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MATERIAL DEPENDENCIES

Competitiveness, Security and Socio-Environmental Issues of Critical Raw Materials

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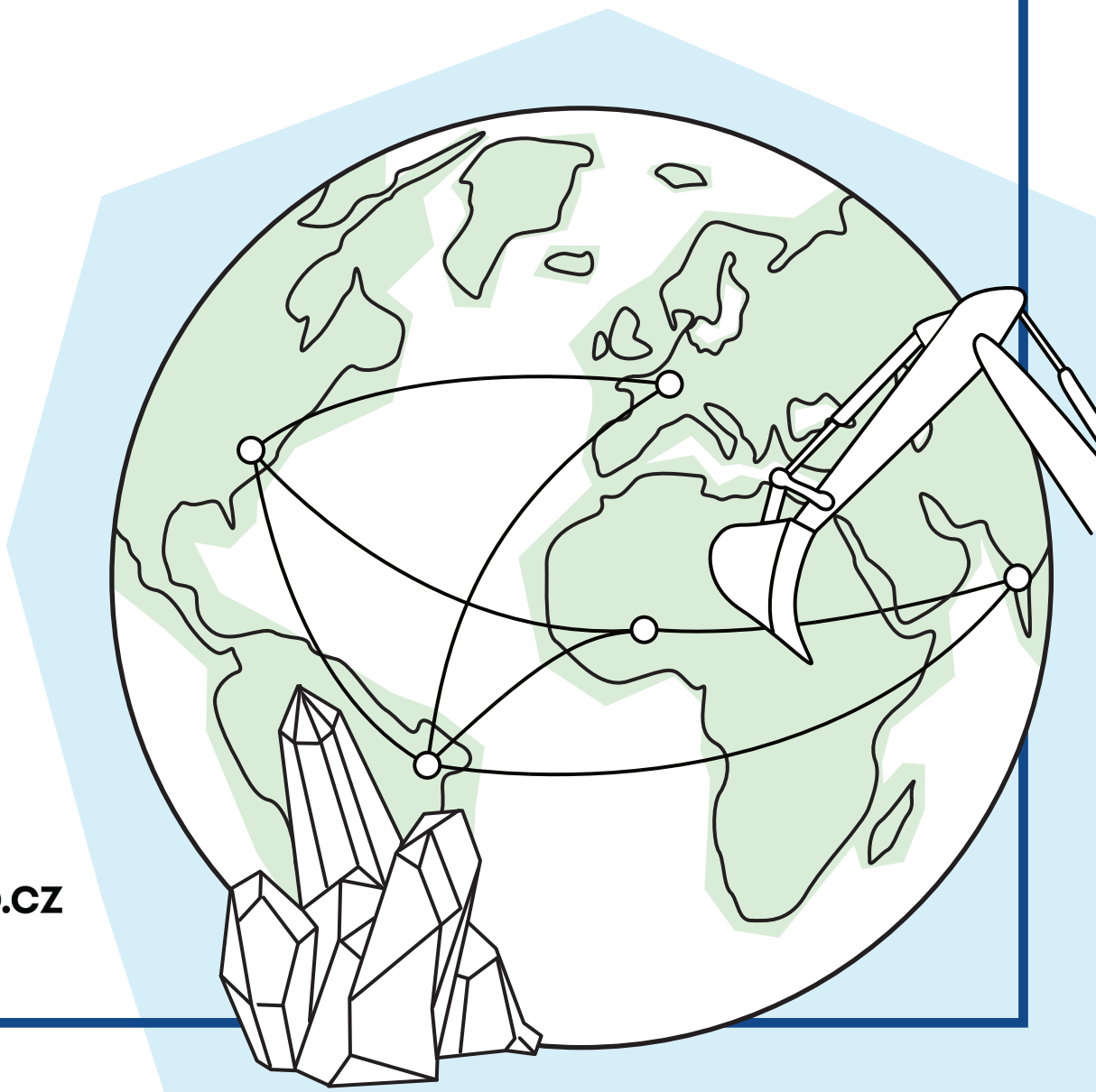

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List of abbreviations

CRMs	Critical raw materials
CRMA	Critical Raw Materials Act
EU	European Union
EVs	Electric vehicles
ESG	Environmental, Social, and Governance
ICE	Internal combustion engine
IEA	International Energy Agency
IRP	International Resource Panel
IRA	Inflation Reduction Act
LDV	Light-duty vehicle
LIB	Lithium-ion battery
LFP	Lithium-iron-phosphate battery
NZE	Net zero emissions
SRMs	Strategic raw materials

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Executive summary

The transition to a low-carbon economy, while necessary, is highly dependent on the extraction and processing of critical raw materials (CRMs), including lithium, cobalt, nickel, and Rare Earth Elements (REEs). This policy paper examines the interdependencies between competitiveness, security, and socio-environmental issues related to the extraction and use of CRMs, with a particular focus on the European Union:

→ **Competitiveness**: The EU seeks to secure access to CRMs to maintain economic growth, industrial leadership, and technological advancements, particularly in the face of competition from China and the United States. Many Global North countries are now moving towards onshoring mining and processing capacities, with policies such as the Critical Raw Materials Act reflecting this concern, leading to an extractivist race to the bottom.

→ **Security**: Rapidly escalating geopolitical tensions are leading to the re-centring of defence as a major concern, with demand for CRMs rising in military and aerospace industries. Yet the securitisation of CRMs is driving increased militarisation, corporate influence, and environmental conflicts, as governments justify extractivist expansion under the guise of economic and geopolitical security.

→ **Socio-environmental Issues**: The extraction and processing of CRMs have devastating environmental and social impacts, including biodiversity loss, pollution, human rights violations, and land dispossession, particularly affecting Indigenous and peasant communities in the Global South, but, increasingly, also Europe. These issues are only expected to intensify with the growing demand for CRMs.

Dominant climate strategies and raw material policies are fundamentally incompatible with climate and sustainability goals, particularly so for the following reasons:

1. **Demand growth:** The projected expansion of CRMs demand is unfeasible within the necessary timeframes for climate action. Mining at the required scale would have catastrophic socio-environmental consequences, exacerbating existing inequalities and ecological destruction.

2. **Extractivism and local resistance:** Current strategies to secure CRMs supply risk reinforcing neocolonial patterns of resource extraction, where local communities across the Global South and increasingly also the Global North bear the environmental and social costs of the transition. Growing resistance from local communities already presents a key challenge to new projects while a wave of deregulation undermines the fair decision-making process.

3. **The backlash against green policies:** Rising social and economic costs of the transition have contributed to the political success of far-right parties in the Global North, derailing climate action. As green policies are being stripped to the bone in response, the climate strategies which are based on continuous mining and extractivism must be seriously reconsidered as they lead to further backlash.

Systemic pathways to a just and sustainable green transition are essential. Key priorities must include:

→ **Focusing on demand reduction:** Policies must focus on reducing the overall material consumption, in absolute terms. Demand reduction is identified as crucial not only in preventing socio-environmental issues and conflicts with local communities, but also in increasing competitiveness and security and reducing material dependencies.

→ **Centring sufficiency-driven approach:** Addressing overconsumption and restructuring economic systems away from continuous growth and material dependency are essential steps towards a green transition that is both environmentally sustainable and socially just. The concept of sufficiency focuses on promoting wellbeing within the ecological and material limits of the planet. Concrete examples include minimising dependence on private car ownership, promoting active and public transport, or reducing working hours.

→ **Breaking free from "carbon tunnel vision":** While CRMs are essential for decarbonising the energy systems, the overfocus on carbon emissions has contributed to an overlooking of other issues such as biodiversity loss, pollution and health impacts, all of which are exacerbated by mining and extractivism. Instead, a holistic approach is needed for the green transition.

→ **Integrating social justice in climate policies:** A just transition must recognise historical inequalities and actively seek to reverse them, ensuring that the benefits of decarbonization are equitably shared and that affected communities have a voice in decision-making.

The status quo response to the ongoing material dependencies risks locking in geopolitical tensions and deepening socio-environmental injustices. A fundamental shift is needed—one that moves beyond the extractivist model and towards systemic solutions to the climate crisis.

Introduction

Climate change has frequently been classified as the defining issue of the present moment as well as possibly the biggest threat modern humans have ever faced.[1] The road to limiting the temperature increase to well below 2°C above pre-industrial levels in accordance with the Paris Agreement[2] was always going to be extremely challenging. Meaningful and coordinated actions have been delayed for decades through well-organised strategies of climate disinformation and greenwashing, funded and managed by fossil fuel interests.[3] [4] [5] The decade of the 2010s finally saw climate change become a fundamental question for governments and policymakers with low-carbon technologies, from massive solar parks or wind farms to electric vehicles, being rolled out at an unprecedented scale as they became safer and more affordable. Technological solutions have thus emerged as central to the green transition, decarbonising economies while promoting economic growth.

However, low-carbon technologies have substantial energy and material needs, including for so-called "critical" raw materials (CRMs) such as lithium, cobalt, nickel, graphite, Rare Earth Elements (REEs) and many others. These metals and minerals have rapidly become a key geopolitical and geoeconomic concern. According to the International Energy Agency (IEA), hundreds of policies related to CRMs have emerged virtually across the world since the COVID-19 pandemic, with the heightened attention to the issue due to supply chain disruptions and shortages.[6] The green transition, coupled with the digital transition, sometimes referred to together as the "twin transition" in the EU context,[7] thus heavily depend on mining and extraction. The demand for CRMs is projected to expand massively, with dire social and environmental consequences that are already being felt in frontline communities across the world.[8]

The world thus faces the challenge of the climate crisis while needing to tackle related issues such as biodiversity loss and pollution which are exacerbated by mining. With some referring to the current geopolitical moment as a Second Cold War,[9] the EU, the US and many other Global North countries are seeking to rapidly onshore the mining and processing of critical raw materials, moving towards increasingly protectionist measures.[10] The increasing geopolitical tensions and the issue of competitiveness have emerged particularly in response to China's dominance over the CRMs supply chains, from mining and processing

[1] Security Council Press Release, "Climate Change 'Biggest Threat Modern Humans Have Ever Faced', World-Renowned Naturalist Tells Security Council, Calls for Greater Global Cooperation," United Nations, February 23, 2021, https://press.un.org/en/2021/sc14445.doc.htm.

[2] "The Paris Agreement," United Nations Climate Change, 2025, https://unfccc.int/process-and-meetings/the-paris-agreement.

[3] Naomi Oreskes, *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming*. New York: Bloomsbury Press, 2010.

[4] René Marsh, "Big Oil has engaged in a long-running climate disinformation campaign while raking in record profits, lawmakers find," CNN, December 9, 2022, https://edition.cnn.com/2022/12/09/politics/big-oil-disinformation-record-profits-climate/index.html.

[5] Vojtěch Pecka, *Továrna na lži,* Alarm & UTOPIA libri, 2023.

[6] IEA, "Introducing the Critical Minerals Policy Tracker," November 2022, https://www.iea.org/reports/introducing-the-critical-minerals-policy-tracker/key-findings.

[7] JRC, "The twin green & digital transition: How sustainable digital technologies could enable a carbon-neutral EU by 2050," European Commission, June 29, 2022, https://joint-research-centre.ec.europa.eu/jrc-news-and-updates/twin-green-digital-transition-how-sustainable-digital-technologies-could-enable-carbon-neutral-eu-2022-06-29_en.

[8] Diego Marin et al., "Sacrifice zones for sustainability? Green extractivism and the struggle for a just transition," EEB, November 2, 2023, https://eeb.org/wp-content/uploads/2023/11/Sacrifice-Zones-final-layout.pdf.

[9] The Second Cold War Observatory (SCWO), https://www.secondcoldwarobservatory.com/.

[10] Thea Riofrancos, "The Security–Sustainability Nexus: Lithium Onshoring in the Global North," Global Environmental Politics 2023; 23 (1), pp. 20-41, https://doi.org/10.1162/glep_a_00668.

to battery production.[11] Meanwhile, global conflicts have intensified questions of security – and securitisation – where the rush for critical raw materials for low-carbon technologies increasingly overlaps with their use in military and aerospace industries.[12]

At the same time, recent years and especially the past several months have witnessed a major backtracking on climate promises across the Global North governments, as well as the rise of the far-right. Following the election of President Donald Trump, the US announced its re-withdrawal from the Paris Agreement in January 2025, and the EU's simplification omnibus adopted in February 2025 has been largely interpreted as a step back for the bloc's climate and environmental objectives.[13] For months, predating the recent political shifts,[14] private companies have been dramatically scaling back on their corporate pledges related to ESG standards and climate commitments, . With the rise of the far right, particularly in the Global North, the opposition to hegemonic green policies has been growing, successfully changing the terms of the debate across parliaments.[15]

Rather than retreating from climate commitments, what is urgently needed is for the question of justice, both locally and globally, to be put at the centre of climate policies as citizens are refusing to bear the costs of the transition. It is in this context that this policy paper sets out to analyse the interdependencies that emerge around the mining and processing of critical raw materials in relation to competitiveness, security and socio-environmental issues.

This policy paper is centred around three interrelated yet often opposing aspects that manifest around the question of critical raw materials:

1. **The issue of the competitiveness** of the EU in the contemporary geopolitical moment, related to the question of industry, access to cheap energy sources, declining economic growth and increasingly protectionist international trade.
2. **The issue of security** in the landscape of an increasingly fragmented global order, related to the questions of material sovereignty both from Russian fossil fuels and Chinese critical raw materials and electric vehicles, as well as to the growing demand for critical raw materials from the military and aerospace industries.
3. **The socio-environmental issues** related to mining, extraction and processing of critical raw materials, ranging from biodiversity loss,

[11] IEA, "Mining and materials production" in Energy Technology Perspectives 2023, January 2023, https://www.iea.org/reports/energy-technology-perspectives-2023/mining-and-materials-production.

[12] Claudiu Pavel, Evangelos Tzimas, "Raw materials in the European defence industry," EUR 27542 EN, Publications Office of the European Union, 2016, JRC98333. Available at: https://publications.jrc.ec.europa.eu/repository/handle/JRC98333.

[13] WWF, "Von der Leyen's deregulation omnibus: A devastating blow to EU environmental objectives," WWF EU, 26 February 2025, https://www.wwf.eu/?17206391/Von-der-Leyens-deregulation-omnibus-A-devastating-blow-to-EU-environmental-objectives.

[14] Evan Halper, "Companies made big climate pledges. Now they are balking on delivering," Washington Post, 3 December 2023, https://www.washingtonpost.com/business/2023/12/03/climate-corporate-cop28/.
Catherine Boudreau, "Wall Street's big green flip-flop," Business Insider, 29 August 2024, https://www.businessinsider.com/wall-street-banks-backtrack-climate-change-fighting-promises-2024-8.
Alastair Marsh, "Wall Street Quietly Turns Tail on Its Sustainability Commitments," Bloomberg, 12 September 2024, https://www.bloomberg.com/news/articles/2024-09-12/wall-street-quietly-turns-tail-on-its-sustainability-commitments?cmpid=BBD091224_GREENDAILY&utm_medium=email&utm_source=newsletter&utm_term=240912&utm_campaign=greendaily.

[15] Milou Dirkx & Julian Wettengel, "Right-wing populists challenge Europe's climate efforts," Clean Energy Wire, 7 June 2024, https://www.cleanenergywire.org/news/right-wing-populists-challenge-europes-climate-efforts.

deforestation, pollution and toxicity, health, human rights violations, and environmental justice conflicts.

The policy paper is intended as a starting point for bridging the gap between these three issues, recognising that many conversations are taking place in silos, often with competitiveness and security on the one hand, and the socio-environmental issues on the other. **While the focus lies on critical raw materials in the context of EU policies, this policy paper also speaks to the broader issues of justice and systemic change under the climate crisis in the context of the contemporary geopolitical moment, particularly by highlighting the lack of attention paid to demand reduction as an essential policy strategy.**

The key question this policy paper explores is thus ***how can the green transition be achieved without reproducing the extractivist model that depends on global inequality and injustice?***

The policy paper aims to do so by focusing on three overarching objectives:

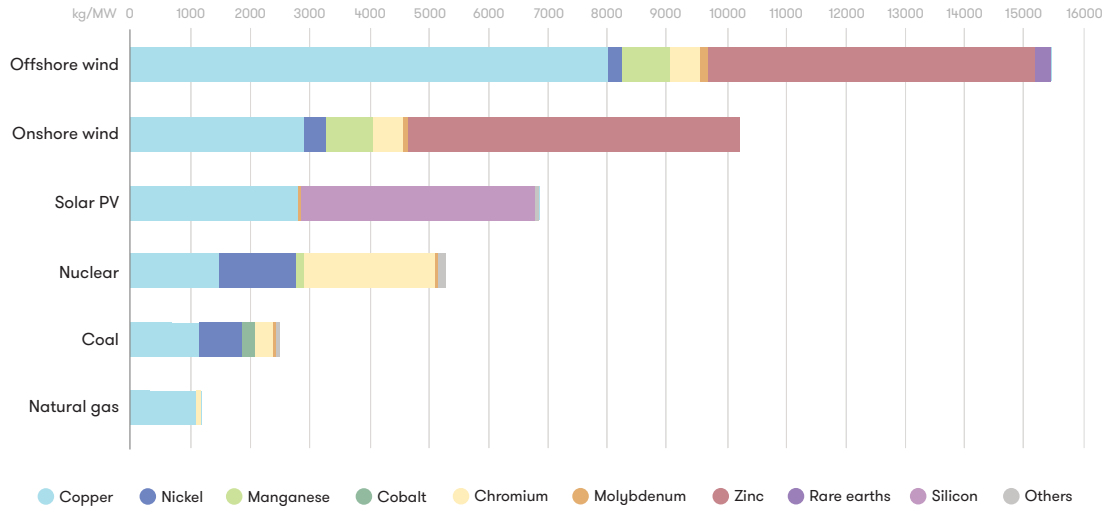
- Analysing the context of the rise of mining and extractivism of critical raw materials
- Exploring the relationship between the questions of competitiveness, security and socio-environmental issues
- Investigating the possibilities of moving beyond mining and extractivism, emphasising the reduction in demand for CRMs as a largely unexplored and underutilised policy area.

First, the policy paper sets the scene of the rapidly rising demand for critical raw materials, providing the background for the scale of the expansion of the mining sector and its impacts. This section also attends to the question of the "criticality" of the raw materials and provides a brief overview context of the Critical Raw Materials Act. Second, it analyses the three interlinked questions of competitiveness, security and socio-environmental issues in the context of the growing geopolitical tensions. It particularly highlights the devastating impact these developments have already had on local communities and environments across the world, especially so in the Global South, yet increasingly also in Europe. Third, the policy paper outlines already existing proposals for moving beyond the extractivist economic system, arguing that reduction of demand is a key policy area for reducing geopolitical dependencies, increasing competitiveness as well as security and minimising the socio-environmental issues associated with mining. Finally, the policy paper concludes by emphasising the significance of moving towards a systemic and transformational change that puts the health and wellbeing of the global ecosystems at its centre.

1 Background: the rise of mining under the green transition

An energy system based on low-carbon technologies is fundamentally different from the one that relies on traditional hydrocarbons. Solar photovoltaic systems, wind farms, and electric vehicles (EVs) need a greater quantity of metals and minerals compared to fossil fuel-based technologies.[16] An average electric vehicle contains six times as many minerals as a standard gasoline car, and an onshore wind farm requires nine times more mineral resources than a gas-powered plant[17] (see figure 1). While low-carbon technologies are central to decarbonisation, the massive demand in the range of different minerals such as copper, lithium, nickel, manganese, cobalt, graphite, zinc, rare earth elements (REEs) and many others is itself set to pose significant challenges. Estimating future demand for these minerals is difficult due to several uncertainties ranging from different decarbonisation scenarios, varying national commitments, the speed of technological innovation, the growth in demand for these technologies, overall economic performance, and many other factors. The estimates range greatly and are also constantly being updated, and the market remains volatile as 2023 and 2024 saw prices plummeting following the previous two years of rapid growth, most dramatically in the case of lithium.[18] Similarly, the projected demand for cobalt has decreased significantly following the developing preference for lithium-iron-phosphate (LFP) batteries which do not contain cobalt or nickel.[19]

Figure 1: Selected minerals used in clean energy technologies compared to other power generation sources.

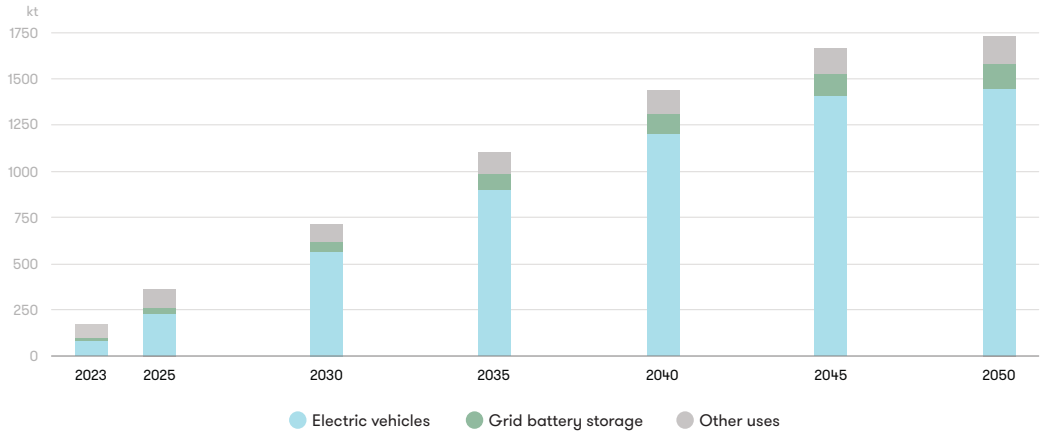


Source: IEA, 2021.[20]

[16] IEA, "Executive Summary" in The Role of Critical Minerals in Clean Energy Transitions, IEA, May 2021, https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions/executive-summary.
[17] Ibid.
[18] IEA, "Executive Summary" in Global Critical Minerals Outlook 2024, IEA, May 2024, https://www.iea.org/reports/global-critical-minerals-outlook-2024/executive-summary.
[19] Litian Wang & Vincent Khoo, "TRADE REVIEW: Asian cobalt market to face pressure from oversupply, weak demand in Q4", S&P Global, 23 October 2024, https://www.spglobal.com/commodity-insights/en/news-research/latest-news/metals/102324-trade-review-asian-cobalt-market-to-face-pressure-from-oversupply-weak-demand-in-q4.
[20] IEA, "Executive Summary" in The Role of Critical Minerals in Clean Energy Transitions, IEA, May 2021, https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions/executive-summary.
Steel and aluminium not included.

Still, under all of these dominant scenarios which assume perpetual growth in economic activity, the demand is expected to rise at an unprecedented scale. BloombergNEF predicts the annual demand for key transition metals to multiply fivefold from 2023 levels by 2050 under more ambitious climate action scenarios.[21] In the Net Zero Emissions (NZE) Scenario, the most ambitious of the three scenarios analysed by the IEA, the demand for critical materials[22] is expected to nearly triple by 2030 (as compared to doubling in the least ambitious STEPS scenario) and increase to over 3.5 times the current levels by 2050.[23] The growth also varies significantly among different materials, with lithium posed to increase the most dramatically, over 8 times by 2040 in the NZE scenario,[24] largely due to its use in electric vehicles that are expected to account for over 80% of its demand by 2050[25] (see figure 2). Under the NZE scenario, demand for the five key critical minerals—lithium, cobalt, nickel, copper, and neodymium—is expected to rise by 1.5 to 7 times by 2030.[26] It is important to emphasise that most of these scenarios account only for the demand needed for the low-carbon transition. Crucially, the rapid expansion of AI and data centres is going to lead to a significantly higher demand both for energy and for CRMs which becomes even more difficult to reliably predict.[27]

Figure 2: Total demand for lithium in the Net Zero Emissions by 2050 Scenario.



Source: IEA, 2024.[28]

[21] BloombergNEF, "Transition Metals Become $10 Trillion Opportunity as Demand Rises and Supply Continues to Lag", BloombergNEF, 18 January 2023, https://about.bnef.com/blog/transition-metals-become-10-trillion-opportunity-as-demand-rises-and-supply-continues-to-lag/.
[22] IEA analyses "37 key metals and minerals that are critical to the clean energy sector under different scenarios and technology cases". IEA, "Critical Minerals Market Review 2023", IEA, July 2023, https://www.iea.org/reports/critical-minerals-market-review-2023#methodology.
[23] IEA, "Global Critical Minerals Outlook 2024", IEA, May 2024, https://www.iea.org/reports/global-critical-minerals-outlook-2024/executive-summary.
[24] Ibid.
[25] IEA, "Critical Minerals Data Explorer", IEA, 17 May 2024, https://www.iea.org/data-and-statistics/data-tools/critical-minerals-data-explorer.
[26] IEA, "Mining and materials production" in Energy Technology Perspectives 2023, IEA, January 2023, https://www.iea.org/reports/energy-technology-perspectives-2023/mining-and-materials-production.
[27] Thomas Spence & Siddharth Singh, "What the data centre and AI boom could mean for the energy sector", IEA, 18 October 2024, https://www.iea.org/commentaries/what-the-data-centre-and-ai-boom-could-mean-for-the-energy-sector.
[28] IEA, "Critical Minerals Data Explorer", IEA, 17 May 2024, https://www.iea.org/data-and-statistics/data-tools/critical-minerals-data-explorer.

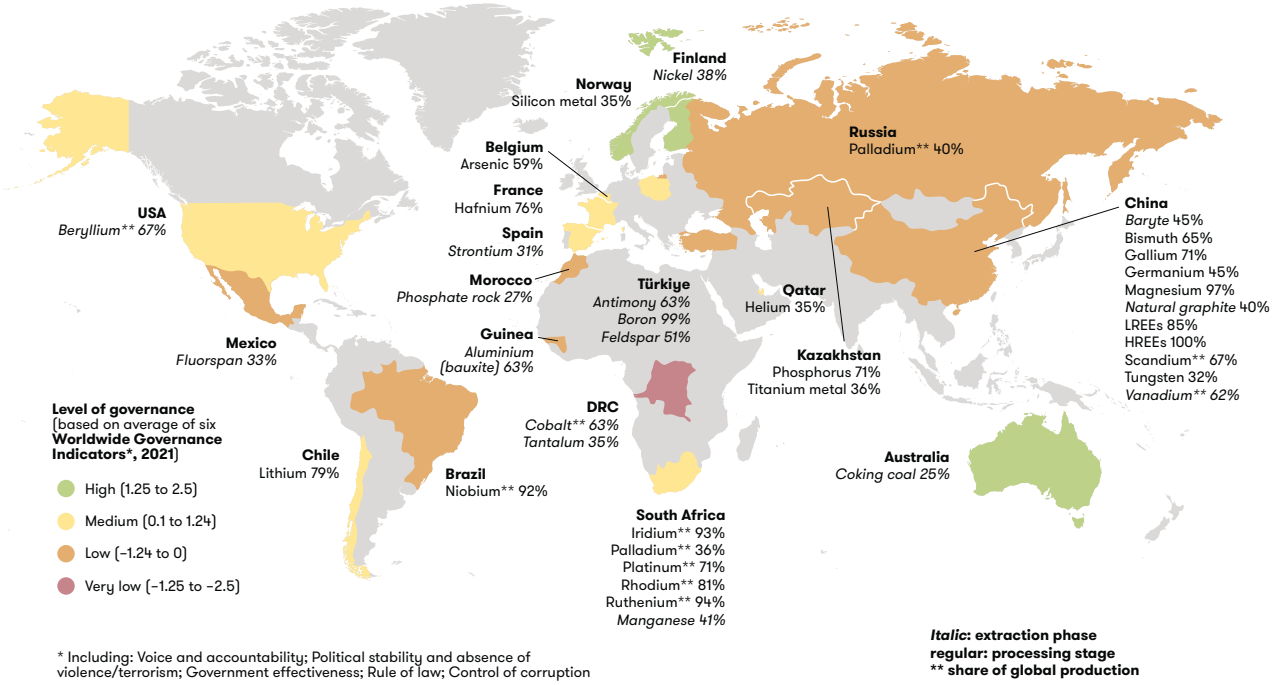
At the same time, mining is considered a major bottleneck for the low-carbon technology supply chains, with a looming gap between future demand and expected supply.[29] Announced mining projects are projected to meet only 70% of copper demand and 50% of the lithium demand in 2035.[30] The EU's demand for cobalt for batteries alone is projected to reach nearly 60% of the current global supply by 2030.[31] In a study from 2019 prepared by the Institute for Sustainable Futures for Earthworks, the authors note that the demand could even exceed the reserves of lithium, cobalt and nickel. In the 1.5°C scenario, the cumulative demand from renewable energy and storage technologies could reach 136% of reserves of nickel, 280% of reserves of lithium, and 423% of reserves of cobalt.[32] **Resources refer to the total known quantity of a mineral that has the potential for extraction, while reserves represent the portion that can be mined profitably under present economic and technological conditions.** Although global reserves are expected to grow with technological advancements and economic incentives for extraction, the scale required raises serious concerns about the viability of climate change mitigation based on extractivism.

Moreover, critical raw materials are highly geographically concentrated, and more so than oil and gas, vulnerable to political and geopolitical risks[33] (see figure 3). For instance, 74% of cobalt is produced in DR Congo[34] where approximately one-fifth of cobalt originates from artisanal and small-scale mining operations, with workers facing hazardous conditions including extracting materials manually from hand-dug pits and cases of child labour being well-documented.[35][36] According to the most recent IEA analysis, the geographic concentration is set to remain high despite efforts to diversify supply chains[37] and current expansion plans suggest that China will continue to dominate the market.[38] This is particularly the case for the currently planned processing projects, indicating significant supply gaps for certain critical materials.[39] Moreover, as the IEA analysis notes, both mining and processing remain highly polluting, with near-zero emissions production continuing to be economically unviable.[40] Current refining processes

[29] IEA, "Policy priorities to address supply chain risks" in Energy Technology Perspectives 2023, IEA, January 2023, https://www.iea.org/reports/energy-technology-perspectives-2023/policy-priorities-to-address-supply-chain-risks.
[30] IEA, "Executive Summary" in Global Critical Minerals Outlook 2024, IEA, May 2024, https://www.iea.org/reports/global-critical-minerals-outlook-2024/executive-summary.
[31] Samuel Carrara et al., "Supply chain analysis and material demand forecast in strategic technologies and sectors in the EU – A foresight study", Publications Office of the European Union, Luxembourg, 2023, doi:10.2760/386650, JRC132889. Available at: https://publications.jrc.ec.europa.eu/repository/handle/JRC132889, p.24.
[32] Elsa Dominish et al., "Responsible Minerals Sourcing for Renewable Energy. Report prepared for Earthworks by the Institute for Sustainable Futures, University of Technology Sydney, 2019, https://earthworks.org/wp-content/uploads/2019/04/Responsible-minerals-sourcing-for-renewable-energy-MCEC_UTS_Earthworks-Report.pdf p. 21.
[33] IEA, "The Role of Critical Minerals in Clean Energy Transitions", IEA, May 2021, https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions.
[34] Bruno Venditti, "Visualizing Cobalt Production by Country in 2023", Visual Capitalist, 31 May 2024, https://www.visualcapitalist.com/visualizing-cobalt-production-by-country-in-2023/.
[35] Elsa Dominish et al., "Responsible Minerals Sourcing for Renewable Energy. Report prepared for Earthworks by the Institute for Sustainable Futures, University of Technology Sydney, 2019, https://earthworks.org/wp-content/uploads/2019/04/Responsible-minerals-sourcing-for-renewable-energy-MCEC_UTS_Earthworks-Report.pdf, p.4.
[36] International Labor Organization, "Tiny but mighty voices against child labour in cobalt mining", ILO, 20 November 2024, https://www.ilo.org/resource/news/tiny-mighty-voices-against-child-labour-cobalt-mining.
[37] IEA, "Executive Summary" in Global Critical Minerals Outlook 2024, IEA, May 2024, https://www.iea.org/reports/global-critical-minerals-outlook-2024/executive-summary.
[38] IEA, "Mining and materials production" in Energy Technology Perspectives 2023, January 2023, https://www.iea.org/reports/energy-technology-perspectives-2023/mining-and-materials-production.
[39] Ibid.
[40] Ibid.

often take place in regions that are primarily dependent on energy from coal and as a result, are significantly carbon intensive.[41] The next section describes the EU's Critical Raw Materials Act (CRMA) which aims to address some of the issues associated with the EU's dependency on other countries.

Figure 3: Major EU suppliers of CRMs (2023) and their level of governance.



Source: RMIS, 2023.[42]

1.1 The criticality of materials and their governance

The "criticality" of a given material is never absolute[43] but rather reflective of various interests that come into play. While governments across the world have in recent years heightened their focus on the governance of critical raw materials, the official lists which they compile differ due to the varying criteria that countries use for national prioritisation. The most common criterion is the mineral's role in the national economy, but other important factors include the risk of supply chain disruptions, the mineral's relevance to national security or defence, and the existence of substantial untapped reserves within the country.[44]

For the EU, critical raw materials have been typically understood as those that face high supply risk while playing a fundamental role in the economy.[45] In other words, they are defined by the vulnerabilities of their supply and the potential limitations to economic growth. However, this definition has

[41] IEA, "Executive Summary" in Global Critical Minerals Outlook 2024, IEA, May 2024, https://www.iea.org/reports/global-critical-minerals-outlook-2024/executive-summary.
[42] RMIS – Raw Materials Information System, "Critical and strategic materials", European Commission Joint Research Centre, 2023, https://rmis.jrc.ec.europa.eu/eu-critical-raw-materials.
[43] European Commission, "Study on the EU's list of Critical Raw Materials", 2020, https://rmis.jrc.ec.europa.eu/uploads/CRM_2020_Report_Final.pdf.
[44] IEA, "Ensuring supply reliability and resiliency" in Introducing the Critical Minerals Policy Tracker, IEA, November 2022, https://www.iea.org/reports/introducing-the-critical-minerals-policy-tracker/ensuring-supply-reliability-and-resiliency#abstract.
[45] European Council, "An EU critical raw materials act for the future of EU supply chains", January 2025, https://www.consilium.europa.eu/en/infographics/critical-raw-materials/#:~:text=Those%20raw%20materials%20that%20are,wide%20range%20of%20industrial%20ecosystems.

also developed over time. In 2011, the European Commission established a list of CRMs for the EU, which undergoes revision and updating every three years. Up until 2020, the classification of CRMs was based on the two factors mentioned above: their economic significance to the EU (measured by the value added in the production of goods containing these materials within the EU) and the level of supply risk. In 2023, during the latest review which informed the initial draft of the CRMA, the category of "strategic raw materials" (SRMs) was created as a subcategory of CRMs[46] (see figure 4). Strategic raw materials are understood as "crucial to technologies important to Europe's green and digital ambitions and for defence and space applications, while being subject to potential supply risks in the future."[47] The number of CRMs has grown from 14 in 2011 to 34 in 2023.

Figure 4: The evolution of the EU's raw material policies.

2008	2011	2014	2017	2019	2020	2021	2022	2023	2024	2025
European Raw Material Initiative					**Action Plan Critical Raw Materials**				**Critical Raw Materials Act**	
	1. list CRM 14 CRMs	2. list CRM 20 CRMs	3. list CRM 27 CRMs		4. list CRM 30 CRMs			5. list CRM 34 CRMs Strategic raw materials established as 17 out of 34		List of Strategic Projects announced
			Conflict minerals regulation (in force 2021)	European Green Deal	Circular economy action plan	RePowerEU Plan	Strategic Compass for Security and Defence	Sustainable Battery Regulation	CSDDD; Defence Industrial Strategy	*Clean Industrial Deal; EU Circular Economy Act; Competitive Compass*
		EIT RawMaterials	European Battery Alliance		European Raw Material Alliance					*EU Critical Raw Material Centre*
						EU Strategic Partnership on sustainable raw materials value chains with: **Ukraine** & **Canada**	EU Strategic Partnership on sustainable raw materials value chains with: **Kazakhstan** & **Namibia**	EU Strategic Partnership on sustainable raw materials value chains with: **Chile, DRC, Zambia Argentina** & **Greenland**	EU Strategic Partnership on sustainable raw materials value chains with: **Serbia, Australia, Uzbekistan, Norway** & **Rwanda**	

Source: Gabriel Eyselein, University of Vienna, 2025.[48]

Yet public scrutiny over which minerals are to be considered CRMs and added to the list is essentially non-existent.[49] Investigations have shown that corporate interests are prepared to continuously lobby for adding new materials to the lists, including on an ad-hoc basis such as in cases of changes in supply chains due to wars or natural disasters.[50] Observatoire des Multinationales and Corporate Europe Observatory have extensively documented the role of the aerospace and defence industry in promoting the opening of new mines. For instance, they trace how the EU arms lobby heavily influenced the decision to include aluminium and titanium which are considered strategic for the aerospace and defence

[46] European Commission, "Fifth list 2023 of critical raw materials for the EU", 2023, https://single-market-economy.ec.europa.eu/sectors/raw-materials/areas-specific-interest/critical-raw-materials_en#fifth-list-2023-of-critical-raw-materials-for-the-eu.

[47] European Commission, "Critical Raw Materials: ensuring secure and sustainable supply chains for EU's green and digital future", Press Release, 16 March 2023, https://ec.europa.eu/commission/presscorner/detail/en/ip_23_1661.

[48] Year 2025 offers an outlook of key policies which have not been confirmed at the time of the writing of this policy paper.

[49] Olivier Petitjean & Lora Verheecke, "Blood on the Green Deal: How the EU is boosting the mining and defence industries in the name of climate action", Corporate Europe Observatory and Observatoire des Multinationales, November 2023, https://multinationales.org/IMG/pdf/crm_english_v1.pdf.

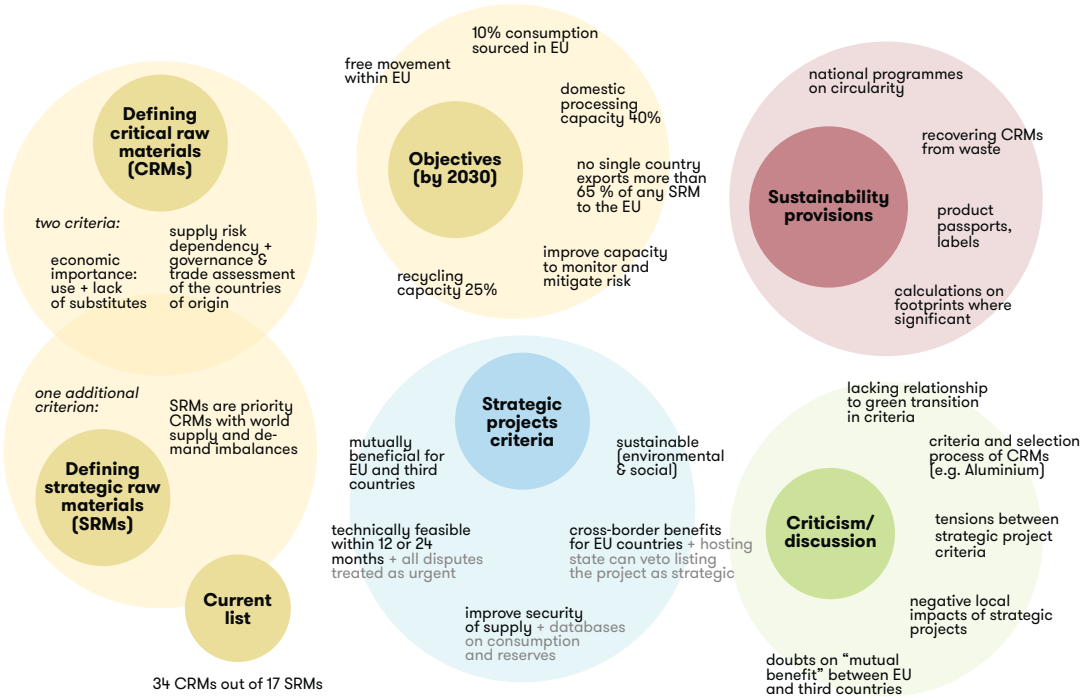
[50] Ibid., pp. 18-19.

industries on the list of critical raw materials[51]. A clear classification of which minerals are critical precisely for which uses is conspicuously missing in the CRMA, **with no prioritisation of the green transition over the military industry.[52]** In a contrary trend, European countries have recently redirected billions of euros earmarked for climate aid to developing nations towards their defence budgets[53]

The EU's Critical Raw Materials Act took effect in May 2024, representing a significant initiative within the EU aimed at enhancing the material sovereignty, the security of the supply chains and the competitiveness of the EU.[54] It focuses on regulating the governance of CRMs through the mitigation of supply chain risks, by boosting the EU's capacity to extract and process CRMs domestically.[55] The CRMA sets four main targets for domestic capacities by 2030, with one of the goals being to extract at least 10% of the EU's annual consumption within the block[56] (see figure 5). Given that the EU accounts for only 3% of global metal production, achieving these targets will require significantly more mining and refining projects within its own borders.[57] At the same time, the EU consumes 25-30% of the world's metals despite representing just 6% of the global population,[58] further underscoring the unequal and unjust overreliance on the Global South. Yet when the EU announced a list of strategic projects under the CRMA in March 2024, focused on the extraction, processing and recycling of CRMs, it included projects that have sparked a significant public backlash, such as with Barroso in Portugal, Sakatti in Finland, Cínovec in the Czech Republic, or Jadar in Serbia.[59] Just as in the case of the designation of raw materials as "critical" or "strategic", the local communities or the wider public have not been involved in the decision-making process regarding the strategic projects list.[60]

[51] Ibid., p.4.
[52] Ibid.
[53] Gautam Naik, "Europe's Defense Budget Rips Through Its Climate-Crisis Buffer", Bloomberg, 5 March 2025, https://www.bloomberg.com/news/articles/2025-03-05/europe-s-defense-budget-needs-threatens-climate-ambitions#:~:text=Europe's%20Defense%20Budget%20Rips%20Through,poorer%20countries%20has%20global%20implications.
[54] European Parliament, "Critical raw materials act", Briefing EU Legislation in Progress, June 2024, https://www.europarl.europa.eu/RegData/etudes/BRIE/2023/747898/EPRS_BRI(2023)747898_EN.pdf.
[55] Ibid.
[56] Ibid.
[57] Diego Marin et al., "Sacrifice zones for sustainability? Green extractivism and the struggle for a just transition," EEB, November 2, 2023, https://eeb.org/wp-content/uploads/2023/11/Sacrifice-Zones-final-layout.pdf., p.4.
[58] Friends of the Earth Europe, Mining the depth of influence: How industry is forging the EU Critical Raw Materials Act, 2023, https://friendsoftheearth.eu/wp-content/uploads/2023/07/Mining-the-depths-of-influence.pdf., p.3.
[59] European Commission, "Selected strategic projects", 25 March 2025, https://single-market-economy.ec.europa.eu/sectors/raw-materials/areas-specific-interest/critical-raw-materials/strategic-projects-under-crma/selected-projects_en.
[60] European Commission, "Questions and Answers on the Strategic Projects under the Critical Raw Materials Act", 25 March 2025, https://ec.europa.eu/commission/presscorner/detail/en/qanda_25_865.

Figure 5: Critical Raw Materials Act visual summary.



Source: Ondřej Kolínský, AMO, 2024.[61]

Apart from ramping up internal EU capacities in relation to CRMs, efforts have also been made to establish strategic partnerships and free trade agreements (FTAs) to secure access to critical raw materials in other countries. The EU's Global Gateway strategy seeks to finance infrastructure projects globally, but there is a lack of public scrutiny over private investments and the current FTAs often prioritise business interests over high ecological or human rights standards, being criticised for their neo-colonial approach.[62] The massive expansion of demand for CRMs outlined in the previous section then results not only in greater production within the EU, but also continuous support for extraction in other countries, many of which are in the Global South. **What is thus notably missing from the dominant raw material policies are any benchmarks that would aim to reduce the EU's primary demand which would increase both its security and competitiveness and decrease the socio-environmental issues within the block and beyond**, as this policy paper explores in the following sections.

[61] Ondřej Kolínský, "Conceptsheet: Summaries of CRMA and NZIA", AMO, 15 May 2024, https://www.amo.cz/en/climate-team/conceptsheet-summaries-of-crma-and-nzia/.
[62] Bettina Müller et al., "The Raw Materials Rush: How the European Union is using trade agreements to secure supply of critical raw materials for its green transition", TNI, January 2024, https://www.tni.org/files/2024-01/The_Raw_Materials_Rush.pdf.

2 Between competitiveness, security and socio-environmental issues

The rising demand for CRMs highlights a complex relationship between competitiveness, security, and socio-environmental issues, often marked by significant trade-offs. Competitiveness drives nations and industries to secure CRMs to maintain technological leadership, and increasingly so, also military leadership under the pretext of security. Yet this drive for CRMs creates its own security risks due to supply chain vulnerabilities and geopolitical dependencies, particularly in regions where CRM production is concentrated. Meanwhile, increased extraction exacerbates environmental degradation and social conflict. Balancing these priorities is of fundamental importance, yet many of the conversations around these topics are happening in silos. The following sections address each of the three aspects in relation to the growing consumption of CRMs while highlighting the crucial role a reduction in demand could play despite remaining largely overlooked by the policymakers.

2.1 Geopolitics of competitiveness: reducing dependencies by reducing demand

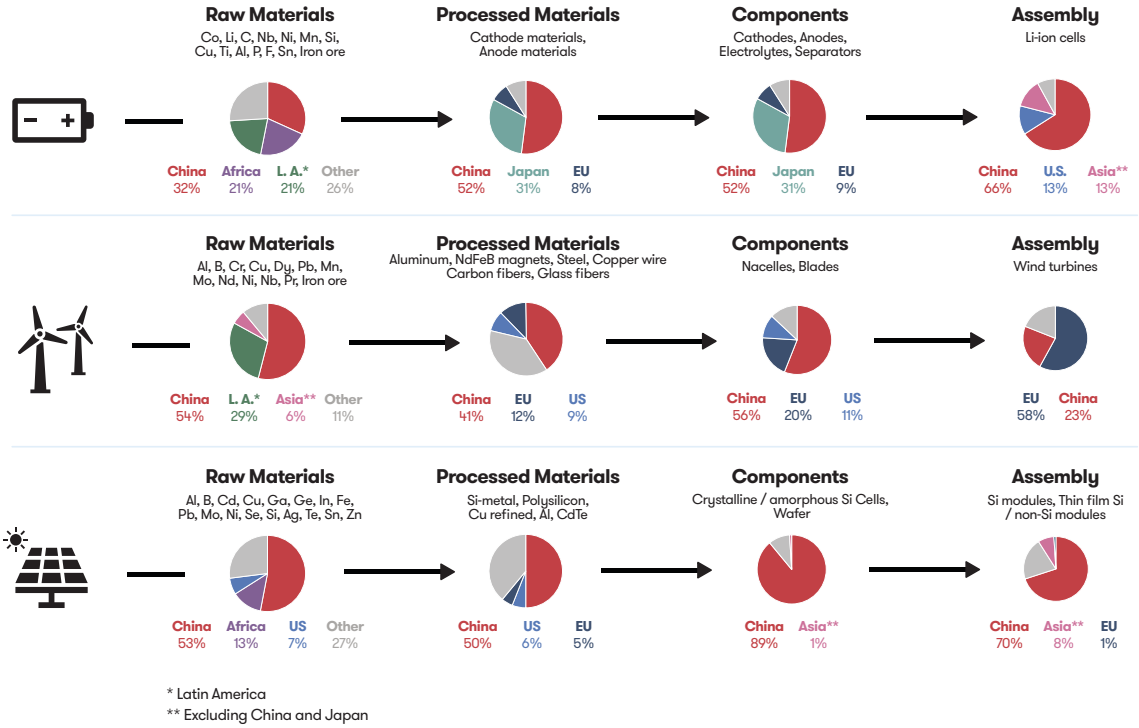
The twin green and digital transitions which include the rapid development of artificial intelligence, alongside increased militarisation, have triggered a geopolitical race to the bottom over control of the extraction and processing of CRMs.[63] The ongoing push for deregulation of industry and "simplification" of rules is just one of the manifestations of the EU's competitiveness campaign, rolling back social and environmental standards.[64] This has been particularly pronounced in the context of increasing competition and trade protectionism between the US, the EU and China which has come to dominate CRMs supply chains, including key technologies such as photovoltaics, wind turbines and EVs. By 2030, China is projected to supply over 90% of battery-grade graphite and 77% of refined rare earth elements.[65] Crucially, most of the planned projects for processing and refining critical minerals are expected to take place in China, where these energy-intensive midstream activities are concentrated. China is set to handle 80% of the newly announced copper production capacity by 2030 and leads in refining capacities for key battery metals, including 95% of cobalt and approximately 60% of lithium and nickel.[66]

Countries in the Global North are moving towards onshoring, nearshoring and friendshoring of the supply chain, i.e. expanding mining projects at "home" and creating geopolitical alliances with partner countries aimed at facilitating access to CRMs and reducing reliance on foreign supply chains.[67] The European Union and its industries have become acutely aware of their dependency on China, especially following disruptions during COVID-19 and the

[63] Sophia Kalantzakos, "The Race for Critical Minerals in an Era of Geopolitical Realignments", The International Spectator, July 2020, https://doi.org/10.1080/03932729.2020.1786926.
[64] Corporate Europe Observatory, "Deregulation Watch: Exposing new developments in the deregulation agenda", 26 February 2025, https://www.corporateeurope.org/en/2025/02/deregulation-watch.
[65] IEA, "Executive Summary" in Global Critical Minerals Outlook 2024, IEA, May 2024, https://www.iea.org/reports/global-critical-minerals-outlook-2024/executive-summary.
[66] IEA, "Mining and materials production" in Energy Technology Perspectives 2023, January 2023, https://www.iea.org/reports/energy-technology-perspectives-2023/mining-and-materials-production.
[67] Thea Riofrancos, "The Security–Sustainability Nexus: Lithium Onshoring in the Global North," Global Environmental Politics 2023; 23 (1): 20–41.https://doi.org/10.1162/glep_a_00668.

war in Ukraine,[68] or Chinese export restrictions such as in the cases of germanium and gallium.[69] The importance of these developments cannot be overstated, as mining is one of the most polluting activities, one of the "least-value-added nodes of supply chains", often violating human rights and sparking conflict - all of which are the reasons behind the historic offshoring of these activities to the Global South under the colonial logic of externalising the socio-environmental costs of mining.[70] While in 1900 Europe produced 50% of global mineral production, it had fallen to less than 5% in 2018.[71] Moreover, Europe is the only inhabited continent in which mining production rates have declined since 2000 – by 35.6%.[72]

Figure 6: Clean energy mineral supply chains and top global suppliers; batteries, wind, and solar PV.



Source: CSIS, 2021.[73]

"Our dependencies have turned out to be vulnerabilities," describes Mario Draghi's policy paper on the current geopolitical and geoeconomic situation, classifying it as an "existential challenge."[74] When Draghi launched his policy paper on EU competitiveness in early September 2024, it was arguably one the most pronounced moments of recognising how rapidly the EU has been falling

[68] Frank Vandermeeren, "Understanding EU-China exposure", European Commission Single Market Economics Briefs, January 2024, doi: 10.2873/425398.
[69] European Parliament, "The Chinese Government's export restrictions on gallium and germanium", Parliamentary Question for written answer E-002165/2023 to the Commission, 10 July 2023, https://www.europarl.europa.eu/doceo/document/E-9-2023-002165_EN.html.
[70] Thea Riofrancos, "The Security–Sustainability Nexus: Lithium Onshoring in the Global North," Global Environmental Politics 2023; 23 (1): 20–41. https://doi.org/10.1162/glep_a_00668.
[71] Manuel Regueiro & Antonio Alonso-Jimenez, "Minerals in the Future of Europe", Mineral Economics, 2021, 34: 209–224. https://doi.org/10.1007/s13563-021-00254-7.
[72] Christian Reichl & Michael Schatz, "World Mining Data 2024", Federal Ministry of Finance, Republic of Austria, April 2024, https://wmc.agh.edu.pl/wp-content/uploads/2024/04/WMD-2024.pdf.
[73] Jane Nakano, "The Chinese Dominance of the Global Critical Minerals Supply Chains" in The Geopolitics of Critical Minerals Supply Chains, Center for Strategic and International Studies (CSIS), 2021, https://www.jstor.org/stable/pdf/resrep30033.4.pdf.
[74] Mario Draghi et al., "The future of European competitiveness, Part A", European Commission, September 2024, https://commission.europa.eu/document/download/97e481fd-2dc3-412d-be4c-f152a8232961_en, p. 1.

behind the US and Chinese dominance.[75] Draghi's policy paper identifies "three areas for action" that are considered essential for reviving the EU's growth: "closing the innovation gap with the US and China", competitiveness and decarbonisation, boosting security and decreasing dependencies.[76] It offers an ambitious vision that is focused on high-tech digitalisation and low-carbon energy, proposing 800 billion EUR in public and private investment which is meant to kickstart growth that has been slowing down for decades. Yet while the policy paper has been praised for offering a sobering diagnosis of the issues that Europe is facing, the proposed solutions have been largely viewed as unrealistic by commentators and policymakers alike.[77]

The electrification of the automobile industry has emerged as a case in point of Chinese companies leapfrogging the EU both in terms of technology and affordability. With Volkswagen threatening in summer 2024 that it will have to shut factories and cut jobs in Germany, the issue of the automotive industry in Europe and its competitiveness has become even more salient. It would be the first time in its history that VW has closed a factory in Europe and globally the first closure since 1988.[78] The Bloomberg News analysis[79] revealed that in 2023, nearly one-third of Europe's major passenger-car plants, operated by BMW, Mercedes-Benz, Stellantis, Renault, and VW - the five largest automakers - were running below capacity, producing fewer than half the vehicles they were designed for. A surprising dip in demand for electric vehicles, combined with increased competition in major export markets like the U.S. and China, is forcing manufacturers to seek cost-cutting measures in Europe to stay competitive. According to some industry suppliers, EV output is 45% lower than the car makers expected, with the ripple effect spreading across the supply chain.[80] In the EU, this is playing out in the context of the ongoing energy crisis, with the price of electricity costing twice as much as in the US[81]. At the same time, Chinese automakers continue with a strong push to the European market while the EU has launched its unprecedented probe into Chinese EVs and imposed duties in October 2024,[82] which has also highlighted the security concerns that are being raised in relation to Chinese EVs.[83]

Such dramatic developments demonstrate the seriousness of the questions of competitiveness, decarbonisation and critical raw materials for the EU's economy and employment - while also highlighting fundamental issues in an economic model that assumes infinite growth. The EU's response to China's dominance in low-carbon technologies should involve a balanced approach that reduces dependency, promotes sustainability, and ensures socio-environmental

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[75] Ibid.
[76] Ibid., p. 2-3.
[77] Carlo Martuscelli, "Mario Draghi's plan to fix a broken Europe already looks impossible", Politico, 9 September 2024, https://www.politico.eu/article/mario-draghi-report-europe-finances-invest-energy-work/.
[78] AP & Euronews, "VW considers German factory closures for first time in 87-year history", 3 September 2024, https://www.euronews.com/business/2024/09/03/vw-considers-german-factory-closures-for-first-time-in-87-year-history.
[79] Stefan Nicola et al., "Half-Empty Car Plants in Europe Spell Trouble for Workers", Bloomberg, 11 September 2024, https://www.bloomberg.com/news/articles/2024-09-11/vw-s-german-factory-closures-highlight-wider-problems-for-europe-s-carmakers.
[80] Albertina Torsoli, "EV Output Is 45% Below What Carmakers Expected, Supplier Says", Bloomberg, 23 July 2024, https://www.bloomberg.com/news/articles/2024-07-23/opmobility-says-manufacturers-are-reviving-combustion-engine-plans-amid-ev-lull.
[81] Carlo Martuscelli et al., "Europe's new normal: High energy bills, fading industry and one chance to fix it", Politico, 10 September 2024, https://www.politico.eu/article/europe-energy-bills-germany-brussels-pipeline-prices/.
[82] European Commission, "EU imposes duties on unfairly subsidised electric vehicles from China while discussions on price undertakings continue", Press Release, 29 October 2024, https://ec.europa.eu/commission/presscorner/detail/en/ip_24_5589.
[83] Parliamentary Question, "Security concerns around Chinese electric vehicles", European Parliament, 26 September 2023, https://www.europarl.europa.eu/doceo/document/E-9-2023-002806_EN.html.

protections. That includes focusing not only on securing the supply side but also on reducing the demand. **It is necessary to recognise that the EU and other countries depend not only on China, but on the exploitation and sacrifice of communities across the world.[84] By reducing those dependencies through demand reduction for both energy-intensive technologies and for CRMs, the EU could move towards a more sustainable and resilient economic model,** as this policy paper further explores in the section on *Moving beyond mining and extractivism*.

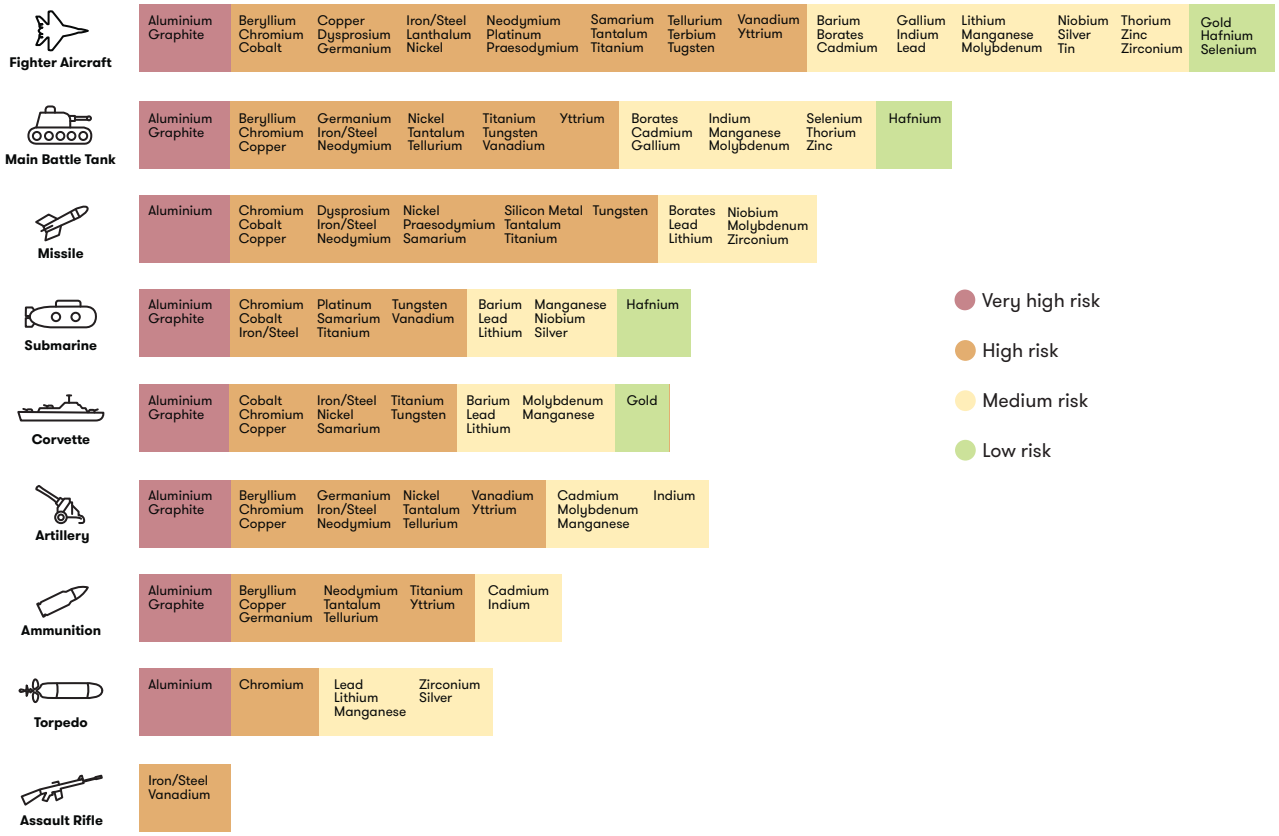
2.2 From security to securitisation: climate, economy and the military

Closely related to the question of dependency and competitiveness is that of security. In the context of the growing geopolitical tensions across the globe, security has emerged as a key concern for citizens. Growing fears over material dependency are fuelling geopolitical tensions and driving the race for dominance along the supply chain. Violent conflicts and genocidal wars, whether in Ukraine,[85] West Papua,[86] Sudan,[87] DR Congo[88] or Palestine[89][90] often have their roots in the global powers' relentless pursuit of resources. Governments across the Global North are framing CRMs, and in the case of the EU also SRMs as national security concerns, as the section on the CRMA highlights. Analyses show that the issues of security and defence have grown steadily over the past year among EU policymakers, with the defence industry gaining substantial lobbying influence.[91] The war in Ukraine has led to a massive increase in defence spending, record profits for arms companies,[92] and increased relevance of the CRMA for the defence and aerospace industry (see figure 7). These dynamics have been further amplified by the re-election of the US President Trump, his focus on Ukrainian[93] and Greenlandic[94]

[84] Diego Marin et al., "Sacrifice zones for sustainability? Green extractivism and the struggle for a just transition", EEB, November 2, 2023, https://eeb.org/wp-content/uploads/2023/11/Sacrifice-Zones-final-layout.pdf.
[85] Ian Aikman & James Gregory, "What we know about US-Ukraine minerals deal", BBC, 5 February 2025, https://www.bbc.com/news/articles/cn527pz54neo.
[86] Kjell Anderson, "Colonialism and Cold Genocide: The Case of West Papua", " Genocide Studies and Prevention: An International Journal, 9(2), pp. 9-25, 2015, DOI: http://dx.doi.org/10.5038/1911-9933.9.2.1270.
[87] Rachel Donald, "Climate wars fuelling genocide in Sudan: Welcome to the genocidal energy transition", Planet: Critical, 12 February 2024, https://www.planetcritical.com/p/climate-wars-fuelling-genocide-in.
[88] Nimi Princewill, "Fighting in Africa's mineral-rich DRC killed over 3,000 in less than 2 weeks. Here's how your phone plays a part", CNN, 13 February 2025, https://edition.cnn.com/2025/02/12/africa/fighting-drc-congo-minerals-phone-intl/index.html.
[89] Energy Embargo for Palestine, "Pipeline to genocide: BP's oil route to Israel", TNI, 9 September 2024, https://www.tni.org/en/article/pipeline-to-genocide.
[90] Rachel Donald, "Everybody Wants Gaza's Gas: The $500 billion windfall shoring up EU supplies", Planet: Critical, 31 October 2023, https://www.planetcritical.com/p/everybody-wants-gazas-gas.
[91] Olivier Petitjean & Lora Verheecke, "Blood on the Green Deal: How the EU is boosting the mining and defence industries in the name of climate action", Corporate Europe Observatory and Observatoire des Multinationales, November 2023, https://multinationales.org/IMG/pdf/crm_english_v1.pdf.
[92] Lorenzo Scarazzato et al., "Developments in Arms Production and the Effects of the War in Ukraine", Defence and Peace Economics, 35(6), pp. 673–693, 2024, https://doi.org/10.1080/10242694.2024.2381784.
[93] Scott L. Montgomery, "US-Ukraine deal highlights Ukraine's wealth of critical minerals, but extracting them isn't so simple", The Conversation, 11 March 2025, https://theconversation.com/us-ukraine-deal-highlights-ukraines-wealth-of-critical-minerals-but-extracting-them-isnt-so-simple-250996.
[94] Adrienne Murray, "Inside the race for Greenland's mineral wealth", BBC, 27 January 2025, https://www.bbc.com/news/articles/c9d5jwvw9nlo.

raw materials, and the resulting race to increase defence spending and rearm Europe.[95]

Figure 7: Supply risk for critical raw materials in military applications.



Source: Girardi et al., 2023.[96]

While the current wave of onshoring is being justified under the banner of sustainability and security, detailed policy analysis shows the impact of corporate interests as the question of meeting both sustainable development goals and energy security has shown notable trade-offs.[97] As an analysis by the Transnational Institute (TNI) points out, both economic and geopolitical security are used as major justifications for the massive expansion of mining despite the many socio-environmental issues.[98] Low levels of private investment, driven by factors such as increasing armed conflicts and geopolitical tensions have pushed dominant political and economic forces to use the green transition as a rationale for large-scale public spending and incentives and financial support for private companies as well as deregulation.[99] These fiscal and regulatory measures include direct investments, tax incentives, loans, and the shortening of the timeframe for approval of permits and licences among many others, all of which can directly lead to heightened socio-

[95] Peter S. Rashish, "Facing a Moment of Crisis, Europe Rewrites Its Economic Playbook", World Politics Review, 17 March 2025, https://www.worldpoliticsreview.com/europe-economy-defense-germany/.

[96] Benedetta Girardi et al., "Strategic raw materials for defence: Mapping European industry needs", The Hague Centre for Strategic Studies, January 2023, https://hcss.nl/wp-content/uploads/2023/01/Strategic-Raw-Materials-for-Defence-HCSS-2023-V2.pdf.

[97] John D. Graham et al., "Lithium in the Green Energy Transition: The Quest for Both Sustainability and Security", Sustainability, 13(20), 2021, https://doi.org/10.3390/su132011274/.

[98] Bettina Müller et al., "The Raw Materials Rush: How the European Union is using trade agreements to secure supply of critical raw materials for its green transition", TNI, January 2024, https://www.tni.org/files/2024-01/The_Raw_Materials_Rush.pdf.

[99] Thea Riofrancos, "The Security–Sustainability Nexus: Lithium Onshoring in the Global North," Global Environmental Politics 2023; 23 (1): 20–41. doi: https://doi.org/10.1162/glep_a_00668.

environmental pressures.[100] In a telling example, US President Donald Trump signed an executive order titled, "Immediate Measures to Increase American Mineral Production" in March 2025.[101] In doing so, a "national emergency" in relation to mining was declared, increasing investment in mining companies and reducing regulatory requirements, directly connected to the Defence Production Act.[102] Moreover, mining is to be prioritised as the primary land use on Federal lands,[103] which include national parks and forests, essentially overriding their environmental protection.

The rhetoric surrounding the green transition based on continued extractivism is used to justify growing militarism, including along Europe's borders, where critical raw materials are increasingly directed toward the booming arms and security industry.[104] As a policy paper by the London Mining Network emphasises, "extractivism is a militarised process" and "militarism is an extractive process."[105] Arms companies and global military powers are relying on growing volumes of materials to be extracted, increasingly employing greenwashing to justify it.[106] At the same time, mining operations across the world, and particularly in the Global South have frequently led to conflicts with local communities, including violent clashes both historically and at present. Scholars have highlighted the common use of counterinsurgency strategies by mining companies to "engineer consent."[107] For instance, a new policy paper by Global Witness documents the militarisation of the mining industry in the Philippines and the targeting of mining critics and Indigenous defenders by labelling and criminally charging them as "terrorists."[108] Moreover, as another policy paper by TNI shows, framing climate security in terms of increased militarisation obscures the role of the military-defence apparatus in causing climate change while precluding other, more systemic approaches to the climate crisis that are based on justice from materialising.[109] Indeed, estimates show that the US military is the single largest

[100] Thea Riofrancos et al., "Achieving Zero Emissions with More Mobility and Less Mining", Climate and Community Project US Davis, January 2023, https://climateandcommunity.org/wp-content/uploads/2023/01/23_03_08_ENG-Lithium.pdf.
[101] White House, "Immediate Measures to Increase American Mineral Production", Presidential Action, 20 March 2025, https://www.whitehouse.gov/presidential-actions/2025/03/immediate-measures-to-increase-american-mineral-production/.
[102] Ibid.
[103] Ibid.
[104] Olivier Petitjean & Lora Verheecke, "Blood on the Green Deal: How the EU is boosting the mining and defence industries in the name of climate action", Corporate Europe Observatory and Observatoire des Multinationales, November 2023, https://multinationales.org/IMG/pdf/crm_english_v1.pdf.
[105] Daniel Selwyn, "Martial Mining: Resisting Extractivism and War Together", LMN, November 2020, https://londonminingnetwork.org/project/martial-mining-2020/, p.2.
[106] Ibid., p.3.
[107] Andrea Brock & Alexander Dunlap, "Normalising corporate counterinsurgency: Engineering consent, managing resistance and greening destruction around the Hambach coal mine and beyond", Political geography, 62, pp.33-47, 2018, https://doi.org/10.1016/j.polgeo.2017.09.018.
[108] Global Witness, "How the militarisation of mining threatens Indigenous defenders in the Philippines", GW, 3 December 2024, https://www.globalwitness.org/en/campaigns/environmental-activists/how-militarisation-mining-threatens-indigenous-defenders-philippines/.
[109] Nick Buxton, "A primer on climate security: The dangers of militarising the climate crisis", TNI, May 2023, https://www.tni.org/files/2023-05/ClimateSecurity-Primer-TNI-updatedMay2023.pdf.

polluter in the world[110] [111] - and likely in history – as it emits more greenhouse gases than most medium-sized counties.[112] [113]

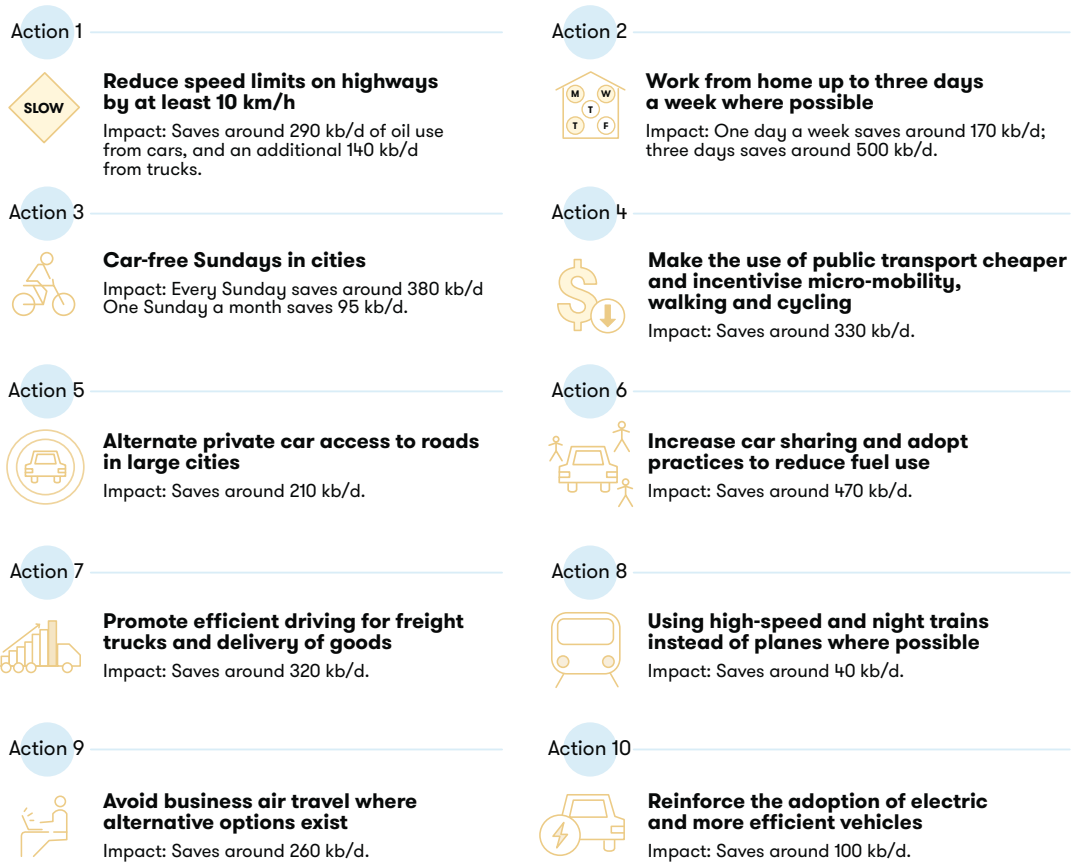
Thus, both the arms races and the races to secure supplies of critical raw materials are in fact leading to more insecurity, and more emissions. The arms industry already wields excessive influence over decision-making in the EU while mining projects are fuelling conflict across the world. This includes cases within the EU and its candidate countries, such as the lithium mining projects in Portugal,[114] Spain[115] and Serbia[116] that drew widespread resistance from local communities, often resulting in social unrest, protests, blockades and other forms of civil disobedience. Disregarding community concerns and environmental impacts is a security issue, potentially leading to conflicts and increasing risk for the supply chain.[117] Hence focusing on reducing the demand for the critical raw materials would not only immediately decrease the security risks associated with the local environmental conflicts[118] but could also be an important starting point in ensuring that the use of CRMs is being prioritised for decarbonisation over the arms industry.

Crucially, the importance of demand reduction has been recognised in the past during times of security crises. When the IEA presented in March 2022 its ambitious 10-Point Plan to Cut Oil Use in light of the Russian invasion of Ukraine, it was largely centred around demand reduction.[119] It included measures such as reducing the speed on highways, encouraging work from home for up to three days per week wherever possible, banning the use of private cars on Sundays in cities, reducing the price of public transport, encouraging walking and cycling, promoting car sharing, prioritising trains over planes, and encouraging EVs over ICE cars. A similar initiative was announced in the EU under the banner *Save Gas for a Safe Winter*.[120] The IEA plan suggested that taking immediate action in advanced economies which account for 45% of oil demand globally could cut oil demand by 2.7 million barrels a day during the following 4 months. As most of the demand for oil lies in the transport sector, the IEA's 10-Point Plan could be equally used to cut future demand for CRMs, which is expected to stem from the

[110] Daniel Selwyn, "Martial Mining: Resisting Extractivism and War Together", LMN, November 2020, https://londonminingnetwork.org/project/martial-mining-2020/, p.2.
[111] Dunlap, A., 2020. Wind, coal, and copper: the politics of land grabbing, counterinsurgency, and the social engineering of extraction. Globalizations, 17(4), pp.661-682.
[112] Neta C. Crawford, "Pentagon Fuel Use, Climate Change, and the Costs of War", Costs of War, Watson Institute, Brown University, 13 November 2023, https://watson.brown.edu/costsofwar/papers/ClimateChangeandCostofWar.
[113] Benjamin Neimark et al., "US military is a bigger polluter than as many as 140 countries – shrinking this war machine is a must", The Conversation, 24 June 2019, https://theconversation.com/us-military-is-a-bigger-polluter-than-as-many-as-140-countries-shrinking-this-war-machine-is-a-must-119269.
[114] Alexander Dunlap & Mariana Riquito, "Social warfare for lithium extraction? Open-pit lithium mining, counterinsurgency tactics and enforcing green extractivism in northern Portugal", Energy Research & Social Science, 95, 2023, https://doi.org/10.1016/j.erss.2022.102912.
[115] Emily Macintosh, "Thousands take to streets to protest Spanish mining boom", META&EEB, 13 February 2018, https://meta.eeb.org/2018/02/13/public-outcry-over-spanish-mining-boom/.
[116] Nina Djukanović, "Mining Lithium In Europe's (Semi)Periphery And The Making Of An Extractivist Frontier", Second Cold War Observatory, Dispatch 2024.5, 2 May 2024, https://www.secondcoldwarobservatory.com/dispatch-2024-5.
[117] IEA, "Executive Summary" in Sustainable and Responsible Critical Mineral Supply Chains, IEA, December 2023, https://www.iea.org/reports/sustainable-and-responsible-critical-mineral-supply-chains/executive-summary.
[118] Joan Martinez-Alier, "Environmental conflicts and the making of world movements for environmental justice", Economia Politica, 40, pp. 765-779, https://doi.org/10.1007/s40888-023-00306-x.
[119] IEA, "A 10-Point Plan to Cut Oil Use", IEA, March 2022, https://www.iea.org/reports/a-10-point-plan-to-cut-oil-use.
[120] European Commission, "Save Gas for a Safe Winter: Commission proposes gas demand reduction plan to prepare EU for supply cuts", Press Release, 20 July 2022, https://ec.europa.eu/commission/presscorner/detail/en/ip_22_4608.

transport sector.[121] [122] In the case of security emergencies, such as the invasion of Ukraine, but also many others that have occurred since, it is of the utmost importance for decision-makers to focus not only on diversifying the supply but also on restraining demand. The following section addresses the many socio-environmental issues that are only expected to worsen should that not become the case.

Figure 8: IEA's 10-Point Plan to Cut Oil Use.



Source: IEA, 2022.[123]

2.3 Socio-environmental issues of mining

While CRMs are necessary for decarbonisation because of their use in low-carbon technologies, the scale at which the demand for CRMs continues to grow poses serious challenges to the sustainability of mining practices and the respect for local communities, including their right to say no.[124] Despite the culture and rhetoric of the mining corporations changing in terms of their stated approach towards local communities and environmental protection,[125] mining remains one of

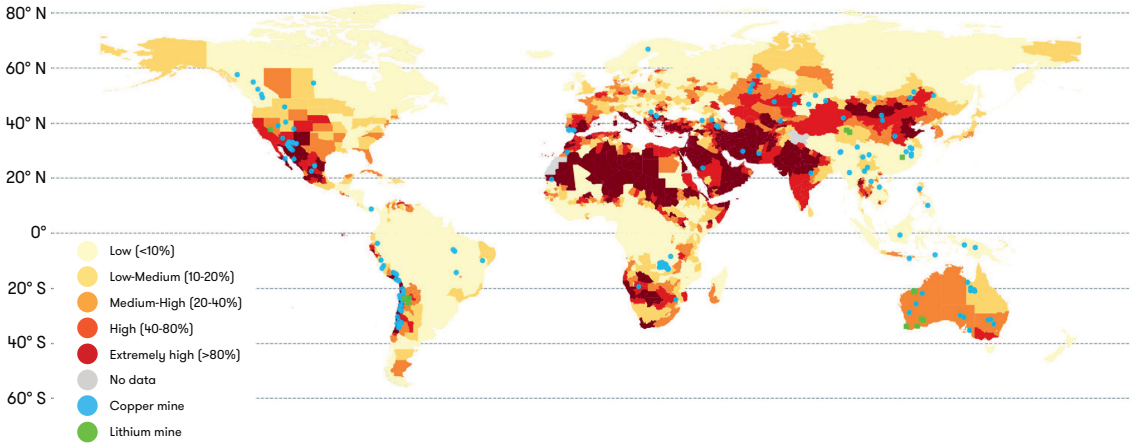
[121] IRENA, "Critical materials: Batteries for electric vehicles", International Renewable Energy Agency, September 2024, https://www.irena.org/Publications/2024/Sep/Critical-materials-Batteries-for-electric-vehicles?trk=public_post_comment-text.
[122] IEA, "Demand for critical raw materials in EVs", International Energy Agency, 17 November 2020, https://www.iea.org/articles/demand-for-critical-raw-materials-in-evs.
[123] IEA, "A 10-Point Plan to Cut Oil Use", IEA, March 2022, https://www.iea.org/reports/a-10-point-plan-to-cut-oil-use.
[124] Kamilya Tyulebayeva et al., "The Right to Say No: A Legal Toolbox for Communities Affected By Mining in the EU", EEB, February 2023, https://eeb.org/wp-content/uploads/2023/03/EEB_brochure_Right-to-say-no-3.pdf.
[125] R. Anthony Hodge et al., "The global mining industry: corporate profile, complexity, and change", Mineral Economics, 35(3), pp.587-606, 2022, https://doi.org/10.1007/s13563-022-00343-1.

the most destructive human activities on Earth.[126] **Projected resource use is fundamentally incompatible with climate and sustainability goals despite the importance of critical raw materials for low-carbon technologies.** According to PowerShift, mining and the processing of primary metal raw materials are responsible for between 10% and 14% of global CO_2 emissions.[127] In the twenty years between 1995 and 2015, greenhouse gas emissions from material production grew by 120%, amounting to 11 billion tons of CO_2-equivalent in 2015.[128]

Scientists have warned that the rapidly growing demand for metals and minerals is leading to an expansion of mining activities into biodiversity-rich and protected areas.[129] [130] Research highlights that mining is a significant driver of deforestation, affecting as much as one third of the global forest ecosystems through direct and indirect drivers.[131] The impacts are particularly severe in critical ecosystems such as tropical forests which are some of the most important carbon sinks globally, endangering both biodiversity and Indigenous territories.[132] Moreover, 54% of mining projects of 30 energy transition minerals and metals are on or near the land of Indigenous peoples and peasants, "two groups whose rights to consultation and free prior informed consent are embedded in United Nations declarations."[133] In 2019, 79% of global metal ore extraction took place in five of the six most biodiverse biomes, with tropical moist forests experiencing a doubling of mining activity since 2000, half of all extraction sites being located within 20 kilometres of protected areas, and 90% situated in regions with below-average water availability[134] (see figure 9 on water pressure and copper and lithium mining). **Recent research has also highlighted the health effects of mining, which last even long after a mine ceases to be active, with at least 23 million people worldwide living on floodplains contaminated by "potentially dangerous concentrations of toxic waste" from metal-mining activity, both past and present.[135]**

[126] Fernando P. Carvalho, "Mining industry and sustainable development: time for change", Food and Energy Security, 6(2), pp. 61-77, https://doi.org/10.1002/fes3.109.
[127] PowerShift, "Towards the urgently needed raw materials transition", 2024, https://power-shift.de/wp-content/uploads/2024/08/PowerShift_Towards_the_urgently_needed_raw_materials_transition.pdf.
[128] Edgar G. Hertwich, "Increased carbon footprint of materials production driven by rise in investments", Nat. Geosci. 14, pp. 151-155, 2021, https://doi.org/10.1038/s41561-021-00690-8.
[129] Victor Maus et al., "An update on global mining land use", Sci Data 9, 433, 2022, https://doi.org/10.1038/s41597-022-01547-4.
[130] Juliana Siqueira-Gay et al., Strategic planning to mitigate mining impacts on protected areas in the Brazilian Amazon, Nat Sustain 5, 853–860, 2022, https://doi.org/10.1038/s41893-022-00921-9.
[131] WWF, "Mining impacts affect up to 1/3 of global forest ecosystems, and tipped to rise with increased demand for metals", World Wildlife Fund, 18 April 2023, https://wwf.panda.org/wwf_news/?8455466/Mining-impacts-affect-up-to-13-of-global-forest-ecosystems-and-tipped-to-rise-with-increased-demand-for-metals.
[132] Radost Stanimirova et al., "Mining Is Increasingly Pushing into Critical Rainforests and Protected Areas", World Resources Institute, 23 October 2024, https://www.wri.org/insights/how-mining-impacts-forests.
[133] John R. Owen et al., "Energy transition minerals and their intersection with land-connected peoples," Nat Sustain 6, pp. 203-211, 2023, https://doi.org/10.1038/s41893-022-00994-6.
[134] Sebastian Luckeneder et al., "Surge in global metal mining threatens vulnerable ecosystems", Global Environmental Change, 69, 2021, https://doi.org/10.1016/j.gloenvcha.2021.102303.
[135] M. G. Macklin et al., "Impacts of metal mining on river systems: a global assessment", Science, 381, pp.1345-350, 2023, DOI: 10.1126/science.adg6704.

Figure 9: Location of copper and lithium mines and water stress levels, 2020.



Source: IEA, 2021[136].

The colonial past[137] [138] - and the present[139] [140] - of mining is also a history of violence. Economic growth, driven by material extraction, sustains political power but often at the cost of human rights and the rule of law. The Global Witness annual policy paper on violence against land and environmental defenders establishes mining as by far the biggest driver of the killings of the defenders. In 2023, at least 25 defenders lost their lives in killings that were directly linked to their opposition to mining operations.[141] In fact, more people were killed in relation to mining than all the other corporate drivers (logging, fishing, agribusiness, roads and infrastructure, and hydropower) combined (see figure 10). A total of 196 defenders were killed in 2023, and over 2,000 since 2012. Between 2012 and 2023, 50% of mining-related killings took place in Latin America, and 40% in Asia - two regions with some of the highest geographical concentration of critical raw materials. Thousands more stories go unreported each year as these are only the cases that were verified and where a link with the industry could be established. As pressure to rapidly develop the mines ramps up, the "green rush" is particularly worrying.[142]

[136] IEA, "Reliable supply of minerals" in The Role of Critical Minerals in Clean Energy Transitions, May 2021, https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions/reliable-supply-of-minerals.

[137] Kendall W. Brown, "A History of Mining in Latin America: From the Colonial Era to the Present", UNM Press, 2012.

[138] Alberto Acosta, "Extractivism and neoextractivism: two sides of the same curse", Beyond development: alternative visions from Latin America, pp. 61-86, 2013.

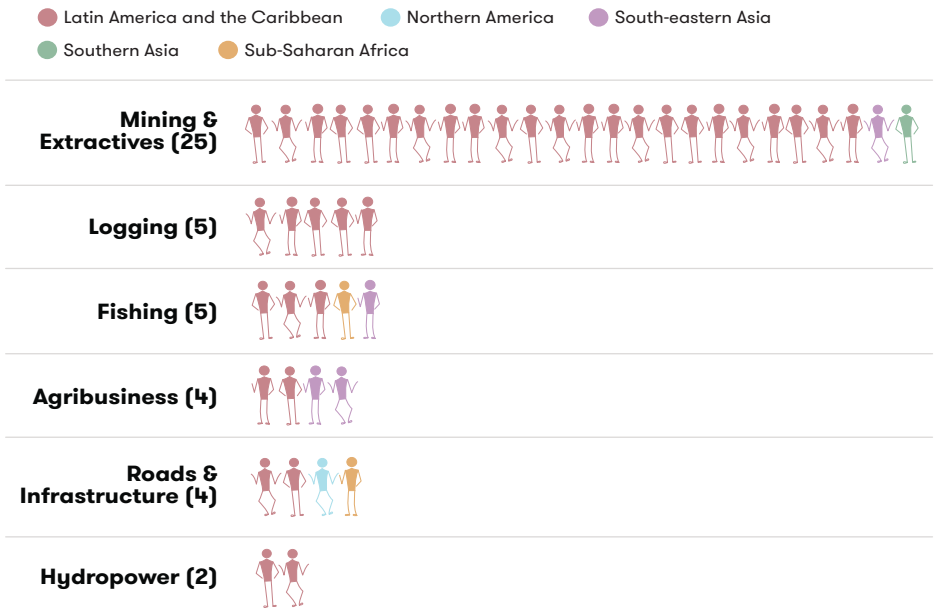
[139] Leah S. Horowitz, "Indigenous peoples' relationships to large-scale mining in post/colonial contexts: Toward multidisciplinary comparative perspectives", The Extractive Industries and Society, 5(3), pp. 404-414, 2018, https://doi.org/10.1016/j.exis.2018.05.004.

[140] Mining Watch Canada, "Voices from the Ground: How the Global Mining Industry is Profiting from the COVID-19 Pandemic", June 2020, https://miningwatch.ca/sites/default/files/covid-19_and_mining_-_snapshot_report.pdf.

[141] Global Witness, "Missing voices: The violent erasure of land and environmental defenders", September 2024, https://www.globalwitness.org/en/campaigns/environmental-activists/missing-voices/#recommendations.

[142] Ibid.

Figure 10: Mining was the biggest corporate driver of defender killings in 2023.



Source: Global Witness, 2024.[143]

Crucially, this expansion is not limited to the land only and the danger for the ecosystems extends beyond human communities and towards the deep sea and outer space. The deep sea has become a yet another frontier of resource extraction, with more than 1.3 million km² of ocean earmarked for mineral exploration.[144] Primarily, this concerns the extraction of polymetallic nodules, sulphides and cobalt-rich crusts.[145] With the extractive technology under development, many uncertainties surround its environmental impact, with scientists warning that it could lead to large-scale destruction of fragile ecosystems and habitats that remain little understood.[146] The physical removal of sediments could cause irreversible biodiversity loss[147] and disrupt the critical carbon cycle in the ocean.[148] [149] In November 2024, the World Wildlife Fund (WWF) took legal action against the Norwegian government[150] which has become one of the first countries in the world to adopt a regulation that opens the door towards deep-sea mining despite opposition from the EU.[151] The rush to secure CRMs has also led the most advanced countries

[143] Ibid.
[144] Seas at Risk, "Breaking free from mining: A 2050 blueprint for a world without mining – on land and in the deep sea", 2021, https://seas-at-risk.org/wp-content/uploads/2021/06/Breaking-Free-From-Mining.pdf, p.5.
[145] Jeremy Spearman et al. "Measurement and modelling of deep sea sediment plumes and implications for deep sea mining", Scientific Reports, 10, 5075, 2020, https://doi.org/10.1038/s41598-020-61837-y.
[146] Deep Sea Conservation Coalition, "Deep-sea mining: an introduction" in Factsheet on Deep sea mining, October 2023, https://deep-sea-conservation.org/wp-content/uploads/2024/01/DSCC_FactSheet1_DSM_intro_4pp_OCT_23.pdf.
[147] Jeremy Spearman et al. "Measurement and modelling of deep sea sediment plumes and implications for deep sea mining", Scientific Reports, 10, 5075, 2020, https://doi.org/10.1038/s41598-020-61837-y.
[148] Seas at Risk, "Breaking free from mining: A 2050 blueprint for a world without mining – on land and in the deep sea", 2021, https://seas-at-risk.org/wp-content/uploads/2021/06/Breaking-Free-From-Mining.pdf, p.12.
[149] Tanja Stratmann et al., "Abyssal plain faunal carbon flows remain depressed 26 years after a simulated deep-sea mining disturbance", Biogeosciences, 15, pp. 4131-4145, 2018, https://doi.org/10.5194/bg-15-4131-2018.
[150] WWF, "WWF-Norway Sues Norwegian Government Over "Illegal" Deep Sea Mining Impact Assessment", Arctic WWF, 28 November 2024, https://www.arcticwwf.org/newsroom/news/wwf-norway-sues-norwegian-government-over-illegal-deep-sea-mining-impact-assessment/.
[151] Angelos Delivorias, "Norway to mine part of the Arctic seabed", European Parliamentary Research Service (EPRS), January 2024,

and corporate powers to move towards outer space mining, with legal regulation already in place,[152] despite the likelihood of widening the inequality on the Earth.[153]

Other fragile ecosystems such as the Amazon are particularly suffering from the boom of illegal mining of critical raw materials, driving deforestation in Brazil and elsewhere.[154] [155] Deforestation is expected to be one of the major topics at next year's United Nations climate summit COP30 in Belém, Brazil,[156] yet Observatório da Mineração, the Brazilian investigative centre on extractivism, has dubbed the upcoming COP as "the COP of mining" for the growing global focus on CRMs as well as Brazil's own role in extractive supply chains.[157] This reveals a fundamental mismatch between CRM policies that are based on overconsumption and extractivism with its well-documented catastrophic effects on communities and environments on the one hand, and other areas that extend beyond the "carbon tunnel vision" such as biodiversity loss, water crises, air pollution, toxicity, resource scarcity or health on the other.[158] The following section outlines ways to position demand reduction as critical in bridging this gap and moving towards a systemic and holistic approach to the climate crisis.

https://www.europarl.europa.eu/RegData/etudes/ATAG/2024/757616/EPRS_ATA(2024)757616_EN.pdf.

[152] Ram S. Jakhu et al., "Space Mining and Its Regulation", Springer Praxis Books, 2017, ISBN : 978-3-319-39245-5.

[153] J.A. Dallas et al., "Mining beyond earth for sustainable development: Will humanity benefit from resource extraction in outer space?", Acta Austronatica, 147, pp. 181-188, 2020. https://doi.org/10.1016/j.actaastro.2019.11.006.

[154] Carlos Fabricio Assunção da Silva et al., "The drivers of illegal mining on Indigenous Lands in the Brazilian Amazon", The Extractive Industries and Society, 16, 2023, https://doi.org/10.1016/j.exis.2023.101354.

[155] Yolanda Ariadne Collins, "As renewable energy demand rises, mining for minerals in the Amazon is at a critical point", The Conversation, 9 September 2024, https://theconversation.com/as-renewable-energy-demand-rises-mining-for-minerals-in-the-amazon-is-at-a-critical-point-237700.

[156] Olivia Rudgard, "As the Amazon's Biggest Champion Approaches 100, He's Still Fighting", Bloomberg, 3 September 2024, https://www.bloomberg.com/news/articles/2024-09-02/the-amazon-s-most-famous-champion-approaches-100-years-old.

[157] Maurício Angelo, "Frustração da COP 29 aumenta a temperatura para Belém em 2025, que deverá ser a "COP da mineração"", Observatório da Mineração, 25 November 2024, https://observatoriodamineracao.com.br/frustracao-da-cop-29-aumenta-a-temperatura-para-belem-em-2025-que-devera-ser-a-cop-da-mineracao/.

[158] Ploy Achakulwisut et al., "It's time to move beyond "carbon tunnel vision", SEI, 28 March 2022, https://www.sei.org/perspectives/move-beyond-carbon-tunnel-vision/.

3 Moving beyond mining and extractivism

Taken together, what the three aspects of competitiveness, security and socio-environmental issues demonstrate is the striking lack of attention paid to a reduction in demand and moving towards green futures that are not only decarbonised but also more secure and just. "Without urgent and concerted action to change the way resources are used, material resource extraction could increase by almost 60 per cent from 2020 levels by 2060, from 100 to 160 billion tonnes, far exceeding what is required to meet essential human needs for all in line with the SDGs," writes the Global Resources Outlook 2024 published by the UN Environment Programme.[159] It emphasises that "[t]he prevailing approach of focusing on supply-side (production) measures must be supplemented with a much stronger focus on demand-side (consumption) measures."[160] Yet an analysis of over 450 policies in 35 countries related to critical materials shows that policies which would specifically target a reduction in demand are severely lacking.[161] This is also largely the case for the CRMA despite its efforts to reduce the EU's dependencies and vulnerabilities and acknowledge the importance of recycling.[162]

A considerable advantage of focusing on demand reduction is that, compared to the ramping up of the supply of CRMs, many of the tools necessary to implement it are already in place and it could be achieved with significantly fewer resources as well as negative externalities. As the IEA puts it in its 10-Point Plan to Cut Oil Use: "Governments have all the necessary tools at their disposal to put oil demand into decline in the coming years, which would support efforts to both strengthen energy security and achieve vital climate goals."[163] Crucially, proposals emphasising the need to reduce demand are nothing new but rather stem from what Indigenous groups, local communities, activists, scientists and many others have been advocating for decades for climate justice,[164] [165] with concrete proposals on moving beyond extractivism coming from the Global South.[166] [167] [168] Moreover, policy papers such as *Breaking Free from Mining*[169] or *Achieving Zero Emissions with More*

[159] UNEP, "Global Resources Outlook 2024 - Bend the trend: Pathways to a liveable planet as resource use spikes", March 2023, https://wedocs.unep.org/bitstream/handle/20.500.11822/44902/GRO24_Summary_for_Policymakers.pdf?sequence=3, p.6.

[160] Ibid., p.8.

[161] IEA, "Introducing the Critical Minerals Policy Tracker," November 2022, https://www.iea.org/reports/introducing-the-critical-minerals-policy-tracker/key-findings.

[162] European Commission, "Critical Raw Materials: ensuring secure and sustainable supply chains for EU's green and digital future", Press Release, 16 March 2023, https://ec.europa.eu/commission/presscorner/detail/en/ip_23_1661.

[163] IEA, "A 10-Point Plan to Cut Oil Use", IEA, March 2022, https://www.iea.org/reports/a-10-point-plan-to-cut-oil-use, p.14.

[164] Farhana Sultana, "Critical climate justice", The Geographical Journal, 188(1), pp.118-124, 2021, https://doi.org/10.1111/geoj.12417.

[165] David Schlosberg & Lisette B. Collins, "From environmental to climate justice: climate change and the discourse of environmental justice", WIREs Climate Change, 5(3), pp. 359-374, 2014, https://doi.org/10.1002/wcc.275.

[166] Eduardo Gudynas, "Transitions to post-extractivism: directions, options, areas of action" in Beyond Development: Alternative visions from Latin America; Permanent Working Group on Alternatives to Development, TNI, pp. 165-188, 2013, https://nbn-resolving.org/urn:nbn:de:0168-ssoar-86752-0.

[167] Alberto Acosta, "Post-extractivism: From Discourse to Practice—Reflections for Action", in Alternative Pathways to Sustainable Development: Lessons from Latin America, pp. 77-101, 2017, https://doi.org/10.1163/9789004351677_006.

[168] Ulrich Brand et al., "Degrowth and post-extractivism: two debates with suggestions for the inclusive development framework", Current Opinion in Environmental Sustainability, 24, pp. 36-41, 2017, https://doi.org/10.1016/j.cosust.2017.01.007.

[169] Seas at Risk, "Breaking free from mining: A 2050 blueprint for a world without mining – on land and in the deep sea", 2021, https://seas-at-risk.org/wp-content/uploads/2021/06/Breaking-Free-From-Mining.pdf.

Mobility and Less Mining[170] have offered a blueprint for shifting away from economic models based on overconsumption and growth dependency. While CRM policies often highlight recycling and material efficiency as playing an essential role in the green transition,[171] [172] these are not sufficient measures to cope with the scale of the issue that the dramatically growing demand presents. Instead, policies that would directly address the urgency to reduce demand are needed,[173] primarily aiming to reduce waste rather than to merely reuse it.

What must be underlined is that the reduction in demand should not be understood as a proposal for economic recession, depression or a collapse that would result in violent austerity which would again impact the most vulnerable communities. A concept of sufficiency is proposed as a "direct downscaling of economic production in many sectors and parallel reduction of consumption that together will enable the good life within the planet's ecological limits."[174] Rather than scarcity, such policies "focus on redistributing existing income, shortening the working week, and introducing a job guarantee and a living wage, while expanding access to public goods."[175] The policies which are guided by the principles of sufficiency and "radical abundance"[176] recognise the need for planned downscaling by design as opposed to through economic shocks. Concrete proposals are already in place, calling for a departure from GDP as an inadequate measure of human and environmental wellbeing and for a move towards holistic visions of the green transition.[177]

The paradigm of green growth fundamentally relies on the belief that economic growth can be achievable within the ecological limits of the planet through technological innovation and increasing efficiency which will result in minimal resource use and environmental impact – this is sometimes referred to as decoupling.[178] Such a belief, alongside the imperative of economic growth and extractivism, and strong corporate and private interests, is indeed to blame for the lack of policies targeting a reduction in demand. **Yet scientists have found "no evidence of the kind of decoupling needed for ecological sustainability,"**[179][180] **highlighting the role of problem shifting and externalisation or rebound effects**

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[170] Thea Riofrancos et al., "Achieving Zero Emissions with More Mobility and Less Mining", Climate and Community Project US Davis, January 2023, https://climateandcommunity.org/wp-content/uploads/2023/01/23_03_08_ENG-Lithium.pdf.

[171] IEA, "Executive Summary" in Global Critical Minerals Outlook 2024, IEA, May 2024, https://www.iea.org/reports/global-critical-minerals-outlook-2024/executive-summary.

[172] Elsa Dominish et al., "Responsible Minerals Sourcing for Renewable Energy. Report prepared for Earthworks by the Institute for Sustainable Futures, University of Technology Sydney, 2019, https://earthworks.org/wp-content/uploads/2019/04/Responsible-minerals-sourcing-for-renewable-energy-MCEC_UTS_Earthworks-Report.pdf, p. 21.

[173] Environmental Justice Foundation, "Critical Minerals and The Green Transition: Do We Need to Mine The Deep Seas?", EJF, January 2024, https://ejfoundation.org/resources/downloads/EJF_critical-minerals-and-the-green-transition.pdf.

[174] Timothée Parrique et al., "Decoupling Debunked: Evidence and arguments against green growth as a sole strategy for sustainability", EEB, July 2019, https://eeb.org/wp-content/uploads/2019/07/Decoupling-Debunked.pdf, p. 3.;
For a review see: Jessica Jungell-Michelsson & Pasi Heikkurinen, "Sufficiency: A systematic literature review", Ecological Economics, 195, 2022, https://doi.org/10.1016/j.ecolecon.2022.107380.

[175] Jason Hickel, "Degrowth: a theory of radical abundance", Real-world Economics Review, 87, pp. 54-68, 2019, http://www.paecon.net/PAEReview/issue87/Hickel87.pdf, p.54.

[176] Ibid.

[177] Giorgos Kallis, "In defence of degrowth", Ecological Economics, 70(5), pp. 873-880, 2011, https://doi.org/10.1016/j.ecolecon.2010.12.007.

[178] Tere Vaden, "Decoupling for ecological sustainability: A categorisation and review of research literature", Environmental Science & Policy, 112, pp. 236-244, 2020, https://doi.org/10.1016/j.envsci.2020.06.016.

[179] Ibid., p. 236.

[180] See also: Helmut Haberl et al., "A systematic review of the evidence on decoupling of GDP, resource use and GHG emissions, part II: synthesizing the insights", Environmental Research Letters, 15(6), 2020, DOI 10.1088/1748-9326/ab842a.

that can result from efficiency gains.[181] These effects are sometimes referred to as the Jevons paradox, which describes, simply put, how an increase in efficiency of resource use leads in the long run to an increase in the consumption of that resource, rather than its decrease.[182] The Jevons paradox is now being particularly discussed also in the context of the rapidly expanding AI sector.[183] Such trends have indeed led some scholars to refer to the "energy addition" rather than the "energy transition", noting how "newer sources of energy are, for the most part, added to – rather than in place of – older ones."[184] [185]

Indeed, as the official EU data show, the adoption of alternative energy sources and the gains in energy efficiency were "more than offset by an increase in transport demand", particularly individual cars.[186] **Transport – domestic and international – is the EU's biggest source of greenhouse gas emissions, standing at 29%.**[187] [188] It also remains the only sector where GHG emissions have increased rather than decreased since 1990 (see figure 11). Reducing the usage and ownership of cars is identified as one of the most impactful demand reduction policies. In 2020, the Scottish Government's Climate Change Plan included a landmark commitment of a 20% reduction in car kilometres by 2030 (compared to 2019), recognising that "technology alone will be insufficient to meet our net zero target by 2045 and that we need to reduce the use of private vehicles."[189]

[181] Thomas Wiedmann, "Degrowth critiques of the circular economy", Australian Circular Economy Hub, 6 March 2023, https://acehub.org.au/news/degrowth-critiques-of-the-circular-economy#:~:text=These%20%E2%80%9Cdegrowth%20critiques%20of%20circular,fundamentally%20to%20achieve%20necessary%20transformations.

[182] Mario Giampietro & Kozo Mayumi, "Unraveling the Complexity of the Jevons Paradox: The Link Between Innovation, Efficiency, and Sustainability", Front. Energy Res., 6, 2018, https://doi.org/10.3389/fenrg.2018.00026.

[183] Peter Howson, "DeepSeek claims to have cured AI's environmental headache. The Jevons paradox suggests it might make things worse", The Conversation, 31 January 2025, https://theconversation.com/deepseek-claims-to-have-cured-ais-environmental-headache-the-jevons-paradox-suggests-it-might-make-things-worse-248720.

[184] Richard York & Shannon Elizabeth Bell, "Energy transitions or additions?: Why a transition from fossil fuels requires more than the growth of renewable energy", Energy Research & Social Science, 51, pp.40-43, 2019, https://doi.org/10.1016/j.erss.2019.01.008.

[185] Richard G. Newell et al., "Global Energy Outlook 2020: Energy Transition or Energy Addition?", Resources for the Future, May 2020, https://media.rff.org/documents/GEO_2020_Report.pdf.

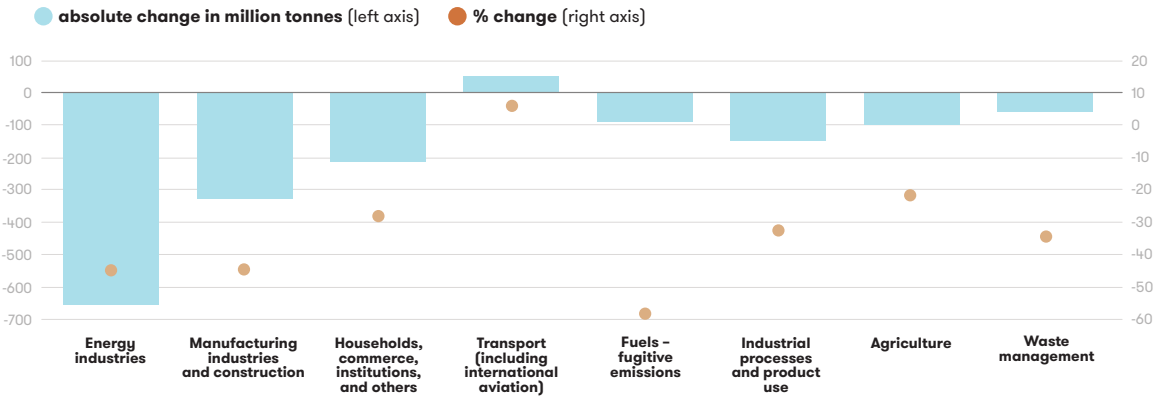
[186] European Environmental Agency, "Climate" in Sustainability of Europe's mobility systems, EEA, 10 October 2024, https://www.eea.europa.eu/en/analysis/publications/sustainability-of-europes-mobility-systems/climate?activeTab=58e33b8c-ed33-494b-b203-8c0d2274c6a9.

[187] European Environmental Agency, "Transport and Mobility", EEA, February 2025, https://shorturl.at/tqcEf.

[188] European Environmental Agency, "EEA greenhouse gases—data viewer", EEA, 13 August, 2024, https://www.eea.europa.eu/en/analysis/maps-and-charts/greenhouse-gases-viewer-data-viewers.

[189] Transport Scotland, "A route map to achieve a 20 per cent reduction in car kilometres by 2030", 13 January 2022, https://www.transport.gov.scot/publication/a-route-map-to-achieve-a-20-per-cent-reduction-in-car-kilometres-by-2030/.

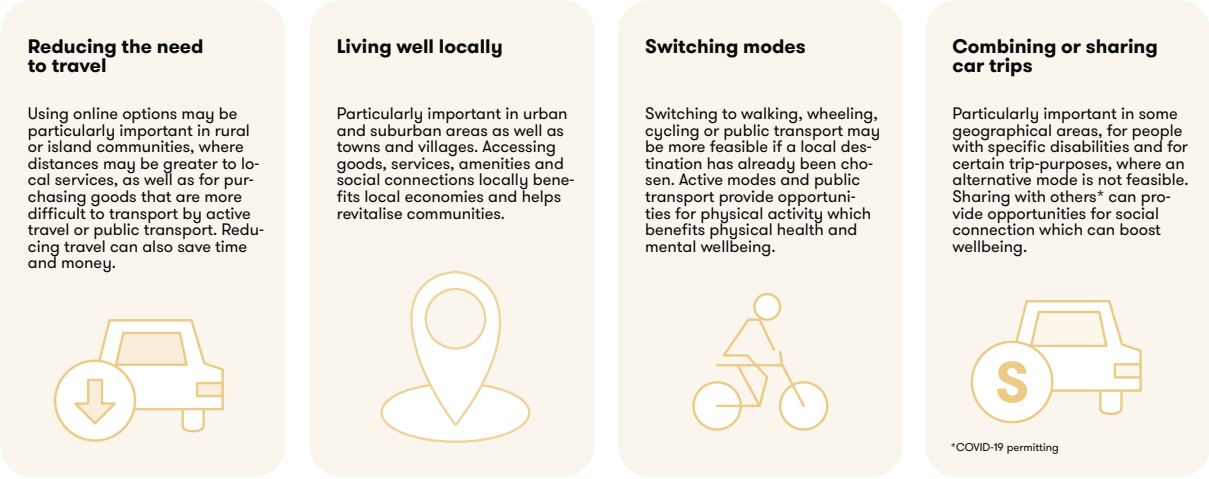
Figure 11: Greenhouse gas emissions falling in all sectors except for transport.



Source: Eurostat, 2022.[190]

Moreover, the "national commitment to reduce car use deliberately includes all types of cars, including electric vehicles, in recognition of the wider benefits of a society less-dominated by the movement and storage of private vehicles."[191] Such concrete initiatives are pioneering action, focused on urban and rural areas alike. The framework includes reducing the need for travel by supporting online, living well locally by revitalising local economies and communities, switching to walking, wheeling, cycling and public transport, and sharing car trips when the use of a car is necessary (see figure 12). Similarly, other investigations have suggested that lithium demand could be reduced by 92% by 2050 compared to mining-intensive scenarios by incentivising public and active transport, limiting the size of EVs and their batteries, and maximising recycling.[192]

Figure 12: Four desired behaviours in reducing car use.



Source: Transport Scotland, 2022.[193]

[190] Eurostat, "Greenhouse gas emissions falling in most source sectors", 23 August 2022, https://ec.europa.eu/eurostat/en/web/products-eurostat-news/-/ddn-20220823-1.
[191] Transport Scotland, "20% reduction in car km by 2030", 2025, https://www.transport.gov.scot/our-approach/environment/20-reduction-in-car-km-by-2030/.
[192] Thea Riofrancos et al., "Achieving Zero Emissions with More Mobility and Less Mining", Climate and Community Project US Davis, January 2023, https://climateandcommunity.org/wp-content/uploads/2023/01/23_03_08_ENG-Lithium.pdf.
[193] Transport Scotland, "Executive Summary" in A route map to achieve a 20 per cent reduction in car kilometres by 2030, 13 January 2022, https://www.transport.gov.scot/publication/a-route-map-to-achieve-a-20-per-cent-reduction-in-car-kilometres-by-2030/executive-summary.

Further concrete policy proposals beyond transport include significantly extending the lifespan of products, regulating the advertising industry to discourage overconsumption and banning planned obsolescence - the business strategy of designing products to last a shorter time than they otherwise could.[194] Equally, rethinking economies and reducing working hours could encourage the revival of rural communities and small-scale agriculture and community farming.[195] The Societal Transformation Scenario for Staying Below 1.5°C developed by the Heinrich Böll Foundation focuses in general on the effect of reduced economic activity in the Global North by "producing and consuming less but also [by] fulfilling concrete human needs and serving common welfare."[196] The scenario, for instance, proposes a reduction of the share of car transport by 81% in urban and 52% in rural areas by 2050, an 81% reduction in flights per person by 2050 or reducing meat consumption by 60% by 2030 in order to stay within the carbon budget.[197] The study highlights that such transformation can avoid overreliance on technological solutions that are deemed high-risk in terms of their social and environmental impact, such as geoengineering, nuclear energy, or carbon capture and storage. As this policy paper argues, the same holds true for mining and extractivism. What emerges is the need for transformational change that centres on human and ecosystem health, security and wellbeing.

[194] Annita Elissaiou, "Lawmakers back EU ban on planned obsolescence, destruction of unsold goods", Euractiv, 15 June 2023, https://www.euractiv.com/section/circular-economy/news/lawmakers-back-eu-ban-on-planned-obsolescence-destruction-of-unsold-goods/.

[195] Seas at Risk, "Breaking free from mining: A 2050 blueprint for a world without mining – on land and in the deep sea", 2021, https://seas-at-risk.org/wp-content/uploads/2021/06/Breaking-Free-From-Mining.pdf, p.56.

[196] Kai Kuhnhenn et al., "A Societal Transformation Scenario for Staying Below 1.5°C", Heinrich Böll Foundation, December 2020, https://www.boell.de/en/2020/12/09/societal-transformation-scenario-staying-below-15degc, p.9.

[197] Ibid., pp.33-34.

Conclusion: towards a systemic and transformative change

This policy paper has sought to explore the question of how the green transition can be achieved without reproducing the extractivist model that depends on global inequality and injustice, while paying attention to the three interlinked yet frequently isolated challenges of competitiveness, security and socio-environmental issues. What it suggests is that taking collectively into consideration the concerns of competitiveness, security and socio-environmental issues, the imperative of economic growth and continuous extractivism is unviable.

Firstly, a reasonable doubt exists that the sheer volume of materials and energy needed for the decarbonisation and electrification of the global economy can be secured within the required timeframe.[198] **Secondly**, despite efforts to align the growing demand with sustainable goals,[199] the socio-environmental consequences of the expansion of mining on that scale would be catastrophic, with conflicts with local communities posing significant challenges.[200] **Thirdly**, there is a growing backlash even at the receiving end of the supply chain – among the citizens of the Global North – as they are increasingly turning to far-right policies, which are already having a devastating impact on the green transition and climate action.[201] This is exacerbated by an ongoing lack of any social justice perspective within the dominant green policies.[202]

The EU's leadership has correctly recognised the material dependencies that it faces under the green transition and the process of decarbonisation, focusing on moving away from the dependencies on countries such as China. However, a holistic approach to the reduction of dependencies is needed - one that recognises as a problem not only the geopolitical tensions that arise from dependency on other countries but also dependency on a system that is exploitative and colonial. The Indigenous and peasant communities across the world are bearing the brunt of the decarbonising policies, most notably through the socio-environmental issues of mining which are escalating. Similarly, other entrenched dependencies include transport dependency on individual automobility, with studies showing that mere electrification of the car fleet will not meet the climate goals.[203] **Moving away from these deep dependencies, both historic and present, requires a systemic change that strives for a future that are not only green but also just.**

The current status quo in response to the issues of critical raw materials locks in geopolitical tensions and neocolonial relationships, exacerbating unsustainability. Responding to the climate crisis brings with it a unique set of challenges to strive for a green transition that protects the environment and human

[198] See for instance: IRENA, "Summary for Policymakers" in Geopolitics of the Energy Transition: Critical Materials, July 2023, https://www.irena.org/Publications/2023/Jul/Geopolitics-of-the-Energy-Transition-Critical-Materials.

[199] UNECE, "COP28: UN urges coordinated action to align soaring Critical Raw Materials extraction and use with sustainable development", Press Release, 6 December 2023, https://unece.org/climate-change/press/cop28-un-urges-coordinated-action-align-soaring-critical-raw-materials.

[200] Joan Martinez-Alier, "Mapping ecological distribution conflicts: The EJAtlas", The Extractive Industries and Society, 8(4), 2021, https://doi.org/10.1016/j.exis.2021.02.003.

[201] Mahir Yazar & Håvard Haarstad, "Populist far right discursive-institutional tactics in European regional decarbonization", Political Geography, 105, 2023, https://doi.org/10.1016/j.polgeo.2023.102936.

[202] Milou Dirkx & Julian Wettengel, "Populists in power: A challenge for ambitious EU climate policy", Clean Energy Wire, 4 July 2024, https://www.cleanenergywire.org/dossiers/populists-power-challenge-ambitious-eu-climate-policy.

[203] Alexandre Milovanoff et al., "Electrification of light-duty vehicle fleet alone will not meet mitigation targets", Nature Climate Change, 10, pp. 1102-1107, 2020, https://doi.org/10.1038/s41558-020-00921-7.

rights, and actively works to undo the long histories of colonial and racialised oppression that the extractivist system entails. To move beyond mining and extractivism, a fundamental change in thinking is needed. Demand reduction should not result in austerity but rather tackle the urgent issue of overconsumption and rising global inequalities and injustices that a green transition based on extractivism is only projected to exacerbate.

Reintroducing the concept of sufficiency into public discourse, despite its potential clash with currently dominant lifestyles, is essential. Decentralising power systems and adopting community-based energy solutions can help challenge the unsustainable creation of wealth for the top 1%. The green transition must also focus on social justice, recognising the nuanced realities of societal divisions and avoiding the pitfalls of polarisation, particularly in the contemporary context of the threat of the far-right escalating across the world. **A radical and systemic transformation that would break free from the extractivist logic can become a foundation for a future based on sufficiency while reducing material dependencies.**

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