



GSEU

GEOLOGICAL SERVICE | FOR EUROPE

High Quality Subsurface Data & Expert Knowledge for EU Energy Policy Makers & Industry

07/03/2024

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Julie Hollis – EGS

www.geologicalservice.eu





Why a Geological Service for Europe?

FINANCIAL TIMES
EU sounds alarm on critical raw materials shortages

Forbes
We Have An Energy Storage Problem

Europe's groundwater – a key resource under pressure

Europe's groundwater — a key resource under pressure

European Environment Agency 



REUTERS

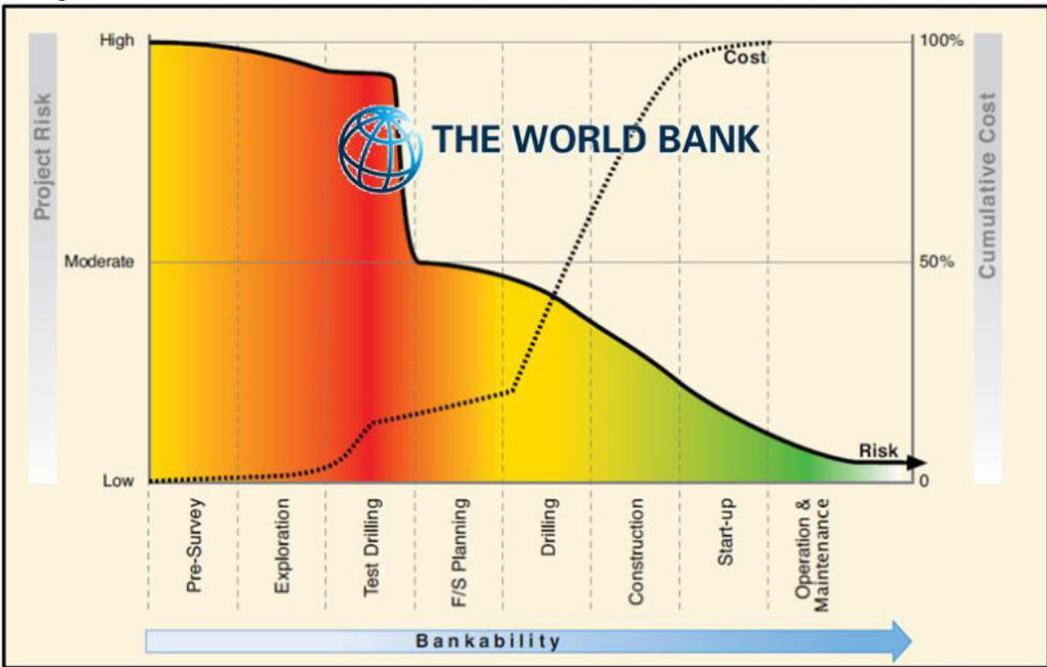
THE WALL STREET JOURNAL.
HEARD ON THE STREET
Critical-Mineral Diplomacy Needs to Focus on Supply, Not Demand
U.S. and EU talk of collaborating to ensure energy security in the renewable age. A bigger priority should be strengthening trade links with big mining nations.

SPIEGEL International

The Global Competition for Raw Materials

Europe at Risk of Losing the Lithium Race

Without lithium, copper and rare earths, our mobile phones, electric cars and wind turbines wouldn't function. Currently we are almost exclusively dependent on China for these critical raw materials. But there might be a way out.



Η ΚΑΘΗΜΕΡΙΝΗ
Η Ε.Ε. ψάχνει στην Ελλάδα κρίσιμες πρώτες ύλες
Επιχείρησ Μυτιλήνης - Κομισιόν για την παραγωγή γαλλίου στη Βοιωτία

LA TRIBUNE
PARTAGÉONS L'ÉCONOMIE
Semi-conducteurs : la prochaine crise viendra-t-elle de l'accès aux métaux stratégiques ?

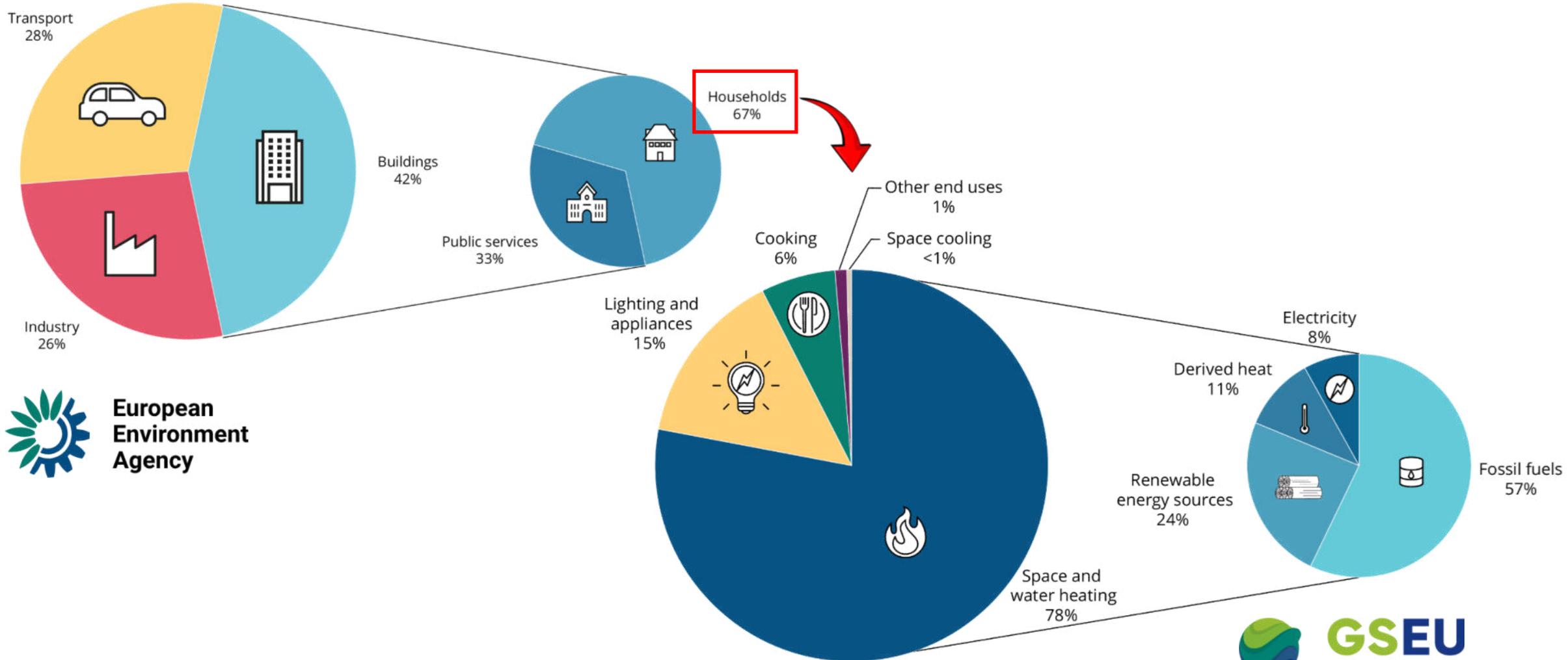
EL PAÍS
La falta de materias primas y la competencia de EE UU amenazan la producción europea de baterías



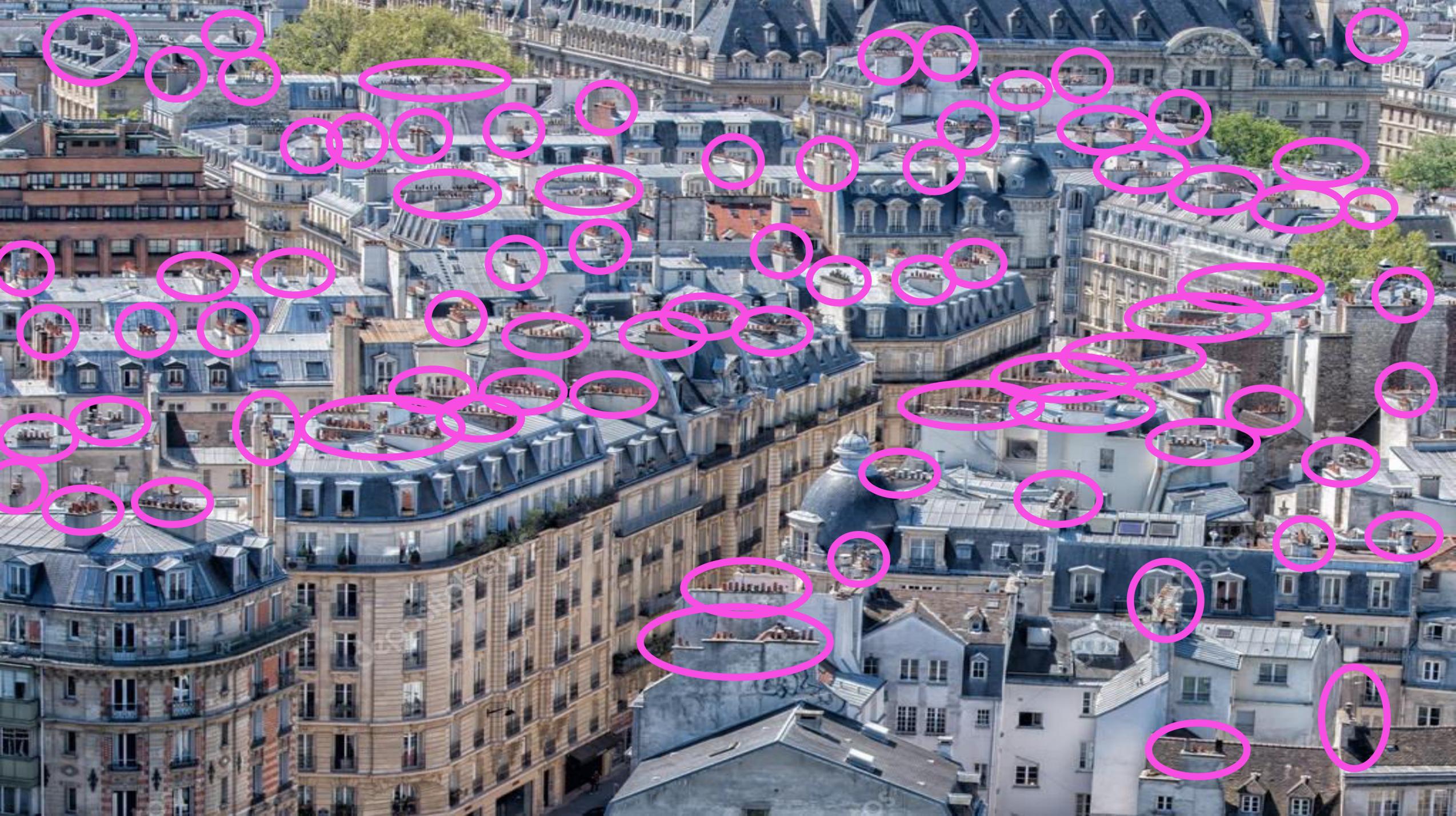
**There is a Critical Need for
High-Quality Subsurface Data!**



EU Energy Consumption by Sector

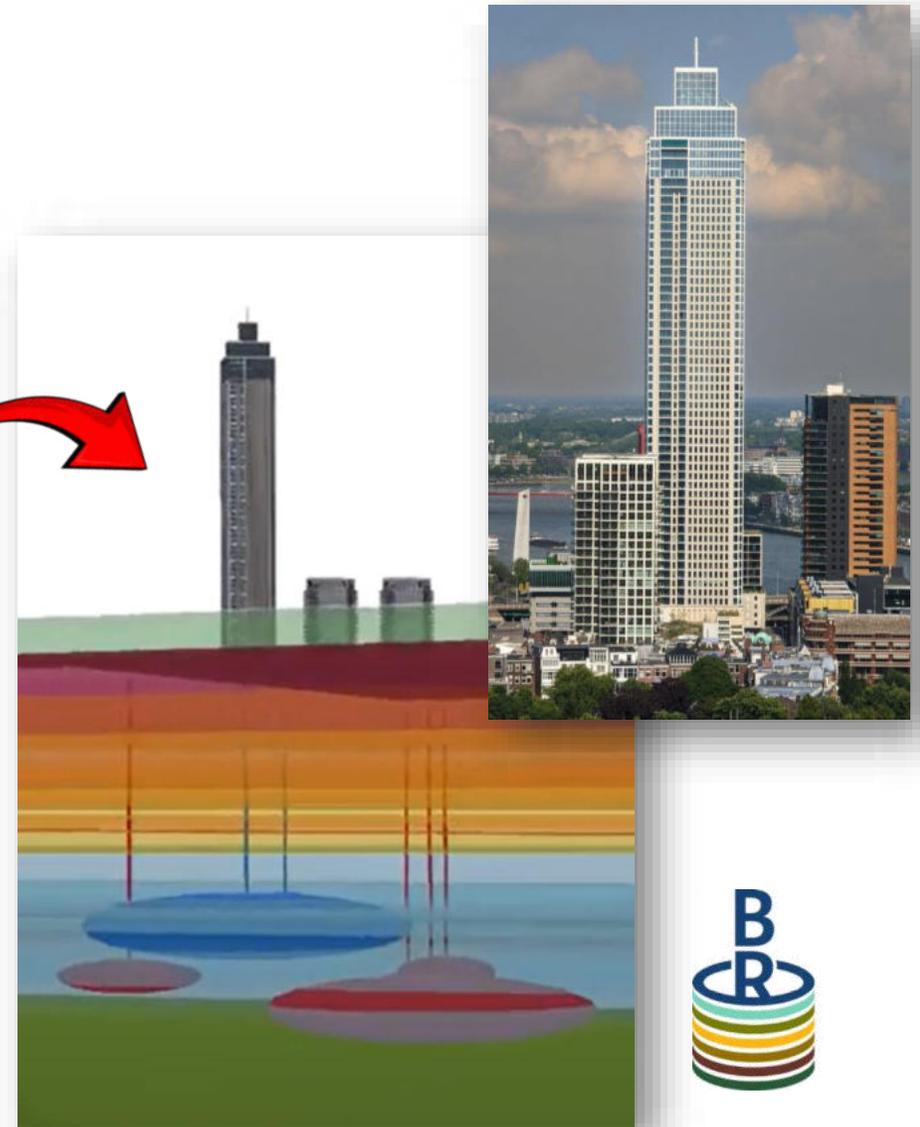
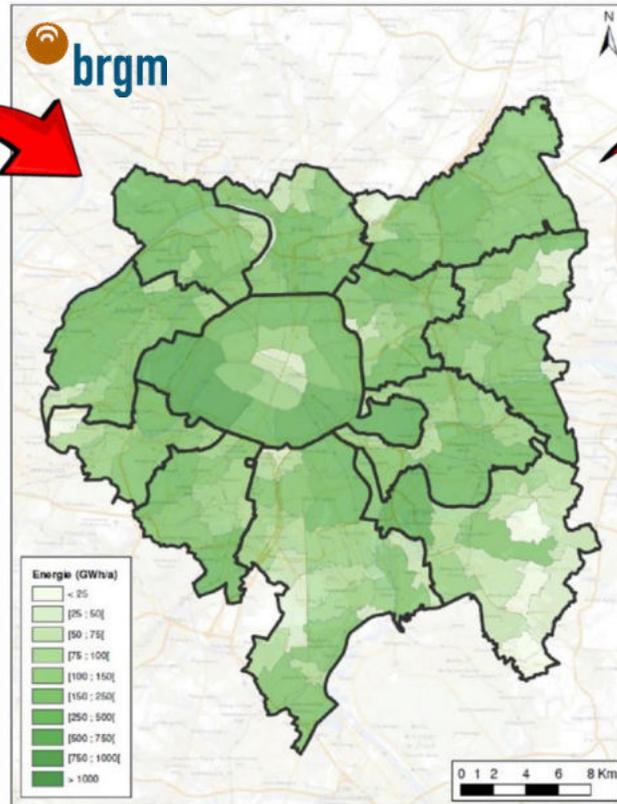
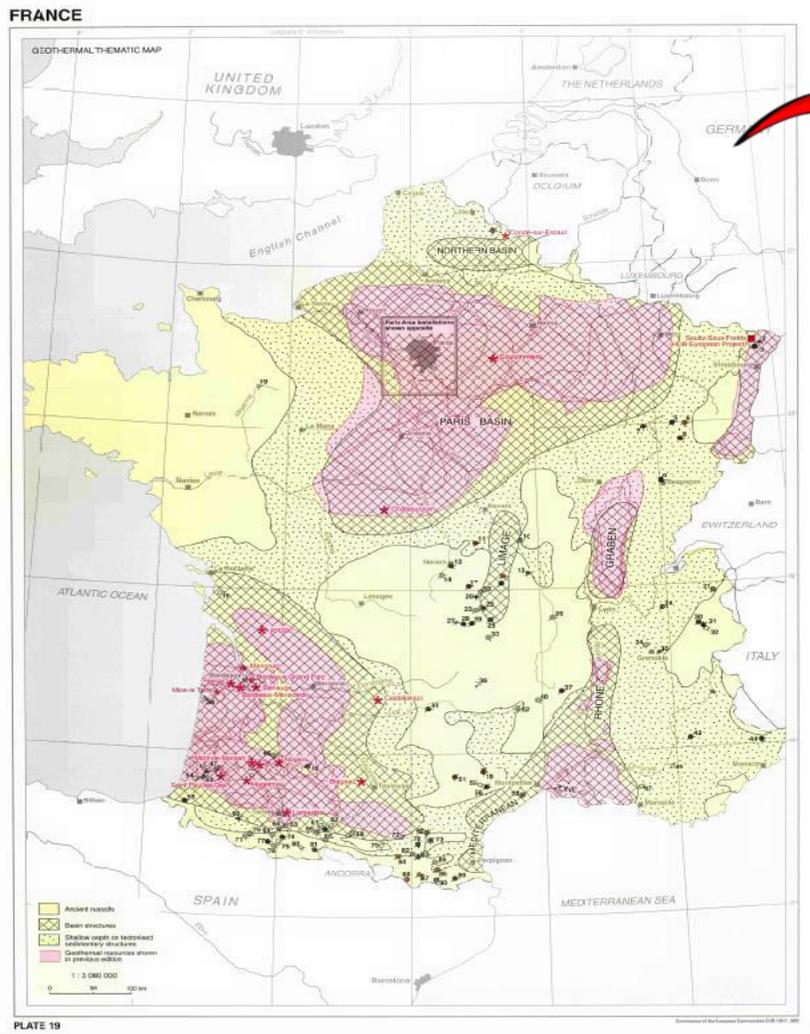








Decarbonizing Heating & Cooling



- Reducing Environmental Risks
- Reducing Public/Private Investment Costs
- Improving Air Quality





There is a Critical Need for High-Quality Subsurface Data!

building
a high quality database,
standardised vocabulary,
shared principles and
open framework -
for everyone



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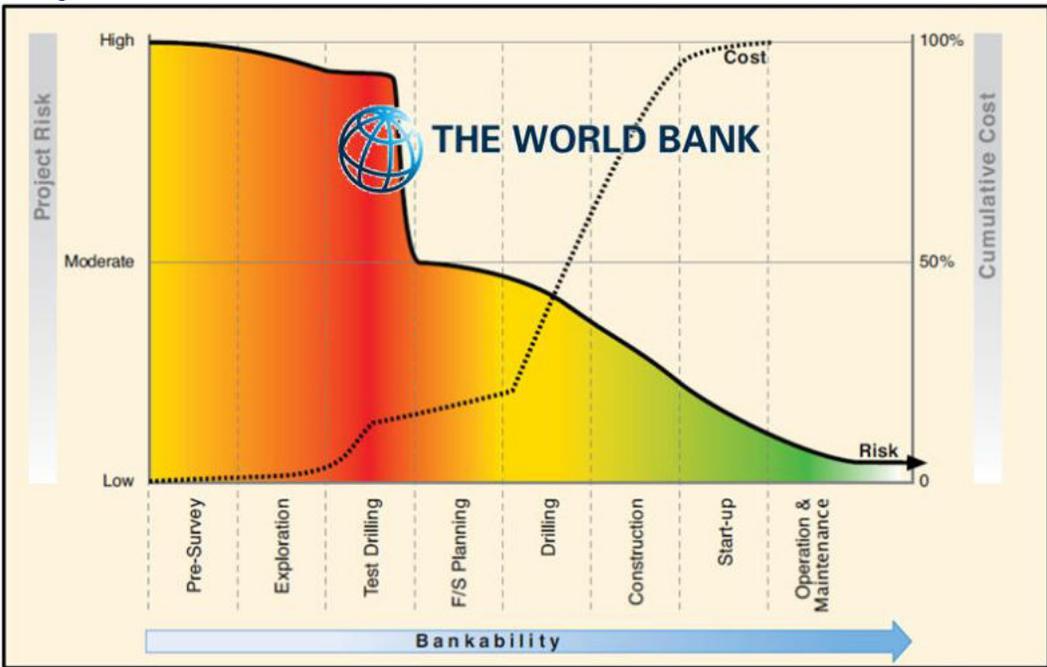
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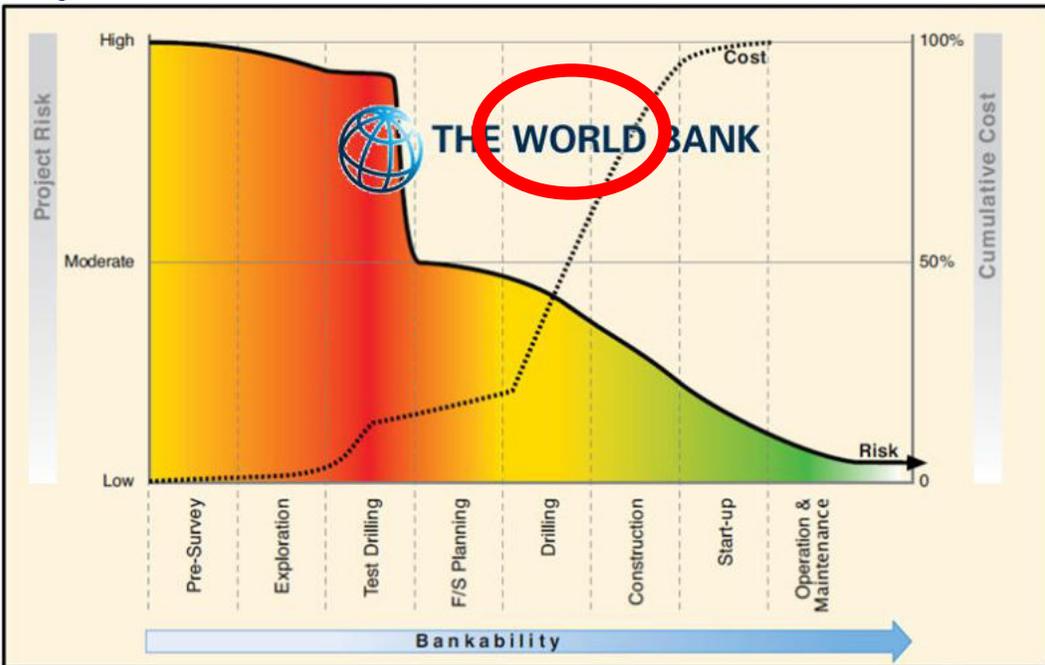
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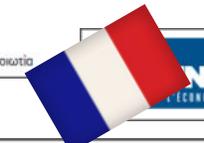
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**Pan-European problems require a
pan-EU efforts and solutions!**

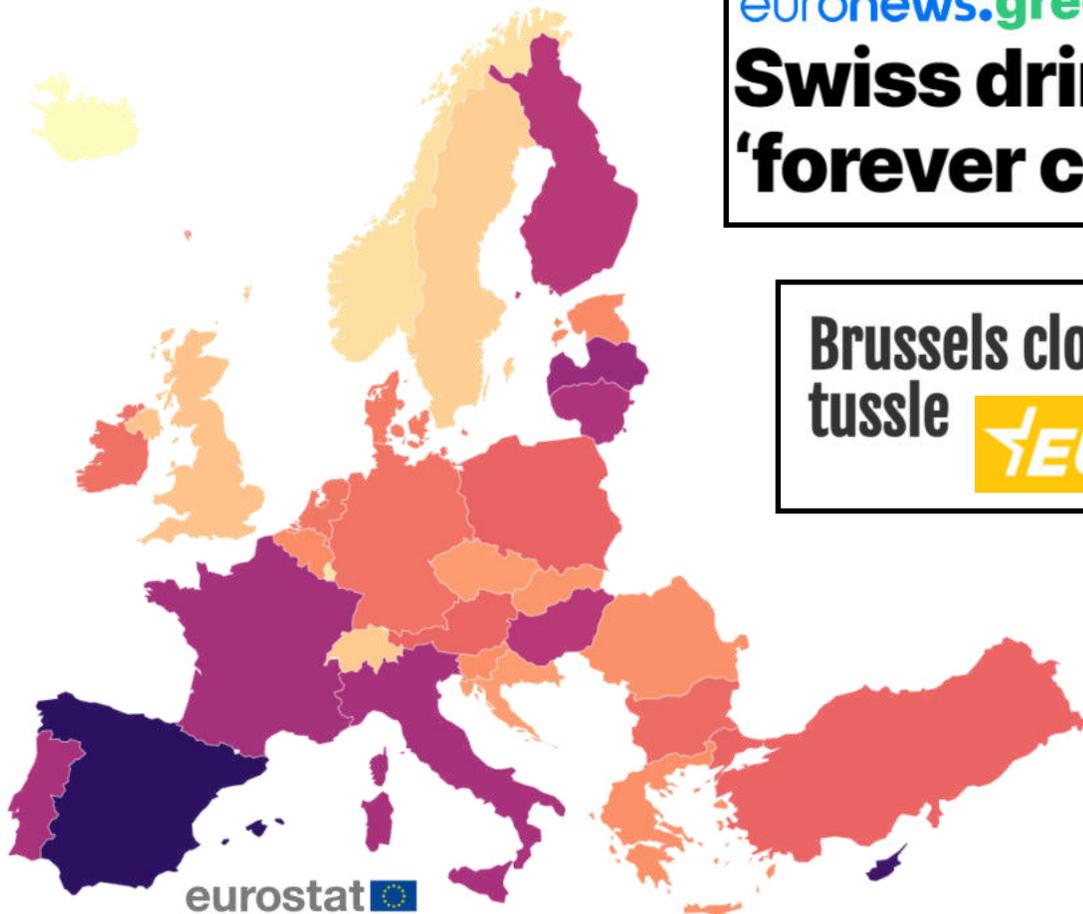


EU Groundwater Pollution

Pesticide sales by inhabitant in Europe

Kilograms per capita of pesticide sold in Europe in 2020.

Kg per capita



eurostat

independent media for better debate
eureporter

Preventing groundwater and surface waters pollution in the EU

euronews.green

Swiss drinking water is contaminated with 'forever chemicals', research shows

Brussels closes German nitrate pollution case after decade-long tussle

EURACTIV

65%

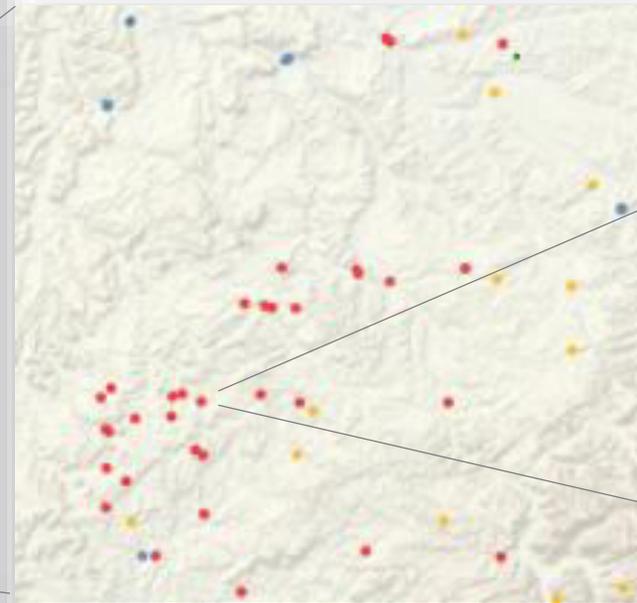
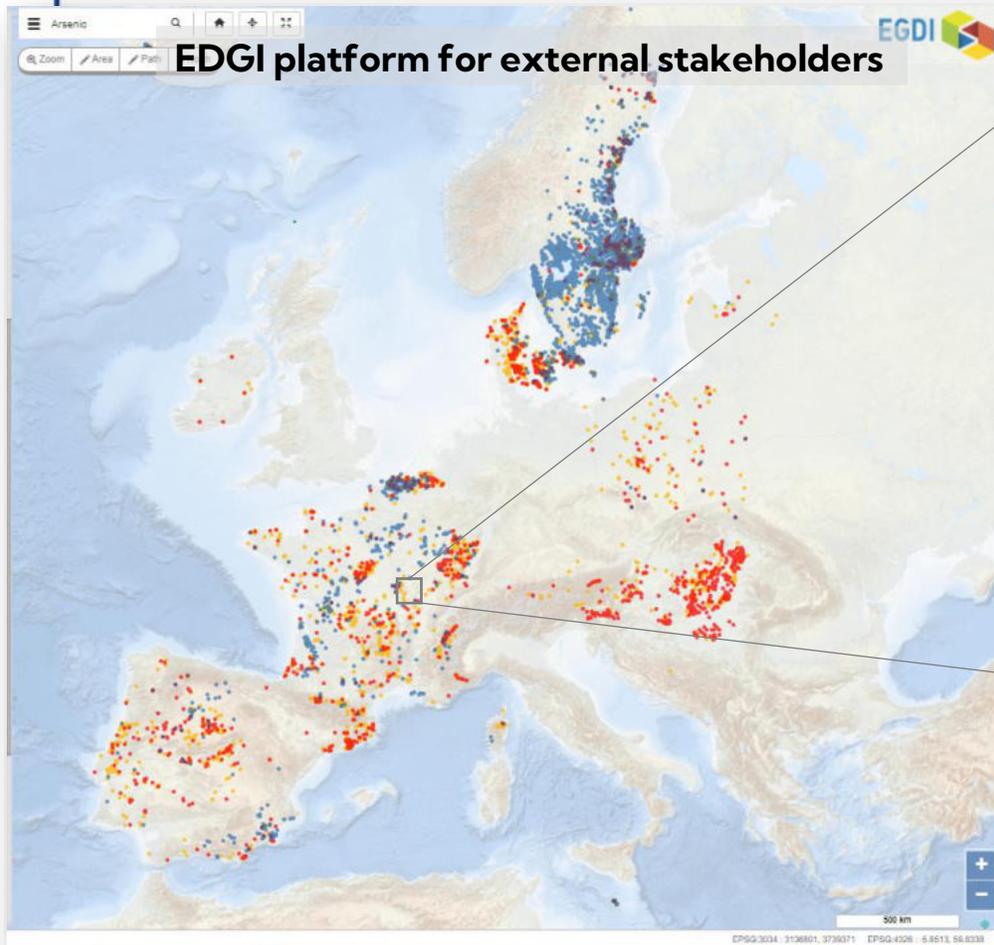
of drinkable EU water comes from the subsurface



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GEOLOGICAL FOR SERVICE EUROPE

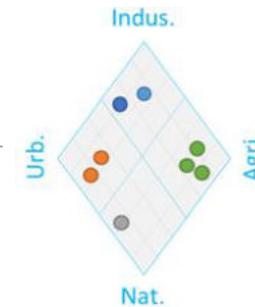
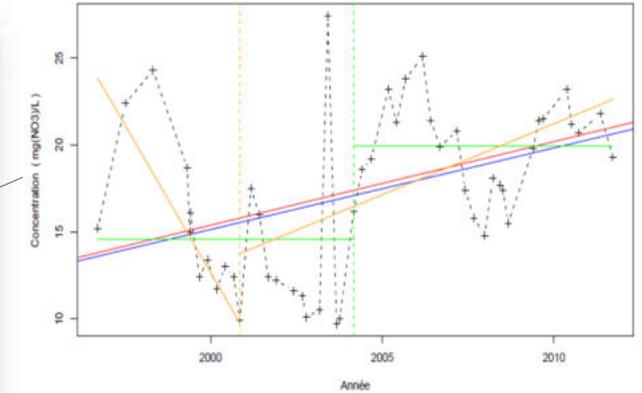


EU Groundwater Quality Patterns and Trend Identification



Groundwater Quality Monitoring Points

Nitrates trend analysis based on state-of-the-art machine learning aided techniques and geostatistical



Anthropogenic groundwater facies at certain location



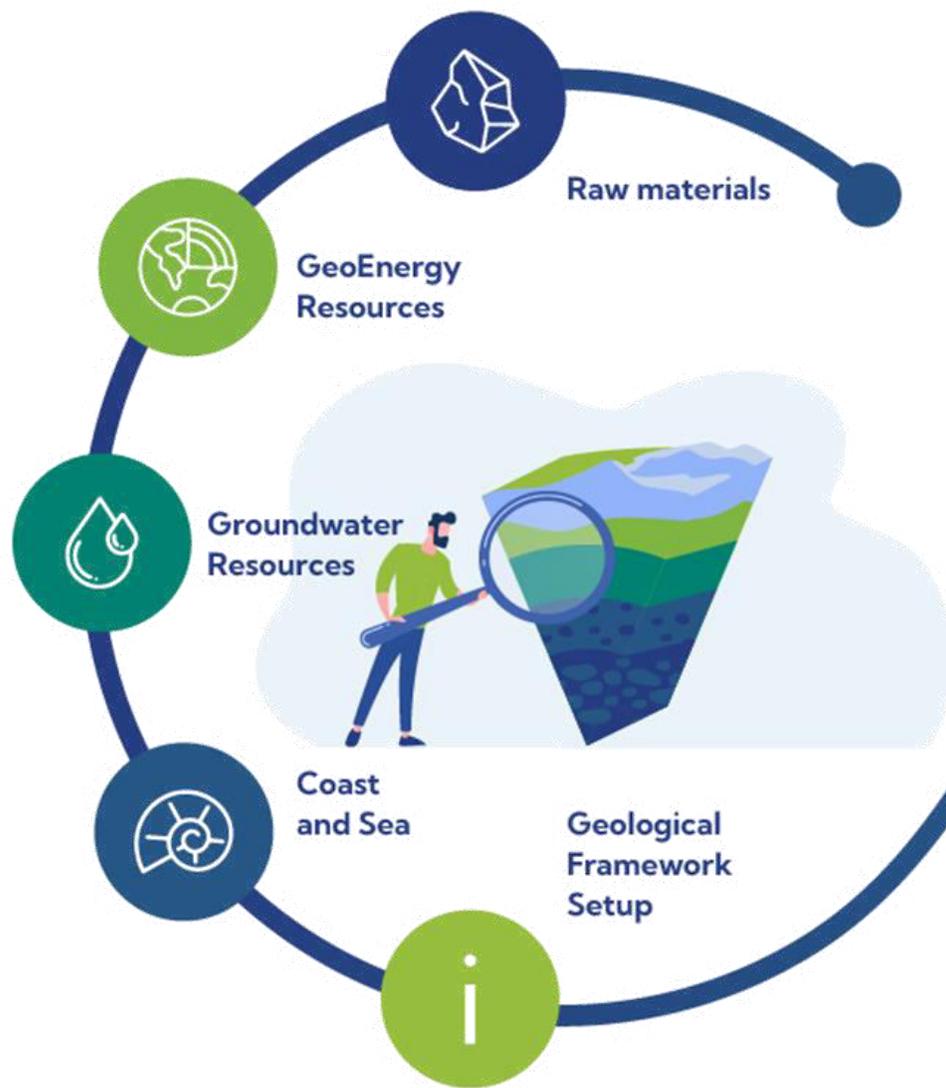
**Pan-European problems require a
pan-EU efforts and solutions!**



48 Partners
from
35 Countries



Approach & Mission





European Green Deal

Approved in 2020, the European Green Deal is the **EU's blueprint for climate neutrality** by 2050.

It involves **reviewing** existing **laws** on their **climate merits** and introducing legislation on circular economy, building renovation, biodiversity, farming, and innovation.

The goal is to **achieve net-zero** greenhouse gas emissions **by 2050**, with a focus on decarbonizing the energy system.

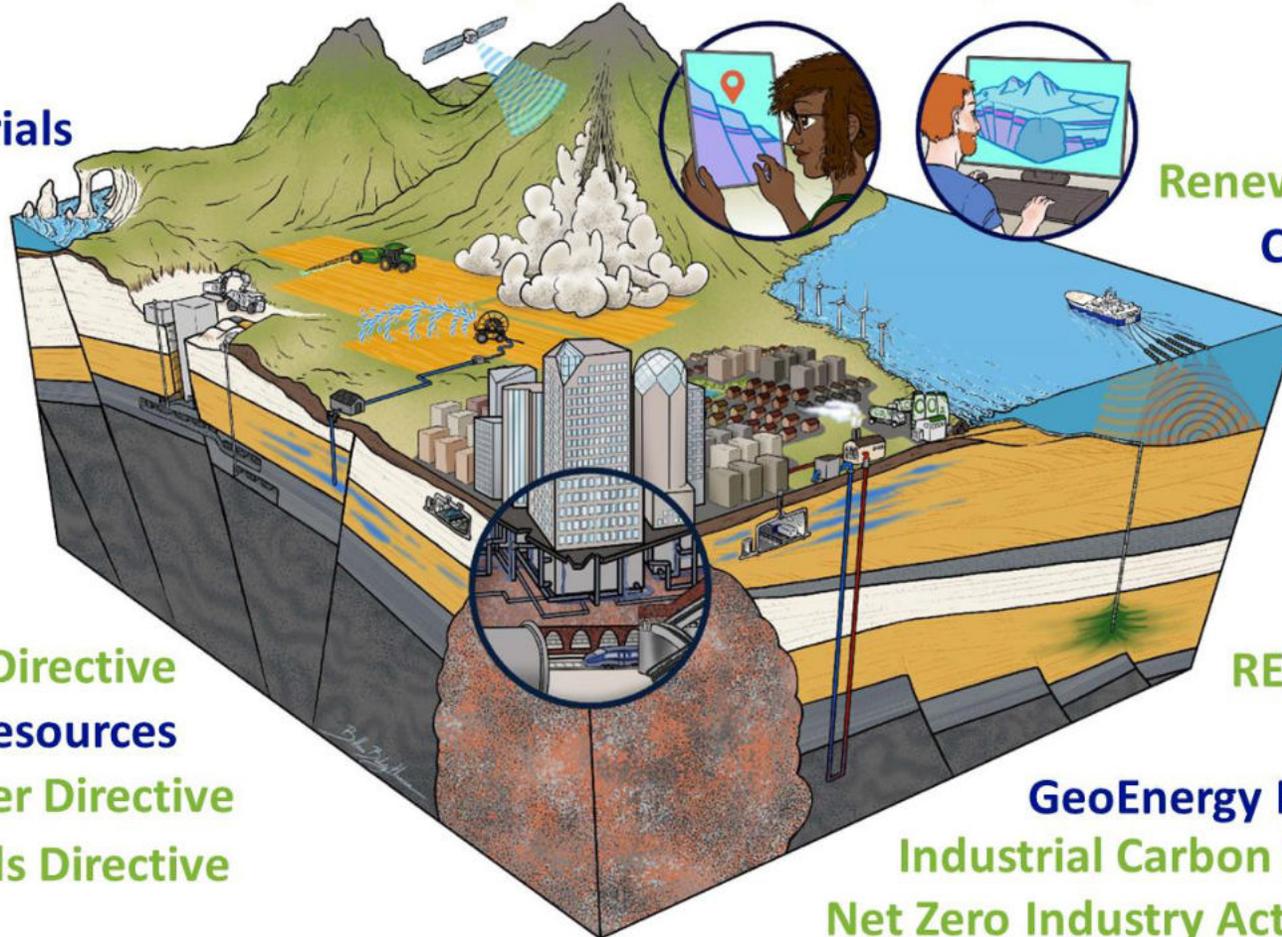




Green Deal Policy & Earth Systems are Interconnected

INSPIRE Directive Geological Framework Setup European Data Strategy

Critical Raw Materials
The Critical Raw Materials Act



Renewable Energy Directive
Coastal vulnerability &
Windfarm siting
Marine Strategy

Water Framework Directive
Groundwater Resources
Groundwater Directive
Floods Directive

REPower EU

GeoEnergy Resources
Industrial Carbon Management Strategy
Net Zero Industry Act



From Geological Data to Policy & Society Support

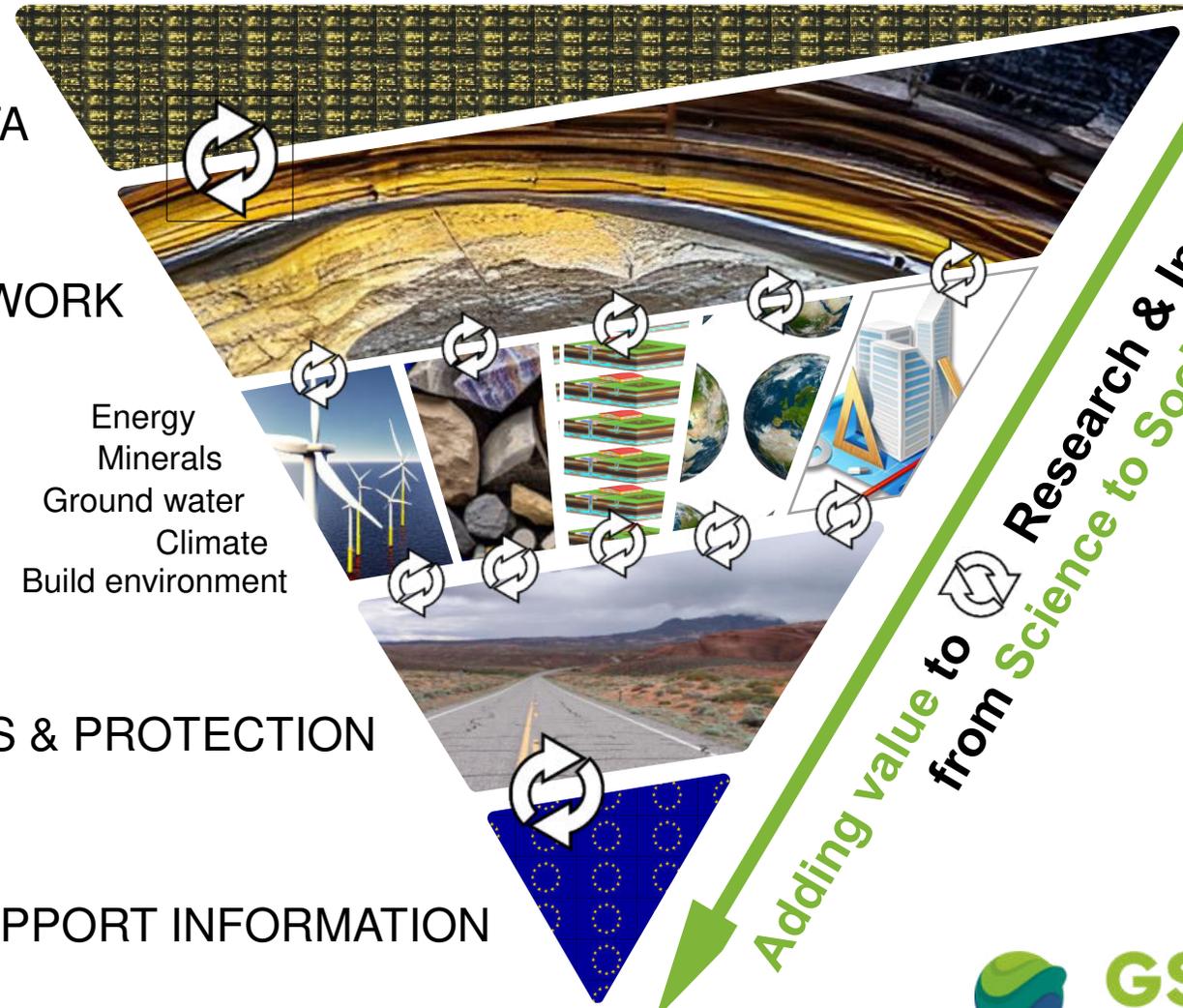
INTEROPERABLE GEOLOGICAL DATA

3D GEOLOGICAL FRAMEWORK

Energy
Minerals
Ground water
Climate
Build environment

IMPACTS & PROTECTION

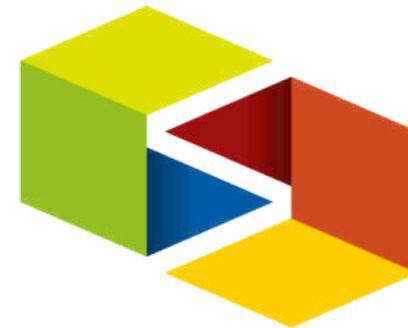
DECISION SUPPORT INFORMATION



*Adding value to Research & Innovation:
from Science to Society*



EGDI



<https://www.europe-geology.eu/>



GSEU
GEOLOGICAL FOR
SERVICE EUROPE



The European Geological Data Infrastructure (EGDI)

TOOLS FOR SEARCHING AND SHOWING DATA



SCIENTIFIC THEMES



Data search

You are here: Home / Tools for searching and showing data / Data Search

Allows users to discover and access available datasets, view their metadata and select, display and download subsets of elements from multiple datasets. Datasets that do not contain in their metadata or their data exactly the terms the user typed in the search can be found because semantically similar words from the Thesaurus are incorporated in the search.

Type your search text

Search Filter

EGDI - All maps



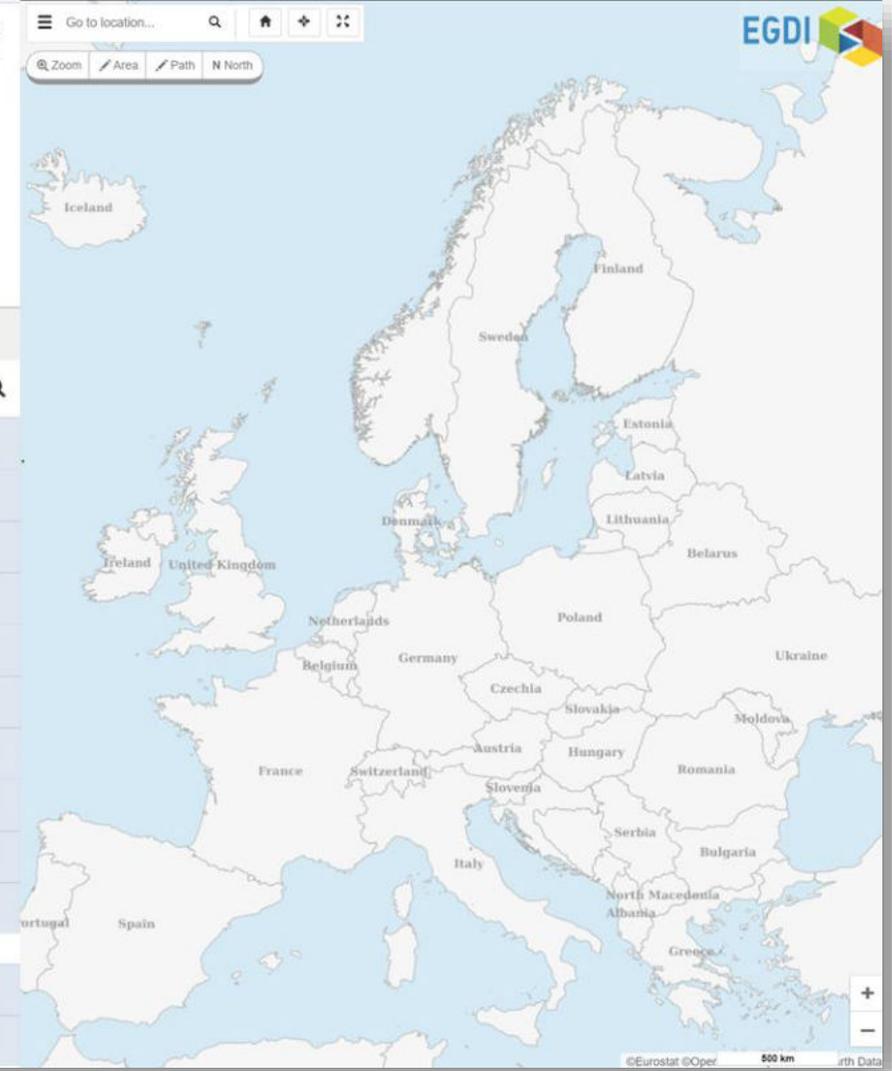
This map shows available data products registered in EGDI.

+ Base layers

Layers

Layer search...

- + Basic Geology
- + Marine Geology
- + Mineral Resources
- + Earth Observation - Geohazards
- + GeoEnergy
- + Geochemistry
- + Groundwater
- + Geophysics
- + Boreholes
- + Geographical topics
- + Search EGDI metadata catalogue
- + Add your own data (WMS)

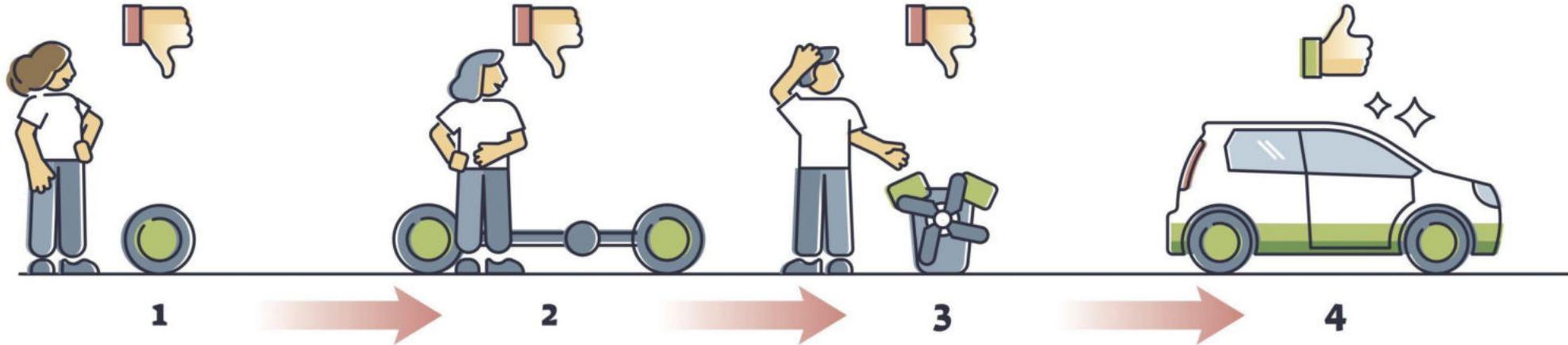


<https://www.europe-geology.eu/>

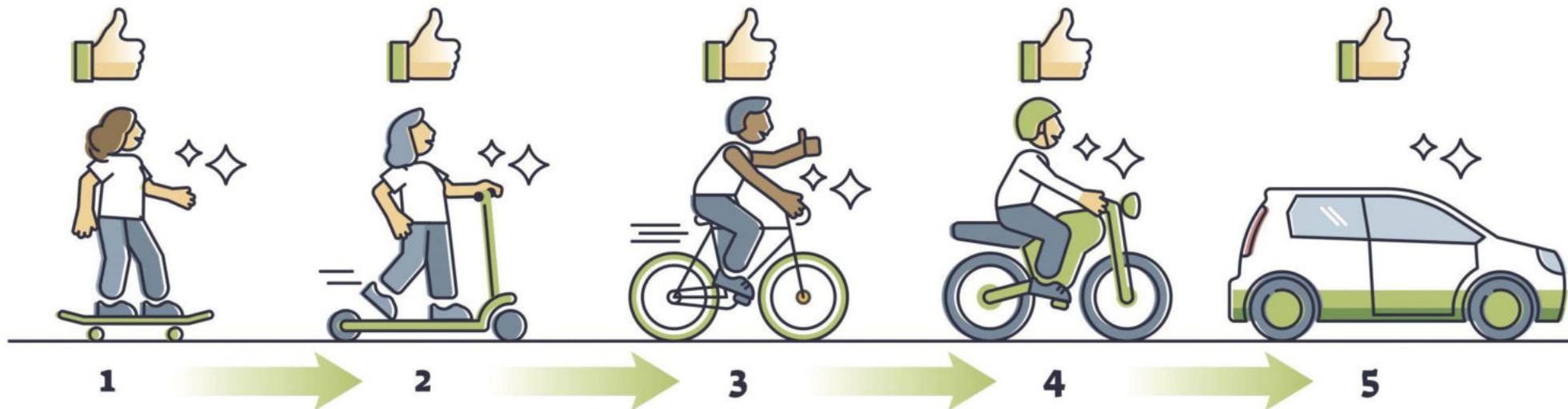


HOW TO BUILD A MINIMUM VIABLE PRODUCT

NOT LIKE THIS

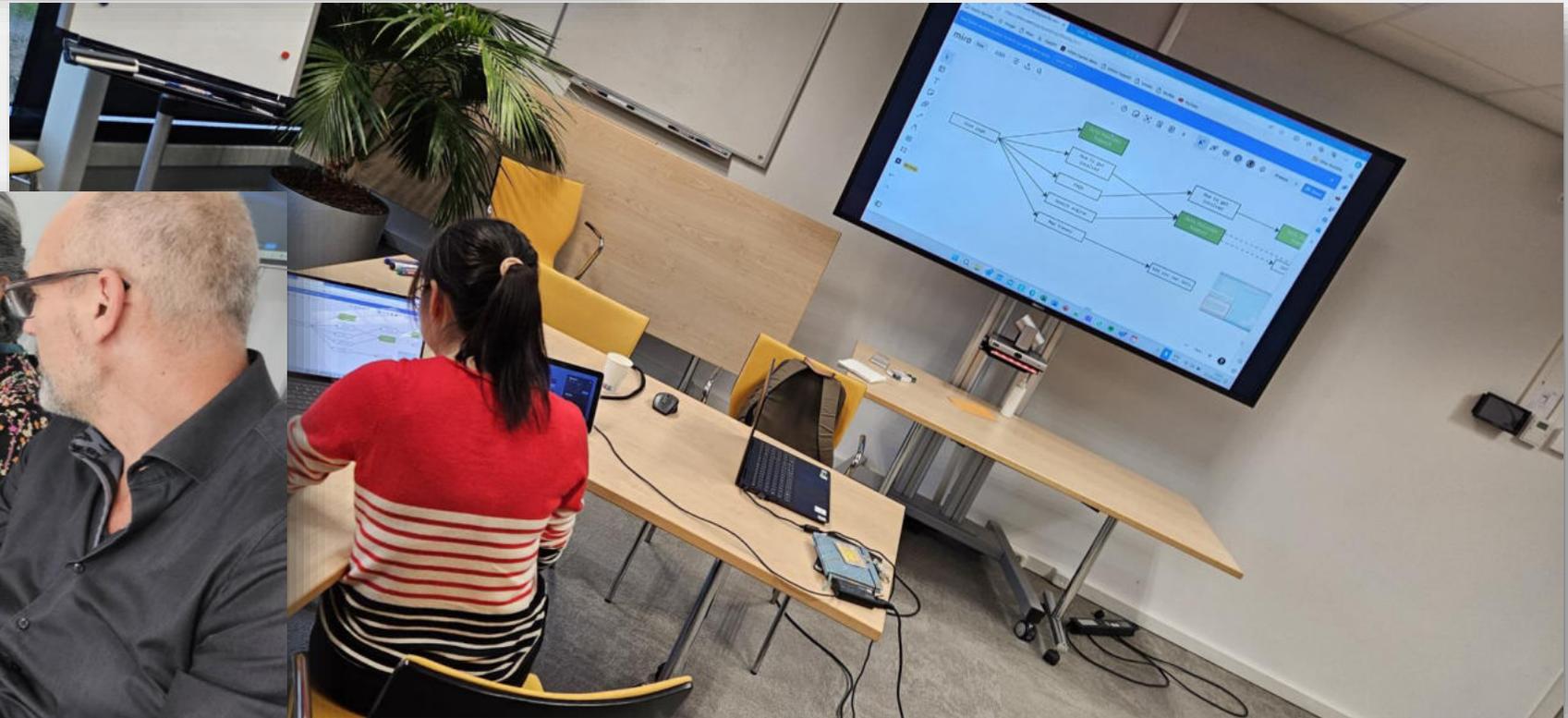


LIKE THIS





Users Test



GOAL – Collect Data to:

- Improve Usability & Clarity
- Simplify the System
- Extend Users Groups
- Tailor Results Visualization



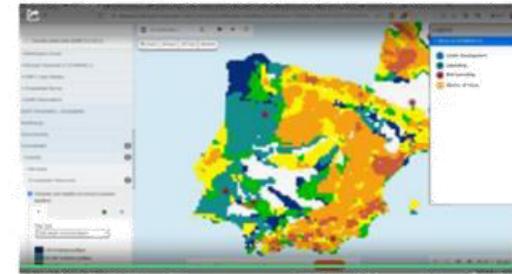
Users Test – Results



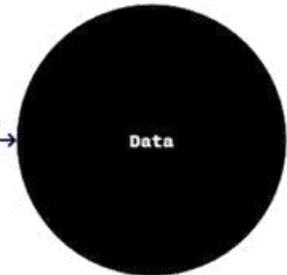
Home page



The first adapter



The second adapter

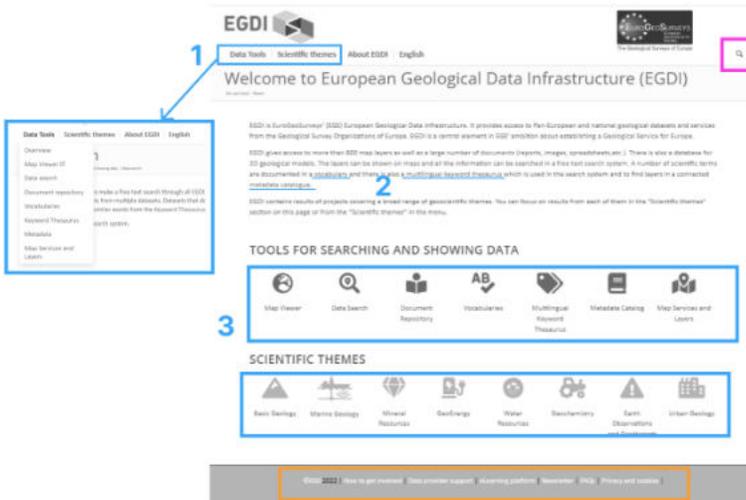


EGDI home page

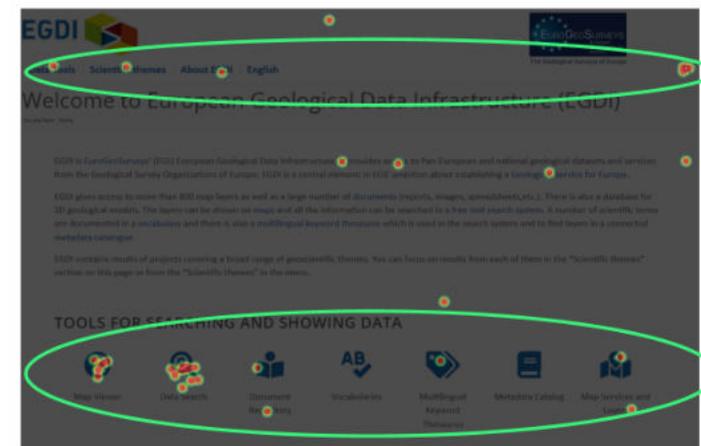
select 'Map Viewer'

Mineral resources -> Mines -> Commodity -> Asbestos

Groundwater -> Quantity -> Groundwater resources -> Volumes and depths(Total depth of active layers)



Scroll map



Click map



The (new) European Geological Data Infrastructure (EGDI)

EGDI

Map Viewer Data Search Get Involved About Us EN

Welcome to the
European Geological Data Infrastructure
a collaborative initiative aimed at facilitating the sharing, integration, and accessibility of geological information across Europe.

Map Viewer
Display and explore datasets grouped by theme on an interactive map.

Data Search
Find and access the datasets you need using different search criteria.

More Info More Info

About EGDI

1038 Data layers	16 Contributing projects	68 Team members	18 Geological Surveys involved
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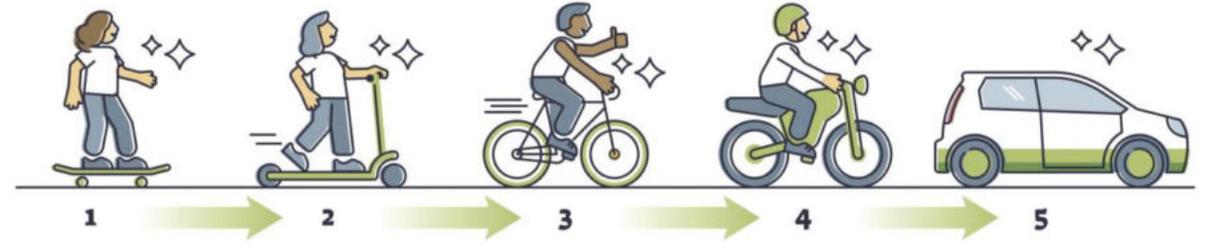


The new platform will be launched in Vienna on April 17





And the Improvements Never Stop



- New Users Test with industry, academia and EC stakeholders in Q3 '24. Do you want to join? Get in touch...



- EU university tour (Rome, Madrid, Utrecht, Ljubljana, Copenhagen, Warsaw, Belgrade, ...) to collect feedbacks and let the future geoscientists discover and use EGDI



EGDI's Impact

- **Enhanced Decision Support:** the development of EGDI as a knowledge infrastructure ensures that **decision-makers, policymakers, citizens and industry** stakeholders have **access to comprehensive and up-to-date** geological **information**, enhancing their ability to make informed decisions related to resource management, environmental protection, and urban planning.
- **FAIR Data Principles:** promotes **openness and accessibility** of geological data and ensures that data can be easily found, accessed, and used by researchers, policymakers, and the public.
- **Stakeholder Involvement:** the involvement of key European stakeholders ensures that the infrastructure **meets the needs** of a diverse range of users.
- **Influence on National Levels:** influence national levels by addressing requirements and ensuring FAIR and open access to subsurface data. This influence extends beyond the European level, impacting national geological data policies and practices.



Areas of Expertise



Raw Materials





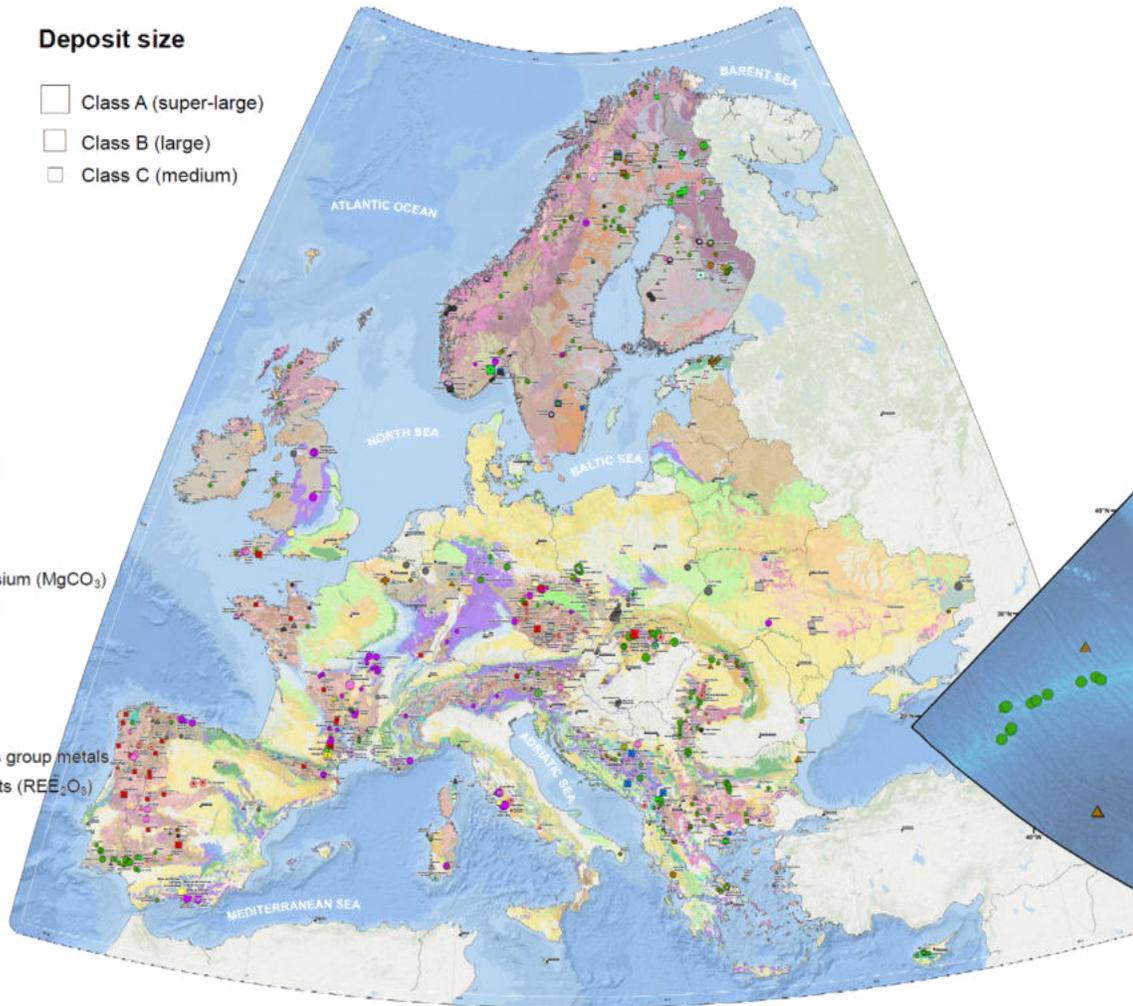
Re-Evaluate EU's On- & Offshore CRMs

Commodity

- Aluminium (metal)
- Antimony (metal)
- Arsenic
- Barite ($BaSO_4$)
- Beryllium (BeO)
- Bismuth (metal)
- Borate (B_2O_3)
- Cobalt (metal)
- Coking coal
- Copper (metal)
- Feldspar
- Fluorite (CaF_2)
- Gallium (metal)
- Germanium (metal)
- Graphite
- Hafnium (metal)
- Lithium (metal)
- Magnesite, Magnesium ($MgCO_3$)
- Manganese (metal)
- Nickel (metal)
- Niobium (Nb_2O_5)
- Phosphorous
- Phosphate (P_2O_5)
- Platinum, platinum group metals
- Rare Earth Elements (REE_2O_3)
- Scandium (metal)
- Strontium
- Tantalum (Ta_2O_5)
- Titanium (metal)
- Vanadium (metal)
- Tungsten (WO_3)

Deposit size

- Class A (super-large)
- Class B (large)
- Class C (medium)



Bathymetry

0 m -8000 m

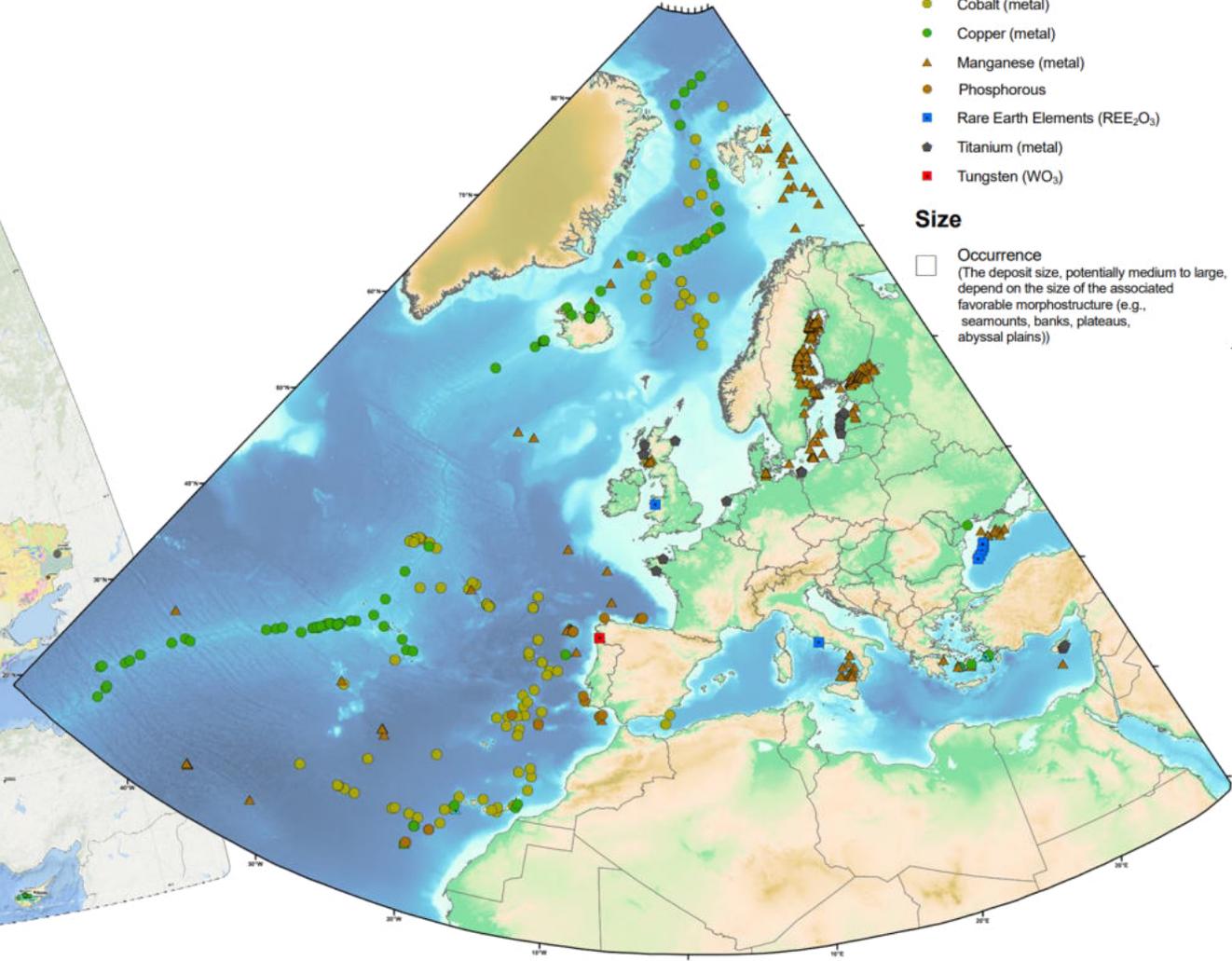


Commodity

- Barite ($BaSO_4$)
- Cobalt (metal)
- Copper (metal)
- Manganese (metal)
- Phosphorous
- Rare Earth Elements (REE_2O_3)
- Titanium (metal)
- Tungsten (WO_3)

Size

- Occurrence (The deposit size, potentially medium to large, depend on the size of the associated favorable morphostructure (e.g., seamounts, banks, plateaus, abyssal plains))



https://www.geologicalservice.eu/upload/content/1495/crm_map_2023_v6_hq3.pdf

https://www.geologicalservice.eu/upload/content/1496/crm_map_offshore_2024_v3.pdf

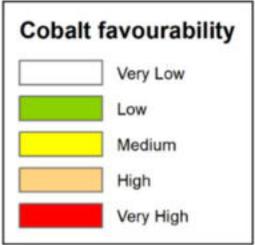
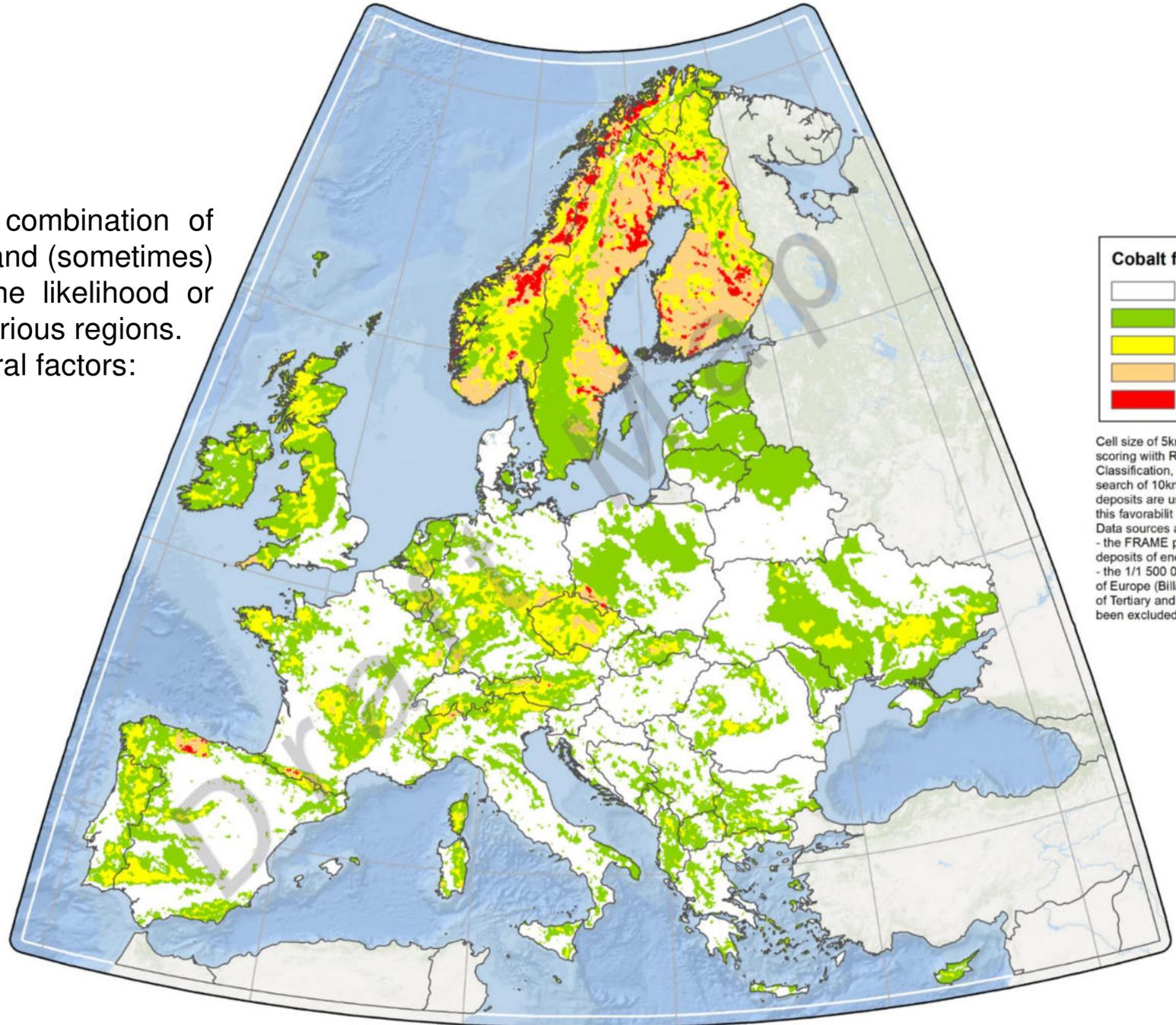


Favourability Maps

These maps are created using a combination of geological data, survey information, and (sometimes) remote sensing data to evaluate the likelihood or favourability of specific minerals in various regions.

The process involves analysing several factors:

- Geological Settings
- Geochemical Data
- Geophysical Data
- Remote Sensing
- Historical Mining Data



Cell size of 5km x 5km. DBA scoring with Random Forest Classification, neighbouring search of 10km. Only known deposits are used to produce this favourability map. Data sources are:
- the FRAME project database on deposits of energy critical elements;
- the 1/1 500 000 geological synthesis of Europe (Billa et al., 2008); lithologies of Tertiary and Quaternary ages have been excluded.

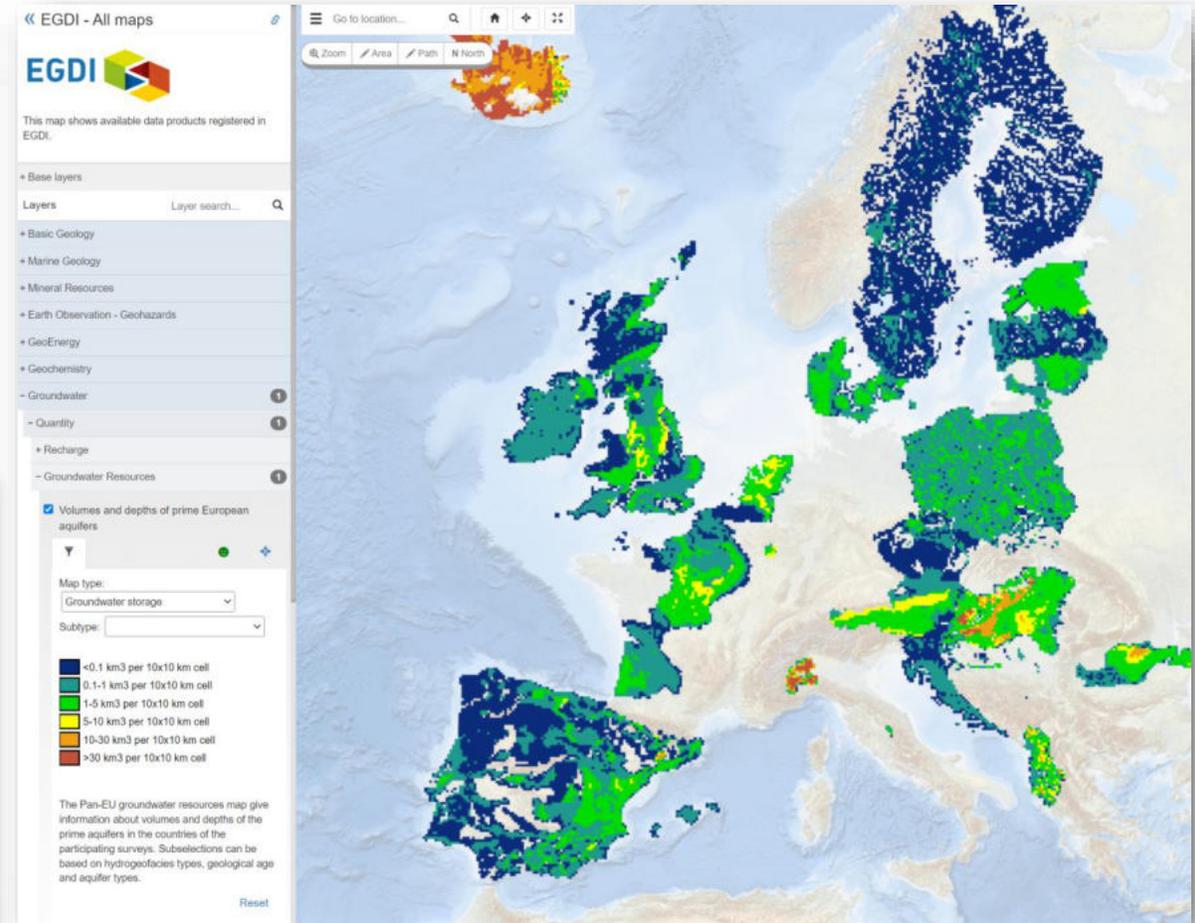
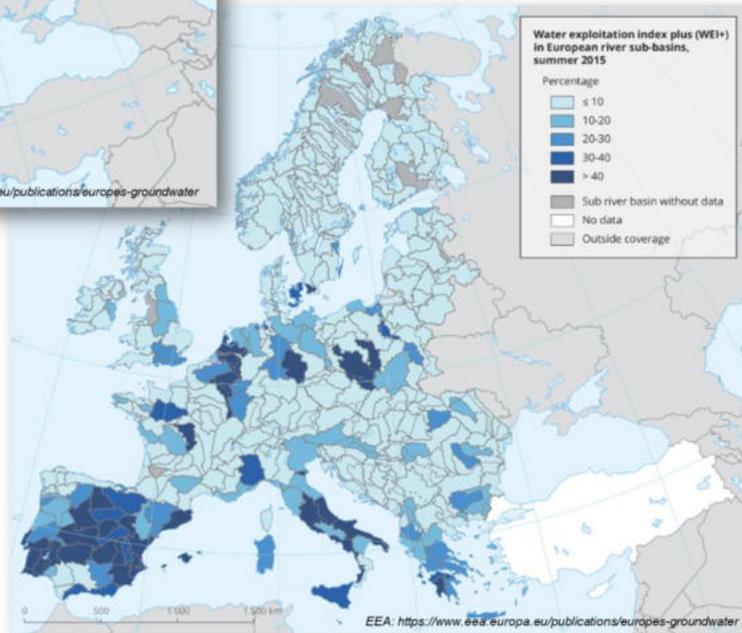
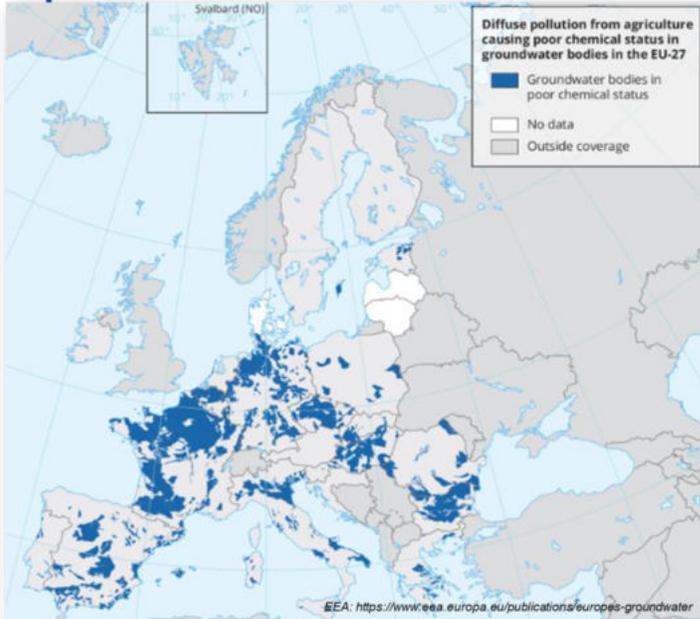


Groundwater Resources





Groundwater Quality & Quantity



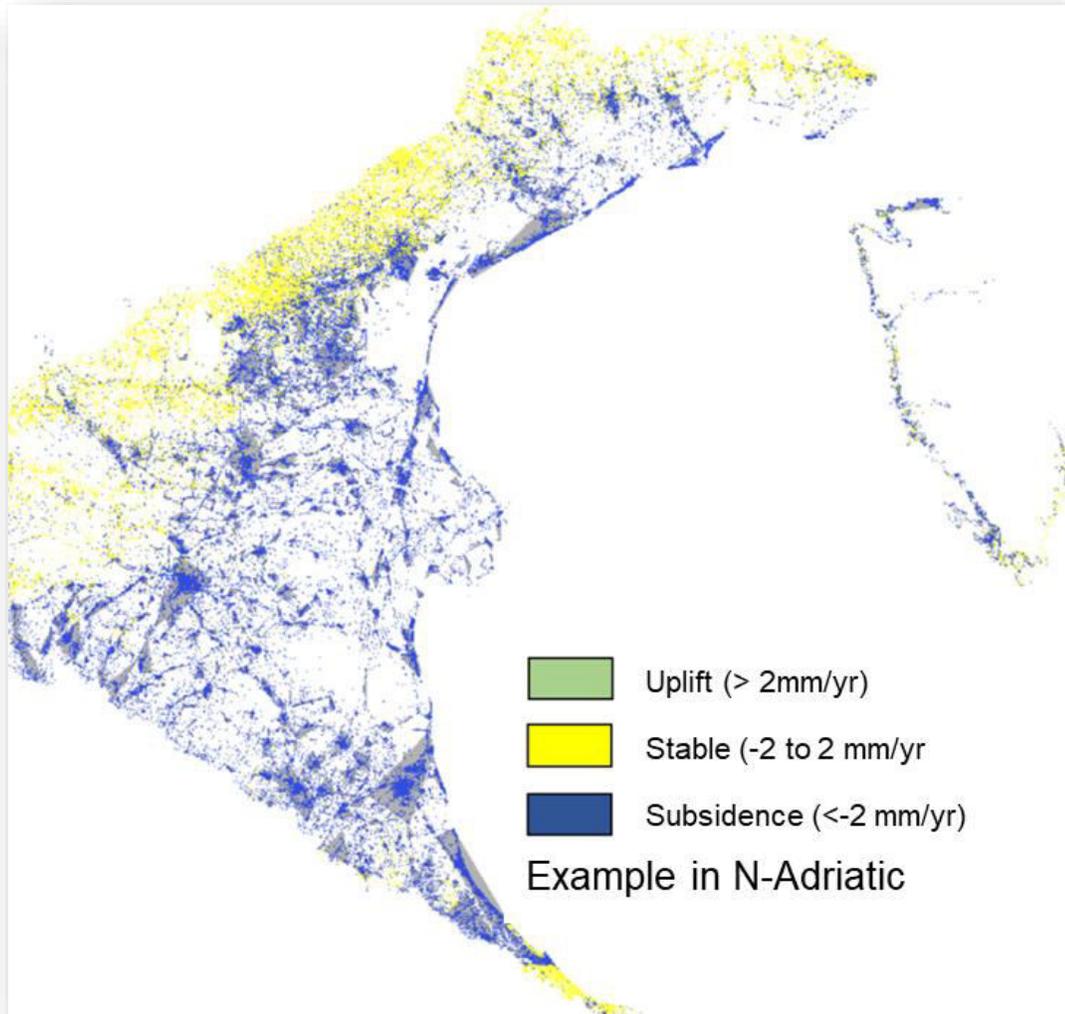


Coast and Sea





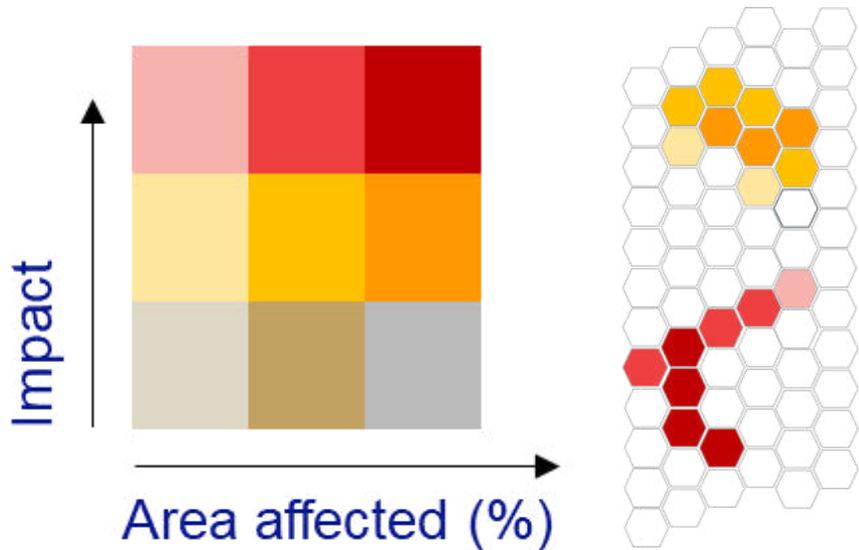
Coastal Vulnerability & Climate Change



Pan-European analysis of relative sea-level changes in Europe considering VGMs based on trends retrieved from the European Ground Motion Service (EGMS).

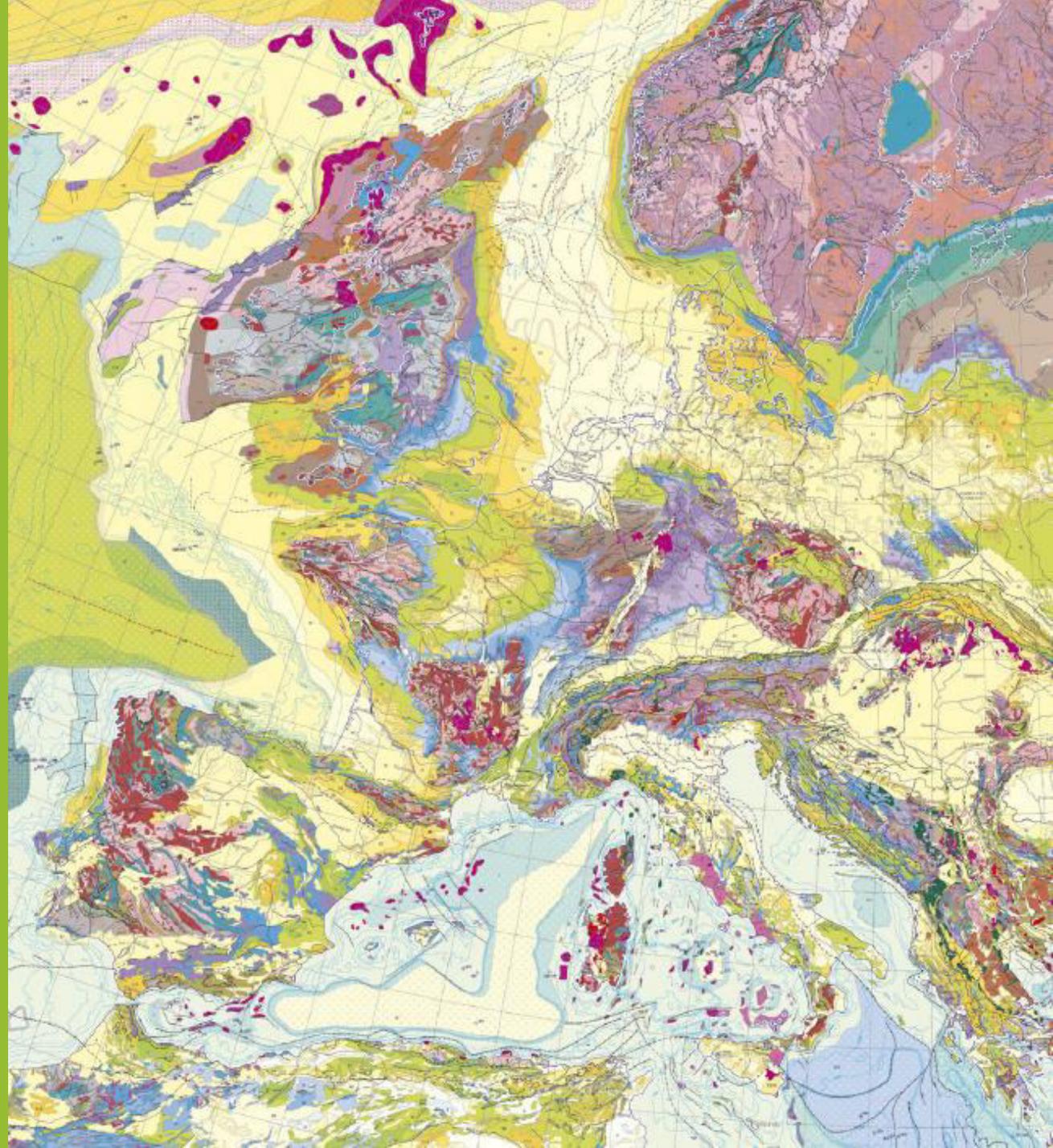


Offshore Windfarm Foundations Constrains



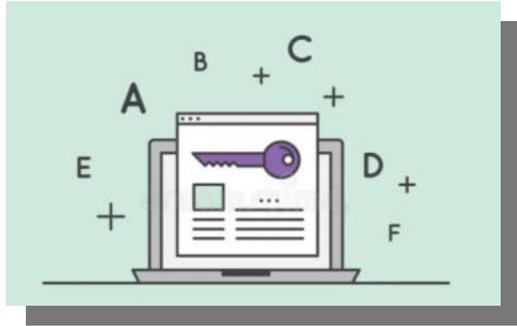


Geological Framework Setup





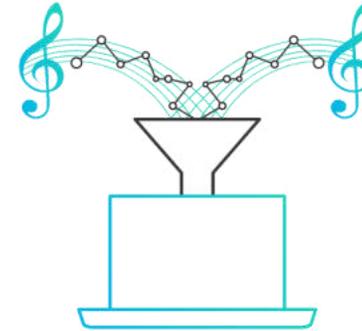
What is it about & Why is it Important?



Metadata



Scientific
Vocabularies



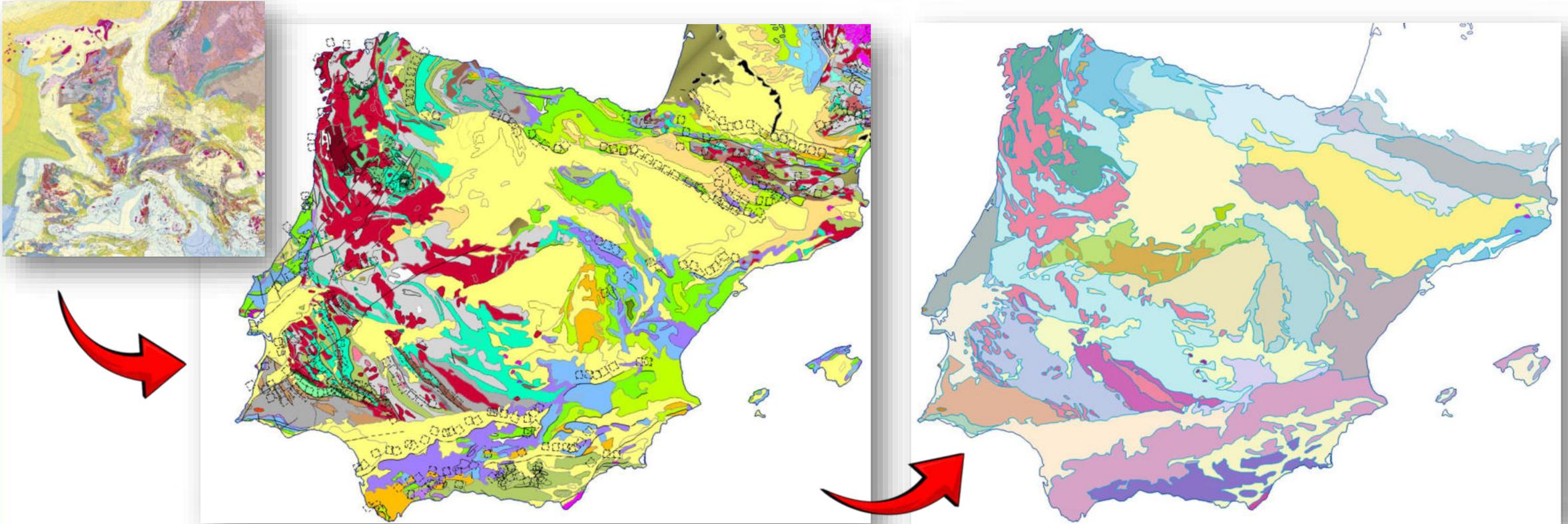
Framework for Data
Harmonization

Harmonized data will be the basis for creating a spatial data infrastructure that is:

- Efficient
- Failure-free
- Understandable
- Unambiguous
- Consistent



Implementation of Lithotectonic Units to IGME 5000



Lithotectonic units provide context for mineral¹ and hydrogeological provinces², and geo energy potential³.

¹ Regions of the crust that are characterized by a concentration of specific types of minerals or mineral deposits.

² Regions characterized by specific hydrological and geological conditions that influence the distribution, movement, and availability of groundwater.

³ Regions characterized by particular geological formations and subsurface processes that give them high potential for geo energy applications exploitation.



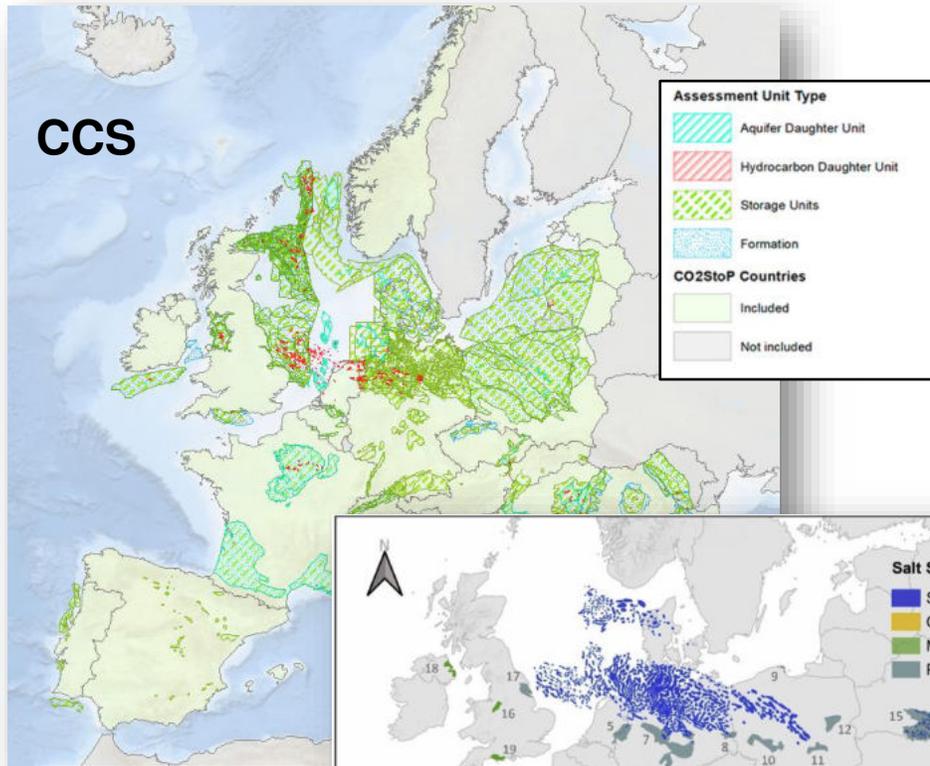
GeoEnergy Resources



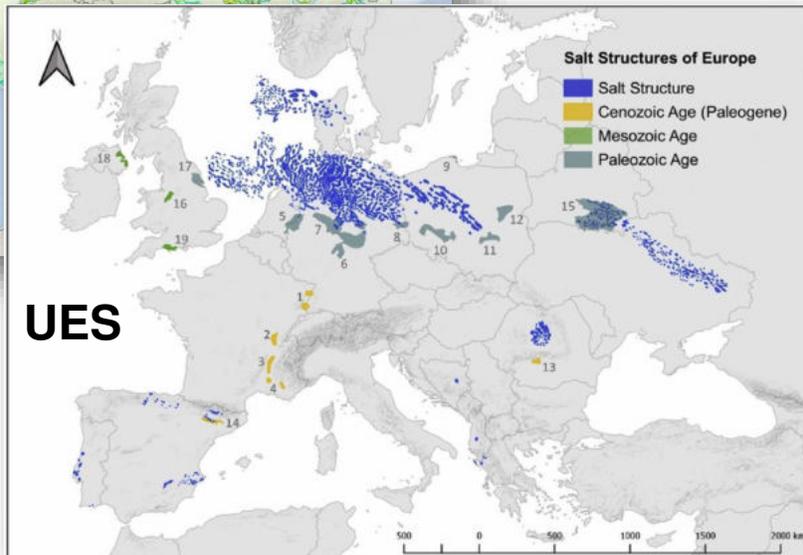


Pan-EU Atlas of Geoenergy Resources

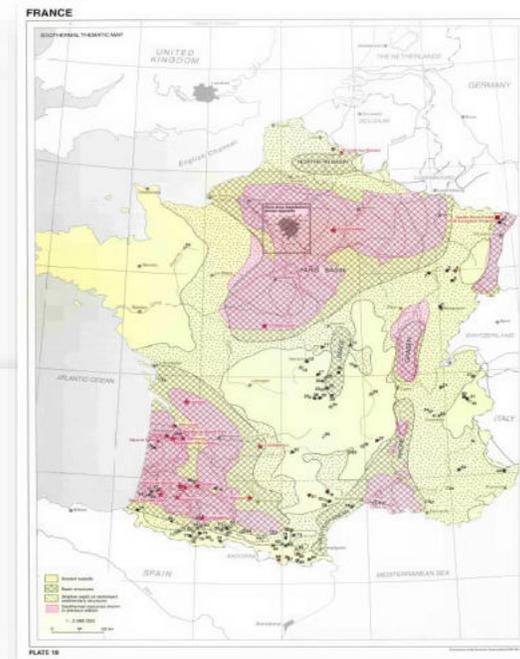
CCS



UES



Shallow Geothermal



Hurtig et al., 1992

2.000 km

Deep Geothermal



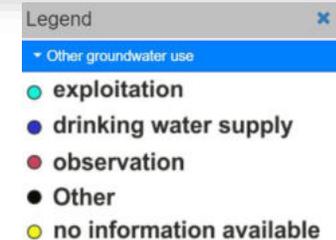
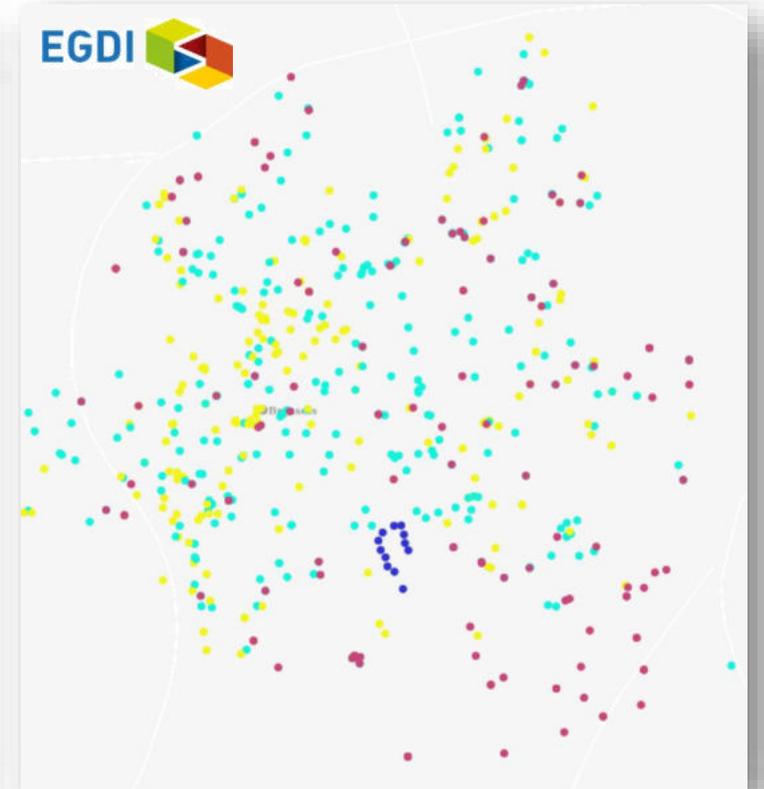
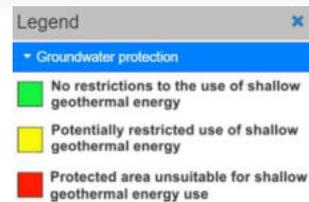
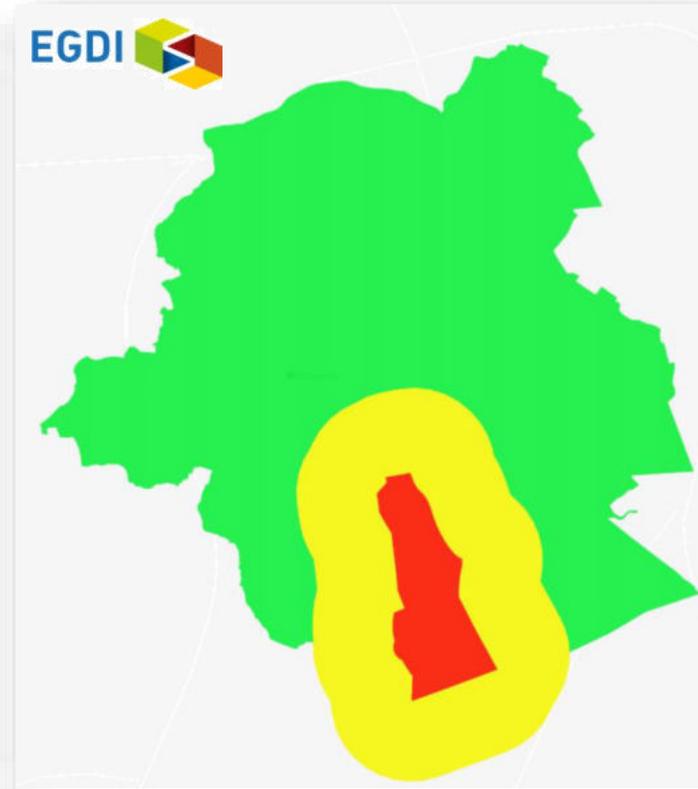
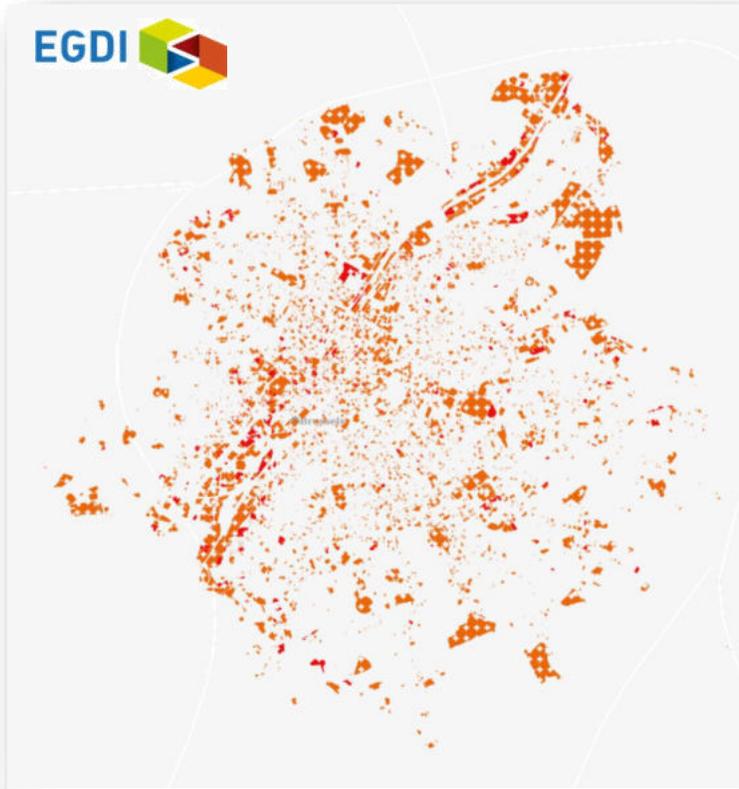
A Sustainable Use of the Subsurface for the Built Environment

The image displays the EGDI (European Geological Data Infrastructure) web application interface. On the left, a sidebar lists various data products and categories. The 'Brussels' category is highlighted with a red box. Below it, the 'GeoEnergy' category is expanded, showing sub-categories like 'Carbon Capture & Storage', 'Geothermal', and 'Urban Shallow (MUSE)'. A green arrow points to the 'Urban Shallow (MUSE)' category. The main area shows a map of Europe with a colorful overlay representing the data products. The EGDI logo and name are visible in the top left of the map area.

- Brussels
 - Limitation of use
 - Contaminated sites
 - Groundwater protection
 - Natural reserves
 - Other groundwater use
 - Shallow geothermal energy system
 - Resources for closed loop systems
 - Average interval bulk thermal conductivity
 - Land surface temperature
 - Resources for open loop systems
 - Extent of confined artesian and subartesian aquifers
 - Groundwater body suitable for open-loop system
- GeoEnergy
 - + Carbon Capture & Storage
 - Geothermal
 - Geothermal wells (DARLINGe)
 - Geothermal plants (PERFORM)
 - Subsurface potentials of the Alpine Foreland Basins (GeoMol)
 - Urban Shallow (MUSE) ←
 - + Aarhus
 - + Bratislava
 - + Brussels
 - + Cardiff
 - + Cork
 - + Girona
 - + Linköping
 - + Ljubljana
 - + Prague
 - + Vienna
 - + Warsaw
 - + Zagreb
 - + Zaragoza
 - + Hydrocarbon

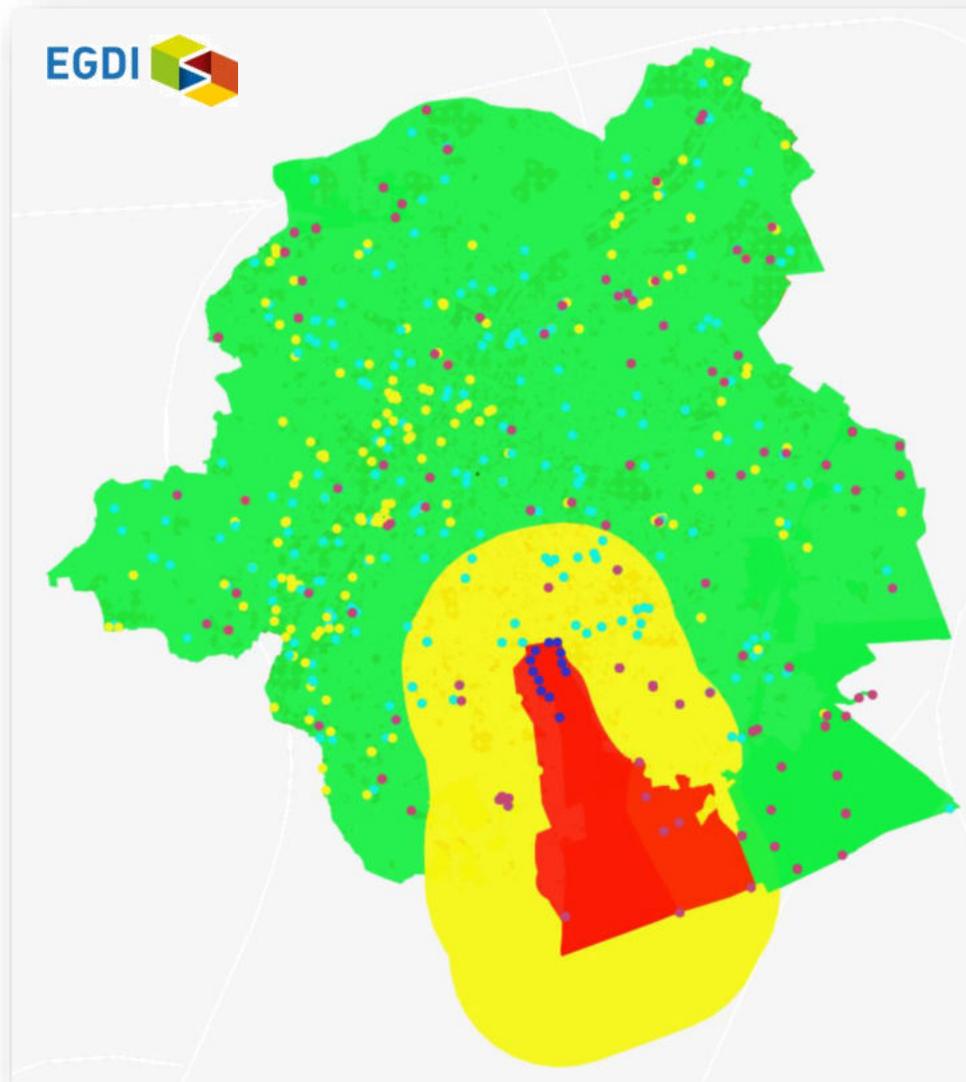


Shallow Geothermal for Urban Environments: Limitation of Use – Brussels





Shallow Geothermal for Urban Environments: Limitation of Use – Brussels



Legend

Contaminated sites

- contaminated site
- potentially contaminated site

Groundwater protection

- No restrictions to the use of shallow geothermal energy
- Potentially restricted use of shallow geothermal energy
- Protected area unsuitable for shallow geothermal energy use

Other groundwater use

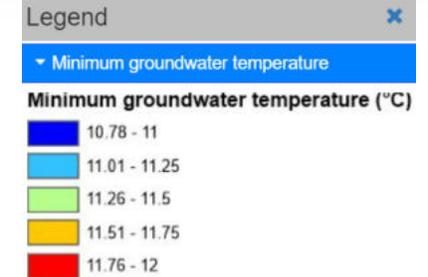
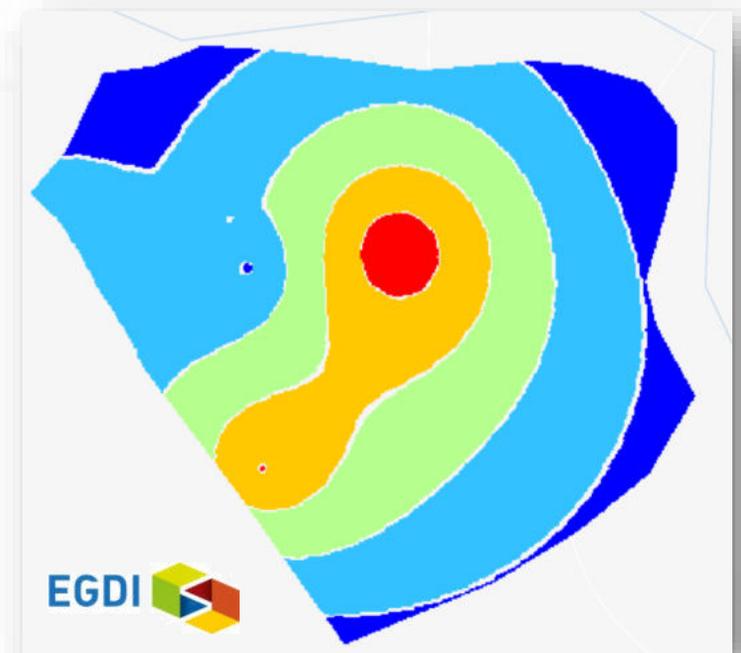
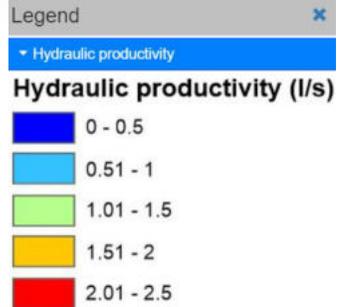
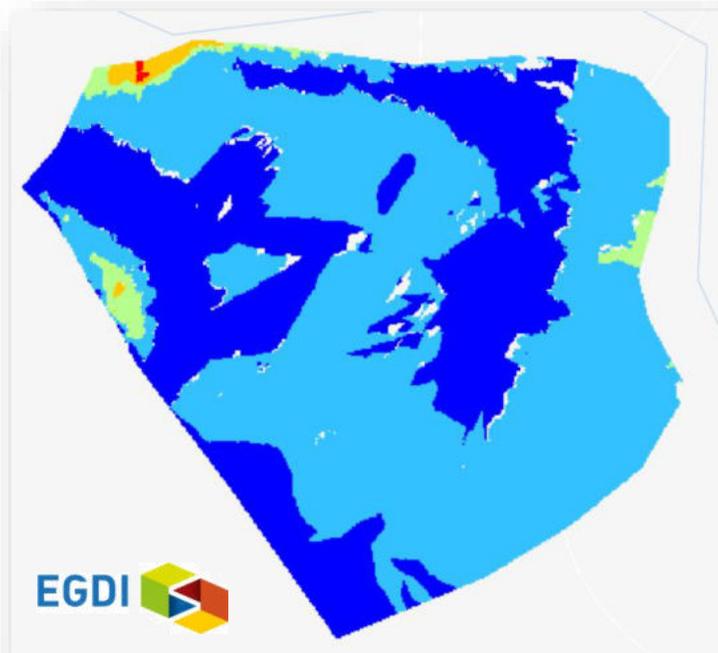
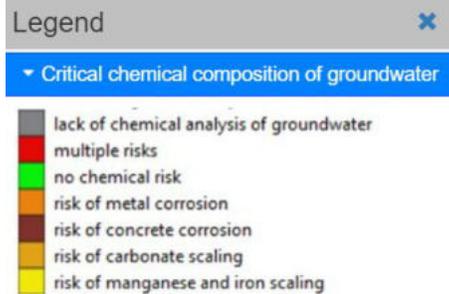
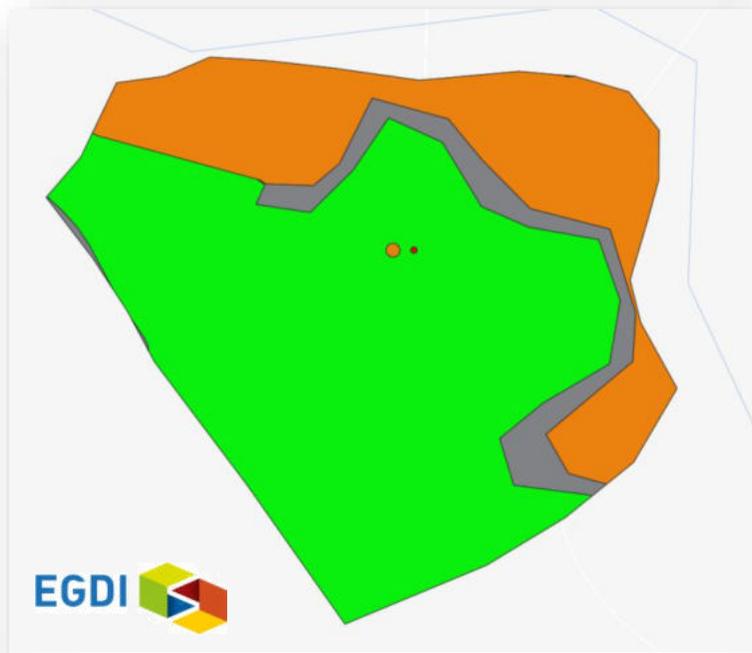
- exploitation
- drinking water supply
- observation
- Other
- no information available



Overlap different layers to get the complete picture



Shallow Geothermal for Urban Environments: Limitation of Use - Bratislava



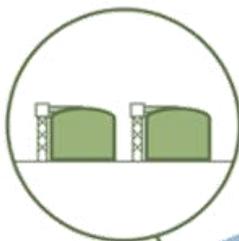


Surface & Subsurface Synergies



Storage tanks

LNG
HYDROGEN
OIL / GASOIL
LIQUID AIR
HEAT



Surface Electrical

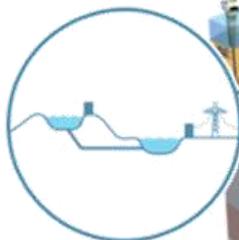
BATTERIES (DIVERSE SOORTEN)
FLY WHEELS
CAPACITORS
SUPERCONDUCTIVE MAGNETS



Surface
Subsurface

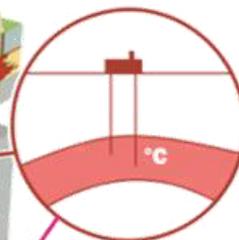
(Elevated*) Lakes Island Basins

PUMP ACCUMULATION
(SURFACE WATER)



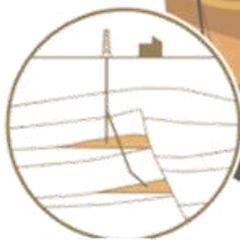
Aquifers

HOT/COLD WATER
NATURAL GAS
HYDROGEN
COMPRESSED AIR/NITROGEN
CO2
BRINE



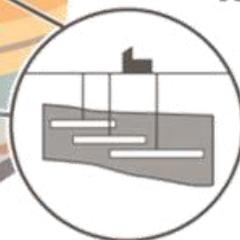
Depleted Oil & Gas Fields

NATURAL GAS
HYDROGEN
COMPRESSED AIR/NITROGEN
CO2
PRODUCTION WATER / BRINE



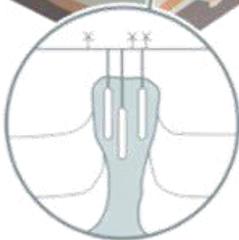
Mines, Tunnels, Cavities

HOT/COLD WATER
PUMP ACCUMULATION (WATER/BRINE)
RADIOACTIVE & OTHER WASTE
(NATURAL GAS *)
(COMPRESSED AIR/NITROGEN *)



Salt Caverns

NATURAL GAS
HYDROGEN
COMPRESSED AIR/NITROGEN
GASOIL
BRINE
HELIUM





Surface & Subsurface Data Integration



European
Commission

JRC Energy & Industry Geography Lab

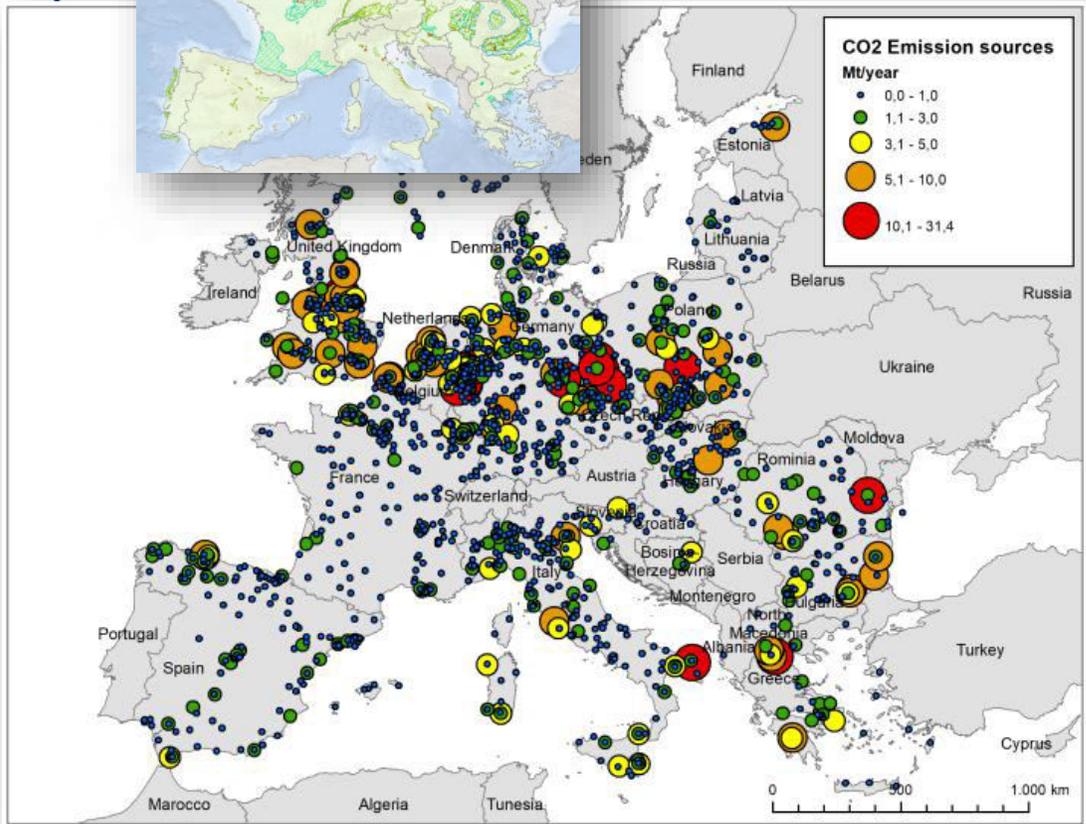
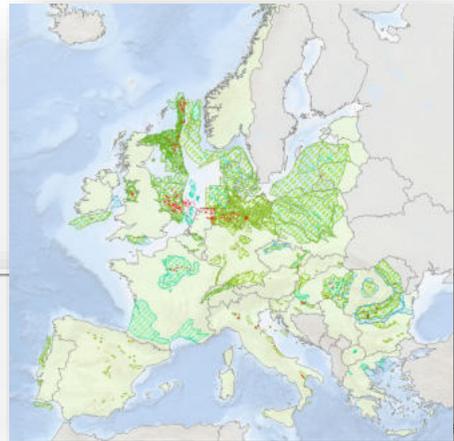
EGDI 



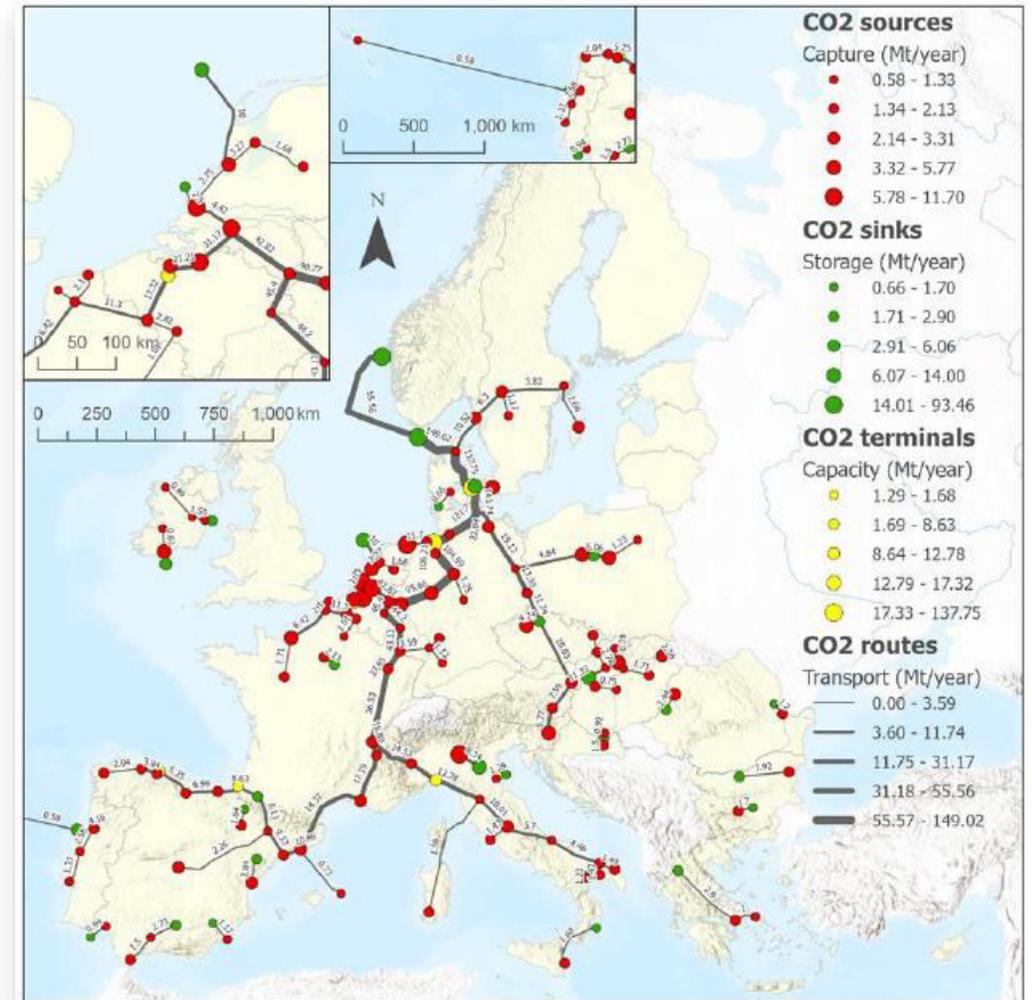
GSEU
GEOLOGICAL FOR
SERVICE EUROPE



Optimal CO₂ Transportation Infrastructure

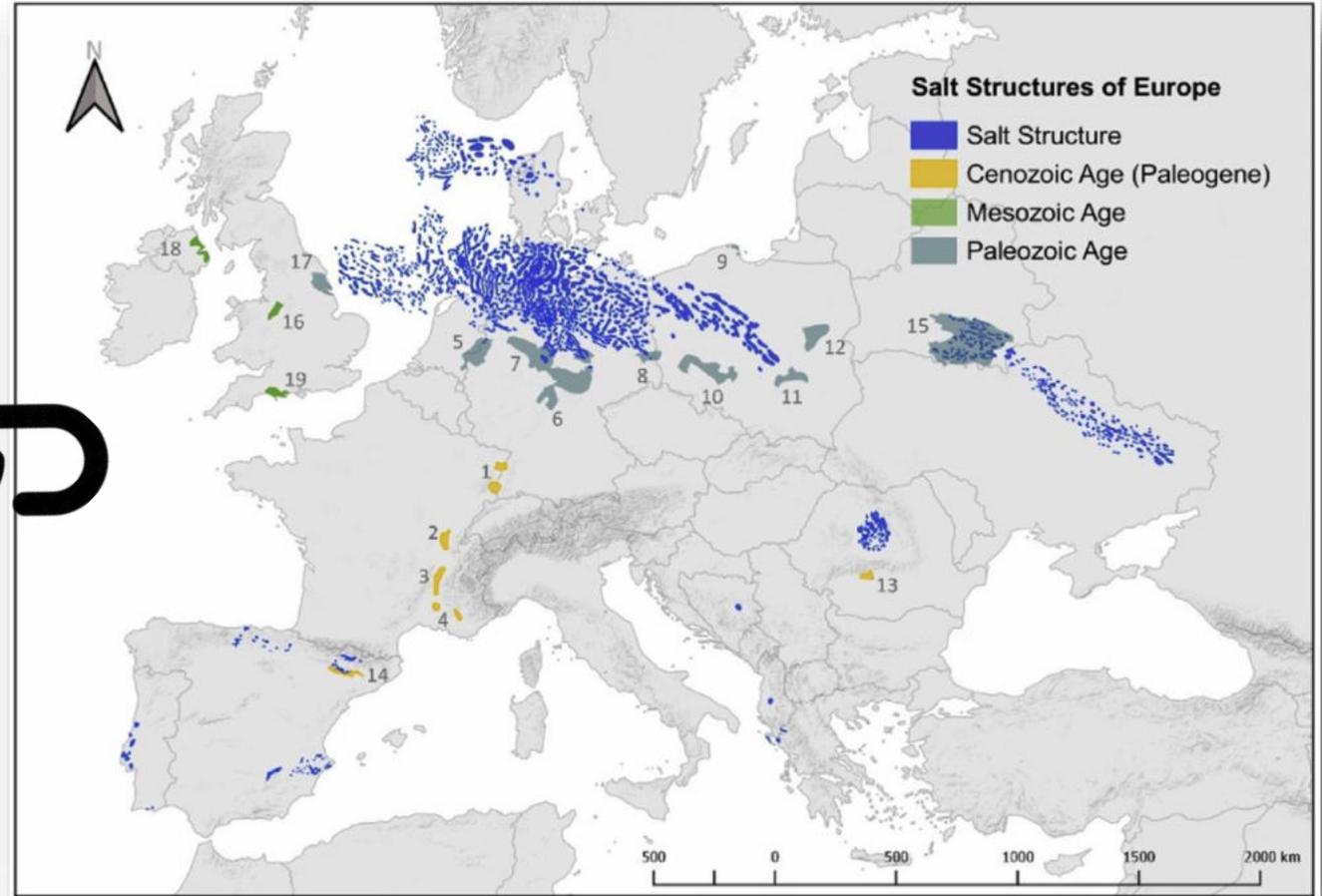
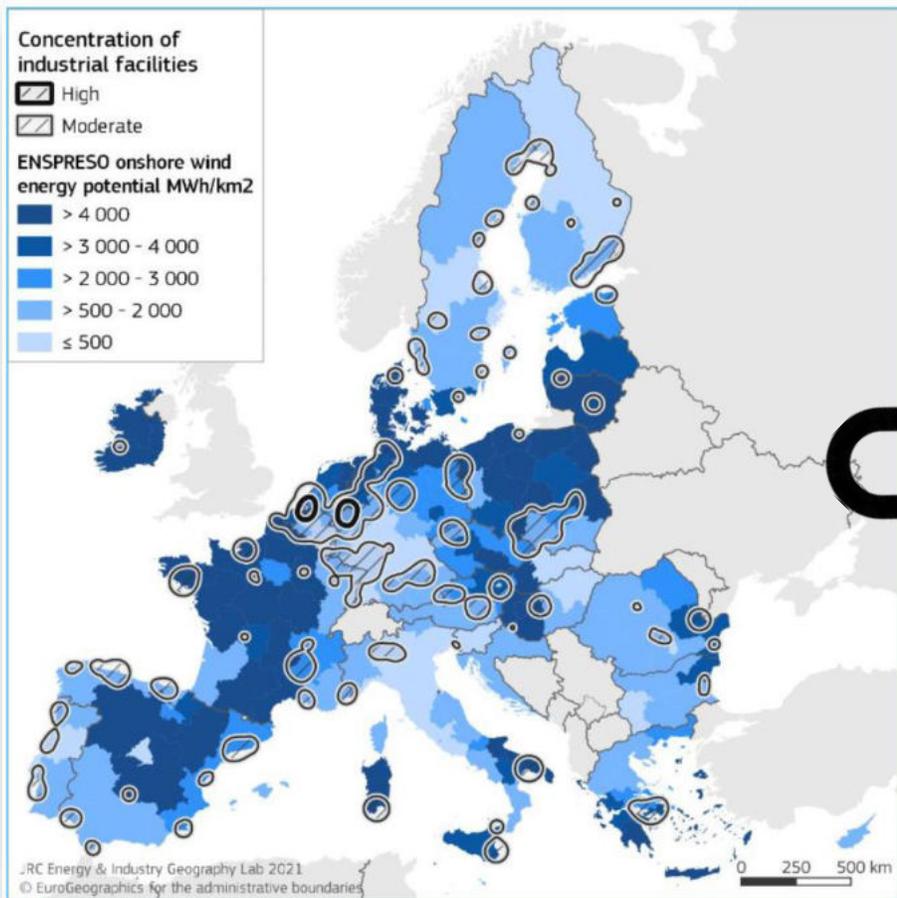


JRC Study on Optimal CO₂ Infrastructure





Optimal H₂ Transportation Infrastructure



Caglayan, D.G., et al, 2020, Technical potential of salt caverns for hydrogen storage in Europe

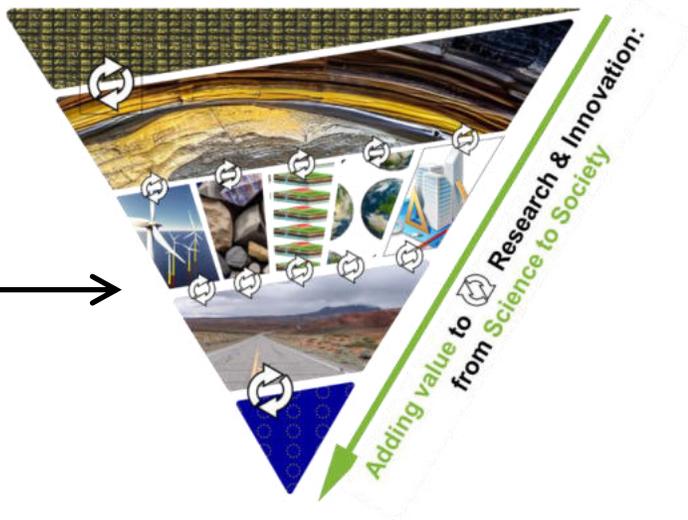




Key Takeaways



- We are turning our web platform into a knowledge hub
- Several parts of the pan-EU GeoEnergy Atlas will be published soon
- We are connecting with a broad range of stakeholders (JRC, OSDU, DGs, Industry Groups) and we love to establish more partnerships!





GSEU

GEOLOGICAL FOR
SERVICE EUROPE



GEOLOGICAL SERVICE FOR EUROPE

WWW.GEOLOGICALSERVICE.EU



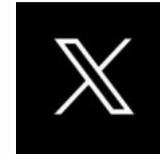
<https://www.youtube.com/@GeologicalServiceforEurope>



<https://www.linkedin.com/company/gseu-geological-service-for-europe>



<https://www.facebook.com/GeologicalServiceForEurope>



<https://twitter.com/GeoServiceEU>

