Powering Europe's rail future

From supply risks to strategic autonomy: securing materials and technologies behind rail innovation

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ITRE Committee of the European Parliament

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Technical Presentation

LEADER2030

Learnings for European Autonomy to Deliver Europe's Rail in 2030

FINAL CONFERENCE
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Europe's Rail

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What the «LEADER 2030» project gave answer to

"Will Europe be able to deploy its target rail innovations at scale by 2030—or will supply chains become the limiting factor in a context of increasing dependencies on critical materials and components, exacerbated by geopolitical competition, conflicts, climate risks, and growing race between countries and sectors to secure them?"

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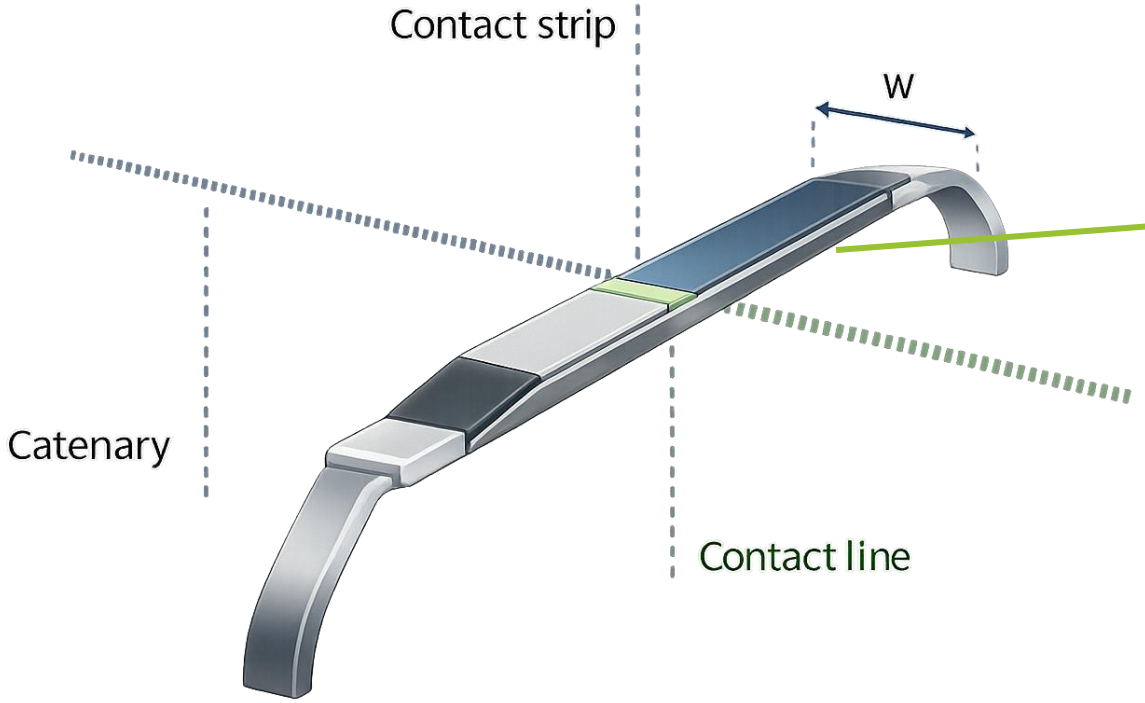
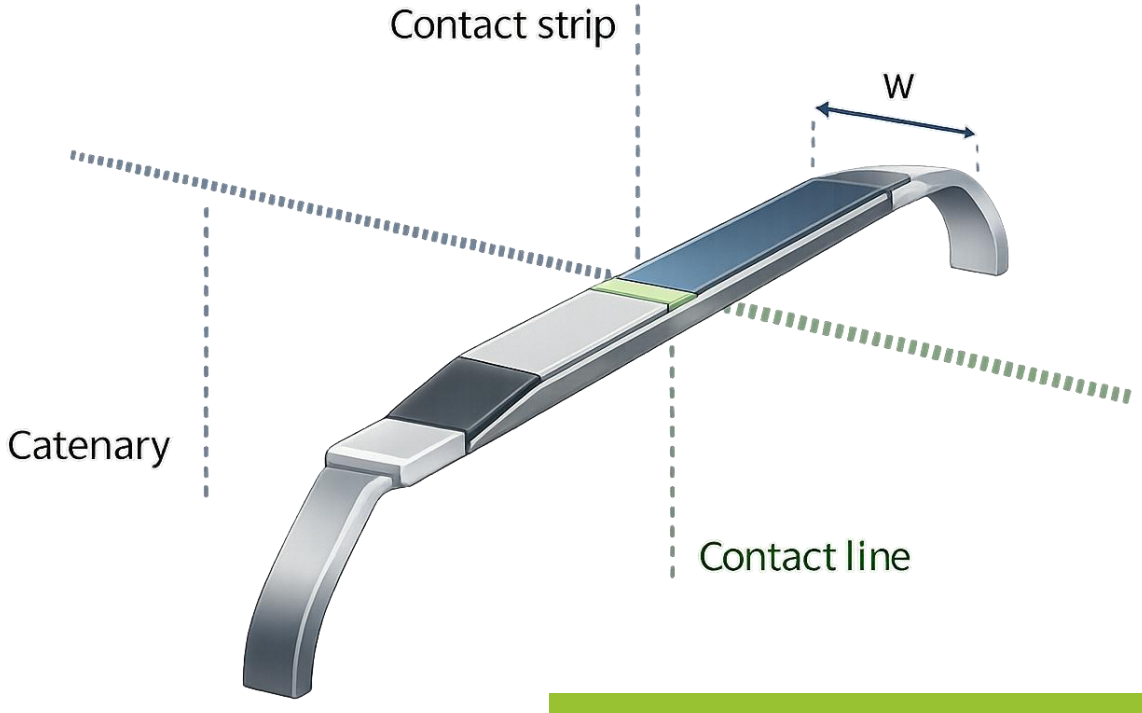
Dependencies, Conflicts and Race between Sectors



Dependencies, Conflicts and Race between Sectors



2022 (after Russia's invasion of Ukraine)

3 months delay on EMUs and Loco

2024 (continuation of Russia-Ukraine conflict)

6 months delay on EMUs and Loco

2026 (continuation of Russia-Ukraine conflict)

9/12 months delay on EMUs and Loco

as Rail suppliers must 'queue' behind Defence suppliers

Disruptions in the European Rail value chain (end 2023)

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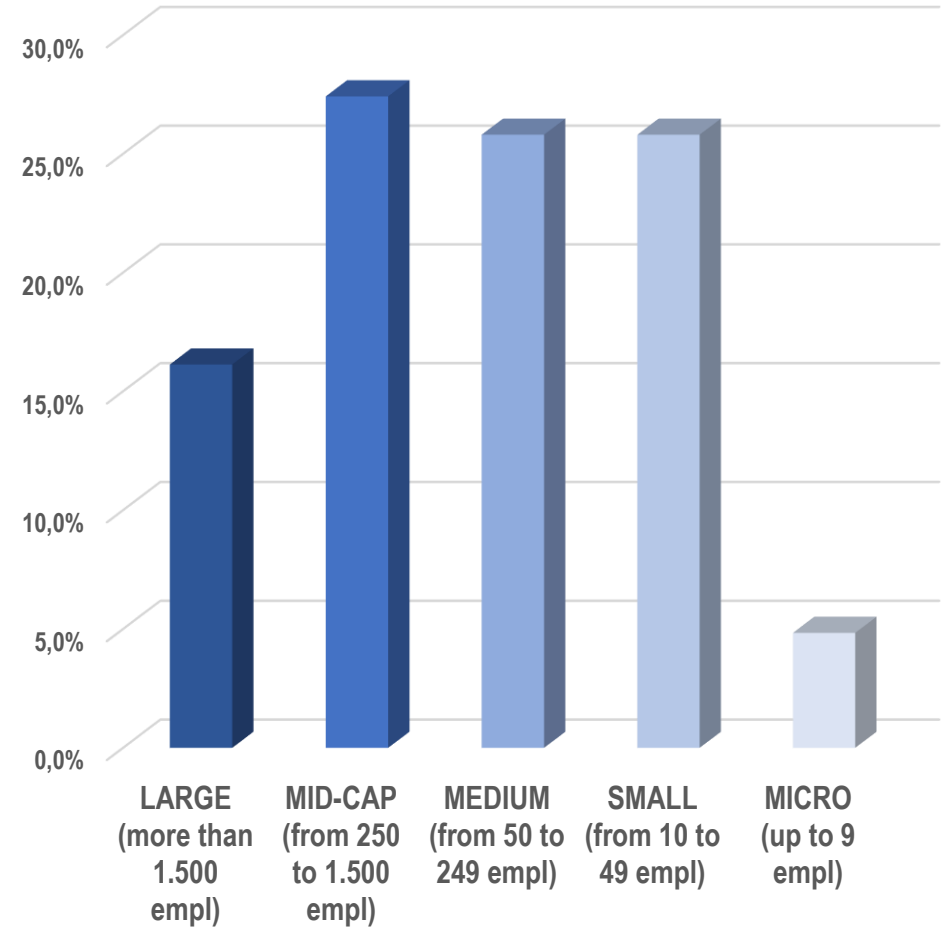

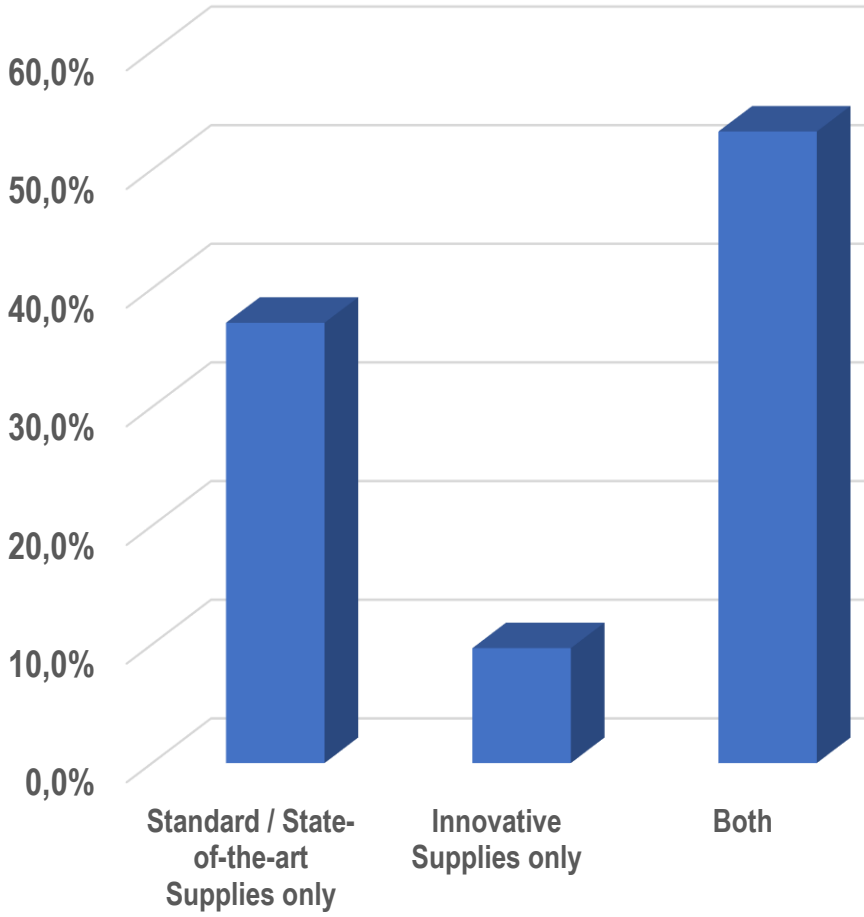

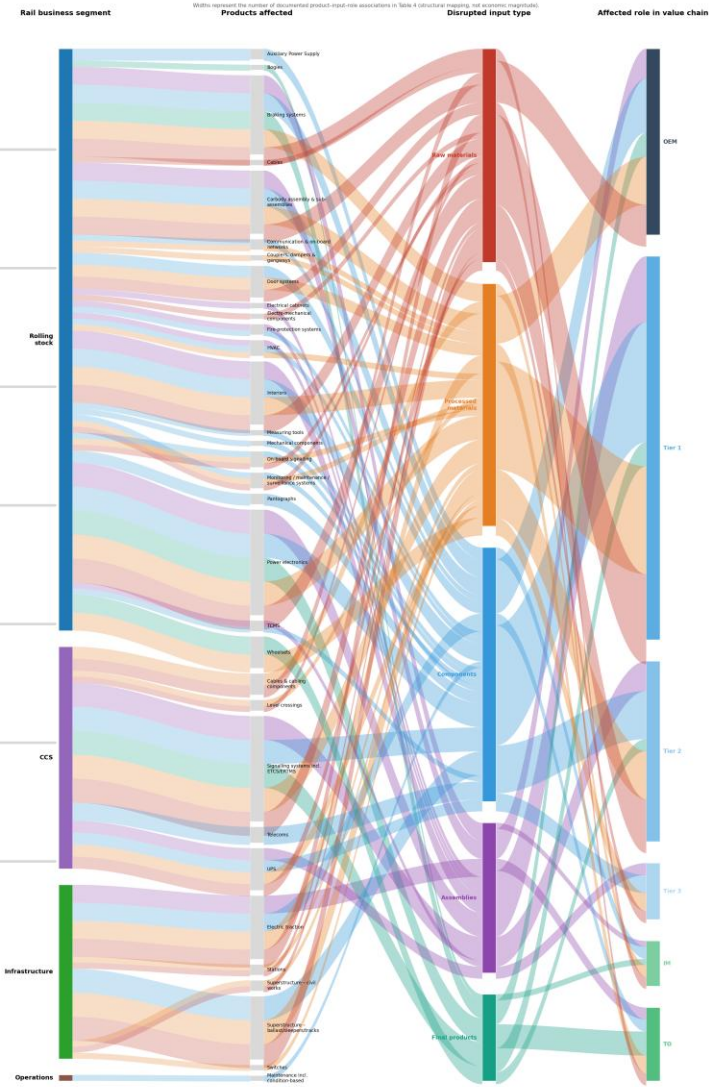

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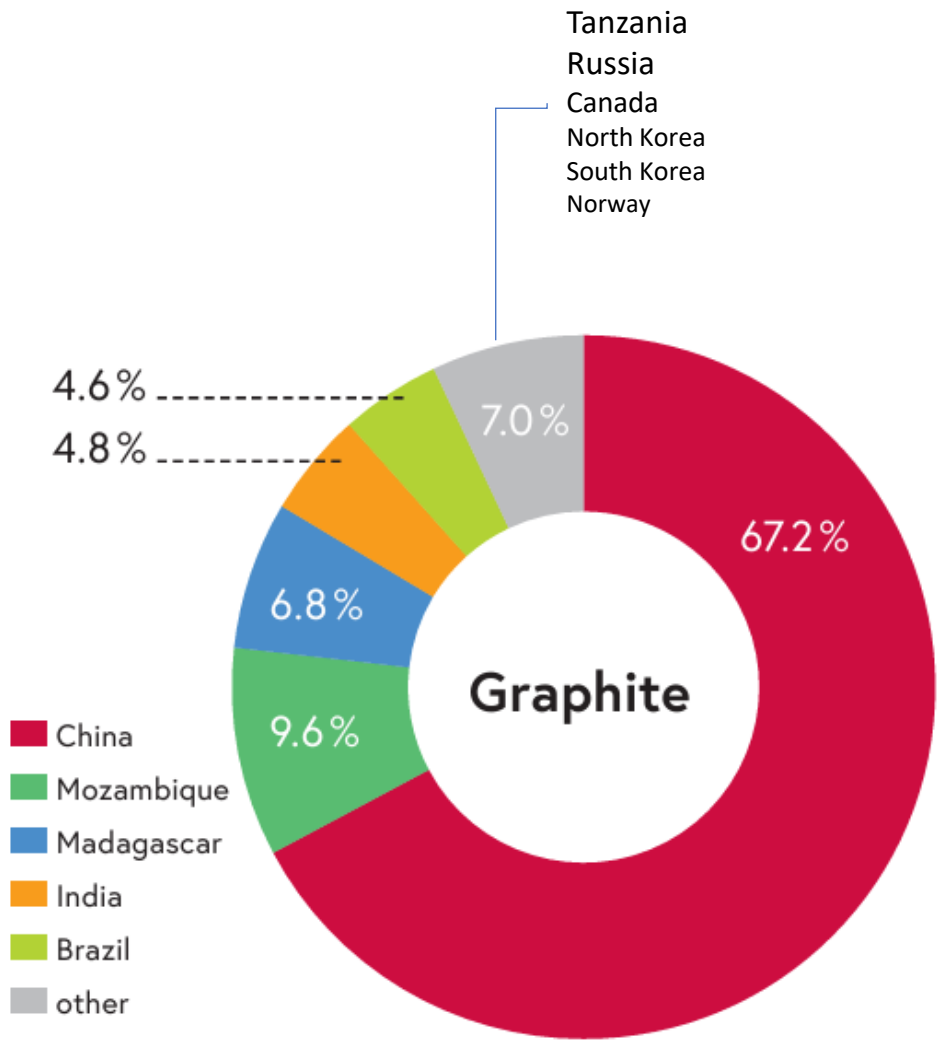

European Commission

Enter the Platform

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EU Energy and Raw Materials Platform

Home | Hydrogen | Raw Materials | Gas

Products

all 17 Strategic Raw Materials under the Critical Raw Materials Act (Annex 1):

- Bauxite/alumina/aluminium
- Bismuth
- Boron — metallurgy grade
- Cobalt
- Copper
- Gallium
- Germanium
- Lithium — battery grade
- Magnesium metal
- Manganese — battery grade
- Graphite — battery grade
- Nickel — battery grade
- Platinum group metals
- Rare earth elements for permanent magnets (Nd, Pr, Tb, Dy, Gd, Sm, and Ce) and permanent magnets
- Silicon metal
- Titanium metal
- Tungsten

Battery-grade graphite is needed for lithium-ion battery anodes

Its introduction here is because EU's great attention to EVs

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Graphite strips
(strips)

Graphite – battery-grade
(powder)

DISRUPTION
(macro-economic definition)

*"Supply chain disruptions are defined as **unexpected** and **unforeseen** events or circumstances that **disturb** the **regular flow of goods and materials** along the value chain".*[1]

≠

DEPENDENCY
(macro-economic definition)

*"**reliance on a limited number of actors** for the supply of goods, services, data, infrastructures, skills and technologies **combined** with a **limited capacity for internal production to substitute imports**".*[2]

whose impact has been further assessed against some type of disruptions

- Future conflicts (namely China-Taiwan for impact on semiconductors industry)
- Climate change (as extreme climate events are growing in Asia-Pacific region, where most European and global supplies come from)

[1] Novoszel L, Wakolbinger T (2022), "Meta-analysis of Supply Chain Disruption Research", *Operations Research Forum*, Springer, para. 2.3.3.
.[2] European Commission (2021), Commission staff working document 'Strategic dependencies and capacities', p. 8.

We measured the supply risk level for the key European Rail innovations

Rail in 2030

- **Network Management & Mobility (FP1 - MOTIONAL):** Advanced traffic management systems, real-time data analytics, and digital platforms enhance operational efficiency and network capacity.
- **Digital & Autonomous Train Operations (FP2 - R2DATO):** Automatic Train Operation (ATO), AI-driven control systems, and advanced sensor technologies improve safety, reliability, and cost efficiency.
- **Intelligent & Integrated Asset Management (FP3 - IAM4RAIL):** Predictive maintenance systems, Digital-Twins, and IoT-based sensors optimize asset lifecycle and reduce maintenance costs.
- **Sustainable & Green Rail Systems (FP4 - RAIL4EARTH):** Energy-efficient propulsion, sustainable materials, and emissions reduction technologies drive sustainability efforts.
- **Competitive Digital Green Rail Freight (FP5 - TRANS4M-R):** Digital Automatic Couplers (DAC), intelligent freight systems, and smart grid integration enhance efficiency and sustainability for seamless Rail freight.
- **Regional & Capillary Rail Services (FP6 - FUTURE):** Modular vehicles, cost-efficient infrastructure, and customer-centric digital services improve accessibility and affordability.
- **New Approaches for Guided Transport (FP7 - Pods4Rail):** Automated multimodal transport systems and ultra-high-speed trains introduce innovative mobility solutions.

Risk level measurement results

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a) **2030 TRL/delivery risk**: indicates the maturity and likelihood of deployment of each rail innovation under development within the Europe's Rail programme of the EU

b) **Global risk**: sums **Material risks** (availability, price volatility, supply concentration) + **Digital dependency risks** (cloud, software, platforms and firmware ecosystems)

c) **SME exposure risk**: indicates the **concentration of vulnerabilities in lower tiers**

a)+b) shows **systemic vulnerabilities**, where disruptions—particularly at lower tiers—can propagate across the value chain and delay the deployment of critical rail innovations

Materials overlap: we've just seen the Graphite case amidst growing demand

Defence

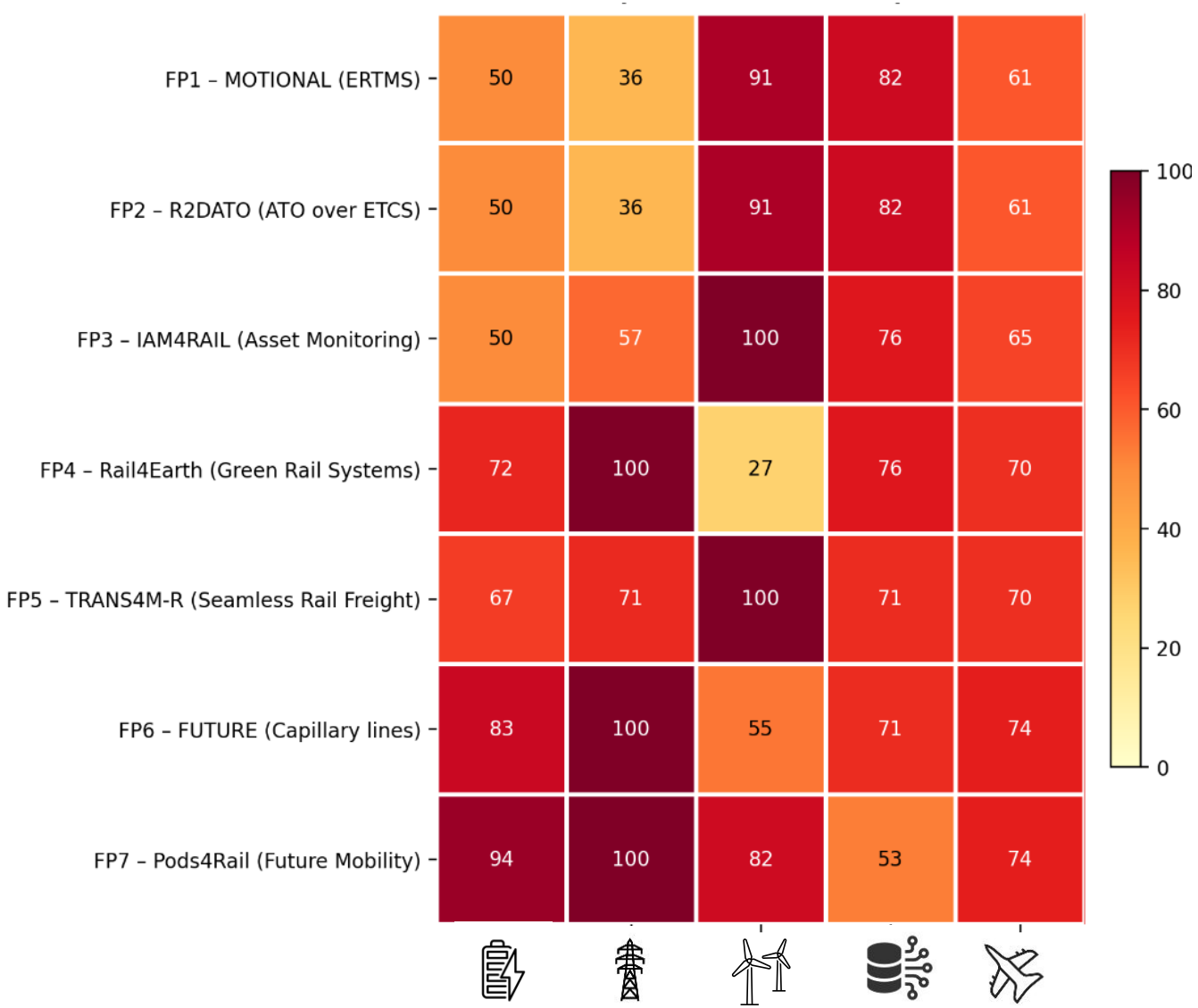
- Missiles
- Graphite "Blackout" Bombs
- Stealth and Protection
- Electrical Conductivity & Current Collection
- Thermal Management & Sealing

Automotive

- EVs Lithium-ion Batteries
- Brake linings
- Gaskets
- Clutch materials

...

Future: CRMs/SRMs overlap between Rail innovations and other technological sectors



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The LEADER 2030 Recommendations

The recommendations derived from the LEADER 2030 project–and further fine-tuned and validated through a Stakeholders Public Consultation and Validation rounds with key stakeholders (January-March 2026)–are structured into a **set of cross-cutting priority areas**, reflecting the **key levers through which the European Union, Member States and industry can strengthen the resilience, sustainability and strategic autonomy** of **both the Rail and Raw Materials value chains–and beyond**.

These priority areas are **inherently interdependent** and **should be implemented in a coordinated manner**, ensuring **consistency between industrial, regulatory, financial and technological actions**.

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1. Strengthening Value Chain Coordination, Governance and Institutional Capacity

A first priority concerns the need to **move from fragmented approaches** towards system-level coordination and governance across both the rail and raw materials value chains, supported by stronger institutional capacity, strategic intelligence and ecosystem-level coordination.

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2. Unlocking Investment, Financing and De-risking Mechanisms

A second priority concerns the mobilisation of adequate financial instruments to support resilience, industrial transformation and strategic autonomy **across both value chains**.

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3. Simplifying Regulation and Ensuring a Competitive Framework

A third priority focuses on improving framework conditions and **reducing the regulatory frictions that limit industrial competitiveness, circularity and supply diversification**.

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4. Scaling Circularity, Innovation and Industrial Capacity

A fourth priority concerns **accelerating** circularity, innovation and industrial capacity development to reduce dependencies and strengthen European competitiveness.

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5. Enhancing Supply Chain Resilience and Strategic Logistics

A fifth priority addresses the **internal capabilities** that companies—especially SMEs—need in order to anticipate disruptions, respond effectively and remain competitive, as well as **intra-EU logistics** capacity.

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6. Aligning Market Design, Procurement and Industrial Incentives

A sixth, cross-cutting priority concerns the need to better align market incentives, procurement practices and industrial policies **with resilience and strategic autonomy objectives**.

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7. Strengthening the Broader Macroeconomic and Strategic Conditions for European Autonomy

A seventh priority concerns the broader macroeconomic and strategic conditions needed **to make resilience and autonomy economically sustainable over time**.

The LEADER 2030 Recommendations in detail

They have been classified:

- **By target value chain:**

1. the first group aims to address **specific challenges of the European Rail value chain**, **while most can be applied to other European industrial ecosystems**
2. the second group aims to address **specific challenges of the European Raw Materials value chain**

- **By target audience:**

1. the "**Industry**" ones require the industry actors—either collectively across the value chain or individually—to take action directly
2. the "**Policy**" ones require policymakers at European, national, or regional level to take action directly

- **By specific goal**

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Recommendations addressing the Rail value chain

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(A) To foster Value chain's resilience *(systemic actions)*

'A chain is only as strong as its weakest link.'

A.1 - POLICY / INDUSTRY: Continue and consolidate Europe's Rail coordinated R&D and intelligence efforts

A.2 - INDUSTRY / POLICY: Foster a value chain preparedness model

A.3 - POLICY / INDUSTRY: Foster a European, SME-inclusive Rail data ecosystem

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(B) To foster Companies' internal resilience *(company-level actions)*

"Supply chains tend to make headlines only when they break, and right now, they're breaking everywhere.'

B.1 – INDUSTRY: Structure supply chain strategy and governance

B.2 – INDUSTRY: Structure supply chain risk and resilience strategies

B.3 – INDUSTRY: Invest in real-time supply visibility technologies

B.4 – POLICY (INDUSTRIAL, REGIONAL): Support SMEs to access technologies for resilience

B.5 – POLICY (INDUSTRIAL, FINANCIAL, COMPETITION): Support stockpiling measures for SMEs

B.6 – POLICY (INDUSTRIAL, REGIONAL): Strengthen Cluster policies for resilience support

Introduce **targeted support measures to help SMEs offset the financial impact of maintaining higher buffer stocks** in response to supply chain turbulence and materials shortage**, explicitly recognising that current stockpiling needs are driven by systemic market failures and distortions** (price volatility, allocation mechanisms, geopolitical shocks), and therefore **go beyond normal entrepreneurial risks**. These may include:

- (…)
- **Tax credits or subsidies linked to resilience-building actions, such as strategic stockpiling of critical and non-critical raw materials, processed materials, and other key component for which risks of scarcity or supply shortages have been identified**
- Pooling and shared storage solutions coordinated at regional or sectoral level to reduce individual SME costs
- Facilitating the **development and uptake of supply chain finance instruments**—such as inventory financing or asset-based lending—whereby eligible inventories (including critical materials and components) can be **recognised as collateral**, thereby reducing working capital constraints and enabling SMEs to maintain strategic stocks without jeopardising liquidity
- (…)
- Encouraging c**ooperation with the financial sector** (including commercial banks, development banks and EU financial instruments such as the EIB/EIF) to design dedicated products aligned with industrial resilience objectives.

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- Supporting **clusters upskilling in providing operational follow-up** to SMEs beyond diagnostics (…), ensuring that **awareness is translated into concrete improvements**
- Supporting **clusters as coordination hubs for multi-tier supply chain visibility and risk monitoring**, facilitating the identification of vulnerabilities and the **dissemination of early-warning signals across industrial ecosystems**
- Mobilising clusters to facilitate **resilience-based collaboration among companies**, including **sharing best practices, pooling flows or stocks, consolidating volumes** and developing joint business continuity approaches, thereby reducing individual exposure to risks and costs, and **increasing overall efficiency**
- **Strengthening interregional and cross-border cluster collaboration** to build integrated European value chains, diversify sourcing options and reduce strategic dependencies
- **Embedding clusters more systematically in EU industrial and resilience-related policies**, ensuring better alignment between bottom-up industrial needs and top-down policy instruments.

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(C) To increase Critical Raw Materials availability *(systemic actions)*

Circularity of materials

''The most secure resource is the one you reuse.'

2028-2034

European Union
European Regional Development Fund

C.1 – POLICY (REGIONAL, ENVIRONMENTAL, INDUSTRIAL): Strengthen Regions as active nodes of resilient and sustainable value chains

C.2 – POLICY (RESEARCH, INDUSTRIAL, ENVIRONMENTAL): Support R&D and business models to boost recycling

C.3 – POLICY / INDUSTRY: Enable industrial uptake of secondary materials through standards, traceability and supply chain support

C.4 – INDUSTRY: Introduce Eco-design and Circularity in all stages of the value chain

C.5 – INDUSTRY: Foster Circularity in procurements

C.6 – INDUSTRY: Develop professional guidance for recyclers

(D) To reduce dependence on Critical Raw Materials *(systemic and company-level actions)*

"Resilience begins where dependency ends."

Alternative design

D.1 – INDUSTRY: Establish 'Resilience Teams' within companies

D.2 – POLICY / INDUSTRY: Introduce more flexibility in materials substitutions

D.3 – POLICY / INDUSTRY: Investigate actions to develop CRMs-free components

D.4 – POLICY / INDUSTRY: Design for extended lifetime of components

(continues)

(D) To reduce dependence on Critical Raw Materials *(systemic and company-level actions)*

Alternative materials

D.5 – POLICY: Simplify and accelerate usage of alternative materials

D.6 – POLICY / INDUSTRY: Foster substitution with Advanced Materials

D.7 - INDUSTRY: Foster substitution with Composites

Alternative production

D.8 - INDUSTRY: Adopt agile production pathways to increase resilience

(E) To secure intra-EU freight logistics *(systemic actions)*

"A resilient industry moves at the speed of its logistics."

E.1 – POLICY (TRANSPORT): Ensure regular flows of critical industrial supplies along EU Rail Corridors

- **Embed industrial continuity considerations into corridor management**, including through the **development of performance indicators capturing the exposure of critical flows** to disruption risks and linking them to predefined escalation thresholds and formalised operational responses
- **Define a "critical freight" category beyond Military/Defence needs (e.g., Critical Raw Materials, semiconductors, energy equipment, medical/chemical essentials)** and **embed it into existing corridor capacity rules, contingency plans and rerouting scenarios**
- (…)
- **Enhance real-time corridor-level performance monitoring and predictive disruption management for critical freight trains**, ensuring that such capabilities are integrated into decision-making processes rather than remaining limited to reporting or visualisation functions
- (…)
- Promote interoperability and coordinated routing of flows across corridors, enabling more flexible and adaptive management of disruptions through improved integration of infrastructure, operations and information systems, including through **more dynamic and modular approaches to routing in line with emerging "Physical Internet" principles.**

Dr. Wolfgang Reimer

WP3 Leader LEADER 2030 project Director GKZ-Geokompetenzzentrum Freiberg

Technical Presentation

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Green transition with, not against industry

Source: @ GIS, GKZ

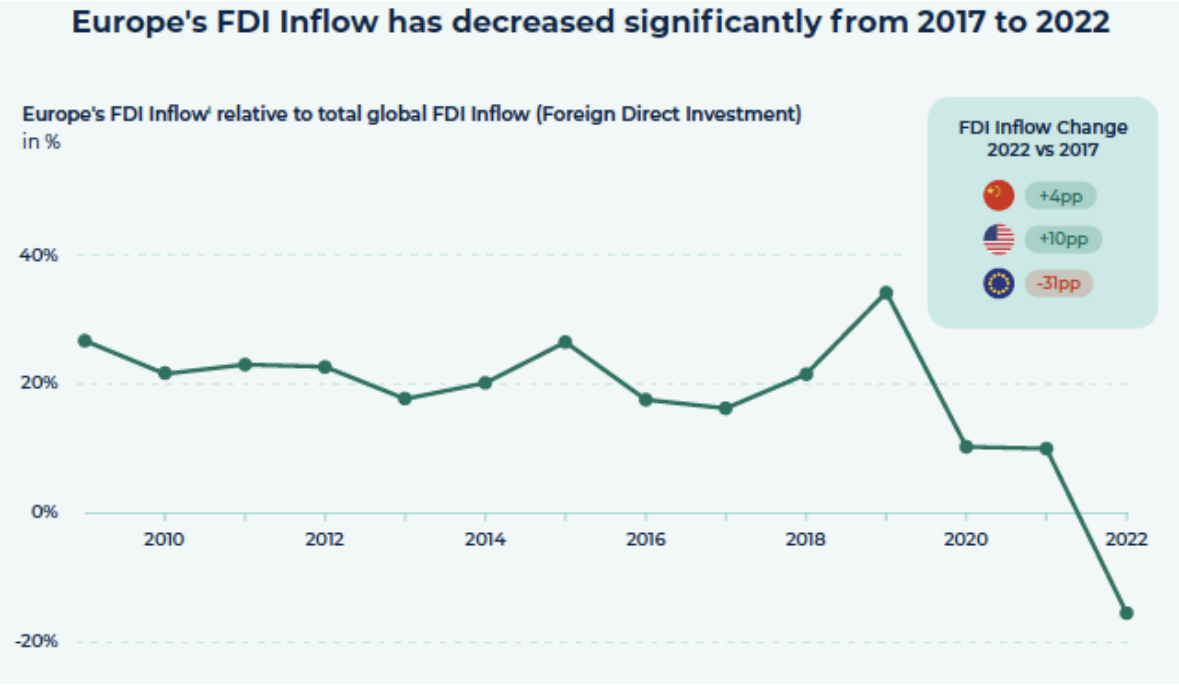
GREEN DEAL:
thick layer of overlapping regulation causing high compliance costs
80–100 separate legal acts that directly or indirectly affect industry
Cumulative regulatory pressure via the back door: (REACH, new chemicals strategy, stricter emission and product rules)

GREEN DEAL INDUSTRIAL PLAN: Plan as **procedurally complex and slow**, with overlapping funding instruments and administrative requirements that smaller firms struggle to navigate.
Compared with the relatively simple US IRA tax-credit model, the GDIP is seen as a **bureaucratic patchwork** rather than a single, predictable incentive framework

→ Relocation of production and future investment to regions with lower costs and softer rules
→ increasing public rejection of the European Union and its politicians

- → Reduce administrative burdens and regulatory fragmentation, ensuring coherence between existing and new legislation (F.1)
- → Ensuring that any new regulatory requirements are proportionate, predictable and accompanied by sufficient transition periods.
- → Enhancing EU–private sector dialogue to better align policy instruments with industrial realities, particularly in CRM supply chains (F.6, I.1, I.2) → Address taxonomy constraints (F.2)

Bad macro indicators in terms of FDI, Productivity, Innovative strength – GDIP is boosting demand, but capital often flows out of the country



Source: Competitiveness of European Energy-Intensive Industries - European Round Table for Industry (2024) **Europe's share of global FDI has been falling sharply since 2019, and according to UNCTAD (the UN Conference on Trade and Development) FDI inflows into Europe dropped by about 58% in 2024 compared with 2023, while global FDI decreased by only around 11% over the same period**

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- Regulation on Nature Restoration / Nature Restoration Law
- Urban Waste Water Treatment Directive (recast)
- EU Water Resilience Strategy
- Water Framework Directive (WFD)
- Groundwater Directive (GWD)
- Environmental Quality Standards Directive (EQSD)
- Commission Delegated Regulation (EU) 2023/2772 on European Sustainability Reporting Standards (ESRS)
- Corporate Sustainability Due Diligence Directive (CSDDD / CS3D)
- Regulation (EU) 2023/1115 on deforestation-free products (EU Deforestation Regulation, EUDR)
- Ecodesign for Sustainable Products Regulation (ESPR)
- Green Claims Directive
- Industrial Emissions Directove (IED2.0) expands to include mining activities and large-scale battery manufacturing.

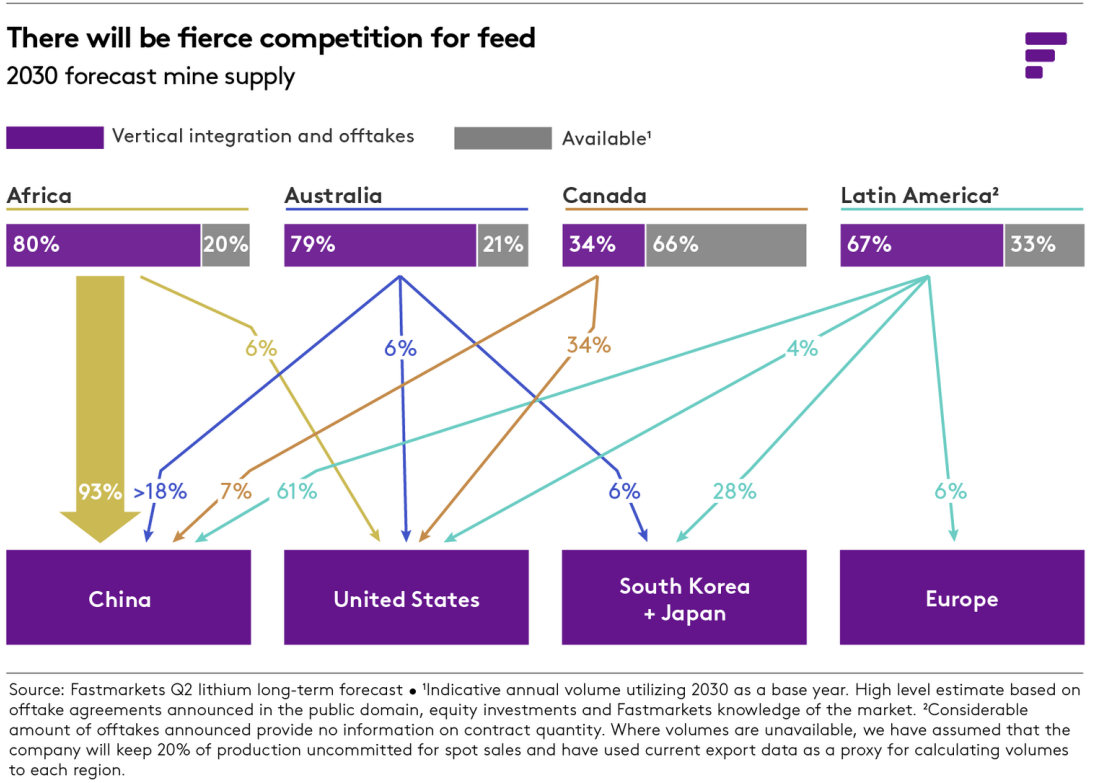
→ **Attract FDI into strategic value chains by cutting red tape, improving financial incentives**

Ownership and raw materials flows

It´s not only about which government controls it´s interior value chain,
It´s also about **who** owns mining companies which supply the EU

	China	United States	European Union	United Kingdom	Canada	Australia	Latin America	Africa
Rare earths	73%	15%	0%	2%	0%	6%	0%	0%
Nickel	14%	17%	19%	5%	6%	9%	6%	3%
Lithium	19%	31%	2%	5%	1%	4%	20%	0%
Copper	17%	27%	7%	8%	3%	5%	22%	2%
Cobalt	28%	5%	4%	0%	1%	6%	1%	16%

Ownership rates by investor origin for cobalt, copper, lithium, nickel and rare earths. Source: Violaine Faubert et.al. (2024) Capital in the Twenty-First Century: Who owns the capital of firms producing critical raw materials? SUERF Policy Brief, No 944, August 2024. https://www.suerf.org/wp-content/uploads/2024/07/SUERF-Policy-Brief-944_Faubert-et-al.pdf



Source: Fastmarkets Q2 lithium long-term forecast • ¹Indicative annual volume utilizing 2030 as a base year. High level estimate based on offtake agreements announced in the public domain, equity investments and Fastmarkets knowledge of the market. ²Considerable amount of offtakes announced provide no information on contract quantity. Where volumes are unavailable, we have assumed that the company will keep 20% of production uncommitted for spot sales and have used current export data as a proxy for calculating volumes to each region.

→ **Continue to pursue the strategy of acquiring direct ownership of strategic raw materials through mine ownership**

→ **Follow JOGMEC (efficiency, effectivenes)**

Move from being only a regulator to also being a co-investor

YEAR	EUROPEAN UNION – INCREMENTAL POLICY INSTRUMENTS	JAPAN – JOGMEC-CENTRED, STEP-BY-STEP RESPONSE
		2002 Legal foundation Japan passes the Law establishing the Japan Oil, Gas and Metals National Corporation – legal basis for a unified state-backed resource-security vehicle.
		2004 Institutional creation JNOC and MMAJ are merged into JOGMEC; mandate: support exploration and secure oil, gas and metals using equity, loans, guarantees and stockpiles. Basic organisation is set up.
		2004-2006 Technical support build-up JOGMEC starts co-funded geological surveys and technical assistance for overseas mining, and pilots exploration-support schemes for Japanese firms.
2008	Raw Materials Initiative, RMSG – first EU raw materials strategy and advisory group.	**2006-2009– Financial tool roll-out** JOGMEC introduces equity participation in overseas mining projects, low-interest loans and guarantees, and begins managing government stockpiles of selected rare metals.
2012	EIP on Raw Materials; EIT RM – partnership and innovation community; no single implementing agency with capital.	**2010– Crisis response** After China's rare-earth export restrictions, Japan launches a Rare Earths Comprehensive Action Plan (~¥100 bn); JOGMEC gets dedicated funds to finance alternative supply, recycling and substitution, and to expand rare-earth stockpiles.
2013	Horizon 2020: raw materials as "societal challenge" – R&I funding across many instruments.	**2010-2015– Active deal-maker** JOGMEC takes equity and JV positions in rare-earth and other critical-mineral projects (e.g. Australia, Vietnam), shares exploration/development risk and links support to long-term off-take for Japanese industry; dependence on Chinese REEs drops from ≈80–90% to <60%.
2014	EIT RawMaterials as KIC – strong innovation network, but not a mining project financier.	
2020	CRMs Action Plan; ERMA; EU Taxonomy – further plans and alliances, still fragmented execution.	**As of 2020– Strategic anchoring** Japan's International Resource Strategy assigns JOGMEC a central role for critical minerals (batteries, renewables, semiconductors), with expanded stockpiles and new supply chains with partners.
2024	Critical Raw Materials Act – benchmarks, "strategic projects", faster permitting and preferential financing (incl. equity via EU financial institutions). commission.europa+3	**2020s Mature critical-minerals agency J**OGMEC acts as specialised public investor and coordinator, combining equity, loans, guarantees, technical support and stockpiling, and structuring JV and off-take deals with allies, aligned with Japan's industrial and decarbonisation goals.
2025	ReSourceEU – umbrella to better coordinate many existing EU tools.	

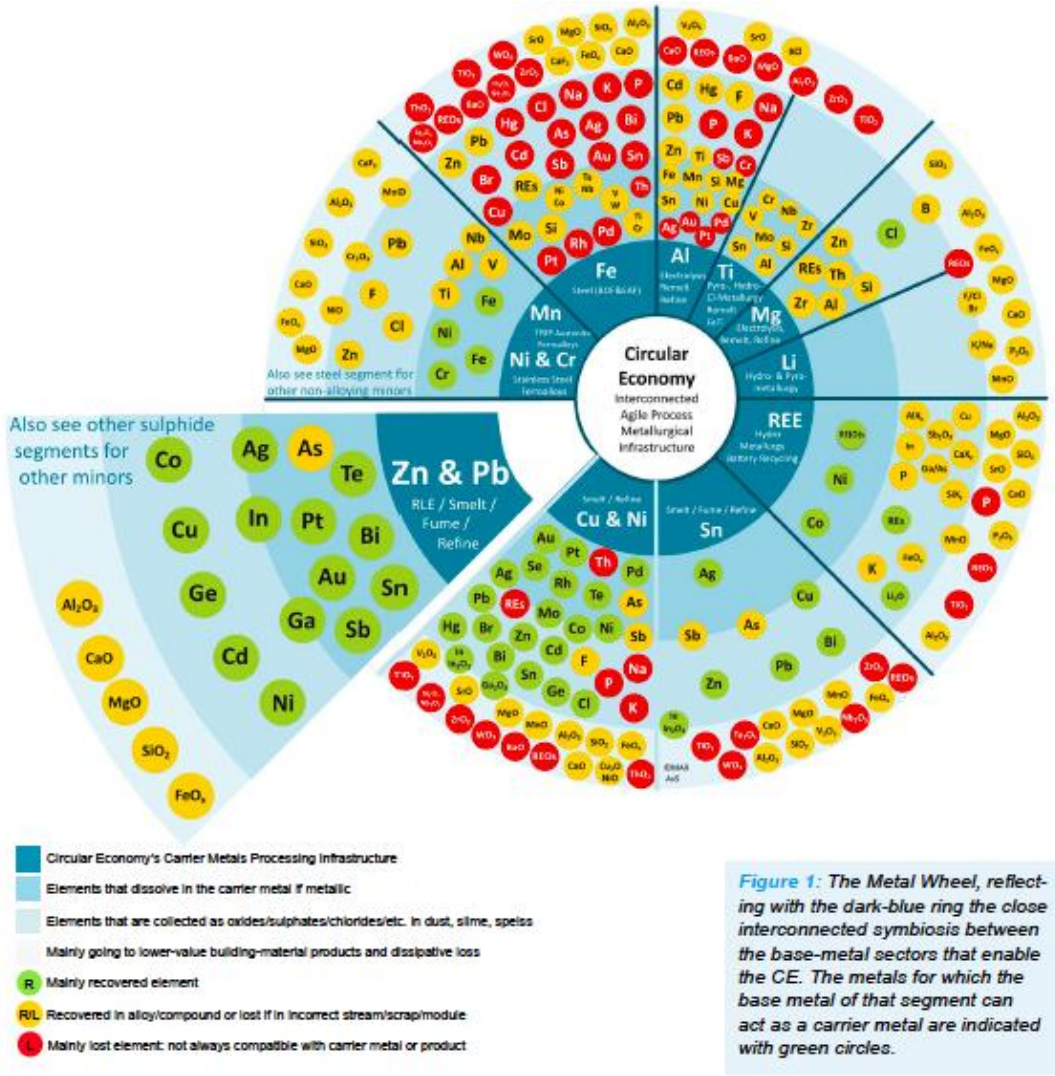


Figure 1: The Metal Wheel, reflecting with the dark-blue ring the close interconnected symbiosis between the base-metal sectors that enable the CE. The metals for which the base metal of that segment can act as a carrier metal are indicated with green circles.

Save Our Smelters!

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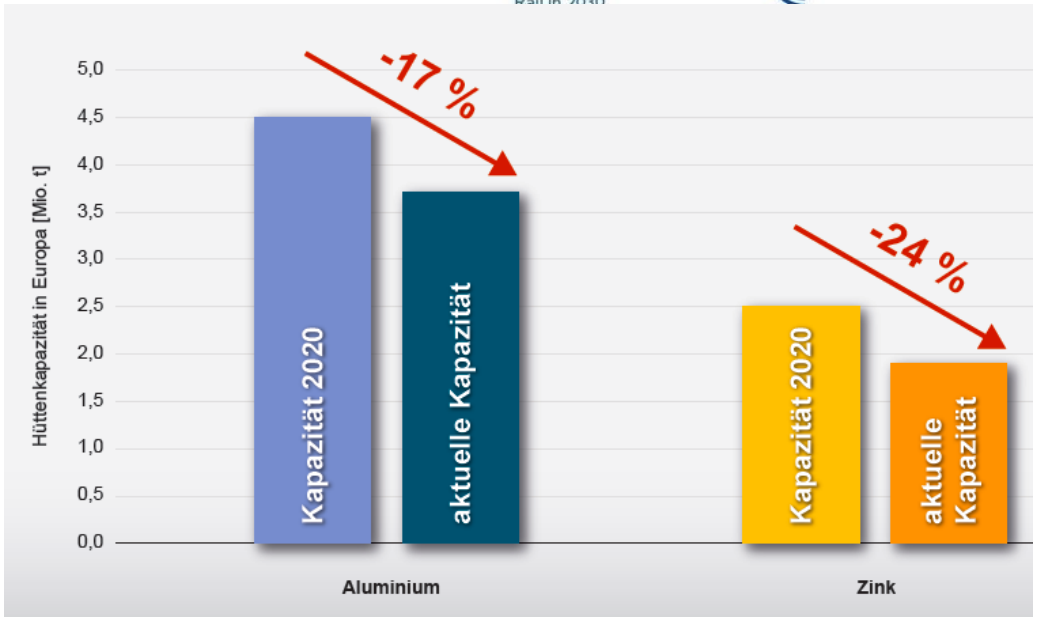


→ **Maintaining and expanding European processing and refining capacity, particularly in the midstream segment (K.6)**

→ **Use the REACH revision to create incentives — such as tax cuts, dedicated funding, and subsidies — for companies that invest in or intend to increase their efforts in these directions. (J.1)**

Figure upper right: European smelter capacity in Aluminium and Zink smelting away as off 2020. Source DERA

CRMA:

Strategic projects

→ Support early-stage developers (junior mining companies) (F.2)

→ Secure a right of first refusal or preemptive purchase right at CRMA strategic project owners

Demands of the GDIP and CRMA require substantial investments by industry

→ Review and adapt the Critical Raw Materials Act (CRMA), ensuring realistic benchmarks, flexible milestones and alignment with industrial capacities (H.2) – better to set succeeding milestones in 1-2 years intervals

Unlocking Europes mineral wealth requires strengthening greenfield exploration

→ Don´t limit CRMA granted strategic projects to a sufficiently mature stage (F.2)

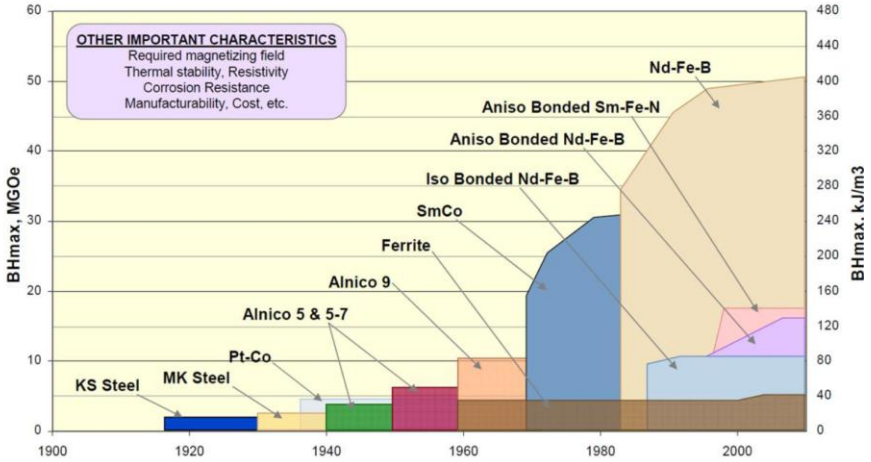
Price Protection

→ Introduce price stabilisation and protection mechanisms (e.g. floor/ceiling guarantees) to mitigate market volatility and enable long-term investments (F.3)

Lessons learnt from the CRMA Public Consultation

→ Reinforcing the role of existing advisory and consultative bodies, such as the European Economic and Social Committee, in shaping balanced policy approaches (G.1)

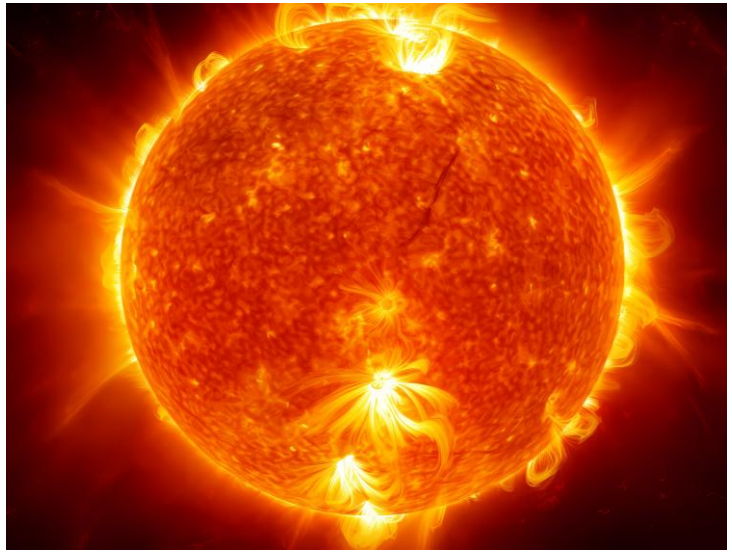
„You win a good proposal but not a good project“



Development of permanent magnets, 1900-2010 – maximum energy density is expressed in megagauss-oersted (MGOe, left vertical axis) and metric system (right axis). Source: Substitution of critical raw materials in low-carbon technologies: lighting, wind turbines and electric vehicles – JRC (2016)

Substitution of critical raw materials in low-carbon technologies: lighting, wind turbines and electric vehicles - https://publications.jrc.ec.europa.eu/repository/bitstream/JRC103284/crm substitution online report.pdf

EU well positioned in nuclear fusion research (ITER), also at MS level. However, focus more on start ups and keep them in Europe.



- → Consider strategic initiatives such as IPCEIs for rare earths primary ore processing to reduce dependency on dominant global suppliers (K.5).
- → Strengthen R&D investment and technological leadership, ensuring alignment with future material needs and dependencies (K.4).
- → Support R&D across the full value chain for technological leadership based on a true industry business case, priorize funding of R&D at higher TRL and close to market uptake (K.3, K.4)

Wishful Thinking

EU wants lithium self-sufficiency by 2025

As the bloc pushes its digital and green transition agenda, policymakers have looked at the raw materials required. Little is mined, processed or assembled in Europe at present but the European Commission has a plan…

OCTOBER 1, 2020 MARIAN WILLUHN

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Internal market commissioner Thierry Breton at the launch event in Brussels.

Image: European Union, 2020, EC - Audiovisual Service, Photographer: Claudio Centonze

Headline message picked up from an internet magazine. Source: https://www.pv-magazine.com/2020/10/01/eu-wants-lithium-self-sufficiency-by-2025/

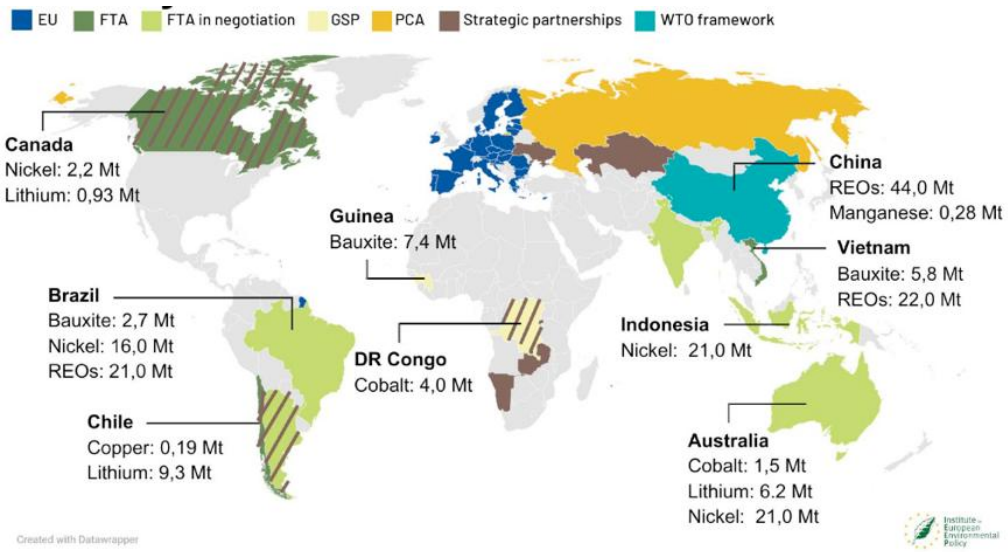
*The EIP RM's (2012) "**to make the EU the world leader in exploration, extraction, processing, recycling and substitution capabilities by 2020**" **proved to be wishful thinking** and is more reminiscent of the five-year plans of former socialist parties in the Eastern Bloc. Such overambitious, unrealistic statements do not inspire confidence in politics.*

→ **Be careful not to rush into announcing unrealistic targets**

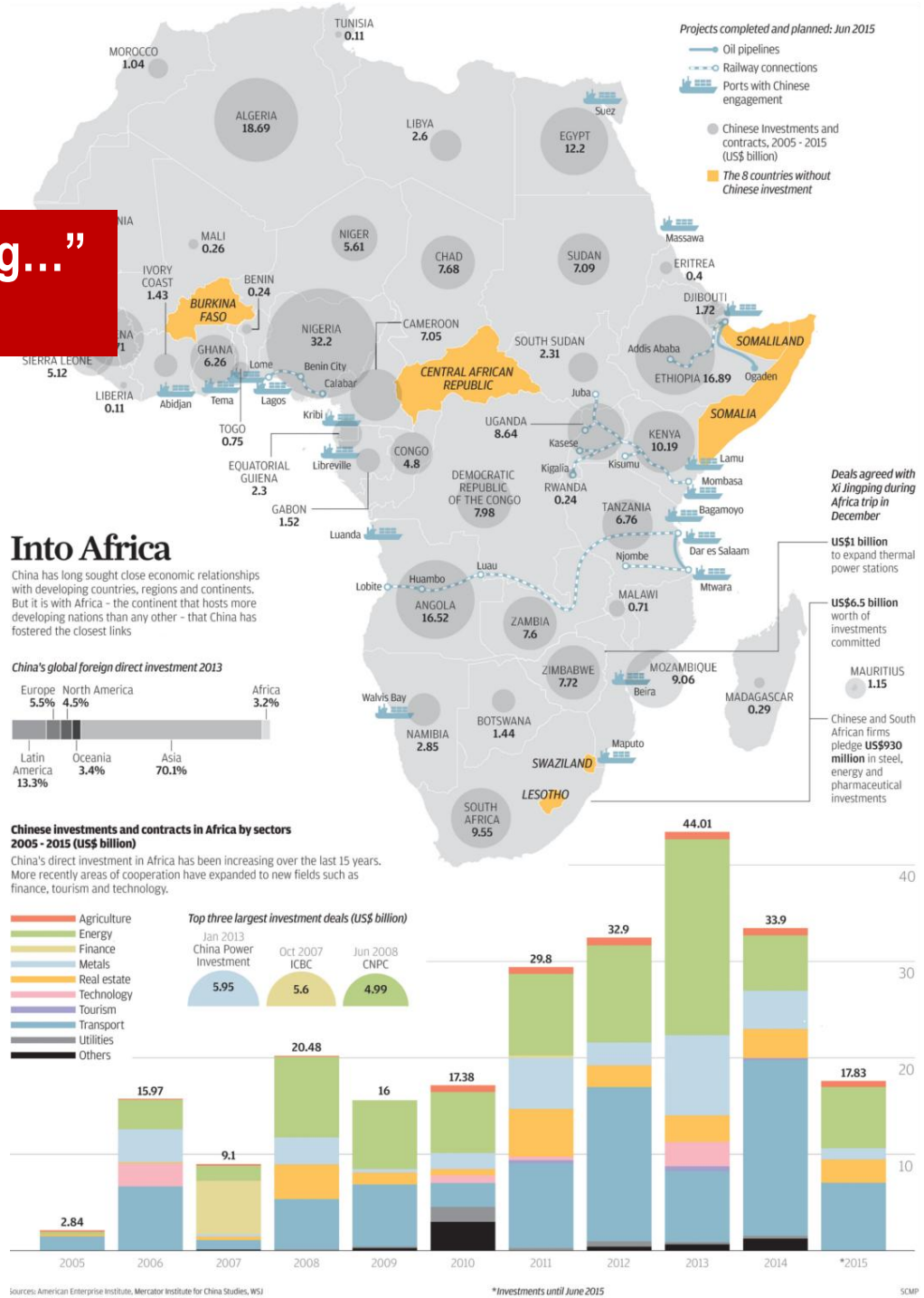
→ **Raising raw materials awareness across EU institutions and Member States, and ensuring adequate staffing and expertise within relevant Directorates-General (G.2)**

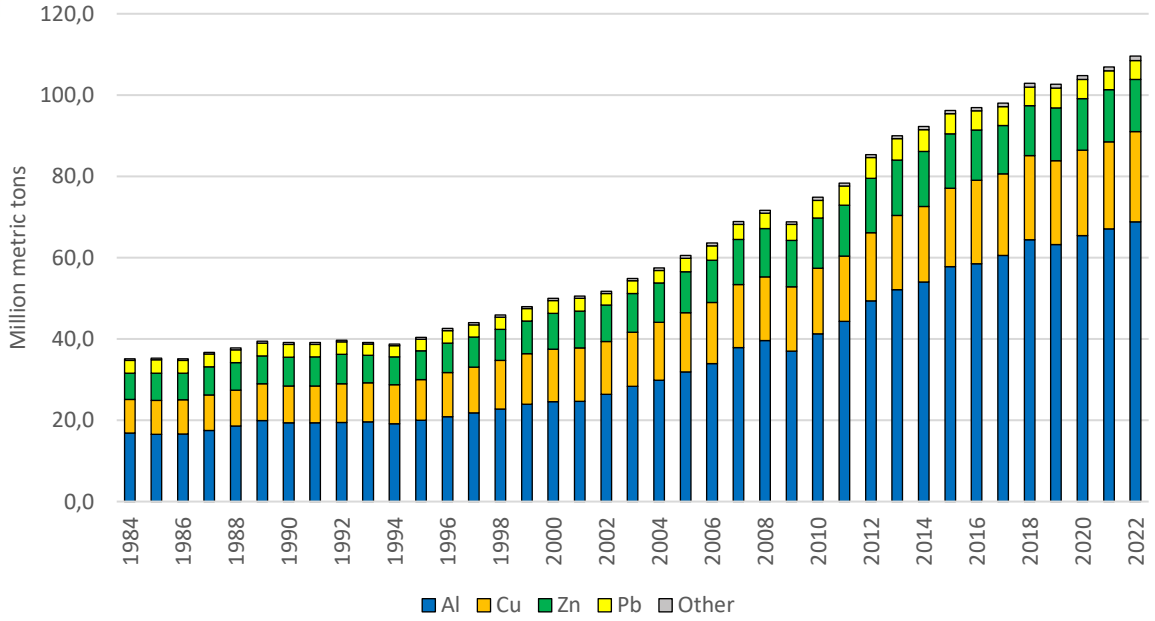
“China brings in money and hardware; the EU is only chatting…” (A Survey senior expert in Namibia)

EU FTA: Long negotiations, ratification needed
(MERCOSUR since 1999, CETA with Canada is ratified by only 17 MS,
US-EU free trade agreement TTIP failed)
Insufficient industry interest in investments via FTA and RMP



→ **Ensure a level playing field globally, considering the strategic policies adopted by competing economies (H.1)**





Mining–like every private business–is to make a profit

The share of non-ferrous minerals in global mining shows that, apart from copper and aluminium, all other CRMs do not even account for 1% of the total volume. Copper and aluminium are mined on a massive scale. The small proportion of mining activity devoted to other critical raw materials is due not only to their comparatively low volumes, but also to the fact that the cost-benefit ratio of mining these materials is significantly worse. Investments are based on profit margins. Source: REICHL, C. & SCHATZ, M. : WORLD MINING DATA 2024 (% „Other“ Ga, Ge, In, REE, Li, … ; 4 Metals ≈ 99.0 %)

Listen to the signals

"The Middle East has oil, China has rare earths"
Deng Xiaoping (1904-1997), Chinese statesman, revolutionary, and political theorist who served as the paramount leader of the People´s Republic of China, from 1978-1989

LEADER
Learnings for European Autonomy to Deliver Europe's Rail in 2030

1986

1992

2006

Cover titles of the German weekly "DER SPIEGEL" warning against global warming (issue 1986) and The new cold war - Battle about raw materials (issue 2006): Source: DER SPIEGEL

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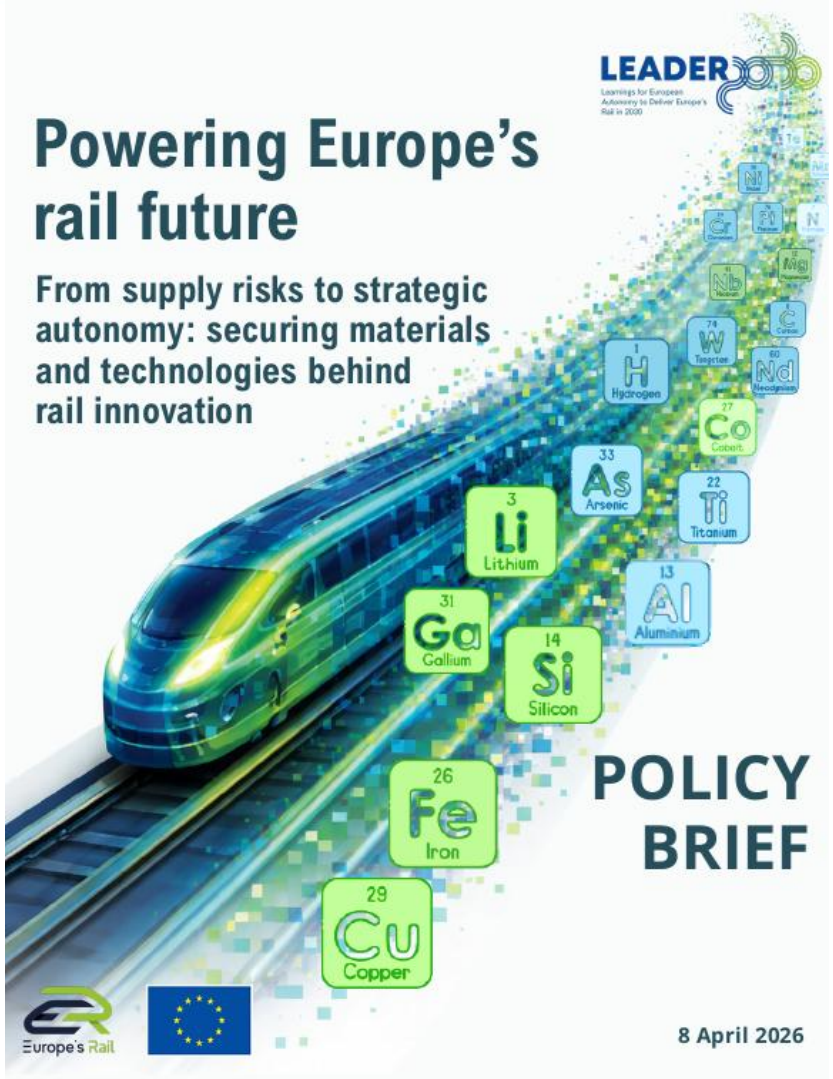

To download the **Policy Brief** and the **detailed Recommendations** within the **'LEADER 2030 Final Intelligence Analysis to deliver Europe's Rail in 2030'**

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Closing Remarks