GSEU

GEOLOGICAL SERVICE | FOR EUROPE

Our Contribution to the Energy Storage Landscape

Francesco Pizzocolo (TNO)

Paula Canteli (IGME)

Serge van Gessel (TNO)

Jullie Hollis (EGS)

2nd European Underground Energy Storage workshop

May 23-24, 2023 (Paris, FR)

Funded by the European Union

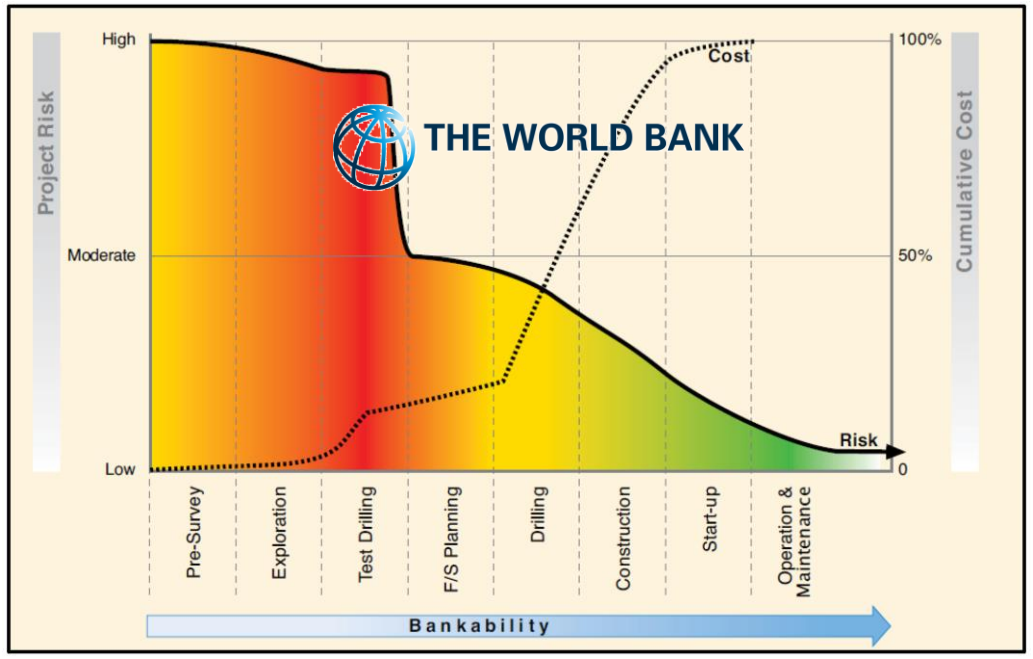
EuroGeoSurveys European Geoscience for Society

The Geological Surveys of Europe

Why a Geological Service for Europe?

FINANCIAL TIMES

EU sounds alarm on critical raw materials shortages

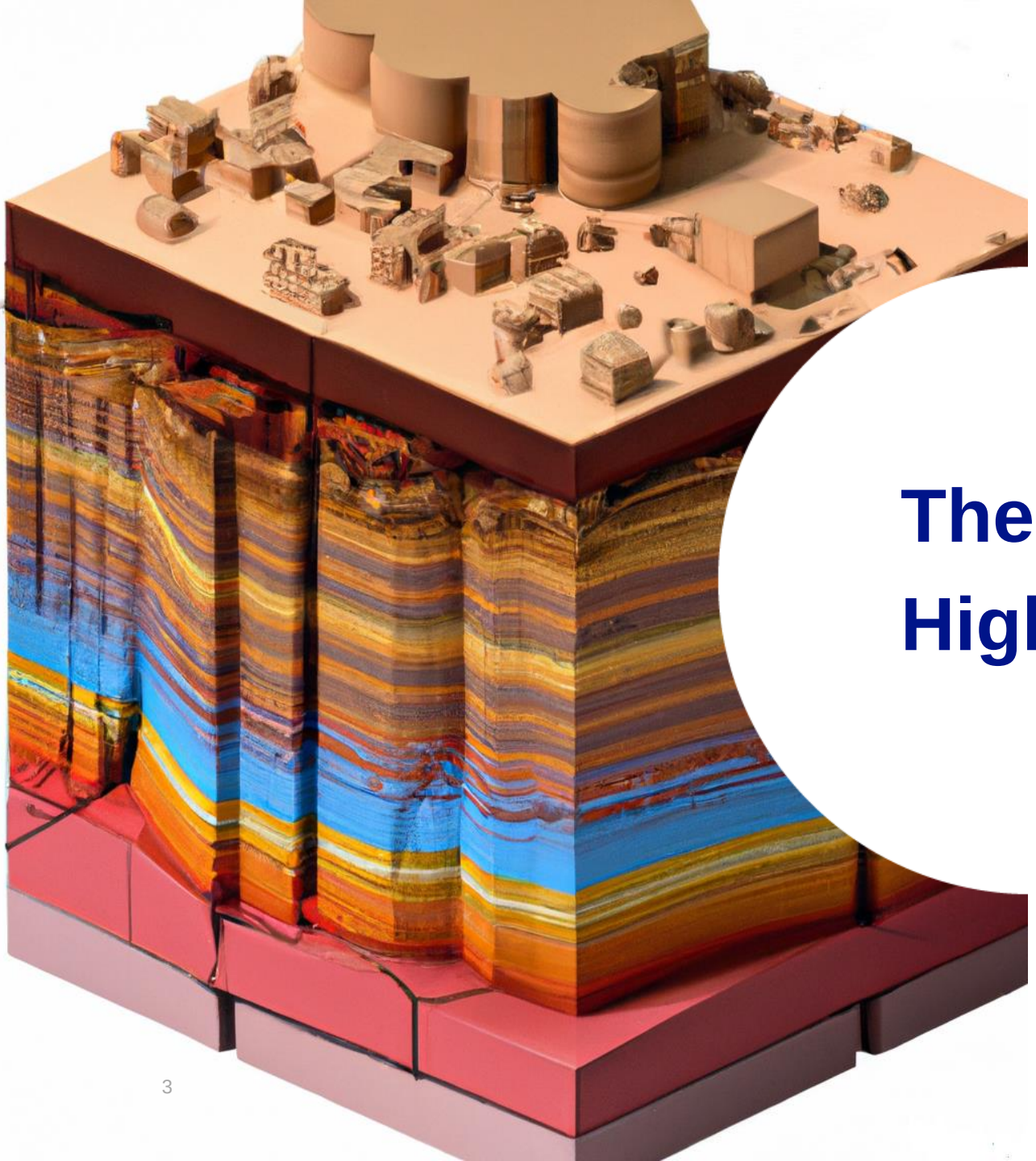


Europe's groundwater – a key resource under pressure

Europe's groundwater — a key resource under pressure

European Environment Agency

GSEU GEOLOGICAL SERVICE FOR EUROPE



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

GSEU
GEOLOGICAL SERVICE FOR EUROPE

Objective

The overall objective of the **GSEU** project is to establish a **Geological Service for Europe** as a permanent **collaborative network of European Geological Survey Organisations**.

GSEU will structurally address specific challenges in the **sustainable management of the subsurface** at EU and national level.

From Geological Data to Policy Support

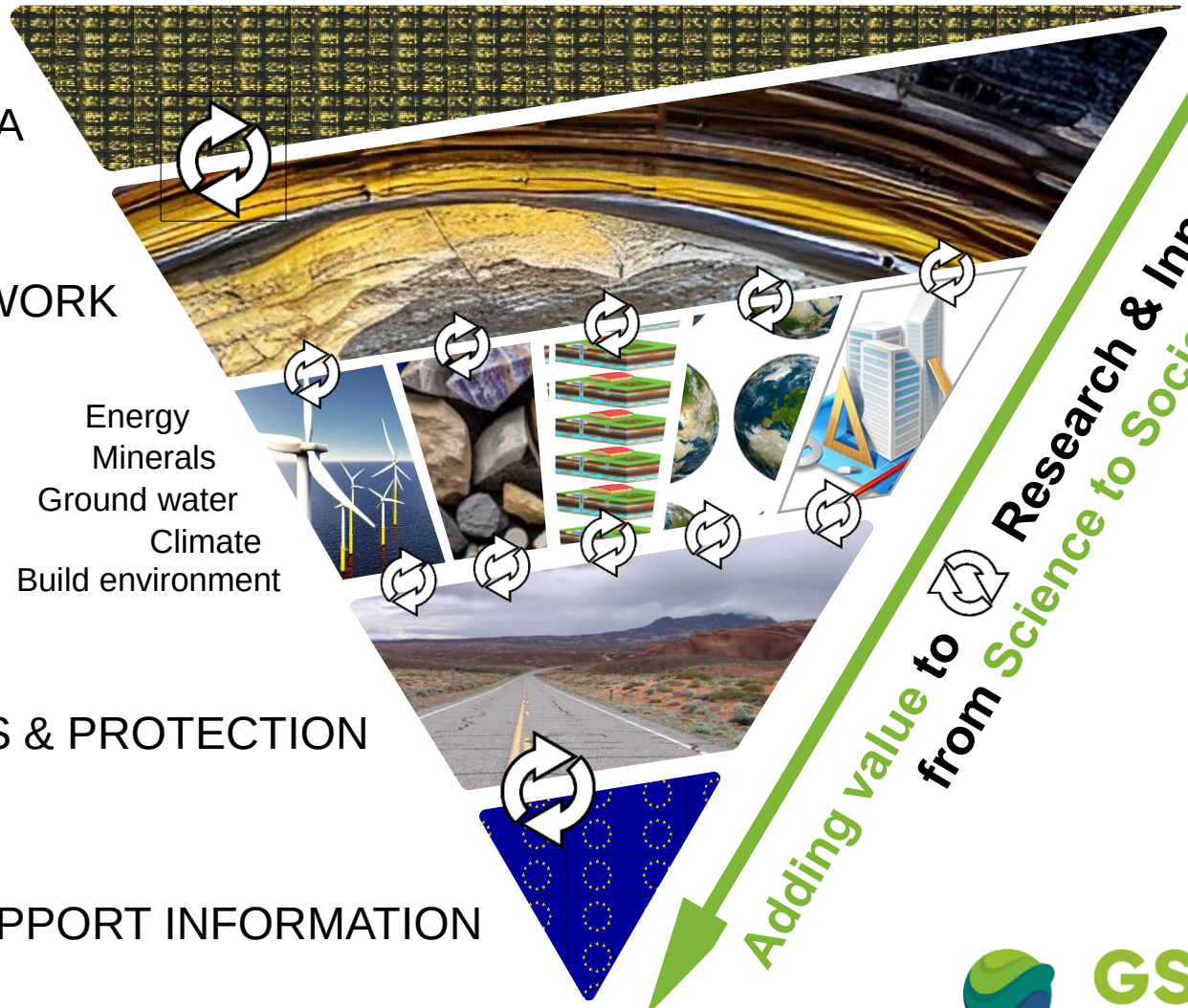
INTEROPERABLE GEOLOGICAL DATA

3D GEOLOGICAL FRAMEWORK

Energy
Minerals
Ground water
Climate
Build environment

IMPACTS & PROTECTION

DECISION SUPPORT INFORMATION



Adding value to Research & Innovation:
from Science to Society

GSEU
GEOLOGICAL SERVICE FOR EUROPE

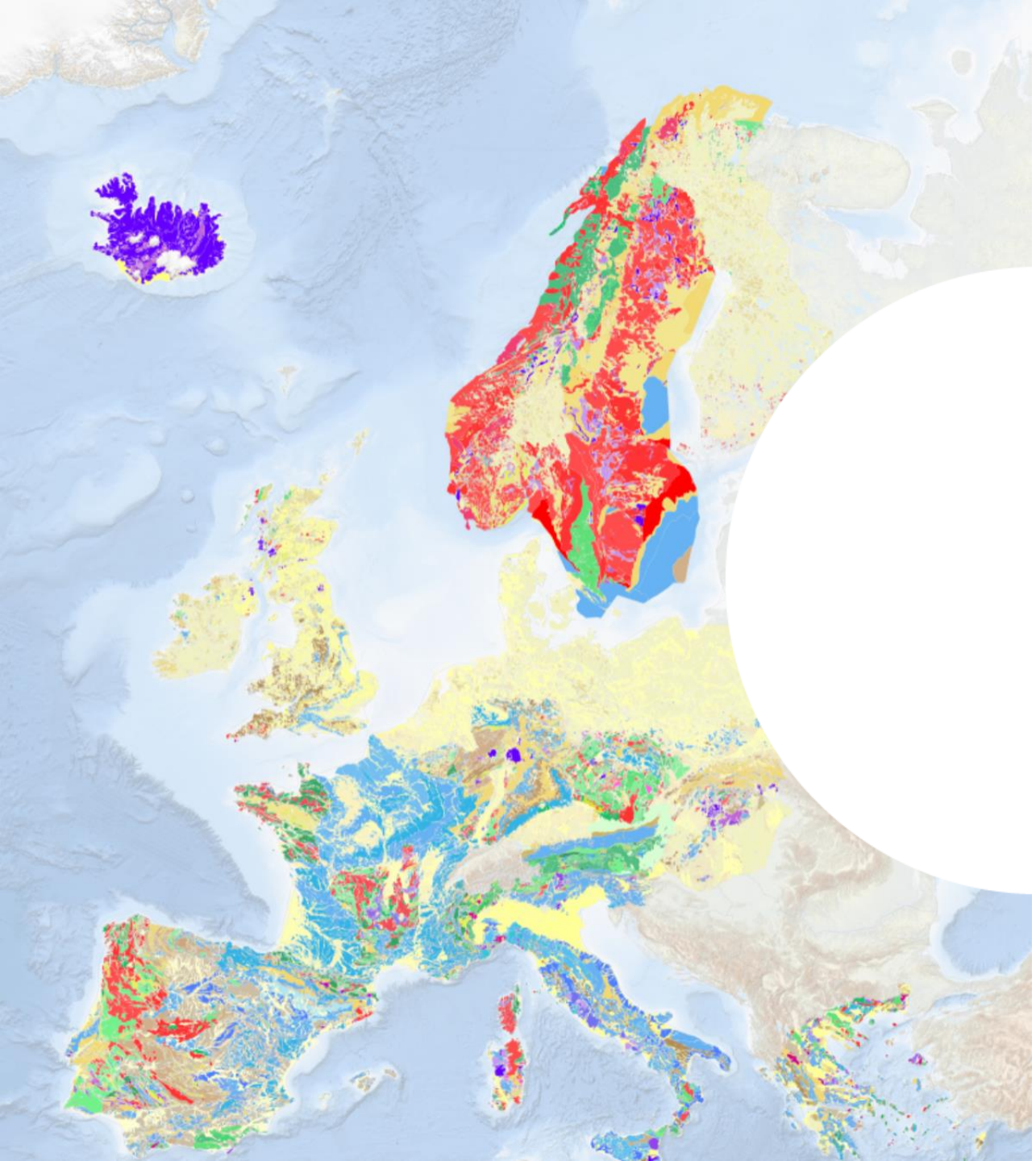
3 Working Groups, 1 Goal

Developing Harmonised Data & Information Service

Developing Information Structure

Communication, Dissemination, Exploitation & Outreach

GSEU GEOLOGICAL SERVICE FOR EUROPE



EGDI

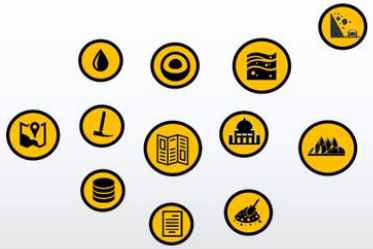
GSEU
GEOLOGICAL SERVICE FOR EUROPE

European Geological Data Infrastructure (EGDI)

Data infrastructure

Web portal

2D Data



Isolated datasets

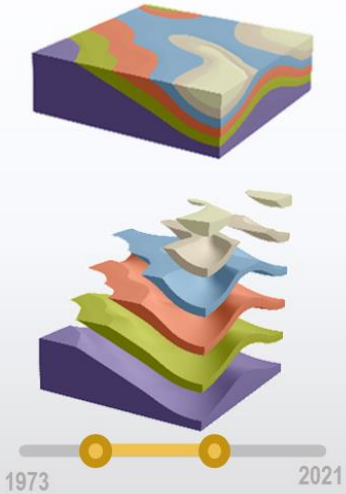
Professional users

Knowledge infrastructure

On-the-fly data analysis

Predictive modeling

3D/4D representation



Intelligent search

Internet of things

All types of users

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

GSEU
GEOLOGICAL SERVICE FOR EUROPE

European Geological Data Infrastructure (EGDI)

Data infrastructure

Web portal

2D Data

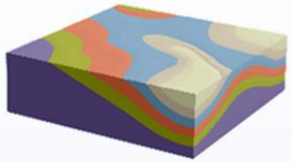
Isolated datasets

Professional users

Knowledge infrastructure

On-the-fly data analysis

Predictive modeling



3D/4D representation

Intelligent search

Internet of things

All types of users

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

YOUR FEEDBACK MATTERS

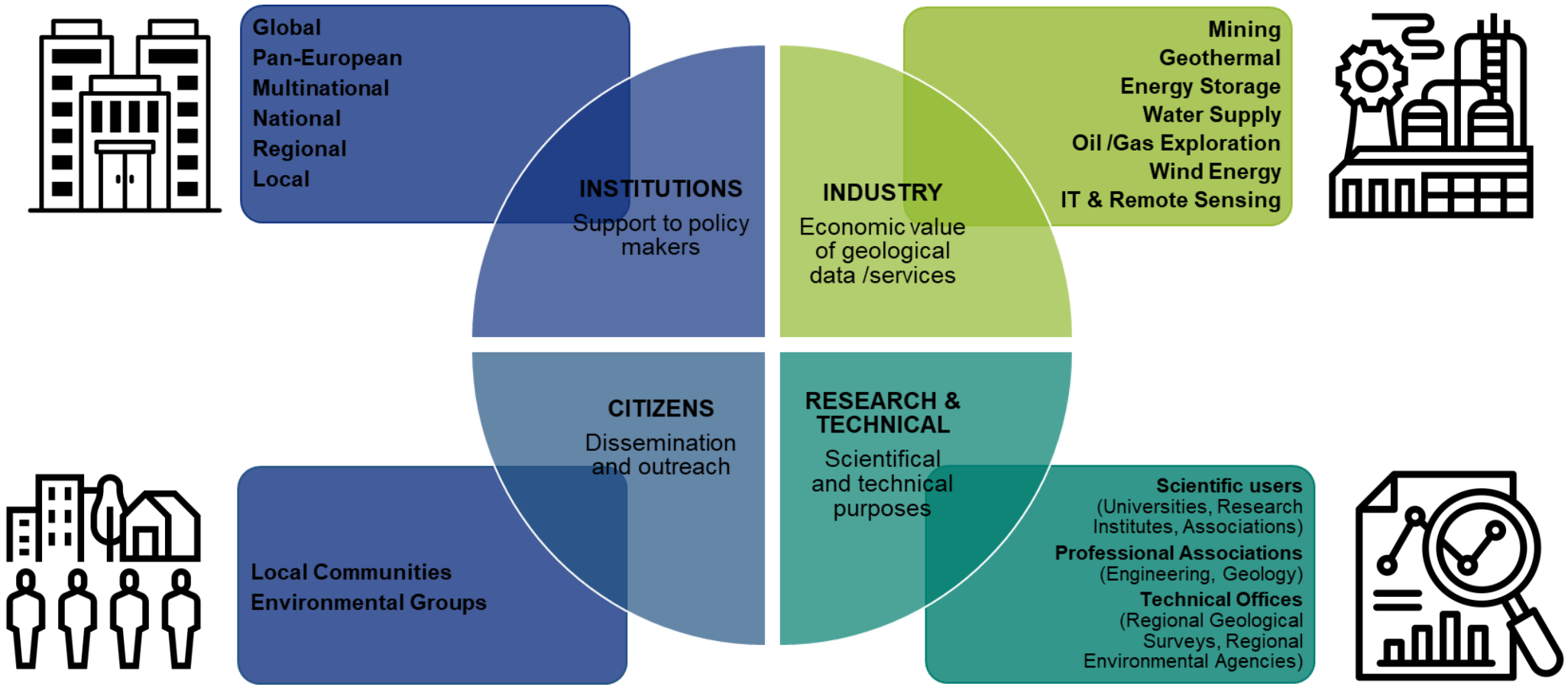
GSEU
GEOLOGICAL SERVICE FOR EUROPE

Maximise Social Impact

GSEU
GEOLOGICAL SERVICE FOR EUROPE

Stakeholder Engagement

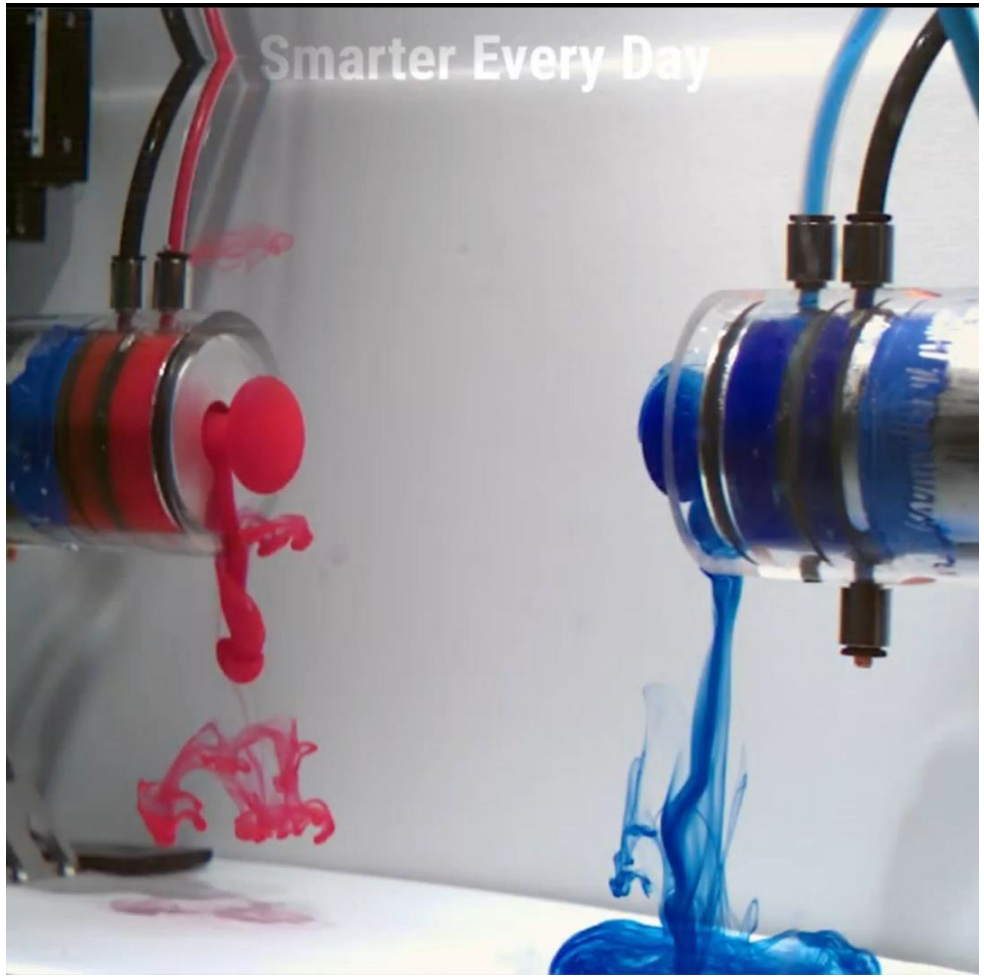
We aim to inform and support a broad range of stakeholders – to raise awareness of the critical value of the earth beneath our feet and its role in a sustainable future.

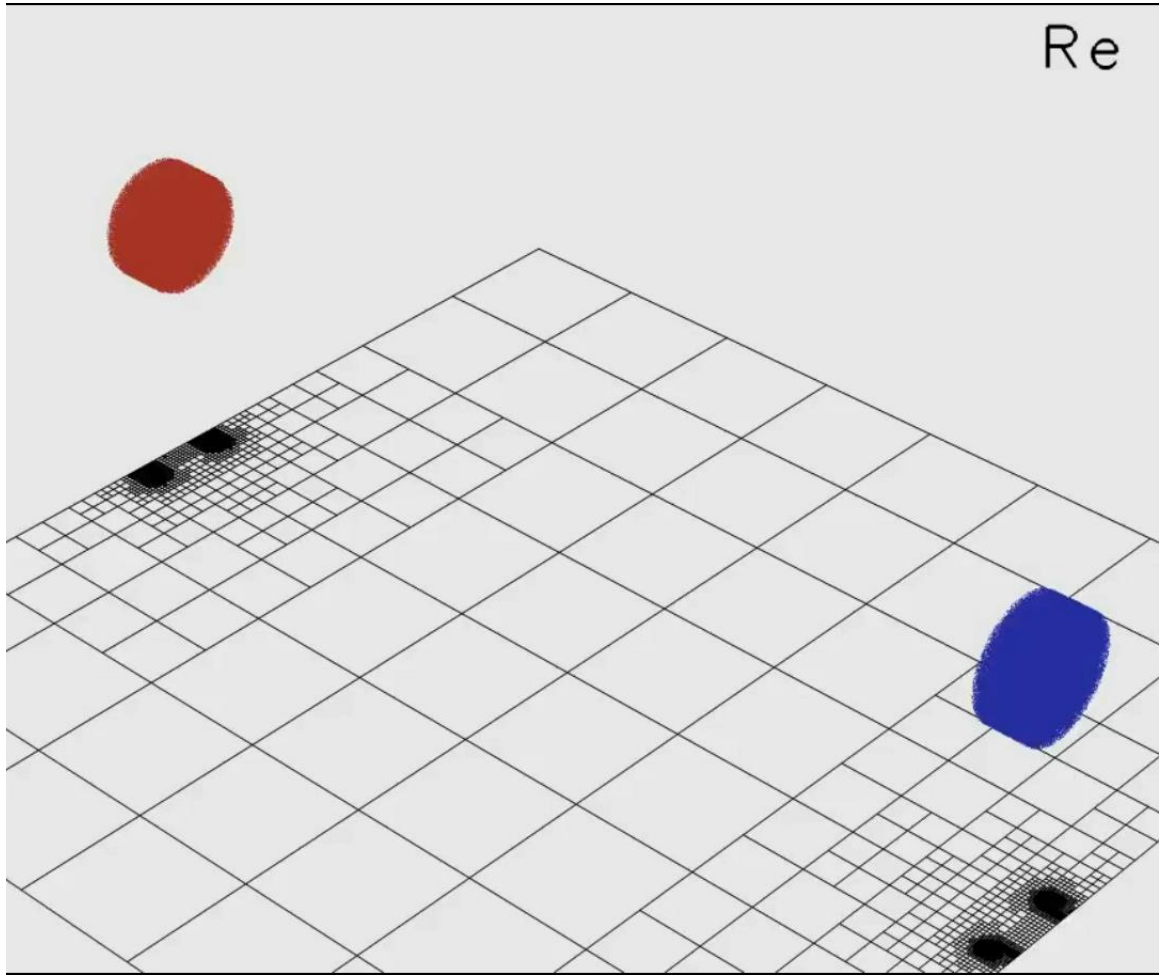


Bringing the subsurface into the light
Making the Invisible, Visible

GSEU
GEOLOGICAL SERVICE FOR EUROPE

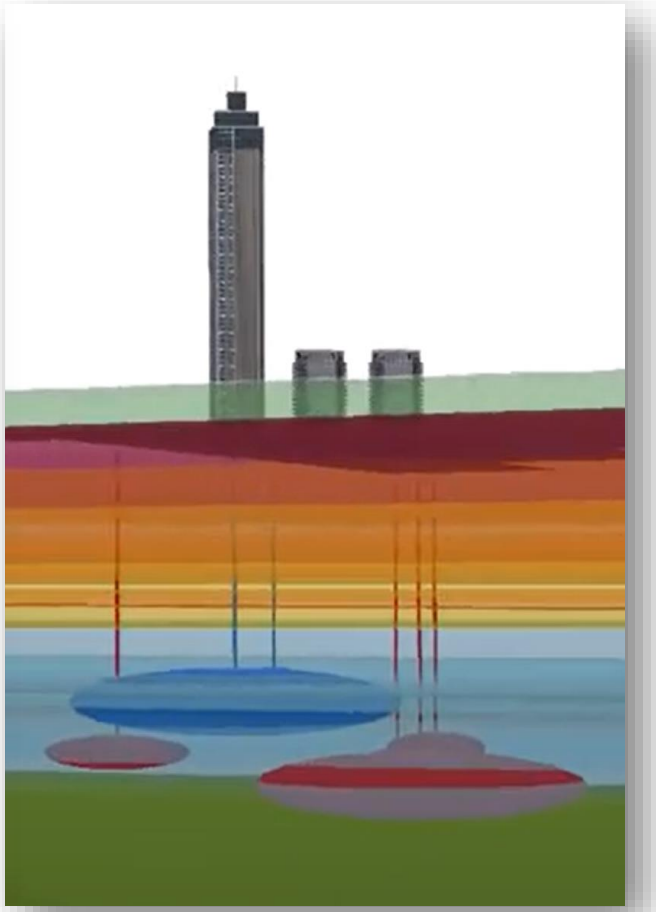
The Visible

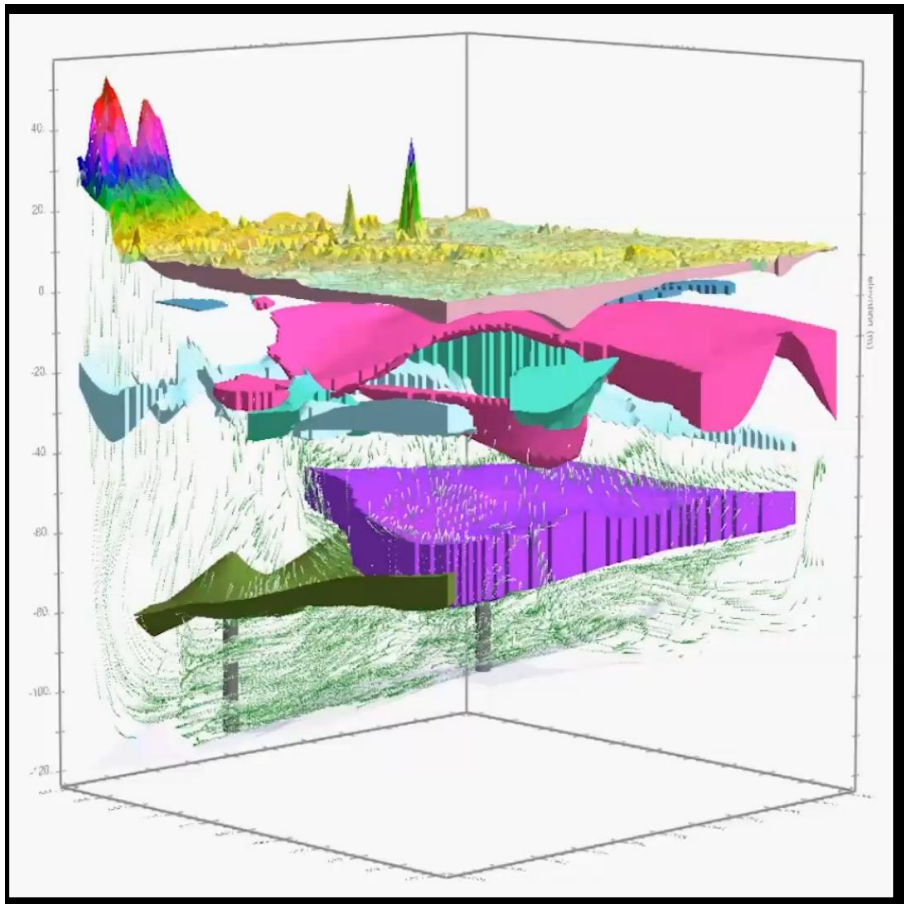




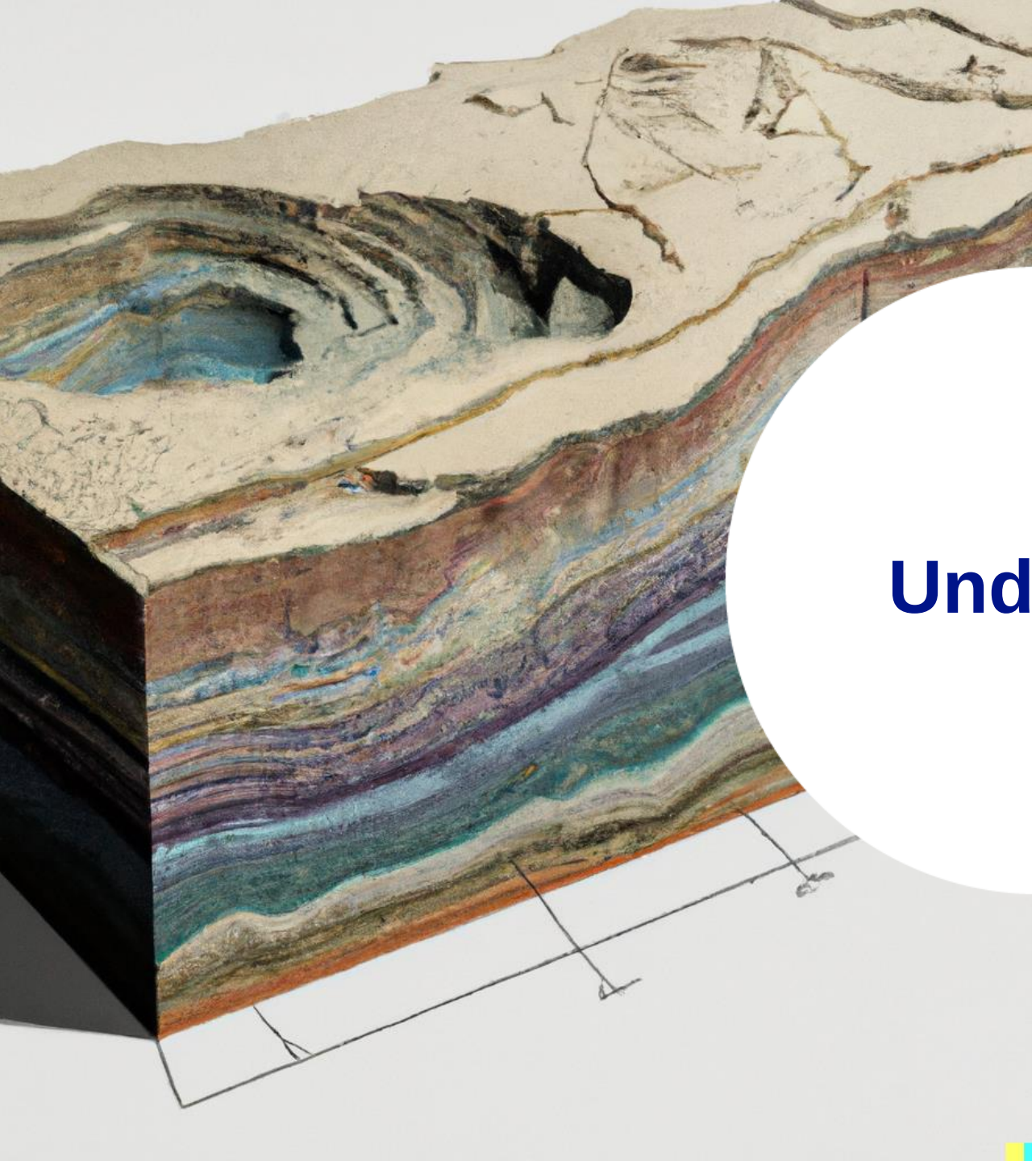
Sources: Smart Every Day – https://www.youtube.com/watch?v=EVbdbVhzcM4&t=243s, A. Kosior (2014) – https://doi.org/10.1016/j.compfluid.2012.01.014

The Invisible





Source: Basisregistratie Ondergrond – https://www.youtube.com/watch?v=vgSWdgS9AcU&t=107s



Underground Energy Storage

GSEU
GEOLOGICAL SERVICE FOR EUROPE

Why is it Crucial to the Success of the Green Transition

Speeding up renewable energy – bottlenecks and how you resolve them

WORLD ECONOMIC FORUM

Scaling up renewables is crucial and beyond boosting yearly capacity additions, we also need a build-out of transmission lines grids, storage solutions and technologies that enable system flexibility.

Forbes

We Have An Energy Storage Problem

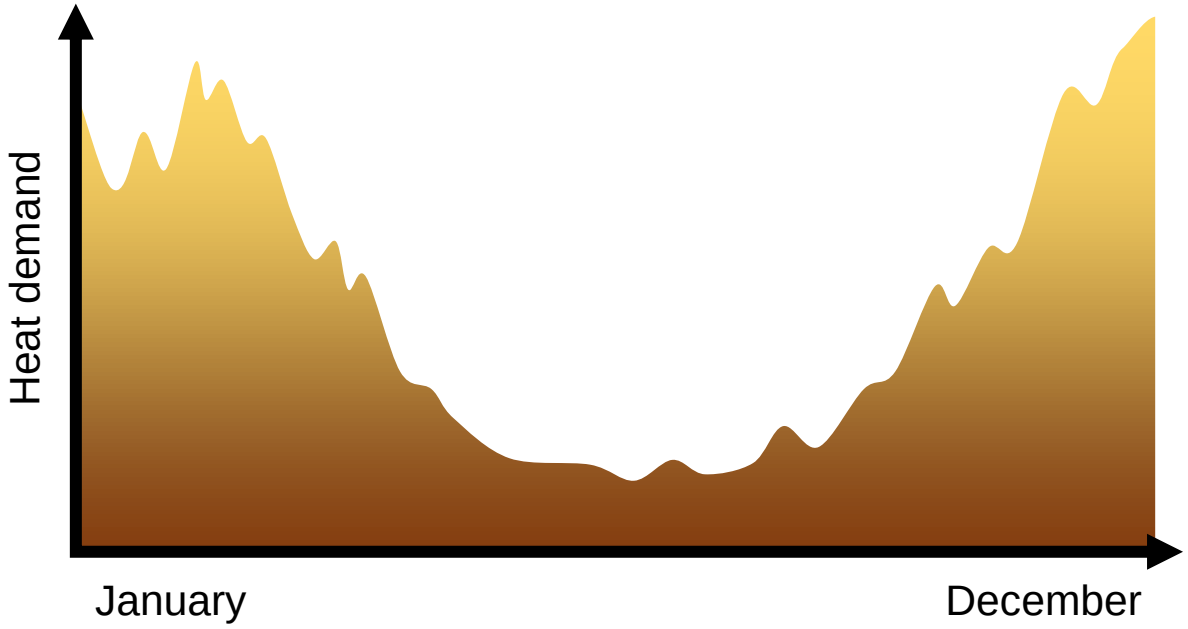
THE NEW YORKER

THE RENEWABLE-ENERGY REVOLUTION WILL NEED RENEWABLE STORAGE

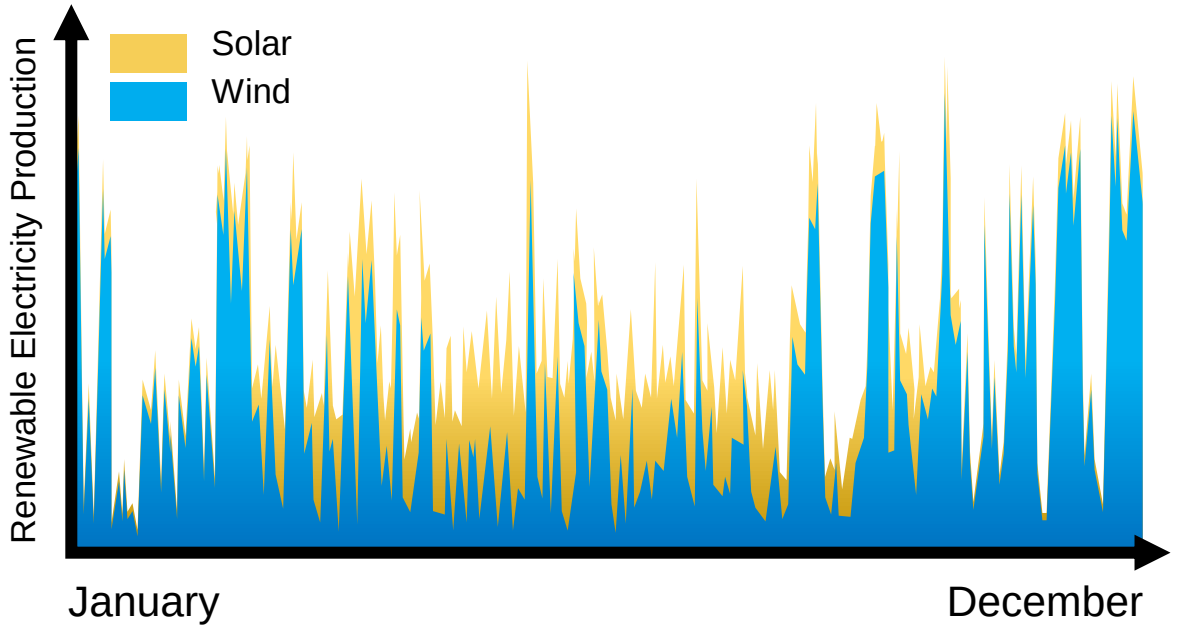
GSEU GEOLOGICAL SERVICE FOR EUROPE

Why is it Crucial to the Success of the Green Transition

How to match this energy demand profile …

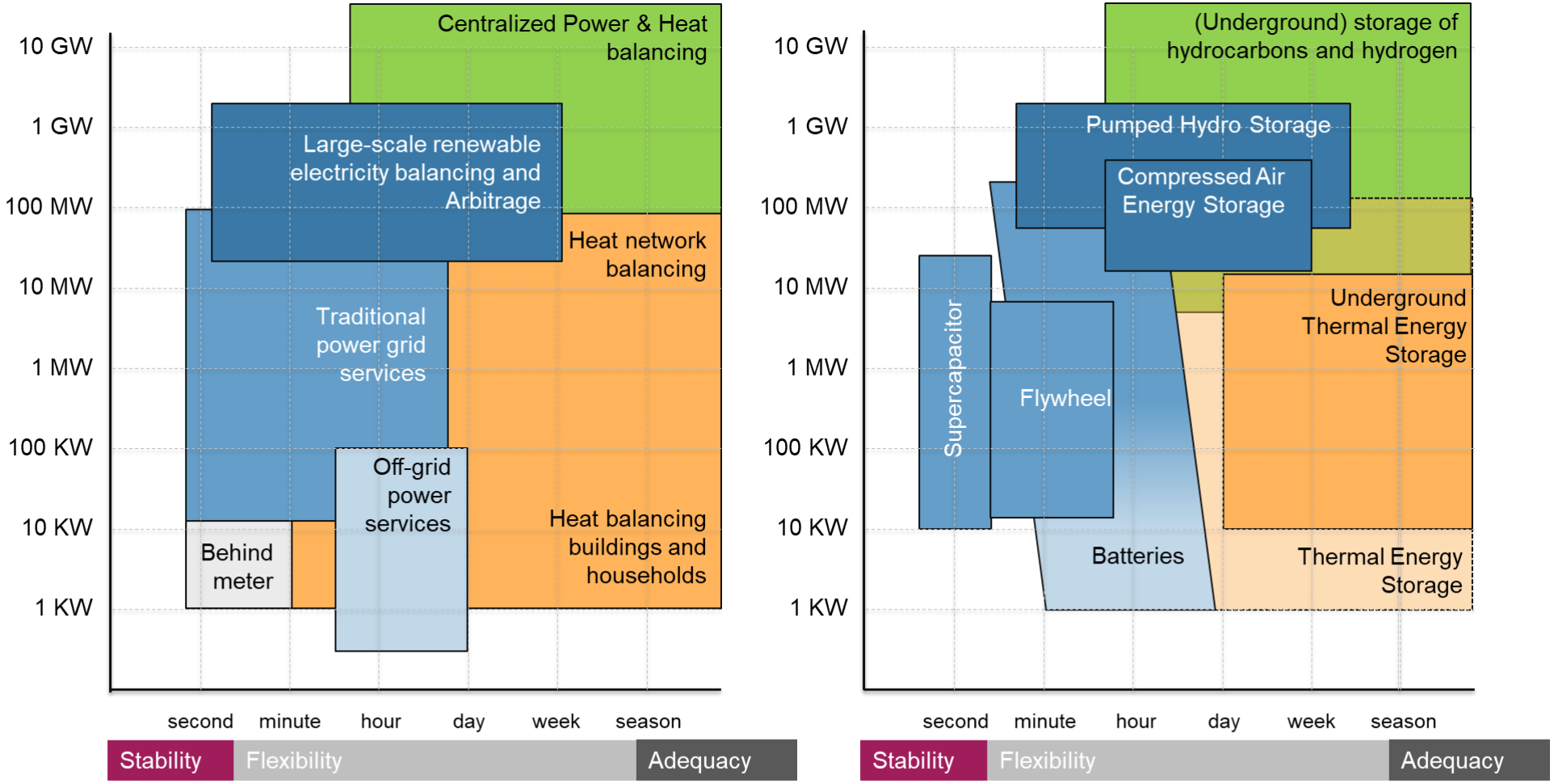


… with this energy production profile…



…without fossil fuels?

Energy Systems Services & Storage



TNO 2020: Energy systems services and storage (modified after IEA 2015 – Technology Roadmap)

Storage tanks

LNG
HYDROGEN
OIL / GASOIL
LIQUID AIR
HEAT

Surface Electrical

BATTERIES (DIVERSE SOORTEN)
FLY WHEELS
CAPACITORS
SUPERCONDUCTIVE MAGNETS

Surface storage

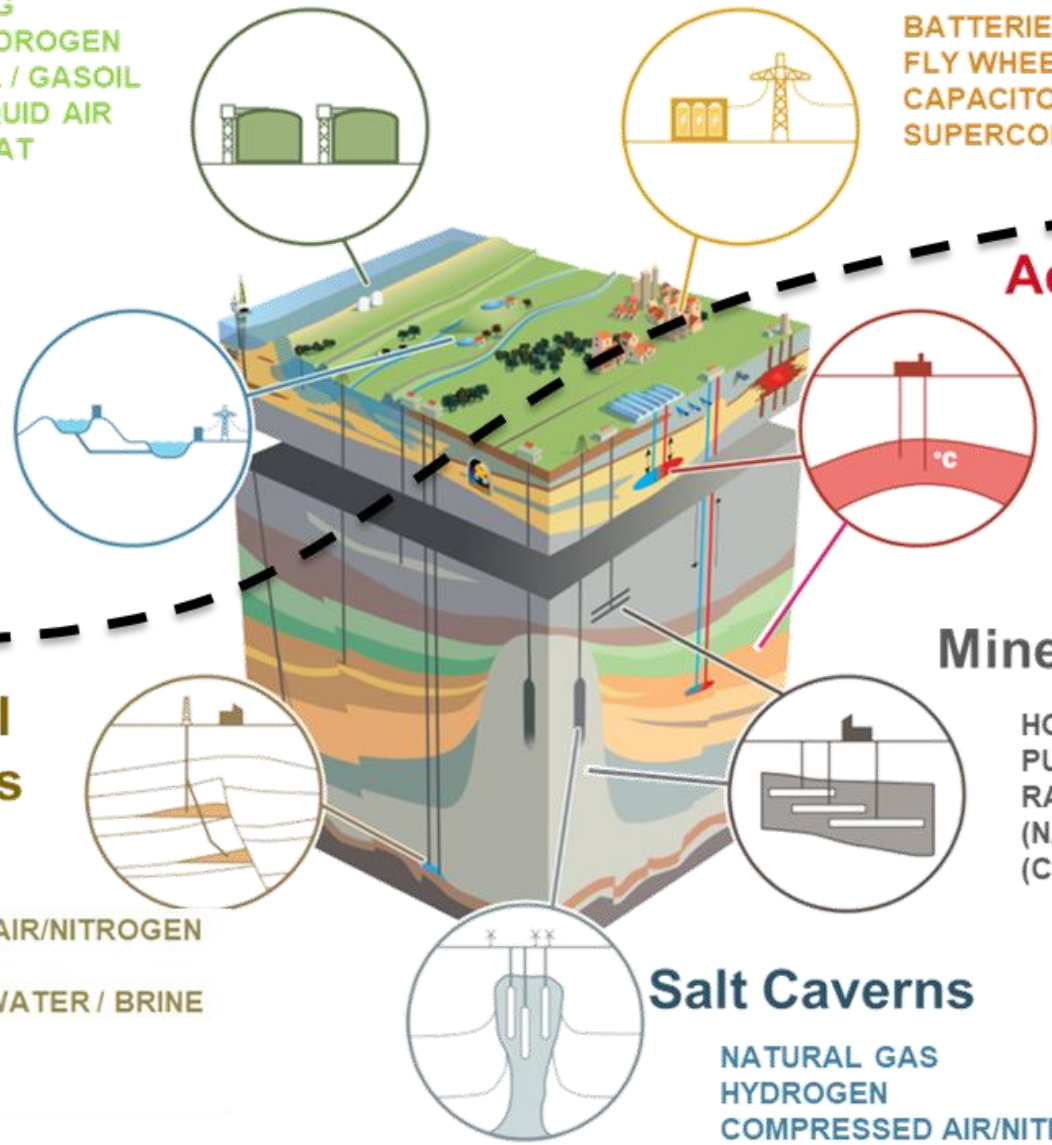
Underground storage

(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

GSEU GEOLOGICAL SERVICE FOR EUROPE

What is Stopping/Slowing Down a Large-Scale Deployment of UES?

Cost: UES needs excavation, drilling, and infrastructures.

Limited Geographic Availability: EUS requires specific geological formations.

Regulatory Hurdles: the development and deployment of underground energy storage facilities require permits and approvals from various regulatory agencies (time-consuming and costly).

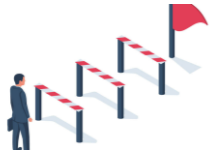
Public Perception: the public may be concerned about the safety and environmental impact of underground energy storage, which can make it difficult to gain support for new projects.

GSEU
GEOLOGICAL SERVICE FOR EUROPE

How can the GSEU help?

Cost: The GSEU can use its knowledge to identify suitable sites for UES that are cost-effective to develop.

Limited Geographic Availability: GSEU's partners can conduct geological surveys to identify suitable formations for large-scale deployment UES.

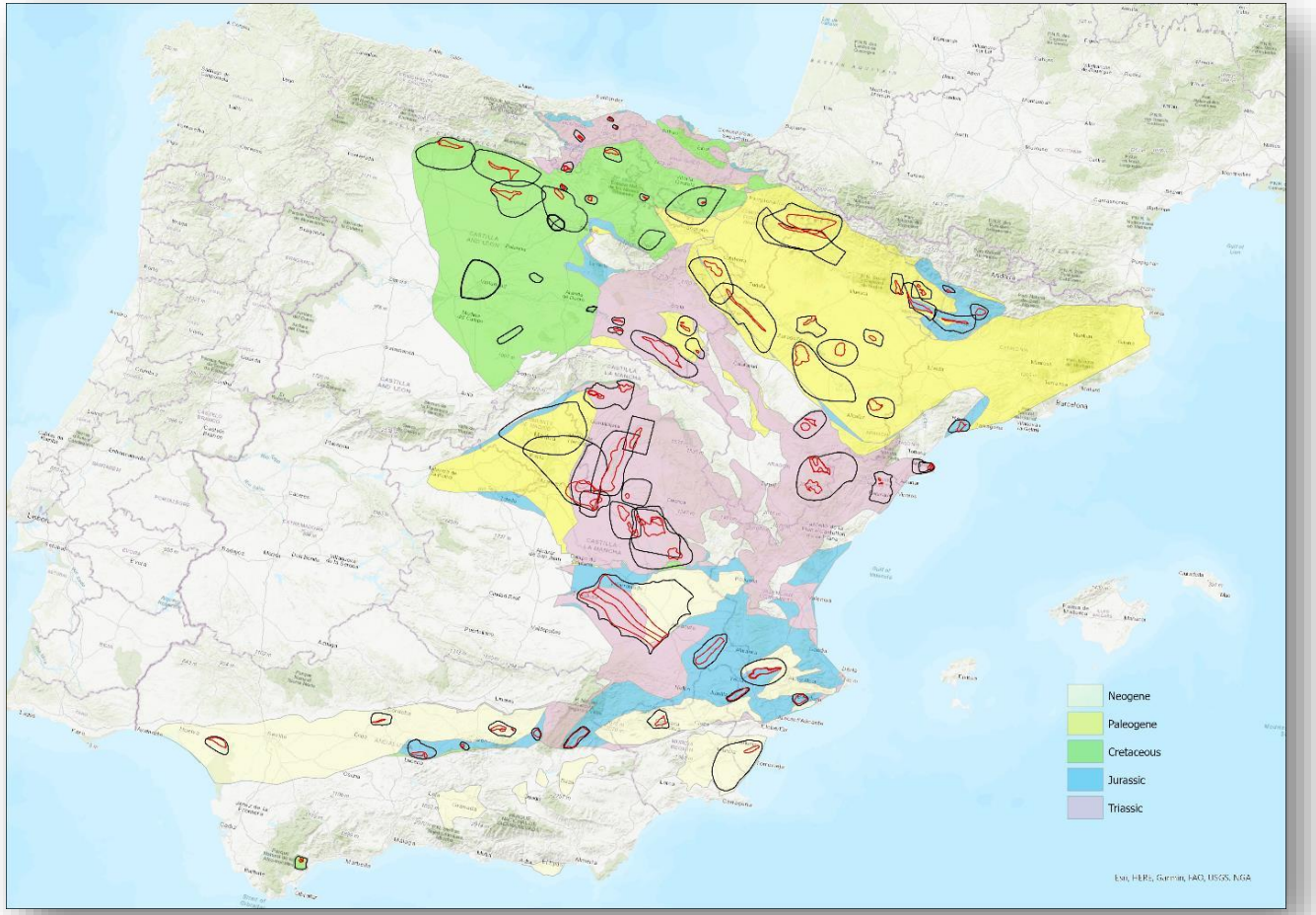


Regulatory Hurdles: the GSEU can provide guidance and support for the regulatory approval process. By working with regulatory agencies, we can help streamline the approval process and ensure that underground energy storage projects meet all necessary safety and environmental standards.

Public Perception: the GSEU can contribute to public outreach efforts by providing information on the safety and environmental impact of underground energy storage. Our partners, by engaging with local communities and stakeholders, can help address concerns and build support for underground energy storage projects.

GSEU
GEOLOGICAL SERVICE FOR EUROPE

EGDI – Providing pan-EU map of UES potential in Europe: our approach



Level 1 – Minimum information about all UES sites in Europe

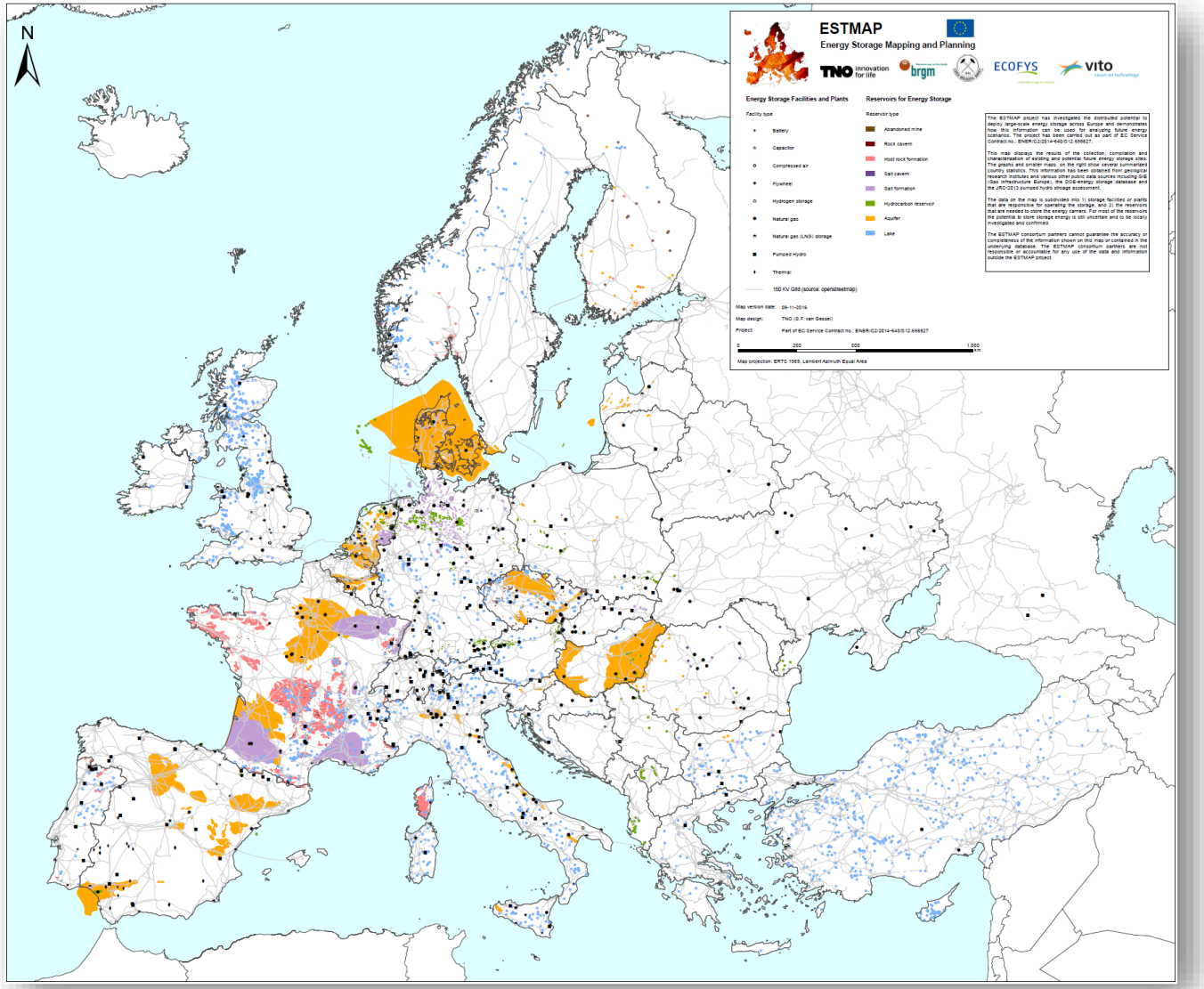
- Definition of the polygons of the formation's layers from isobaths maps
- Definition of storage units' polygons by grouping favorable structures
- Definition of traps polygons from the defined structures

Level 2 – Covering all the EU with Level 1 maps

Level 3 – Defining more detailed maps with more information and local studies

GSEU
GEOLOGICAL SERVICE FOR EUROPE

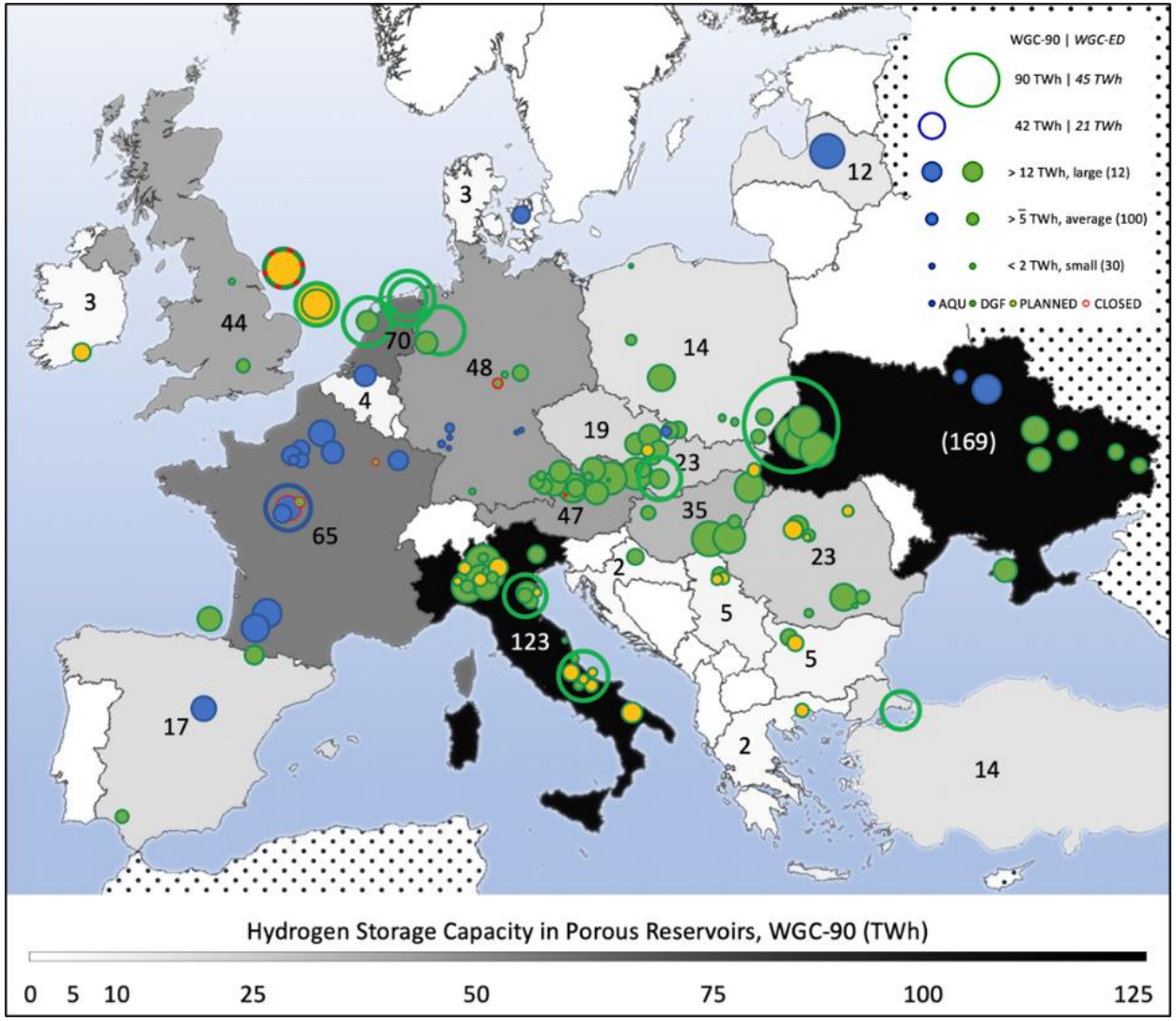
EGDI – Energy Storage Mapping & Planning



- On Surface Sites
- Subsurface Sites
- Existing and Potential Sites
- Standardized Database
- Technology KPI’s
- Application in EU systems models

GSEU
GEOLOGICAL SERVICE FOR EUROPE

EGDI – Hydrogen Storage Capacity in Porous Reservoirs

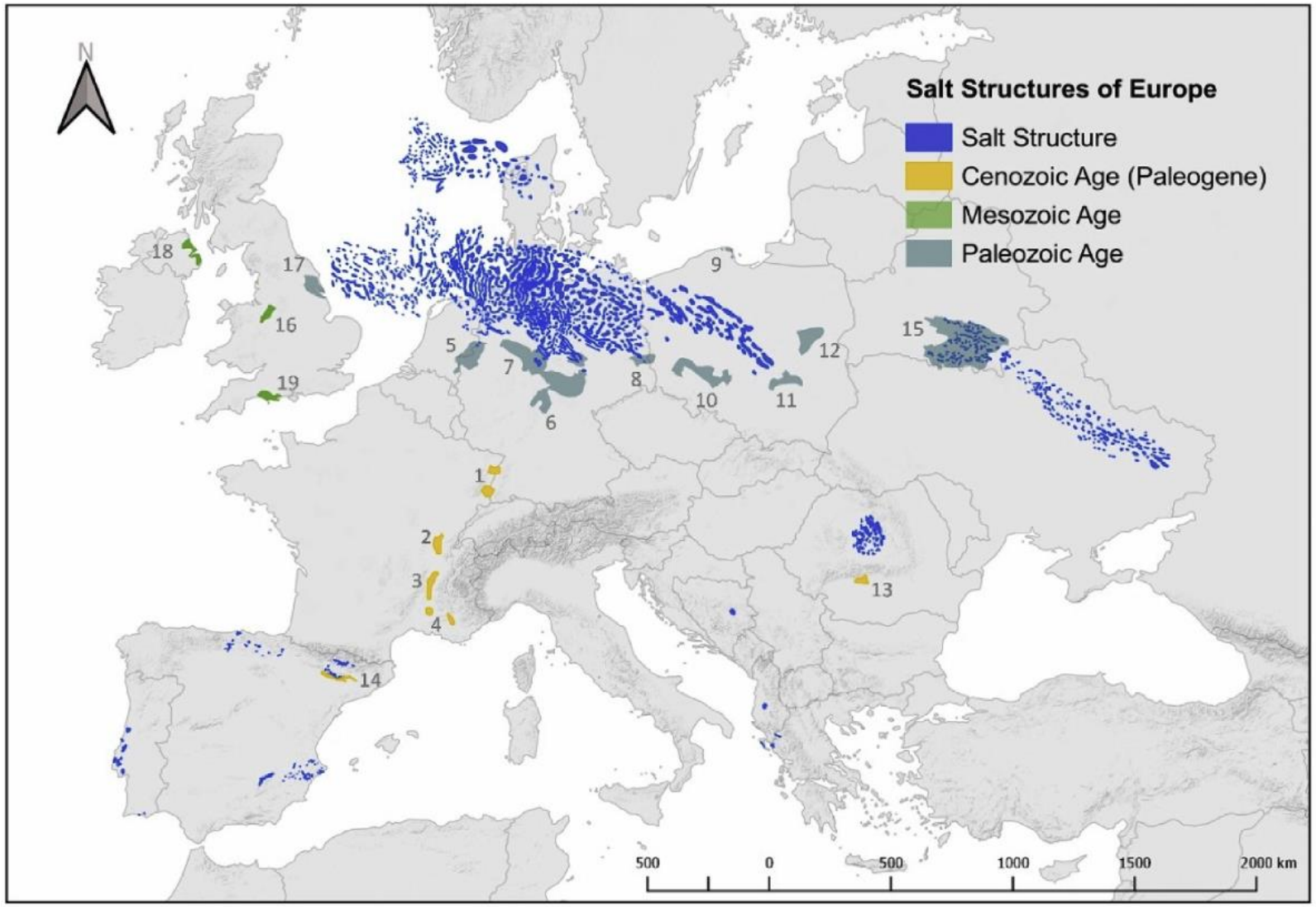


- Less advanced: pre-demonstration stage
- Many complexities (flow, recovery, quality)
- Larger capacities (typically 10-20x bigger than a cavern)
- Cushion gas requirements!
- Widespread potential

H2020 – HyUSPRe: Cavanagh, AJ, Yousefi, SH, Wilkinson, M & Groenenberg, RM. 2022: Hydrogen storage potential of existing European gas storage sites in depleted gas fields and aquifers.

GSEU GEOLOGICAL SERVICE FOR EUROPE

EGDI – Hydrogen Storage Capacity Salt Caverns

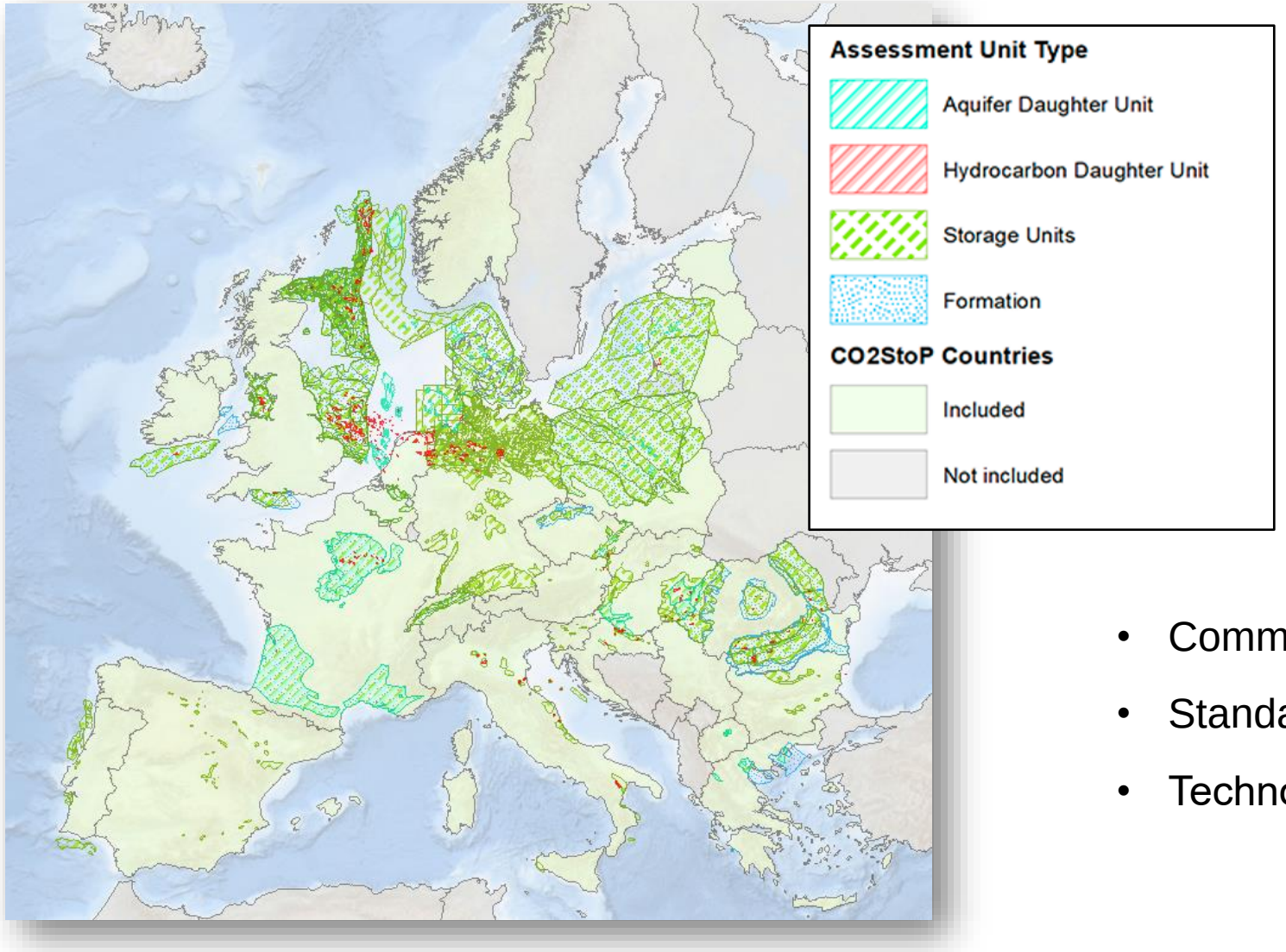


- Advanced stage: feasibility demonstrated
- Less complex than depleted reservoirs
- Smaller capacity (but scalable)
- Limited to specific regions

Caglayan, D.G., Weber, N., Heinrichs, H.U., Linßen, J., Robinius, M., Kukla, P.A., Stolten, D., 2020. Technical potential of salt caverns for hydrogenstorage in Europe

GSEU
GEOLOGICAL SERVICE FOR EUROPE

EGDI – CO_2 Storage Potential in Europe



- Common Assessment Methodologies
- Standardized Database
- Technology KPI’s

GSEU
GEOLOGICAL SERVICE FOR EUROPE

GSEU

GEOLOGICAL SERVICE | FOR EUROPE

Funded by the European Union

EuroGeoSurveys
European Geoscience for Society
The Geological Surveys of Europe