Materie prime critiche e strategiche

UNA INTRODUZIONE

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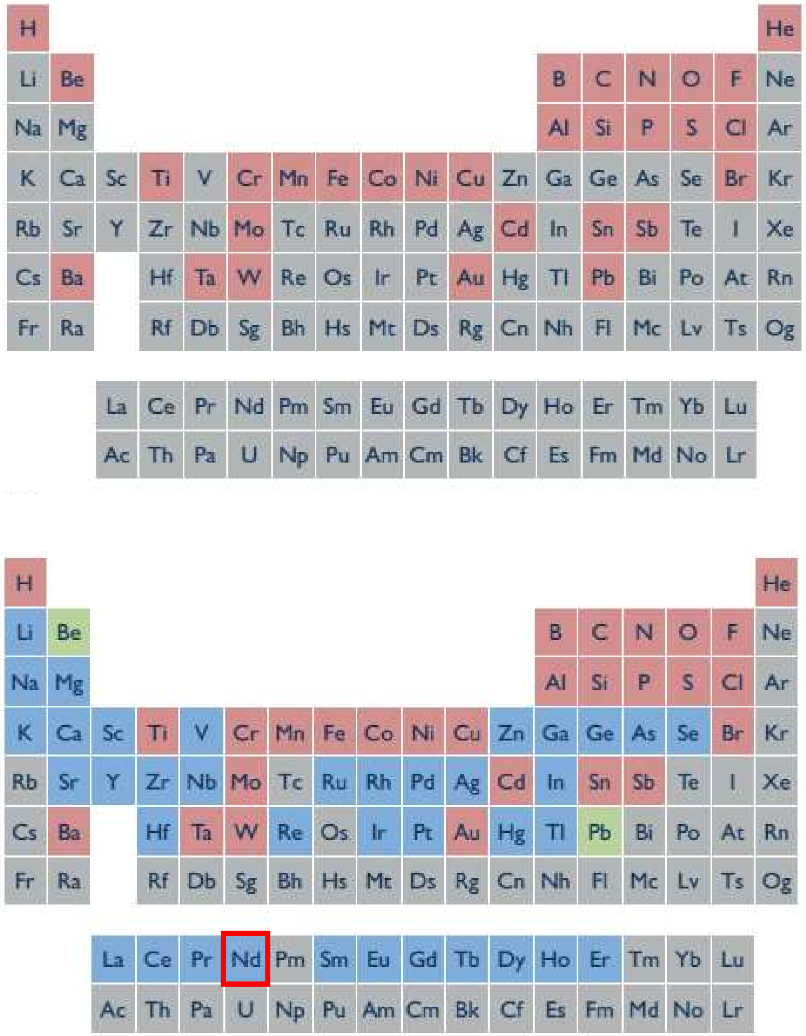


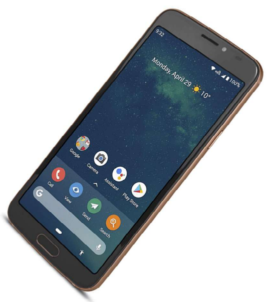
[figura da: A. King, Critical Materials, Elsevier 2021]

1983

"In un lasso di tempo sorprendentemente breve, siamo diventati dipendenti da un mucchio di elementi, e di materiali fatti da questi.

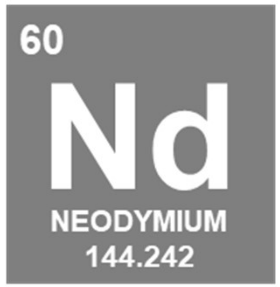
Prof. M. Ashby
Materials and Sustainable development
Elsevier 2016

2020

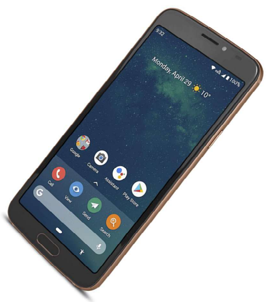


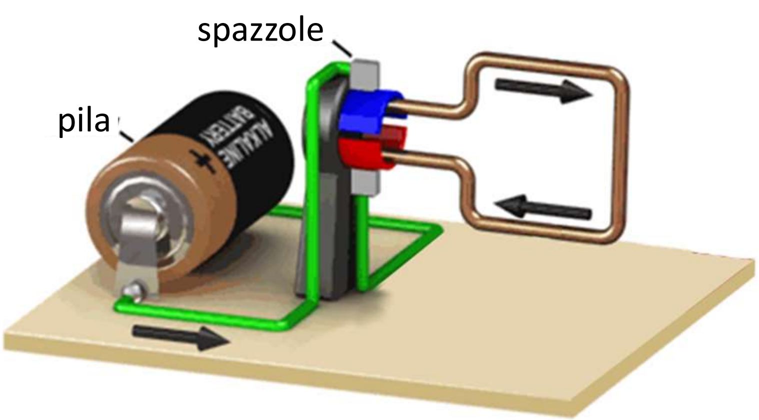
"Un sempre maggior numero di elementi vengono utilizzati in praticamente tutte le nostre tecnologie. I dispositivi di oggi dipendono da una gamma di elementi che è la più ampia mai utilizzata in tutta la nostra storia."

A. King, Critical Materials, Elsevier 2021

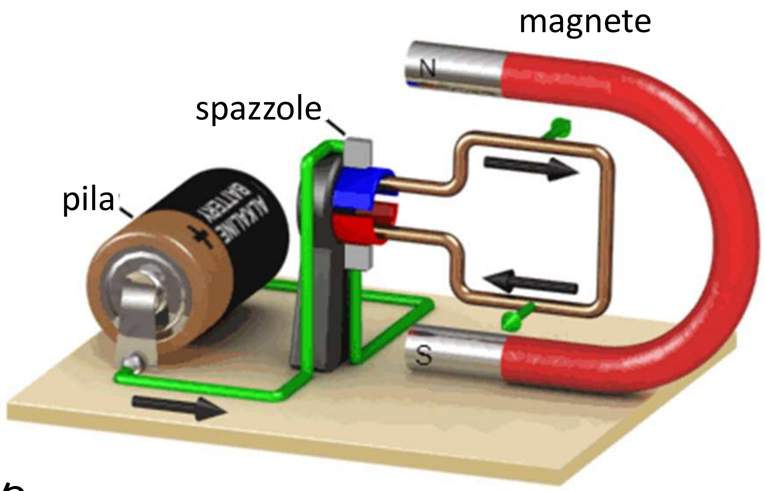


magneti
NdFeB

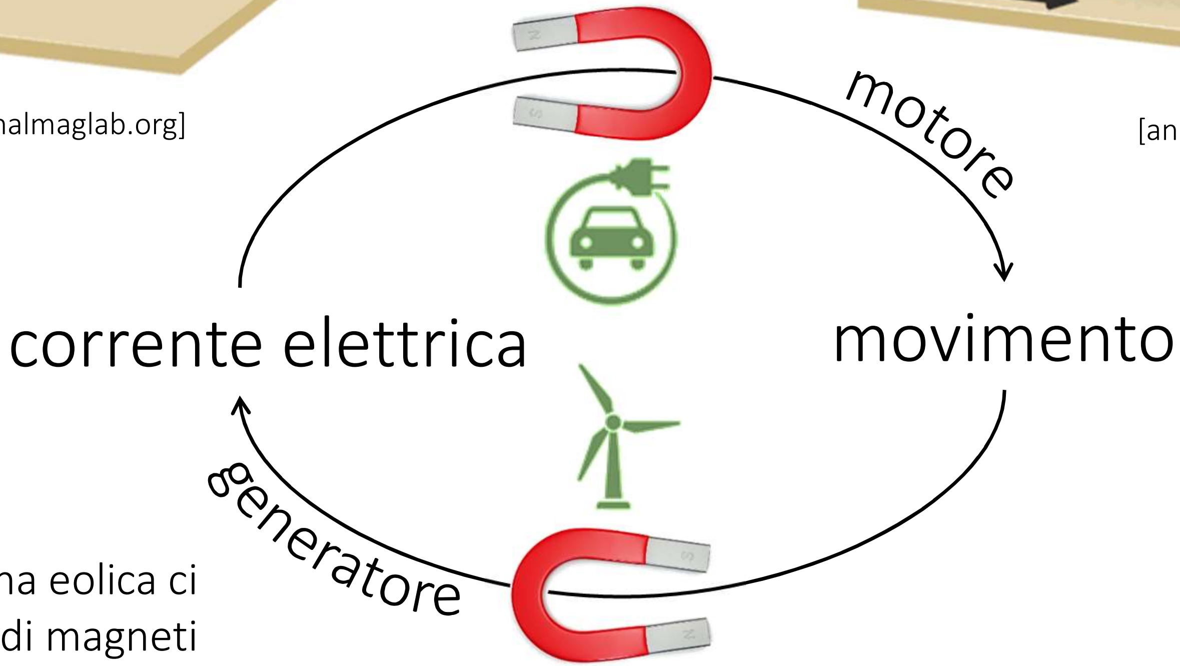




[immagine adattata da: nationalmaglab.org]



[animazione da: nationalmaglab.org]



in una turbina eolica ci
sono ~2t di magneti
NdFeB (> **500 kg** di Nd)

[figura da: www.japantimes.co.jp, © Reuters]

miniera di *Bayan Obo*,
Cina (Mongolia interna)

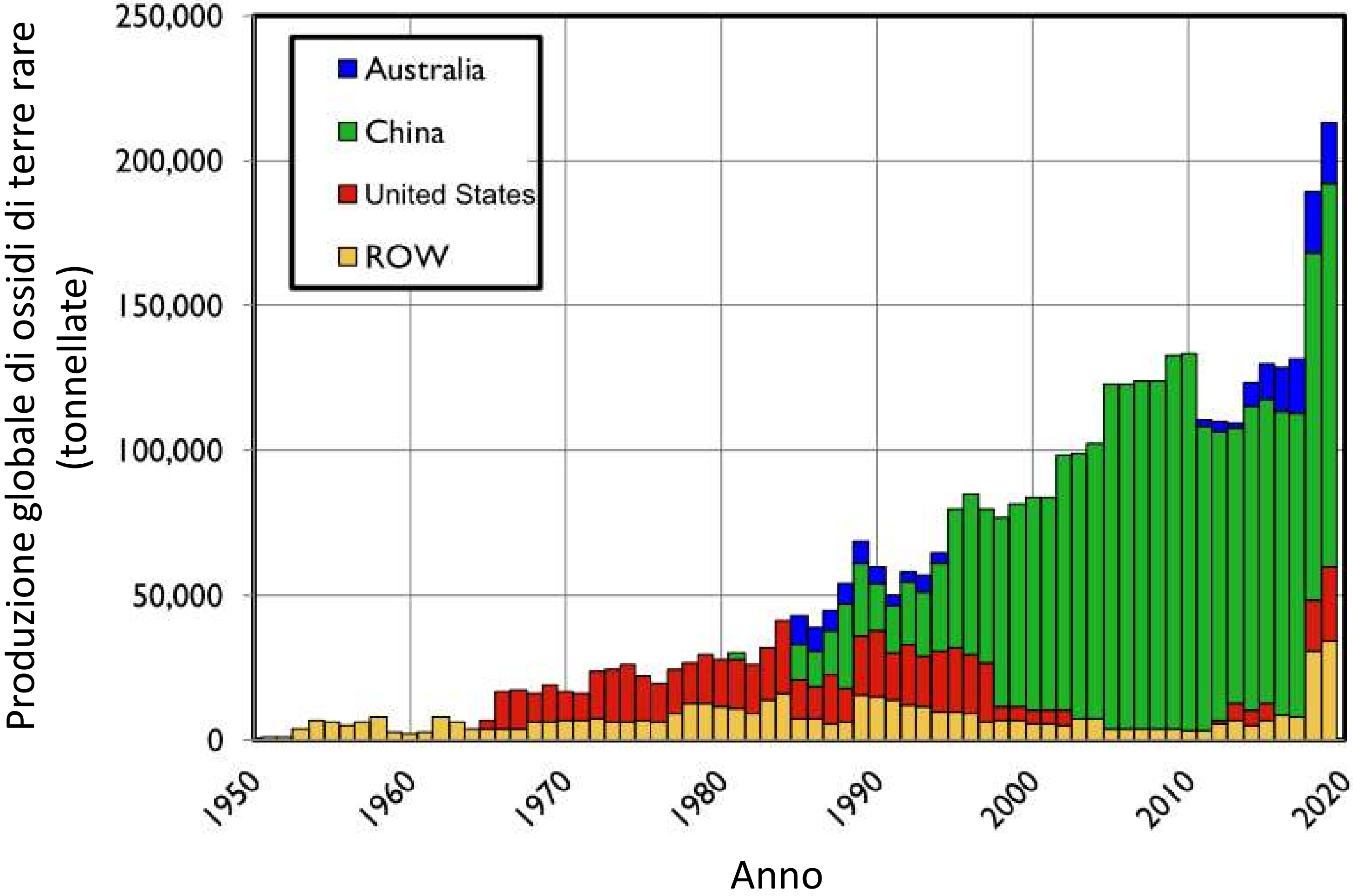
90 **Th** THORIUM 232.0377

92 **U** URANIUM 238.02

[figura da: https://www.bbc.com/future/article/20150402-the-worst-place-on-earth]

bacino di stoccaggio a *Baotou*, Cina (Mongolia interna)

[figura da: A. King, Critical Materials, © Elsevier 2021]



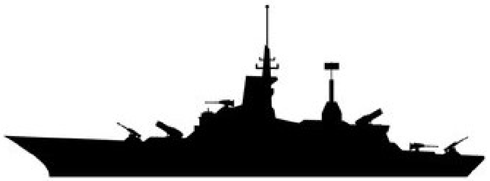
Terre rare e sicurezza nazionale USA

"Rare earth permanent magnets are not only essential components in a range of defense capabilities, including the **F-35 Lightning II** aircraft, Virginia and Columbia class **submarines** and **unmanned aerial vehicles** […].

Magnets produced from rare earth elements are used in systems such as **Tomahawk missiles**, a variety of **radar systems, Predator unmanned aerial vehicles**, and the Joint Direct Attack Munition series of **smart bombs**. The F-35, for instance, requires more than 900 pounds of rare earth elements. Each Arleigh Burke DDG-51 destroyer requires 5,200 pounds, and a Virginia class submarine needs 9,200 pounds. "

(Source: US Dept. of Defense website, 2024)

400 kg REE

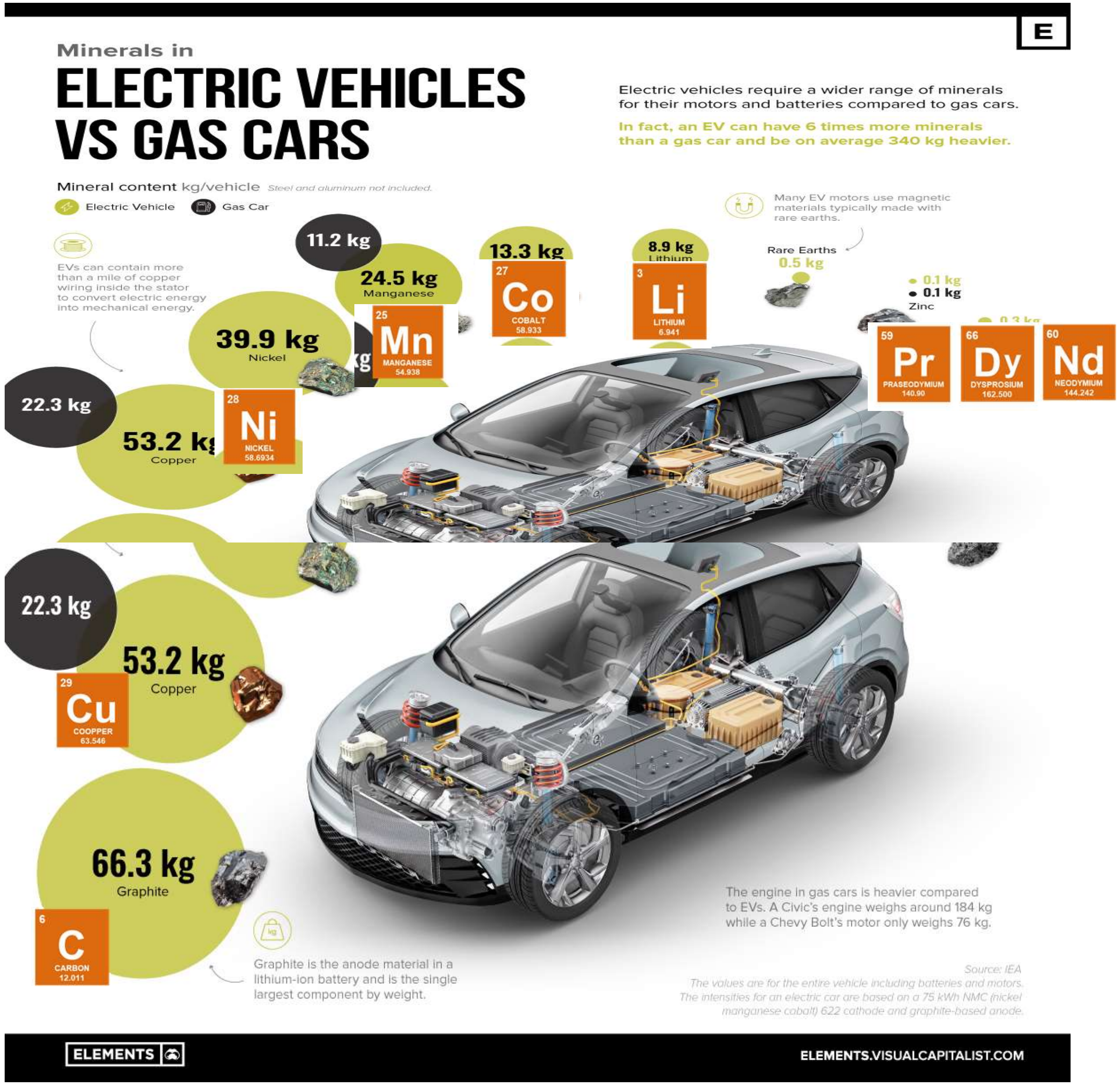


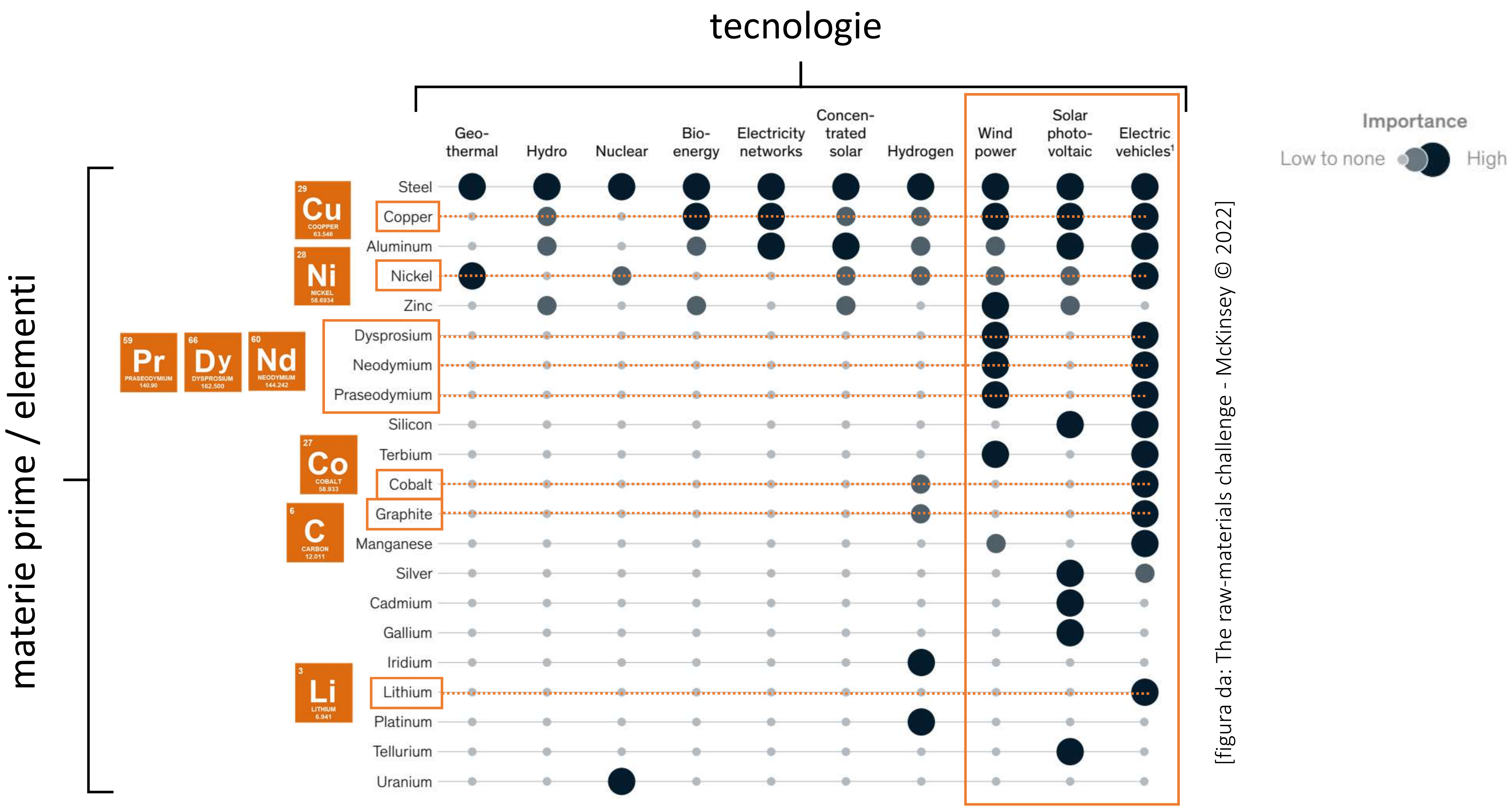
2.300 kg REE

4.100 kg REE

...non solo
Terre rare...

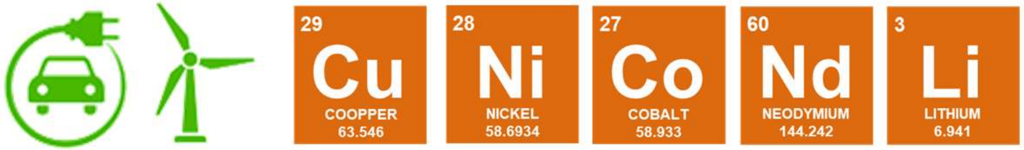
[da: elements.visualcapitalist.com/evs-vs-gas-vehicles-what-are-cars-made-out-of/]



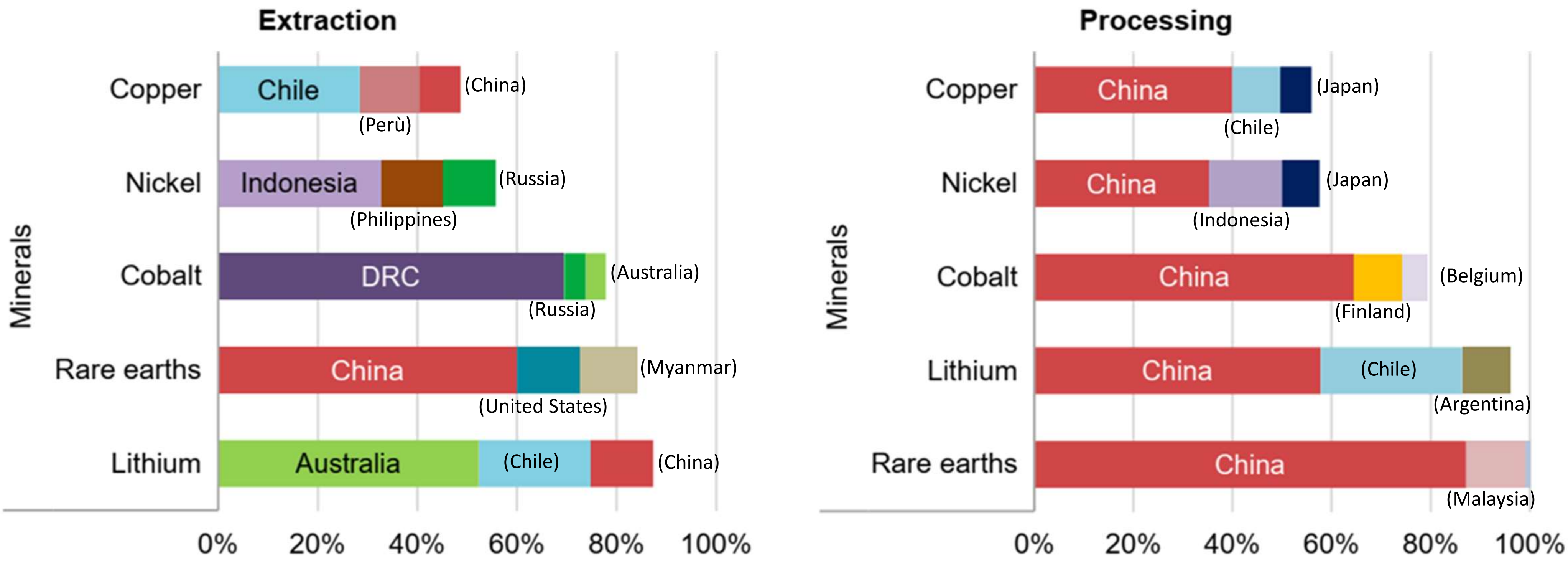


[figura da: The raw-materials challenge - McKinsey © 2022]

¹Includes energy storage.
Source: *Critical raw materials for strategic technologies and sectors in the EU*, A foresight study, European Commission, Mar 9, 2020; *The role of critical minerals in clean energy transitions*, IEA, May 2021; McKinsey analysis



quote dei **primi tre paesi produttori** di alcune materie prime, 2019



[fonte: IEA 2021, dati: IEA (2020a); USGS (2021), World Bureau of Metal Statistics (2020); Adamas Intelligence (2020)]

[figura adattata da: The role of critical minerals in clean energy transitions, © IEA 2021]

Materie prime critiche e Unione Europea

Discorso di Ursula von der Leyen all' EU Industry Days 2021 (**23 Feb 2021**)

"Green and digital technologies currently depend on a number of **scarce raw materials**"

" 98% of the **rare earth elements** we need come from a single supplier: China.
This is not sustainable."

Rischi geopolitici legati alle materie prime critiche

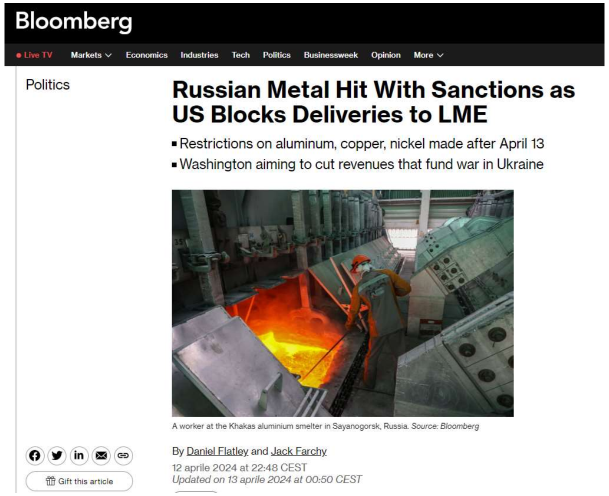
FIGURE S4 Key geopolitical risks to the supply of materials

1	**External shocks**	Natural disasters, pandemics, wars, mine accidents, etc.
2	**Resource nationalism**	Tax disputes, expropriation, foreign investment screening, etc.
3	**Export restrictions**	Export quotas, export taxes, obligatory minimum export prices, licensing, etc.
4	**Mineral cartels**	Co-ordination of production, pricing, market allocation, etc.
5	**Political instability and social unrest**	Labour strikes, violence, corruption, etc.
6	**Market manipulation**	Short squeezing, market cornering, spoofing, insider trading, etc.

[IRENA (2023), *Geopolitics of the energy transition: Critical materials*]

Invasione dell’ Ucraina

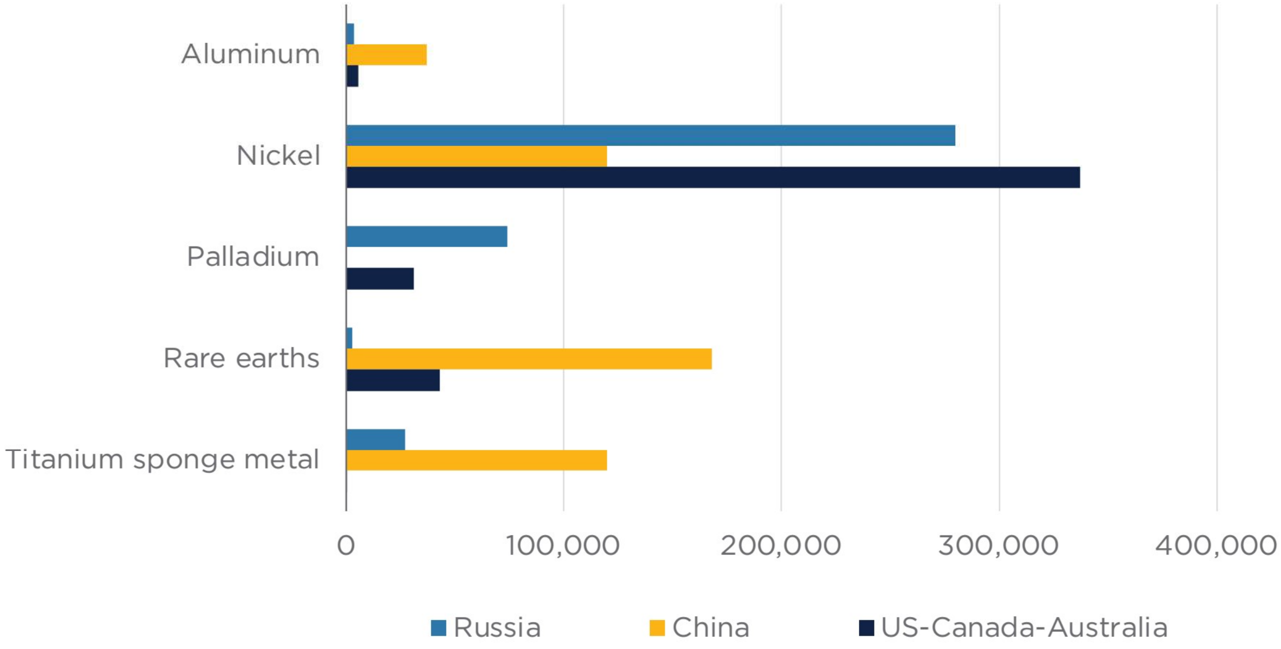
1 External shocks


Bloomberg
● Live TV Markets Economics Industries Tech Politics Businessweek Opinion More
Politics
Russian Metal Hit With Sanctions as US Blocks Deliveries to LME
- Restrictions on aluminum, copper, nickel made after April 13
- Washington aiming to cut revenues that fund war in Ukraine

A worker at the Khakas aluminium smelter in Sayanogorsk, Russia. Source: Bloomberg
By Daniel Flatley and Jack Farchy
12 aprile 2024 at 22:48 CEST
Updated on 13 aprile 2024 at 00:50 CEST
Gift this article

[Bloomberg, 12th April 2024]

Figure 1: Critical minerals in Russia, China, and combined US-Canada-Australia, 2021 annual production (1,000 tons)



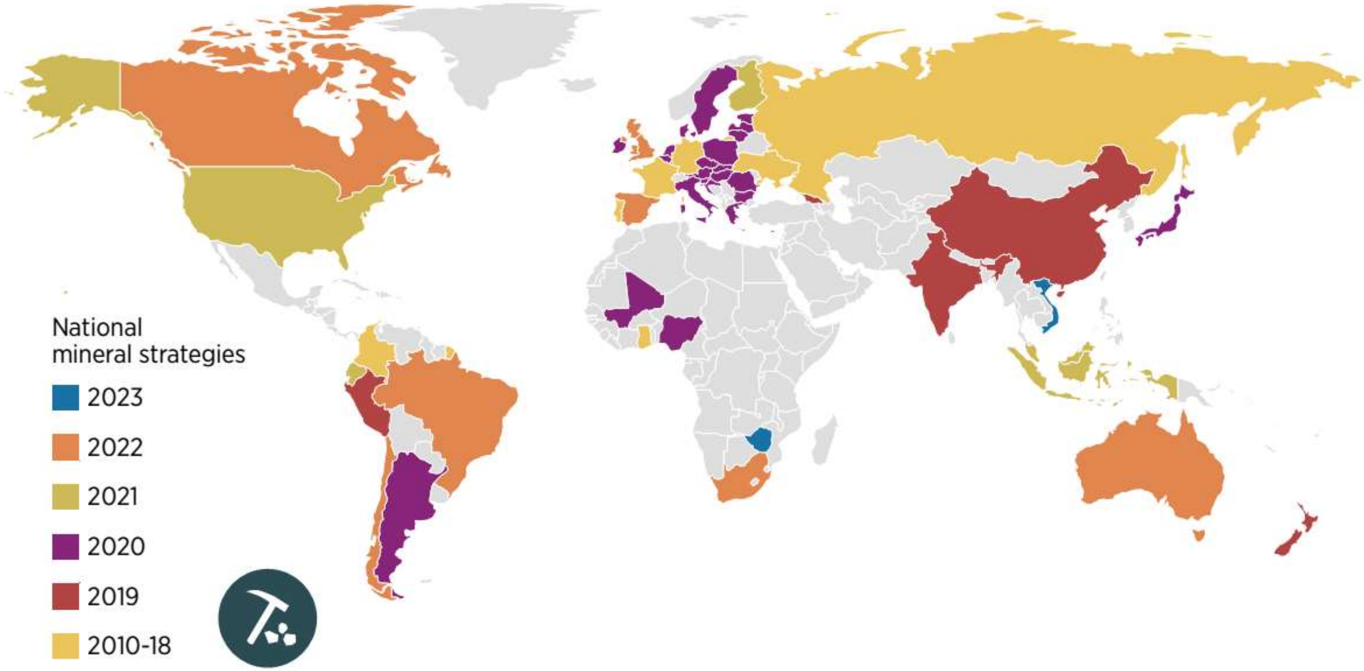
Source: Natural Resources Canada and US Geological Survey.

[Columbia Univ. (2022), SUPPLY OF CRITICAL MINERALS AMID THE RUSSIA-UKRAINE WAR AND POSSIBLE SANCTIONS]

	Overlapping		
	US	EU	China
Aluminium/bauxite	●	●	●
Antimony	●	●	●
Cobalt	●	●	●
Fluorspar	●	●	●
Graphite/natural graphite	●	●	●
Lithium	●	●	●
Nickel	●	●	●
Rare earth metals	●	●	●
Tungsten	●	●	●
Arsenic	●	●	
Baryte	●	●	
Beryllium	●	●	
Bismuth	●	●	
Germanium	●	●	
Hafnium	●	●	
Magnesium	●	●	
Manganese	●	●	
Niobium	●	●	
Platinum group metals	●	●	
Tantalum	●	●	
Titanium	●	●	
Vanadium	●	●	
Tin	●		●
Zirconium	●		●
Copper		●	●
Phosphorus		●	●

2 Resource nationalism

FIGURE 4.1 Countries that have adopted national mineral strategies, 2010-2023



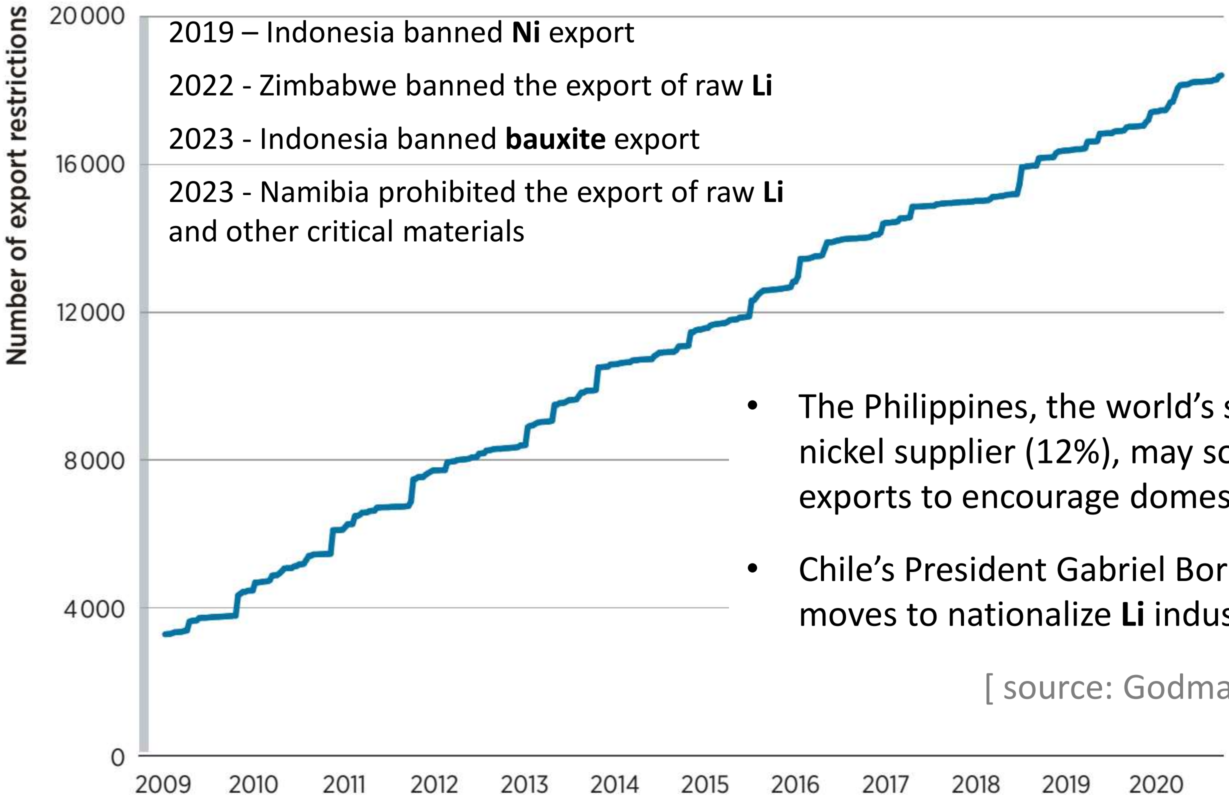
Note: The map shows national critical material strategies, visions and policy documents. Mining codes or specific regulations were not retained.

Disclaimer: This map is provided for illustration purposes only. Boundaries and names shown on this map do not imply any endorsement or acceptance by IRENA.

[IRENA (2023), *Geopolitics of the energy transition: Critical materials*]

3 Export restrictions

FIGURE 2.11 Global incidence of export restrictions on raw materials, 2009-2020



2019 – Indonesia banned **Ni** export

2022 - Zimbabwe banned the export of raw **Li**

2023 - Indonesia banned **bauxite** export

2023 - Namibia prohibited the export of raw **Li** and other critical materials

- The Philippines, the world's second-biggest nickel supplier (12%), may soon tax **Ni** exports to encourage domestic industry
- Chile's President Gabriel Boric has made moves to nationalize **Li** industry

[source: Godman-Sachs, 2023]

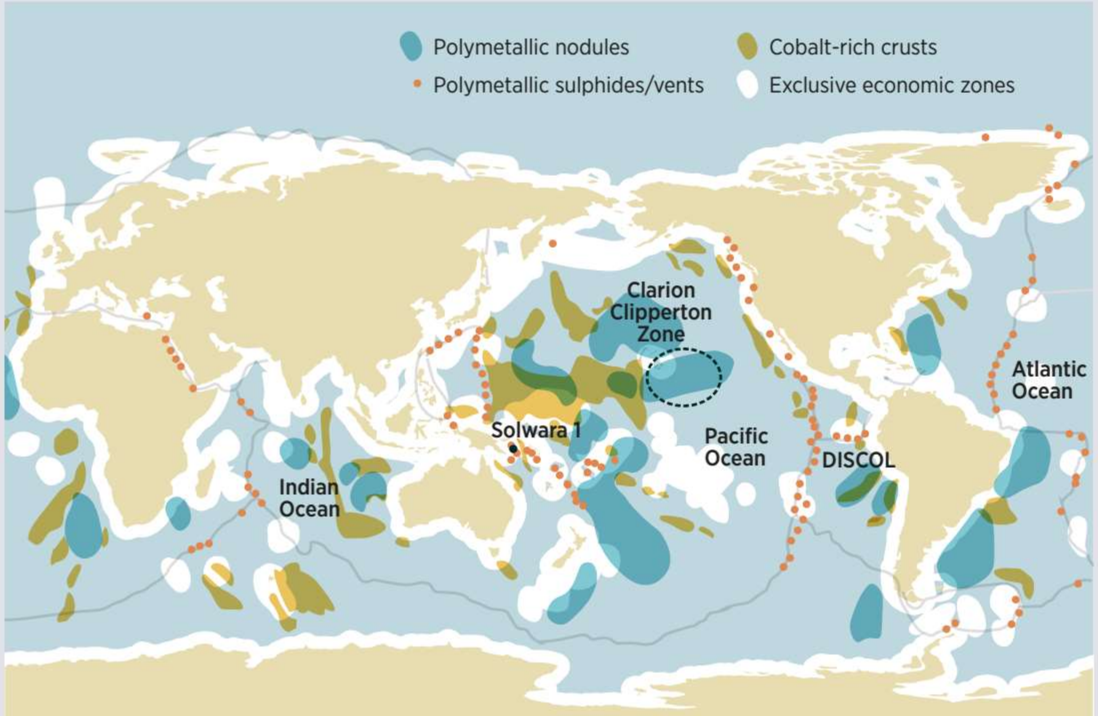
Sources: (Kowalski and Legendre, 2023; OECD Inventory of Export Restrictions on Industrial Raw Materials, 2022).

Notes: The y-axis shows the number of export restrictions in force. The database covers information on 65 industrial raw materials and 80 exporting countries, which accounted for 97% of the world's mineral and metal production in 2018. The methodological note available at www.oecd.org/trade/topics/trade-in-raw-materials/documents/methodological-note-inventory-export-restrictions-industrial-raw-materials.pdf.

[IRENA (2023), *Geopolitics of the energy transition: Critical materials*]

Competition over World’s resources

FIGURE 2.15 Geographical distribution of the three types of mineral deposits targeted by deep-sea mining



Source: (Miller *et al.*, 2018).

Disclaimer: This map is provided for illustration purposes only. Boundaries and names shown on this map do not imply any endorsement or acceptance by IRENA.

[IRENA (2023), *Geopolitics of the energy transition: Critical materials*]

Environmental (and social) impact

TABLE 3.1 Selected social, environmental and governance risks associated with critical materials

Risk Areas		Description	Solutions
Social	**Indigenous communities**	Mining has been associated with land loss, displacement and human rights abuses against indigenous communities.	Facilitate robust and proactive community engagement throughout the entire project cycle
	Labour conditions	Poor labour conditions have been persistent in the global mining industry, which lacks adequate social protection and labour laws.	Implement stringent safety regulations and ensure fair wages and social protection for workers
	Artisanal and small-scale mining (ASM)	ASM has been linked to hazardous conditions, child labour, low wages and a lack of social protection.	Improve ASM oversight, engage in dialogue with ASM communities and offer alternative livelihood opportunities
Environmental	**Climate change**	The metals and mining sector is responsible for 10% of the global greenhouse gas emissions.	Increase energy efficiency investments, shift to cleaner fuels and renewables, and foster circularity and recycling
	Biodiversity	Mining activities can harm biodiversity through deforestation, habitat loss and soil erosion.	Integrate biodiversity considerations into mining practices through sustainable planning and resource management
	Waste and pollution	Mining waste can pose hazards for local environments and communities if not managed properly.	Adopt stringent waste reduction, management, and reclamation and rehabilitation programmes
	Water stress	Mining and processing have significant water requirements and pose contamination risks.	Encourage water saving, reuse and desalination, and responsible water discharge

[IRENA (2023), *Geopolitics of the energy transition: Critical materials*]

1. Environmental impacts
   - GHG emissions
   - Biodiversity loss
   - Water stress
   - Waste and pollution
   - Deforestation / soil erosion

2. Social impacts
   - Artisanal mining (child labour)
   - Forced labour
   - Labour conditions
   - Indigenous communities / displacement

"THIS IS WHAT WE DIE FOR"

HUMAN RIGHTS ABUSES IN THE DEMOCRATIC REPUBLIC
OF THE CONGO POWER THE GLOBAL TRADE IN COBALT

[2016]

AFREWATCH

AMNESTY INTERNATIONAL

[2021]

IN BROAD DAYLIGHT

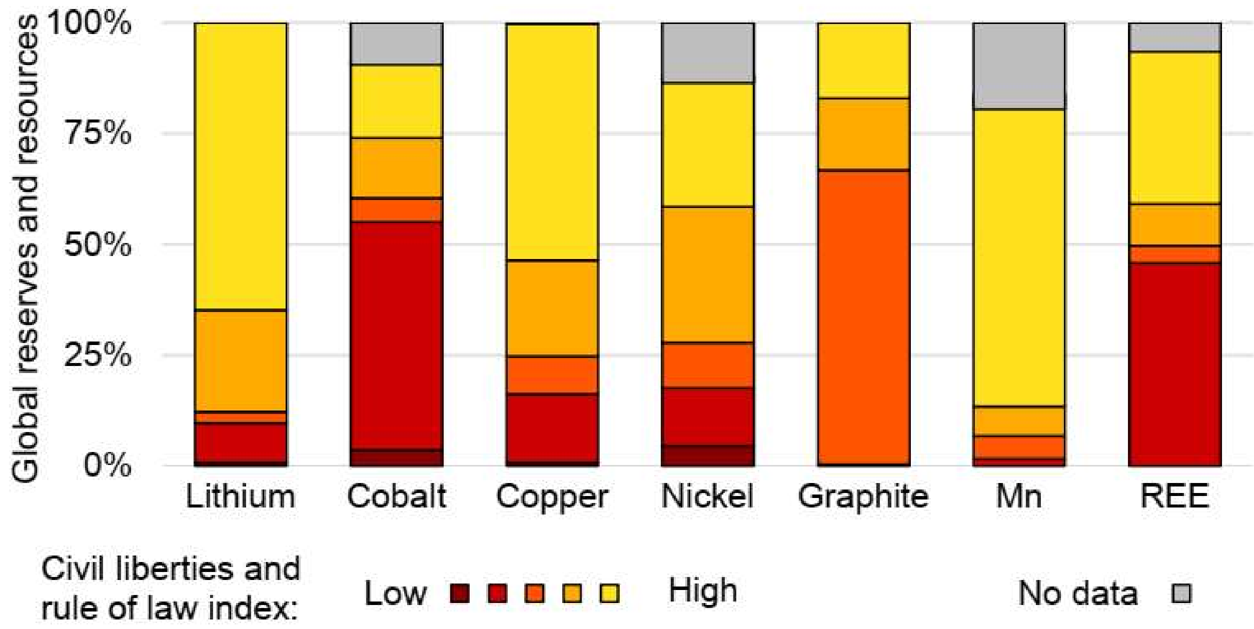
Uyghur Forced Labour and Global Solar Supply Chains

LAURA T. MURPHY & NYROLA ELIMÄ

Sheffield Hallam University | Helena Kennedy Centre for International Justice

Social impact

Civil liberties and rule of law index for global critical mineral reserves and resources

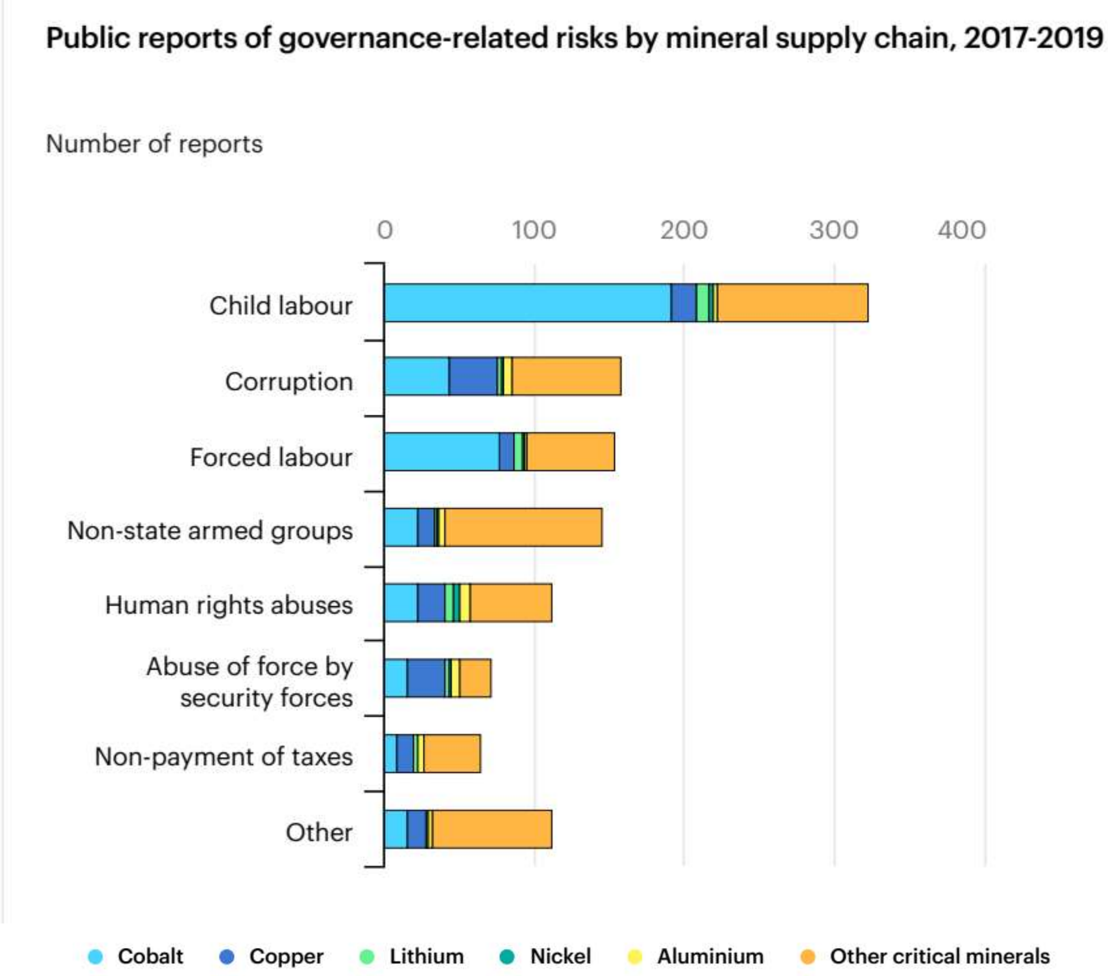


Notes: Mn = manganese; REE = rare earth elements. Data are from the V-Dem Dataset, and averages their civil liberties index, physical violence index, political civil liberties index, private civil liberties index, rule of law index, and access to justice index.

Sources: IEA analysis based on V-Dem data and Owen, Lebre & Kemp (2022), Energy Transition Minerals (ETMs): A Global Dataset of Projects.

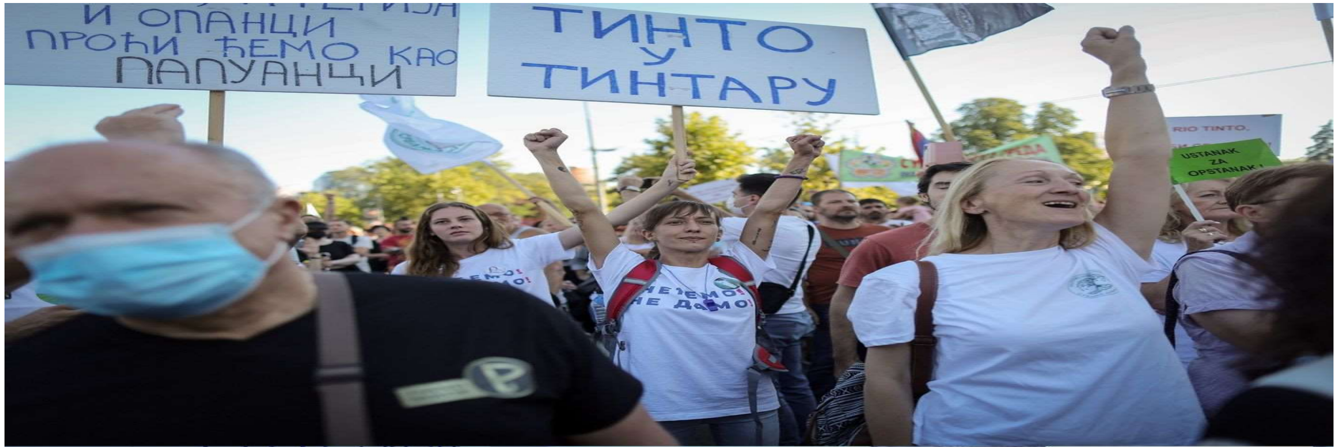
[IEA, 2023, Sustainable and responsible critical mineral supply chain]

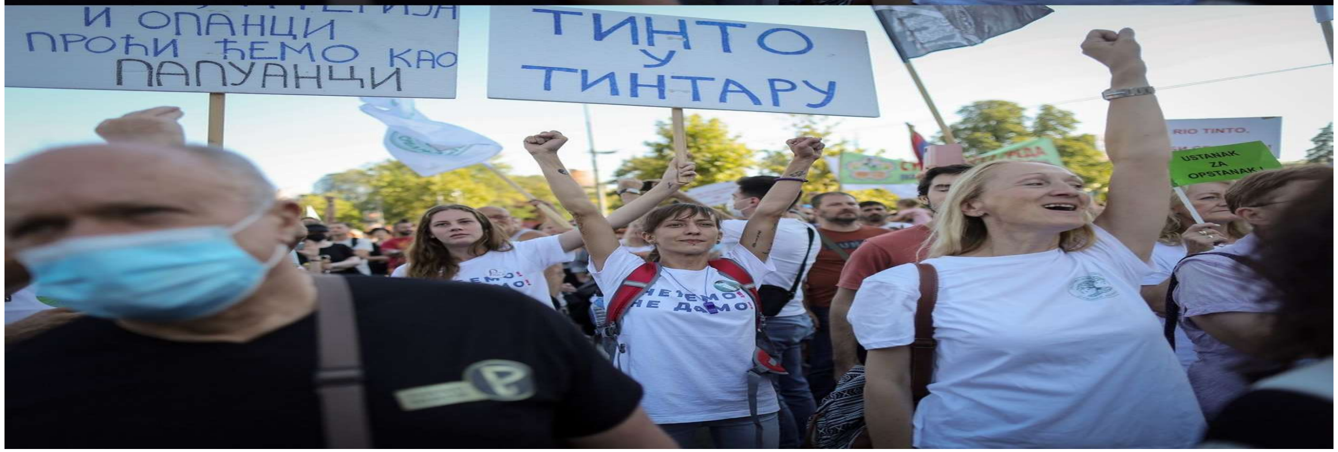
Social impact



[https://www.iea.org/commentaries/why-is-esg-so-important-to-critical-mineral-supplies-and-what-can-we-do-about-it]

Not In My Backyard (NIMBY)





[Belgrado 2021, proteste contro apertura miniera di litio – fonte: bloomberg.com – © Oliver Bunic/Bloomberg]

Critical Raw Materials Act (March 2023)

SETTING PRIORITIES

List of Critical Raw Materials

It identifies raw materials which are important for the whole European economy and face a high risk of supply disruption

List of **Strategic Raw Materials**

It identifies a list of raw materials characterised by high strategic importance and projected global supply/demand imbalances

SETTING 2030 BENCHMARKS FOR STRATEGIC RAW MATERIALS

EU EXTRACTION

At least **10%** of the EU's annual consumption for extraction

EU PROCESSING

At least **40%** of the EU's annual consumption for processing

EU RECYCLING

At least **15%** of the EU's annual consumption for recycling

EXTERNAL SOURCES

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

[from: critical raw materials act factsheet, https://ec.europa.eu/commission/presscorner/detail/en/fs_23_1663]

Critical Raw Materials Act (March 2023)

[from: critical raw materials act factsheet, https://ec.europa.eu/commission/presscorner/detail/en/fs_23_1663]

Bibliografia Minima

approfondimenti (relazioni tecniche)

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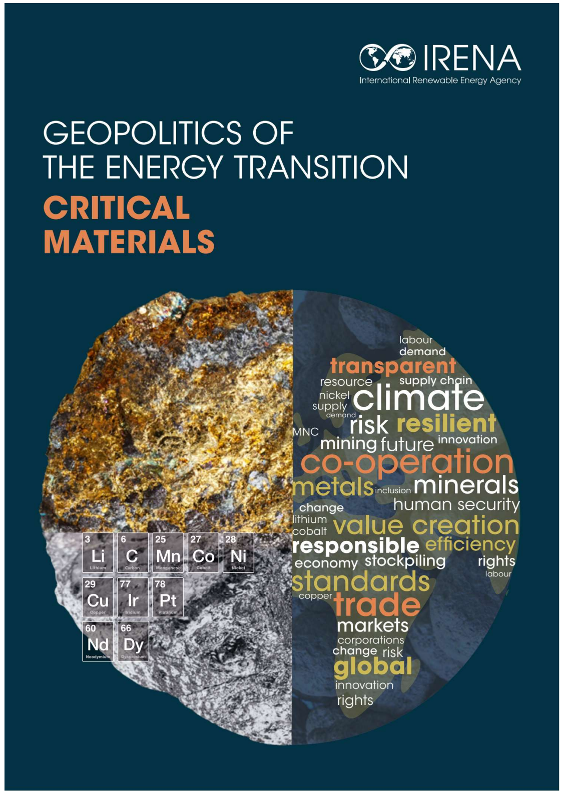

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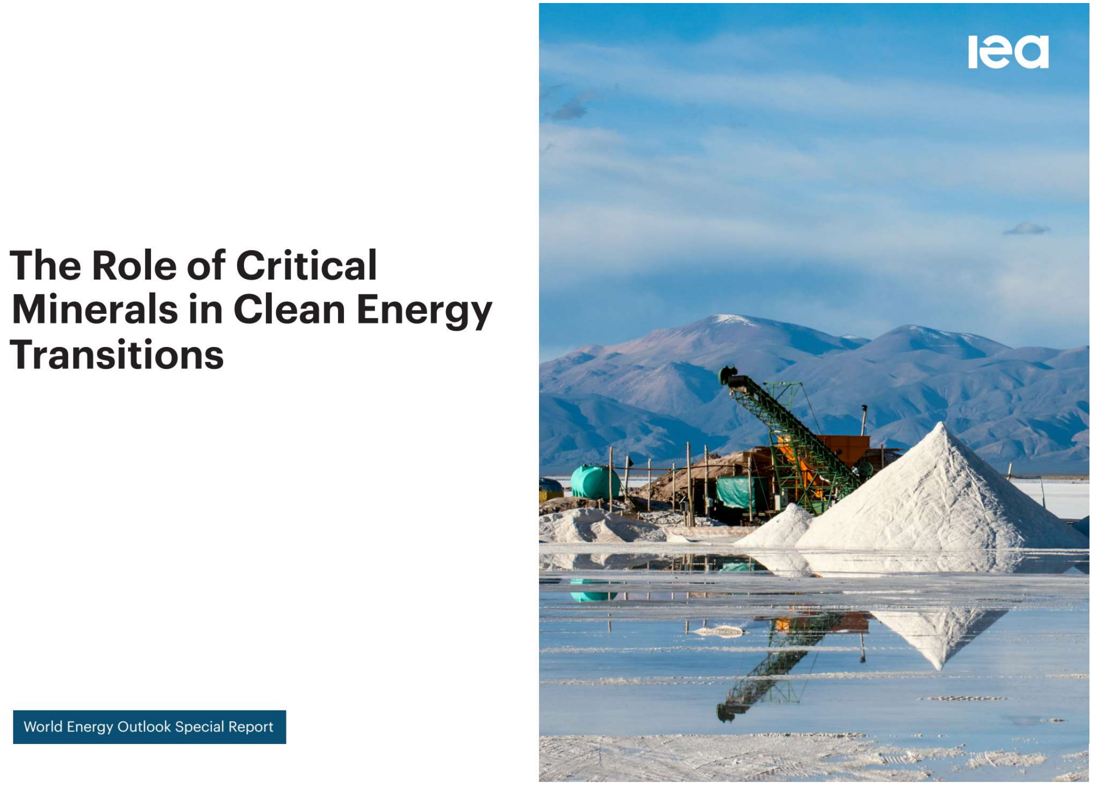
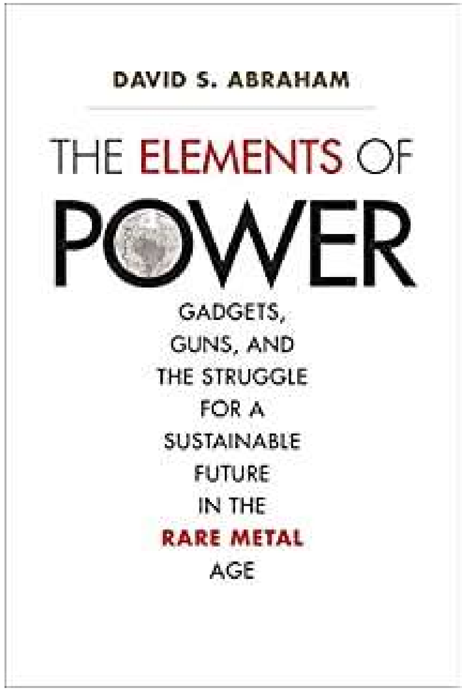
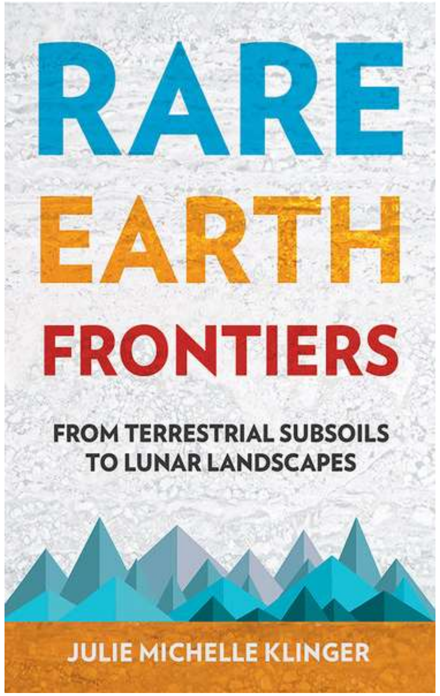


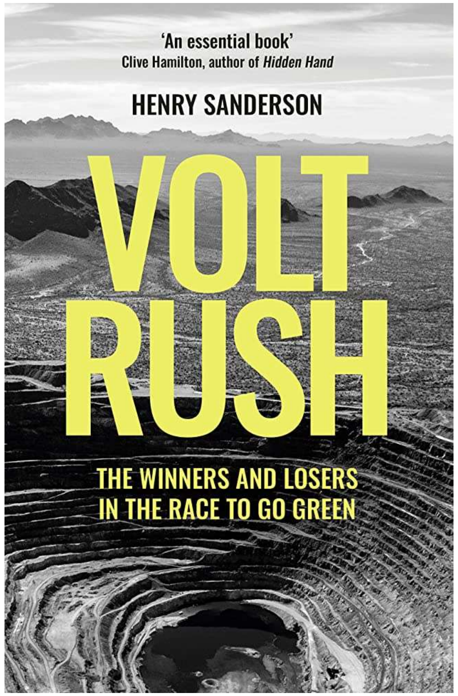
non-fiction



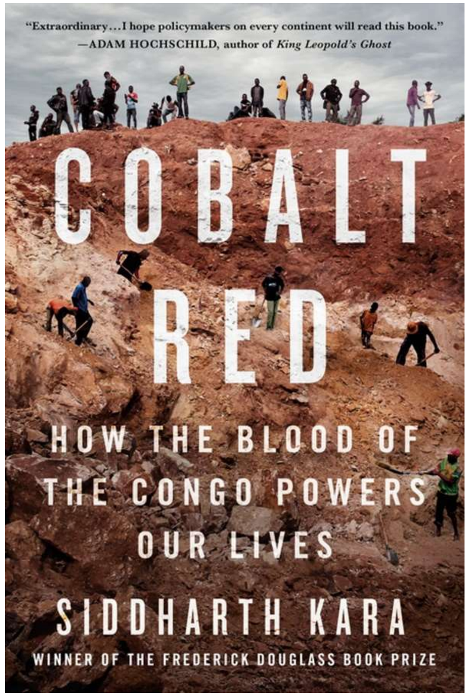
[2015]



[2017]



[2023]



[2023]