potential. Performance at the EU country level demonstrates that matching the exploration expenditure levels of leading jurisdictions is achievable. Bringing EU-

wide exploration to Finnish expenditure levels per square kilometre would represent a fourfold increase, while matching Canada and Australia would require the targeted tenfold increase.

Decades of underinvestment in exploration have led to the region being incorrectly perceived as a mature, historically explored jurisdiction with limited new mineral prospects. Reversing this perception and achieving CRMA targets requires coordinated action across multiple fronts. Careful sequencing and coordination between EU institutions, EU members and private industry will maximise returns. Countries must address the fundamentals – streamlined permitting, robust geological data, clear regulatory frameworks and social licence – before financial incentives can effectively catalyse private sector investment. Without fixing these fundamentals, financial incentives alone will fail to attract the necessary exploration capital.

The European Investment Bank Group (the EIB Group) fully aligns with the goals of the Critical Raw Materials Act. Recognising Europe's dependency on critical raw materials imports, the EIB Group pledged in March 2025 to deploy €2 billion per year for funding critical raw materials projects across the entire value chain from extraction, processing and recycling. To date, the EIB Group has not financed upstream exploration at large scale, as the risk profile of exploration does not match the EIB Group's standard loan products. Exploration financing requires instruments geared towards equity rather than debt, with the JUMP programme representing a potential model for public support to exploration financing given its equity-risk features.

The pathway to critical raw materials sovereignty is clear: fix the fundamentals, establish appropriate financial mechanisms, coordinate action across EU countries and monitor progress rigorously. Success will reduce Europe's dependency on external suppliers for materials essential to the green and digital transitions. Failure to act presents unacceptable strategic and economic risks for the European Union.

1 BACKGROUND: THE MINERAL EXPLORATION SECTOR IN EUROPE

The following section is included for reference purposes and additional context for people not generally familiar with the exploration industry. Individuals with this knowledge may advance to Section 2.

1.1 What is mineral exploration?

Mineral exploration is the systematic process of identifying and evaluating geographical areas that potentially host economically valuable concentrations of metals and minerals. Exploration targeting may be carried out at a regional scale, covering several hundreds to thousands of square kilometres, or within smaller, defined licensed/permitted areas of between 25 and 100 km^2, depending on the country or jurisdiction.

The process begins with regional studies, where geologists analyse geological maps, satellite imagery, and structural features of the Earth's crust to pinpoint favourable settings. Following the regional targeting, early-stage exploration includes higher-resolution satellite or airborne image analysis and geochemical sampling, involving the collection of surface soils, rocks or stream sediments to detect anomalous concentrations of target elements. If initial indications are promising, more advanced methods may be applied. Geophysical surveys use the principles of physics to study the Earth's physical properties and internal processes. This includes variations in the Earth's magnetic, electrical or gravitational field properties, which help infer the presence and geometry of potential ore bodies beneath the surface. These indirect techniques are followed by drilling, the most definitive and costly stage, to retrieve core samples from depth to directly confirm the mineral content, grade and continuity of a deposit.

The discovery of mineralisation alone does not guarantee a route to mine development. Factors such as ore quality, extraction costs, infrastructure access, environmental sensitivities, community acceptance and sources of finance all determine viability. Mineral exploration is a combination of geological expertise, science, technology and risk assessment. It is a relatively high-stakes endeavour that compiles multiple layers of geological evidence to locate the hidden concentrations of natural resources on which industries and societies depend.

1.2 The importance of exploration

Mineral exploration is vital because modern economies rely on a steady and secure supply of metals and minerals for energy, transport, construction and advanced technologies. Without new discoveries, reserves deplete, costs rise and industries face supply risks. Exploration ensures future mineral resources to support innovation, infrastructure and economic stability. Within the European context, the importance of raw material supply risk is magnified. Europe has ambitious climate and energy transition goals, including electrification, renewable power and large-scale battery storage, which all depend on secure access to raw materials. As highlighted in the 2024 Draghi Report, Europe is highly import-dependent, often sourcing from geopolitically unstable regions. This reliance exposes industries such as automotive, aerospace and defence to supply disruptions and price volatility.

By investing in domestic exploration, the European Union can strengthen its strategic autonomy, reduce vulnerabilities in supply chains and align with the European Critical Raw Materials Act (CRMA), which sets targets for sourcing within the European Union. Moreover, exploration across the European Union is conducted under some of the world's most rigorous environmental and social regulatory standards, ensuring that resource development aligns with sustainability principles and community expectations. In short, mineral exploration is central to Europe's economic security, technological leadership and successful transition to a low-carbon future.

1.3 Exploration in the context of the Critical Raw Materials Act

The EU act directly addresses this challenge by setting targets for domestic extraction, processing and recycling. For the 17 critical raw materials below the 10% extraction benchmark – and especially for the 12 critical raw materials with no current EU production – exploration is the first step towards meeting these goals. Exploration enables Europe to identify and evaluate its own resource potential. By advancing exploration, Europe can strengthen its resilience, reduce reliance on external suppliers and ensure that raw material production occurs under high environmental and social standards.

1.4 Stages of mineral exploration

The stages of a mineral exploration project from the grassroots stage through to a mining operation are summarised, and each stage attracts different types of investor profiles. These stages are further elaborated in Section 2.

In the exploration-to-mining cycle, the process starts with grassroots exploration (a higher-risk investment), progresses through later stages of resource delineation (less risky) and reaches mine-site development and construction (least risky). The early stages of exploration are based largely on a geological concept or hypothesis based on available data acquisition, experience of similar mineral targets in other regions, and the expertise of the geologists developing the target model. All of this helps to determine where minerals may be located, and follow-up work goes through a logical series of exploration steps to either prove (potential economic deposit identification) or disprove (insufficient mineral concentrations), allowing the project to advance or be abandoned in favour of exploring elsewhere. Unfortunately, most exploration projects tend to be unsuccessful – the chances of successful exploration are set against significant odds.

The main stages of the development of a successful minerals project are listed below as five distinct stages. This sequence of steps is illustrated further as the Lassonde Curve in Figure 1.

A. Exploration (three to nine years)

- Grassroots exploration (one to three years)
  - Early-stage prospecting: claim staking, geologic mapping, sampling, geochemical and geophysical surveys, exploration drilling.
- Advanced exploration to discovery (one to three years)
  - Detailed drilling programs, trenching, advanced geochemical and geophysical studies, metallurgical testing.
  - Outlining of mineralised zones and estimating size/grade.
- Resource definition (one to three years)
  - Systematic drilling to define an orebody.

B. Project development (three to eight years)

- Preliminary and full feasibility studies (economic, environmental, engineering).
- Permitting and environmental baseline work.

C. Project financing and construction (one to four years)

- Mine design, financing, infrastructure building.
- Transition from exploration to production.

D. Mining and production (more than ten years)

- Extraction, processing, refining and closure planning.

E. Mine closure (one to five years)

- Physical and geochemical stability, water management, land rehabilitation, ecosystem restoration, socio-economic transition.

1.5 Types of mineral explorers and their role in exploration at each stage of investment

1.5.1 Role of the junior mining company in mineral exploration

Different classes of companies view exploration with varying levels of acceptable risk (Tables 1 and 2). Junior exploration companies are structured to take on higher acceptable geological risk in exchange for potentially greater rewards. Their business model usually focuses on discovery, generating new projects and advancing them just enough to attract joint ventures, farm-outs or acquisitions. While most juniors either get acquired or remain small, there are success stories of companies that scale up independently to mid-tier status. This requires significant discoveries and the ability to secure the large amounts of financing needed to grow. For example, Lundin Mining, a junior-style exploration company started in the 1990s that, through significant discoveries, evolved into a recognised and respected mid-tier to large-cap producer with operations across several continents. Another example is IAMGOLD, which started in the 1990s as a junior focused on gold in Africa and, through exploration success and partnerships, has transitioned into a mid-tier gold producer.

Juniors typically fund exploration through raising capital on stock exchanges such as the Toronto Stock Exchange (TSX) and Toronto Stock Venture Exchange (TSXV) in Canada or the ASX in Australia, which are recognised as primary sources of investment capital for exploration companies. Several other stock exchanges worldwide also contribute to the sector, including the London (LSE), Frankfurt (FSE), Hong Kong (HKEX) and New York (NYSE). Successful junior grassroots exploration creates a project pipeline for larger mining companies, which often prefer to let juniors carry out the early high-risk exploration before stepping in to acquire or enter a joint venture once a project shows real promise.

The key traits of a junior are risk-taking and pioneering. They raise funds and operate in the more speculative end of the exploration spectrum; they are less risk averse, and they pioneer new target areas and reassess historic areas. They usually operate in the grassroots and advanced exploration stages up to discovery.

1.5.2 The role of project generator companies in mineral exploration

The relatively recent appearance of niche “project generators” is a key component of the exploration sector. These companies raise private capital and work with strong technical teams of geologists, geochemists, geophysicists and remote-sensing specialists. They identify target areas, apply for licences, develop them with fieldwork and sampling, and present advanced projects for the next tier of finance – often either junior explorers or mid-tier companies. Juniors usually retain operational management of the project through the different stages of funding until the incoming party holds the majority shareholding.

1.5.3 Role of mid-tier mining companies in mineral exploration

A mid-tier company in exploration refers to one that bridges the gap between a junior and a major. Mid-tiers tend to be larger and better capitalised than juniors but not as globally diversified as majors. Some have grown out of a successful junior explorer following the discovery of a company-making project and have continued advancing the project into production, bringing with it the internal capacity to raise exploration funds and develop strong internal technical teams. These companies take more calculated technical risks by partnering with junior projects and conducting district-scale studies to generate exploration targets.

1.5.4 Role of major mining companies in mineral exploration

A major company in exploration and mining, refers to a large, multinational mining corporation with the financial strength, technical expertise and operational capacity to develop and operate world-class mineral deposits. Majors typically have diversified portfolios spanning multiple commodities – such as gold, copper, iron ore or coal – and operate mines across several countries. Unlike junior explorers, majors rarely focus on high-risk grassroots exploration and often acquire or partner with juniors once a project has been advanced and de-risked. Their role lies in bringing large-scale discoveries into production, managing multibillion-dollar capital projects, and ensuring a long-term, stable supply of key minerals. Majors dominate the later stages of the mining cycle. Examples include BHP, Rio Tinto, Anglo American, Glencore, Vale, Teck and Newmont, which represent the top tier of the industry in terms of size, production capacity and influence.

At the grassroots level, while some of the major companies may carry out large-scale regional generative studies, most prefer to leave this to junior exploration companies. The presence of majors in earlier-stage, large regional- or district-scale exploration programmes can be cyclic for any given company. A major may enter the grassroots arena for several years, specifically for a single commodity such as copper, base metals or uranium. This investment move before the project is usually driven by a commodity boom or a lack of new pipeline projects to add to their mineral inventories.

Majors generally step in once there are signs of a significant discovery and the increased costs of advanced exploration (discovery drilling, resource definition). When a smaller junior company needs higher levels of finance or technical support, majors may provide funding and technical muscle through joint ventures or earn-in agreements. Majors monitor global exploration activity to identify promising projects for acquisition. They become central players during the project development stage (pre-feasibility, feasibility, permitting), because this requires large amounts of capital and experience. Their role includes funding expensive feasibility studies; navigating environmental and social licensing; building relationships with governments and communities; and designing the mine plan, processing plant and supporting infrastructure.

1.5.5 Role of government geological surveys in mineral exploration

Government-funded geological surveys are critical to exploration. They carry out countrywide basic exploration programmes that cover large areas with wide-spaced data collection. Data may include geological mapping, geochemical sampling (rocks, soils, rivers) and geophysical surveys, which may be ground-based and/or airborne. Surveys may also carry out targeted exploration drilling in underexplored areas to develop important geological frameworks that identify the potential for mineralisation. These datasets allow a country to discover its mineral potential. These datasets usually become freely available to exploration companies, which can then license specific areas for more detailed exploration aimed at making a discovery. Across the European Union, some geological surveys are vastly more advanced than others. Certain jurisdictions are well known for mineral exploration and development, while others, based on either geological or financial constraints, are less advanced. The critical raw materials act mandates each EU country to develop a national CRM strategy (including exploration), which could have a significant positive effect on EU exploration.

Table 1: Relative positioning of company type and exploration stage

EXPLORATION STAGE	MAJORS (1)	MID-TIERS (2)	JUNIORS (3)	GOVERNMENTS (4)	PROJECT GENERATORS (5)
1.1 Exploration grassroots/ reconnaissance	Rarely involved directly; may fund alliances	Limited involvement; sometimes selective	Strong presence; risk-tolerant, first movers	Often support via geological surveys and mapping	Core focus – prospecting and assembling early-stage projects
1.2 Advanced exploration to discovery	Minimal; may monitor juniors/projects	Occasionally active in niche commodities	Very active with boots-on-the-ground exploration	Provide data, incentives or funding support	Lead role to identify and advance projects until partnerships
1.3 Resource definition	Engage via partnerships or acquisitions	Increasing involvement often at the drill programme funding stage	Active but often capital constrained	May regulate or co-invest in strategic projects	Typically farm-out projects at this stage to partners
2 Project development feasibility studies	Highly active with strong technical and financial capacity	Selective; focus on advancing key assets	Limited role; may sell projects to larger firms	Occasionally participate for strategic minerals	Usually exit after joint venture or option agreements
3 Mine development/construction	Lead role; only majors have capital scale	Capable but selective, often through joint venture	Rare; juniors seldom have financing capacity	Sometimes fund or operate state-owned projects	No role; projects already partnered or divested
4 Production and operations	Dominant; operate large-scale mines	Important operators, but fewer assets	Rare; with only exceptional cases with financing	Operate state-owned mines in some countries	No role
5 Closure and rehabilitation	Responsible for legacy site closure	Manage closure of their own mines	Rare; projects usually sold before this stage	Regulate and enforce closure standards	No role

Table 2: Relative financial appetite of company type and exploration stage

STAGE/FACTOR	MAJORS	MID-TIERS/INTERMEDIATES	JUNIORS
Financial scale	Multibillion budgets; can dedicate large sums to grassroots	Moderate budgets; capital mostly tied to operations or growth acquisitions	Very limited; raise funds project-by-project from investors
Exploration focus	Grassroots (that is, greenfield projects) and brownfield projects; need a long-term pipeline	Mostly brownfields (around existing mines) to extend the life of current operations	Mostly grassroots (high-risk, high-reward discoveries)
Risk tolerance	High, can spread risk across many regions/projects	Medium, cannot afford long high-risk programmes; need nearer-term results	Very high (by necessity); often single-project companies
Growth strategy	Reserve replacement through grassroots plus acquisitions of juniors' discoveries	Incremental growth through near-mine exploration and selective acquisitions	Value creation via discoveries; aim to sell/partner projects
Typical role	Provide capital and technical expertise; often fund juniors via joint ventures or earn-ins	Focus on mine-site exploration; occasionally acquire advanced project	Generate new prospects; test early-stage ideas; hand over to majors
Association with grassroots spending	Strong, because even a small percentage of substantial budgets represents significant capital, often channelled through junior companies	Weak, grassroots seen as too risky; limited funds better spent on operations	Strong, but in smaller absolute amounts; often depend on majors for follow-up funding

1.5.6 Typical role of different types of source capital in the exploration stage

Exploration financing routes vary according to project stage and company type, with each avenue reflecting distinct risk profiles. Early-stage projects experience rapid risk fluctuations, creating dynamic financing conditions. Junior companies encounter significantly greater capital acquisition challenges than majors, requiring access to specialized, risk-tolerant funding sources.

Table 3: Comparison exploration stage and investor type

STAGE	CAPITAL TYPE	ROLE AND CHARACTERISTICS
Grassroots	Private capital	Dominated by high-net-worth individuals, family and private offices, and small venture funds. Capital is speculative, high risk and often relationship driven
Advanced exploration to discovery	Private and retail	Juniors raise capital via private placements, friends and family, and retail investors (possibly royalty generation groups)
Resource drilling to early project development	Emerging institutional	Mid-sized funds and specialist resource investors (for example, mining-focused hedge funds or royalty generation companies). Still moderate to high-risk decisions based on technical studies
Late project development feasibility stage	Institutional	Larger private equity firms, sovereign wealth funds and strategic corporate investors Reducing levels of risk, this stage requires detailed technical and financial studies
Construction to production	Institutional and debt	Banks, streaming and royalty companies, institutional equity, and project finance (for example, debt) dominate at this stage Risk is further reduced, and capital levels are higher

2 HIGHER INVESTMENT RISKS OF MINERAL EXPLORATION VS. MINE DEVELOPMENT

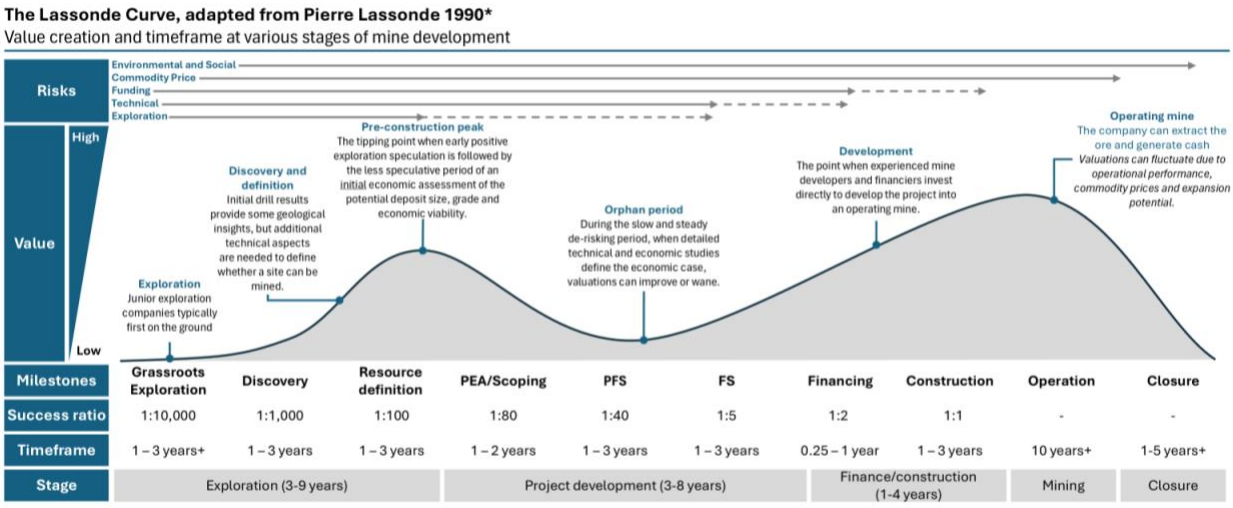
2.1 The Lassonde Curve: A visual depiction of value creation through the exploration cycle

The industry standard for presenting the value curve associated with exploration and mine development is the Lassonde Curve, developed by Pierre Lassonde, a Canadian mining financier and co-founder of Franco-Nevada. He introduced the Lassonde Curve to illustrate how the market typically values mining companies at different stages of project development. The curve starts with grassroots exploration and progresses through exploration, project development, financing/construction, mining and closure. The curve highlights that investor sentiment and perceived value don't increase in a straight line with technical progress; instead, projects often experience cycles of excitement, disillusionment and renewed interest as milestones are reached. Ultimately, returns on investment are multiplied and recouped during the years of production. The Lassonde Curve graphic has been modified many times since the original version, and Figure 1 shows a further modification for this report.

Using the Prospectors and Developers Association of Canada data together with the Lassonde Curve, we can define 10 distinct stages in a mining project, each of which is a key component to the prospect to mine cycle. Each of these stages has a variable timeline for completion. The progress of an exploration project from discovery to mine production broadly follows the same series of stages for any mineral commodity. A project may fail at any of these stages due to technical or economic factors or, usually, a combination of both. The reasons for exploration project failures are addressed in Section 1.3.

From the modified Lassonde Curve, typical exploration lead time – from grassroots to producing mine – can range from seven to 21 years. This broadly accepted figure is supported by an S&P Global report by Paul Manalo (2023), which reported the average lead time as 15.7 years. The report is based on 127 precious and base metal mines that began production between 2002 and 2023 and were discovered from 1980 onwards. The report illustrated that lead times were significant globally, with the two mines in Europe (both in Spain) showing an average lead time of 15 years. By comparison, Canada, with 11 mines, reported an average of 17.9 years, while Australia, with 11 mines, reported an average lead time of 14.5 years.

Figure 1: The Lassonde Curve: Ten stages of mine development



Source: The Lassonde Curve was first introduced by Pierre Lassonde in The Gold Book (1990), and was further elaborated by Visual Capitalist and expanded for this study by V. Williams of Aurum Exploration and J. Allott of the European Investment Bank).
Note: The Lassonde Curve outlines the company life stages, beginning with exploration and ending at production. It also shows the perceived value that investors broadly assign to each stage.

2.2 Typical ratio of success from exploration project to operating mine

The mineral exploration industry is recognised as a relatively risky business for investment, but with very significant financial upsides on returns if an exploration project advances to a producing mine. There are two worldwide, industry-recognised and often quoted rule-of-thumb metrics for illustrating the success rate of the exploration industry across different countries and jurisdictions. The most frequently quoted metrics, which illustrate the relative chance of success, are sourced from the Prospectors and Developers Association of Canada (2005b). Each metric corresponds to a specific stage of the exploration project.

2.2.1 Exploration : "prospect to mine" (1:10 000)

An exploration prospect is an area of geological interest where there may be indications of mineralisation, and early-stage exploration may include geological mapping, rock and soil sampling, and geophysics. At this stage, the available data are insufficient to define a potential resource and are based on an idea or exploration model requiring further testing. The Canadian association estimates that the ratio of success from exploration prospect to mine is extremely low – only one in 10 000 (0.01%) advances to a producing mine (PDAC, 2005b). This metric illustrates just how difficult it is to discover and successfully develop new mineral deposits from an early-stage exploration concept. With respect to the stages of the Lassonde Curve, this equates with the span covered by grassroots exploration to mine operation.

2.2.2 Exploration : "project to mine" (1:1 000)

A more technically comparable metric of projects across the industry is the ratio of exploration project to mine. An exploration project is technically more advanced; systematic exploration has been conducted and has moved beyond the prospect stage, where more detailed data are available. At this stage, exploration work such as diamond or reverse-circulation drilling may indicate more continuous zones of mineralisation and at coherent grades, giving more confidence that the project may advance further by developing a maiden mineral resource. The metric now proposes an improved level of success and estimates that, out of every one thousand of these more advanced projects, only one in 1 000 (0.1%) will advance to become a mine (PDAC, 2005b). With respect to the stages of the Lassonde Curve, this equates with the span covered by a project with a resource definition to mine operation.

These metrics highlight the extreme difficulty and risk involved in mineral exploration, especially in the earliest stages. At this stage, almost all initial prospects do not progress to mine development and production stages.

2.2.3 Exploration: Grassroots exploration (one to three years)

Exploration starts once an area has been identified as prospective for a specific commodity. This stage marks the early search for a mineral deposit and is conducted through ground-based activities such as sampling, geological mapping, geochemistry, geophysics and remote-sensing studies. When indications of the presence of mineralisation are confirmed, the programme may progress to early-stage drilling and additional sampling, followed by detailed analysis to determine the concentration and distribution of metals or minerals within the rock. Although exploration represents the phase of highest risk, success can be enhanced through strong technical expertise, responsible engagement with stakeholders and effective experience in capital markets.

2.2.4 Exploration: Discovery (one to three years)

Discovery marks the point at which grassroots exploration delivers success. It occurs when drilling intersects mineralisation that may be considered potentially economic, often assessed by benchmarking results against comparable, more advanced projects with a similar genetic model of formation and comparable mineralogical characteristics. Following a discovery, exploration efforts intensify to define the deposit's size, geometry and grade, as these factors are critical in evaluating a project's economic potential. At this stage, drilling activity is significantly

expanded and is complemented by additional geochemical and geophysical surveys, all aimed at further delineating and potentially enlarging the mineral resource.

2.2.5 Exploration: Resource definition (one to three years)

Once a discovery is confirmed and enough evidence suggests the mineralised zone may be potentially mineable, the project advances into the resource definition stage. The objective of this stage is to delineate the size and grade of the deposit in greater detail, effectively transforming a "discovery" into a classified "resource." This involves more intensive drilling, extensive sampling and comprehensive analyses, supported by statistical resource modelling. This stage requires a significant increase in funding, but the investment risk reduces significantly. The chances of success increase from ~1:1 000 to ~1:100 as drilling progresses and the maiden resource estimate is declared.

The process culminates in the preparation of a Mineral Resource Statement, which provides an estimate of tonnage and grade. Based on this information, a decision is made either to conduct additional drilling to increase confidence in the resource or to increase the size of the known mineralised zone, or to conclude that the deposit is not currently economic to develop due to financial or technical constraints.

2.2.6 Project development: Preliminary economic assessment/scoping study (one to two years)

After a promising deposit has advanced through the discovery stage and an encouraging Mineral Resource Statement has been established, the project moves into the Preliminary Economic Assessment or scoping study stage. At this point, the deposit is evaluated for its potential economic viability. The study incorporates a wide range of engineering data to estimate mine size, equipment and infrastructure requirements, workforce needs, and environmental and social (ESG) considerations. Capital estimates are typically in the ±40-50% range. In parallel, preliminary metallurgical testing is carried out to determine expected metal recoveries for the targeted commodity.

2.2.7 Project development: Pre-feasibility study (one to three years)

This stage is longer and more capital-intensive than the preliminary economic assessment, aimed at determining whether continued investment is justified. The study addresses in detail the engineering requirements and evaluates options for extracting and processing the mineral commodity. Often, additional resource and metallurgical drilling is conducted. At this level, capital and operating costs are estimated with an accuracy of roughly ±35%.

2.2.8 Project development: Feasibility study (one to three years)

Once the pre-feasibility study is completed, viable projects advance to the feasibility study, sometimes called a bankable feasibility study. This stage is designed to further assess economic viability, with costs estimated to within approximately ±10-15% accuracy. The feasibility study also finalises the definition of resources and reserves and includes extensive metallurgical testing, often supported by site-scale pilot programmes. At the same time, permitting activities continue, expanding to cover all aspects of the proposed mining operation. If the results are positive, the project will use the study to raise capital for later stages.

While feasibility studies are supposed to estimate costs (OPEX and CAPEX) within ±10-15%, it is worth referring to McKinsey research (Dussud et al., 2019), which surveyed 40+ mining construction projects in the last ten years, finding that 80% were over budget with the average overrun of 60%.

2.2.9 Financing (a quarter to one year)

Once the technical and economic viability of the project has been demonstrated, the focus shifts to the financing stage. This phase typically involves a wide range of stakeholders, including strategic partners, off-takers, streaming groups, and equity and credit providers. Experienced mining investors conduct rigorous due diligence across all aspects of the project to validate the development plan outlined in the study. During this process, significant risks may be identified, and a final investment decision is made. Financing at this stage may be structured through a combination of debt, equity, royalty agreements and other instruments, tailored to support the project's advancement.

2.2.10 Construction (one to three years)

Once economic viability has been confirmed and financing secured, the project advances to detailed engineering and construction. This phase involves building the infrastructure and facilities necessary to extract, process and transport the minerals. In some cases, the availability or development of supporting infrastructure can itself become a key factor in determining the mine's overall viability. At this stage, the company must assemble a capable management team and recruit the required workforce to support operations. Extensive planning and effort are also directed towards minimising environmental impact and maintaining meaningful engagement with communities and stakeholders. The phase concludes with commissioning, which includes testing of equipment, water treatment systems and overall performance to ensure a smooth transition from construction into full-scale operations.

2.2.11 Mining: Operation (more than ten years)

Bringing a project from discovery through to production can take many years before revenue is generated from the sale of the mineral commodity. Once in operation, mining follows a continuous cycle of drilling, blasting, loading and hauling ore to the processing plant, where the material is treated to extract valuable minerals. A mine's operating life concludes when the deposit is exhausted or when continued production is no longer economically viable.

2.2.12 Closure (one to five years)

Although mining operations *can* last for decades, they remain a temporary use of the land. For this reason, closure planning must be integrated from the earliest stages of mine development to ensure that, once operations cease, the site leaves behind a positive legacy.

2.3 Costs of mineral exploration to meet CRMA goals for EU domestic extraction

Top-down estimate of mineral exploration spending per stage

This is a very difficult metric to estimate as exploration costs can vary widely depending on country, jurisdiction, difficulty of terrain, commodity type, inherent difficulties of navigating different deposit model types, depths to mineral target, length of time to develop the project through to a resource, infrastructure and permitting, planning and finance. Individual projects may cost more, but a broad average budget rule-of-thumb would approximate as follows:

- Exploration: Grassroots exploration: ~€0.05-0.15 million per year – 1:10 000
- Exploration: Discovery: ~€0.4-0.6 million per year – 1:1 000
- Exploration: Resource definition: ~€1.1-15.0 million per year – 1:100

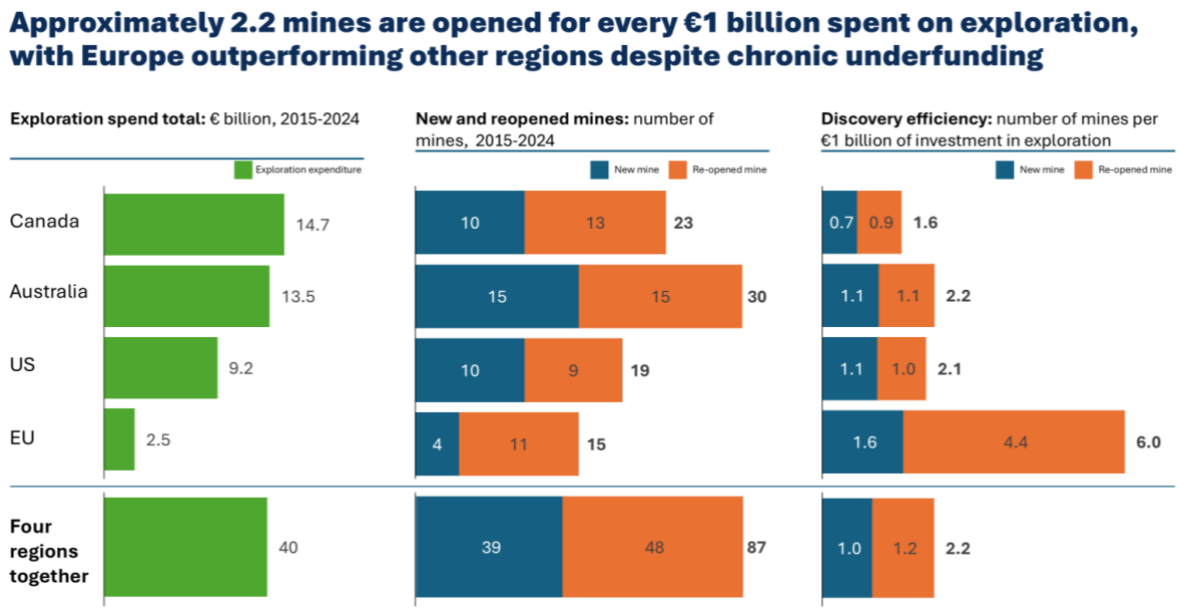
Using these cost estimates together with the typical failure rates of early-stage exploration projects, it is possible to estimate the annual cost for a hypothetical group of projects. Developing a purely grassroots prospect to a feasible economic mine equates to ~€1-3.6 billion per year in combined exploration spending in the first three stages of the Lassonde Curve.

Current exploration spending across the European Union between 2015 and 2024 is estimated at ~€0.2 billion per year (S&P CapitalIQ Pro, 2025). This illustrates a long-standing and significant gap between the EU exploration investment and the levels needed to meet CRMA targets. By comparison, over the same period, Canada and Australia spent €1.5 and €1.2 billion per year, respectively (S&P CapitalIQ Pro, 2025, this study).

2.3.1 Bottom-up calculation of mineral exploration spend per stage

According to the analysis of exploration spending and discoveries across the four jurisdictions of the European Union, Canada, Australia and the United States, between 2015 and 2024, approximately 87 metal mines began production – 39 from greenfield projects and 48 from brownfield projects (or restarts) – for a total exploration spending of ~€40 billion (S&P Global, 2025). This equates to a cost of exploration of €1 billion per one new and 1.2 re-opened mines (Figure 2).

Figure 2: Discovery rate and exploration spending, 2015-2024



Source: S&P Capital IQ benchmarking, Aurum historical exploration database.
Note: Data resolution prevented further disaggregation of discovery and reopened mines. A combined rate has been considered given the consistency of new and reopened ratios across the 4 regions and the last 20 years.

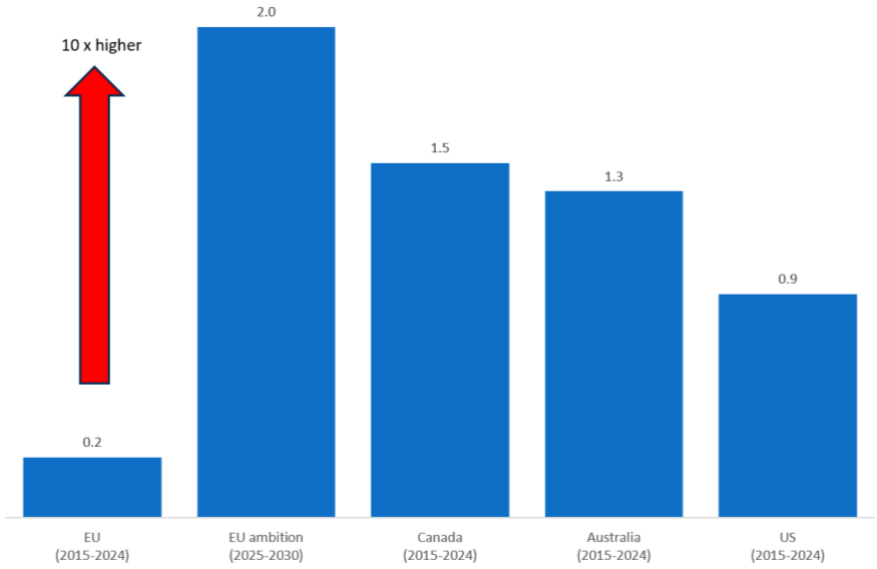
Analysis of the data shows that across the European Union, from 2005 to 2014, a total of 16 mines discovered from grassroots exploration commenced production. However, for the following 10-year period, 2015-2024, this reduced to four mines. Similar figures combining discoveries along with brownfield mine restarts show 23 and 13, respectively, across the two 10-year periods. This illustrates a concerning downturn in EU exploration in recent years.

The Critical Raw Materials Act's target for domestic production implies a desire to discover or (re)open at least 17 mines over the next five years (by 2030) – one for each critical raw material that is not currently meeting extraction benchmarks in the European Union. For this study, five non-CRM mines have been added to this ambition because

it is often impossible to distinguish the primary commodity of a mine at the grassroots stage. This means the minimum ambition should be at least 22 new mines by 2030.

It is estimated the mineral exploration required for the European Union to regain its critical material sovereignty will cost ~€2 billion per year over the next five years. This is a 10× increase over the current ~€0.2 billion per year spending. As shown in Figure 3, this is slightly higher than the current comparable estimated spendings for Canada (€1.5 billion per year), Australia (€1.3 billion per year) and the USA (€0.9 billion per year).

Figure 3: Annual exploration expenditure (€ billion)**, by jurisdiction**



Source: S&P Capital IQ benchmarking, Aurum historical exploration database
Note: Due to project development timelines of 7-20 years mines will start several years after initial discovery.

Public sources of funding alone cannot reach this level of investment; the private sector must be stimulated to fund the junior, mid-tier and major companies. If public investment banks are to enter the initial stages of exploration, then different types of investment models with acceptable associated risk mitigations must be developed. Furthermore, mechanisms other than loans may be needed for return on investment (for example, equity, royalty). A broad set of initiatives to tackle the European Union exploration market attractiveness is suggested in Section 5.

2.4 Typical reasons for failure of exploration projects

2.4.1 Industry cycles

Mineral exploration is a relatively risky industry, and investors and explorers understand the risks associated with potential failure as well as the significant upside of success. The demand for commodities outweighs the risks, such that financing has always been available to exploration companies; however, the industry is affected by broad fluctuations or commodity cycles characterised as “boom and bust” phases. These cycles can be very difficult to predict and can, in themselves, present a high underlying level of investment risk. During downturns, exploration investors, who remain, will be more selective with where globally and in which commodities or projects they invest.

Several structural and cyclical forces drive the wide fluctuations in global exploration spend. Figure 10 shows the ~10× swings in global exploration spend over the last 30 years (~$2 billion low in 2002 and $20 billion high in 2012). The drivers of this include:

Supply inelasticity: Commodity production often involves long lead times (for example, mining exploration projects), meaning supply is unable to quickly adjust to demand changes. This is when demand and prices spike, investors are attracted, but returns are slow to materialise, given long project development timeframes. Furthermore, the mineral exploration industry is poor at effectively deploying these large influxes of cash in exploration.

Global economic cycles: These cycles are characterised by growth periods (especially in emerging markets), which fuel demand for raw materials, while recessions reduce consumption.

Investment and speculation: Investment in commodity markets amplifies price movements.

Technological change: This is driven by technological innovations (for example, shale oil extraction, renewable energy), which can abruptly alter supply-demand balances.

Geopolitical events: An increasingly common factor, whereby conflicts, trade policies and sanctions disrupt supply and trade flows.

These cycles can be separate or can combine to create several recognised exploration and mining industry cycles:

The mining supercycle: When commodity markets experience unusually long and pronounced booms and busts (for example, the China-driven Supercycle of the 2000s-2010s).

The mineral commodity cycle: This highlights the role of global demand/supply dynamics that drive exploration spending. (for example, the boom in Lithium exploration in anticipation of battery demand growth).

The exploration cycle: This focuses specifically on the phases of investment into exploration activities. This can be influenced by other destinations for risk capital that exploration would traditionally attract. In recent years, such destinations have included the dot.com bubble (1990s-2000), the legalisation of marijuana in some countries (2000s), cryptocurrencies (2017-present), biotech and life sciences (1980s-2020s), and special purpose acquisition companies (SPACs) (2020-present).

Secular trends: Events such as the energy transition and decarbonisation affecting fossil fuel demand; shifts in industrialisation patterns across regions; and the growing influence of financialisaton and environmental and social governance (ESG) investment considerations.

Along with the broader industry-led factors that operate on a global scale as described, each exploration project exhibits inherent physical features, which may cause a project to fail.

2.4.2 Geological constraints

Complex geology: The mineralisation may exist but is too dispersed, deep, metallurgically complex or associated with contaminants (deleterious elements).

Inaccurate or incomplete data: Historical data dispersed or lost, poor sampling methodologies, outdated downhole or topographic surveys, or misinterpreted geophysics.

Geological factors: The most common reason that a developing project fails to prove the presence of any mineralisation or not in economic concentrations. Underlying reasons may include:

- Rock types did not provide a good host or trap for the mineralisation.
- The mineralising systems were not present or too weak and so not conducive to the localisation and concentration of an economic quantity of mineralisation.
- Source fluids carrying metals must meet a very specific range of temperature and chemistry and must be sourced from original host rocks that contain low levels of the same mineralisation. When this mineralisation is dissolved and transported, the fluids can cool and become trapped in a geological trap to create the deposit.
- Later fluids with differing chemistry or temperatures may pass through the same zone, altering existing mineralisation and depleting its grade by remobilising metal content elsewhere. An example of this is lithium-bearing spodumene pegmatites, which form at very specific temperature and chemistry ranges, forming high-grade lithium-bearing crystals in veins and dykes. Later fluid flow events with different characteristics can reduce the lithium content in these rocks, resulting in a sub-economic lithium grade concentration.
- Deposits may have formed and then at a later stage been folded, faulted and broken up into complex geometries, making mining difficult.
- Levels of weathering and erosion may erode a deposit away partially or completely, like concentrations of gold-bearing veins eroded and the gold transported in rivers into secondary depositional environments.

2.4.3 Financial and market-driven constraints

Financial constraints

- High exploration costs, especially in remote or politically unstable areas (logistics, security complexities).
- Lack of funding, whereby junior explorers or miners run out of money before reaching resource definition. This is a particular issue in downturns in the commodity cycles for explorers who must continue to explore due to the timelines.
- Equity dilution, when too many capital raises dilute investor returns, making future raises harder.

Market-driven factors

- When a commodity price drops due to economic or political factors, a marginally economic deposit may become unviable at the lower prices. This may result in a project being put on care and maintenance until market conditions improve.
- Investor fatigue and sector rotation lead to poor sentiment and potentially to capital flight from junior mining stocks. This is often a feature in a cyclic timeline.
- Negative feasibility study whereby a preliminary economic assessment or pre-feasibility study shows weak economics (for example net present value and internal rate of return). This can happen quickly for a project, if there is market and commodity price volatility and especially, in the context of the Lassonde Curve, this process may take anywhere between one and eight years to complete.

2.4.4 Jurisdiction, regulatory and managerial constraints

Regulatory and permitting challenges

- Permitting delays or denials whereby local, regional or national authorities may delay or withhold permits during lengthy and protracted planning and public negotiations.
- Environmental or social opposition from indigenous land rights groups and/or ESG groups.

Regulatory and political instability

- Risk of government expropriation (resources nationalisation), sudden regulatory changes.
- A change in political leadership may result in the revocation of or a moratorium on mining licences.
- Government imposition of unrealistic royalties on mining projects.

Strategic and managerial issues

- Promoter competence and reputation, whereby experience and credibility affect the ability to inform the public and shareholders of relevant market data, which can either inspire or degrade confidence in a project.
- Inexperienced management overseeing poor project planning, below-par execution or difficulties engaging in community relations reflects market confidence.
- Poor communication with stakeholders results in weak investor relations.
- Lack of exit strategy: no clear path to sale, partnership or production.

2.4.5 Environmental and social licensing constraints

Environmental restrictions

- Progress of a project may be blocked due to potential impacts on habitats and communities.
- Increasing areas of land being designated as National Parks, Natura 2000 sites (EU), UNESCO World Heritage sites (fundamentally a good policy), but it does restrict land areas and very often specific types of landscape, such as mountain ranges, which are some of the most geologically prospective areas to explore.

Social licence and community opposition

- Environmental protests can instil political and voter pressure and lead to the delayed issuance of existing permits, as well as add lengthy timelines for the issue of new permits.
- Provinces or provincial governments revoke permits.
- Protests by local communities fearing environmental issues without proper discourse.
- Public opposition can derail exploration, even if legal permits are granted.

Water access and rights

- Local communities opposing projects due to water use and contamination concerns.

Infrastructure and logistical constraints

- Early-stage progress is slowed by a lack of infrastructure, primarily roads, power, ports.
- The project only advances after a large investment and partnerships are established with infrastructure providers, once planning has been approved.
- Remote deposits need costly infrastructure, which can deter investment or delay timelines.
- Physical environmental constraints exist, such as operating in deserts, mountains and permafrost.

3 CHALLENGES FACING MINERAL EXPLORATION IN THE EUROPEAN UNION

3.1 Exploration across the European Union vs. benchmark peers

This study looked at a series of benchmark countries from around the world and assessed what factors each of the jurisdictions uses to attract and promote investment finance into mineral exploration at its earliest stages. We identified what key strategies these countries use and determined how the European Union may apply similar strategies to kick-start the industry to the 10× increase in investment levels targeted by the CRMA directives. Australia, Canada, Latin America (as a regional jurisdiction) and the USA were reviewed as the four primary benchmark jurisdictions. All these have a well-established exploration and mining industry, as well as a high regulatory standard, and can attract very significant investments (60-80% of global exploration spend).

A second group of countries, including Chile, Namibia and Japan, comprises jurisdictions that follow many of the primary promotional strategies but also exhibit different approaches to more specific regional challenges. The Republic of Ireland was chosen as a jurisdiction within the European Union that has a well-established exploration and mining industry and shows strong policy application. Other European Union examples could have been used, for example, Finland.

To illustrate the status of investment in exploration across the European Union and to compare against selected benchmark countries, licensed data from Standard & Poor (S&P Global) have been interrogated and used to determine key trends and factors affecting the industry in the European Union. S&P Global is a well-renowned third-party source of worldwide data relating to the exploration industry. It is a global provider of financial market analysis, benchmarks and credit ratings. Using these statistical datasets, observations can be made and conclusions relating to the status of the exploration industry across the European Union and the factors that inhibit growth within the sector.

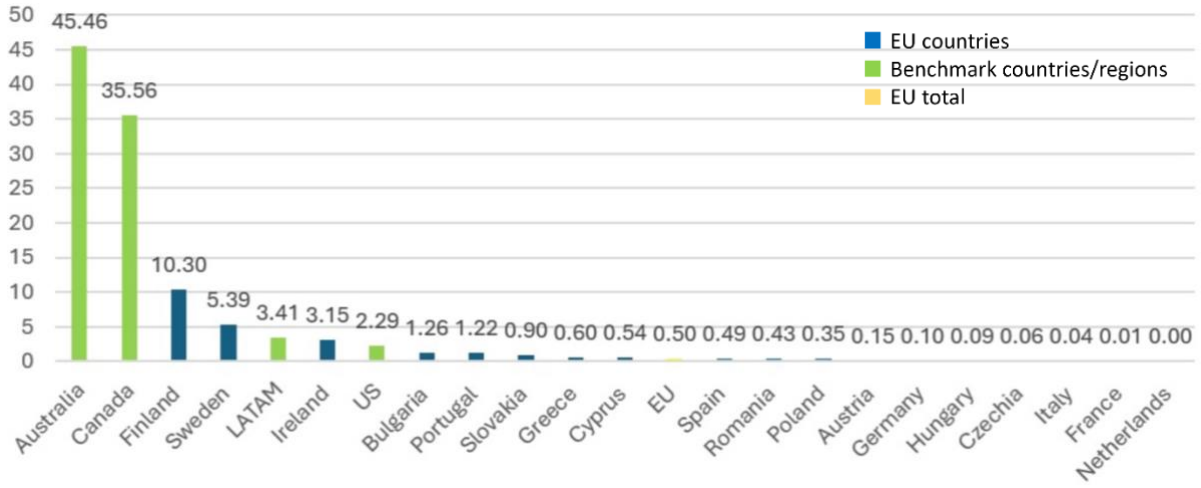
3.1.1 Exploration comparison, the European Union vs. selected benchmark countries – US dollar per capita

One of the standard methods of comparing exploration spending across different countries and regions is how many exploration dollars are spent per head of population. Figures 9 and 10 chart the annual average spending over two time periods: from 1997 to 2024, and more recently, from 2019 to 2024. The primary countries exploring for minerals in the European Union are compared against the four main benchmark countries of Australia, Canada, the USA and the region of Latin America. There is also an average bar for the whole of the European Union across those time periods (data source S&P CapitalIQ Pro, 2025, this study). The main purpose of choosing these two time periods is to illustrate the 27-year average since data were collected and compare it to the most recent six-year period to see how the investment landscape may be changing in the context of renewed interest in Europe about the issuing of the Critical Raw Materials Act.

Period 1997-2024

Across the 27-year period, Australia and Canada have been consistently ahead for exploration dollars per capita at $45.46 and $35.56, respectively. The European Union across the same period registers $0.5 per capita, showing a significant gap in exploration investment. Three EU countries have consistently remained ahead of the EU average: Finland ($10.30), Sweden ($5.39) and Ireland ($3.15). This highlights some key underlying points. Each of these countries has (i) prospective geology, (ii) known mineralogical endowment and most importantly (iii) more advanced exploration permitting and legislation systems than the rest of the European Union countries (Figure 4).

Figure 4: Exploration budget intensity ($ spent per capita)**, European Union vs. benchmark countries, 1997-2024**



Source: Own calculation based on data from S&P CapitalIQ Pro

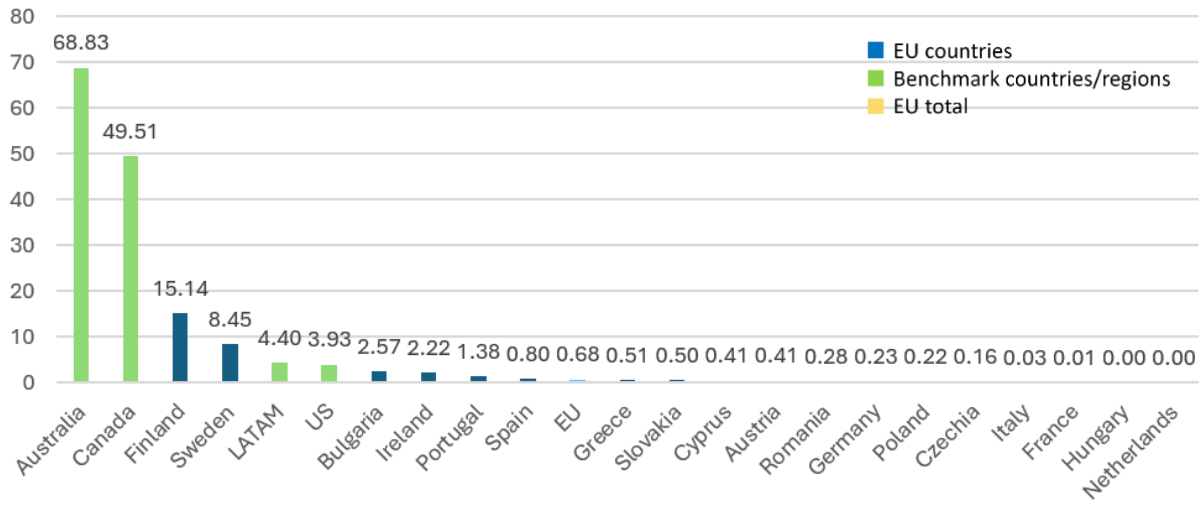
Note: EU countries not displayed had no data or had not exploration budget.

Period 2019-2024

The six-year period from 2019 to 2024 has seen some changes. Australia and Canada increased their per capita spending ratio to $68.83 (+$23.38/51) and $49.51 (+$13.95/39%), respectively, recognising the push for countries to become more self-sufficient in mineral commodities in general and critical/strategic minerals in particular. The EU countries only showed modest spendings ($0.18/36%) increase to $0.68/capita. Finland ($15.14) and Sweden ($8.45) continue to make significant increases, but most of the rest of the European Union countries have remained low, illustrating that levels of promotion – and investor attractiveness – has stagnated (Figure 5).

There are several countries within the European Union that, until recently, mined significant amounts of mineral resources. Most of these mines have now reached maturity or have closed, and during the same period, very few new projects reached the mining stage. These countries, including Spain, Portugal and Germany, along with other EU countries, remain highly prospective for discoveries. But exploration spending and perceived attractiveness for exploration investment are much lower for their level of mineral prospectivity. If inherent geology/prospectivity is not the problem, then other factors – such as legislation/policy and a lack of incentive schemes – may be dissuading exploration companies.

Figure 5: Exploration budget intensity ($ spent per capita)**, European Union vs. benchmark countries, 2019-2024**



Source: Own calculation based on data from S&P CapitalIQ Pro.

Note: EU countries not displayed had no data or had no exploration budget.

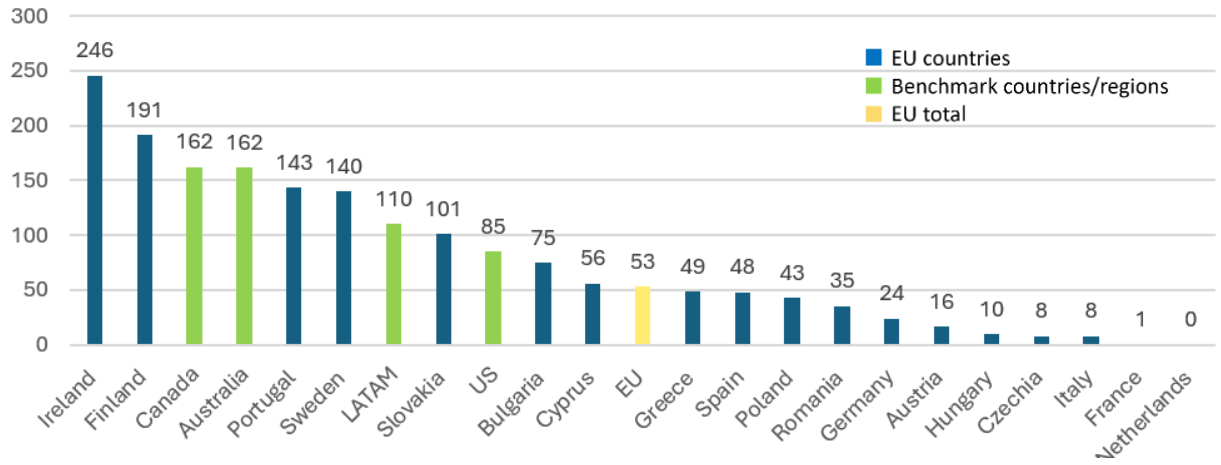
3.1.2 Exploration comparison, the European Union vs. benchmark countries – US dollar per km2

Another metric for assessing exploration spending across different countries is to compare how many exploration dollars are spent per km^2 of the country's land area. Figures 6 and 7 chart average annual spending over two time periods: from 1997 to 2024, and more recently from 2019 to 2024.

Period 1997-2024

During this period, Ireland ($246/km^2) and Finland ($191/km^2) reported higher spending per km^2 than those of the two primary benchmark countries, Canada ($162/km^2) and Australia ($162/km^2). Considering their relative sizes, this shows strong and consistent exploration across the 27-year period. Portugal ($143/km2), Sweden ($140/km2) and Slovakia ($101/km2) also reported relatively robust exploration industries during this period, while most of the remaining EU countries recorded spending levels that were significantly lower (Figure 6).

Figure 6: Exploration budget intensity ($/km^2)**, European Union vs. benchmark countries, 1997-2024**



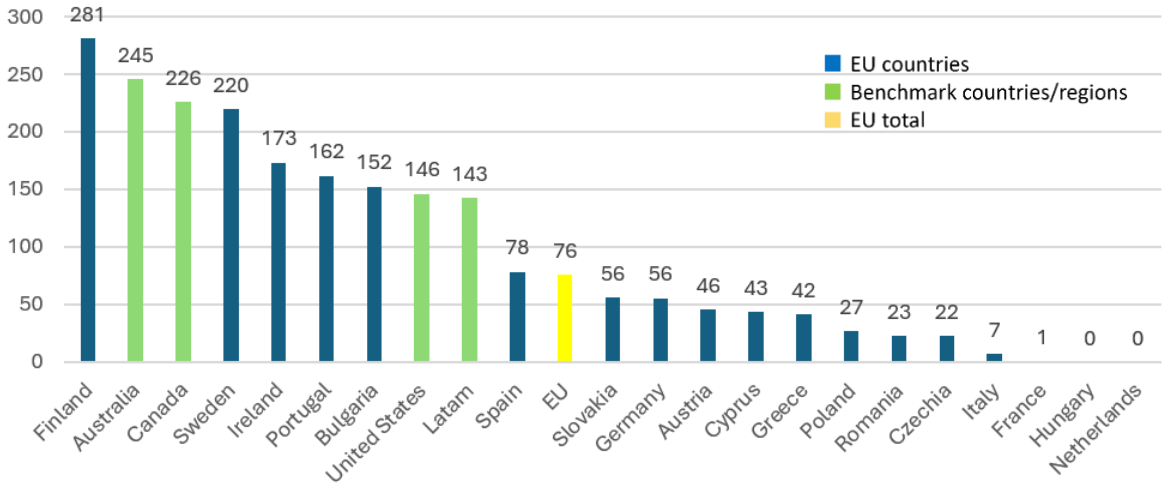
Source: Own calculation based on data from S&P CapitalIQ Pro 2025.
Note: EU countries not displayed had no data or had no exploration budget.

Period 2019-2024

During this period, Ireland reduced to 70% of its 27-year average ($173/km^2), but Finland ($281/km^2) and Sweden ($220/km^2) reported increases of 147% and 157%, respectively. This compares favourably with the two benchmark countries, Canada ($226/km^2) and Australia ($245/km^2), which similarly show increases of 140% and 151%, respectively (Figure 7).

These figures should be interpreted with the caveat of restricted capacity for exploration companies during the global COVID-19 lockdown, which started in March-April 2020 and extended through to mid-2021. This clearly is linked to the slowdown in exploration spending across Europe. However, during the same period, the benchmark countries – and EU countries with a more robust policy system (Finland, Sweden) and, to a lesser extent, Ireland, Portugal and Bulgaria – managed to maintain exploration intensity levels. On average, the rest of the European Union ($53 to $76/km^2) shows only a marginal increase over the two different time periods.

Figure 7: Exploration budget intensity ($/km²)**, European Union vs. benchmark countries, 2019-2024**



Source: Own calculation based on data from S&P CapitalIQ Pro.
Note: EU countries not displayed had no data or had no exploration budget.

3.1.3 Exploration across the European Union: Global budget by geographic areas

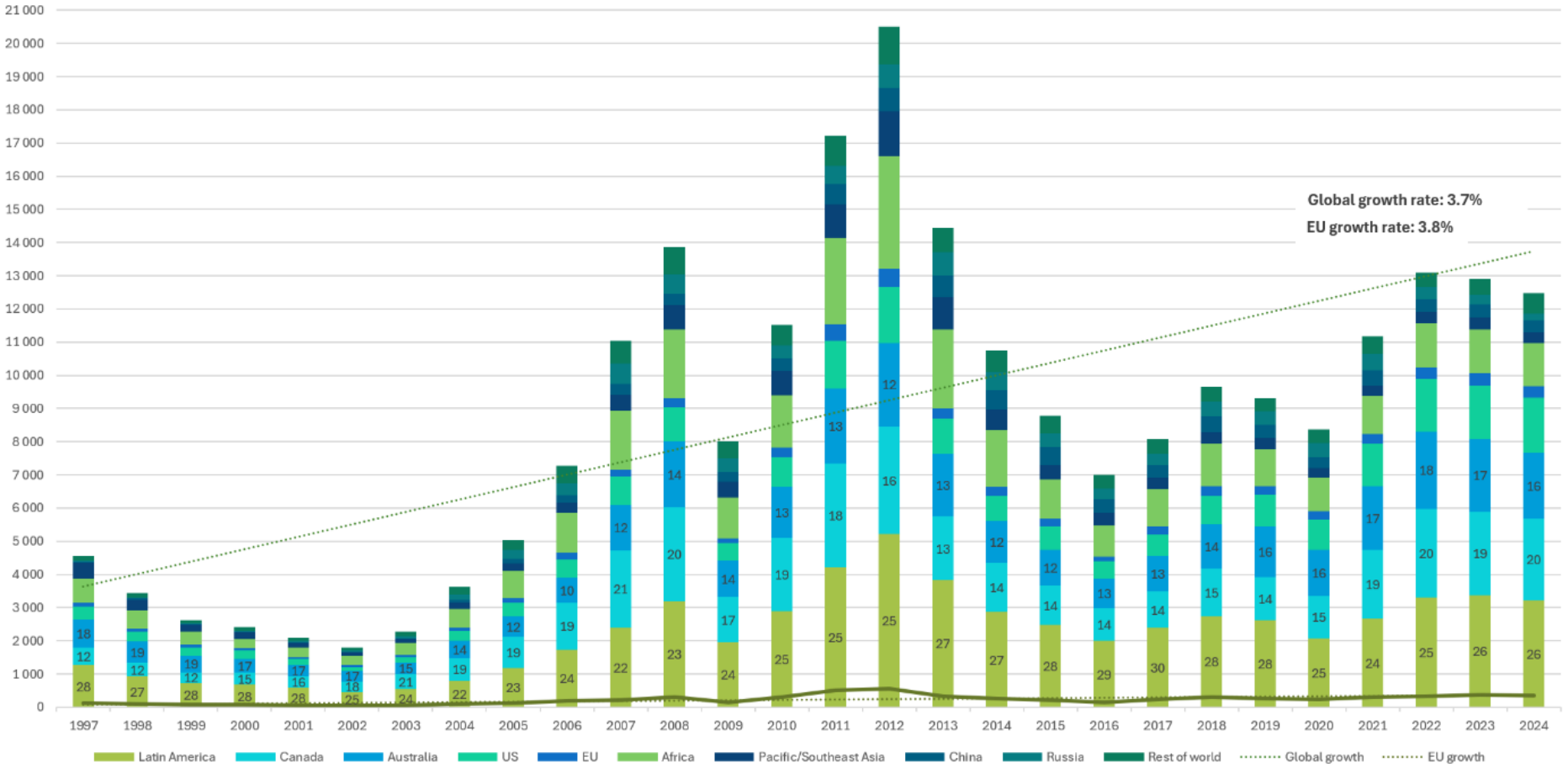
A key indicator of the relative health of exploration financing across the European Union is a comparison with global exploration spending over time. Since the EU announcement of the European critical raw material act and associated initiatives, it is possible to see if there has been a renewed interest across the European Union to carry out exploration either by EU companies or by non-EU companies. Over the last 20 years, Canadian and Australian juniors have taken a great deal more interest in Europe and Africa as jurisdictions to invest and explore. However, evidence from recent years shows a drop in exploration activity by these companies in both jurisdictions, in favour of increased exploration in their "home" jurisdictions. This has, in part, been fuelled by increasing competition for risk capital over that same period from competing industries, as well as the developing opinion that Europe is becoming more difficult to operate in relative to Canada and Australia.

A review of the S&P data between 1997 and 2024 (Figure 8) charts global exploration budgets over this period and highlights the exploration budgets of benchmark countries – Australia, Canada and the USA – against the European Union and other countries and regions, including China, Asia/Pacific, Russia, Latin America and the rest of the world (data source S&P CapitalIQ Pro). The data illustrate that the European Union proportion of global exploration spending has remained remarkably unchanged over the recorded period between 1997 and 2024, ranging between 2% and 4%, even during the positive and negative global exploration commodity cycles. This clearly indicates that attracting a greater proportion of the global budget to the European Union should be a key strategy going forward.

Looking at the exploration-related spending that were taking place within the European Union during the 1997-2024 period (Figure 9), three countries – Sweden, Finland and Spain – have consistently recorded the highest proportion of all the EU spending ranging between 50% and 77% of the total EU budget (S&P CapitalIQ Pro, 2025, this study).

Over the same period, several other countries have shown significant spending for short periods, such as Ireland (2007-2022), Germany (2010-2013 and 2018-2024) and Portugal (2007-2014). However, none of these have been so consistent as Sweden, Finland and Spain. Clearly, this is most likely a function of the legacy mining history of these countries, and they have a high public awareness of the exploration and mining sector, as well as a relatively effective permitting system throughout that period. This is the standard that all the other EU countries need to attain to attract future exploration investment.

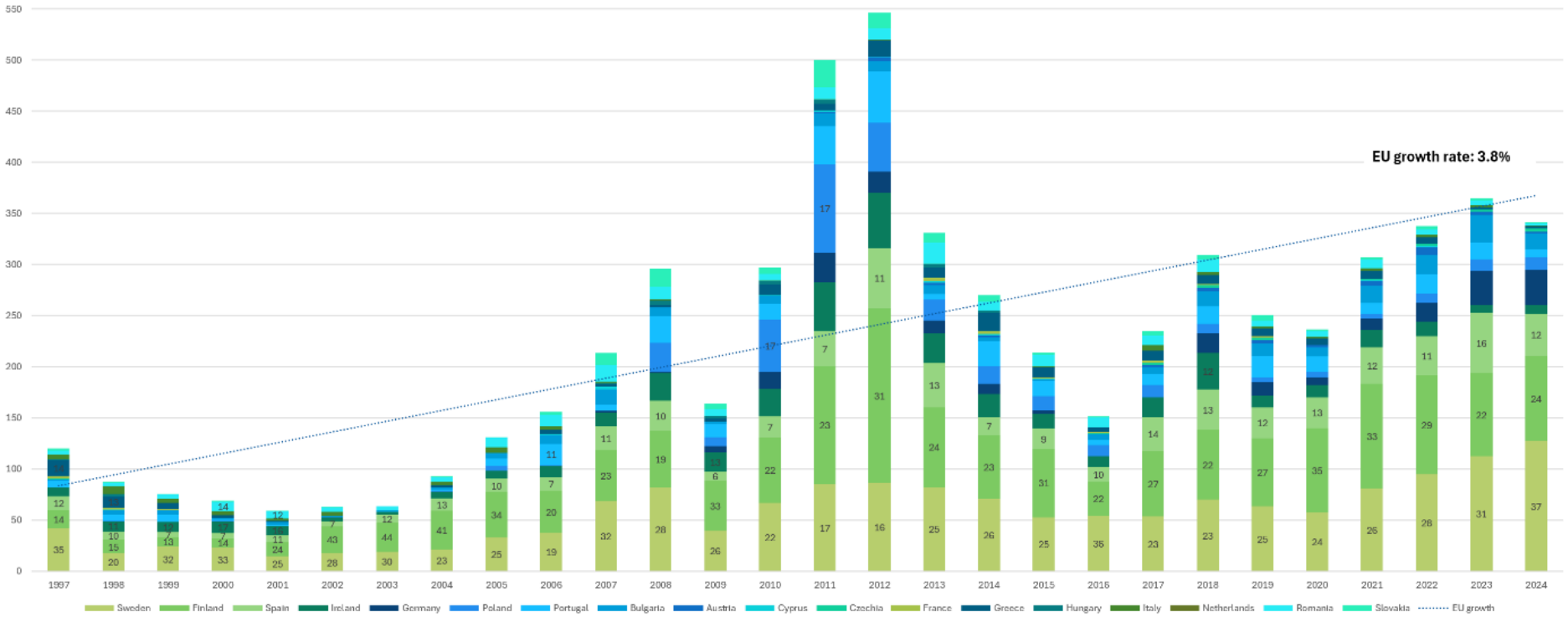
Figure 8: Annual global exploration budget ($ million; % of total)**, by region, 1997-2024**



Source: S&P CapitalIQ Pro.

Note: EU countries not displayed had no data or had no exploration budget.

Figure 9: Annual global exploration budget ($ million; % of total)**, by specific EU countries, 1997-2024**



Source: S&P CapitalIQ Pro.

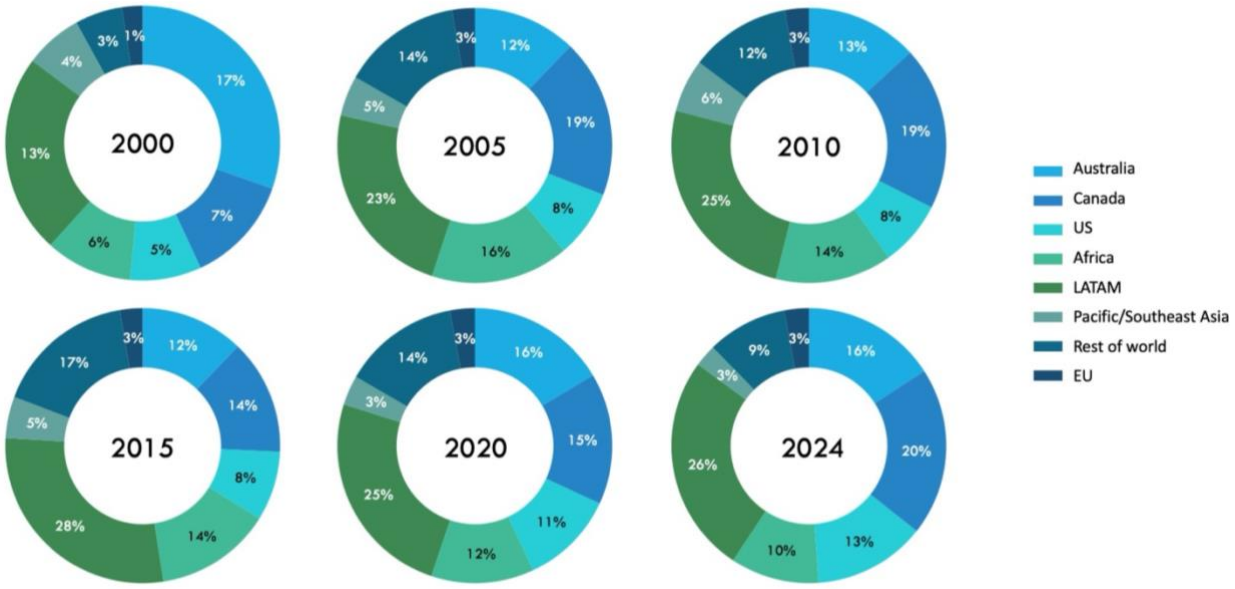
Note: EU countries not displayed had no data or had no exploration budget.

3.1.4 EU share of global exploration budgets, 2000-2024

When looking at the S&P data in five-year stages between 2000 and 2024, the EU share of global exploration budget has remained remarkably static. The European Union has a long historical association with exploration and mining, which has dwindled over the years, as other countries have discovered bigger and better deposits in arguably easier geographical regions to operate in (Figure 10).

The perception that the European Union may be a relatively difficult domain to operate in due to the population density is a very real drawback. However, the historical legacy of mining in the European Union, along with the historical knowledge and familiarity of the populace with the industry, coupled with the high technical levels of expertise generated by long-established universities and mining schools, makes the region still attractive. It appears the mineral potential of Europe may have been "forgotten" as EU-based companies spread their exploration activities worldwide. The time has now come for the European Union to collectively promote the jurisdiction more aggressively, and they must show that the fundamentals of regulation and permitting are modernised and coordinated across the whole European Union. Promotion by EU countries at events such as the prospectors and developers association of Canada (PDAC) – where already Ireland and the European Union collectively have booths – is a very good start, but these efforts need to be significantly ramped up to attract the levels of investment required.

Figure 10: Share of global exploration budget, 2000-2024



Source: S&P CapitalIQ Pro.

3.1.5 Exploration drilling statistics across the European Union

Exploration drilling is a very practical metric, as it illustrates exactly how much of the exploration is focused on more advanced projects. It should be noted that these figures also include drilling adjacent to existing mine operations – or so-called "brownfield" exploration. Large amounts of exploration funding can be utilised in early-stage exploration, including geological mapping and sampling, geochemical and geophysical surveys, and remote sensing. However, when it comes to testing and developing a mineral resource, the only way to advance a project further is diamond drilling, one of the more expensive exploration techniques. At this point, potential investors start to get more interested, and risk perception begins to reduce, as potential investors compare projects and review

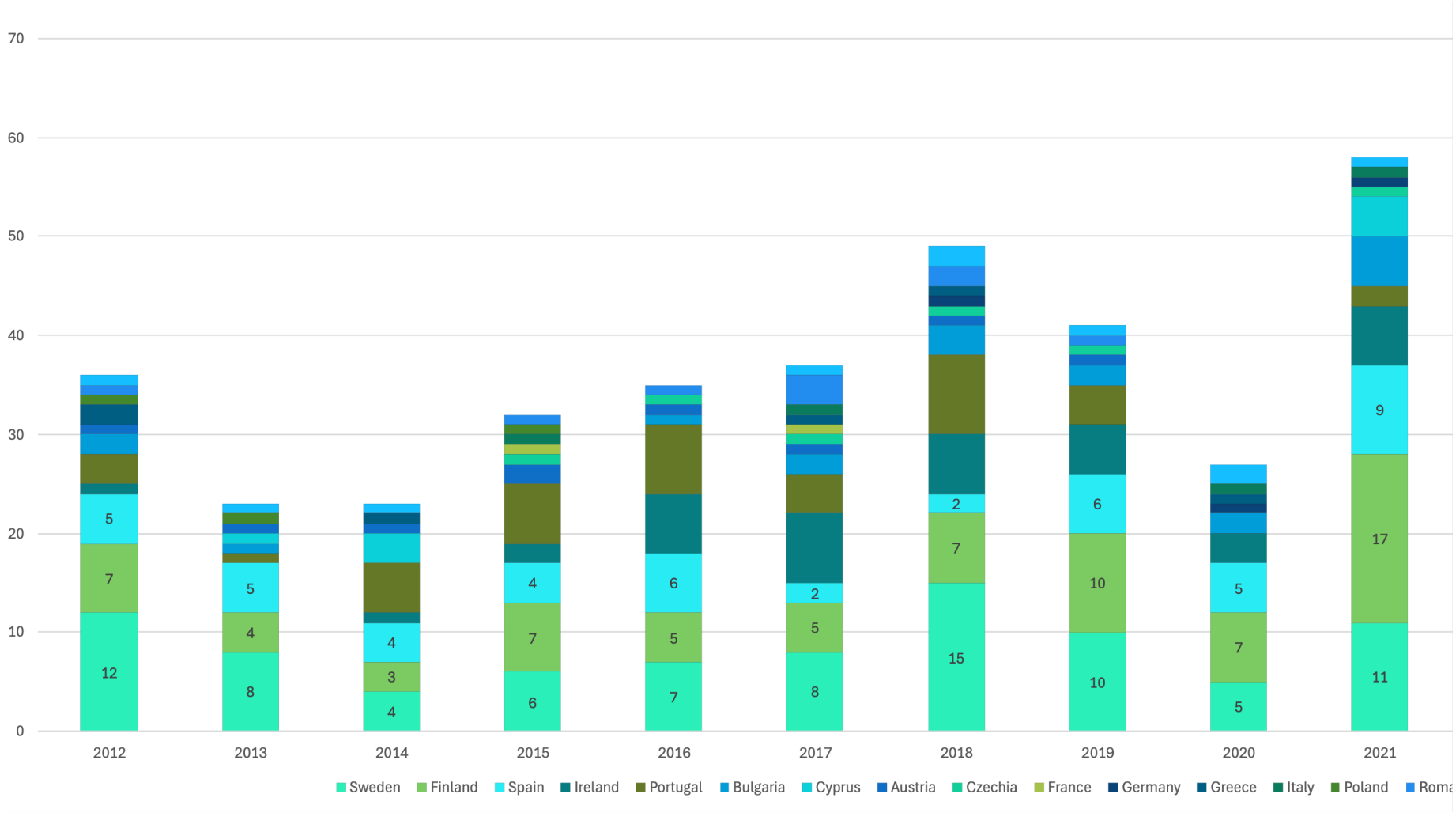
intersection widths and grades (see Section 2). This is the biggest step a project can take (if the results are good) to attract significant investment and realise an improved value of its stock.

Figure 11 shows that, in 2024, there were 31 exploration targets being drilled across the European Union (Source: S&P CapitalIQ Pro, this study). By way of comparison, analysis suggests that approximately 440 projects per year need to be drilled to achieve the CRMA domestic targets for exploration. This approximation is based on the requirement for 22 new CRMA-related "greenfield-only" mines over the next five years, which equates to 4.4 per year. Using the industry standard project failure ratio of 100:1 for a discovery drilling project making it to full mine production, this calculates at 4.4 × 100, which culminates at 440 drilling projects. Given the low current levels of EU exploration activity, it might be more realistic to target a range of drilling projects between 220 and 440. This statistic also incorporates purely new grassroots projects that progress to a drilling campaign, as well as historical or "rediscovered" projects that have restarted after a period of dormancy.

Using the most recent data for 2024 charting the drilling currently ongoing across the European Union, Sweden (26%), Finland (32%), Spain (16%) and Ireland (14%) together account for 88% of all exploration drill metres in that year. This illustrates that four countries out of the European Union were carrying out the lion's share of the active advanced exploration at this time. The positive takeaway is that there is a very significant upside across the European Union to kick-start exploration and discover more minerals with a focus on strategic and critical raw materials.

However, when EU activity is compared with the rest of the world (Figure 11), it reiterates how little advanced exploration activity is taking place across the European Union (Figure 12), although the exploration drilling figures across the European Union remain remarkably consistent between 2012 and 2024, reporting between 3% and 5% of the global budget (Source: S&P CapitalIQ Pro, this study). There is an urgent requirement to increase drive across the European Union to try and reinvigorate the exploration industry to capitalise on the region being a well-endowed jurisdiction for the discovery of new mineral deposits and close to a hungry market for those materials. In this context, matching the exploration spending levels of Canada and Australia – or even Finland and Sweden – on a per capita and per km^2 basis should be a clear and urgent aspiration.

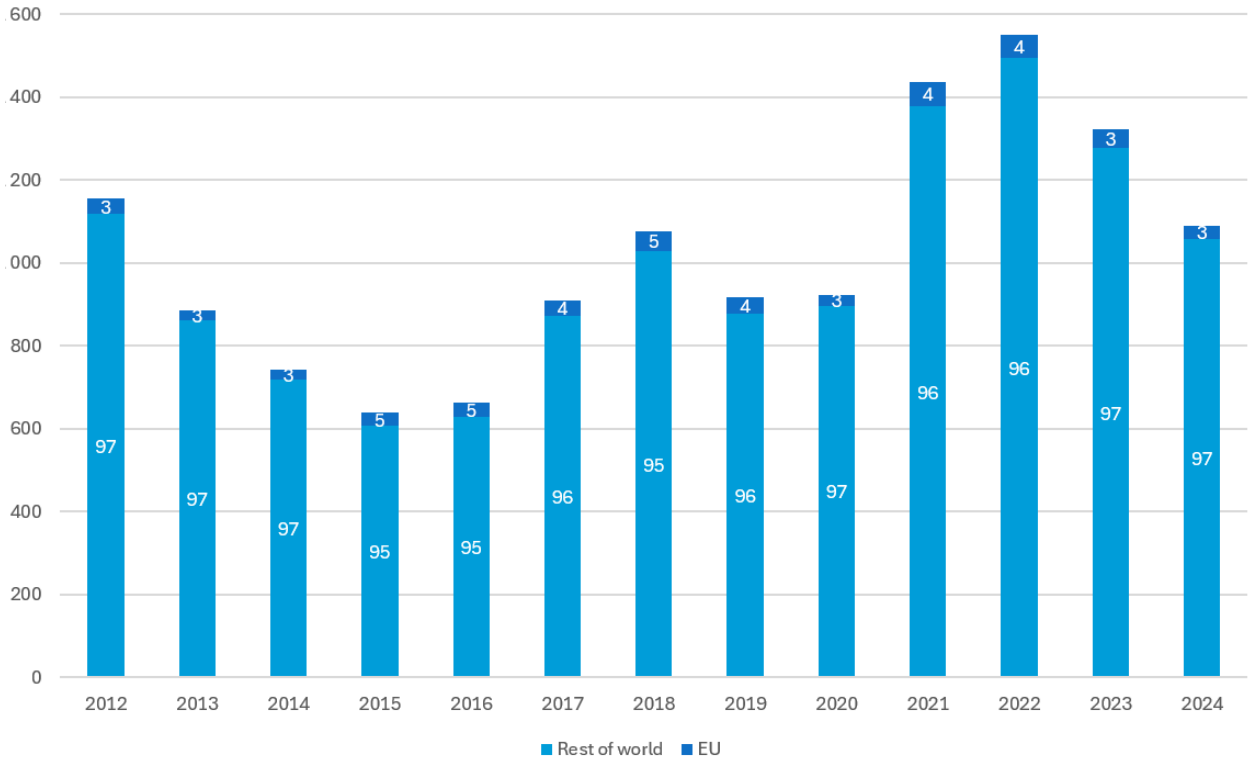
Figure 11: EU drilling activity (number of projects drilled)**, by country**



Source: S&P CapitalIQ Pro.

Note: Due to limited data coverage, earlier years were not included.

Figure 12: Global drilling activity (number of projects drilled; % of total)**, European Union vs. rest of the world**



Source: S&P CapitalIQ Pro.

Note: Due to limited data coverage, earlier years were not included.

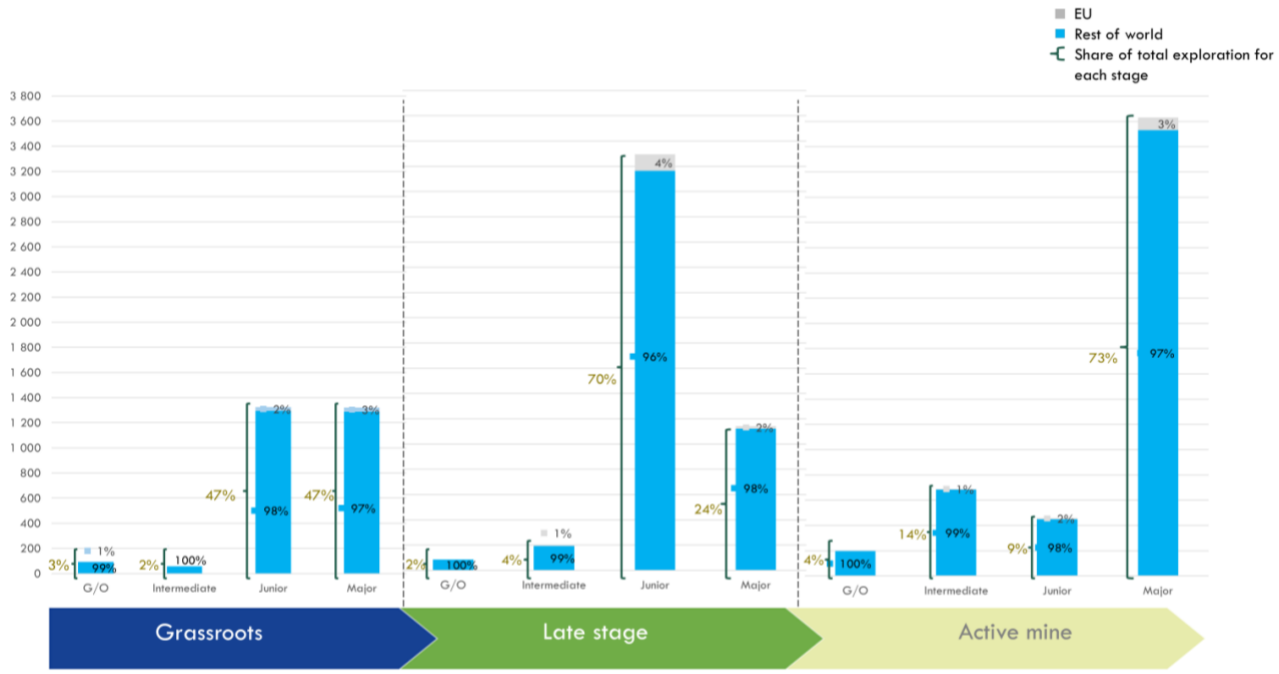
3.2 Exploration across Europe, by company class and stage of exploration

The key to attracting exploration companies is understanding the different roles of the companies in the investment landscape. Traditionally, private exploration companies are divided into three broad categories: junior-, mid-tier- and major-mining companies. Public bodies, such as national geological surveys, also conduct exploration operating on funding primarily from the state.

At grassroots level (Figure 13), juniors and majors tend to focus on the more upstream sector of exploration, juniors raising risk capital and majors largely leveraging funding from producing mines revenue. This type of exploration, although risky, tends to be less funding intensive with simpler field programmes and only a relatively small amount of diamond drilling. In later stages of advanced exploration, juniors' budgets increase significantly as drilling programmes start, and it is also where mid-tiers' increased focus allows them to fund broader and regional-scale exploration programmes associated with recognised mineral belts, an activity that requires higher levels of funding to identify multiple targets for drill testing.

The mine site stage is primarily the domain of majors but with exceptions where some juniors and mid-tiers also find success (Figure 13). Several key areas must be addressed if the European Union is to attract such companies, and this involves a combination of attractive policy, along with financial and structural incentives. These incentives need to be coordinated across the whole European Union to make this process even more attractive and sustainable.

Figure 13: Annual global exploration budget ($ million)**, by company class**



Source: S&P CapitalIQ Pro.

4 WHAT LEADING MINING JURISDICTIONS DO TO PROMOTE MINERAL EXPLORATION

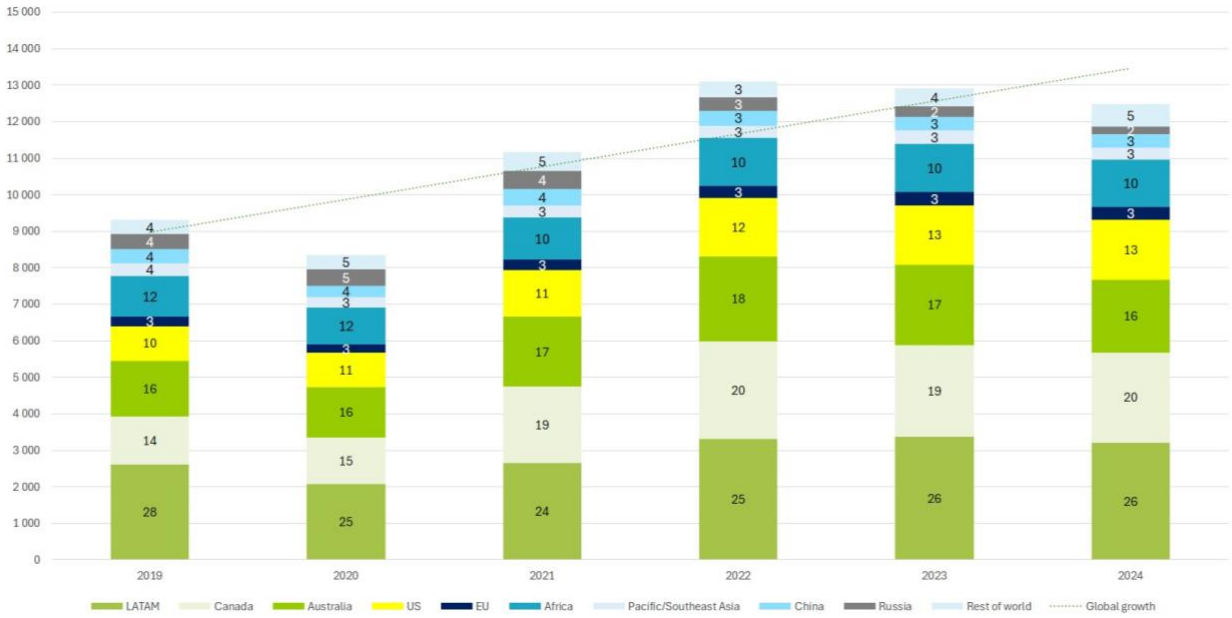
4.1 Introduction

This section compares several different benchmark jurisdictions and the best practice strategies used by each to compare with the European Union. The benchmark countries chosen comprise active and legislatively advanced exploration jurisdictions, providing a broad global spread. The countries analysed were Canada, Australia, the USA, Latin America (Chile), Africa (Namibia), Asia (JOGMEC – Japan Organization for Metals and Energy Security) and Europe (Ireland). During the analysis, it became apparent that Canada and Australia stand out as the two best benchmark countries to compare against the European Union, and they illustrate what more the European Union could be doing to attract increased exploration investment.

Canada supports a very well-developed and well-regulated exploration industry. As a result, it has developed as one of the most highly invested jurisdictions in the world. Canada has led by developing and rolling out better and more advanced mineral exploration policies in support of the industry and the environment. The regulators and policymakers along with the exploration companies have developed a system of clear and workable guidelines for mineral exploration companies to operate.

In 2024, Canada accounted for $2.5 billion (20%) of the total global exploration budget, the highest of any single country. Australia reported 16% at $1.9 billion, and the European Union reported only 3% at $0.36 billion (Figure 14).

Figure 14: Global exploration budget ($ million; % of total)**, by global regions, 2019-2024**



Source: S&P CapitalIQ Pro.

Most of the other benchmark countries used in this study similarly have strong policies, developed to encourage exploration investment. The data suggest that there are significant variations across the benchmark countries with respect to levels of application regionally, and this is driven primarily by where most of the exploration is currently active in those countries.

Table 4 summarises the relative strengths of Canada, Australia, the USA and the European Union for each jurisdiction's status against the key exploration investment promotional strategies identified. This is a relatively subjective view and is used to illustrate what different jurisdictions do well and what strategies require further development. For illustrative purposes, the table below groups all EU countries together, but some countries within the European Union are far more advanced in some of these strategies than others.

Further details on investor support strategies are presented in Table 4. Canada as a jurisdiction stands out as a world leader for exploration investor attractiveness, and this is largely due to the flow-through-shares (FTS) system in operation. Australia has a strong combination of tax incentives (JMEI) and geoscience investment, making early-stage exploration attractive. The USA is strong in data provision and critical minerals security narrative but lacks direct investor incentives. The European Union focuses on policy frameworks and sustainability-driven finance, but investor support for early exploration is inconsistent and fragmented.

Table 4: The European Union compared against promotional strategies of benchmark countries

	Strategy	Impact	Importance	Australia	Canada	US	EU
Enable responsible exploration	Streamline permitting efficiency	Critical in attracting explorers into country. When poor, the impact is significant.	High	Clear mining laws and strong property rights. Fast-track, digital platforms and risk-tiered approval systems are necessary.	Stable legal system; varies by province.	Fragmented regulation (federal vs. state); permitting complexity	Generally slow and complex. Differences among EU countries, with some countries having their own national permitting frameworks. Projects designated as strategic benefit from streamlined permitting procedures and single points of contact, but rollout remains slow.
	Enable land access and tenure	Key factor to attract licence applications.	Medium /high	Transparent, online systems (such as Western Australia Minerals Titles Online)	Transparent and efficient in many provinces	Varies by state; Bureau of Land Management and Forest Service complexity.	Fragmented, local member state variation is often weak and there is a lack of support at a national level
	Strengthen agreements with indigenous people and communities	Access is a key factor for exploration, even if permits have been awarded.	Medium	Indigenous land use agreements, clear legal frameworks.	FPIC (Free, Prior and Informed Consent) in most regions	Free prior informed consent evolving; tribal consultation required.	Densely population, EU countries need to make more of an effort to engage with local communities. There is increasing pressure to integrate Free, Prior, and Informed Consent (FPIC) guidelines. Local opposition common to projects is common, and a greater level of government support is of ten necessary. This will ensure exploration is socially responsible, ethical and sustainable, fostering trust, local support, and long-term benefits for communities.
	Integrate ESG into seamless permitting	Very important that ESG and permitting systems align to attract and support explorers.	Medium	ESG embedded in exploration permitting.	Strong ESG practices, especially First Nations	ESG compliance evolving.	Strong (yet prohibitive) ESG policies limit permitting. Varying level of support for projects among EU countries.
	Develop infrastucture for field access	Important, but each country has different challenges which can be overcome.	Medium	Government-backed infrastructure provided in remote regions.	Provincial infrastructure programs	Some federal support in mining areas.	Limited coordination, but EU funds are available, such as the Enhancing EU Mining Regional Ecosystems initiative, the Strategic projects initiative under the CRMA, plus existing Cohesion Policy, ERDF and regional development programmes.
Execute and promote CRMA	Implement critical minerals strategy	Critical to drive the CRMA directives and attract explorers	High	Comprehensive federal and state strategies.	Federal strategy, provincial programs emerging	Multiple strategic documents (Defense Production Act, the CHIPS act, the Inflation Reduction Act (IRA))	EU Critical Raw Materials Act (2024) introduces a comprehensive strategy but implementation is progressing slowly.
	Boost government-led promotion	Public awareness of the importance of exploration is extremely important to lay groundwork for explorers.	Medium /high	Strong roadshows for projects and state-level taskforces to encourage investment.	Present, mainly PDAC and international trade missions	Modest promotion through smaller scale mining roadshows.	Promotion of the CRMA across the European Union is gaining traction, but more work is needed to implement the directive in individual EU countries.
	Build flagship conferences	Key to promoting jurisdictional exploration and develop project networking.	Medium /high	Africa Down Under; International Mining and Resources Conference (IMARC)	PDAC Convention (largest global mineral exploration and Investment event)	SME Annual Conference; state-led mining investment forums.	Flagship EIT Raw Materials Summit along with the EU Comision Raw materials Week. Recently strong presence at PDAC events, some EU funding missions.
	Foster international cooperation	Increasingly important factor for all countries especially for critical and strategic raw materials.	Medium	Memorandums of understanding with the United States, European Union and Japan for supply chains.	Active cooperation, especially on ESG and Indigenous rights	Strong bilateral agreements, IRA collaboration	Minerals Security Partnership Forum (MSP Forum), Expanding national memorandums of understanding and partnerships.
	Educate and build capacity and awareness	Key to developing innovation, new ideas and exploration methodologies for national geoscience programmes.	Medium	Cooperative research centres, strong geoscience training pipelines.	Good geoscience base, university-linked programs, PDAC student programs	Strong institutions, declining enrolment in geoscience programmes.	Uneven training through programmes like the EU-funded Raw Materials Academy (EIT Raw Materials). Skills shortages identified. Some countries have made more progress than others, namely Ireland (Ireland Centre for Applied Geoscience (iCRAG).

GOOD
MODERATE
POOR

Source: Aurum analysis.

Table 4: continued

	Strategy	Impact	Importance	Australia	Canada	US	EU
Fuel discovery with public geoscience programmes	Supercharge national critical raw materials geoscience datasets	Comprehensive free datasets can attract junior explorers.	High	Nationally available precompetitive data via Geoscience Australia, state surveys.	Strong public mapping (Natural Resources Canada, provincial surveys).	United States Geological Survey initiatives, patchy coverage.	Patchy and vary depends on the country. Recent push with the European Raw Materials Allince; variable EuroGeoSurveys datasets; GeoERA;
	National/publicly funded drilling and advancement of targets	National surveys developing new domestic mining targets could be underexplored.	Medium	Government-led deep drilling (National Drilling Initiative).	Provincial core drilling and mapping in selected regions.	Some USGS involvement, but limited coverage.	Minimal public drilling programs on average across the European Union, some countries are more active than others.
	Designate strategic zones/regions	Key to unlocking underexplored areas and attract exploration.	Medium	Designated zones in underexplored areas.	Mineral development corridors, provincial zoning.	Limited; mostly legacy mining regions.	Currently not yet widely documented or harmonised at the EU level.
Amplify exploration capital	Provide exploration incentives	Enables risk-sharing, unlocks private capital.	High	Junior Mineral Exploration Incentive (JMEI), Co-funding (EIS, NDI), tax incentives (historic).	Flow-through shares, provincial support.	Tax deductions limited, some federal support (such as Department of Energy grants).	Currently has few (if any) uniform tax credits across EU countries for exploration at the scale of Canada or Australia, where tax incentives are available. However, the European Union and the European Bank for Reconstruction and Development (EBRD) have committed to invest €100 million in critical raw material projects, including exploration. Other incentives include Horizon funding (research-oriented).
	Build investor support structures	Attracts junior mining firms into the jurisdiction and promotes exploration.	Medium /high	Junior explorer tax schemes (JMEI), capital access programmes.	Strong junior finance ecosystem (Toronto Stock Exchange's Venture Exchange).	Weak junior exploration market.	Weak junior exploration market but mechanisms under EU+EBRD for development of critical raw material mining, along with the EBRD junior Mining Programme "JUMP," European Institute of Innovation and Technology, raw materials funding, Horizon 2020 grants.
Foster mining innovation ecosystems	Promote use of AI and targeting tools	Increasing use of a target definition across large areas, but requires good empirical datasets.	Medium	Advanced maching learning/AI tools via research councils.	Some use via universities, for example NRCan.	Growing private-sector use.	EU funding for development of AI technologies including Goldeneye Horizon 2020. EU grants also exist to develop new technologies under Horizon 2020 (S34i projet), National surveys of Finland, France, Germany, Spain, etc.
	Nurture innovation for novel processing	Accelerates diversification, lowers costs/emissions, unlocks low-grade ores, and boosts recycling—strengthening supply security and competitiveness.	Medium	Australia promotes innovation via tax incentives, funding facilities, shared infrastructure, R&D partnerships, and strategic policies to boost sustainable mineral processing.	Canada funds R&D, grants, and tax credits as well as supports pilot plants, recycling and refining. It is also accelerating permitting under its Critical Minerals Strategy.	Funds processing through the Energy Department and Defense Production Act programmes, IRA incentives, recycling R&D, and strategic partnerships to strengthen domestic supply chains.	The European Union is advancing processing innovation through the CRMA, the funding strategic projects and by accelerating permits, promoting recycling and ensuring diversified, sustainable supply chains.

GOOD
MODERATE
POOR

Source: Aurum analysis.

4.2 What benchmark countries do to attract exploration capital

4.2.1 Case study 1: Canada

Canada stands as a global leader in mineral exploration, offering vast geological diversity, world-class deposits, and a highly supportive business environment. The country is rich in gold, nickel, copper, uranium and potash and has increasingly developed its critical minerals assets, for example, lithium, cobalt and rare earth elements. Exploration activity is widespread, with major hubs in Ontario, Quebec, British Columbia and the Northern Territories. Canada's transparent regulatory framework, stable political environment and well-established mining sector provide investors with security and efficiency.

Toronto is home to the world's largest concentration of mining finance – the TSX – giving companies unparalleled access to capital. Government support, including tax incentives like flow-through shares, bolsters exploration activity. Challenges include infrastructure gaps in remote regions, permitting timelines and the need for strong partnerships with Indigenous communities. Regardless, Canada's combination of rich geology, financial ecosystem and commitment to sustainable resource development makes it a premier destination for mineral exploration businesses. Natural Resources Canada (NRC) and the prospectors and developers association of Canada (PDAC) are excellent sources of knowledge and data, as evidenced by the amount used as the basis of this study.

Canada has developed as one of the most highly regulated jurisdictions in the world, and it continues to develop and roll out better and more advanced policies to support the broader public and give clear and workable guidelines for the mineral exploration companies to operate. There is a lot the European Union can learn from this to make them a more attractive destination for exploration investment. The list below is a comprehensive list of the 15 main factors that are used by Canada to successfully keep itself as a prime exploration jurisdiction.

A. Flow-through share programme (FTS)

- Canadian tax-incentive mechanism under which eligible exploration expenditures incurred by a qualifying resource company may be renounced or "flowed through" to investors
- Investors may deduct eligible Canadian Exploration Expenses (CEE) against taxable income, generally up to 100% of the renounced amount

- For qualifying exploration directed at specified critical minerals, individual investors may also claim the Critical Mineral Exploration Tax Credit (CMETC), a 30% non-refundable federal tax credit on eligible expenses renounced under flow-through shares.

Impact: Enables risk-sharing, unlocks private capital for early-stage exploration.

B. World-leading junior-friendly capital and finance ecosystem (TSX/TSXV)

- The Toronto Stock Exchange and TSX Venture Exchange specialise in mining listings.
- It is home to over 1 200 mining companies, with relatively low barriers to raising capital for exploration.
- Canada has a large network of private exploration and early stage exploration and royalty generation companies (for example, Altius Minerals and EMX Royalties).

Impact: Provides ready access to equity financing for grassroots projects.

C. Well-known, rich, diversified geology and proven endowment

- Canada's extensive Archean and Proterozoic terrains host globally significant deposits of gold, base metals, nickel, uranium and increasingly lithium and rare earths, making it a geologically attractive jurisdiction.
- Global reputation ranking among the top jurisdictions in the Fraser Institute's Annual Survey of Mining Companies, with a strong global brand that reassures junior and major mining investors.

Impact: Often first thought of by many explorers as a destination.

D. Provincial exploration grant programmes

Nearly every province/territory has its own support program:

- Yukon Mineral Exploration Program (YMEP)
- Ontario Junior Exploration Program (OJEP)
- Quebec's MERN and tax rebates

Impact: Matches or co-funds private exploration spending, reducing early risk.

E. World-class public geoscience

Geological Survey of Canada produces the following:

- Modern geophysical, geochemical and geological maps
- 3D geological models
- Deep crustal studies

Impact: Increases efficiency, reduces targeting risk, supports discovery.

F. Open data and digital access

- All geological, geochemical, geophysical and drilling data are digitally accessible and often free.
- For example, NRCan's GEOSCAN and provincial databases (SIGÉOM, Geoscience BC).

Impact: Lowers entry barriers, speeds up project generation.

G. Transparent and predictable permitting

- Provinces offer clear, publicly available permitting timelines and processes.
- Example: Quebec offers exploration permits in ~30-60 days.

Impact: Reduces investor uncertainty and supports faster project advancement.

H. Early Indigenous and community engagement frameworks

Guidelines and financial support for:

- Impact benefit agreements

- Shared decision-making
- Indigenous community mapping programmes

Impact: Increases social licence and access to land. Shares the benefits of mining with First Nations.

I. Clear, modern mining laws at provincial level

- Resource development is governed at the provincial level, creating local accountability and policy competition.

Impact: Encourages innovation and reduces red tape in mining codes.

J. Research and development (R&D) and innovation support (for example, Canadian Mining Innovation Council (CMIC), NRC IRAP)

- CMIC supports:
  - Geoscience AI
  - Deep exploration
  - ESG tools
- NRC IRAP supports innovation in exploration tools and software in small and medium firms.

Impact: Encourages tech-enabled and deeper targeting exploration.

K. Investment in access infrastructure

- Governments co-invest in roads, energy and airstrips in remote but prospective regions.
- Example: Yukon Resource Gateway Project.

Impact: Unlocks previously inaccessible areas for exploration.

L. ESG guidance and best practice protocols

- Governments publish clear guidance on water use, tailings and land rehab during exploration.
- National standards aligned with global ESG frameworks (Towards Sustainable Mining, Initiative for Responsible Mining Assurance).

Impact: De-risks future permitting and builds community trust.

M. Strategic land packages and "map staking"

- Provinces facilitate easy online staking (for example, Ontario's Mining Lands Administration System).
- Large areas of Crown land available for claim via low-cost digital systems.

Impact: Low-cost access to highly prospective land.

N. Clustering and incubation support

Mining clusters in cities like Vancouver, Toronto and Sudbury support:

- talent development;
- access to consultants;
- service provider networks.

Impact: Builds capacity and encourages cross-pollination of innovation.

O. Global promotion of exploration leadership

- Active international promotion at events: Prospectors and Developers Association of Canada (PDAC), Mines and Money, and Invest Canada North.

Impact: Attracts foreign direct investment (FDI) and showcases the jurisdiction as exploration friendly.

4.2.2 Case study 2: Australia

Australia offers one of the world's most attractive and secure mineral exploration landscapes, built on vast geological diversity and a strong mining tradition. The country is a top producer of iron ore, gold, coal and bauxite and holds significant reserves of lithium, nickel and rare earths essential for the clean energy transition. Advanced infrastructure, transparent regulations and a stable political environment make Australia the most attractive jurisdiction for mining investment. Key exploration hubs include Western Australia for iron ore, gold and lithium, and Queensland for coal and base metals. Government initiatives and tax incentives, such as the Junior Mineral Exploration Incentive, further encourage exploration. Challenges include remote operating environments, high labour and energy costs, and increasing environmental scrutiny. Nonetheless, Australia's combination of resource endowment, investor confidence and innovation ensures it remains a global leader in mineral exploration opportunities.

Australia has consistently been the second-largest destination globally to attract exploration investment internally and externally. Australia reported 16% of the global exploration spending budget at $1.9 billion in 2024 (Source: S&P CapitalIQ Pro, 2025, this study).

According to Geoscience Australia (AIMR, 2024) in their "Australia's Identified Mineral Resources 2024," the country held the largest economically demonstrated resources worldwide for gold, iron ore, lead, rutile, uranium, vanadium, zinc and zircon. It was also in the top five for 14 additional commodities, including lithium, bauxite, cobalt, copper, rare earths and more (Geoscience Australia, 2025).

Furthermore, according to Geoscience Australia, in 2023 production, Australia ranked:

- #1 for bauxite, iron ore, rutile, lithium;
- #2 for lead, zircon;
- #3 for gold, manganese ore, zinc;
- #4 for cobalt, rare earths, tantalum, uranium;
- #5 for metallurgical coal.

The following list shows the key areas why Australia is attractive for exploration investment.

A. Exploration incentive scheme (EIS)

- Federal and state programmes provide co-funding for greenfield drilling and geophysics.

Impact: Reduces upfront risk for explorers, especially in underexplored regions. EIS programmes have directly led to multiple discoveries in greenfield terrains and significantly increased drilling activity in frontier regions, strengthening Australia's project pipeline for gold, nickel, lithium and base metals.

B. Pre-competitive geoscience (Geoscience Australia)

- National-scale, publicly funded mapping, gravity, magnetic, seismic and hyperspectral surveys.
- Delivered via programmes like Exploring for the Future (EFTF), covering vast frontier regions.

Impact: Pre-competitive data have reduced geological uncertainty across vast underexplored areas, unlocking new mineral provinces and attracting billions in private exploration investment into northern and central Australia.

C. Critical minerals strategy (2023-2030)

- Aligns geological potential, investment and industrial development.
- Focus on downstream processing and supply chain partnerships with allies (for example, the United States, Japan).

Impact: Positioned Australia as a globally trusted supplier of lithium and rare earths, catalysing downstream processing investment and strengthening strategic partnerships with the United States, Japan and the European Union.

D. State-led exploration promotion

- Jurisdictions like Western Australia and South Australia run global roadshows and investor missions targeting explorers and capital.
- Public-private platforms like METS Ignited and Core Innovation Hub support innovation.

Impact: Helped maintain Australia as a top global destination for exploration capital, consistently ranking among the world's leading jurisdictions for exploration spending.

E. Digital tenure and geodata portals

- Has online staking systems (for example, Western Australia's Mineral Titles Online) and access to integrated datasets via platforms like GA Portal, SARIG and Geoview.WA.
- Reduces information barriers for explorers.

Impact: Reduced entry barriers and administrative delays, enabling faster project generation and improving transparency, which enhanced investor confidence and competitiveness.

F. National drilling initiative (NDI)

- A government-funded programme to drill deep stratigraphic holes in data-poor regions, unlocking new mineral provinces.
- Part of the EFTF initiative.

Impact: Improved understanding of concealed mineral systems beneath cover, directly contributing to new targeting concepts and stimulating private exploration in previously overlooked basins.

G. Infrastructure planning for remote exploration

- State-led development of roads, power and water to support access to remote critical mineral regions (for example, Pilbara, Barkly region).
- Often integrated with resource corridors.

Impact: Reduced logistical and capital constraints in remote provinces like the Pilbara and Northern Territory, making critical mineral deposits commercially viable that may otherwise have remained stranded.

H. Environmental fast track and streamlining

- WA and NT offer faster exploration permitting for low-impact activities (for example, single drill rigs).
- Risk-tiered approvals reduce time without sacrificing ESG performance.

Impact: Shortened exploration approval timelines while maintaining ESG standards, improving Australia's attractiveness relative to competing jurisdictions with slower permitting processes.

I. Native title and land access frameworks

- Clear, consultative agreements (for example, ILUAs) streamline exploration on Aboriginal lands.
- Support Indigenous capacity building and economic participation.

Impact: Provided legal certainty for explorers while increasing Indigenous economic participation, reducing land access disputes and long-term project delays.

J. State critical minerals offices

- Several states (for example, Western Australia, Queensland, South Australia) have dedicated critical minerals taskforces to assist explorers and investors with permits, land access and funding.
- They act as a "concierge" service for strategic projects.

Impact: Accelerated project advancement for lithium, cobalt, rare earths and vanadium by streamlining cross-agency processes and facilitating investor engagement.

K. Exploration development incentive (historic, now reviewed)

- Provided tax offsets for shareholders of eligible junior explorers incurring greenfield exploration losses.
- Demonstrated successful investor engagement before it ended in 2017.

Impact: Stimulated equity investment into high-risk greenfield exploration during downturn years, demonstrating that fiscal incentives can meaningfully influence capital flows into early-stage projects.

L. Data integration and machine learning in targeting

- National collaboration via the Commonwealth Scientific and Industrial Research Organisation, Geoscience Australia and universities to deploy AI in mineral systems targeting (for example, MinEx CRC).
- Tools are increasingly open-source or public.

Impact: Improved targeting precision under cover, increasing discovery efficiency and reinforcing Australia's leadership in technology-driven mineral exploration.

M. University and industry research hubs

- Centres like the Mineral Exploration Cooperative Research Centre (MinEx CRC) and Centre for Ore Deposit and Earth Sciences (CODES) provide frontier research and student pipelines.

Impact: Sustained a globally respected exploration research ecosystem, producing skilled geoscientists and breakthrough concepts that underpin long-term discovery success.

N. Targeted exploration zones (TEZs)

- State initiatives designate high-potential greenfield belts with integrated geoscience support and permitting priority (for example, Gawler Craton, Albany-Fraser Belt).

Impact: Concentrated exploration capital into strategic greenfield regions, resulting in increased drilling density and new mineral system discoveries in areas such as the Gawler Craton and Albany-Fraser Belt.

O. International partnerships and export development

- Australia's strategy includes memorandums of understanding with the United States, the European Union, India, Japan and South Korea to foster exploration, processing and trade of critical minerals.

Impact: Strengthened Australia's geopolitical role in critical minerals supply chains and attracted foreign direct investment into upstream exploration and downstream processing facilities.

4.2.3 Case study 3: United States

The United States presents a diverse and strategically significant mineral exploration landscape, with a vast geological potential and a strong demand for critical resources. Rich deposits of copper, gold, lithium, rare earths and industrial minerals exist across states such as Nevada, Arizona, Alaska and Wyoming. While the country has a mature mining industry, exploration opportunities are expanding due to the clean energy transition and growing need for domestic supply chains in batteries, semiconductors and defence applications (Mordor Intelligence, 2025).

According to Mordor Intelligence, semiconductors and defence will grow have a compound annual growth rate of 3.58% between 2025 and 2030, while the battery market in the United States is expected to reach a projected revenue of ~$43 billion by 2030 (Grand View Horizon, 2025). A compound annual growth rate of 14.1% is also expected of the US battery market from 2024 to 2030 (Grand View Horizon, 2025).

The regulatory framework is transparent but complex, with permitting often lengthy due to federal, state and environmental requirements. However, supportive policies, such as incentives under the Inflation Reduction Act, are improving the outlook

for critical minerals (US Government Accountability Office (USGAO), 2022, 2024). The United States also benefits from advanced technology, skilled labour and capital availability, making it attractive for major and junior explorers. Even with permitting hurdles, the United States remains a premier jurisdiction for innovation-driven, sustainable mineral exploration.

Of the countries benchmarked, the United States compares most closely to the European Union economically (Figure 15), as they are the world's two largest economies in nominal terms according to the Statistics Times (Statistics Times, 2025). Looking at the comparison between the United States and the European Union for exploration spending – per capita and per km^2 – the United States charts at approximately 3.5 times more spending than the European Union. There are several factors affecting this, such as the United States being a single country while the European Union consists of 27 separate countries. However, in a global context, it provides an illustrative level of where the European Union should be striving to attain.

A relatively recent development in the United States may pave the way for other countries to follow. In December 2017, the US administration issued Executive Order 13817, establishing a federal strategy to ensure the secure and reliable supply of "critical minerals" in the United States for economic and national security reasons. On March 20, 2025, the government enacted a follow-up executive order titled *Immediate Measures to Increase American Mineral Production*, which invoked emergency powers (for example, under Title 3 and the Defence Production Act) to accelerate domestic mineral exploration, mining and processing and to reduce reliance on foreign supply (CSIS, 2025a).

The key objectives of the executive order are as follows:

Strategic framing of minerals: Minerals such as rare earths, uranium, copper, potash and others are being declared integral to national security, supply chain resilience and global competitiveness.

Mobilising public capital: The government is using tools like the Defense Production Act (DPA) and directing agencies to provide loans, guarantees, direct investment and offtake commitments.

Fast-tracking regulations/permitting: Recognising that mining and exploration have long lead times in the United States, the policy emphasises shortening permitting timelines and reducing regulatory barriers.

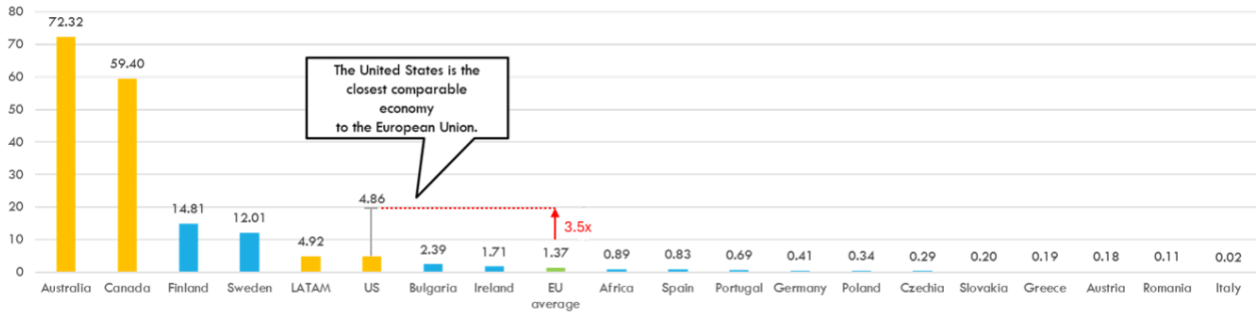
Domestic on-shoring of supply chains: The aim is to relocate parts of the mineral extraction, processing and refining chain back into the United States, reducing dependence on foreign supply (especially China).

Public-private partnership and investment signal: By signalling mining/minerals as a priority, the government hopes to attract private capital into exploration and development.

Economic and job growth angle: Beyond security, the policy is framed as creating domestic industry, jobs and economic growth tied to mineral development.

The United States is also moving beyond just domestic projects and is beginning to support investment in mineral ventures abroad, especially in "critical minerals" and supply chain diversification in allied/partner countries (CSIS, 2025b). Recent investments in REE extraction and separation companies are an example.

Figure 15: Exploration budget intensity ($ spent per capita)**, European Union vs. benchmark countries**



Source: Own calculations based on S&P CapitalIQ Pro.
Note: EU countries not displayed had no data or had no exploration budget.

4.2.4 Case study 4: Chile

Chile's mineral exploration jurisdiction is among the most attractive globally, driven by its vast reserves of copper, lithium, gold and other critical minerals. The country consistently ranks as a top destination for mining investment due to its geological potential, political stability and well-developed mining infrastructure. Chile supplies more than a quarter of the world's copper and is a leading player in lithium, positioning it strategically in the global energy transition. The regulatory framework is generally transparent, though evolving environmental and royalty policies require careful navigation. Key challenges include water scarcity in the arid north, stricter environmental standards and the need to build strong relationships with local communities. Exploration activity remains vibrant, with major international firms and juniors investing heavily. For businesses, Chile offers long-term opportunities in critical minerals essential for electrification and renewable energy, with government support for sustainable mining practices.

The key areas for Chile as an attractive destination for exploration investment are:

- **World-class mineral endowment**: Chile is the world's top copper producer and among the largest lithium producers, anchored by prolific belts like the Atacama Desert and Lithium Triangle, creating strong investor confidence.
- **Public geological mapping via Servicio Nacional de Geología y Minería (SERNAGEOMIN)**: Extensive open-access geological data are available across the national territory, enabling exploration targeting.
- **National Lithium Strategy (2023)**: It defines strategic lithium zones, public-private joint-venture models and clear guidelines for new exploration areas.
- **Exploration investment protections (DL600)**: Stable investment frameworks allow foreign firms to repatriate profits and guarantee legal terms.
- **Mining concessions regime (exploration vs. exploitation)**: Distinct, time-bound permits encourage efficient early-stage exploration while reducing speculation.
- **State-led pre-competitive data collection (SERNAGEOMIN)**: Geophysical and geochemical surveys are conducted in underexplored regions with publicly released results.
- **Royalty reform with exploration incentives (2023)**: Differentiated royalty rates reward early investment in high-risk greenfield projects.
- **Digital cadastre system**: This fully online system for claiming, viewing and managing mineral tenements is transparent and efficient.
- **Community engagement protocols**: Early-stage exploration requires stakeholder engagement plans with local and Indigenous groups.
- **Water use licensing streamlining**: It supports simplified permitting for non-consumptive water use during exploration phases.
- **Access to CORFO Funding and FDI Support**: CORFO (economic development agency) supports exploration tech, early-stage mining innovation and public-private partnerships.
- **Public infrastructure support for remote areas**: Government investment in roads, power lines and connectivity in northern desert regions with critical mineral potential.
- **International cooperation agreements:** Memorandums of understanding with the United States, the European Union and Japan on lithium and greentech supply chains facilitate exploration collaboration.
- **Research-industry collaboration**: Partnerships with universities and R&D centres (for example, AMTC) to support AI- and sensor-based exploration methods.
- **Exploration tax deductions (R&D focus)**: Exploration R&D spendings are tax deductible, encouraging advanced targeting technologies.

4.2.5 Case study 5: Japan (Japan Organization for Metals and Energy Security - JOGMEC)

Japan's mineral exploration strategy is characterised by limited domestic resources, placing a high priority on resource supply chain security, as it depends on imports for energy and raw materials. The country is highly dependent on imports for most raw materials, yet it has identified critical mineral deposits such as gold, silver, rare earths and base metals, particularly in underexplored volcanic regions. Japan's advanced technology base, skilled workforce and robust infrastructure support exploration and development, while its government promotes innovation in resource extraction, including recycling. However, environmental sensitivities, land-use constraints and high costs make large-scale mining challenging.

To secure supply chains for industries such as batteries, semiconductors and clean energy, Japan actively encourages partnerships with foreign exploration companies and invests abroad in resource-rich nations. The European Union must consider this idea for the interim period covering the time lag of seven to 21 years in discovering new EU-sourced mineral commodities. For businesses, Japan offers niche exploration opportunities, especially in high-tech minerals and marine resources, combined with strong government backing and a focus on sustainable, technology-driven approaches to mineral development.

The following bullet points list the key areas of Japan as an attractive destination for exploration investment:

- **Public-private exploration funding via JOGMEC**: JOGMEC co-finances exploration globally with Japanese firms (for example, Sumitomo, Mitsui) to secure supply chains.
- **Overseas resource acquisition support**: JOGMEC provides debt/equity financing to acquire exploration assets in Africa, Australia and Latin America.
- **Exploration risk insurance** – unique offering: JOGMEC insures against political and exploration failure risk to de-risk investment.
- **Resource diplomacy and memorandums of understanding**: Japan signs bilateral agreements to secure access to mineral-rich regions (for example, Australia, DRC, India).
- **JOGMEC geoscience programmes**: Funds global geophysical, geological and metallogenic mapping through partners.
- **Exploration and investment guidelines**: Publishes best practice frameworks to guide Japanese companies exploring abroad.
- **Human resource development and overseas training**: JOGMEC trains international geologists and exploration managers in Tokyo, promoting global best practice.
- **Co-investment with host governments**: Participates in joint ventures with state-owned mining companies to build trust and access.
- **Participation in global exploration ventures**: Co-invests in greenfield exploration (for example, rare earths in Namibia, lithium in Argentina).
- **Integrated supply chain planning**: Exploration is embedded within long-term vertical integration – from mine to magnet to EV supply.
- **Environmental and social due diligence standards**: JOGMEC mandates ESG screening and community consultation for any funded exploration project.
- **Participation in international research programmes**: Works with United States Geological Service, Geoscience Australia and EU RMIS on shared data and mineral systems modelling.
- **Strategic focus on battery metals**: Explicitly targets lithium, nickel, manganese and cobalt in exploration partnerships.
- **Support for domestic rare earth revival projects**: Funds projects in Hokkaido and southern Japan to reopen old mines or develop new sources.

- **Alignment with Japan's green growth strategy**: Exploration is framed as critical to achieving Japan's 2050 carbon neutrality and energy security goals.

4.2.6 Case study 6: Namibia

Namibia offers a highly attractive mineral exploration jurisdiction, combining rich geology with a stable political and business environment. The country hosts world-class deposits of uranium, diamonds, gold and base metals, and there is increasing interest in critical mineral potential such as lithium and rare earth elements. Its mining sector is a cornerstone of the economy, supported by modern infrastructure, deep-water ports and transparent mining legislation that provide security for investors. Namibia's government actively promotes foreign investment, offering clear licensing procedures and a relatively low-risk jurisdiction, compared to many peers in Africa.

Key exploration regions include the Erongo area for uranium and lithium, and the Damara Belt for base and precious metals. Challenges include water scarcity, energy constraints and the need for ongoing community engagement. Nonetheless, the combination of geological potential, regulatory stability and strategic location makes Namibia one of Africa's most promising frontiers for mineral exploration and long-term business growth. Namibia shows how quickly and effectively a project may be permitted through to first production. The B2Gold Otjikoto gold project received its mining licence in December 2012, construction started in April 2013, and first production occurred in December 2014 – only 19 months after construction began (B2gold, 2025).

The key areas for Namibia as an attractive destination for exploration investment are:

- **Geological prospectivity:** Namibia hosts world-class mineral belts, for example, the Damara Belt (uranium, gold, base metals), Erongo Region (lithium) and the Kalahari Copper Belt.
- **Strong Geological Survey of Namibia (GSN):** This active public geoscience body provides free access to regional-scale geological, geochemical and geophysical data.
- **Pre-competitive mapping programmes**: They extensively map mineral belts (for example, Damara, Erongo) with support from international donors and technical partners.
- **Active promotion of critical minerals:** The government identifies lithium, rare earths, graphite and rare metals as strategic and fast-tracks their development.
- **Government-backed infrastructure development:** Mining corridors are supported with roads, ports (Walvis Bay) and electricity expansion to facilitate exploration and future mining.
- **Stable legal and fiscal regime:** Consistent legislation or low sovereign risk attracts investment.
- **Transparent mining cadastre system:** Mineral rights portal (MME) is available for tenure and licensing data.
- **Open market to foreign investment:** No restrictions on foreign ownership; 100% foreign-owned exploration companies are permitted.
- **Expedited licensing for greenfield projects:** Mineral prospecting licences (EPLs) are processed relatively quickly; digital submission is expanding.
- **ESG integration through EIAs:** Mandatory environmental impact assessments for exploration ensure early-stage risk mitigation.
- **Local stakeholder engagement protocols:** Community consultation and local employment plans are expected, particularly in rural exploration areas.
- **Regional exploration clustering:** Strategic support is provided for exploration near existing operations (for example, Lofdal rare earths, Andrada lithium zone).
- **Public-private research collaborations:** GSN works with institutions like the University of Namibia and international geological surveys.
- **Coordination with National Development Plans (NDPs):** Exploration aligned with NDPs.
- **Supportive royalties and taxation:** Competitive royalty rates and corporate tax incentives are provided.

- **Special economic zones:** Export-oriented mineral processing zones (for example, Walvis Bay Corridor) aim to attract downstream investors.
- **Regional cooperation with Southern African Development Community and African Continental Free Trade Area:** Harmonised mining policy across borders encourages cross-border exploration campaigns.
- **Promotion through Mining Indaba and global forums:** Namibia actively promotes its exploration potential at major mining investment conferences.

4.2.7 Case study 7: Republic of Ireland – EU special case

For the past 35 years, Ireland has maintained a vibrant exploration and mining industry with high standards of technical knowledge.

Ireland presents a promising and stable mineral exploration jurisdiction, combining favourable and prospective geology with a transparent regulatory framework. The country is best known for its zinc-lead silver deposits. Currently, the Boliden-owned Tara Mine (active since 1977) in County Meath is the only producing zinc mine; however, Ireland has a rich history of zinc and lead production with mines such as Galmoy (1997-2012), Lisheen (1999-2015), Tynagh (1965-1981) and Silvermines (1968-1982), which are now closed. Recent exploration successes are focusing on significant discoveries at several locations including the new Group-11 Ballywire project and the reactivated Shanoon Galmoy project. Beyond base metals, Ireland holds potential for lithium and gold.

The Irish government actively supports mineral exploration and development through clear licensing systems, comprehensive geoscience data and pro-investment policies. Modern infrastructure, skilled labour and membership in the European Union further enhance its attractiveness to international explorers.

Challenges include relatively high operating costs; slow regulatory turnaround related to permitting, due to a sharp increase in requirements for government-level public engagement during the permitting notification stage; and environmental considerations. Exploration activity has declined in recent years. Total exploration spending has decreased from a relatively high level of €36 million per year in 2018 (representing 11.7% of the European Union total) to €9.2 million, or 2.7% of the European Union total, in 2024. This shows a significant tail off in activity and is reflected in the number of active prospecting licences reported extant at the end of each year between 2018 and 2025. According to government reports, in December 2018, there were 614 extant prospecting licences; by December 2020, this had reduced to 490, and by June 2025, this had dropped to 210. In 2018, the Irish government issued 12 new licences to exploration companies, while in 2025, only 25 new ones were issued against the backdrop of significant licence surrenders (Gov.ie, 2025). Ireland's favourability as a jurisdiction to operate, coupled with its mineral-endowment potential, has not changed, but like much of the European Union, Ireland is struggling to attract significant exploration investment.

Currently, Ireland is on the point of completing its flagship Tellus Survey, which started in 2014. The countrywide, pre-competitive, geochemistry and geophysical datasets have provided a strong data foundation for attracting exploration investment. While this has not yet materialised, the ever-increasing pressure for well-presented, detailed datasets from prospective juniors, mid-tiers and majors places Ireland in a strong position ahead of most of the European Union that are yet to start their national CRM inventories.

The key areas for Ireland as an attractive destination for exploration investment are:

- Robust public geoscience (via Geological Survey Ireland – GSI): Tellus survey programme collecting and making publicly available high-quality, national-scale geophysical, geochemical and geological data freely available. This is a programme that started in 2011 and is nearing completion by the end of 2026. This survey has collected invaluable datasets, which will aid exploration companies for years to come. This type of survey should be used as an excellent template – in design and execution – for all other EU country surveys that are yet to start.

- Transparent online mapping (GeoDiscover): Centralised digital platform for accessing geological data, maps and licensing boundaries.
- Efficient licensing system: Prospecting licences issued quickly, typically with a 6-8-week turnaround.
- Renewable licence terms based on work performance: Licence renewals based on performance metrics and committed work programmes, discouraging speculation.
- Environmental sensitivity mapping integration: Geographic Information System tools link exploration to designated environmental areas to assist in early-stage planning and screening.
- Exploration guidelines aligned with EU directives: Clear, modern regulatory framework compliant with Natura 2000 and other EU environmental requirements.
- Supportive tax regime: Allowable deductions for exploration expenses from taxable income under corporation tax.
- Active government promotion: Enterprise Ireland and GSI attend international mining events to promote Ireland as an exploration destination.
- Sustainable mining policy: Ireland's exploration strategies embedded in the national mineral policy, promoting sustainability and circularity.
- Industry engagement forums: Regular dialogue between government, industry and academia (for example, at Prospectors and Developers Association of Canada (PDAC) and Raw Materials Week).
- Integrated environmental assessment tools: Early-stage screening protocols help companies evaluate environmental constraints before fieldwork.
- University-industry research partnerships: Strong collaboration with Irish universities (for example, iCRAG) to develop AI and 3D modelling techniques for targeting.
- International collaboration (for example, EU Horizon 2020 projects): Ireland leads or participates in pan-European mineral exploration R&D projects (for example, MinExTarget, Smart Exploration).
- Low corruption, strong rule of law: Ireland ranks high in transparency indices, reducing risk and administrative friction for investors.
- Strong ESG framework: Exploration projects must meet high ESG standards; permits require early stakeholder engagement and EIA scoping.
- Accessible national drill core library: Historic cores stored and catalogued for research and exploration reuse.
- Targeting underexplored zones: The government encourages exploration in new terrains (for example, the Irish Midlands for lithium, rare earths).
- Critical Raw Materials Strategy (2023): Ireland aligns with the EU critical raw materials act to identify domestic potential and fast-track strategic projects.
- Climate and biodiversity-aligned mineral policy: Mineral development policies integrate with national climate adaptation and biodiversity plans.
- Strong industry-led professional associations
    - **Geoscience Ireland (GI)** is a business network supported by GSI and Enterprise Ireland, created to help Irish companies in the geoscience sector grow internationally.
    - **The Institute of Geologists of Ireland (IGI)** is the professional body for geoscientists in Ireland. It promotes the science of geology and its professional application, ensuring its members maintain high professional standards. The IGI provides career-long support for geoscientists, including professional accreditation, training and networking opportunities.
    - **The Irish Association for Economic Geology (IAEG),** founded in 1973, is Ireland's leading geological body, representing geologists working on ore deposits and in mining and exploration.
    - **Royal Irish Academy (RIA)** was founded in 1785 as a society for "promoting the study of science, polite literature and antiquities," and it began publishing scholarly papers, assembling a library and museum, and encouraging new research in the sciences, Irish studies, languages, archaeology and history.

- **The Irish Mining and Quarrying Society** is a small, voluntary, membership-funded, non-profit-making organisation, founded in 1958 to provide a focal point for all those working in the extractive industry in Ireland.

- Strong history of developing world-leading geological consulting companies
  - Very strong level of technical expertise in the exploration services sector. Many geoscience consulting and contracting companies have developed in Ireland over the last 60 years, too many to list individually.
  - Many of these companies now operate on a worldwide footprint, providing a full range of geoscience services, including geological, geochemical, geophysical and hydrological. The country hosted drilling contractors, world-renowned analytical laboratories and remote-sensing groups.

How does Ireland, as a leading EU example of an active mineral exploration jurisdiction, compare to Canada

This is a subjective tabulated view of the comparison between Canada and Ireland as an example of an advanced exploration jurisdiction in Europe, highlighting aspects of key promotional strategies that attract exploration investment. Table 5 compares Canada with Ireland with respect to favourability as a jurisdiction for mineral exploration. Scores are ranked from 1 (Good) to 5 (Poor).

Table 5: Direct comparison of Ireland to Canada as a favourable jurisdiction for mineral exploration

DIMENSION	SCORE	CANADA	SCORE	IRELAND	IMPORTANCE
Capital-raising ecosystem	1	Global leader: ~40% of the world's public mining companies list on TSX/TSXV; ~32% of global mining equity raised over the past 5 years via TSX/TSXV	4	Far fewer mining listings and a smaller domestic mining finance base on Euronext Dublin	Critical to draw in exploration dollars as well as raise the industry profile
Exploration tax incentives	1	Powerful combo: 100% CEE deductions via flow-through shares + 15% federal Mineral Exploration Tax Credit; extended by Ottawa in 2025	4	No flow-through equivalent; standard corporate tax rules apply; incentives mainly via licence terms rather than national tax credits; revenue	Directly affects early-stage funding and runway
Corporate tax	2	Standard corporate tax (varies by province/federal blend; not sector-specific for mining exploration)	3	Mining profits generally taxed at 25% (higher CT rate) rather than 12.5% trading rate	Influences post-discovery economics and valuation
Royalties and state take	2-3	No federal royalty; provincial/territorial royalties vary by jurisdiction (project-specific)	3	Royalties set/regulated under the Minerals Development Act 2017; terms set in mining leases/licences and can vary by mineral; state may adjust within prescribed ranges. A recent temporary royalty abatement noted for some leases (2024-2025).	Royalty design affects project NPV and risk

Permitting and consultation	3	Multilayered federal/provincial system; duty to consult and, where appropriate, accommodate Indigenous groups are constitutional and embedded in Impact Assessment processes	3	EU-aligned regime: EIA required per EU Directive (2011/92/EU as amended 2014/52/EU) and transposed/operated via Irish EPA and planning system	Clarity, duration and obligations shape schedule and risk
Early-stage access and licences	3	Province/territory-run tenure systems (often efficient map staking; details vary by jurisdiction)	2	Centralised prospecting licence system via DECC/Exploration and Mining Division; applicants must show technical/financial capacity and meet work/renewal rules	Predictable, transparent access reduces friction at entry.
Public geoscience	1-2	Extensive federal/provincial geological surveys and open data (varies by region)	1-2	Tellus national geochemical/geophysical programme provides high-resolution datasets nationwide via GSI	Quality geodata lowers targeting costs and increases discovery odds
Regulatory stability/perception	2	Consistently high scores for many provinces in Fraser Institute rankings; Saskatchewan and Newfoundland and Labrador in the global top 10 (2024)	3	Generally stable; Ireland typically mid-pack in Fraser surveys (varies year to year)	Signals relative policy attractiveness to explorers/investors
Macro/tax headwinds	3	Recent capital-gains inclusion rate increase drew industry concern about its effect on junior financing, though METC extension offsets some pressure	2	No sector-specific capital gains tax changes flagged; standard Irish CT rules apply.	Headwinds/tailwinds can tilt where juniors raise and spend
Land access and social licence	3	Large crown-land base but Indigenous rights central; formalised consultation frameworks (for example, Ontario)	3-4	High private land ownership; landowner engagement typically needed alongside state licences (licence does not replace landowner agreements)	On-the-ground access strongly affects timelines/costs
EU/US market proximity	2	Strong access to North American supply chains; key for critical minerals	2	Inside EU single market; alignment with EU Critical Raw Materials policies and ESG standards	Offtake, permitting expectations and ESG positioning differ by bloc

4.3 Summary of the main factors contributing to lower EU exploration activity

In summary, the European Union countries significantly lagged their peers for over 30 years with respect to promoting mining exploration. The region, in recent years, has increasingly – and incorrectly – come to be seen as a historic exploration and mining jurisdiction with little new mineral potential. This is an incorrect classification, and this view should be reversed. As EU mines (some of which are world class) have become more mature, they have done so alongside increasing population density across the whole of the European Union. The fragmented nature of EU countries' individual regulatory environment and permitting system has also made the European Union less attractive, particularly as many of these policies are outdated and difficult to operate under. These issues stagnated exploration funding. Most of the global exploration investment transferred to jurisdictions with higher perceived potential and simpler operation – areas that are relatively underexplored and promote clearer, more coherent and mining-friendly exploration policies.

Many factors contribute to the extremely low exploration activity across the European Union. The following list is presented as a checklist for further action.

4.3.1 Regulatory complexity and permitting delays

- Fragmented regulations: Each EU country has its own permitting rules, timelines and environmental frameworks.
- Lengthy permitting: Exploration licences can take two to seven years or more vs. approximately one to two years in other mining jurisdictions (for example, Canada, Australia).
- Overlapping EU and national rules: Directives like the Habitat Directive and Water Framework Directive add layers of complexity.
- Example: Finland and Sweden are relatively efficient, while countries like France and Germany, as well as Spain, Ireland and the Czech Republic, can face long delays and uncertainty in their permitting process.

4.3.2 Comprehensive environmental and ESG standards

- The European Union enforces some of the world's most comprehensive environmental regulations, offering clear high-level regulatory policy and GIS datasets to be used effectively by exploration and mining companies when operating in any given jurisdiction or country. Levels of local country complexity reach down to individual regional council level and benefit from a national harmonisation policy within individual EU countries and across the European Union.
- Complex or non-harmonised ESG regulation makes permitting for greenfield exploration more difficult, extending timelines and associated costs.

4.3.3 Social licence and public opposition

- Lack of public awareness on the importance and source of raw materials (including critical raw materials) disconnects public perception and realities of the types and sources of materials that sustain modern living and execute the green and digital transitions.
- Mining is seen as environmentally destructive and inconsistent with green values.
- Media coverage of sustainable mining and exploration remains low.
- Lack of community engagement by exploration and mining companies in the early stages undermines trust. Governmental platforms or forums can improve this by providing national-level support while also alleviating fears of the public by presenting the environmental policy checks and controls to oversee the industry.

- While early exploration is often supported locally due to clear communication and minimal disruption, successful projects and new investments bring uncertainty. Local communities weigh potential economic benefits against the risk of disruption as the project moves towards possible mining and its broader social and environmental impacts.

4.3.4 Limited geological data and historical underinvestment

- Large parts of Europe remain underexplored due to decades of exploration companies focusing on more geologically underexplored areas across the world. The European Union is incorrectly viewed as a relatively mature exploration jurisdiction.
- Geological mapping is incomplete, outdated or not publicly accessible in some regions. This is due to years of underfunding of national geological surveys.
- Mineral-rich areas (for example, northern Sweden/Finland, Iberian Pyrite Belt, Western Tethyan Belt) are often remote and with underdeveloped geological knowledge.

4.3.5 Land access and competing land use

- High population density leads to land-use competition (urban development, agriculture, tourism).
- Even in rural areas, securing access to explore is politically and socially difficult.

4.3.6 Poorly developed European junior mining sector

- Unlike Canada, the United States and Australia, the European Union has a poorly developed junior sector in the exploration industry.
- Historically, many of the larger majors formed out of London (LSE), and most of them have retained their listings there (Rio Tinto, Glencore, Anglo American and Antofagasta). Some of these companies also hold dual listings on the Canadian and Australian exchanges. Most of the other top 20 majors are listed on their home country exchanges of Canada (TSX), Australia (ASX), the United States (New York NYSE), China (Shanghai), South Africa (Johannesburg JSE) and the Saudi Stock Exchange.

4.3.7 Financing gaps

- Exploration in the European Union is severely underfunded and in need of a 10-fold increase to meet the European critical raw materials act goals.
- Limited Public Incentives, few tax breaks, grants or fast-track programmes to encourage greenfield exploration.
- Venture capital and junior mining sectors are small or non-existent in many EU countries.
- Institutional investors are hesitant due to a lack of jurisdictional familiarity, the perception of Europe being "too difficult" to operate in, perceived low success rates, ESG risk and long timeframes. This study has shown, however, that the success rate of exploration to mine development and spending levels to discover is better than its peers worldwide. The restricting factor is the small scale of the EU exploration and mining industry.
    - The CFA Institute's survey on the EU ESG regulatory framework highlights investor concerns about "complex regulations" and "unreliable ESG data," which raise barriers to investment in European jurisdictions (CFA Institute, 2025).
- ESG frameworks often screen out mining from investment portfolios, especially exploration-stage projects.
- Early-stage exploration is generally funded by a combination of European small-cap explorers and several Europe-based majors carrying out brownfield exploration. This is supported by several Canadian or Australian

juniors and mid-tier companies also operating in the European Union. The S&P data reviewed for this report show that on a global scale only 2% of global junior exploration dollars are expended within the European Union, and similarly, only 3% of budgets by major companies are spent across the European Union.

4.3.8 The European Commission has set a strategic ambition, but it will take time to translate to results

- The Critical Raw Materials Act (23 May 2024) sets ambitious domestic sourcing of critical raw materials and strategic raw materials with targets (for example, 10% of EU demand from EU mining by 2030).
- Policy ambition outpaces real-world capacity for exploration, permitting and processing.
- Few incentives for junior explorers; most funding still comes from non-EU capital.
- No tangible incentives like tax credits, grants or fast-tracking for early-stage exploration.
- Public funding is complex to access and not tailored to high-risk exploration.

5 EU COUNTRIES AND INSTITUTIONS CAN CLOSE GAPS AND BOOST EXPLORATION

5.1 Best practices the European Union should adopt to close gaps with benchmark peers

This report aims to identify a structured approach to illustrate a strategic framework to increasing exploration activity and investment across the European union. It identifies two key "themes" subdivided into five "strategic pillars" which are further broken down into 13 actionable "levers." To be successful, the overarching vision for boosting exploration must be held at an EU governance level, that is, broad alignment on the "themes" and "strategic pillars." This will give a clear direction and concrete support for each EU country to roll out coordinated frameworks and systems (fit for purpose "levers") which will then improve the investment landscape significantly developing a strong exploration industry (Figure 16).

The first theme addresses the broader investment landscape, where the modernisation and streamlining of the fundamental frameworks need to be set in stone, termed **Theme 1: "Fix the Fundamentals."**

Once the framework has been established for responsible exploration, then the second theme, termed **Theme 2: "Fund the Front-Runners,"** addresses financial incentivisation, which encourages exploration companies (for example, juniors and mid-tiers) to start exploring in the European Union.

Levers under Theme 1 must be well advanced before the landscape becomes more attractive for investors to come in under Theme 2. While careful sequencing and coordination between EU institutions, countries and private industry will maximise returns for public and private funding, poor sequencing or partial completion will result in wasted public money, as without fixing the fundamentals, the private sector will not crowd in.

Under the two themes, there are five strategic pillars, each addressing specific topics necessary to reach the ambitious targets outlined under the critical raw materials act.

Figure 16: Five pillars of action for EU countries and institutions

The fundamentals of EU exploration need to be addressed before capital can be effectively deployed at the scale envisaged

Theme	Strategies	Levers	Actions for EU countries	Actions for European institutions
Fix the fundamentals	Enable responsible exploration	Streamline and integrate permitting	Implement EU-wide improvements to permitting, reduce long lead times and overlapping ESG requirements, strengthen legal support.	European Commission mandates maximum deadline for permitting decisions. Provide technical assistance to EU countries and make use of existing Commission and EIB Group advisory programs, such as JASPERS.
		Enable land access and tenure	Educate public and land-owners about the Critical Raw Materials Act and rights and obligations to third parties when exploration and mineral rights have been granted.	
		Develop Infrastructure for field access	Consider providing either a) infrastructure (water, power or roads) or b) funding support to exploration companies to aid access in remote areas.	Provide complementary EU budgetary funding to national funding programs. The EIB Group can provide loans to EU countries, regions and public agencies
	Execute and promote the Critical Raw Materials Act	Implement the critical raw materials strategy	Develop national critical raw materials strategy, building on the European act, taking into account national specificities, reserves and industrial needs	European Commission selects strategic projects for streamlined development.
		Boost government-led promotion	National promotion of critical raw materials, visible support of exploration, regional events to share knowledge across regions (Nordics, Iberian, West Tethyan)	Elevate the EU RM Week into a major industry event with global footprint, like Indaba or PDAC. Attract more exploration companies and investment groups
		Educate to build capacity and awareness	Identify national skills-gap in critical raw materials, promote vocational and higher education. Raise the profile of mining through awareness campaigns.	Provide complementary EU budgetary funding to national funding programmes. EIB public-sector debt products already available can support national programmes.
	Fuel discovery with public geoscience	Supercharge national critical raw materials geoscience	Build/beef up national geoscience programs, focus on national critical raw material potential. Make public remote sensing, geology, geochemistry and geophysics.	Provide complementary EU budgetary funding to national funding programs, such as: - small states joint programs - negotiation of drilling cost EIB public-sector debt products already provide support national programmes. EU countries' target definition strategies and associated data could make investment more attractive.,
		Public-funded drilling	Consider public drilling programmes in high-potential or under explored regions, using national funds to catalyse private investment.	
		Designate Strategic zones/regions	Based on results of geoscience and other public data (historic mining areas) establish strategic zones with additional benefits for mineral explorers	
Fund the front-runners	Amplify exploration capital	Provide exploration incentives	Give tax incentives to exploration companies designed to top up or refund exploration expenditure for critical raw materials, Careful definition of implied costs.	European commission could complement national tax incentives with additional grants.
		Build investor support structures	Establish national exploration (and eventually mining) investment funds to provide equity injections to promising discoveries	Establish a financial instrument to de-risk and provide additional EU exploration funding
	Foster mining innovation ecosystems	Promote use of AI and targeting tools	Promote AI and other targeting tools by research institutions and companies though publicly available data (historic mine records/geoscience data)	Leverage existing EU support - e.g. Horizon Europe grant. EIB loans for corporate RDI or venture debt (aimed at start/scale-ups). EC led harmonisation of geological date.
		Nurture innovation for novel processing	Identify mining waste and/or geological deposits with processing challenges and promote public/private technology innovation to extract them economically.	As above leverage Horizon Europe grant and EIB corporate RDI or venture debt loans. EC could act as match-maker between technologies and deposits

Source: Aurum analysis.

Explaining the five pillars of action

Pillar 1: Enable responsible exploration

This pillar is the remit of each EU country. One of the fundamental issues currently affecting efficient exploration across the European Union is permitting. Long lead times and uncertainty from application to issue are having a negative effect on attractiveness to explore. EU country governments should consider giving regional administrations the authority to grant exploration licence applications and oversee compliance from the exploration companies. They should aid and support these companies through environmental and social engagement processes, helping them understand and adhere to the high standards of the European Union.

Part of the ESG support should involve a clear message from regional and local government to educate the public on critical raw materials and the need for exploration. This would help build support for exploration while reassuring the public about responsible exploration and mining. Currently, little to no information reaches secondary schools (ages 12-18). For example, in Ireland, there is no stand-alone, mandated subject in the secondary curriculum – such as geography – that includes even a short module specifically on the importance of exploration, mining or critical raw materials. Subjects like geography, science, engineering, technology, and climate action and sustainable development could include related content, but it is up to individual schools and teachers how deeply these topics are explored (online Curriculum 2026).

Pillar 2: Execute and promote the Critical Raw Materials Act

The European Commission is already taking a strong lead in executing and promoting Pillar 2 by creating a robust and actionable Critical Raw Materials Act. All EU countries are now tasked under the act, and this is the next priority. Strong guidance and support are needed to make the act effective and drive practical actions because that will encourage exploration. Promotion across all EU countries must be encouraged, the remit of the act needs to be placed in the collective public consciousness, and the risks of not carrying out the objectives of the act must be laid bare. Comparisons with other jurisdictions worldwide – such as the United States, China and Russia – need to be explained, and the need for the European Union to establish its own secure supply chains must be made clear.

Pillar 3: Fuel discovery with public geoscience

The Critical Raw Materials Act specifically and legally mandates under Article 19 for an effective national minerals/CRM inventory. Article 19 (1) specifies the obligation: "By 24 May 2025, each Member State shall draw up a national programme for general exploration." Article 19 (2) further specifies that the programme must include measures to increase information on occurrences, including mineral mapping, geochemical campaigns, geoscientific surveys, data processing/predictive maps and reprocessing existing survey data.

The mechanism to achieve this mandated target already exists in the form of individual EU member national geological surveys. Many countries already have excellent geological surveys, and some of them are actively developing regional targeting datasets of airborne geophysics, stream and soil geochemistry (such as the Tellus programme by the Geological Survey of Ireland). The main issue is that many of the Surveys are grossly underfunded/-staffed, and over the last 25 years, government departments, once tasked with overseeing critical natural resources, have now been amalgamated and subsumed within broader diffuse departments. This has had a detrimental impact on the industry, where underspending has cut back the ability of many of the existing surveys across the European Union to now hit the ground running in Europe's hour of need for natural resources.

The formation of EuroGeoSurveys (EGS), a not-for-profit association representing all the geological surveys of Europe, is meant to coordinate the response of the national bodies and create a practical strategic plan. The core mission is to enable the sustainable and responsible use of the Earth's subsurface environment and resources. The EGS brings national geological surveys together to share expertise, standardise data and combine efforts on key geoscience issues. Operating through initiatives like the European Geological Data Infrastructure (EGDI), EGS provides open-access geological maps, datasets and tools that span borders and support pan-European decision-making (EuroGeoSurveys, 2026).

Some EU countries are underlain by known mineral belts such as the Iberian Pyrite Belt, the Tethyan Arc, the Fennoscandian Shield, the Fore-Sudetic Basin (Kupferschiefer Belt), the Variscan Belt, the Ossa Morena Hellenic Belt and the Alpine Metallogenic Belt. These areas are already more advanced with significant repositories of technical data and many years of historic exploration. These areas should form the initial focus for exploration. They should be designated as strategic zones and should carry specific incentives for explorers of critical raw materials in these belts.

Pillar 4: Amplify exploration capital

As soon as the fundamentals of Pillars 1-3 have been rolled out, financial incentivisation mechanisms need to be established, and inspiration can be taken from successful benchmark countries discussed in this report. Strict control to promote CRM exploration is fundamental. There may need to be strict oversight on establishing the bona fides of each company availing of the incentives to maximise the return on investment through rapid discovery. Building investor support structures will be key to this pillar, establishing national exploration (and mining) investment funds to provide equity injections for promising discoveries.

The most well-documented system is Canada's flow-through share system, which is widely regarded as successful in financing mineral exploration. It consistently accounts for around 65-70% of the capital raised on Canadian exchanges for exploration companies, especially juniors, making early-stage exploration possible by shifting tax incentives to investors and spurring substantial activity across Canada's geology. The mechanism is considered a cornerstone of Canada's mining finance ecosystem, helping channel funds into grassroots and critical mineral exploration that might otherwise struggle to attract capital (PDAC, 2026). The European Union should look at this and other mechanisms successfully deployed in other mineral exploration jurisdictions.

An EU starting point could be the EBRD Junior Mining Programme (JUMP). This is a €150-million framework facility for equity and quasi-equity investments in early-stage mining companies. Its limitation is its incomplete coverage of the European Union, as it covers only the European Bank for Reconstruction and Development's countries of operations – 12 of which are EU countries, representing only 27% of the EU land area.

The establishment of a JUMP-like facility for the remaining 15 EU countries – covering 73% of EU land area and including the entire top five states for current exploration spend – would enable a holistic EU response to this challenge. This report estimates that the fund would have to be in the range of ~€300-500 million per year. This estimate is based on the ~€2 billion exploration finding gap, the 73% of land covered by the 15 states, and the 1:3-5 public-to-private capital mobilisation ratio (or "crowd-in effect").

Pillar 5: Foster mining innovation ecosystem

New technologies for the collection of empirical data are surging; new remote-sensing technologies and satellites with increasingly advanced algorithmic processing are now becoming the norm for regional exploration targeting. The use of 3D and 4D subsurface geological modelling is advancing, as more data are collected. The demand for funding across these areas of critical innovation is key to further advancing the ability of these technologies to aid in the discovery of new deposits. Much of this technological innovation centres on artificial intelligence, particularly machine learning and digital modelling. With its long mining history – many of the world's type localities are in Europe – and its excellent research institutions, Europe could play a leading role in this niche.

This final lever under this pillar involves the identification of potential resources sourced in historic mining waste and/or geological deposits with processing challenges. Funding new technology research into unlocking these deposits could make a fundamental difference to the CRMA timelines. Many mining districts contain many historical mines with waste materials – processed waste in dumps and mine waste tailings – that could be re-evaluated using modern technologies. Many of these waste resources hold multiple unextracted critical raw materials when initially mined. The issue of economics, however, is a key aspect also to processing these dumps and tailings, as many of them will be marginal or loss-making from an economic perspective.

In conclusion, the 13 actionable levers must be driven forward by each EU country. As soon as these fundamentals are fixed, financial incentives must follow to encourage and attract European and non-European exploration companies to return to the European Union, restart exploration and strengthen the security of EU CRM supply chains.

The sources of funding will follow the technical lead as companies return, and different types of funding will focus on different sections of the exploration-to-mine cycle (Lassonde Curve). Traditional sources of funding at the exploration level must be supplemented by non-traditional sources, which until now have tended to reside in the less risky mine-finance period of the curve. Sources of funding, which traditionally have been more focused on the mining end of the curve, could look further upstream to become part of the exploration and development funding deficit solution.

5.2 Role of public investment banks in attracting exploration investment

5.2.1 Role of public investment banks in supporting early-stage mineral exploration in the European Union

Early-stage mineral exploration is widely recognised as a high-risk, capital-intensive activity that public investors often do not have the risk appetite for. Yet the European Union's transition to a green and digital economy requires reliable supplies of the 34 critical raw materials – as mandated by the Critical Raw Materials Act, at least 10% of this material should be mined from inside the European Union. Decades of underdevelopment have left a backlog of exploration and a lack of shovel-ready EU mining projects.

To bridge the financing gap, crowding-in of private capital to EU exploration is required – public investment banks could take this role. A holistic set of tools to support the industry in the form of debt funding, equity investment and advisory support targeted at early-stage exploration is required.

Besides actors such as European Bank for Reconstruction and Development or the different national promotional banks, the European Investment Bank (EIB), as the European Union's lending arm, following the Critical Raw Materials Act and its own CRM strategic orientation, has assumed a central role in addressing Europe's need for secure, sustainable and resilient access to critical raw materials. The EIB has three fundamental building blocks to catalyse investment in this area, but needs risk coverage, new financial instruments and a wider mandate from the EU commission:

A. **Strategic alignment with EU policy**

   The EIB Group is fully aligned with the goals of the EU Critical Raw Materials Act. Recognising Europe's dependency on CRM imports, the EIB pledged a €2 billion per year initiative for funding critical raw materials in March 2025. As part of this, the Bank created a one-stop shop to streamline access to finance for CRM-related projects. This is already benefiting EU companies in project development and financing/construction through technical assistance and project finance (EIB, 2025c).

B. **Financing high-risk ventures**

   One of the EIB Group's core contributions has been its willingness to provide quasi-equity financing to projects that private lenders consider too risky. One example is the TechEU programme (2025-2027) under which the EIB is committing €70 billion of financing to innovative projects, including high-risk projects. While early-stage mineral exploration companies may fall into this risk category, given they require substantial upfront capital but generate little to no revenue until long after resource confirmation, the failure rates experienced in exploration are often orders of magnitude higher than start-/scale-ups.

C. **Existing mechanisms for pre-financing support – advisory services and technical assistance**

Beyond finance, the EIB also offers critical advisory services that help early-stage companies progress from concept to investment-ready projects. Through the InvestEU Advisory Hub, exploration ventures can access tailored advice on project structuring, risk assessment and financial modelling. Furthermore, under existing mandates, technical assistance for governments planning/conducting pre-competitive geoscience is possible.

5.2.2 Existing and recommended financial instruments for mineral exploration

Existing instrument: Corporate loans

The Bank aims to support Europe's major raw materials companies in the European Union along the entire value chain (exploration, extraction, processing, recycling, substitution) via corporate loans along with Research, Development and Innovation (RDI) projects that have the potential to contribute to the goals of the act.

Furthermore, the Bank provides loans to companies developing new technologies and exploration techniques (equipment innovation, new and more accurate sensor technology, new and improved software and algorithms and AI technology) developed within the European Union.

Existing instrument: Public sector (governmental) loans

The EIB can provide loans to EU member governments to fund national exploration incentive schemes.

Furthermore, the EIB can provide public sector loans to national bodies responsible for pre-competitive exploration (for example, TELUS/Finland), as well as loans supporting higher education and research.

Existing instrument: Intermediated financing

Intermediated lending to the newly established national investment funds focused on critical raw materials in the European Union and beyond (including exploration). Intermediated lending to mining technology players.

Existing instrument: Project finance (and associated advisory services)

By lending to constructors of innovative and competitive EU mining projects, the EIB Group is creating a vacuum effect, pulling projects through the pipeline and reversing the notion that no new mines are built in Europe. Furthermore, advisory services and technical assistance, which improve project bankability, accelerate this pull. While not supporting early-stage exploration, this has a value of signalling to the market that projects get financed and built in Europe.

Existing instrument: Quasi-equity/venture debt

Existing Venture debt is limited to companies developing CRM-related *technology* (including geophysical, chemical or remote sensors; algorithms and so on) as opposed to companies conducting exploration specifically.

6 GLOSSARY OF TERMS

Annual consumption of strategic raw materials: An aggregate of the amount of strategic raw materials consumed by undertakings established in the union in processed form, excluding strategic raw materials incorporated in intermediate or final products placed on the union market.

Critical raw materials: Under the European Union's Critical Raw Materials Act, a critical raw material is economically important to the European Union but faces a considerable risk of supply disruption.

Critical Raw Materials Act (CRMA): The EU act is a regulation designed to ensure a secure, resilient and sustainable supply of critical raw materials for the European Union. It aims to strengthen CRM value chains through diversified imports, domestic production and recycling, and robust monitoring of supply risks. The act supports strategic projects, promotes efficiency and circularity and sets targets for the European Union's strategic autonomy in processing and recycling these materials for the green and digital transitions.

Critical raw material project: Any planned facility or significant extension or repurposing of an existing facility that is active in the extraction, processing or recycling of critical raw materials.

Exploration: All activities aimed at identifying and establishing the properties of mineral occurrences.

Extraction: The extraction of ores, minerals and plant products from their source as a main product or as a by-product, from mineral occurrences underground, under and in water, and from brine and trees.

Feasibility study: A feasibility study in mining assesses technical, economic, environmental and legal factors of a project, demonstrating whether resource extraction is practical, profitable and sustainable before development proceeds.**General exploration:** Exploration at the national or regional level, not including targeted exploration.

Government/geological survey: A national geological survey is a government organisation responsible for studying and mapping a country's geology. It collects, analyses and publishes data on minerals, rocks, soils, groundwater and geohazards. Its work supports resource management, environmental protection, infrastructure planning, scientific research, and policy and economic development decisions.

Intermediate or mid-tier company: An intermediate, or mid-tier, exploration company is larger than a junior but smaller than a major. It actively explores, develops and sometimes produces natural resources like minerals, oil or gas. With more capital and experience than juniors, it balances growth opportunities with moderate risk, often progressing projects towards commercial production.

Junior company: A junior exploration company is a small, early-stage mining or energy firm that focuses on discovering and developing natural resources such as minerals, oil or gas. Unlike major producers, they do not operate large-scale mines and instead take higher risks to explore promising sites and attract investors for growth.

Major company: A major exploration company is a large, well-established firm engaged in discovering, developing and producing natural resources such as minerals, oil or gas. With substantial financial resources, advanced technology and global operations, majors focus on large-scale projects, ensuring steady production, long-term growth and lower risk compared to junior or intermediate companies.

Mineral occurrences: Any single mineral or combination of minerals occurring in a mass or deposit of potential economic interest.

Mineral reserves: A mineral reserve is the economically mineable part of a measured or indicated mineral resource, demonstrated by feasibility studies, considering modifying factors, distinguishing it from broader, less certain mineral resources.

Mineral resources: A mineral resource is a concentration of material of economic interest with reasonable prospects for possible extraction but without demonstrated economic feasibility, unlike a mineral reserve proven to be mineable.

National programme: A national programme or a compiled set of programmes covering the entire territory, prepared and adopted by relevant national or regional authorities.

National promotional banks: National promotional banks and institutions are legal entities carrying out financial, development and promotional activities on a professional basis with a mandate by a country at the central, regional or local level.

Permit-granting process: A process covering all relevant permits to build and operate a critical raw material project, including building, chemical and grid connection permits and environmental assessments and authorisations. It encompasses all applications and procedures from the acknowledgement that the application is complete to the notification of the comprehensive decision on the outcome of the procedure by the single point of contact concerned.

Predictive map: A map indicating areas that are likely to contain mineral occurrences of a given raw material.

Pre-feasibility study: A pre-feasibility study in mining provides a preliminary assessment of technical options, costs, economics and risks, determining project viability and guiding decisions before a full study.

Preliminary economic assessment: An early-stage, conceptual assessment of the potential economic viability of a project for the recovery of critical raw materials from extractive waste.

Processing: All physical, chemical and biological processes involved in the transformation of a raw material from ores, minerals, plant products or waste into pure metals, alloys or other economically usable forms, including beneficiation, separation, smelting and refining, and excluding metal working and further transformation into intermediate and final goods.

Raw material: A substance in a processed or unprocessed state used as an input for the manufacturing of intermediate or final products, excluding substances predominantly used as food, feed or combustion fuel.

Raw materials supply chain: All activities and processes of the raw materials value chain up to the point a raw material is used as an input for the manufacturing of intermediate or final products.

R**aw materials value chain:** All activities and processes involved in the exploration, extraction, processing and recycling of raw materials.

Recycling: Recycling as defined in Article 3, point (17), of Directive 2008/98/EC.

Strategic raw materials: Under the EU act, a strategic raw material is a critical raw material (a material important for the economy with a high risk of supply disruption) that is crucial for achieving the European Union's strategic objectives in key sectors like renewable energy, digital technologies, space and defence. These materials are identified by their high demand growth, difficulty in increasing production and significant role in applications such as batteries, electric vehicle motors and wind turbines.

Supply disruption: Unexpected significant decrease in the availability of a raw material or significant increase in the price of a raw material beyond normal market price volatility.

Supply risk: Supply risk as calculated in line with Annex II, Section 2 of the Critical Raw Materials Act.

Targeted exploration: Detailed investigation of an individual mineral occurrence.

Union processing capacity: An aggregate of the maximum annual production volumes of processing operations for strategic raw materials, excluding such operations that are typically located at or near the extraction site, located in the union.

Union recycling capacity: An aggregate of the maximum annual production volume of recycling operations for strategic raw materials after reprocessing, including the sorting and pre-treatment of waste and its processing into secondary raw materials, located in the union.

References

B2gold (2025). About Otjikoto. Available at: https://www.b2gold.com/operations-projects/producing/otjikoto-mine-namibia

Blengini, G.A., El Latunussa, C.E.L., Eynard, U., Torres de Matos, C., Wittmer, D., Georgitzikis, K., Pavel, C., Carrara, S., Mancini, L., Unguru, M., Blagoeva, D., Mathieux, F., & Pennington, D. (2020). *Study on the EU's List of Critical Raw Materials (2020): Final Report*. Luxembourg: Publications Office of the European Union. http://doi.org/10.2873/11619

CFA Institute (2024). CFA Institute survey report on the ESG regulatory framework in the EU. Available at: https://rpc.cfainstitute.org/sites/default/files/-/media/documents/survey/esg-regulatory-framework-eu.pdf

CSIS (2025a). Unpacking Trump's new critical minerals executive order. Available at: https://www.csis.org/analysis/unpacking-trumps-new-critical-minerals-executive-order

CSIS (2025b). A U.S. mineral strategy for global energy Transition. Available at: www.csis.org/analysis/us-mineral-strategy-global-energy-transition

European Commission (2025). *Critical Raw Materials Act*. Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs. Available at: https://single-market-economy.ec.europa.eu/sectors/raw-materials/areas-specific-interest/critical-raw-materials/critical-raw-materials-act_en

EuroGeoSurveys (2026). EuroGeoSurveys bridging geoscience and policy. Available at: https://eurogeosurveys.org/

European Investment Bank (2025). EIB steps up financing for European security and defence and critical raw materials. Available at: https://www.eib.org/en/press/all/2025-156-eib-steps-up-financing-for-european-security-and-defence-and-critical-raw-materials

European Parliament and Council of the European Union (2024). Regulation (EU) 2024/1252 of 11 April 2024 establishing a framework for ensuring a secure and sustainable supply of critical raw materials and amending Regulations (EU) No 168/2013, (EU) 2018/858, (EU) 2018/1724 and (EU) 2019/1020. Official Journal of the European Union, L 2024/1252, 3 May 2024. Available at: https://eur-lex.europa.eu/eli/reg/2024/1252/oj/eng

Geoscience Australia (2025). Australia's identified mineral resources. Available at: https://www.ga.gov.au/scientific-topics/minerals/aimr

Gov.ie (2025). Six monthly reports to the Oireachtas on mineral exploration and mining in Ireland. Available at: https://www.gov.ie/en/department-of-climate-energy-and-the-environment/collections/six-monthly-reports-to-the-oireachtas-on-mineral-exploration-and-mining-in-ireland/

Grand View Horizon (2025). U.S. battery market size & outlook, 2023-2030. Available at: https://www.grandviewresearch.com/horizon/outlook/battery-market/united-states

Manalo, P. (2023). Market Intelligence report: Discovery to production averages 15.7 years for 127 mines. S&P Global. Available at: https://www.spglobal.com/market-intelligence/en/news-insights/research/discovery-to-production-averages-15-7-years-for-127-mines

Mordor Intelligence (2025). US Defense Industry size & share analysis – growth trends & forecasts (2025-2031). Available at: https://www.mordorintelligence.com/industry-reports/united-states-defense-market

Natural Resources Canada (2025). Tax incentives for mining and exploration. Available at: https://natural-resources.canada.ca/minerals-mining/mining-policy-taxation-industry/mining-taxation/mining-specific-tax-provisions

Prospectors & Developers Association of Canada (PDAC) (2025a). Access to capital. Available at: https://pdac.ca/programs-and-advocacy/access-to-capital

Prospectors & Developers Association of Canada (PDAC) (2025b). Exploration is the riskiest stage of the mineral development cycle. Available at: https://www.pdac.ca/programs-and-advocacy/access-to-capital/convention-program

Prospectors & Developers Association of Canada (PDAC) (2026). Made in Canada investment tools, flow-through shares & the mineral exploration tax credit explained. Available at: https://pdac.ca/programs-and-advocacy/access-to-capital/flow-through-shares

S&P Global (2025). Market Intelligence. Available at: https://www.spglobal.com/market-intelligence/en/news-insights/research/world-exploration-trends-2024

Statistical Times (2025). Comparing United States and European Union by economy. Available at: https://www.statisticstimes.com/economy/united-states-vs-eu-economy.php

United States Government Accounting Office (GAO) (2022). CRITICAL MINERALS: Building on federal efforts to advance recovery and substitution could help address supply risks. Report to the Ranking Member, Subcommittee on Interior, Environment, and Related Agencies, Senate Committee on Appropriations. Available at: https://www.gao.gov/assets/gao-22-104824.pdf

United States Government Accounting Office (GAO) (2024). Critical minerals, status, challenges, and policy options for recovery from nontraditional sources. Report to Congressional Addressees; Technology Assessment. Available at: https://www.gao.gov/assets/gao-24-106395.pdf

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