# ENabling Onshore $CO_2$ Storage in Europe :

## *Fostering international cooperation around pilot and test sites*

ENOS
Enabling Onshore $CO_2$ Storage

enos-project.eu

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## Context

In order for the EU to reach its commitment of an overall reduction of greenhouse gas emissions of at least 80% by 2050, $CO_2$ Capture and Utilisation and Storage (CCUS) needs to be deployed widely and applied to power plants and key industries by then. This means storing 3 to 13 billion tonnes of $CO_2$ across Europe by 2050. In light of these figures, Europe cannot rely solely on the North Sea, despite its great and readily available storage potential; $CO_2$ geological storage also needs to be deployed onshore. Developing onshore storage, relatively near the emission points, will contribute to reducing the costs of CCS, enable territories to manage their $CO_2$ emissions locally, and build lasting public confidence in CCS as a mitigation option that can also contribute to local economic development. Therefore to reach the EU's ambitious goal of greenhouse gas emission reduction, while ensuring the security, flexibility and competitiveness of energy supply, deployment of onshore $CO_2$ storage will be crucial. The ENOS project is an initiative of $CO_2$GeoNet, the European Network of Excellence on the geological storage of $CO_2$ and a result of its recognition of the need to support onshore storage as a priority in today's context.

## Objectives

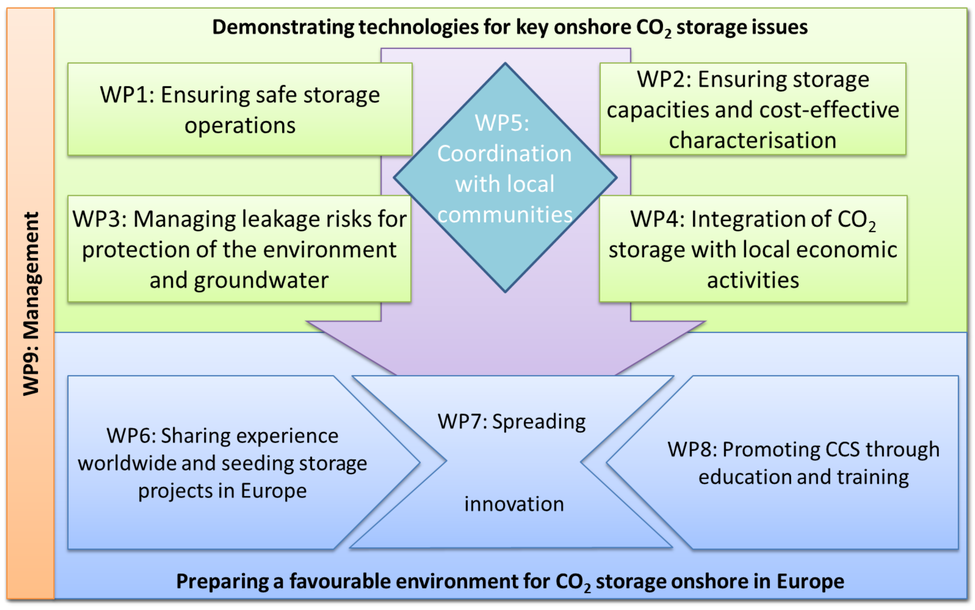
ENOS aims to develop $CO_2$ storage onshore in Europe by:

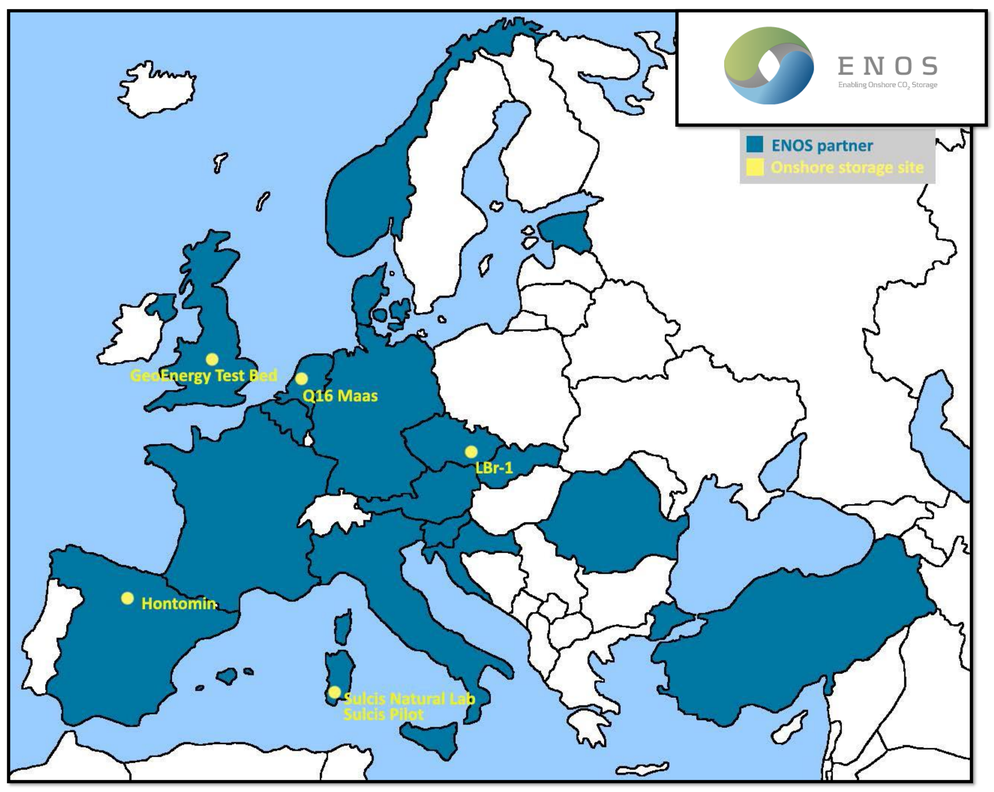
1) Developing, testing and demonstrating in the field, at pilot and experiment sites, key technologies specifically adapted to onshore applications;
2) Integrating $CO_2$ geological storage into the socio-economical fabric of the concerned territories by involving the local population;
3) Contributing to the creation of a favourable environment for onshore storage across Europe through knowledge-sharing, education, and support for new CCUS pilot and demonstration projects.

| WP | Objective | Tangible outcomes |
|---|---|---|
| 1 | Demonstrate safe and environmentally sound injection management:<br>- Test injection strategies<br>- Provide tools for injection and reservoir monitoring<br>- Provide monitoring data integration solutions and alert systems | Demonstration of:<br>• History matching for site conformance<br>• Cost-effective injection strategies in a tight fractured reservoir<br>• Mitigation techniques and reduction of uncertainties for induced seismicity<br>• Reservoir monitoring tools for site conformance at pilot scale, ready for use at demonstration sites.<br>• Smart Monitoring integrated approach<br>• Development of Workflow to integrate operation, monitoring and modelling data into risk management and alert system |
| 2 | Provide bankable capacity assessment convincing to stakeholders and operators by:<br>- Quantifying the reliability of estimates<br>- Lowering the cost for characterisation | Development and validation of:<br>• A reliability index for capacity assessment, therefore improving capacity assessment TRL<br>• A smart characterisation methodology to optimise exploration costs based on existing data<br>• FEED study for low cost smart drilling. |
| 3 | Demonstrate safe storage through effectiveness of leakage monitoring techniques and strategies:<br>- Demonstrate ability to monitor groundwater<br>- Demonstrate ability to monitor leakage pathways up to the surface<br>Provide integrated monitoring solution | Demonstration of:<br>• Monitoring strategies to demonstrate there is no unwanted migration or leakage of $CO_2$ at storage sites, including diffuse leakage and leakage through faults and boreholes;<br>• Tool-box of techniques to assess the geochemical reactivity of groundwater and definition of key parameters to monitor for early leakage detection.<br>• Monitoring at pilot scale ready for use at demonstration sites. Including wide range of tools validated<br>These tools will address both the need for wide-areal techniques to identify leakage and for detailed point data to confirm and quantify leakage. |
| 4 | Integrate the $CO_2$ storage concept into given economic activities by tackling technical, economic and regulatory issues. | • Technical feasibility of combined condensate production, $CO_2$ buffering and permanent storage in the Q16 Maas gas field, the Netherlands<br>• EOR and storage coupling based on both technical and economic factors for LBr-1 field. Assessment of the market potential and economic viability of CCS taking into account synergies and conflicts, legal and regulatory aspects. |
| 5 | Engage the local population<br>Develop best practices integrative of societal aspects<br>Verify how the integration of societal input can increase awareness and confidence | • A methodology to link the scientific and technical development of the best practices with societal concerns and implementation issues at local level<br>• Developed relationship between R&D community and local population<br>• Online public information tool, providing information relevant to the population based on their input and feed-back<br>• Enhanced relationship between the ENOS pilot sites and the local populations |

*Technical objectives and expected outcomes of the ENOS project*

*ENOS WP structure*




*ENOS participating countries and Location of the experiment sites*

## International collaboration

ENOS is initiating strong international collaboration between European researchers and their counterparts from the USA, Canada, South Korea, Australia and South Africa for sharing experience worldwide based on real-life onshore pilots and field experiments. Fostering experience-sharing and research alignment between existing sites is key to maximising the investment made at individual sites and to supporting the efficient large scale deployment of CCS. ENOS is striving to promote collaboration between sites in the world through a programme of site twinning, focus groups centered around operative issues and the creation of a leakage simulation alliance, and focus groups centered around operative issues.

### Storage site twinning

**Why:**
- To create a durable close working relationship between onshore site owners

**Who:**
- Planned or actual $CO_2$ injection site owners. Limited to a few participants

**What**:
- mutual visits,
- regular exchangesof information and data,
- discussions on real-life issues encountered
- where possible, identification of collaborative actions

### Leakage simulation alliance

**Why:**
- To foster cooperation and allow comparison and generalisation of results in understanding $CO_2$ leakage and its consequences

**Who:**
- Owners of and teams working on $CO_2$ leakage simulation sites

**What**:
- site visits,
- workshops,
- data exchange
- joint reports/publications

### Experience sharing focus groups

**Why:**
- to share practical experience (both successes and failures)of $CO_2$ injection, the issues faced and the potential solutions to overcome them
- To jointly identify the necessary developments of technologies and methodologies.

**Who:**
- Owners of and teams working on $CO_2$ injection sites
- In cooperation with GCCSI

**What**:
- Webinars
- workshops

Anticipated topics: site characterisation, $CO_2$ injection management, site monitoring strategy or relation with the local population.

Participation open to interested parties. Contact enos@brgm.fr

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