

REX-CO₂

NEWSLETTER

September 2020

REX-CO₂ Completes its First Year!

One year into the project and REX-CO₂ has been hard at work to investigate the potential of re-using existing wells for CO₂ storage operations. As you'll note from the work package highlights in this newsletter, most of the effort in the past year has been in laying down the foundation of the re-use assessment workflow, ramping up the experimental work, and gathering data on regulations around well re-use. Despite the ongoing global pandemic, the consortium partners have been doing their best to continue their efforts through these trying times, turning to webinars and an online General Assembly to take the place of physical meetings. Their progress can be seen through the deliverables available on the project website (rex-co2.eu). In the upcoming months, there will be even more news to report, as the first version of the REX-CO₂ tool for assessing the potential of re-use will be completed, so be sure to subscribe to REX-CO₂ newsletter and updates to stay informed (rex-co2.eu/subscribe).

QUICK NUMBERS

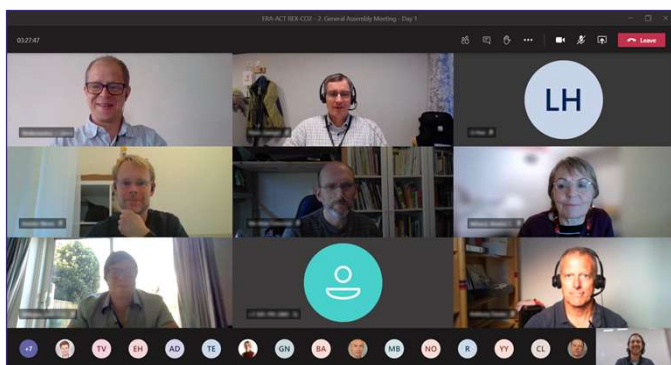
- 1 year complete, 2 years to go
- 5 out of 22 technical deliverables complete
- 5 out of 20 milestones complete
- 6 countries involved
- 9 research partners, 3 operators, 4 stakeholders (1 operator, 1 organizational partner, 2 national authorities)

Re-use Tool Development (WP2)

Work Package 2 titled "Well re-use and leakage assessment tool development" is focused on creating a publicly available well screening tool that is designed for detailed assessment of existing wells to determine their re-use potential. WP2 is led by LANL with contributions from TNO, BGS, GeoEcoMar, IFPEN and SINTEF.

The WP2 team has made significant technical progress during the first year, successfully completing and submitting 3 deliverable reports and 1 milestone report.

The team performed an extensive review of the current standards and guidelines used for managing well integrity in the petroleum sector. The approaches and tools used in the petroleum industry which have been proposed for CO₂ storage sites as well as state-of-the-art well re-use assessments were also reviewed. WP2 also reviewed previous assessments of re-using existing oil and gas wells for commercial scale CO₂ storage operations. The review showed a critical need to have a standardized workflow. Results of the review are summarized in deliverable report, "D2.1 Current state-of-the-art assessments and technical approach for assessment of well re-use potential and CO₂/brine leakage risk" (Opedal et al, 2020). (continued on next page)

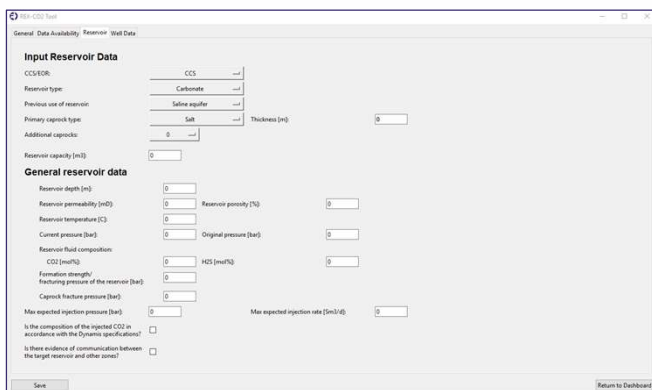
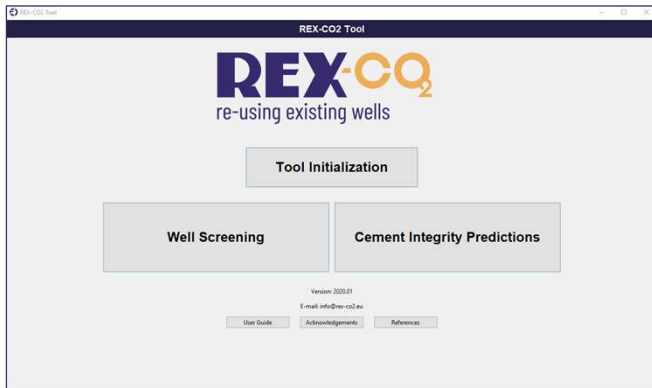


A taste of the REX-CO₂ (online) General Assembly.

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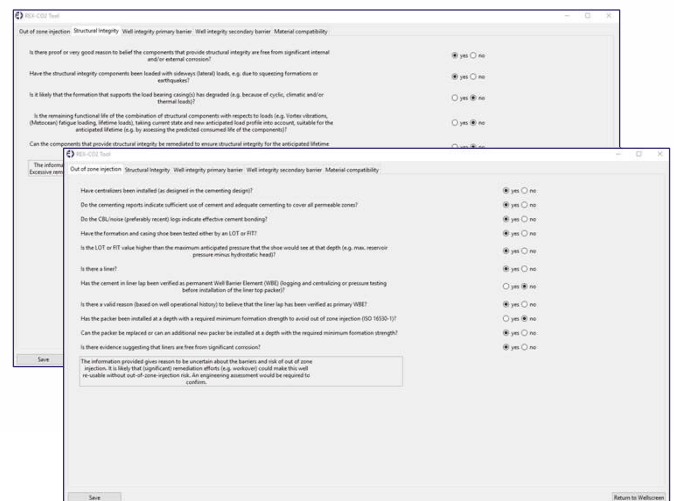
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Sample screenshots from the re-use assessment tool.

- 1) Assessment of appropriateness of well design, barrier materials and well integrity to ensure safe operations and CO₂ containment.
- 2) Initialization, including basic field information, well data and storage operation parameters.
- 3) Well suitability assessment for desired purpose (e.g. injector, monitoring well, producer).
- 4) Assessment of potential CO₂ leakage through primary cement barrier above storage reservoir.

Details of the conceptual framework are summarized in deliverable report, "D2.2: Summary report of well assessment tool framework" (Pawar et al, 2020a). This framework has been the basis for the ongoing development of the re-use assessment tool (see figures), which will have its first version complete in October 2020. The tool will have a well screening aspect, building off of the framework's decision trees, and a cement integrity prediction aspect, which will run reduced order models based on geomechanical and flow simulations.



Sample screening questions in the re-use assessment tool.

WEBINAR ON RE-USE WORKFLOW

On 2 April 2020, a webinar was held to provide feedback on the conceptual well re-use framework developed within the project. This framework, detailed in Deliverable 2.2, comprises the basis of the well assessment tool by laying out the general steps of the tool: initialization/field assessment, well suitability, assessment of well cement integrity, and the results.

The webinar was attended by 21 people, including research and industrial partners and a government regulator, who provided useful comments and insightful questions on the approach. Their feedback has been incorporated throughout the tool development process.

WEBINAR ON EXPERIMENTAL WORK

Work Package 3, "Experimental investigation for re-using wells for CO₂ storage", held an internal workshop where the participating WP3 project partners discussed the status and plans for the experimental activities in REX-CO₂. The workshop was arranged by SINTEF from 27-28 April 2020. Due to the current COVID-19 situation, the workshop was held remotely (by Skype) over the two days. Workshop participants included representatives from SINTEF, TNO, IFPEN, BGS, LANL, ReStone and Equinor.

The objective of the workshop was to discuss and align all experimental activities in WP3. Therefore, all project partners responsible for experimental work presented their current status and plans for their respective experimental activities. Furthermore, an important ad hoc objective was to discuss the current COVID-19 situation and how this impacts the progress and planned deliverables.

All presentations went well and generated good discussions. It was agreed that the proposed activities complement each other, and the workshop was considered successful.

The COVID-19 situation has had a considerable impact on the progress of laboratory activities, but much work has nevertheless been performed. Although delayed, all WP3 activities are progressing well with good results:

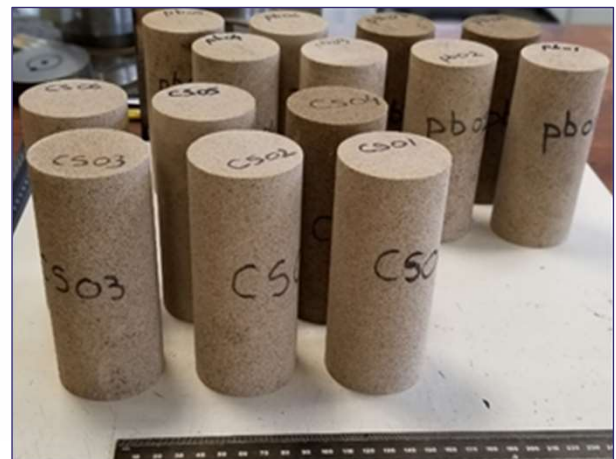
- SINTEF has started work on experimentally determining the influence of rock stiffness on radial crack development in cement sheaths. Subsequently, a potential remediation solution will be tested in collaboration with the industrial partner ReStone.
- TNO is studying well stress changes, microannuli development and leakage remediation, both experimentally and numerically.
- IFPEN is performing a detailed characterization of the cement-rock and cement-steel interface strength in simulated well conditions. The mechanical tests will be calibrated with numerical simulations.
- BGS is testing a bio-remediation method as a new way to seal porous materials in projected well conditions.
- LANL has started work on experimental determination of state of stress in cement, which is vital input to cement integrity models.

Experimental Investigation (WP3)

WP3 consists of experimental and numerical investigations of well barrier degradations, well damage processes, self-healing mechanisms and potential remediation measures. Most of the work is experimental, and so far into the project, an emphasis has been put on proper planning and start-up of the experimental activities. Furthermore, several meetings and an internal workshop have been held to coordinate activities between partners.



Push-out mould with sandstone and cement slurry for shear bond tests at IFPEN



Rock samples to be tested for mechanical properties at BGS

National Case Studies (WP4)

In the first year of the project, the focus of WP4 was on identifying potential national case studies and selecting the most promising ones. Work started with determining the criteria for the case studies and identifying potential case studies. This was done in strong collaboration with the consortium's industry partners. Additionally, for the UK case study, BGS prepared a milestone report on potential storage sites considered for case study selection (Williams, 2019). (continued on next page)

After establishing this strong suite of case studies, a final selection per country was made and each country has successfully selected at least one site, meeting Milestone 5 in June 2020. Some of the countries aim at performing at least two case studies with different characteristics to meet national goals. For the selected options, initial data has been gathered and collected via a description template, which provides the background and basic information of the case study with some relevant parameters. The selected case studies are a good mix of on- and offshore locations, applications for CCS and CO₂-EOR, depths that range from 1,400 to 5,000 m, sites that cover both sandstone and carbonate reservoirs with different types (gas fields, oil fields and aquifers) and lastly reservoir storage capacities ranging from 37 to 280 Mt CO₂.

At this moment, WP4 is preparing to perform an initial assessment with the first version of the well screening tool that will be prepared in WP2. The knowledge gained will be used in turn to update the tool.

Best Practice Guidelines (WP5)

Since the beginning of the project, the WP5 team has been monitoring the progress and activities of the technical work packages to determine how the outputs can be effectively summarized as best practice recommendations. WP5 officially kicked-off in June 2020 with the REX-CO₂ Management Team meeting (online, of course) to refine the intended content, structure and scope of the best practice report and to initiate the work program. It is clear that the design of existing wells and condition of their materials will differ from those of newly drilled wells completed specifically for CO₂ storage. It is therefore important to consider the actions required for bringing existing wells closer towards the idealized case. Recommendations delivered by WP5 will seek to address this issue.

Legal, Environmental and Social Aspects (WP6)

The activities in WP6 over the past year have focused primarily on collecting all relevant data for the assessment of environmental and legal frameworks on well re-use in the participating countries: France, the Netherlands, Norway, Romania, the United Kingdom and the United States. The data collection materialized

through a synthesis report, deliverable D6.1. The synthesis will be used to highlight the existing regulatory gaps on well re-use present in the national legislations and to enable a comparative analysis between partner countries. The aim will be to formulate recommendations for completing the legislation to support implementation of CO₂ geological storage projects using existing hydrocarbon wells as injection, monitoring or water production wells.

The existing regulatory gaps and further improvements needed will be discussed in a regulatory online workshop organized together with WP4 in February 2021. Together with the regulators, the partners will analyze the permitting process in the different countries using the national case studies selected within WP4.

A second focus of the WP6 activities was the preparation of national public surveys which will be deployed in the participating countries till the end of November. The results will then be compiled in December. Until now, the national coordinators have selected specific target groups for the surveys and TNO, the coordinator of this activity, focused on the preparation of the questionnaire, which is to be finalized together with the WP6 partners in the upcoming month.

WHERE WE'LL BE IN THE UPCOMING MONTHS

- American Geophysical Union (AGU) Fall Meeting
 - December 2020, San Francisco, USA
- Greenhouse Gas Control Technologies Conference (GHGT-15)
 - March 2021, Abu Dhabi, UAE
- Trondheim Conference on Carbon Capture, Transport and Storage (TCCS-11),
 - June 2021, Trondheim, Norway

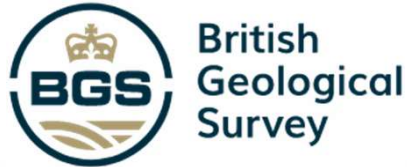
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