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Closing the Circle: Supply chains and circularity approaches for delivering a decarbonised energy system

June 26, 2024

Diego Marin



The Raw Materials Coalition

- A civil society coalition of more than 55 organisations.
- Working groups on trade (partnership), beyond growth, global justice, CRMA
- [EU Raw Materials Coalition](https://eurmc.org) (eurmc.org)



EU Raw Materials Coalition



Limiting environmental damage, human rights abuses and Indigenous Peoples' rights violations:

NEWLY LAUNCHED

Civil society guidelines for the implementation of the EU Critical Raw Materials Regulation



A call to ensure equitable, sustainable and just critical raw materials strategic partnerships.





Section 1

The Global Energy Transition and Mineral Demand

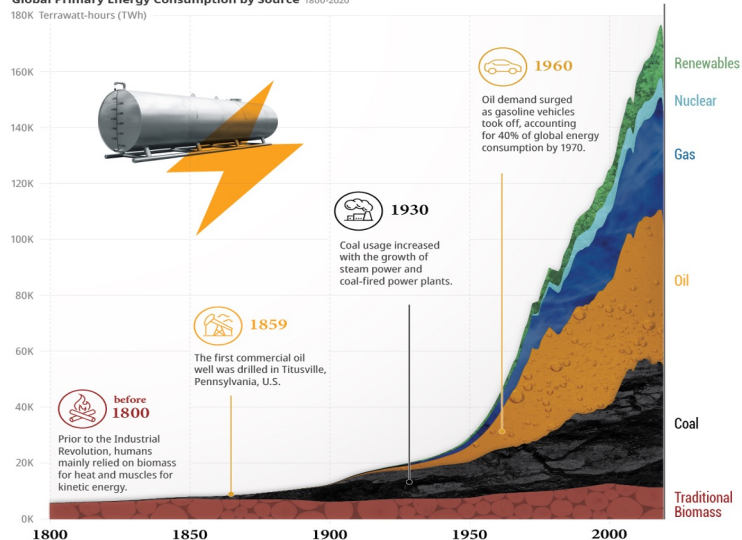
THE HISTORY OF *Energy Transitions*

The economic and technological advances over the last 200 years have transformed how we produce and consume energy.

Here's how the global energy mix has evolved since 1800.

Global Primary Energy Consumption by Source 1800-2020

180K Terrawatt-hours (TWh)

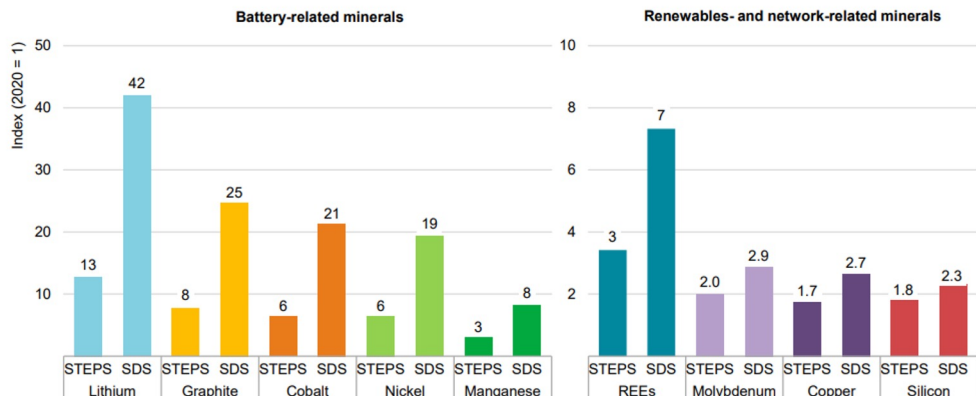


Source: Vaclav Smil (2017), BP Statistical Review of World Energy via Our World in Data

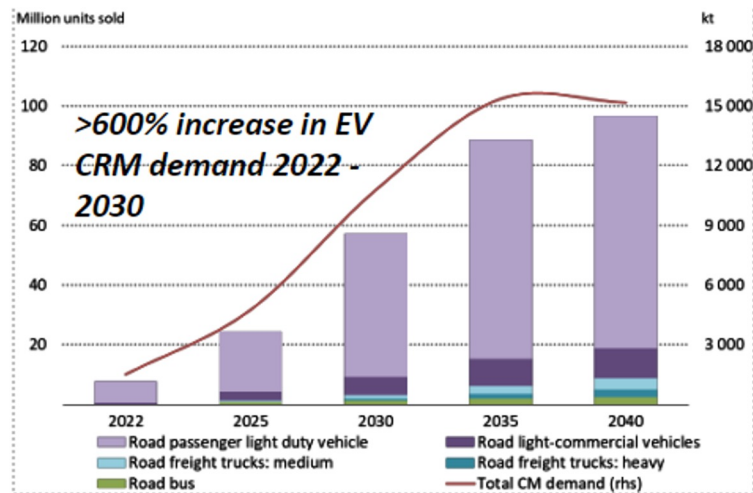


Global Demand and Technologies

Growth in demand for selected minerals from clean energy technologies in 2040 relative to 2020 levels



IEA. All rights reserved.



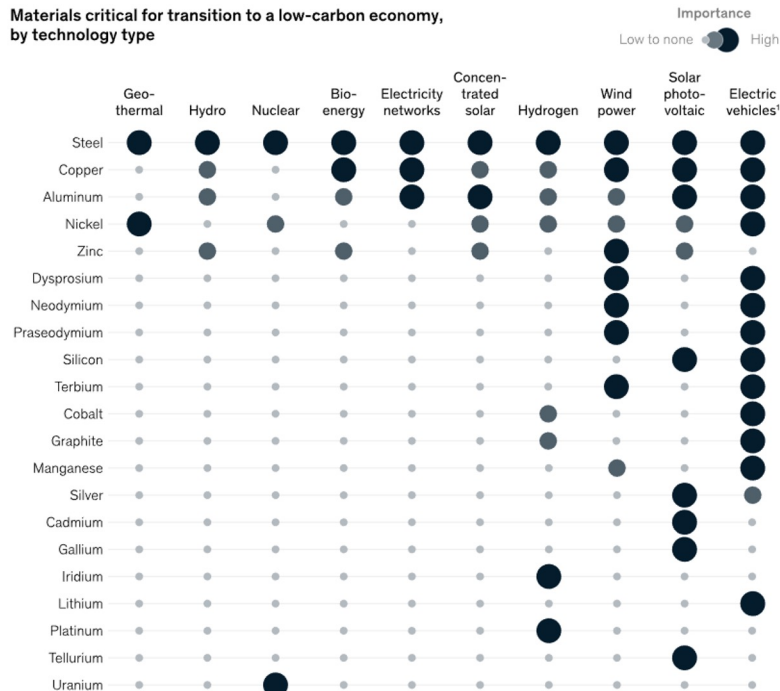
Source: IEA

Source: IEA, "The Role of Critical Minerals in Clean Energy Transitions", [link](#)



A variety of raw materials will play critical roles in low carbon technologies

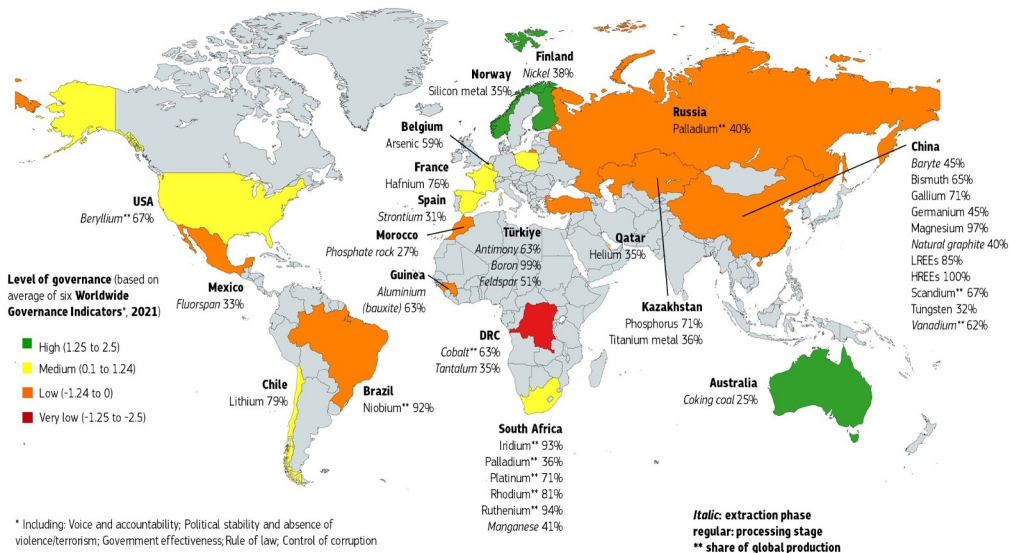
Materials critical for transition to a low-carbon economy, by technology type



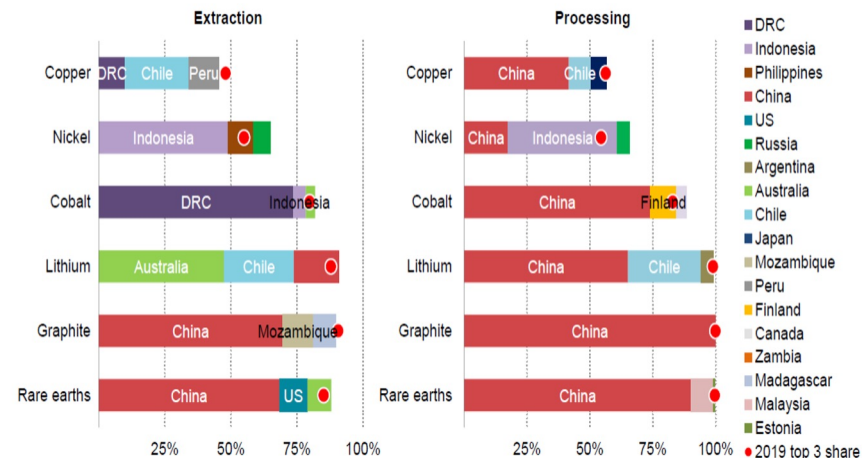
Source: McKinsey, "The raw-materials challenge: How the metals and mining sector will be at the core of enabling the energy transition",

[link](#)

Geopolitics of Critical Raw Materials



Share of top three producing countries in total production for selected resources and minerals, 2022

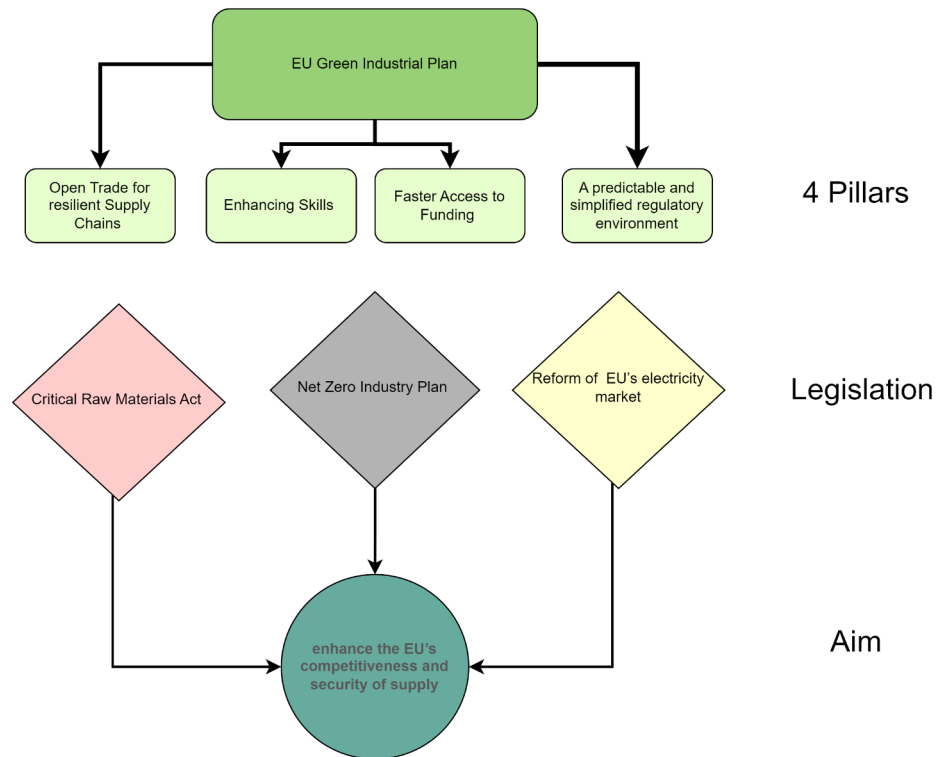


Source: IEA, "Critical Minerals Market Review 2023", [link](#)



The EU's Green Deal Industrial Plan

- EU's aim to enhance the EU's competitiveness and security of supply as it pursues the European Green Deal and other goals
- In response to:
 - **Feb. 22** - The Russian Invasion of Ukraine (energy crisis/supply chain crunch)
 - **Aug. 22** - US Inflation Reduction Act (funding, industrial exodus)
- EU Green Industrial Plan - March 2023
 - A proposal for the reform of the EU's electricity market
 - A proposal for a Critical Raw Materials Act
 - A proposal for a Net-Zero Industry Act.





The Critical Raw Materials Act

Strengthening self-reliance

To reduce **dependence** on third countries to access critical raw materials, the EU set the following **objectives for 2030**:



EU EXTRACTION:

at least **10%** of the EU's annual consumption from EU extraction



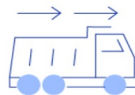
EU PROCESSING:

at least **40%** of the EU's annual consumption from EU processing



EU RECYCLING:

at least **25%** of the EU's annual consumption from domestic **recycling**

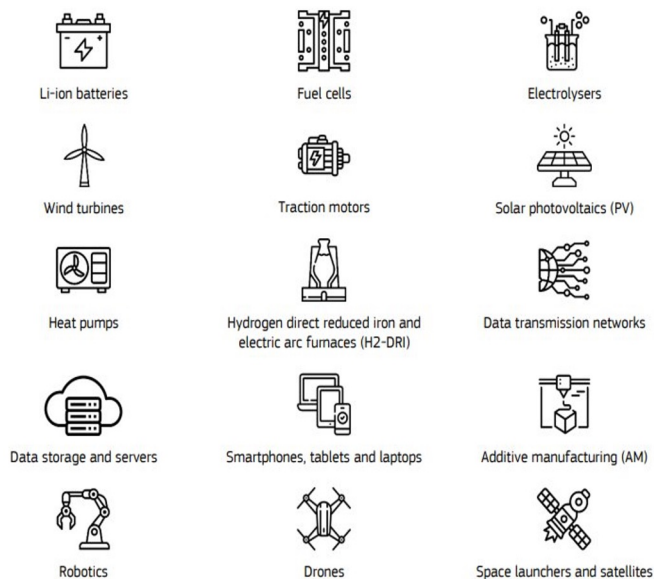


EXTERNAL SOURCES:

not more than **65%** of the Union's annual consumption of each strategic raw material at any relevant stage of processing from a single third country

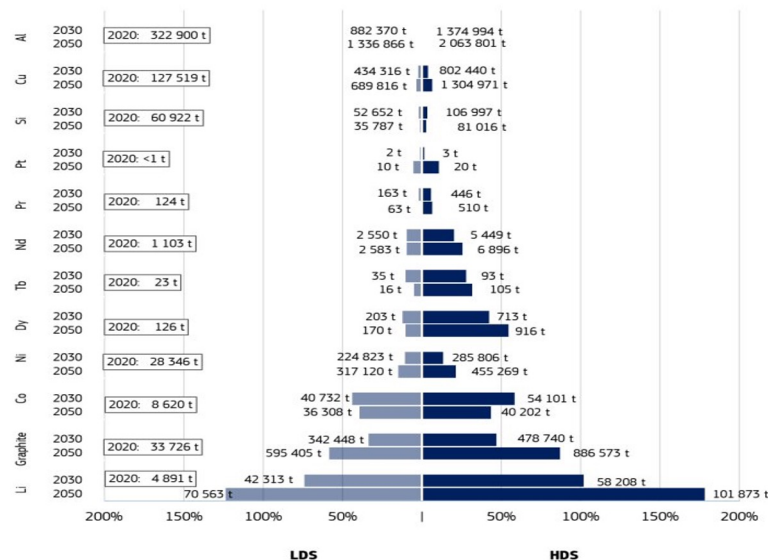
EU-27 Demand and Technologies

Figure 1. Schematic representation of the fifteen technologies explored in this report



Source: JRC elaboration based on flatiron.com

Material demand forecast - All sectors - EU



Source: JRC analysis (Li = lithium, Co = cobalt, Ni = nickel, Dy = dysprosium, Tb = terbium, Pr = praseodymium, Pt = platinum, Si = silicon metal, Cu = copper, Al = aluminium).



Critical Raw Materials and Strategic Raw Materials

Yellow:
Strategic raw materials

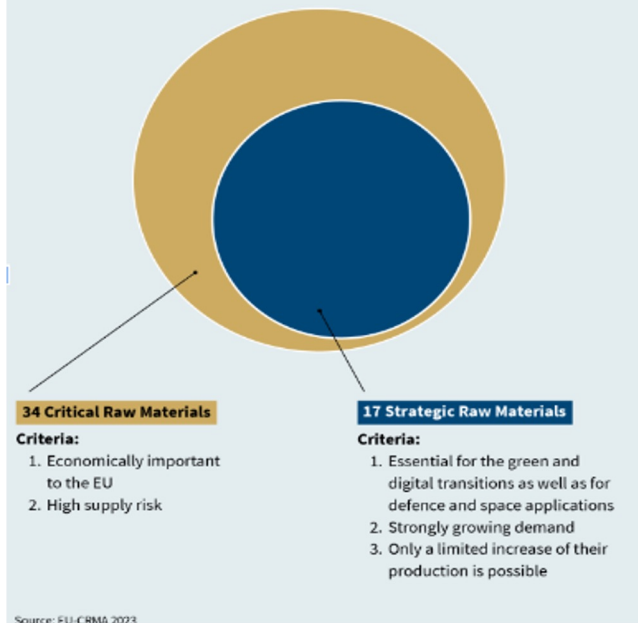
Blue:
Critical Raw Materials



Council of the EU, "[Infographic – An EU critical raw materials act for the future of EU supply chains](#)"

European Critical Raw Materials Act (CRMA)

List of Critical and Strategic Raw Materials (2023)



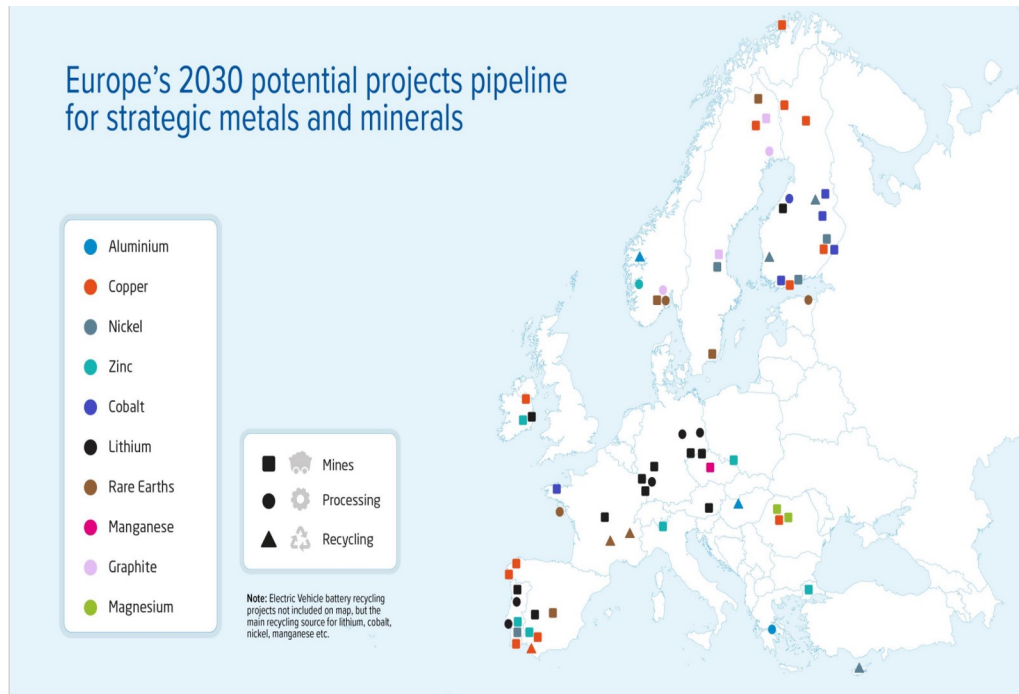
Source: EU-CRMA 2023

[Security of Supply in Times of Geo-economic Fragmentation - Stiftung Wissenschaft und Politik \(swp-berlin.org\)](#)



Strategic Projects

- **Across the whole SRM value chain:** extraction, processing, recycling and also substitution
- Selected by the **EU Critical Raw Materials Board**
- **Enables Access to:**
 - Financing
 - Fast-tracking
- **Eligibility Criteria:**
 - Address one or more of the strategic raw materials
 - By the year 2030, make a significant contribution to the targets
- Information Day for strategic projects under the Critical Raw Materials Act: [Strategic Projects Presentation 30042024.mp4 - Google Drive](#)



Eurometaux Source (not official EU data): [PowerPoint Presentation \(europa.eu\)](#)

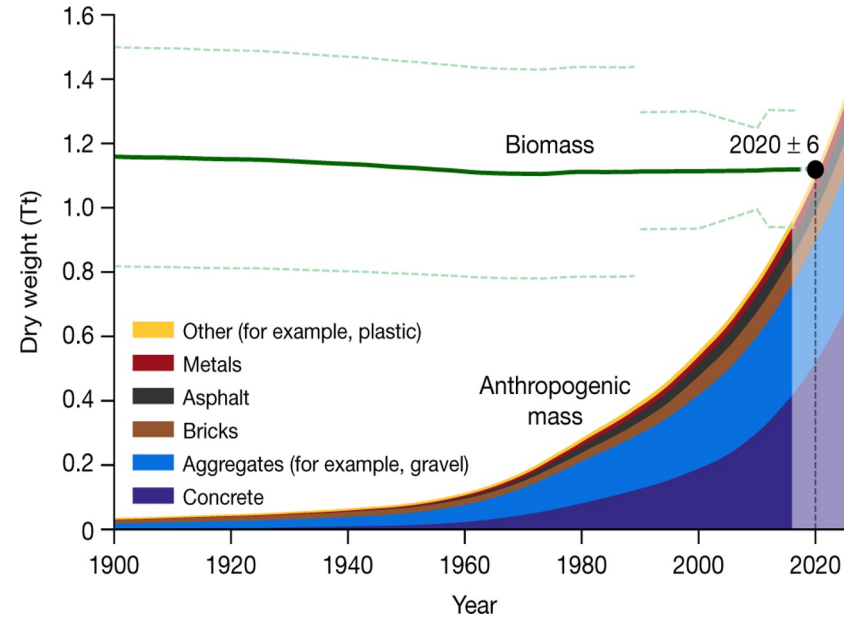
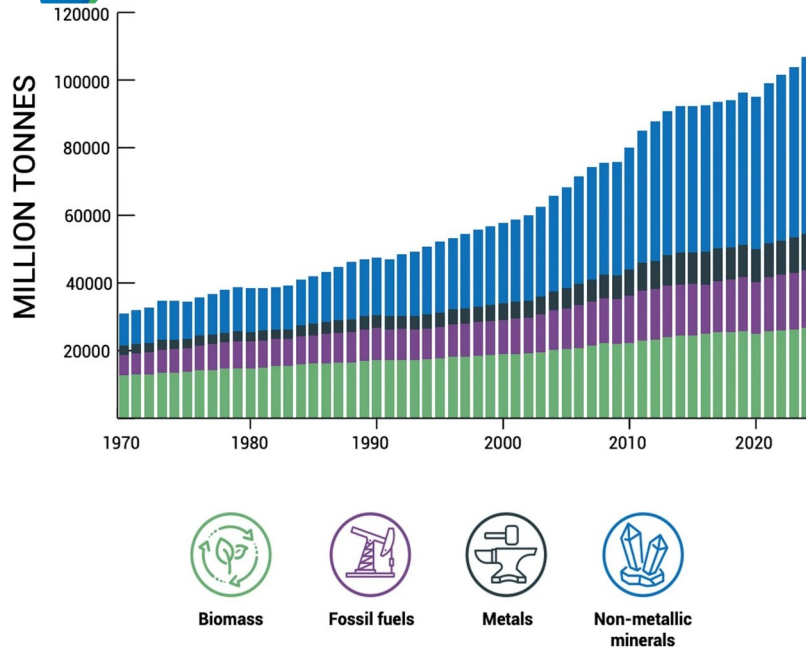


Section 3

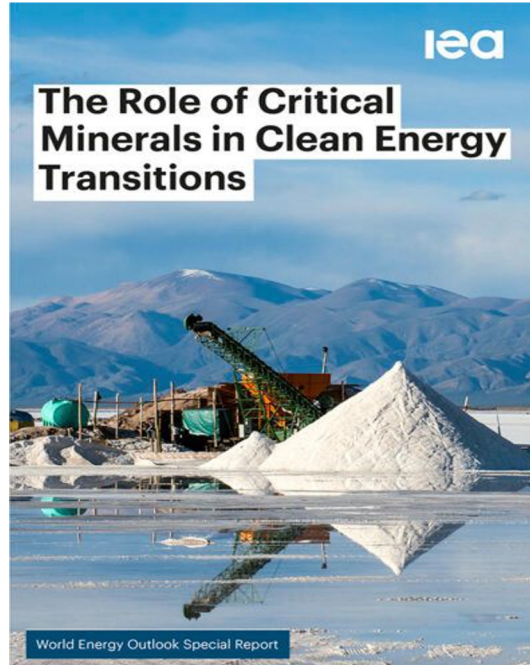
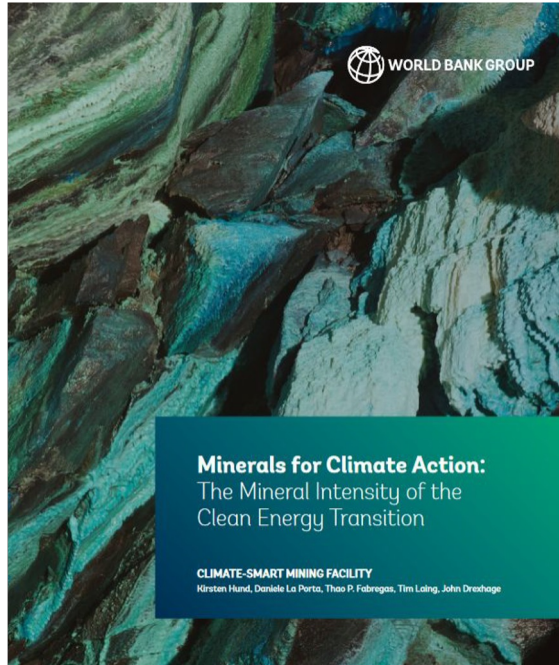
Material Challenges and Assumptions



Material consumption is growing across all material categories

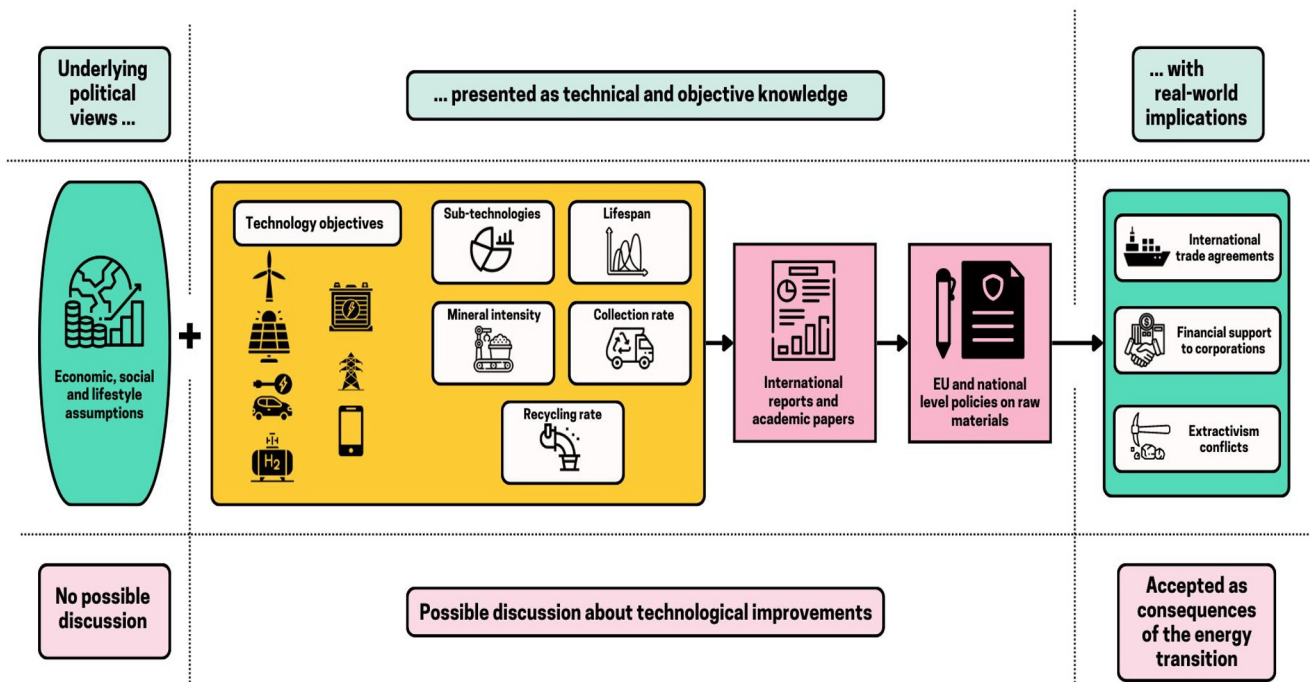


Main International Reports





Green Growth's perverse logic of future mineral demand forecasting



Source: Martín Lallana & Adrián Almazán
University of Zaragoza
Carlos III University of Madrid



Problematic Elements in Projections

Strong decoupling considered

3% annual growth rate considered, leading to a global GDP in 2050 that doubles the current global GDP

While meeting +2°C GHG emissions targets and slightly reducing final energy demand - OECD considers material resources consumption will double between 2011 and 2060 due to socioeconomic factors and IRP considers an increase of 60% by the same timeframe

Mobility largely based on private vehicle use

IEA Energy Technologies Perspective 2023 (Net Zero by 2050) → 2.000 M electric light duty vehicles in 2050

Expectations of twice the number of vehicles currently on the road

Reproduces and intensifies car dependence, while it risks meeting climate targets

Perpetuates colonial inequalities

Energy demand and global EV fleet distribution considered maintain strong international inequalities

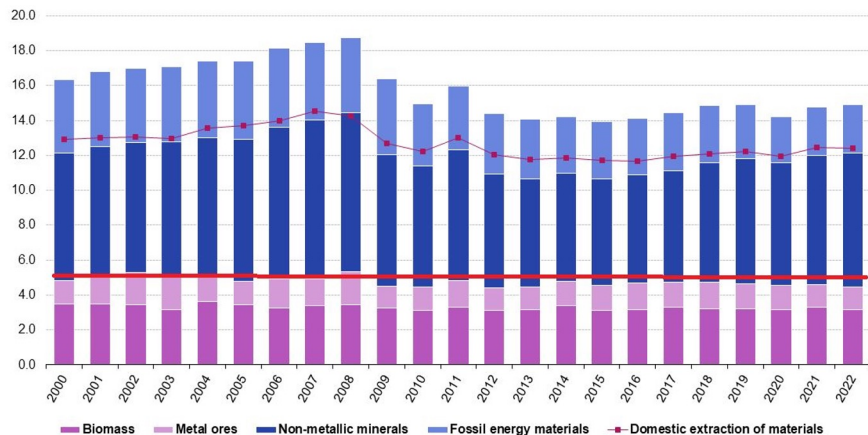
Unequal distribution of forecasted mineral demand and a reproduction of imperial modes of living

A dynamic which is reinforced by the debt-trap that forces the development of extractives industries



Material Footprint is Double Sustainable Limits

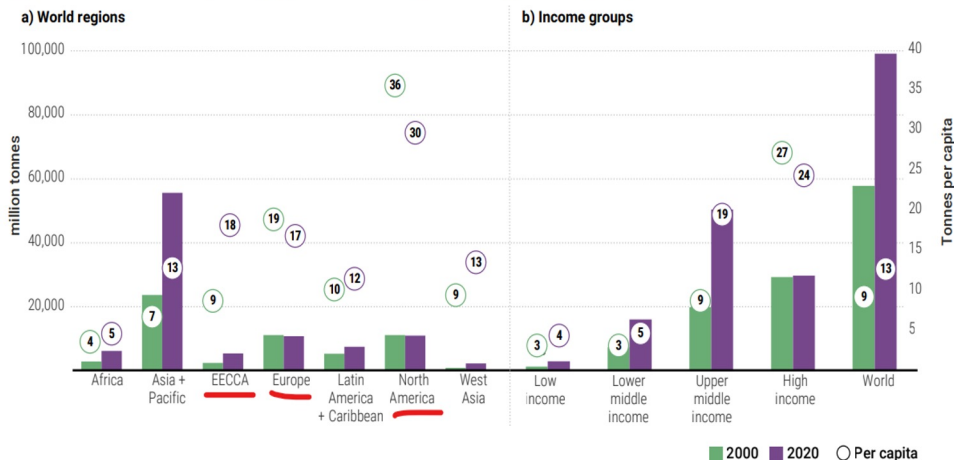
Raw material consumption (RMC) by main material categories, EU, 2000-2022
(tonnes per capita)



Source: Eurostat (online data codes: env_ac_mfa, env_ac_rme)

eurostat

Figure 2.19: Material footprint by (a) seven world regions and (b) income groups.



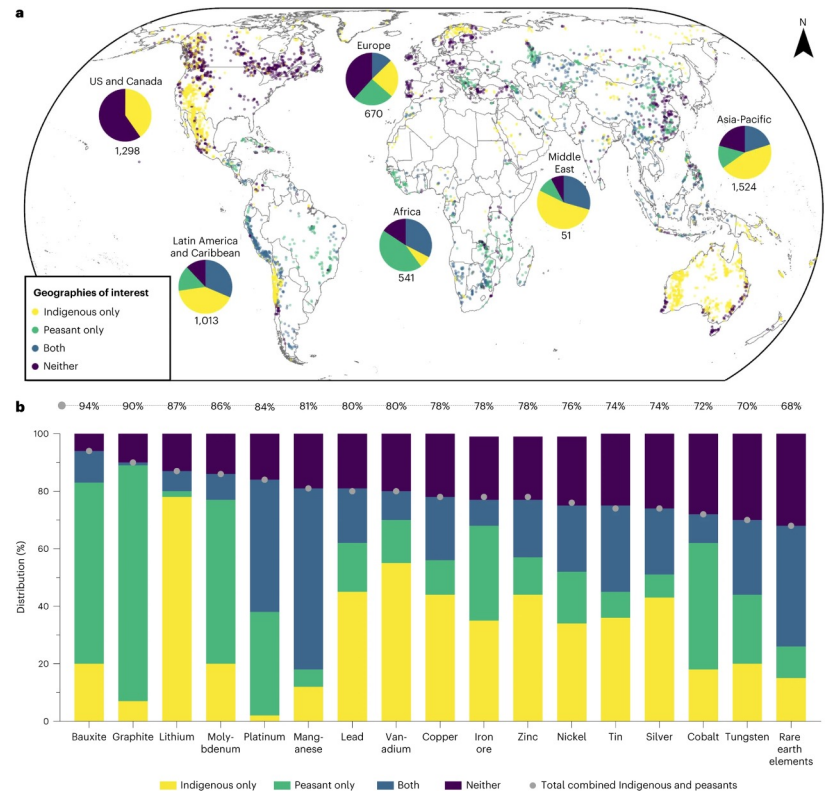
Source: Global Material Flows Database (UNEP 2023a).



Indigenous Peoples Are Disproportionately Impacted

- “Although Indigenous Peoples account for only around **5 percent of the world’s population**, they effectively manage an estimated 20 to 22 percent of the Earth’s land surface. This land coincides with areas that hold **80 per cent of the planet’s biodiversity** and about **40 percent of protected areas** an ecologically intact landscapes” - [UN International expert group meeting on the theme “Indigenous Peoples in a greening economy”](#)
- More than half of the world’s transition minerals are located on or near lands and territories managed by Indigenous peoples, according to a [2023 study in Nature Sustainability](#).

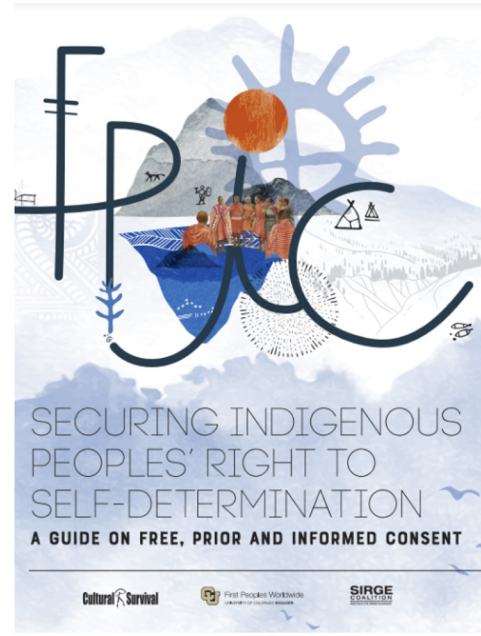
Distribution of ETMs by Indigenous peoples’ and peasant land - [Energy transition minerals and their intersection with land-connected peoples | Nature Sustainability](#)



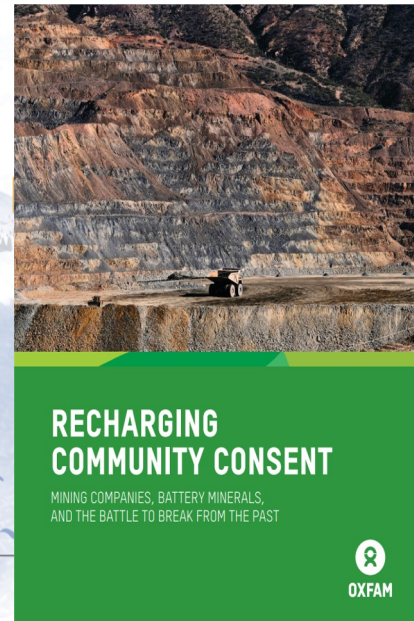


Indigenous Peoples Are Disproportionately Impacted

- Lack of consent continuous to be a problem with development and many indigenous peoples see the green energy industry continuing the same trend of not doing enough to inform Indigenous communities about upcoming projects, and prioritizing profits over human rights.
- **Free, Prior and Informed Consent (FPIC)** is a right that is recognized by international standards like the UN Declaration on the Rights of Indigenous Peoples (UNDRIP) and the International Labor Organization Convention (ILO169)
- Lack of serious enforcement of FPIC continues to be an issue



[FPIC Protocol Guide — SIRGE Coalition](#)



[2023 OXF Recharging Community Consent Report FNL-AA.pdf](#)
oxfamamerica.org



Certification Schemes and the Risk of Greenwashing

Main Concerns – industry schemes are a tool, not a proxy to due diligence

- **Multi-Stakeholder Governance:** Schemes often lack equal decision-making power for civil society and affected rights-holders, which can lead to industry-led initiatives that do not fully address social and environmental concerns.
- **Audit Credibility:** The credibility of audits is questioned due to the limited involvement of impacted rights-holders and the potential for overlooking serious human rights and environmental abuses. This can result in certifications that do not guarantee adequate human rights due diligence.
- **Transparency Issues:** There is a lack of transparency in the audit findings of many schemes. Without detailed public reports, it's difficult for external stakeholders to trust the assurance process and its outcomes, increasing the risk of unchecked harmful behaviors.
- **Corrective Actions and Grievance Mechanisms:** There are insufficient requirements for corrective actions and the lack of robust grievance mechanisms. This can prevent meaningful improvements in company practices and hinder the remedy of harms caused to rights-holders.

ICMM
International Council
on Mining & Metals

ASSESSMENT

Flawed scheme that fails to meet most of the minimum criteria for governance, auditing and / or accreditation

OVERALL SCORE

1.25

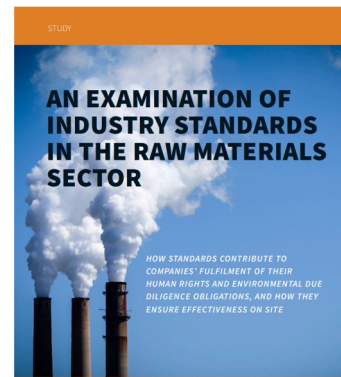
IRMA Initiative for Responsible
Mining Assurance

ASSESSMENT

Robust scheme overall that still has some shortcomings but meets nearly all of the minimum criteria for governance, auditing and / or accreditation against its standard

OVERALL SCORE

7



Rebecca Hertz, Johanna Sydow & Florian Urich

[germanwatch abstract an examination of industry standards in the raw materials sector 2022-09.pdf](#)



[LeadTheCharge-Assessment-06022024.pdf](#)

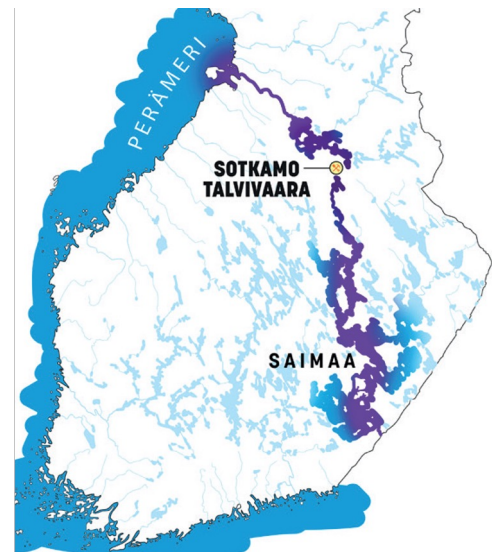


Mining Waste Poses Risk for Downstream Communities and Ecosystems

- Billions of tons are produced per year
- Tailings are forever - we should treat them as such
- Typically, mine tailings are permanently stored behind a dam constructed out of other mine waste, and are dangerous when they are poorly constructed, become saturated or are subjected to an earthquake.
 - Tailings can travel up to 120 km/hr and flow for hundreds of kilometers during a failure



Tailings traveled for almost 600 km during the Mariana dam failure - Credit: Rogério Alves/TV Senado



Model of the spreading of harmful substances from Terrafame's extractive waste when structures fail: acute and chronic toxicity limits are exceeded with various substances. (In the calculation, 1/1000 of contaminants can spread to water bodies in one year). - MiningWatch Finland.



Visualizing Mining Tailings

- If mining material for Cu is at 0.4% or 0.2% - 99.6% or 99.8% is waste





Mining Tailings Facilities are Increasing

- One-third of the current global portfolio of Tailings Storage Facilities are impaired and in need of urgent intervention
- **Only 13 facilities constructed over the last decade of the 1,742 tailings facilities** reviewed used a dewatering technology that improves tailings stability.
 - However, research shows tailings dams estimated 29,000-35,000 tailings storage facilities (TSF) hold approximately 223 billion tonnes of tailings, including active, inactive and abandoned facilities.
- Dams are failing with increasing frequency and severity. A [paper](#) published in Scientific Reports in 2021 found that one in 10 tailings facilities reported “*notable stability concerns or failure to be confirmed or certified as stable at some point in their history.*”

Fig 1 CUMULATIVE TAILINGS DEPOSITIONS 1915-2019

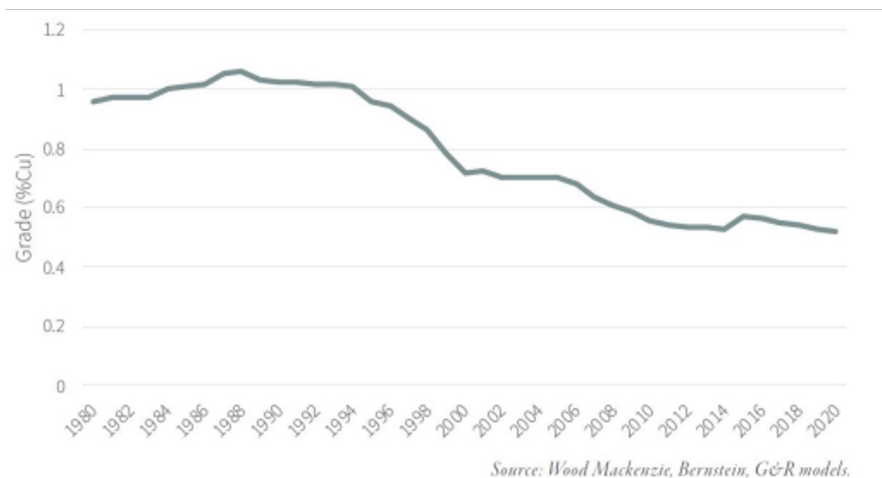


SOURCE: BASED ON GAVIN MUDD RAW DATA ON SELECTED MINERALS AS PREPARED FOR AND SUMMARIZED IN UNEP'S GEO6 <https://www.unenvironment.org/resources/global-environment-outlook-6>



Decreasing Ore grades

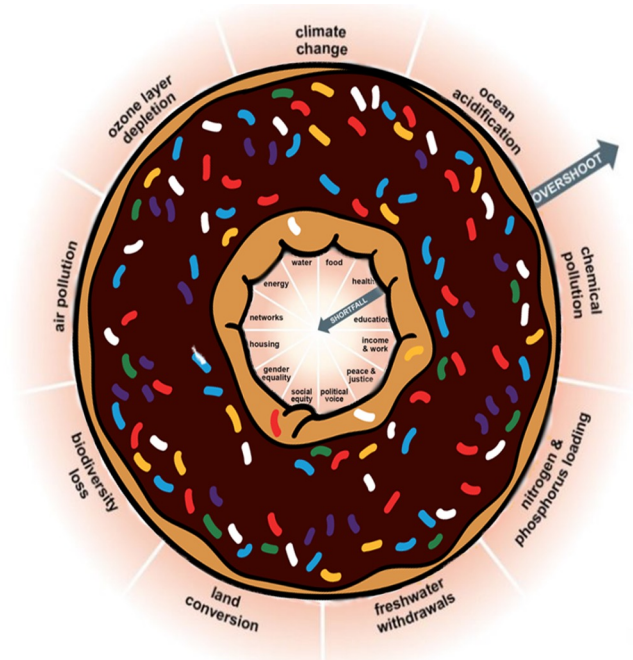
- The amount of contained copper metal in discoveries globally has decreased by 45% since the 1980s and a 25% decrease in the average copper ore grade over the last decade.
- A more fundamental issue is that the amount of possible Cu is apparently limited - We lack enough copper for more than 30% market penetration by EVs, needing an extra million tonnes annually for the next 20 years. This requires finding the equivalent of one Escondida mine each year until 2040
- Columbia Center on Sustainable Investment estimated that the mining sector accounts for up to 11% of Global Energy Demand. This will increase by 36% by 2035
- In order to satisfy this growing demand for metals for the energy transition:
 - Mining companies are increasing their own demand for energy - Columbia Center on Sustainable Investment estimated that the mining sector accounts for up to 11% of Global Energy Demand, which will increase by 36% by 2035
 - It now takes double the amount of water and 15 times the amount of power to produce 40 kg of Cu metal than in 1900
 - However, many companies are moving to renewable power, water free processes and conversion to electrically powered processes





Section 4

Opportunities and Unexplored Potential





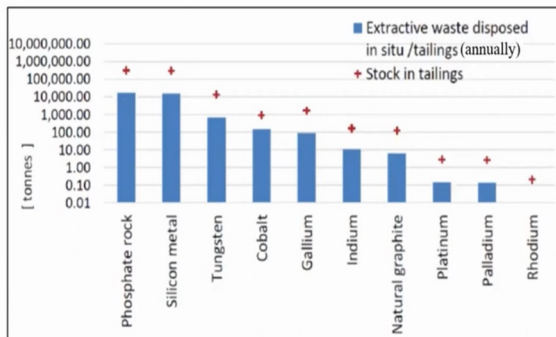
Circular Economy and the mining of mining waste

Recovery potential: Global and EU

• Global:

- ~8500 active, inactive, and closed tailings facilities → ~217 billion m³ tailings
- Percentage of tailings produced by commodity: Cu 46%, Au 21%, Fe 9%, coal 8%, phosphate 4%, Pb/Zn 3%, Ni 2%

• EU:



Source: Blengini et al., 2019 (2012 estimates)



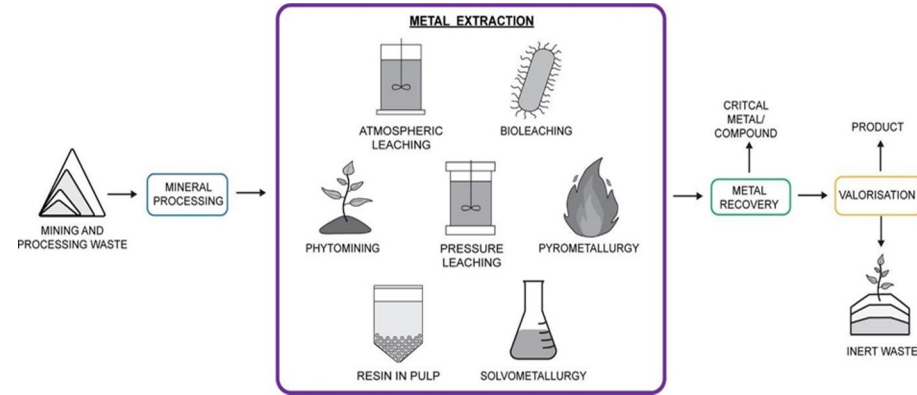


Targets of Remining Projects

- Nearly all projects are currently in characterisation or economic value phase, some with lab pilot scale processing - bioleaching (using microbes) is common
- Source material targets
 - Tailings, coal ash and waste, ore production byproducts, AMD, and associated sludges
 - Nearly all owned by mining companies
- Metal Targets
 - Most focus on gold, but also increasingly CRMs
 - REEs in Coal Ash
 - Legacy and modern mine waste (largely tailings) for original target metals vs metals not originally targeted

Examples of Remining Projects

- Chvalětice Manganese Project - in the Czech Republic is expected to recover manganese from tailings (20% of the projected 2030 European demand)
- LKAB in Kiruna, Sweden aims at re-mining rare earths from their Iron Ore mines (30% of today's European demand).
- In operation:
 - Kasese Cobalt Site, Uganda: recovery of cobalt from former copper mine tailings using bioleaching methods
 - Golden Sunlight Mine, Montana, U.S.: recovery of Au from existing Au tailings using existing facilities
 - DRDGold, South Africa: recovery of Au from former Au mine dumps and tailings
 - New Century Project, Australia: recovery of Zn from former Zn/base metal tailings
 - Pan African Resources, South Africa: recovery of Au from historic Au tailings



Maest, A.S. Remining for Renewable Energy Metals: A Review of Characterization Needs, Resource Estimates, and Potential Environmental Effects. *Minerals* **2023**, 13, 1454. <https://doi.org/10.3390/min13111454>



Section 4

Towards a New Paradigm

We need a much SMALLER and regenerative global economy in order to keep our planet sustainable.

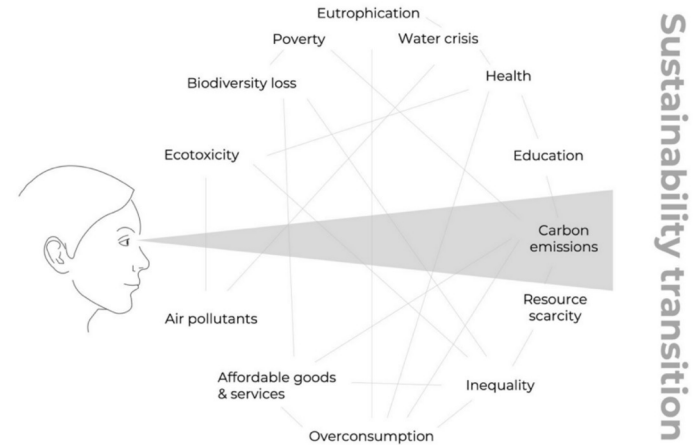


► Semertzidis, T. 2022
► Hoomans, S.
Welp, M. 2022
► Dahm, D. 2022



Escaping the Carbon Tunnel Vision

- Europe does not live within the limits of the planet: uses between 70% and 97% of the 'safe operating space' in terms of resource impacts for the whole world.
- Most resources in high income countries used for built environment, mobility and energy, in low income countries for food.

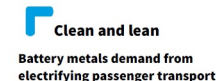
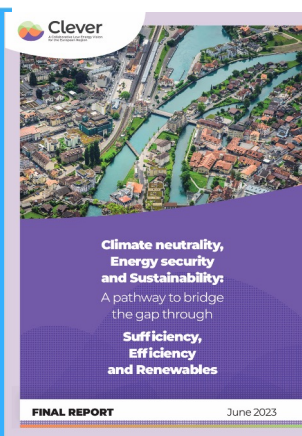
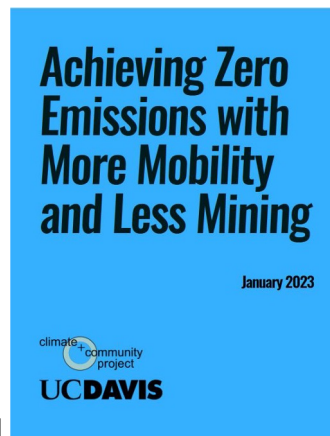


Graphic by Jan Konietzko

[It's time to move beyond "carbon tunnel vision" | SEI](#)

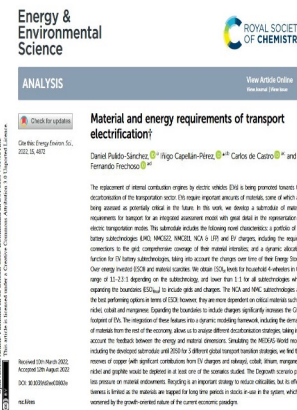
Some examples of alternative mineral demand scenarios

- Achieving Zero Emissions with More Mobility and Less Mining [1]
- Material and energy requirements of transport electrification [2]
- Critical raw materials demand for green & digital pathways in Spain [3]
- Final Report Clever Scenario [4]
- Clean and Lean [5]



July 2023

A study by TRANSPORT & ENVIRONMENT



[1] Riofrancos, T., Kendall, A., Dayemo, K., et al. (2023). Achieving Zero Emissions with More Mobility and Less Mining

[2] Pulido-Sánchez, D., Capellán-Pérez, I., de Castro, C., et al (2022). Material and energy requirements of transport electrification

[3] Lallana, M., Torrubia, J. & Valero, A. (2023). Critical raw materials demand for green & digital pathways in Spain

[4] Clever Scenario: [clever_final_report-exec_summary.pdf](https://clever-final-report-exec-summary.pdf) (clever-energy-scenario.eu)

[5] Clean and Lean - Transport and Environment - <https://www.transportenvironment.org/articles/clean-and-lean-battery-metals-demand-from-electrifying-cars-vans-and-buses>

Initial Proposal for a Legislative Framework

- **A Directive:** To set a legal objective for the Union to reach sustainable levels of resource consumption in relation to its biocapacity.
- **Targets:** A binding reduction in EU material footprint to a sustainable level of 5 tonnes per capita by 2050 (66% reduction compared to 2022 levels of 14.8 tpc)
- Mid-term targets and differentiated national targets





Initial Proposal for a Legislative Framework

1. **Addressing the ecological crises:** Reducing material extraction and use is crucial to mitigating environmental harm and thus essential for achieving decarbonisation and biodiversity goals
2. **Transitioning to a true circular economy:** Circularity is impossible without a holistic shift towards strategies that reduce unnecessary consumption
3. **Achieving strategic autonomy:** Reducing dependence on external sources will foster strategic autonomy, enhancing resilience in case of shocks and conflicts
4. **Fostering global peace & security:** Mitigating risk factors linked to resource exploitation such as violence, poverty, and poor governance, will promote global peace and security
5. **Delivering resource justice:** Reducing resource consumption in Europe will provide the necessary biophysical space for low-income countries to exercise their right to development and meeting their own needs
6. **Respecting human & workers' rights:** The initiative will bolster broader efforts to ensure respect for human and workers' rights, particularly in EU value chains
7. **Societal wellbeing & equity:** Reducing resource consumption is pivotal for transitioning to a future-proof economic model that prioritises the wellbeing of people and the planet

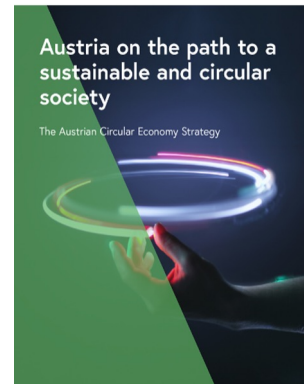




Political context: why now?

EU Member States: the frontrunners at national level

- **Austria** committed to a binding material footprint reduction per capita by 80% by 2050.
- **The Netherlands** has as its “guiding ambition” for a circular Dutch economy to be using 50% less primary abiotic resources (minerals, metals and fossil carbon resources) by 2030.
- **Flanders (Belgium)** committed to reducing the material footprint by 30% in 2030 and 75% in 2050 and developed a paper calling for a EU material resources law.
- **Finland** established a target to stabilise total consumption of domestic primary raw materials, so that in 2035, it will not exceed the 2015 level.





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Thank you for listening!

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Keep in touch



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<https://www.bbc.com/news/world-latin-america-34389803>