POLICY BRIEF

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Securing responsibly sourced mineral resources for the transition: six levers for France and Europe

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KEY TAKEAWAYS

CONTEXT

The transition towards a more sustainable world depends on metals whose demand is rising sharply. The development of the production capacities will need massive investments worldwide, increased by export restrictions that multiplicate quickly. EU and France have built a toolbox to handle the questions related to critical minerals (Critical Raw Materials Act, OFREMI, BRGM's new mineral inventory, a critical metals fund). Yet, access to responsibly produced resources is still not secured.

OBSERVATIONS

- Supply is modelled without its real constraints: falling discovery rates, decreasing grades, water availability, reagents and energy cost, limits of recycling for secondary production.
- By-product metals do not respond to their own demand.
- Financiers require guaranteed offtake, which contradicts a demand described as booming.
- Local mining project consent and skills have become bottlenecks.
- Criticality lists do not prioritise what is essential: fertilisers, sulphur, water.

RECOMMENDATIONS

Ten recommendations across six levers:

1. Build physical constraints into every foresight exercise and revive exploration;
2. Organise by-product recovery;
3. Share value and give local actors independent expertise;
4. Build on existing training networks;
5. Develop a water–energy–food–metals nexus assessment;
6. Make public support consistent and conditional on financial safeguards and demanding ESG criteria.

Context: soaring demand, lagging supply

The policy problem is simple to state: France and Europe need access to responsibly produced mineral resources to deliver the energy transition and the digital transformation in line with their climate commitments (net zero by 2050 under the Paris Agreement and the European Climate Law). Three stakes depend on it: industrial sovereignty, the retention of skills on European soil, and the feasibility of the transition itself.

The gap between needs and investment is widening. Critical mineral investment fell by 9% in 2025 and exploration spending by more than 10%. Public finance commitments in advanced economies reached around USD 65 billion, but a wide gap remains between announcements and disbursements [1]. Expected supply shortfalls reach 30–40% for lithium and rare earths and 10–20% for copper [2]. Meanwhile, export restrictions on industrial raw materials have increased more than fivefold since 2009 [3].

Demand is already well documented at global level, and national-scale studies are emerging. They show that circular economy and sufficiency measures could cut primary extraction by 11% to 61% depending on the metal [4]. They also show that some high-demand scenarios cannot be met even when every lever is pulled, notably for lithium [5]. Technological shifts (sodium ion batteries) may answer that issue. Sufficiency remains the under-considered perspective (lower battery capacities for EV's for instance if considering Li).

Public authorities have responded:

- At EU level, the Critical Raw Materials Act (2024) sets a list of 34 critical raw materials and 2030 benchmarks. 60 strategic projects were selected in 2025, followed by 46 more in October 2026.
- In France, OFREMI[1], created in 2022, monitors supply and demand and runs foresight work. BRGM[2] is conducting a new inventory of subsurface resources (with a budget of EUR 53 million backed up by France 2030 funding program). A critical metals fund managed by InfraVia, seeded with EUR 500 million by the State, targets EUR 2 billion and has started to invest in minerals value chain related projects.

These tools exist, but they leave several structural bottlenecks unaddressed, set out below.

Observations

Supply is modelled without its real constraints

- **Real primary and secondary production capacities.** Mining is a heavy, strongly capital-intensive industry, marked by significative development times. Both characteristics that limit its growth rate. End-of-life recycling remains limited for most metals. Currently, it meets 23% of copper demand. Even in the most favourable case, this share would only reach about 50% by 2050, and primary production would remain above its 2020 level in 87% of simulations [8]. For materials like lithium, with a limited historical market volume, recycling will not be able to play a significant role as long as the growth

[1] OFREMI : Observatoire Français des Ressources Minérales pour les Filières Industrielles
[2] BRGM : Bureau de Recherches Géologiques et Minières

of demand will remain very high, i.e as the electrification of the mobility will not be complete.

- **Water**. Water is essential for mining, particularly at the processing stage. Copper resources are more exposed to water risk than lead-zinc or nickel resources, partly because Chile and Peru face severe water stress [6]. 65% of lithium resources lie in areas of medium to very high-water risk [7].
- **Exploration and projects development.** Artificial intelligence has a significant potential in exploration, as soon as data is available. Its expected gains depend on coupling it with geological knowledge [9], and therefore on high-quality data: precisely what ongoing mineral inventories can deliver. New technologies, like direct lithium extraction, also offer real opportunities, but their industrial potential needs to be confirmed: only 30% of direct lithium extraction tests have been run on real brines [10].
- **Reagents and impacts.** Mine production also relies on various inputs, especially reagents. Sulfuric acid may be the most significant one, as its availability may decrease if oil and gas production decreases. These reagents may also bear an important share of the mining impacts: on average, direct lithium extraction sites in Germany and the US have climate impacts seven times higher than conventional brines sites due to a higher consumption of reagents [11].

Foresight scenarios rarely combine these constraints. Ongoing research at Mines Paris – PSL coupling integrated assessment models with mineral supply shows that they significantly alter production pathways [21].

Metals that do not respond to their own demand

In a 2015 study, 38 of 62 metals studied are obtained mostly (over 50%) as by-products of a host metal. For 18 of them, including germanium, terbium and dysprosium, production is also geopolitically concentrated, and recycling is close to zero [12]. Their supply follows the host metal's market and barely reacts to their own price: cobalt follows copper and nickel, gallium follows alumina, germanium and indium follow zinc [13]. Criticality lists flag these metals, but do not really integrate the limit in their availability.

The financing paradox

The European Court of Auditors stated in April 2026 that financing for extraction and processing in the EU is only just beginning. It describes a vicious circle: without stable supply, processing does not develop, which weakens the incentive to secure supply [14]. When the October 2026 strategic projects were selected, the lack of buyers was named as the main risk.

This is where the inconsistency lies. If demand is growing as fast as announced, producers should have no trouble selling their output. Yet financiers require guaranteed offtake contracts before funding a project. The real risk is therefore not volume but price: volatility (see for instance the 2023–2024 lithium price collapse), refining and buyers. According to McKinsey, prices would need to rise by at least 19% for copper and 28% for lithium, compared to 2025, to trigger the required investment [2]. Requiring guaranteed offtake to finance projects shifts this price risk onto miners, who cannot bear it.

Consent treated as a corporate risk

The notion of a 'social licence to operate' has mostly served to manage industrial risk rather than to build development shared with host territories [15]. Yet 70% of cobalt resources and 84% of platinum resources lie in high environmental, social and governance

risk contexts [7]. Producing in Europe, under demanding rules, is therefore also a matter of responsibility. Good governance practices exist [16], but the expertise gap between project developers and local actors persists, and lessons from French projects are not captured nor publicly advertised.

Eroding skills

Mining engineering enrolment has fallen by about 63% in Australia since 2014, and graduations by 39% in the United States since 2016. 71% of mining leaders say the talent shortage is holding back their targets [17]. In France the problem is twofold. On the way in, students are turning away from mining careers. On the way out, the mining revival has not yet translated into jobs, which weakens training programmes. Networks already exist to respond: engineering schools, industry, the Société de l'industrie minérale (SIM), EIT RawMaterials, but the answer has yet to arise to ensure viability of mining training programs during the transition period.

If everything is critical, nothing is

Criticality assessments reach different results depending on their goals and scope, and cause-and-effect links remain poorly understood [18]. With 34 critical raw materials, the EU list does not prioritise. Above all, it omits resources on which vital needs depend, as shown by the two following examples:

- Phosphorus. A non-renewable resource essential to fertilisers, which should rank among food security priorities [19].
- Sulphur. Over 80% of global supply comes from the desulphurisation of oil and gas. Demand for sulphuric acid, needed for phosphate fertilisers and for processing nickel and cobalt ores, could rise from 246 to 400 Mt by 2040. Phasing out fossil fuels could create an annual shortfall of 100 to 320 Mt, and green technologies could outbid the fertiliser industry [20].

The transition thus creates its own tensions with food and water. No tool currently assesses them together.

Recommendations

Lever 1 – Follow up the mineral inventory with realistic foresight and renewed exploration

R1. Build physical constraints into all foresight scenarios. Supply, demand and energy scenarios should account for water, energy and reagent availability, and for the limits of recycling. OFREMI and BRGM can draw on existing academic work to do so.

R2. Create a tax incentive for greenfield exploration. The aim is to turn the areas of interest identified by the inventory into projects, on the model of Canada's flow-through shares, which pass exploration expenses on to investors.

Lever 2 – Organise by-product recovery

R3. Track companion metals and target strategic stocks on them. Without changing the EU criticality methodology, complement it with dedicated monitoring of companion metals and of the production of their host metals. Use this monitoring of companion

metals and of the least elastic companion metals, gallium and germanium first, within the coordinated stockpiling scheme under preparation.

R4. Recover by-products at refineries and from mining residues. Require a recovery study at European host-metal refining sites (alumina, zinc, copper, nickel), with investment support where the study shows potential, since volumes are too small for the market to fund the installation alone. In parallel, map processing residues and historical mining waste containing by-products, with a view to their later recovery (post-mining).

Lever 3 – Build acceptance with host territories

R5. Assess how value sharing shapes local acceptance. Fund field-based social science research on how different redistribution mechanisms (royalties [AS10.1]to municipalities, local equity, community agreements) affect local acceptance over a project's life. Drawing on French and European case studies, this would ground benefit-sharing schemes in evidence rather than assumptions.

R6. Give territories access to independent expertise. Create a pooled fund, financed by project developers and the State, managed by a neutral third party, so that local authorities and associations can commission their own expert studies (hydrogeology, ecotoxicology, residual risks), on the model of third-party expertise already used for classified industrial installations but triggered by the territory. Complement it with a public observatory of lessons learned from mining projects, run by a third-party academic actor, such as a research institution or engineering school to ensure neutrality.

Lever 4 – Maintain skills by building on what exists

R7. Launch a national skill plan built on existing network. Quantify future skills needs with existing networks: engineering schools, industry, the Société de l'industrie minérale, the Mines and Metallurgy strategic sector committee. Earmark doctoral contracts and industrial chairs for mineral resources. Mobilise European training networks (EIT RawMaterials and Erasmus Mundus master's programmes) rather than creating new schemes.

Lever 5 – Prioritise what is essential

R8. Develop a water–energy–food–metals nexus assessment methodology. It would help arbitrate between competing uses of the same resource, such as sulphur between fertilisers and battery metals, or phosphorus between agriculture and LFP batteries. Over time, it could inform choices such as producing sulphuric acid from sulphides or recovering phosphorus from sewage sludge.

Lever 6 – Consistent and conditional public support

R9. Give the "strategic project" label financial substance. The CRMA label speeds up permitting but does not guarantee financing. It should open access to public guarantees on project debt (EIB, Bpifrance), drawing on mining engineering schools to assess them, and to priority review with binding deadlines with public financiers. This should address the financing paradox: the State carries part of the price risk instead of requiring miners to secure guaranteed offtake.

R10. Make all public support conditional on verifiable commitments. Supported projects should commit to apprenticeships and local employment, which create outlets for training programmes. They should also meet ESG criteria aligned with the most demanding standards, such as IRMA, audited by a third party.

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