Securing Critical Raw Materials for the Green Transition

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International energy transition, no 'one size fits all'; various speed of change

Energy transitions are unpredictable and take time

Wind and solar energy are growing rapidly. Yet the world's reliance on fossil fuels isn't changing any time soon

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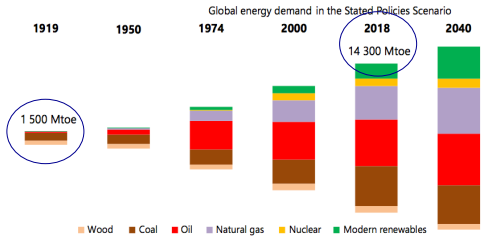
IEA WEO 2019

Perspectives from energy history



- The last century has witnessed *multiple transitions* to and from different fuels and technologies
- The challenge today is one of scale: global energy use is *ten times* higher than in 1919 …. and growing

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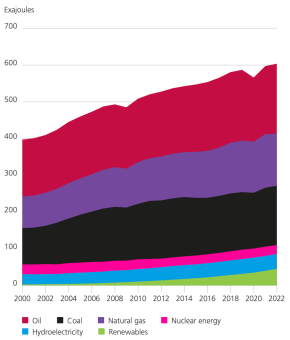
Energy Institute, June 2023

Statistical Review of World Energy

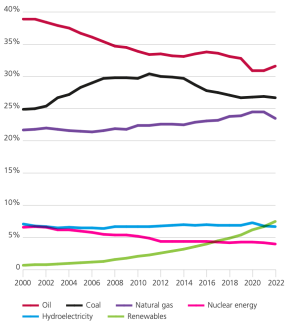
2022

- global primary *energy consumption* grew by around 1%
- the *dominance of fossil fuels* was largely unchanged at almost 82% of total consumption

World consumption



Share of global primary energy



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2022 power play

The new age of energy and security

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If…. 2022 were an earthquake for the global energy system, *Europe was the epicenter*

https://www.energypolicy.columbia.edu/europes-energy-security-challenge/

- Russia's invasion of Ukraine sent energy prices skyrocketing
- Consumers across the continent struggled to pay their bills
- European governments spent more than €800 billion shielding consumers from these high prices
- 2023 prices lower, but Europe's energy system remains precarious

EU is a resource-poor geography (also facing deindustrialization): **we are not yet out of the woods!**

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Geopolitics

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Geopolitics is Centre Stage again!

End of 30 years period after the Iron Curtain Collapse:

- end of a time of open markets and globalisation
- back to a more divided world
- Western world slammed the door on Russia
- WTO consensus world is over now in an era of great power competition/ strategic collaboratory

Start of a world of fragmentation/geopolitical blocks

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New energy order

European energy markets are looking for a new normal

- *diversification of energy sources*
- *acceleration of renewable energy sources*
- *concerns about energy security*

Reality: current energy order is still heavily dependent on hydrocarbons *(oil, gas, coal)*

Energy security remains at the heart of energy policy but is coming at a cost and can derail other objectives

Transition to a new energy order will not be smooth and orderly as frictions between the major players on the world stage increase (US - China, Russia - West, slowing down globalisation)

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Ambitions for the coming decades

2050:

Climate neutral

Strategic autonomy

Global competitiveness

2049: "Chinese dream" - Industrial and technological leadership

2060: Climate neutral

Surge in demand for critical raw materials

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What are Critical Raw Materials?

Concept of critical raw materials (CRM) was introduced by the EU

Popularized with the first CRM list in 2011

CRM are economically and strategically important minerals for the European economy, but have a high risk associated with their supply

due to high import dependence and lack of substitutes

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What are Critical Raw Materials?

The EU defines 30 minerals as critical

2020 critical raw materials (new as compared to 2017 in bold)		
Antimony	Hafnium	Phosphorus
Baryte	Heavy Rare Earth Elements	Scandium
Beryllium	Light Rare Earth Elements	Silicon metal
Bismuth	Indium	Tantalum
Borate	Magnesium	Tungsten
Cobalt	Natural graphite	Vanadium
Coking coal	Natural rubber	**Bauxite**
Fluorspar	Niobium	**Lithium**
Gallium	Platinum Group Metals	**Titanium**
Germanium	Phosphate rock	**Strontium**

Source: European Commission, 2020.

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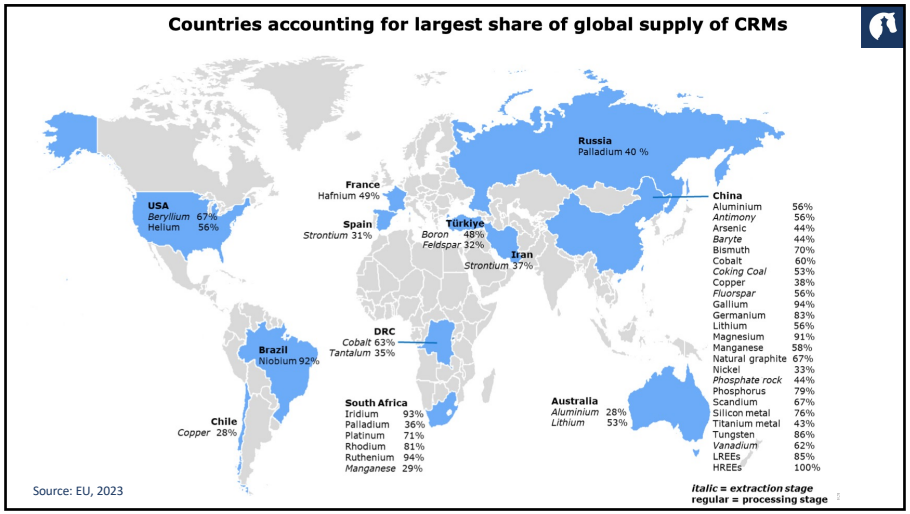

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CRM in energy and digital sectors

Rare Earth Elements
(85-100% China)

Gallium (94% China)
Germanium (83% China)
Silicon metal (76% China)

Lithium (56% China)
Cobalt (63% extracted in Congo, 60% processed in China)
Natural graphite (67% China)

Cobalt (63% extracted in Congo, 60% processed in China)
Gallium (83% China)
Germanium (83% China)
Silicon metal (76% China)

In brackets major global producers

Transmission grid: Copper, Aluminum

Geothermal energy: Steel, Titanium

CCS: Cobalt, Niobium, Vanadium

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IEA, 2020

Risks and Vulnerabilities

Security of minerals supply for a clean energy future

- Lithium, cobalt and nickel give batteries greater charging performance and higher energy density
- Copper is essential for the increasing use of electricity throughout energy systems thanks to its unmatched ability to conduct electric currents
- Rare earth elements such as neodymium make powerful magnets that are vital for wind turbines and electric vehicles

- highly complex global supply chains
- production subject to a high degree of monopoly

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IRA: a new industrial strategy

US Inflation Reduction Act (IRA):

An unprecedented government commitment to energy transition

IRA passed in August 2022

- It followed the Bipartisan Infrastructure Law (BIL) and the CHIPS & Science Act to become the third legislative piece of a *new industrial strategy* that emerged in less than 12 months
- It focuses on building domestic capacity in the applications and industries that will advance the energy transition
- It will give the United States a long-lasting competitive advantage
- It catalyzes investment through roughly $500 billion in tax credits

Post IRA:
- increased reliance on imports for nickel, lithium, cobalt and copper
- difficult to secure production and/or extraction in the USA or FTA countries without sourcing from a *"foreign entity of concern"*
- a significant constraint will be China's dominant position in processing minerals

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Impact Inflation Reduction Act, S&P 08 2023

IRA: Operational Challenges

Permitting as a central concern

- at least 50% of battery components of electric vehicles must be finally assembled in North America (100% by 2029)
- "reshoring" supply chains, including mining and processing minerals
- reshoring = operational challenges: lengthy, multi-authority permitting processes, post-permit litigation risks, social license to operate, and political and environmental challenges to mining

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Proposal EU Commission
16 March 2023

EU Net Zero Industry Act

EU's own green industry plan in global subsidy race

A response to fears that EU's industry will lose out to the US and China, which benefit from generous subsidies and government programmes

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EU ambitions

EU Critical Raw Materials Act by 2030

- 10% extraction
- 40% processing
- 15% recycling
- max 65% dependent

EU Net Zero Industry Act by 2030

The EU's industrial capacity should meet

- 40% of its annual demand for solar panels
- 85% of wind tech
- 60% of heat pumps
- 85% of batteries
- 50% of electrolyzers

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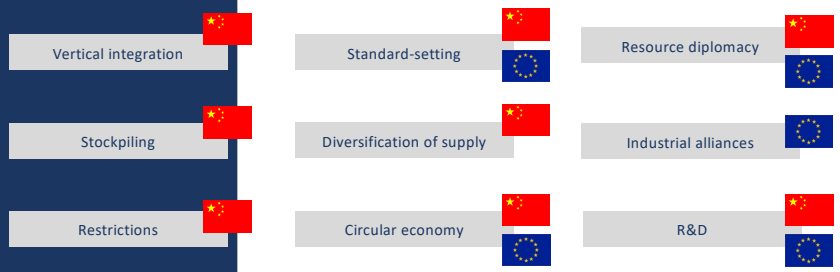
Strategies

Technical and political approaches employed by countries / companies in order to secure supply of materials



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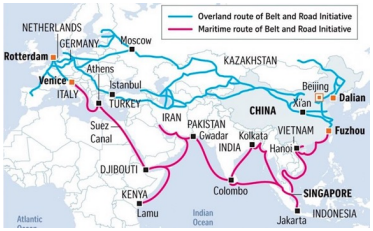
Vertical integration

- Strategy applied by China in many sectors, including rare earth elements and lithium companies
- The entire Chinese REE industry is dominated by the six integrated enterprises
- The Belt and Road Initiative (BRI) is the most significant integration of international logistical networks
- China holds a near-monopolistic position in several stages of supply chains



Source: Indo-Pacific News, 2020

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4 july 2023

The tech battle with the US and EU heats up!

China curbs export of metals critical to chips and other tech

- Germanium and gallium are key to manufacture electronics and semiconductors
- China produces 60% of world's germanium and 80% of gallium
- China and the US locked in a technological trade war

Germanium, a silvery-white metal, is formed as by-product of zinc production. Fellow soft, silvery metal Gallium, meanwhile, is a by-product of processing bauxite and zinc ores.

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An age of strategic rivalry

A new geopolitical landscape

- Power politics in countries with *critical minerals* will emerge
- The development of the new geopolitical landscape is uncertain
- The speed and success of the energy transition therefore relies on
  1. policy choices
  2. international relations
  3. technological breakthroughs
  4. infrastructure development

➢ Becoming part of the solution will require *collaboration and cooperation* between industries to establish a unified position
➢ Incremental change in both *infrastructure and market development* is required simultaneously

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Key take-aways

1. Develop a long-term national strategy
2. Support technical expertise
3. Encourage European and national alliances
4. Goal is not to remove dependencies on other countries, but increase resilience within critical sectors

December 2022:

NL Raw Materials Strategy *(Grondstoffenstrategie)* to expand the competitive advantages of its industries in order to secure supply of minerals

Focus on
- circular economy
- European mining and processing
- diversification
- sustainable supply chains
- knowledge building and monitoring

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