ULTimate CO_2

"Understanding the Long-term fate of geologically stored CO2"

A 4-year EC-funded collaborative research project involving 12 partners

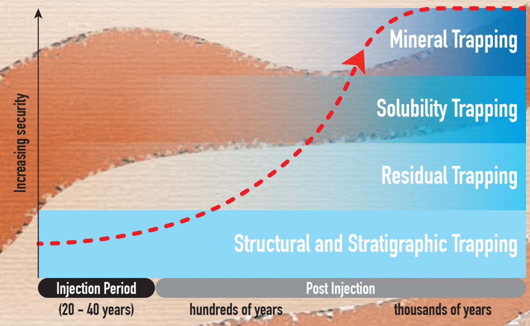
www.ultimateco2.eu

CONTEXT

CO_2 Capture and Storage, known as **CCS**, involves capturing CO_2 at power stations and industrial plants, transporting it by pipeline or ship to a storage location, and injecting it via a well into a suitable deep geological formation for permanent storage. CCS is a smart and proven solution that can contribute to reducing our CO_2 emissions and thus help tackle climate change.

However, a better understanding of the behaviour of the injected CO_2, particularly over long time scales (1000s of years), is needed to answer prevailing questions with confidence:

"What happens to the CO_2 after injection?"...
"How is it trapped?"...
"Will it leak from the reservoir?"...
"Will it stay underground?"...
"And for how long?"...



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The goal of ULTimateCO2 is to significantly advance our knowledge of specific processes that may affect the long-term fate of geologically stored CO_2 and to yield innovative modelling and experimental methodologies for predicting long-term storage site performance.

IMPACT

Improved scientific knowledge on the long-term fate of geologically stored CO_2

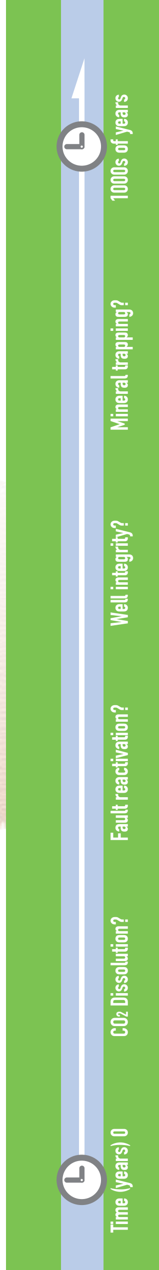
- define what to look for during storage site characterisation
- clarify what to avoid (potential leakage pathways, fluid mixing, etc.)

Increased confidence (or reduced uncertainty) that CO_2 can be completely and permanently contained

- help gain social acceptance of CCS
- help answer questions, backed up by scientific facts, on the safety and efficiency of long-term CO_2 geological storage

Guidelines

- provide improved technical criteria for establishing the conditions under which CO_2 can be permanently contained in the long term
- improve robustness and clarity of CO_2 storage regulations



UNDERSTANDING THE LONG-TERM FATE OF GEOLOGICALLY STORED CO_2

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ULTimateCO2 Key Research Topics:

- Reservoir trapping evolution
- Sealing integrity of faulted and fractured caprock systems
- Near-well sealing integrity
- Adaptation of the study results to regional scale
- Uncertainty assessment

12 partners:

BGR (DE), BGS-NERC (UK), BRGM (FR), EIFER (DE), GEOGREEN (FR), GEUS (DK), IFPEN (FR), IGG-CNR (IT), PHIMECA (FR), SWISSTOPO (CH), TNO (NL), UU (NL)

For more information:
www.ultimateco2.eu

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RESEARCH

Detailed studies, involving **laboratory experiments, numerical modeling and field data,** focus on three crucial aspects of a geological storage site: the reservoir (the rock layer or layers that contain the CO_2), the caprock (low-permeability rocks that seal the reservoir and prevent the CO_2 from moving out of the reservoir) and the wellbore (injection and monitoring well(s), plus legacy wells that may intersect the storage site).

The evolution of the CO_2 inside the storage **reservoir** is studied to estimate how and how much of the CO_2 is trapped over centuries. Three-dimensional models of onshore northeastern France and offshore UK geology have been built, and dynamic simulations of CO_2 injection are underway.

Comparison with natural analogues of outcropping geological formations that have been in contact with CO_2 for millions of years will also help compile information on chemical interactions between CO_2 and rocks over long time scales.

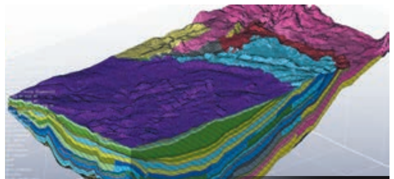
Buntsandstein outcrop, Black Forest, Germany ©BGR

Comprehensive laboratory experiments are conducted to provide new data on resistance of the clay **caprock**, subjected to chemical acidification due to the presence of CO_2 (changes in mechanical properties with time (stress-strain), hydraulic conductivity of faulted clay during shearing experiments).

Wellbore experiment © Swisstopo

An innovative 1:1 scale **wellbore** experiment is underway in the Mont Terri Underground Rock Laboratory in Switzerland. A pseudo cemented well has been built in lithologies similar to caprocks and then exposed to dissolved CO_2 for several months. The performance of the well completion materials and adjacent near-field rocks are being monitored.

Numerical modelling of brine displacement and fault reactivation are then calculated at the basin scale to evaluate the possible impact of CO_2 injection outside the storage complex. The evolution and related hydrogeological development of the Paris Basin has been calculated using a backstripping modelling approach.



Backstripping model © IFPen

Modern uncertainty assessment techniques are applied in order to correctly represent the confidence in the long-term efficiency and safety of CCS. These techniques have the advantage of being dynamic in the sense that confidence measures can be refined as new information is gathered. Thanks to the high level of uncertainty and the heterogeneity of the type of data, this project represents a great research challenge in the field of uncertainty theories.