

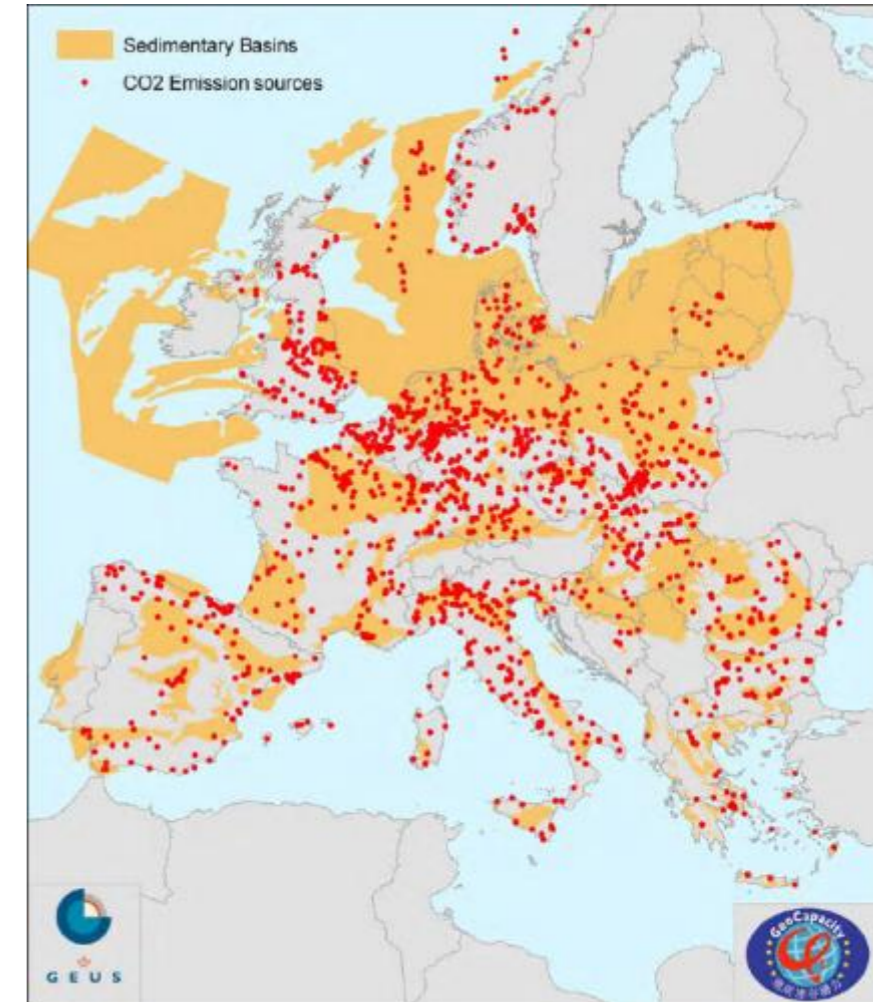
ENOS

Enabling Onshore Storage in Europe

Presentation To CSLF Technical group

Need for CCS onshore

- EU commitment of an overall reduction of greenhouse gas emissions of **at least 80% by 2050**
- This means storing **3 to 13 billion tonnes of CO₂** across Europe by 2050
- Europe cannot rely solely on the North Sea, despite its great and readily available storage potential.
- Need **onshore storage**, relatively near the emission points, to **reduce the costs** of CCS, enable territories to manage their CO₂ emissions locally, and **build lasting public** confidence in CCS as a mitigation option that can also contribute to local economic development.
- To reach ambitious goal of greenhouse gas emission reduction, while ensuring the **security, flexibility and competitiveness of energy supply**, deployment of onshore CO₂ storage will be crucial.



Enabling CO₂ storage onshore in Europe

By building on past experiences and national initiatives to support CCS

By developing and field testing key technologies adapted to onshore applications;

By engaging the local population in the storage research and projects, without which project development is impossible.

By Creating a favourable environment for onshore storage across Europe:

support knowledge sharing to maximise the benefits of site demonstrations,

integrate research results and creating best practices from real-life experiments,

support preparation of new pilot projects and upscaling to demonstration,

bring innovation to society through dialogue and communication,

promote CCS through training and education.

Developing and field testing key technologies

- Demonstrating through practical experience that injection operations can be run safely and efficiently onshore, which is key for optimising operations and to enable a positive regulatory environment;
- Ensuring that estimated matched storage capacities are sufficiently reliable and also affordable to verify, which is needed to enable investment in projects and therefore the deployment of CCS;
- Demonstrating our capacity to understand, detect and manage potential leakage risks, which is key for regulatory issues and to demonstrate storage is environmentally sound and safe for human health;
- Integrating CO₂ storage into the local economic activities so that the benefits are also reflected at the local scale, which is vital to enable the deployment of CCS;

Project Fact Sheet

29 Partners (parties and third parties) in 17 countries:

Europe: CO2GeoNet	Italy: NHAZCA, OGS*, Sapienza University of Rome*, Sotacarbo
Austria: GBA*	Norway: IRIS*
Belgium: GSB-RBINS*	Romania: GeoEcoMar*
Croatia: UNIZG-RGNF*	Slovakia: SGUDS
Czech Republic: Czech Geological Survey*	Slovenia: GEOINZ*
Denmark: GEUS*	Spain: CIEMAT, CIUDEN*, IGME*
Estonia: TTUGI*	The Netherlands: TNO*
France: BRGM* (Coordinator), Flodim, Geogreen, IDIL	Turkey: METU-PAL*
Germany: BGR*	UK: BGS*, Heriot Watt University*, Silixa, University of Nottingham

Duration: September 2016 – August 2020

Budget: 12.5 M€ of EC contribution. National funding supporting infrastructure development.

Working on actual sites

Leakage simulation:

GeoEnergy Testbed

Sulcis fault lab

Pilot CO₂ storage:

Hontomin

Pre injection studies:

Q16-Maas

LBR-1

GeoEnergy TestBed

Q16-Maas

LBR-1

Hontomin

Sulcis Fault Lab

Hontomín Technology Development Plant, Spain

Unique onshore **pilot injection site** in the EU, recognized by the European Parliament as a key test facility (*E.P. Resolution 2014*)

Deep saline aquifer comprised of **fractured carbonates** with low porous matrix permeability

Injection well (HI) and **observation** well (HA) reaching the depth of 1600 m

Well monitoring (P/T sensors, deep sampling, DTS, DAS, ERT and hydrophone array)

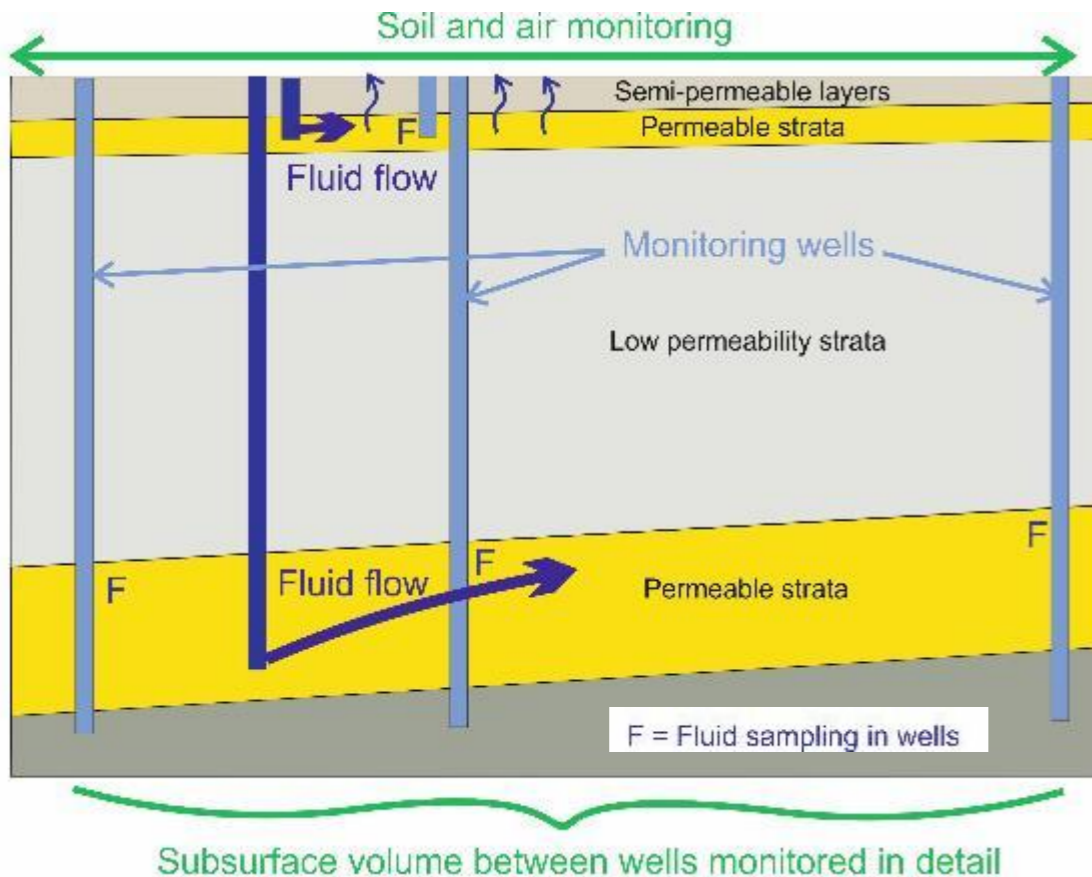


In **ENOS**: **Test** of different injection schemes, iDAS-VSP, deep sampler,

Development of monitoring data integration solutions and alert systems

The UK GeoEnergy Test Bed (GTB)

The GTB is a **research facility** initiated by the British Geological Survey and the University of Nottingham comprising an instrumented borehole array (depth c. 200m)



The GTB will:

Improve understanding of impacts and processes in the shallow subsurface

Enable development and testing of **innovative monitoring technologies**

Provide ground truthing for advanced simulation software

For **ENOS**, the GTB will be used to **advance innovative monitoring technologies** and techniques for **detection of fluid migration** in the shallow subsurface **and leakage**

The GTB site represents a £6M investment **to support new and emergent geo-energy sectors critical for a sustainable energy future** (including £2.5M UK government-funding through the ERA project)

Field laboratories – Sulcis Fault Lab (SFL)

CO₂ will be injected into a fault zone (depth c. 250-300 m) to better understand impacts of CO₂ leakage.

SFL will test the sensitivity and effectiveness of monitoring technologies and techniques designed and developed by ENOS partners.

SFL infrastructure is **funded by Sardinian Region and National funds** – (Center of Excellence for Clean Energy and Research on Electric System)

The SFL project has multiple purposes:

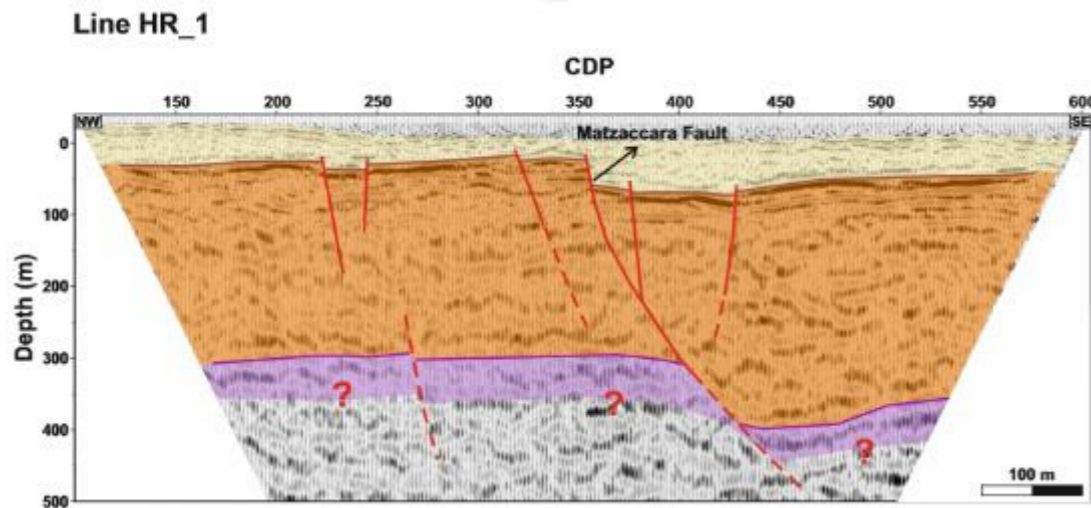
Study CO₂ **migration through faults**;

Examine water-gas-rock interactions including potential changes of **groundwater quality**;

Study behaviour & changes in rock / fault parameters by monitoring micro-seismicity and technical rock characteristics;

Test geochemical and geophysical monitoring tools (in-house manufactured and low cost CO₂ sensors)

Develop a **robust groundwater monitoring strategy**



LBr-1, Czech Republic

Depleted hydrocarbon field in the Czech part of the Vienna Basin, produced mainly in the 1960s

Tertiary **sandstones** at ca. 1100 m depth

Planned **ENOS activities**:

- **Assessment of leakage risks** through abandoned wells and faults, including possible shallow groundwater contamination
- Scenarios for CO₂-driven Enhanced Oil Recovery (**CO₂-EOR**) and its integration with CO₂ storage
- Study on **regional CO₂-EOR potential** of the Vienna Basin



Q16-Maas, the Netherlands



Condensate-rich gas field in Triassic sandstone reservoir

Production started in April 2014, finished end of 2019

ROAD project with enhanced recovery and storage: Cancelled!

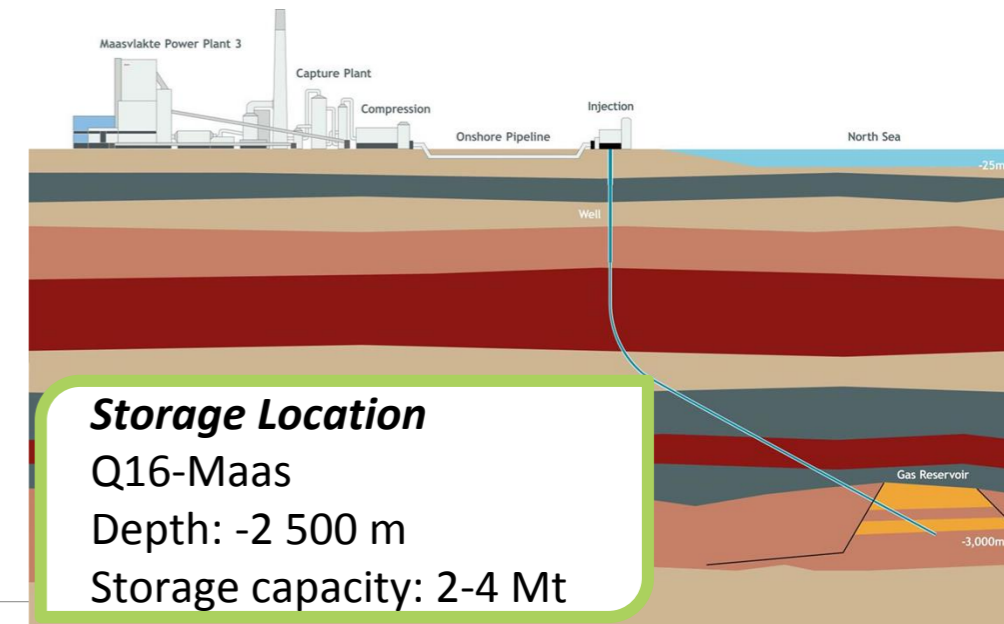
Potential for **seasonal buffering** after primary production

Support **seasonal CO₂ buffering concept** for use in greenhouses

- To make efficient use of waste CO₂: match supply and demand
- Support geothermal energy development in horticulture sector
- Decrease use of CHP installations

Stakeholder: **OCAP** transports CO₂ to greenhouses by pipeline

- **Technical and economic feasibility**
- Involvement of citizens; public engagement
- **Roadmap** for buffer implementation



Engaging with local communities

Finding solutions together: direct input of the population in making sense of the technology

Systematic exploration of technical challenges together with members of the public to identify the “good conditions” for onshore storage

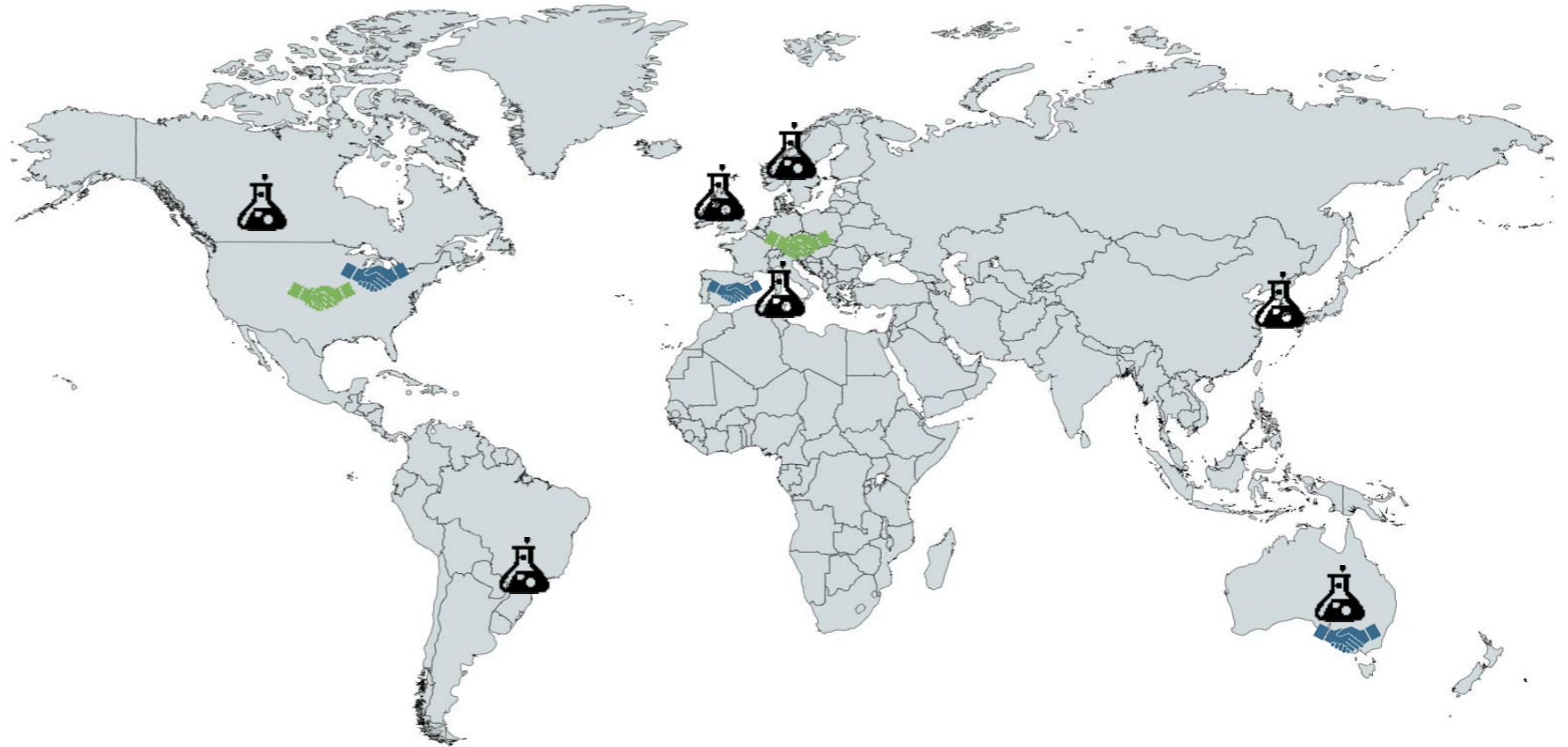
Listening to all points of view: collaboration with citizens and stakeholders for producing socially sensitive best practices

Public info tool: a communication infrastructure for storage pilots



International Collaboration

- Site twinings (🤝)
- Leakage simulation Alliance (🧪)
- Experience sharing workshops on specific topics open to all
(tomorrow 14:00 advanced characterisation techniques)
- Establishing contacts with European initiatives



Preparing for future projects

- Identification of **storage pilot opportunities** in Europe,
- Planning of further **development** of ENOS sites
- **Roadmap** for identified synergies for CO₂ storage and CO₂ utilisation



Capacity building

- Intensive training weeks for early career scientists (once a year)
- Building of an international master degree in CO₂ storage
- E-lectures for the general (but interested) public
(available online)



For information please contact enos@brgm.fr

visit www.enos-project.eu to get access to all events, documents and results.



ENOS
Enabling Onshore CO₂ Storage



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