Laboratório Nacional de Energia e Geologia, I. P.

Energy Transition

THE ROLE OF THE GEOLOGICAL SURVEYS

Teresa Ponce de Leão
LNEG

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REPÚBLICA PORTUGUESA
AMBIENTE E ENERGIA

Government Institutions – GEOLOGY & MINING

Ministry of Environment Spatial Planning and Energy

State Secretary of Energy

…

General-Direction of Energy and Geology DGEG

Industrial Administration:
- Permitting
- Regulation
- Approval of Exploitation Plans

National Laboratory for Energy and Geology LNEG

Scientific and Technological Research:
- Geological Mapping
- Mineral Resources Mapping
- Mineral Resources Characterization

Enterprise for Mining Development EDM

Administration of the Public Assets in the Mineral Sector

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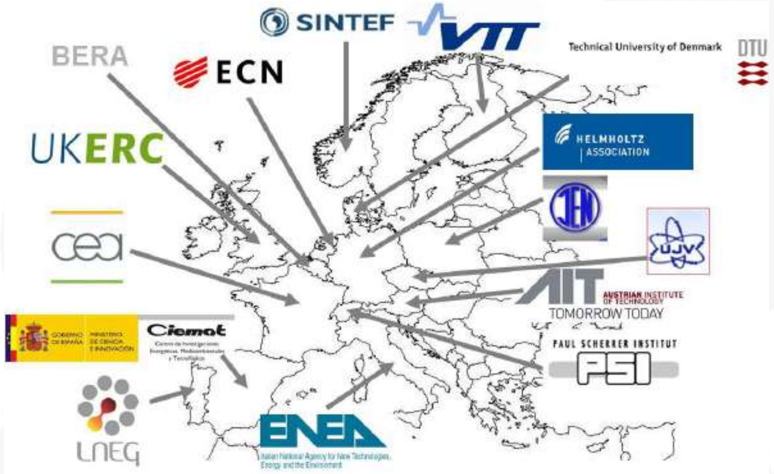
LNEG
National Laboratory for Energy and Geology

LEN
Laboratory of Energy
Member of European Energy Research Alliance

LGM
Laboratory of Geology and Mining
Member of the European Geological Surveys



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Introduction

- **Renewable Energy Site Selection**: Geology helps identify suitable locations for renewable energy projects such as wind, solar, and geothermal energy. Understanding subsurface conditions, seismic activity, and landforms assists in determining the viability and optimal placement of renewable energy infrastructure.
- **Geothermal Energy**: Geology is fundamental to harnessing geothermal energy, which utilizes heat from the Earth's subsurface. Geological surveys assess the availability of geothermal reservoirs, determine their characteristics, and identify potential sites for geothermal power plants.
- **Carbon Capture and Storage (CCS)**: Geology is integral to CCS, a technology aimed at mitigating greenhouse gas emissions from fossil fuel combustion. Geologists assess suitable geological formations, such as depleted oil and gas reservoirs or deep saline aquifers, for storing captured CO2 securely underground.
- **Hydrocarbon Exploration and Production**: While the energy transition seeks to reduce reliance on fossil fuels, hydrocarbons still play a significant role in the global energy mix. Geology is essential for identifying and accessing oil and gas reserves efficiently and sustainably, helping to optimize extraction methods and minimize environmental impact.

Introduction

- **Critical Mineral Exploration:** Transitioning to renewable energy technologies requires vast amounts of critical minerals such as lithium, cobalt, and rare earth elements. Geology guides the exploration and extraction of these minerals, ensuring a stable and sustainable supply chain for renewable energy technologies like batteries and solar panels.
- **Understanding Earth Systems:** Geology provides insights into Earth's processes and systems, including the carbon cycle, climate history, and natural hazards such as earthquakes and volcanic eruptions. Understanding these phenomena is crucial for developing resilient and sustainable energy infrastructure.
- **Environmental Impact Assessment:** Geologists assess the environmental impact of energy projects, considering factors such as land use, water resources, and ecosystem health. By evaluating potential risks and mitigating measures, geology helps ensure that energy transition projects are implemented sustainably.
- In essence, geology contributes to the energy transition by providing essential knowledge, resources, and insights for the development of sustainable energy solutions, while also addressing environmental concerns and minimizing negative impacts on ecosystems and communities.

Introduction

“EU imports most of the materials it uses rather than mining them itself. It is a **net importer of raw materials**, in which it has had a trade deficit since 2002. Last year (2019) that trade deficit stood at €31 billion”

“Europe still has many resources. **Europe mines more than 42 different metals and minerals, plus ornamental stones, sand and gravel and aggregates**”

“Though there is **significant political will** to ensure security of supply for raw materials, there is also **public opposition to increased mining** because of its environmental effects. There is especially strong local opposition to new mines”

“European Commission is now focusing on **collecting information about the deposits available in Europe** – not necessarily for new mines, but also to expand existing mines or use them more efficiently”

Circular Economy

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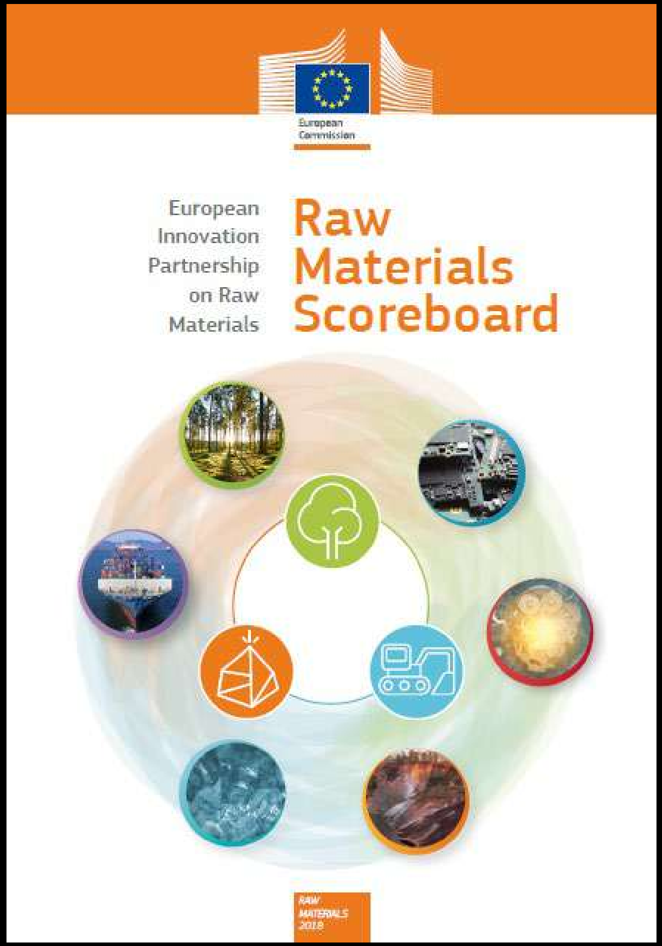
Raw materials in the EU economy; Feb 2020
https://eurac.tv/9Rgr

Introduction

"**Raw materials** are becoming **increasingly important** for the **competitiveness of Europe's industry**, for **innovation** and for the **transition to a low-carbon, more circular economy.**
Many new enabling technologies **rely on materials that are predominantly produced outside of the European Union**, such as cobalt for Lithium-Ion batteries powering low-emission mobility or rare-earth elements for energy-saving electronics.
International competition for such raw materials is **becoming more intense.**"

Vladimír Šucha and Lowri Evans, Raw Materials Scoreboard 2018



3rd Raw Materials Scoreboard (2021)

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Introduction

	WASTE TYPE	Valuable and Critical Raw Materials	Required/Viable Input for End-processing	Current Business Practice
PCBs Desktop computers, professional IT Laptops Mobile phones Tablets External CDDs/ODDs, devices with internal CDDs/ODDs	WEEE	Au Ag Bi Pd Sb	PCBs (shredded and unshredded), CuPM granulates, mobile phones w/o. batteries	✓
Li-ion BATTERIES Laptops Mobile phones Tablets Li-ion batteries in other WEEE (battery packs from e-bikes, tools, ...)	WEEE	Co Li	Batteries	✓*
BEV, (P)HEV	ELV			
LEAD-ACID BATTERIES Uninterruptable Power Supplies Other WEEE (e-scooters without seats, ride-on toys,...)	WEEE	Sb**	Batteries	✓
Cars containing LABs, other vehicles (e-scooters with seats, ...)	ELV			
FLUORESCENT POWDERS Fluorescent lamps CRT monitors and TVs	WEEE	Eu Tb Y Ce La Y Tb Eu Gd La Ce	Fluorescent Powder	✗
Nd-MAGNETS Laptops (HDD) Desktop computers, professional IT (HDD) E-bikes	WEEE	Nd + Dy Gd Pr Tb	Magnets	✗
BEV, (P)HEV (electro engine)	ELV			

*Current business practice does not (yet) include recycling of Li
**Current feasibility refers to recycling with lead (Pb)

"End-of-life circuit boards, certain magnets in disc drives and electric vehicles, EV and other special battery types, and fluorescent lamps are among several electrical and electronic products containing critical raw materials"

"…recycling most of the products rich in CRMs is not commercially viable, with low and volatile CRM prices undermining efforts to improve European CRM recycling rates, which today are close to zero in most cases"

CEWASTE PROJECT FINAL REPORT, 2021

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End-of-life recycling input rate (EOL-RIR) [%]

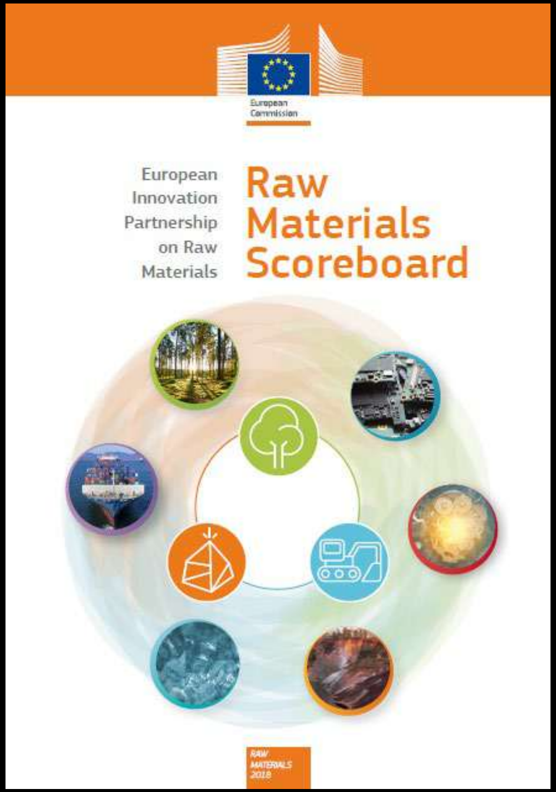
- > 50%
- > 25-50%
- > 10-25%
- 1-10%
- < 1%

H																	He 1%
Li 0%	Be 0%											B* 0.6%	C	N	O	F* 1%	Ne
Na	Mg 13%											Al 12%	Si 0%	P* 17%	S 5%	Cl	Ar
K* 0%	Ca	Sc 0%	Ti 19%	V 44%	Cr 21%	Mn 12%	Fe 31%	Co 35%	Ni 34%	Cu 17%	Zn 31%	Ga 0%	Ge 2%	As	Se 1%	Br	Kr
Rb	Sr	Y 31%	Zr	Nb 0%	Mo 30%	Tc	Ru 11%	Rh 9%	Pd 9%	Ag 55%	Cd	In 0%	Sn 32%	Sb 28%	Te 1%	I	Xe
Cs	Ba 1%	La-Lu[1]	Hf 1%	Ta 1%	W 42%	Re 50%	Os	Ir 14%	Pt 11%	Au 20%	Hg	Tl	Pb 75%	Bi 1%	Po	At	Rn
Fr	Ra	Ac-Lr[2]	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Uut	Fl	Uup	Lv	Uus	Uuo

[1]Group of Lanthanide	La 1%	Ce 1%	Pr 10%	Nd 1%	Pm	Sm 1%	Eu 38%	Gd 1%	Tb 22%	Dy 0%	Ho 1%	Er 0%	Tm 1%	Yb 1%	Lu 1%
[2]Group of Actinide	Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

Aggregates	Bentonite	Coaking Coal	Diatomite	Feldspar	Gypsum	Kaolin Clay	Limestone	Magnesite	Natural Cork	Natural Graphite	Natural Rubber	Natural Teak Wood	Perlite	Sapele wood	Silica Sand	Talc
7%	50%	0%	0%	10%	1%	0%	58%	2%	8%	3%	1%	0%	42%	15%	0%	5%

* F = Fluorspar; P = Phosphate rock; K = Potash, Si = Silicon metal, B = Borates.

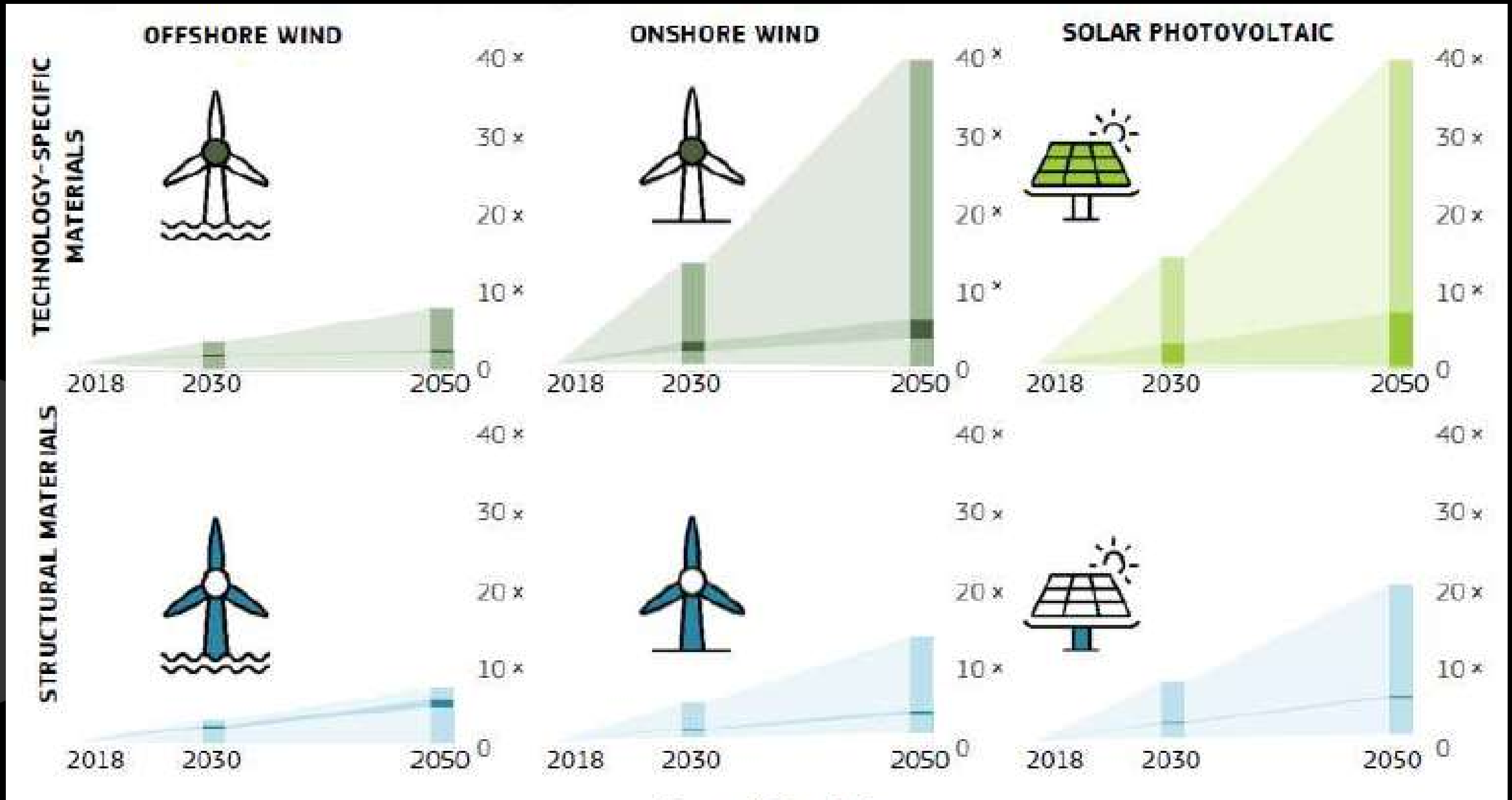


3rd Raw Materials Scoreboard (2021)

What is the Energy Transition?

Energy transition refers to the global energy sector’s shift from fossil-based systems of energy production and consumption — including oil, natural gas and coal — to renewable energy sources like wind and solar, as well as lithium-ion batteries

With a severe impact in the demand for raw materials needed for each type of renewable energy type :



Source: JRC analysis.

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A wind turbine as an example

produced depends on the size of the turbine

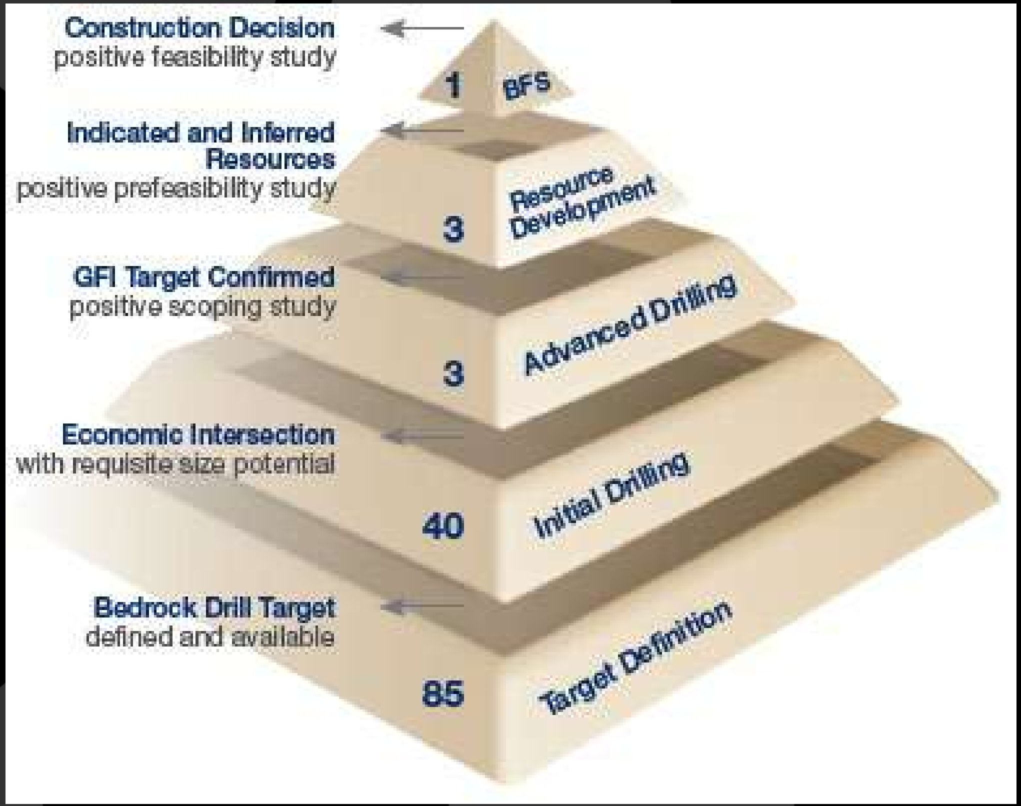
- Larger turbines = more raw materials

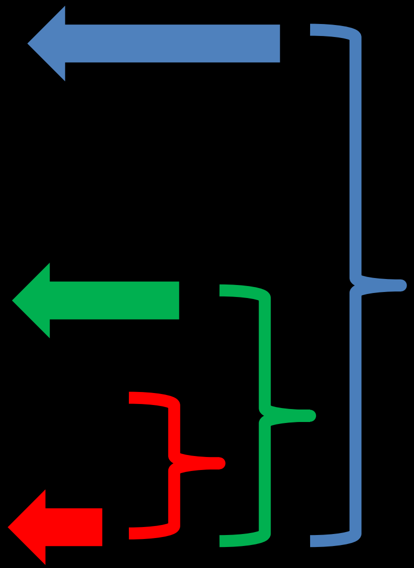
Iazzotta B. an…
…sed energy system, EU…
…, doi:10.2760/160859, JRC1…

Materials used in wind turbine manufacture

- Steel
- Polymers
- Glass/carbon composites
- Aluminium (Al)
- Boron (B)
- Chromium (Cr)
- Copper (Cu)
- Dysprosium (Dy)
- Iron (cast) (Fe)
- Manganese (Mn)
- Molybdenum (Mo)
- Neodymium (Nd)
- Nickel (Ni)
- Praseodymium (Pr)
- Terbium (Tb)
- Zinc (Zn)

The Role of the Geological surveys





Companies do target definition:

- Delineate regions of interest,
- more detailed geophysics,
- Mapping,
- Sampling

Essential work by the surveys BEFORE target definition:

- Regional geophysics,
- Regional geochemistry,
- Analytical work,
- Mapping,
- Geochronology,
- Geochemistry (detail),
- Petrography,
- Detailed mapping

Limits of geological survey intervention (?)

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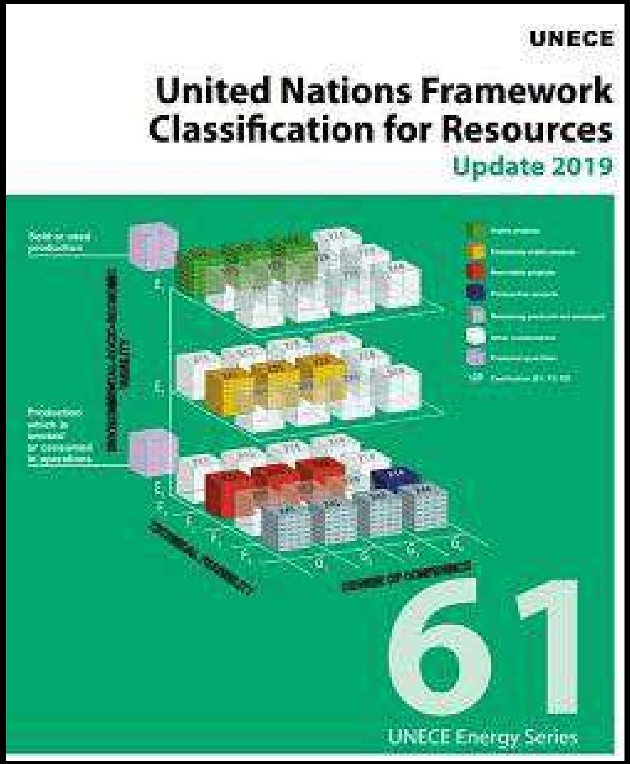
The Role of the Geological surveys

- **Survey data** (geophysics, geochemistry, geochronology, remote sensed data)
- Knowing and understanding the subsurface environment
  MAPS
- Understanding the metallogenic processes that give rise to ore deposits
  MODELS
- Inventorying the subsurface for (CRM & SRM) mineral deposits
  INVENTORY
- Turning individual small data packages into large data packages
  DATA HOMOGENISATION
- **UNFC** classification



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The Role of the Geological surveys

Key roles

- Collecting and understanding data
- Sharing knowledge and best practices
- Collaborating on cross-border projects
- Advising local, regional and national authorities to maintain access to the territory
- Advise other national surveys on the CRM potential in their countries

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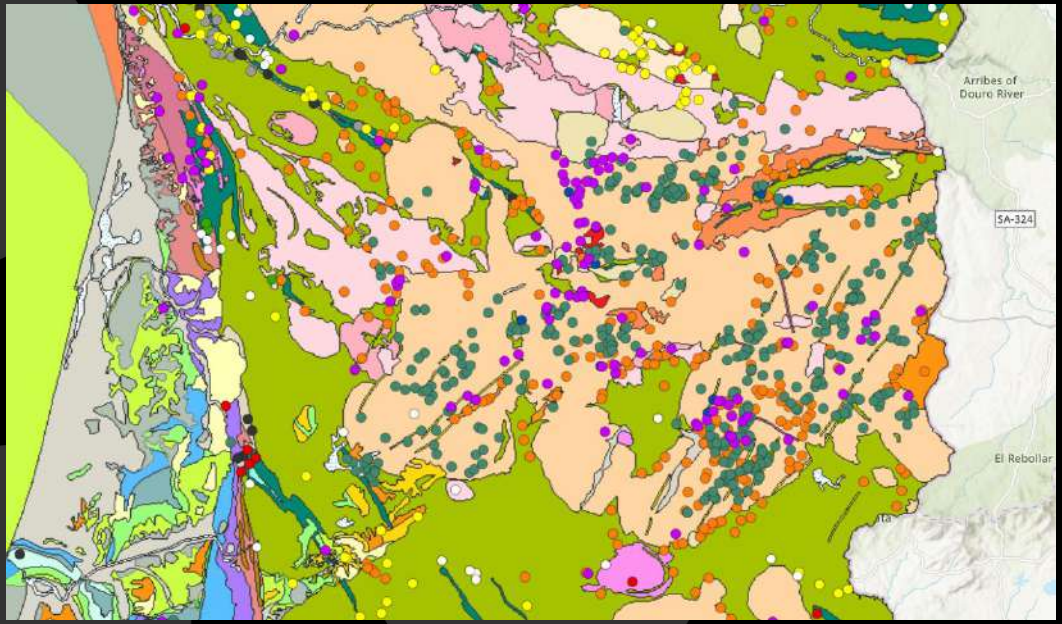
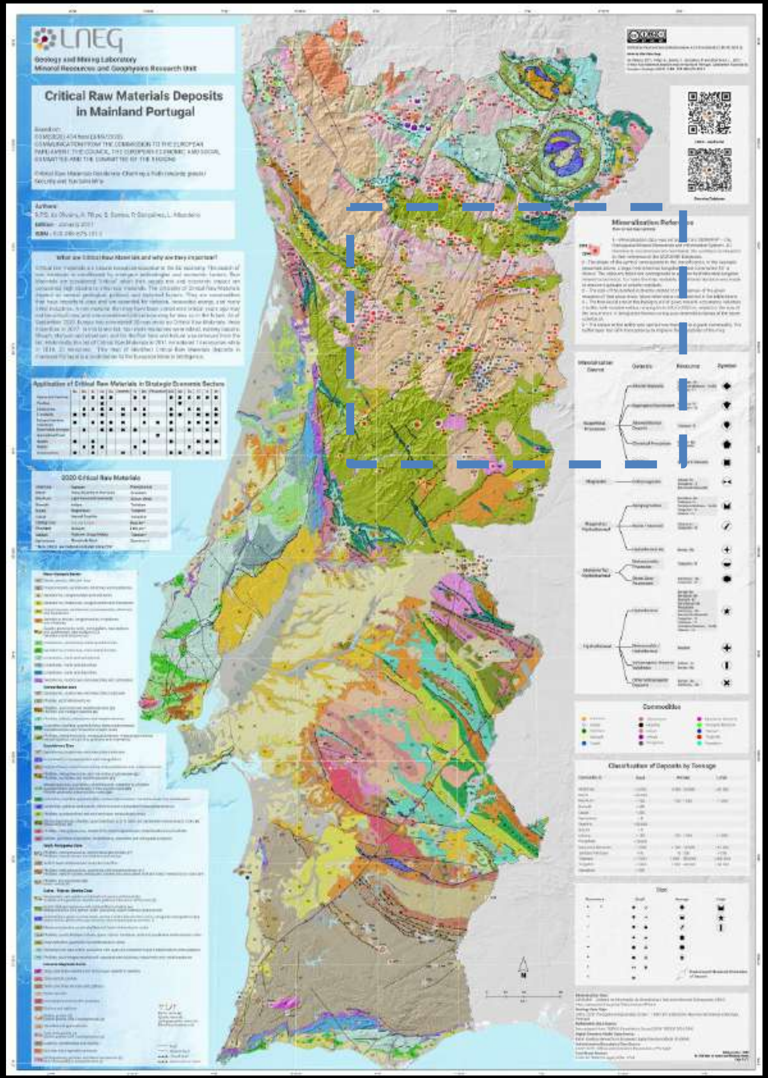
The Role of the Geological surveys

Inventorying the subsurface for (CRM & SRM) mineral deposits



SIORMINP Data - https://geoportal.lneg.pt



https://www.lneg.pt/product/critical-raw-materials-deposits-in-mainland-portugal/

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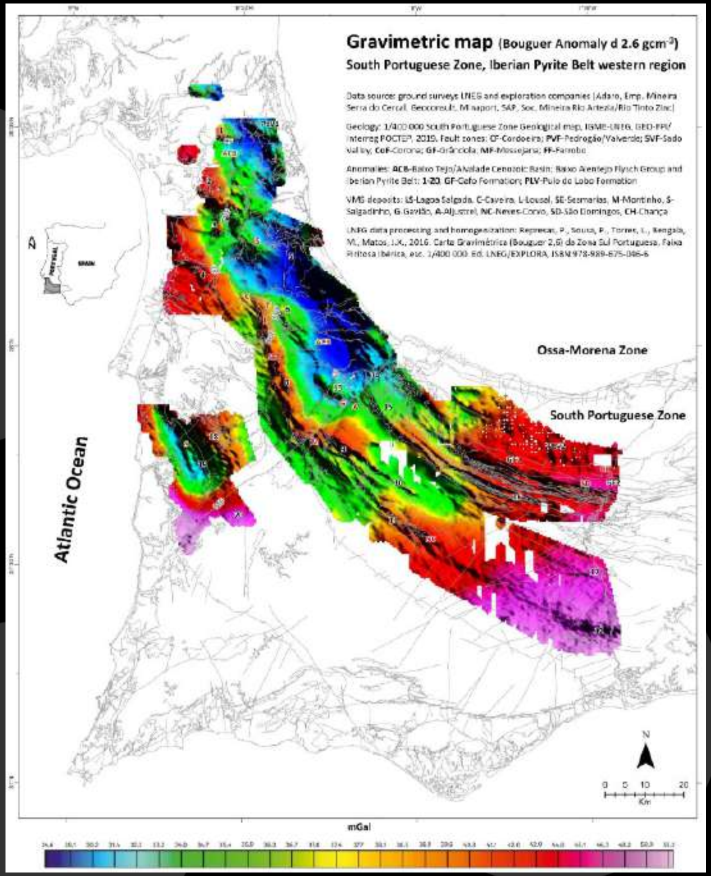
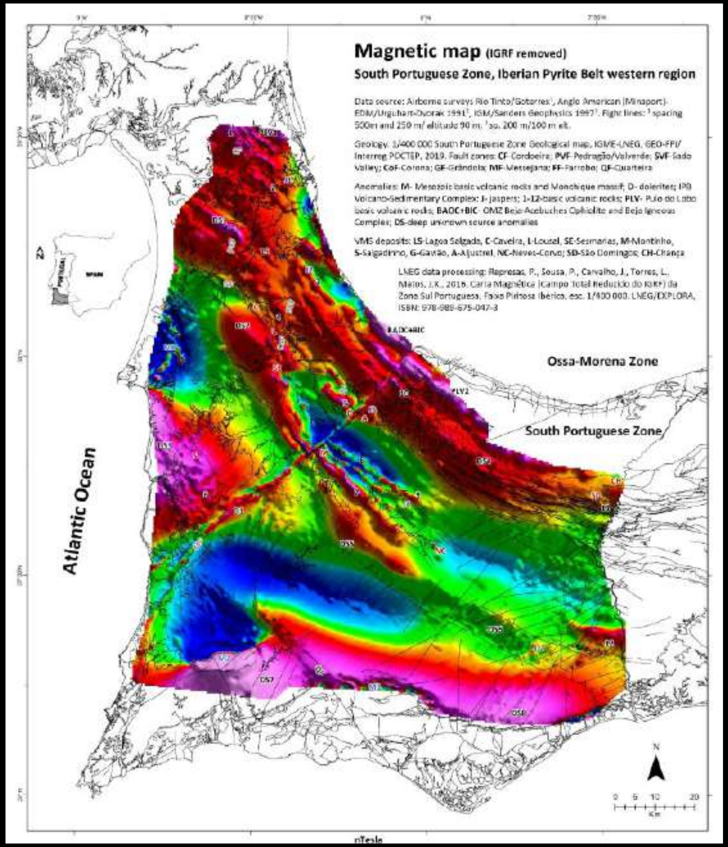
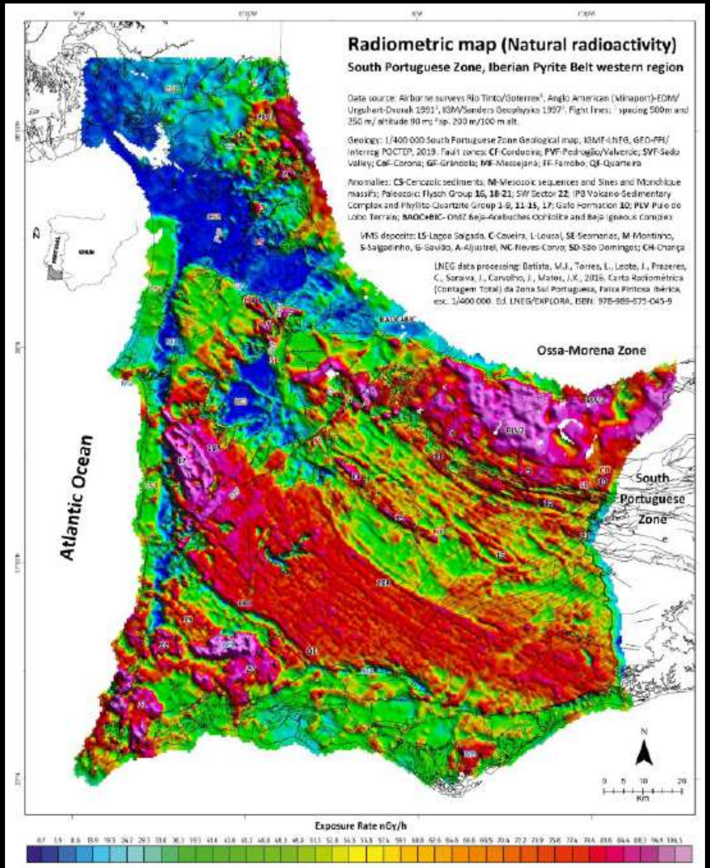
The Role of the Geological surveys

Matos et al., 2020. Comunicações Geológicas 107, Especial III, 41-78







https://www.lneg.pt/wp-content/uploads/2020/11/05_Matos-et-al_2020_107_III_41-78.pdf

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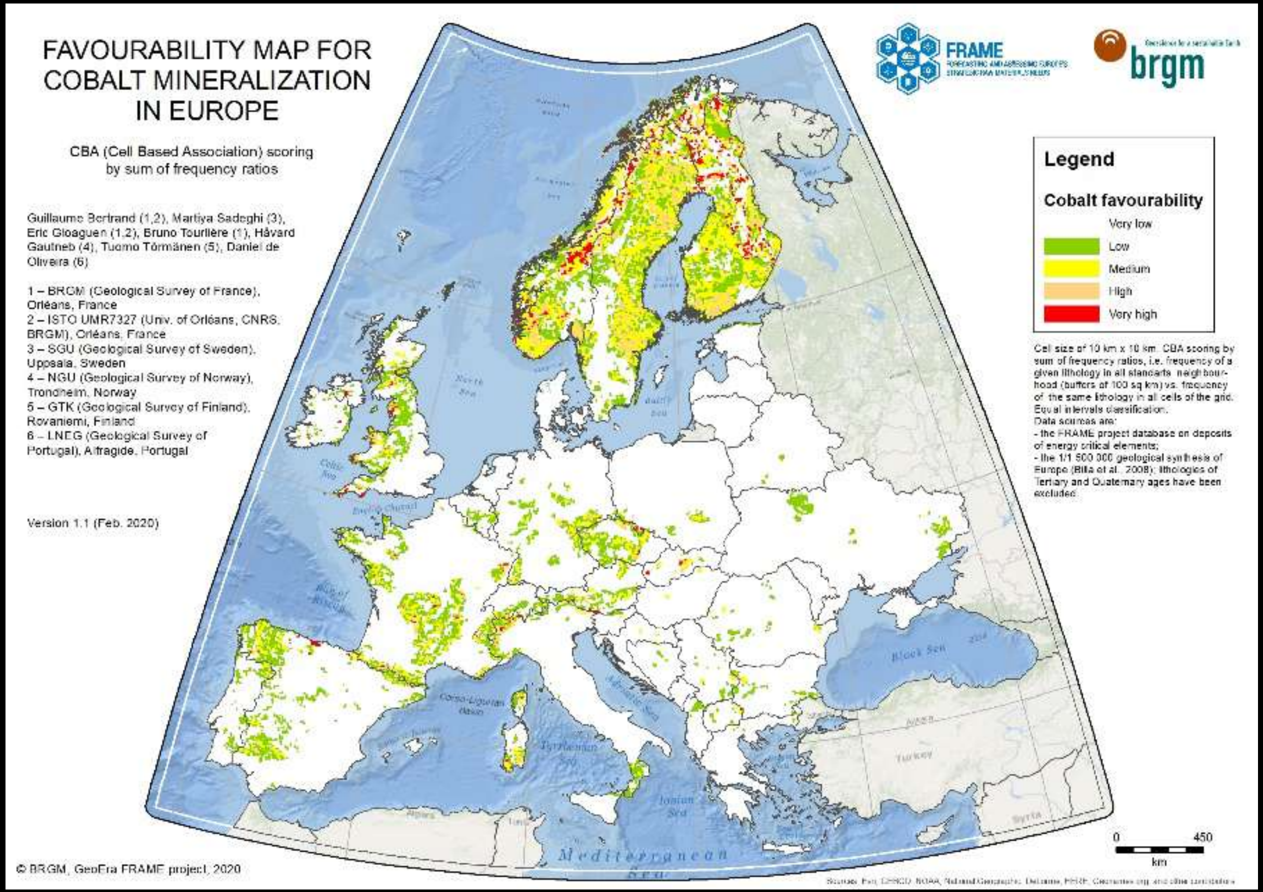
The Role of the Geological surveys

- National programme for general exploration targeted at critical raw materials
- Increase available information on the Union's critical raw material occurrences

  (a) Mineral mapping at a suitable scale
  (b) Geochemical campaigns
  (c) Geoscientific surveys
  (d) Processing of the data and **predictive maps**
  (e) Reprocessing of existing geoscientific survey data

- Make the information publicly available on a
- **Free access website**
- **Cross border cooperation**



https://www.europe-geology.eu/
https://doi.org/10.3390/materproc2023015024
http://info.igme.es/visor/?Configuracion=geo_fpi

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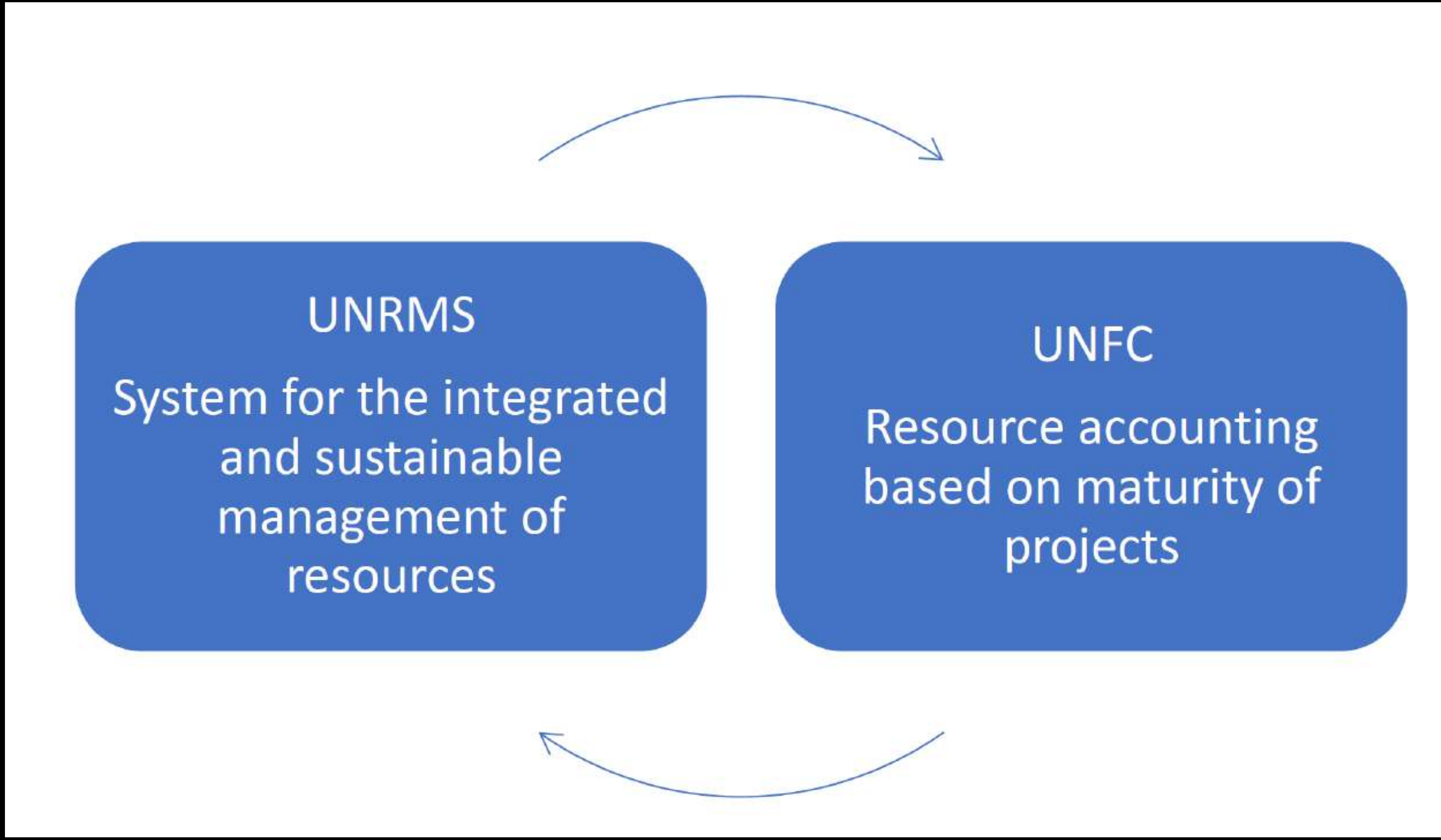
What is UNRMS to the 2030 Agenda?

UNECE

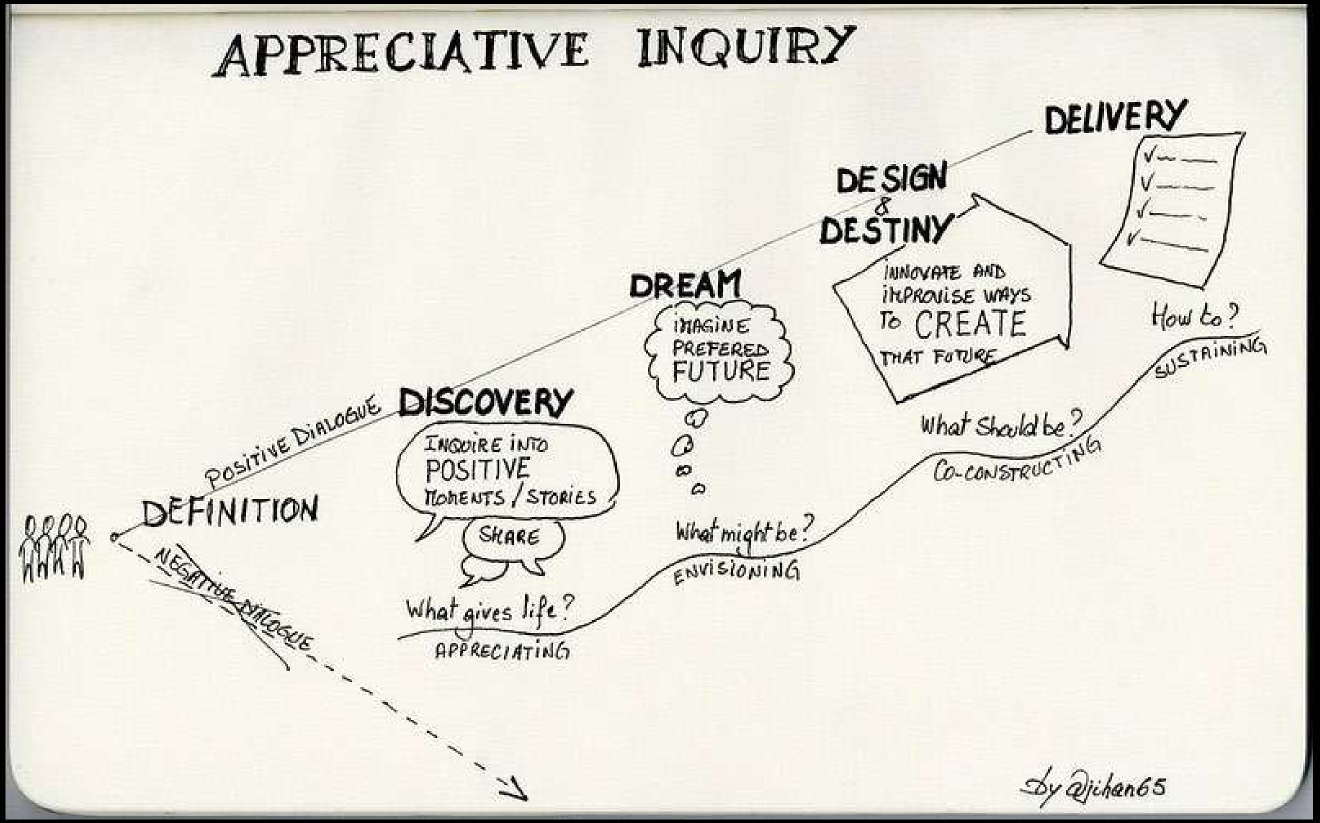
- UNRMS is a **framework** to assure that resources are produced and utilized in a sustainable manner.
- Comprehensive, sustainable RMS that supports and enables the implementation
- Meets specific governmental requirements for supporting and mediating the supply, the use and the value-chain of natural resources
- Voluntary global standard for integrated and sustainable development of resources.
- Principles-based, so could serve different needs of stakeholders.

UNRMS builds on the strengths of UNFC



Discovering long-term value

- The appreciative inquiry (AI) involves concentrating on the strengths, positive attributes and potential of a project rather than weaknesses.
- AI focuses on the whole organization on identifying its greatest assets, capacities, capabilities, resources, and strengths – to create new possibilities for change, action, and innovation.
- A natural resource project does not exist in isolation rather within a network of people.
- People, service and experience – A new pathway for resources.



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RESEARCH FOR **SUSTAINABILITY**

ENERGY AND GEOLOGY BUILDING A **CLEANER, BETTER FUTURE**

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