KAREN HANGHØJ, BRITISH GEOLOGICAL SURVEY, BGS

Mineral Criticality – why critical minerals are different and why they are not

British Geological Survey

The Minerals Planning Conference

Mineral Planning at a Crossroads, London June 15 2023

Windturbine
Iron
Copper
Aluminum
Zinc
Graphite
Rare Earth

Structures
Bricks (clay)
Concrete (sand,gravel, cement)
Iron
Painting (limestone, titanium)
Electricity (copper, iron)

Airplanes
Aluminum
Iron
Magnesium
Zinc
Titanium
Copper
Rare Earth

Wires
Copper
Iron

Mast
Iron
Zinc
Aluminum
Copper
Feldspar
Quartz

Truck
Iron
Aluminum
Lead
Copper
Zinc
Magnesium
Quartz

Concrete
Cement (limestone)
Sand & gravel
Iron

Vehicles
Iron
Magnesium
Aluminum
Chrome
Nickel
Rare Earth
Lead
Zinc
Limestone
Graphite
Titanite
Quartz

Glass
Feldspar
Quartz

Electronics
Copper
Tantalum
Rare Earth
Niobium
Indium
Gold
Aluminum
Silicium
Iron

Washing mashine
Iron
Aluminum
Zinc
Copper

Plumbing
Copper
Lead
Iron
Limestone

Solar Panels
Indium
Gallium
Aluminum
Silicium

Tracks
Iron
Sand & gravel
Limestone

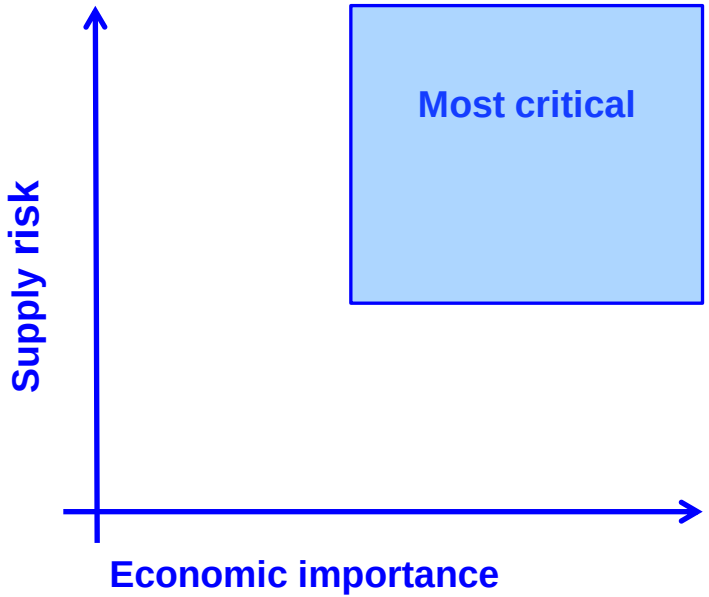
Fill
Sand & gravel
Stone

Rubber
Dolomite
Limestone
Talc
Graphite

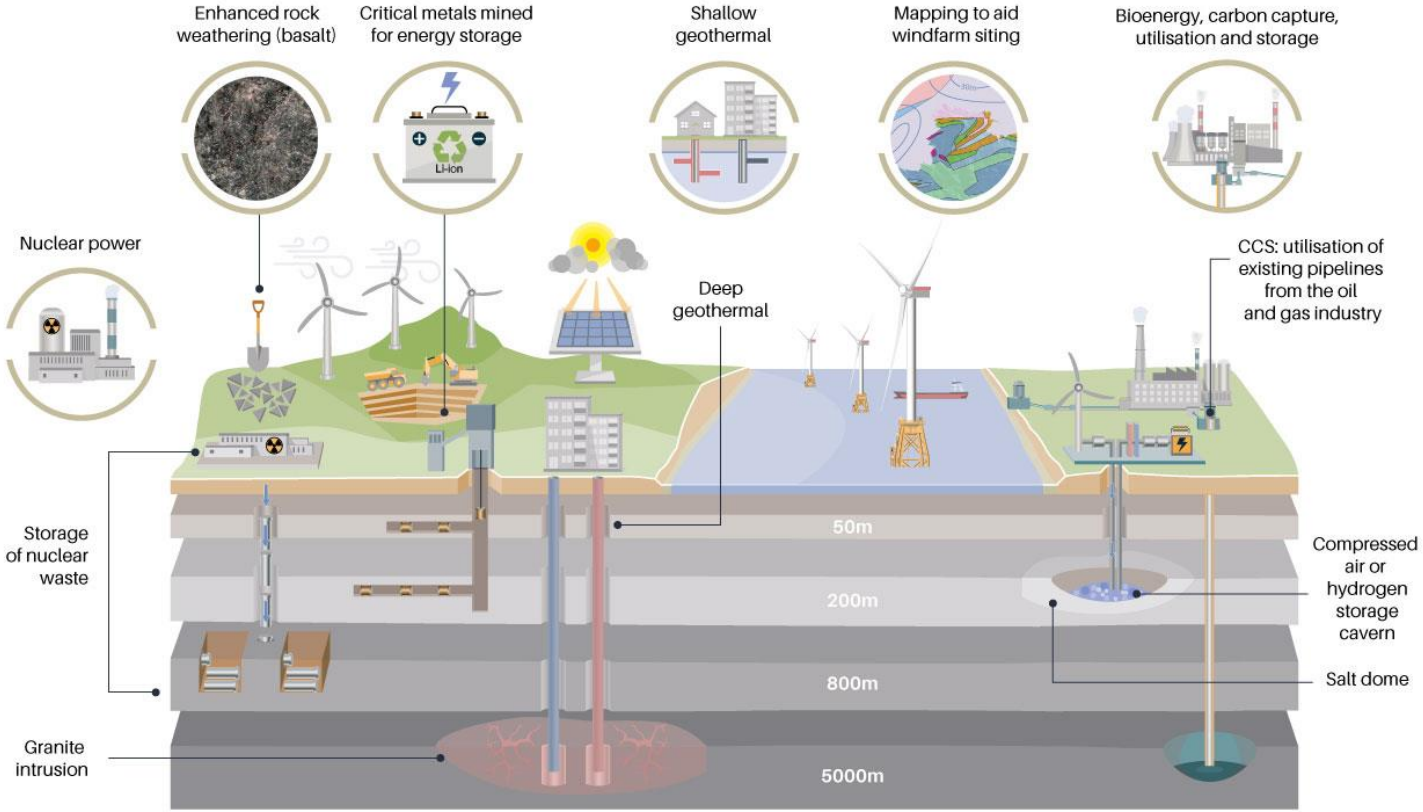
After PR Neeb, 2006

What is criticality?

- Combines consideration of economic importance with vulnerability to supply disruption
- Can also take into account environmental and/ or ethical issues
- Assessed on a bloc-/ country-/ sector-/ company-specific basis

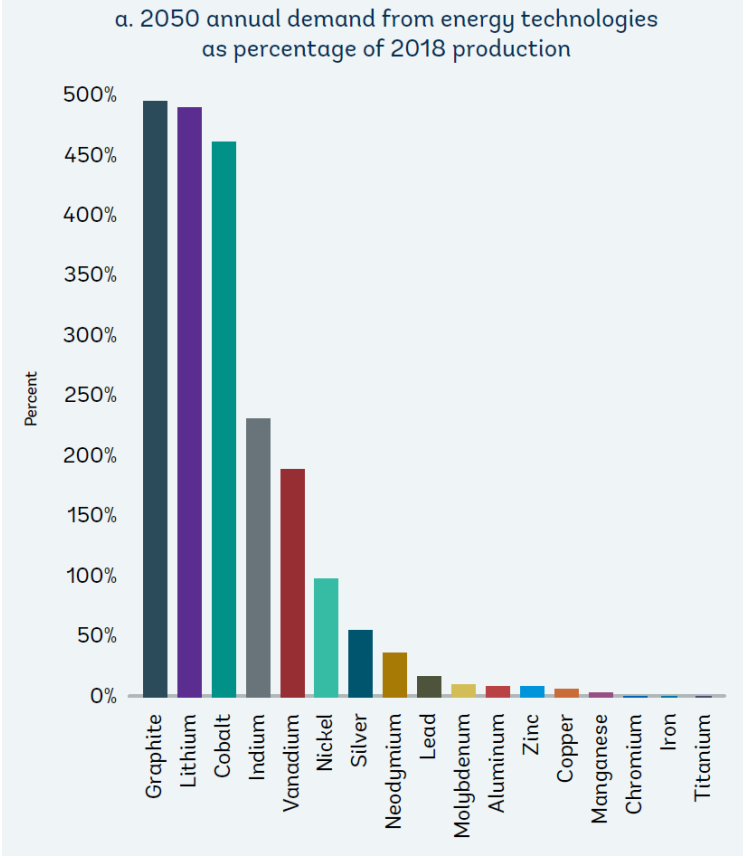


The energy transition in a nutshell



Metals and minerals in the energy transition

	Wind	Solar photovoltaic	Concentrated solar power	Hydro	Geothermal	Energy Storage	Nuclear	Coal	Gas	Carbon capture and storage
Aluminum	■	■				■	■	■	■	
Chromium	■			■	■	■	■	■	■	■
Cobalt						■		■	■	■
Copper	■	■	■	■	■	■	■	■	■	■
Graphite						■				
Indium		■					■			
Iron	■					■				
Lead	■	■		■		■	■			
Lithium						■				
Manganese	■			■	■	■		■	■	■
Molybdenum	■	■		■	■		■	■	■	■
Neodymium	■									
Nickel	■	■		■	■	■	■	■	■	■
Silver		■	■				■			
Titanium				■	■		■	■	■	
Vanadium						■	■	■		
Zinc	■	■		■		■	■			
Total	10	8	2	8	6	11	11	9	8	6



Source: World Bank 2018 Report; Minerals for Climate Action: The Mineral Intensity of the Clean Energy Transition

What are we going to do and where do we get them?

- Manage without them
- Recycling/circular economy
- Mining

Can we manage without minerals for (clean) energy?

- 940 million (13% of the world) do not have access to electricity.
- 3 billion (40% of the world) do not have access to clean fuels for cooking. This comes at a high health cost for indoor air pollution.
- Per capita electricity consumption varies more than 100-fold across the world.
- Per capita energy consumption varies more than 10-fold across the world.
- Energy access is strongly related to income: poorer households are more likely to lack access.

Source: Hannah Ritchie and Max Roser (2020) - "Energy". Published online at OurWorldInData.org. 'https://ourworldindata.org/energy'


SUSTAINABLE DEVELOPMENT GOALS
1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AN CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS
SUSTAINABLE DEVELOPMENT GOALS

Mine e-waste, not the Earth, say scientists

By Victoria Gill
Science correspondent, BBC News

2 days ago

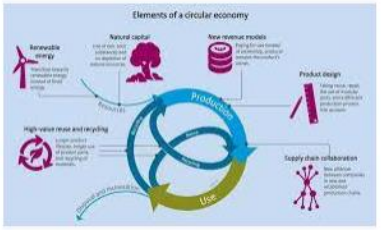
Source: . BBC News, May 2022

Recycling and closing the loop?

Profitable shift to Circular Economy ...
iceclog.com

The circular economy concept, explained
innovationnewsnetwork.com

The Circular Economy In Detail
ellenmacarthurfoundation.org



Circular economy: a definition and most ...
kenniskaarten.hetgroenebrein.nl

Circular economy: definition ...
europarl.europa.eu

Support to the Public Consultation on ...
ecologic.eu

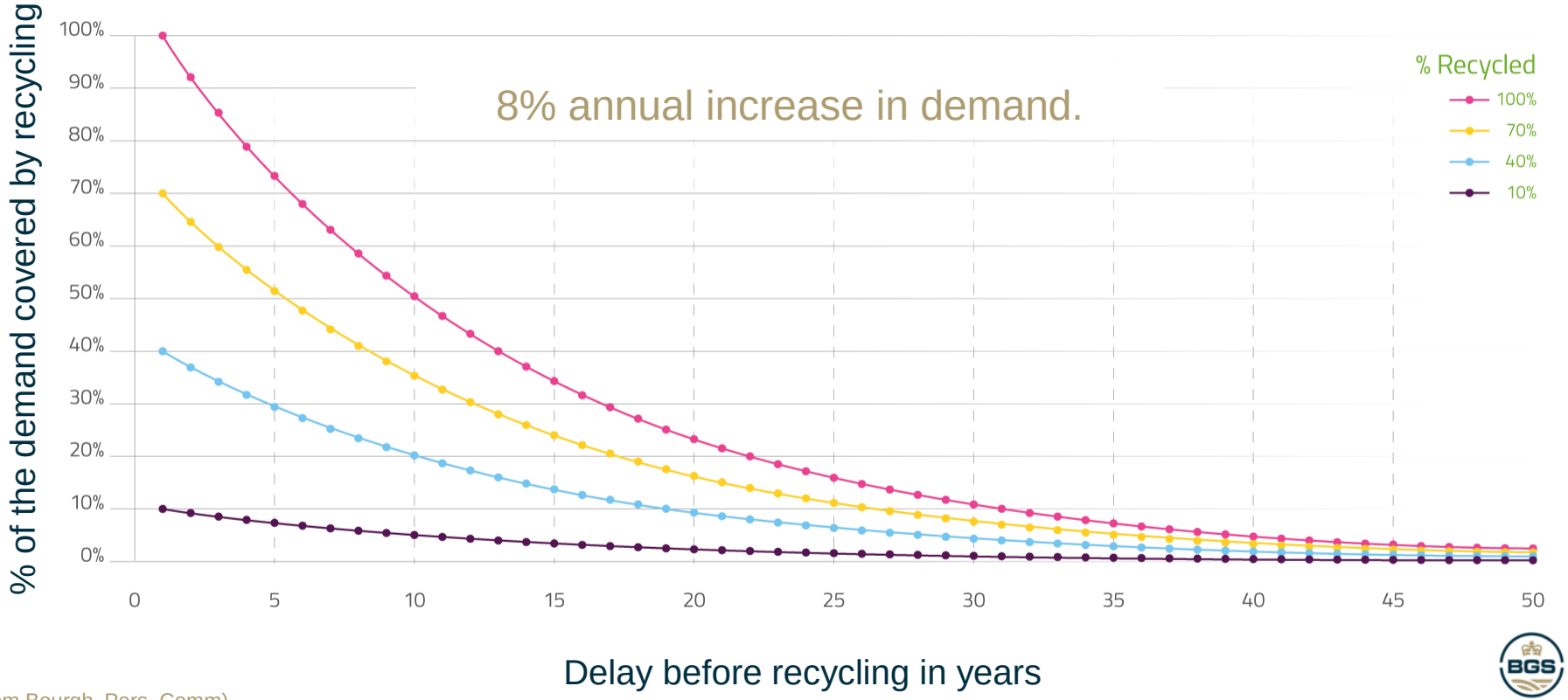
step change in waste management ...
managementors.co.uk

Closing the loop / Circular E...
tarkett.com

Eastman | Enabling a Circular Economy ...
eastman.com

Research helps Europe advance towards ...
ec.europa.eu

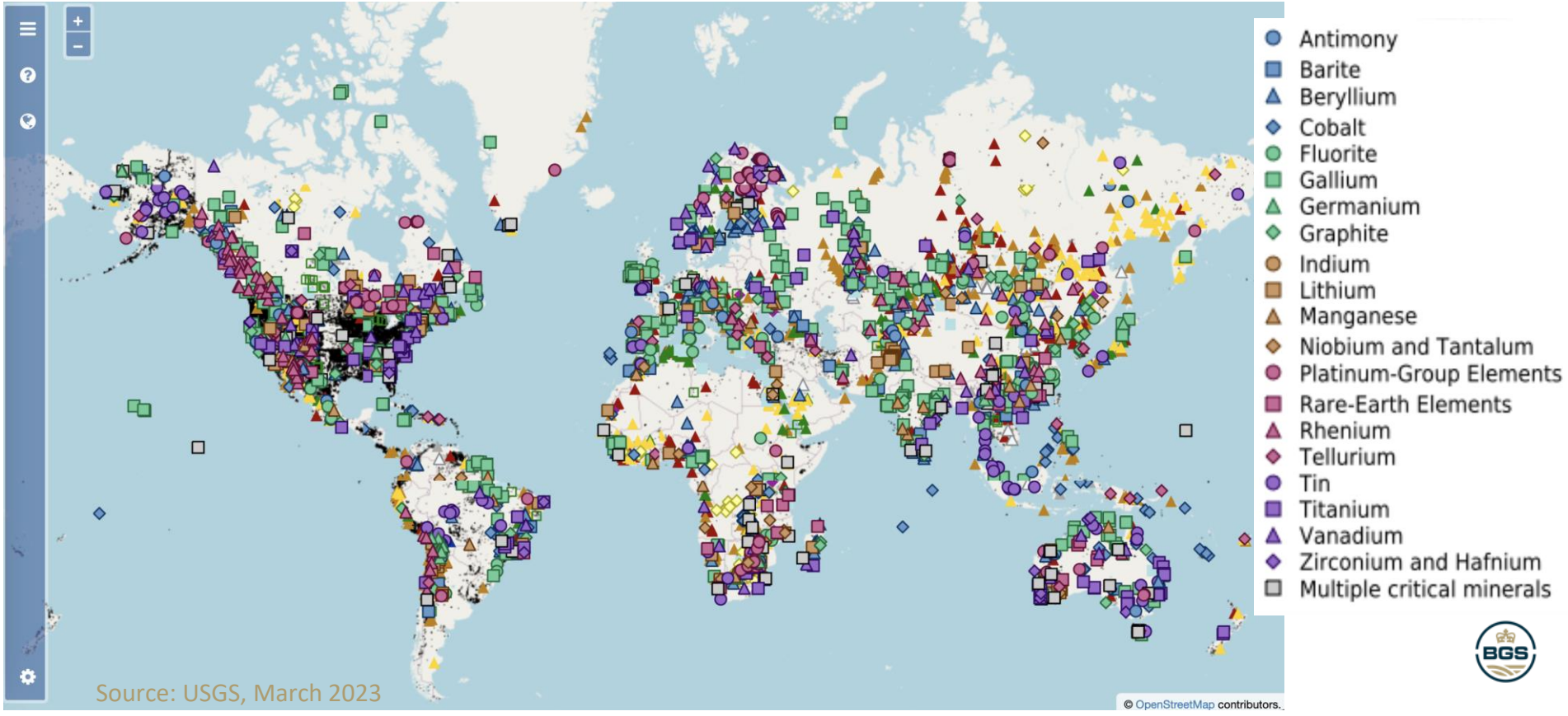
How much do we recycle?



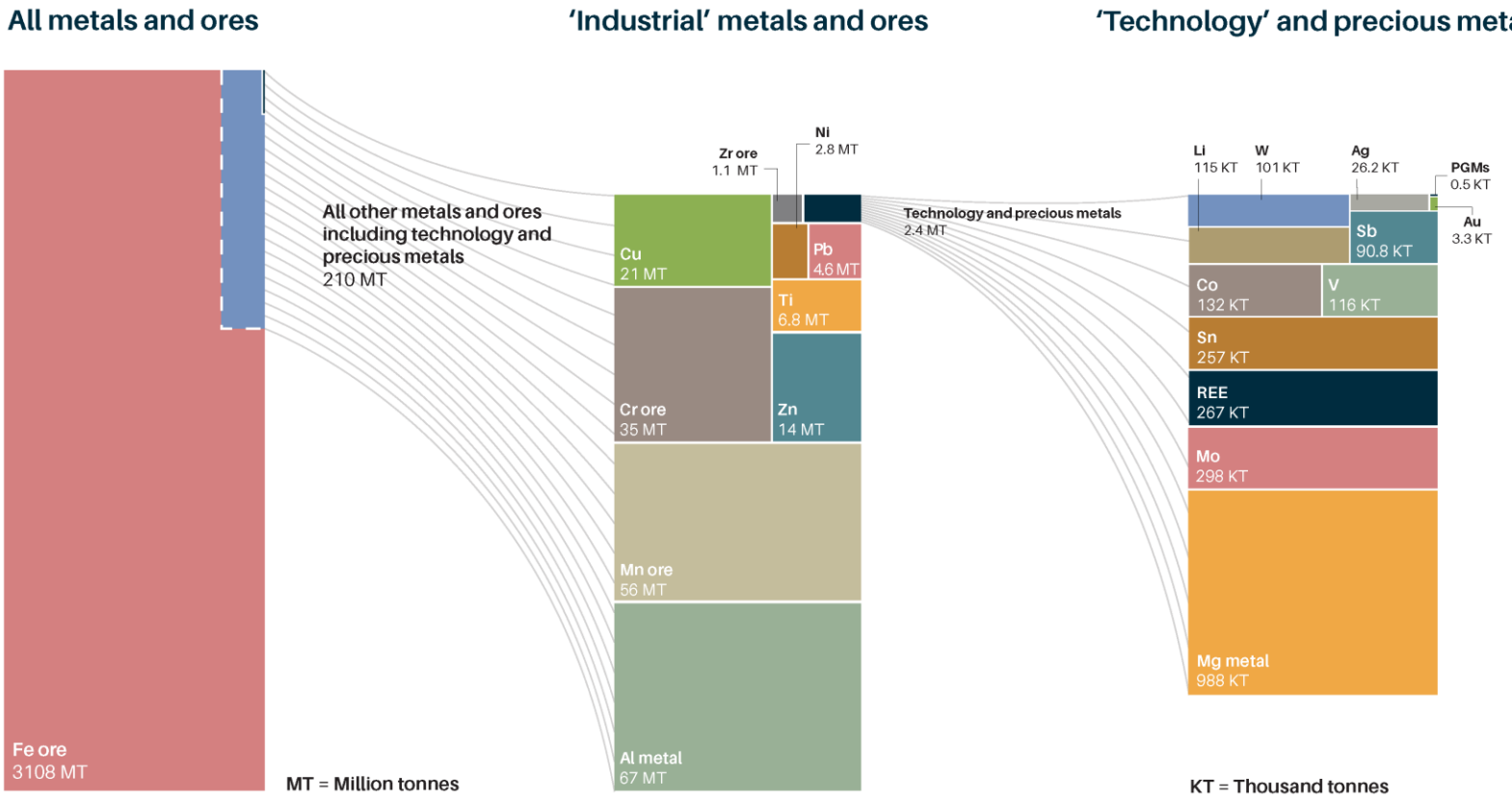
(From Bourgh, Pers. Comm)


88

Global mineral deposits



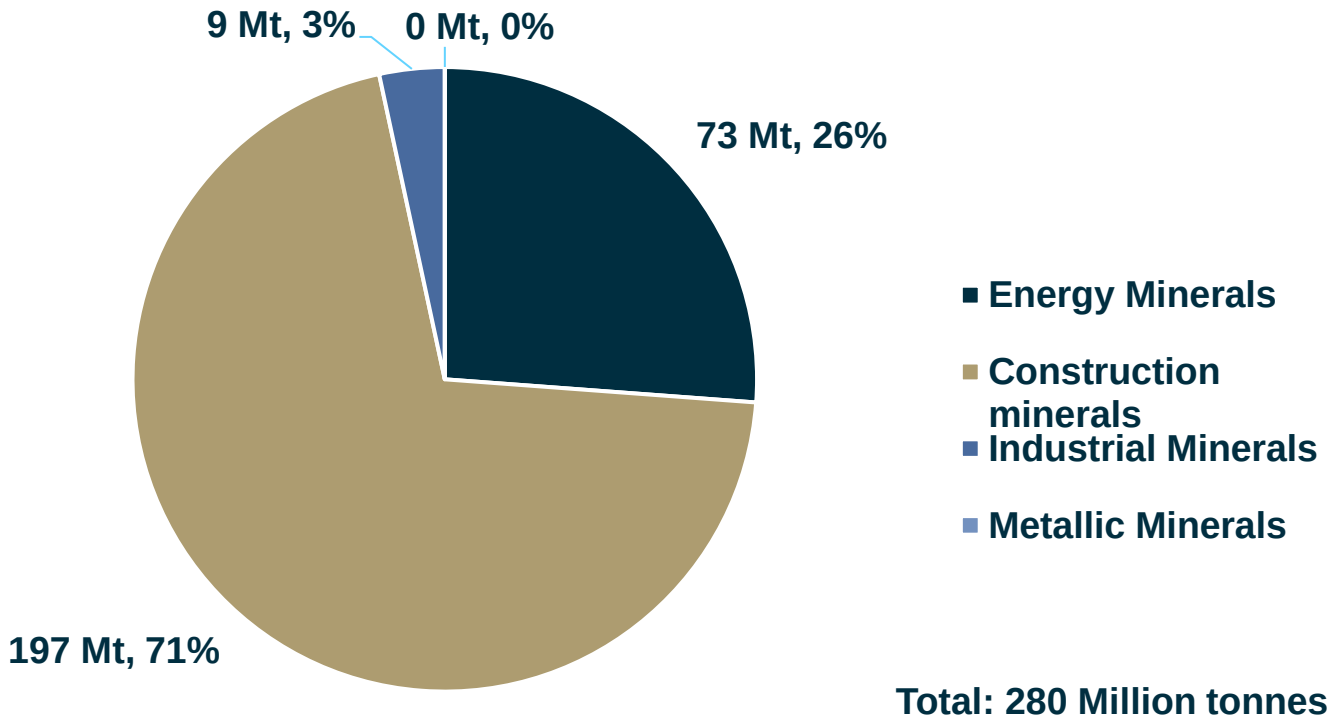
WHAT DO WE MINE?



Footnote: unless otherwise stated all figures are metal content.

Source: BGS

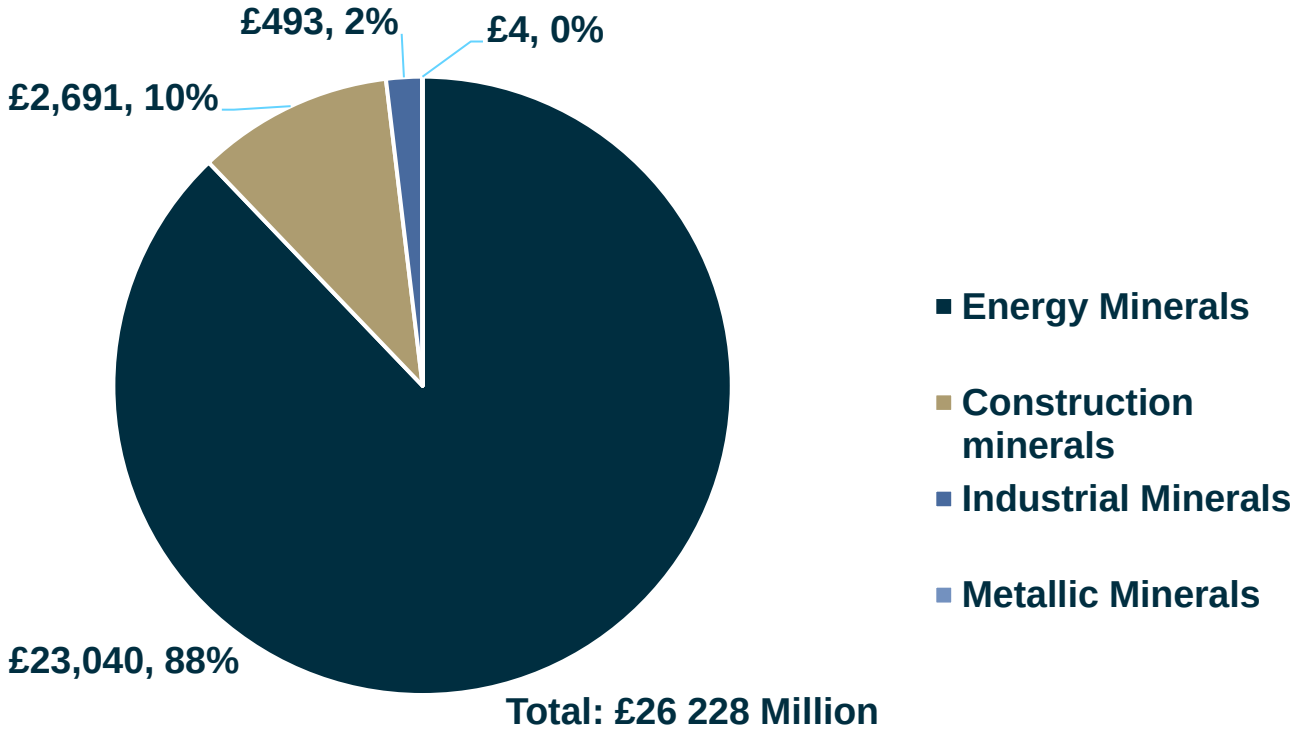
UK: Mineral Production, 2021



Total: 280 Million tonnes

Source: British Geological Survey, United Kingdom Minerals Yearbook

UK: Value of Mineral Production, 2021



Source: British Geological Survey, United Kingdom Minerals Yearbook

What are we going to do and where do we get them?

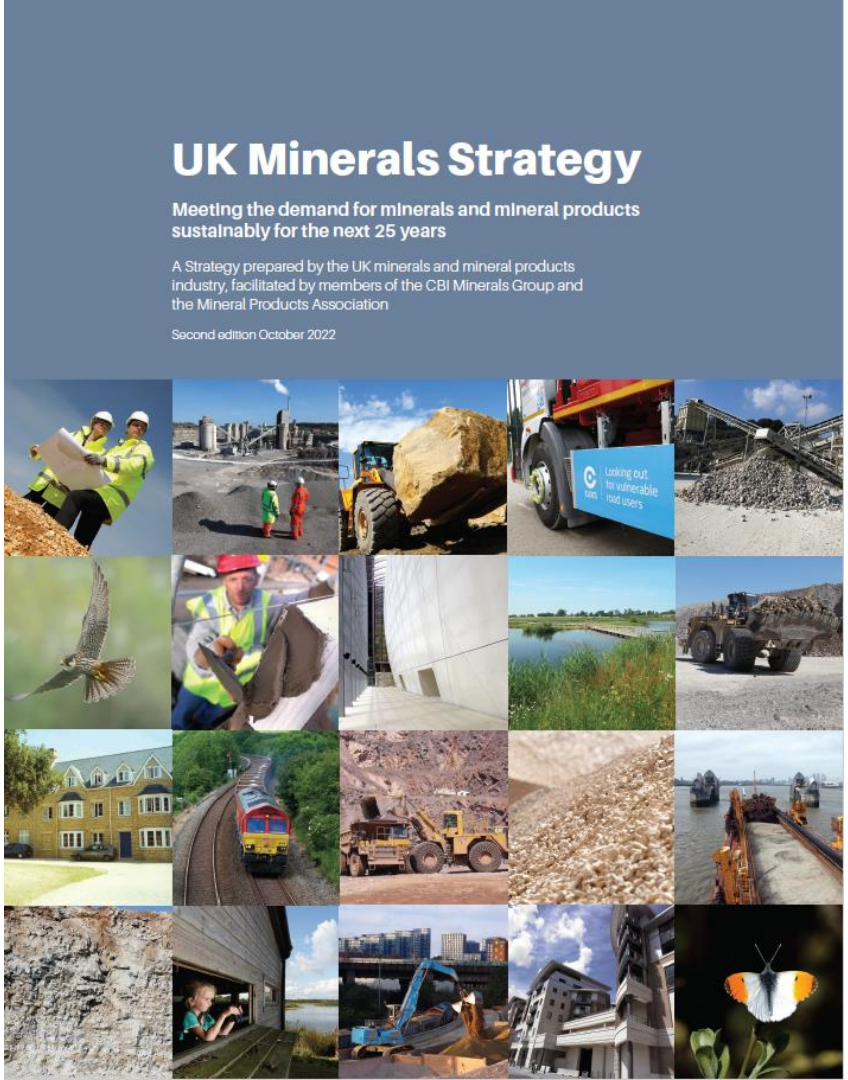
- Manage without them/more sustainable consumption and more equality
- Recycling/circular economy
- Mining
- Understand resources – from geology to supply chains

Department for
Business, Energy
& Industrial Strategy

Policy paper

Resilience for the Future: The UK's critical minerals strategy

Published 22 July 2022



The aim of the Strategy is to ensure that UK demand for minerals and mineral products is supplied sustainably for the next 25 years.

Accelerate the UK’s domestic capabilities

1. Maximise what the UK can produce domestically, where viable for businesses and where it works for communities and our natural environment.
2. Rebuild our skills in mining and minerals.
3. Carry out cutting-edge research and development to solve the challenges in critical minerals supply chains.
4. Make better use of what we have by accelerating a circular economy of critical minerals in the UK – increasing recovery, reuse and recycling rates and resource efficiency, to alleviate pressure on primary supply.

Collaborate with international partners

5. Diversify supply across the world so it becomes more resilient as demand grows.
6. Support UK companies to participate overseas in diversified responsible and transparent supply chains.
7. Develop our diplomatic, trading and development relationships around the world to improve the resilience of supply to the UK.

Enhance international markets

8. Boost global environmental, social and governance performance (ESG), reducing vulnerability to disruption and levelling the playing field for responsible businesses.
9. Develop well-functioning and transparent markets, through improved data and traceability.
10. Champion London as the world’s capital of responsible finance for critical minerals.

2023 Critical Minerals Strategy Refresh

- Independent Task & Finish Group to investigate the critical mineral dependencies and vulnerabilities across UK industry.
- Accelerating collaboration on critical minerals with international partners, including bilateral partnerships and engagement through the Minerals Security Partnership, International Energy Agency and G7.
- Identifying funding instumnets for Research and Innovation for critical minerals in the UK and in developing countries.

Key Pillars of the Strategy

DEMAND & IMPORTANCE

Government should provide clear national policy and a statement of need for all minerals and mineral products to underpin local plan-making, policy and decisions to enable a steady and adequate supply of minerals and mineral products to be maintained|

SUPPLY & DISTRIBUTION

The **Industry** will submit sufficient planning or marine licence applications. Mineral planning authorities and marine regulators should ensure that sufficient sites are allocated in plans and consents or marine licences granted, to maintain a steady and adequate supply of indigenous minerals and mineral products to meet demand and diversify supply, while also ensuring that reuse and recycling is maximised to achieve a more circular economy.

TRADE & INVESTMENT

Government should ensure there is a supportive regulatory, operating and trading environment to enable investment, encourage trade and export of UK minerals and mineral products, and ensure that risks from insecurity of international supply are understood and reduced.

PLANNING & REGULATION

Government should ensure that the mineral planning system is properly resourced at national and local levels to operate effectively and efficiently, thus ensuring that production and capacity to supply is maintained for the long-term, and that duplication with other regulation, particularly environmental permitting, is minimised.

ENVIRONMENTAL BENEFITS

The **Industry** will continue to deliver environmental net gains through responsible site management and high quality restoration, adding to the legacy of wildlife, recreational, landscape and wider natural capital assets already created contributing to climate change adaptation and resilience.

ENVIRONMENTAL IMPACTS

The **Industry** will continue to avoid and mitigate the negative impacts of mineral extraction, processing, manufacturing and transportation and contribute to the transition to net zero and the circular economy and ensuring operations are resilient to climate change impacts.

EDUCATION, SKILLS & EMPLOYMENT

The **Industry** will continue to provide attractive career opportunities and work with educational establishments to meet skills needs for a modern, healthy, safe, well-trained and educated, and diverse workforce, and encourage people to choose to work in the industry.

PUBLIC UNDERSTANDING & ENGAGEMENT

The **Industry** and **Government** should work with stakeholders to improve public understanding of the need for minerals and mineral products and their associated supply chains, and strengthen the evidence base and availability of statistical and related data.

RESEARCH & INNOVATION

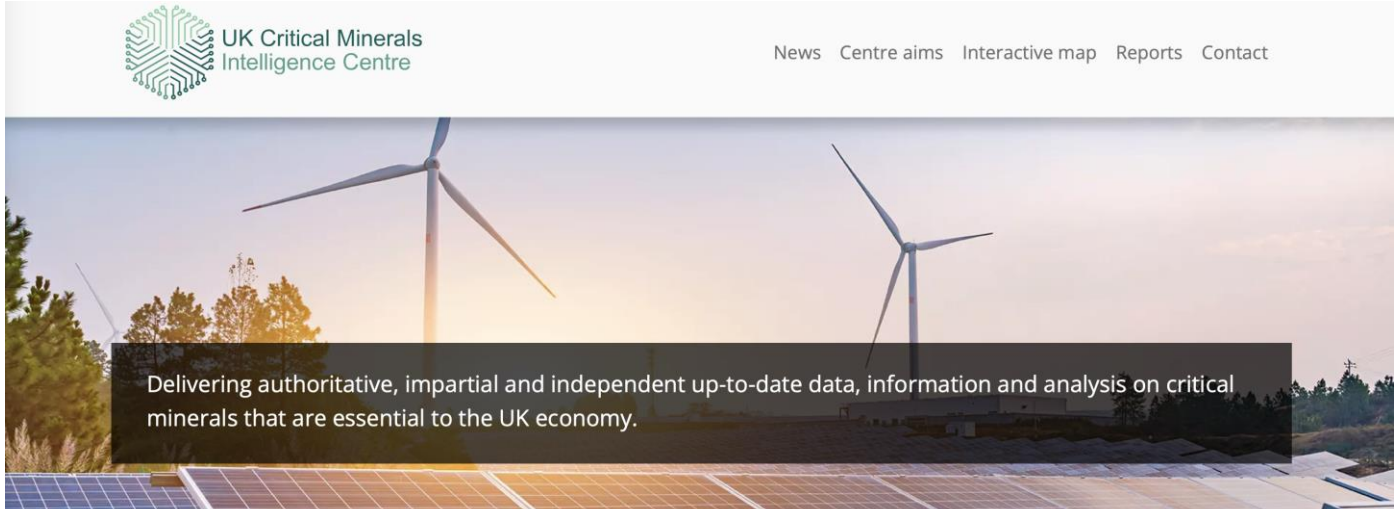
The **Industry** will encourage and invest in innovation, research and development, including the identification and development of new sources of minerals, resilient and sustainable supply chains, and supporting new markets.

UK Critical Minerals Intelligence Centre

https://ukcmic.org

The new UK Critical Minerals Intelligence Centre (CMIC) is based at BGS. The centre will take a holistic approach to:

- mapping global critical mineral supply chains
- tracking stocks and flows and monitoring market dynamics
- understanding economic, geopolitical, environmental and ethical risks and opportunities



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Quartz

Concrete
Cement (limestone)
Sand & gravel
Iron

Vehicles
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Nickel
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Talc
Graphite

After PR Neeb, 2006

Natural Environment Research Council

UK Critical Minerals Intelligence Centre

British Geological Survey

UK criticality assessment of technology minerals and metals

- **Supply risk**
  production concentration,
  companion metal fraction
  recycling rate

- **Economic vulnerability**
  production evolution
  price volatility
  substitutability
  global trade concentration
  UK import reliance
  UK gross value added contribution

Source: . P A J Lusty, R A Shaw, A G Gunn, N E Idoine. A J Bloodworth (Editor) BGS Commissioned report, 2021