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CRM ONLINE GAME – KEY KNOWLEDGE

Smartphone Life Cycle: Exploring Critical Raw Materials

This project has received funding under the European Union's Horizon Europe research and innovation programme under grant agreement No 101058178.

AGEMERA Project Introduction

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The AGEMERA project

Agile Exploration and Geo-modelling for European Critical Raw materials

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Project number/ Grant agreement number: 101058178

Topic: HORIZON-CL4-2021-RESILIENCE-01-06 – Innovation for responsible EU sourcing of primary raw materials, the foundation of the Green Deal (RIA)

Type of Action: HORIZON-RIA
(Research and Innovation Action)

Duration: 36 months
started 1.8.2022 - ending 31.7.2025

Partners: 20 from 11 countries
7 universities, 2 research institutions, 5 SMEs,
6 industrial partners

Coordinator: University of Oulu, Kerttu Saalasti Institute

Budget: 7,5 M€

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THIS CALL	INNOVATION FOR RESPONSIBLE EU SOURCING OF PRIMARY RAW MATERIALS, THE FOUNDATION OF THE GREEN DEAL (RIA)					
AIMS TO	STRENGTHEN EU'S CRM AUTONOMY	IMPROVING KLOWLEDGE BASE ON CRM'S	ACCELERATE DEVELOPMENT OF EXPLORATION PROJECTS	INCREASE THE AWARENESS OF THE IMPORTANCE OF CRMS	PROMOTING THE UTILIZATION OF UNFC AND UNRMS	
AGEMERA OFFERS	Geological CRM potential database in EDGI compatible GIS format	Novel, non-invasive mineral exploration methods	GEO DATACUBE	CRM educational material for student and general public	GIS based social, environmental and cultural potential vulnerability map concerning mining	UNFC and UNRMS as evaluation tools for future experts

EU has launched several actions

European Raw Materials Alliance (ERMA 9/2020)

The European Raw Materials Alliance (ERMA) aims to make Europe economically more resilient by diversifying its supply chains, creating jobs, attracting investments to the raw materials value chain, fostering innovation, training young talents and contributing to the best enabling framework for raw materials and the Circular Economy worldwide.

European Raw Materials act (9/2022)

During the State of the European Union address, Commission President Ursula von Der Leyen announced the EU's plans to put forward a European Critical Raw Materials Act. “Lithium and rare earths will soon be more important than oil and gas. Our demand for rare earths alone will increase fivefold by 2030. [...] We must avoid becoming dependent again, as we did with oil and gas. [...] We will identify strategic projects all along the supply chain, from extraction to refining, from processing to recycling. And we will build up strategic reserves where supply is at risk. This is why today I am announcing a European Critical Raw Materials Act.”

EC has launched several calls to help reach EU´s goals

- to secure the autonomy on CRM
- to support the development of new technologies
- to increase the awareness of green and digital transitions
- to promote globally uniforming United Nations Framework Classification and United Nations Resource Management System

1. Life Cycle of a Smartphone

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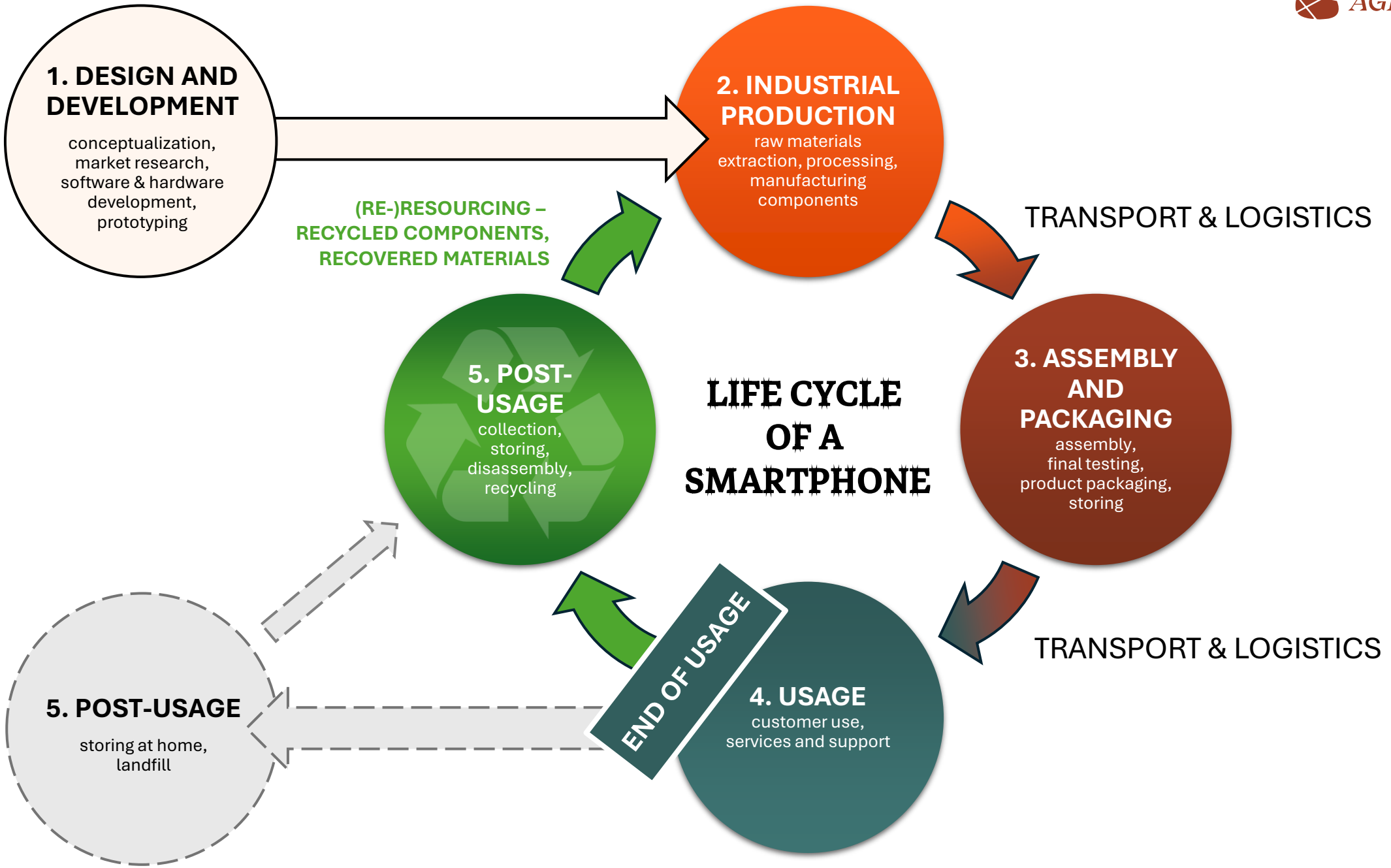
1. DESIGN AND DEVELOPMENT
conceptualization, market research, software & hardware development, prototyping
2. INDUSTRIAL PRODUCTION
raw materials extraction, processing, manufacturing components
TRANSPORT & LOGISTICS
3. ASSEMBLY AND PACKAGING
assembly, final testing, product packaging, storing
TRANSPORT & LOGISTICS
4. USAGE
customer use, services and support
END OF USAGE
5. POST-USAGE
storing at home, landfill
5. POST-USAGE
collection, storing, disassembly, recycling
(RE-)RESOURCING – RECYCLED COMPONENTS, RECOVERED MATERIALS
LIFE CYCLE OF A SMARTPHONE

2. Critical Raw Materials

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Critical Raw Materials (CRMs)

CRMs are of great **economic importance** and **supply risk** for Europe

Importance and Strategic Value:

- CRMs are essential to **produce high-tech products** and **renewable energy technologies**.
- They play a crucial role in the manufacturing of **batteries**, **electronics**, and **other advanced materials**.
- Ensuring a stable supply of CRMs is vital for **economic growth** and **national security**.
- Countries with access to CRMs have a strategic advantage in the global market.
- The **demand for CRMs is increasing** due to the transition to sustainable energy and transportation systems.

https://op.europa.eu/en/publication-detail/-/publication/57318397-fdd4-11ed-a05c-01aa75ed71a1

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Critical Raw Materials list

2023 list of Critical Raw Materials (34)			
Antimony	Copper*	LREEs - light rare earth elements	Scandium
Arsenic	Feldspar	Magnesium	Silicon metal
Baryte	Fluorspar	Manganese	Strontium
Bauxite	Gallium	Natural graphite	Tantalum
Beryllium	Germanium	Nickel*	Titanium
Bismuth	Hafnium	Niobium	Tungsten
Borate	Helium	PGMs - platinum group metals	Vanadium
Cobalt	HREEs - heavy rare earth elements	Phosphate rock	
Coking coal	Lithium	Phosphorus	

*Copper and Nickel do not meet the CRM thresholds, but are included as Strategic Raw Materials

https://single-market-economy.ec.europa.eu/sectors/raw-materials/areas-specific-interest/critical-raw-materials_en

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Example of a CRM - Lithium

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Importance:

- Lithium is a key component in the **production of batteries for EVs**.
- It is essential for energy storage solutions, which are crucial for renewable energy integration.

Strategic Value:

- The demand for lithium is increasing rapidly due to the **growth of the EV market**.
- Countries with lithium reserves have a strategic advantage in the global market e.g. Australia, Chile, China and Argentina.
- Ensuring a stable supply of lithium is vital for the transition to sustainable energy and transportation systems.

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3. Rare Earth Elements

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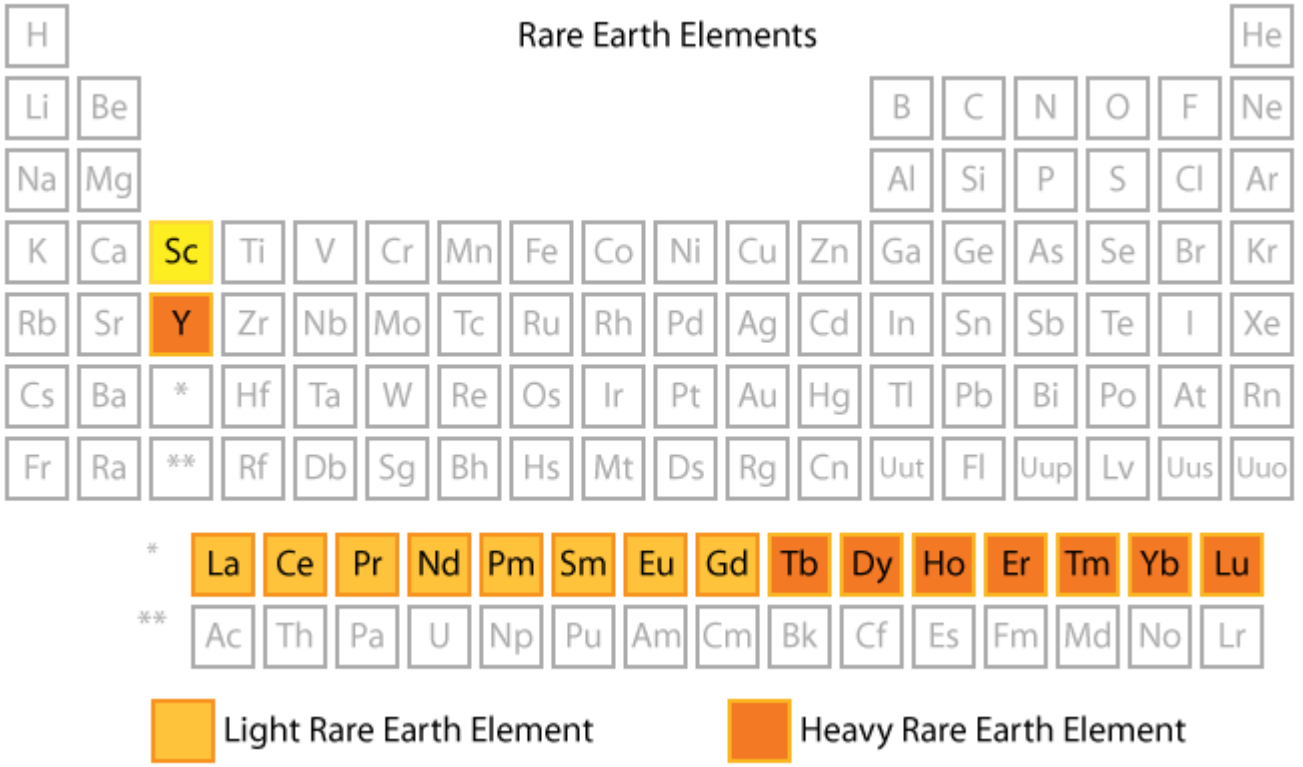
Rare Earth Elements (REEs)

Rare Earth Elements are a **group of 17 chemical elements** that play a crucial role in modern technology, particularly in the energy sector.



https://sciencenotes.org/wp-content/uploads/2015/09/RareEarthElements.png

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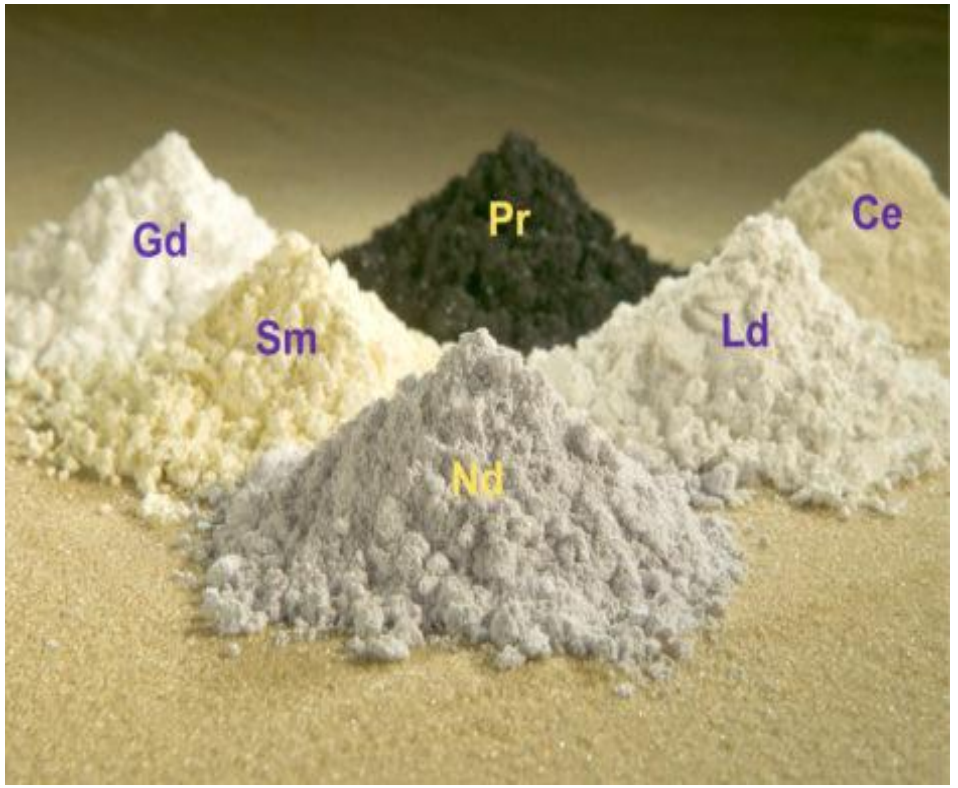
REEs and Global Demands

- REEs are **essential to produce high-tech products**, including smartphones, electric vehicles, and renewable energy technologies.
- They play a crucial role in the manufacturing of **magnets, catalysts, and other advanced materials**.
- The **demand for REEs is increasing** due to the transition to sustainable energy and transportation systems.
- Ensuring a stable supply of REEs is vital for economic growth and national security.
- Countries with access to REEs have a strategic advantage in the global market.



Colorado Geological Survey

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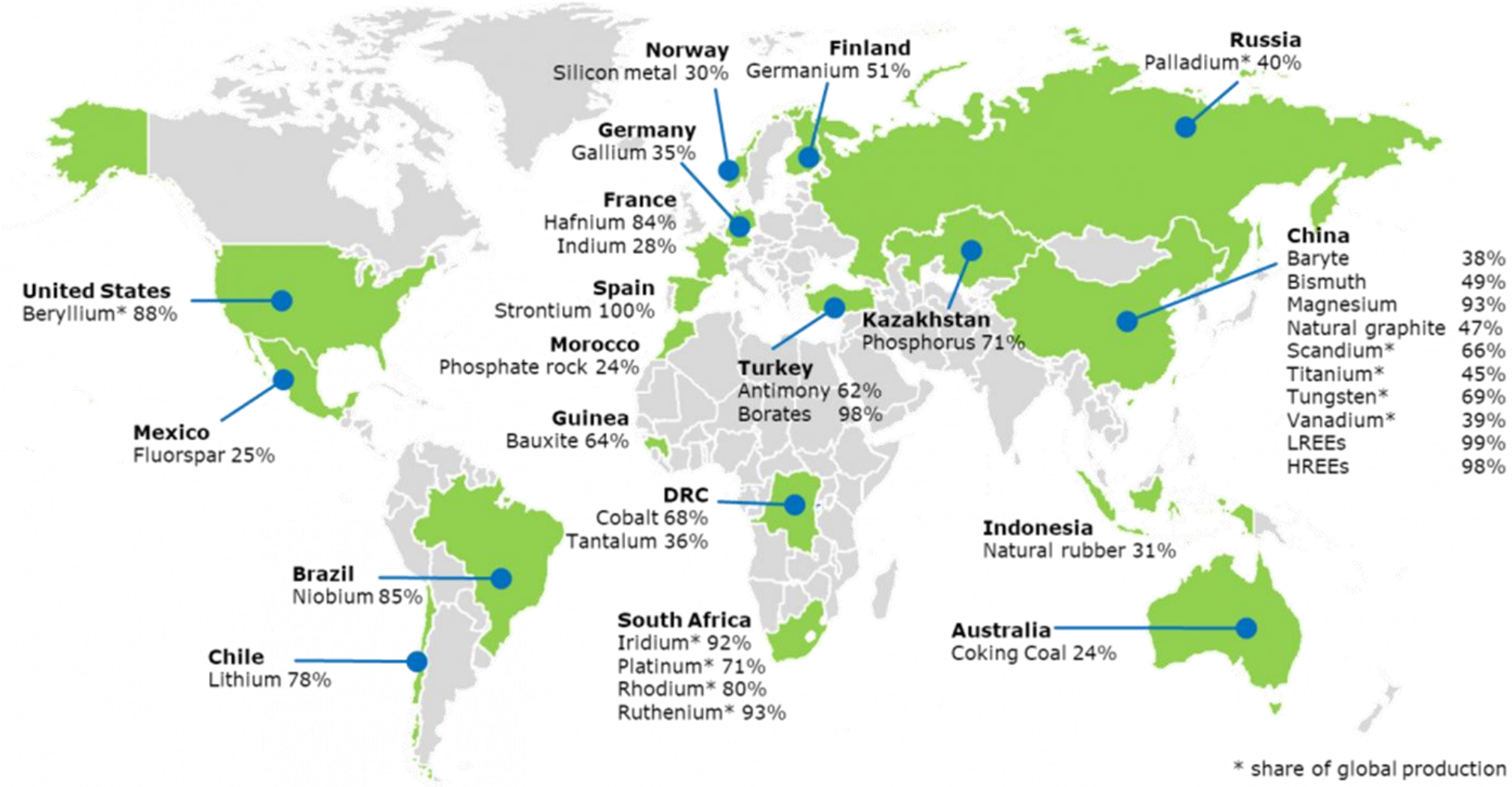
China supplies almost all of the REEs globally



https://rmis.jrc.ec.europa.eu/uploads/CRM_2020_Report_Final.pdf

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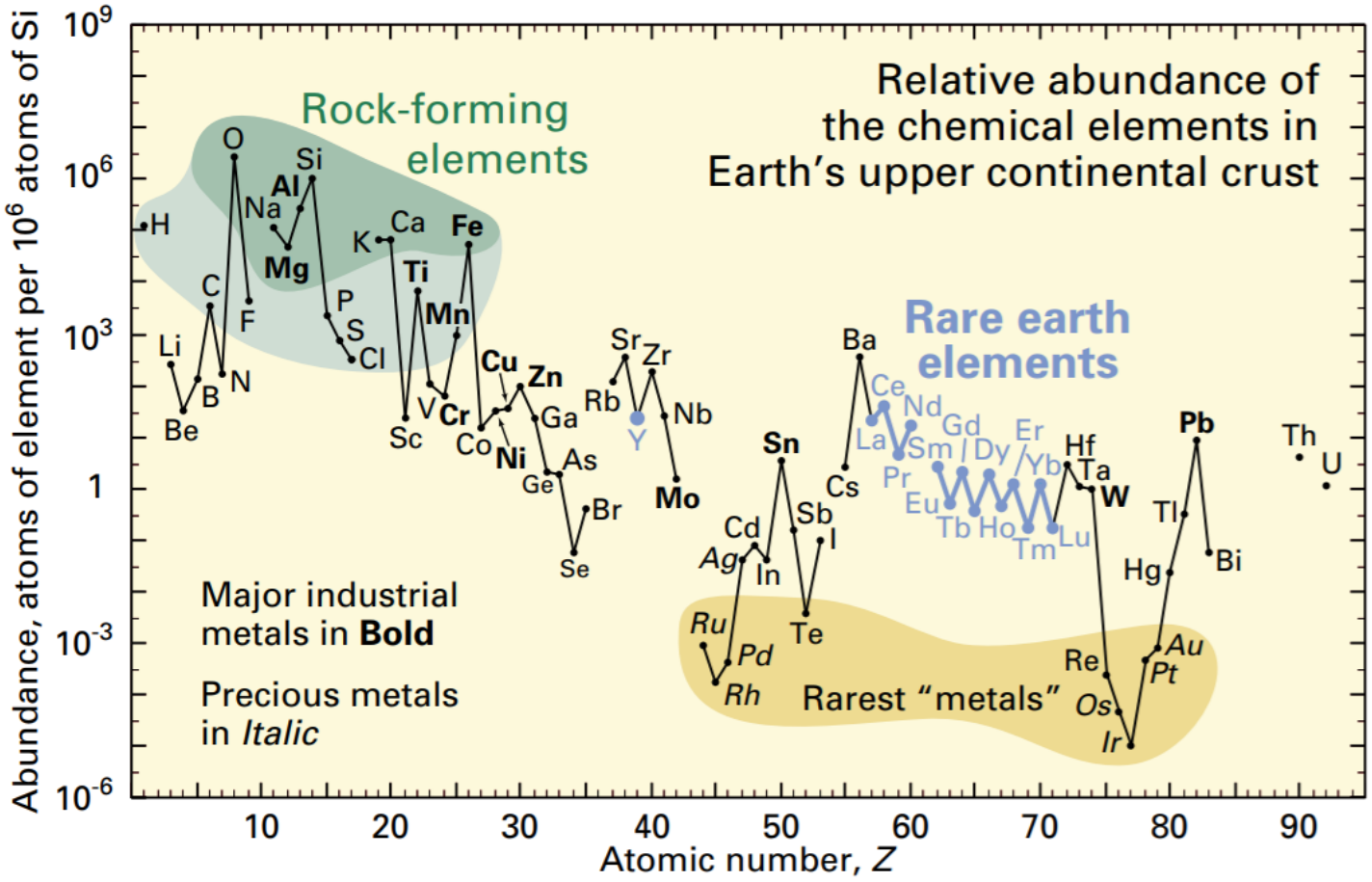
Are they rare?

- REEs are not as rare as their name suggests.
- Despite the label, these elements are more abundant in the Earth's crust than one might think.



Haxel, Hedrick, & Orris, 2002

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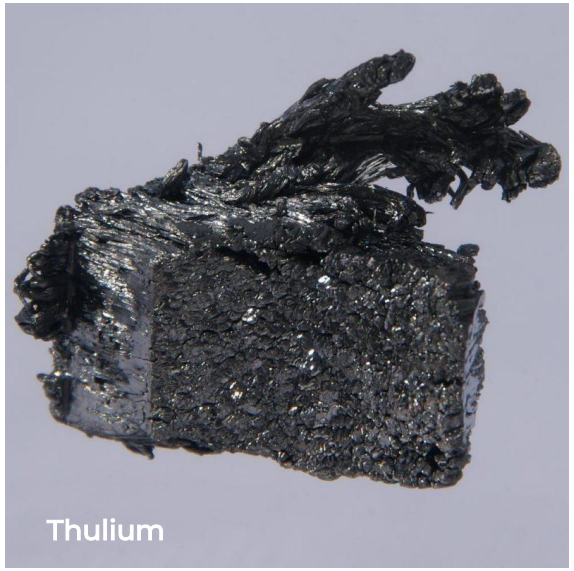
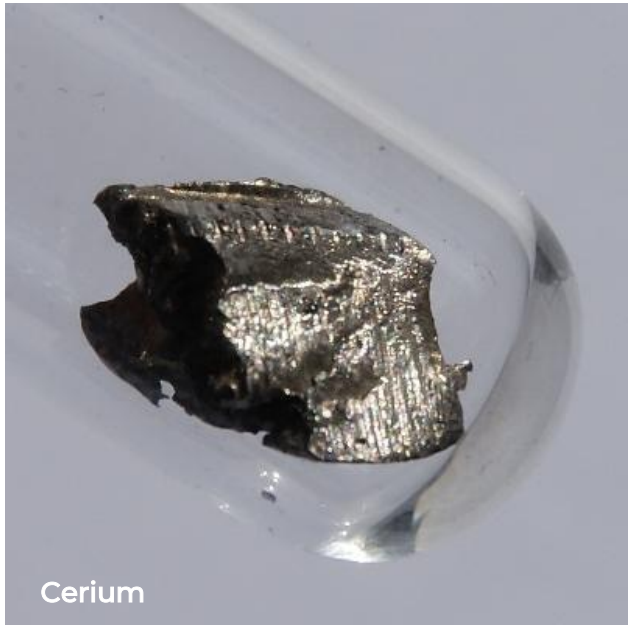


The rarest rare earth element. Image via Jurii.



https://images-of-elements.com/cerium.php#a

The least-rare REE, cerium, is a whopping **15,000** times more abundant than gold.

Even the rarest REE, thulium, is **125** times more common than gold.

4. Global Supply Chains & Transport Logistics

Movement of materials from mine to market

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The Value Chain of Raw Materials

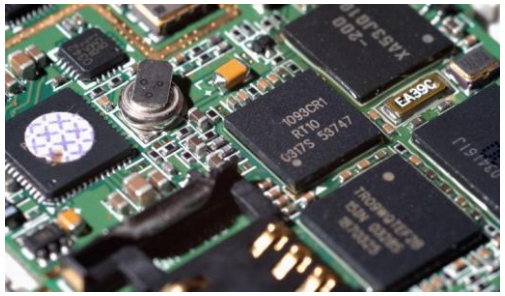
EXPLORATION

MINING

TRANSPORT

SMELTING

PRODUCTION



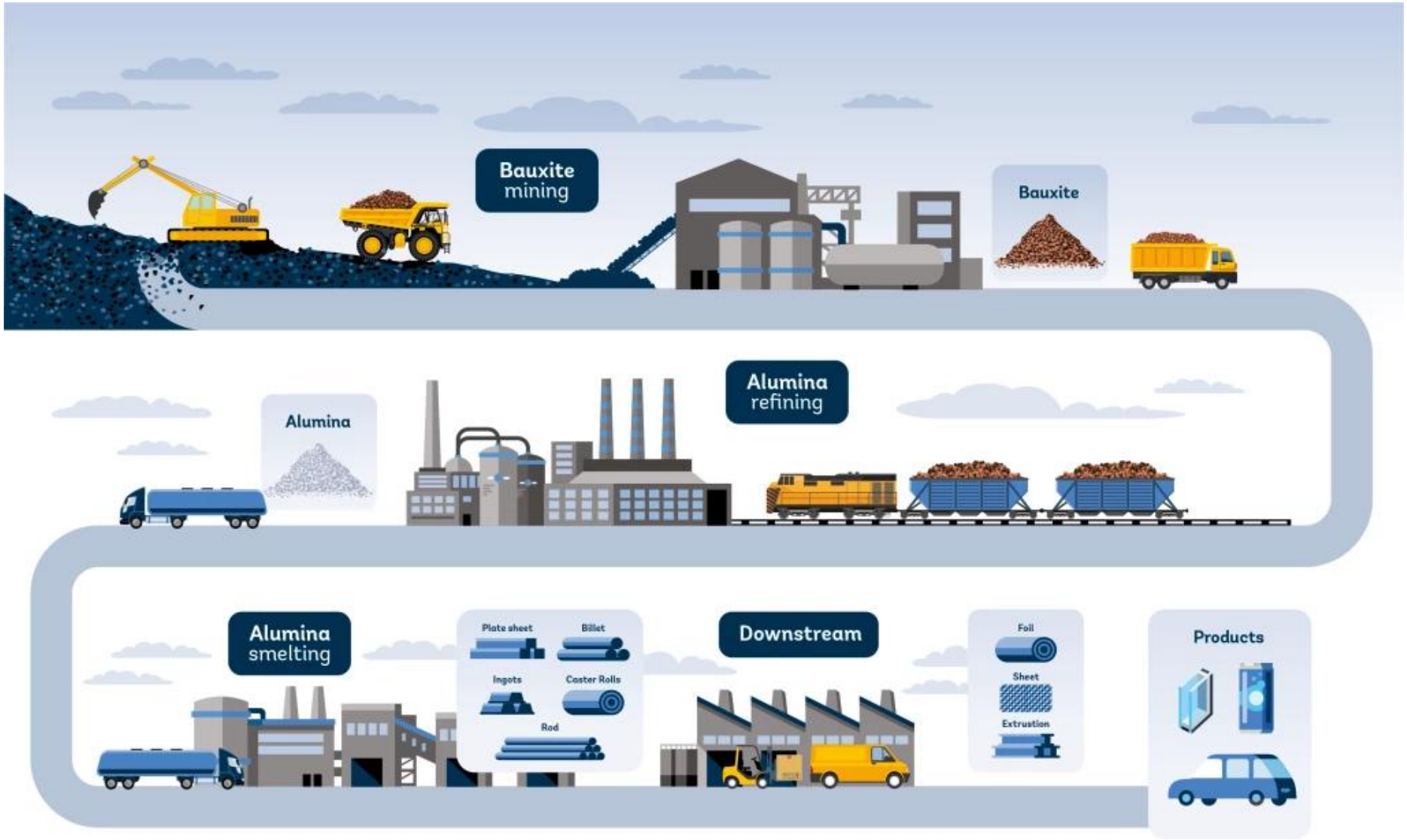
SUBSTITUTION

END-USE MARKETS

RECYCLING

CIRCULAR ECONOMY

Mining process – Aluminium example



https://blogs.worldbank.org/en/energy/cost-competitive-low-carbon-aluminum-key-energy-transition

Supply Chain Issues

- **Geopolitical Tensions**: Concentration of mining and processing in a few countries, particularly China, leads to vulnerabilities.
- **Environmental and Social Concerns**: Mining activities often face opposition due to environmental degradation and social impacts.
- **Supply Chain Concentration**: High dependency on a limited number of suppliers and countries for critical minerals.
- **Regulatory and Trade Barriers**: Export controls, tariffs, and trade restrictions can disrupt supply chains.
- **Investment and Infrastructure**: Insufficient investment in mining infrastructure and technology can lead to supply bottlenecks.
- **Market Volatility**: Fluctuations in commodity prices and demand can impact the stability of supply chains.
- **Technological Challenges**: Need for advancements in mining and processing technologies to improve efficiency and reduce environmental impact.
- **Pandemic Impact**: Global events like COVID-19 have shown how pandemics can disrupt mining operations and supply chains.

5. Recycling & Sustainability

Circular economy in action

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Circular Economy

A **closed-loop system**, where the use of resource inputs and the creation of waste, pollution and carbon emissions are **minimised** and the resource use is **maximised**

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Urban Mining

Urban mining involves reclaiming raw materials from used products, buildings, and waste.

- It supports the **circular economy** by reducing waste and optimizing resource use.
- Helps recover **valuable materials** like metals, plastics, and rare earth elements from e-waste.
- **Reduces reliance** on environmentally harmful traditional mining.
- Promotes a more **sustainable and resource-efficient economy**.

6. Ethical & Environmental Issues

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Responsible sourcing and social impact related to cobalt production

Ethical Issues:

- Child labour and poor working conditions in cobalt mines, particularly in the **Democratic Republic of Congo** (DRC).
- Human rights abuses and exploitation of workers.

Image: Trafigura

However, there are benefits in many cases

- **Better labour conditions**: Fair wages, safety, and no child labour.
- **Community benefits**: Support for education, healthcare, and infrastructure.
- **Eco-friendly practices**: Reduced pollution and sustainable mining.

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Environmental Issues

- **Environmental degradation** due to unregulated mining practices.
- **Contamination of water** sources and soil with heavy metals and other pollutants.
- **Loss of biodiversity** and destruction of ecosystems.

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Some positive environmental developments

- **Rehabilitation of mine sites**: Restoring ecosystems through reforestation and land reclamation.
- **Water recycling**: Reducing freshwater use through advanced water treatment and reuse systems.
- **Emission controls**: Adoption of cleaner technologies to lower greenhouse gas emissions.
- **Waste reduction**: Improved waste management and reuse of mining byproducts.
- **Energy efficiency**: Use of renewable energy and energy-saving technologies in operations.

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Critical Raw Materials for a Resilient Europe

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