

# REX-CO<sub>2</sub> PROJECT OVERVIEW

## 2022.06.09

REX-CO<sub>2</sub> Re-using Existing wells for CO<sub>2</sub> storage operations

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Project coordinator



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**REX-CO<sub>2</sub>**  
re-using existing wells

# What is REX-CO2?

Re-using Existing wells for CO<sub>2</sub> storage operations

- International research project, funded through the 2<sup>nd</sup> call ACT (Accelerating CCS Technologies) programme (<http://www.act-ccs.eu/>)
- 6 Countries: Netherlands (Project lead); USA, France, UK, Norway, Romania
- 19 partners (R&D; Branch Organisation; national authorities; Operators)
  - 3 new partners during project
  - International interest
- Duration: September 2019 – August 2022
- Project website: <https://rex-co2.eu/>

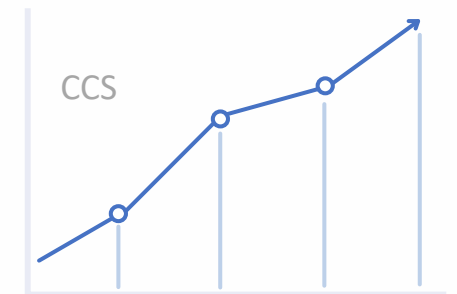


# Motivation: facilitate CCS in hydrocarbon fields

- Applies to onshore & offshore
- Potential re-use modes
  - Re-use without modification
  - Workover with modification
  - Side-track from a portion of the well
  - Deepening or milling to access a shallower target
  - Partial plugging of well sections
  - Re-entry of abandoned well
- Objective: Screening methodology (not an engineering solution)

Challenge: All wells that penetrate a caprock have to be assessed → time consuming and subject to inconsistency / incompleteness

**A structured & independent well screening process is required**



# Objective of REX-CO<sub>2</sub>: Provide decision makers with mechanisms and information to evaluate re-use potential of existing oil and gas well infrastructure

WP1 (TNO, Maartje Koning)  
Project Management and Coordination

WP6 (GeoEcoMar,  
Alexandra Dudu)  
Legal, environmental  
and social aspects

WP2 (LANL, Rajesh Pawar)  
Well reuse and leakage  
assessment tool

WP3 (SINTEF, Nils Opedal)  
Experimental studies to  
support well reuse

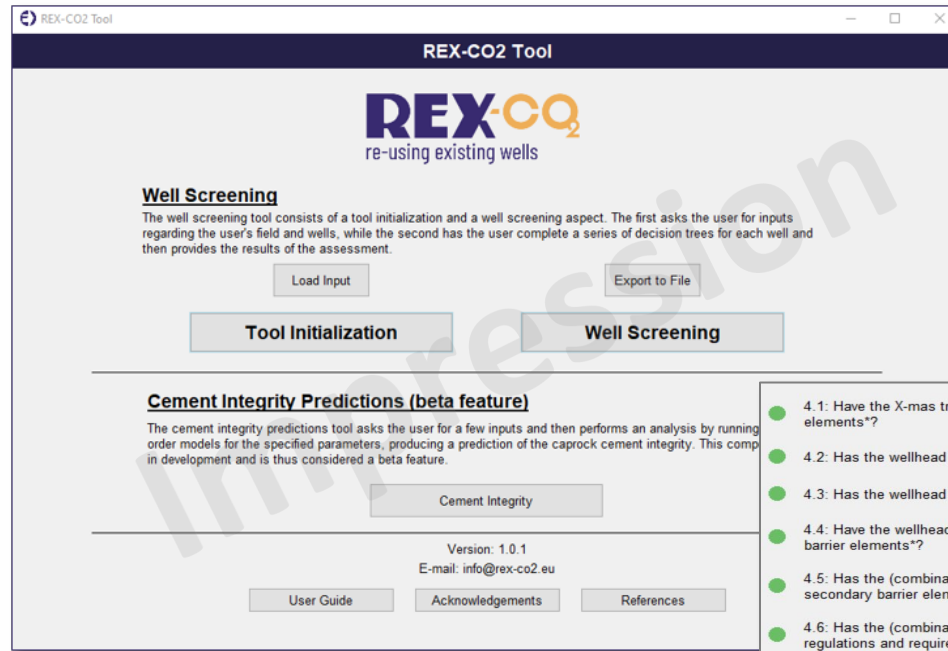
WP4 (TNO, Vedran Zikovic)  
National case studies for well  
reuse

WP7 (TNO,  
Lydia Rycroft)  
Dissemination and  
communication

WP5 (BGS, John Williams)  
Best Practice Recommendations for reusing existing wells for CO<sub>2</sub>  
storage

# REX-CO2 Well Screening Tool

Category	Data
Reservoir and caprock	Target formation
	Caprock
	Current and expected pressure and temperature
	In-situ fluid composition
Well construction and history	Production history
	Drilling history and completion
	Well design and configuration
	Workover history
	Side-tracks
	Cement composition
Well integrity record	Cement evaluation logs
	Well barrier schematics
	Abandonment plan (if applicable)
	Completion reports or End of well report
	Mechanical integrity test
	Formation integrity/leak-off test
	Annular pressure
	History of well performance and issues
Well maintenance history	
Load history	



**Cement Integrity Predictions (beta feature)**  
The cement integrity predictions tool asks the user for a few inputs and then performs an analysis by running order models for the specified parameters, producing a prediction of the caprock cement integrity. This component is in development and is thus considered a beta feature.

Version: 1.0.1  
E-mail: info@rex-co2.eu

- 4.1: Have the X-mas tree body and valves recently been inspected, tested and verified as secondary barrier elements\*?  yes  no  unknown
- 4.2: Has the wellhead recently been inspected, tested and verified as a secondary barrier element\*?  yes  no  unknown
- 4.3: Has the wellhead casing hanger recently been tested and verified as a secondary barrier element\*?  yes  no  unknown
- 4.4: Have the wellhead connections, seals and annuli valves recently been tested and verified as secondary barrier elements\*?  yes  no  unknown
- 4.5: Has the (combination of) production casing (and liner including liner hanger) been tested and verified as a secondary barrier element\*?  yes  no  unknown
- 4.6: Has the (combination of) production casing (and liner) been cemented according to current national regulations and requirements?  yes  no  unknown
- 4.7: Has the quality of the cement at the relevant intervals been assessed and verified as a secondary barrier element\*?  yes  no  unknown
- 4.8: Does the well have sustained annulus pressures in any relevant annuli or any other indication of cement integrity issues?  yes  no  unknown
- 4.10: Does the secondary barrier envelope include an additional impermeable formation?  yes  no  unknown
- 4.11: Are there any indications of integrity issues with the impermeable formation that is part of the secondary barrier envelope?  yes  no  unknown
- 4.12: Are there any other indications of integrity issues with the secondary barrier (envelope)?  yes  no

● Recommendation: red

The information provided gives reason to assume that the well does not have all the required secondary well barriers in place for CO2 injection. Major remediation work (e.g. workover) is foreseen to ensure well integrity. An engineering and techno-economic assessment would be required to confirm complexity and cost benefit analysis.

Recommendation	Explanation
	No or only minor remediation could be expected
	Moderate remediation or additional verification efforts could be expected
	Severe remediation or a comprehensive risk management strategy on retrievable/replaceable items could be expected.
	Severe remediation or a comprehensive risk management strategy on non retrievable/replaceable items could be expected.
	Critical information is missing for the tool.

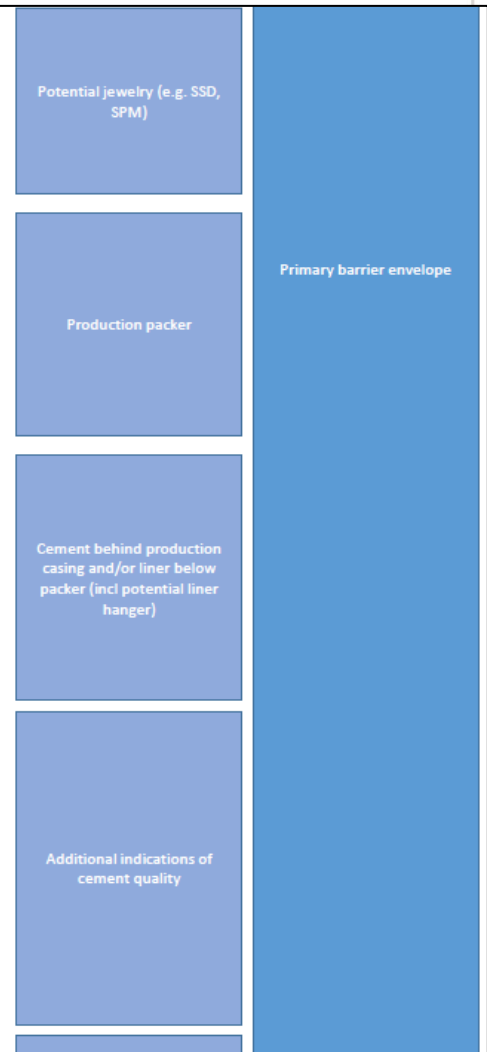
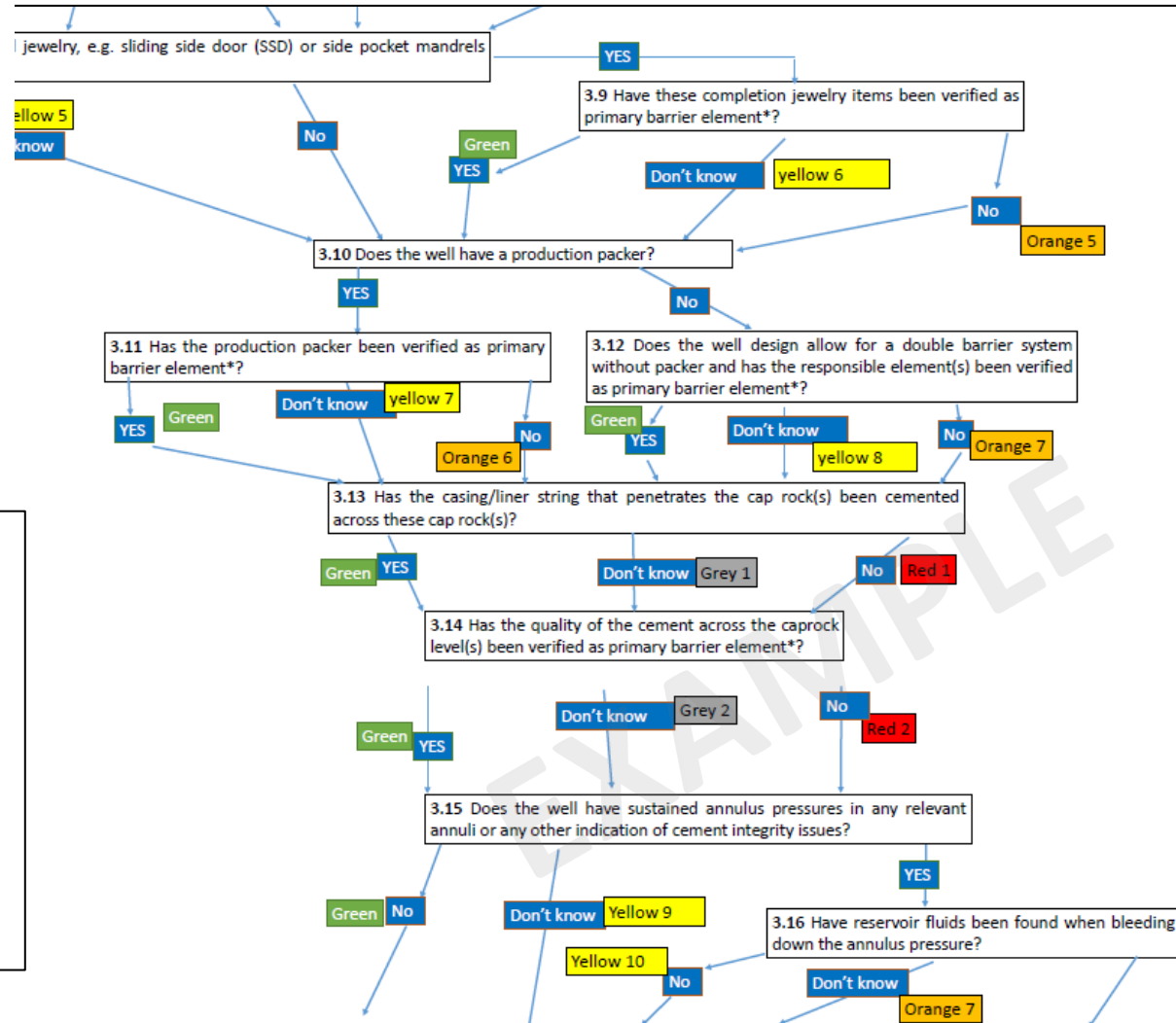
	Out of zone injection	Structural integrity	Well integrity primary barrier	Well integrity secondary barrier	Material compatibility
Well 1					
Well 2					
Well 3					
Well 4					
Well 5					
Well 6					

# Well screening

- Decision trees for 5 integrity components
- Relevant for any well design
- Evaluation per question

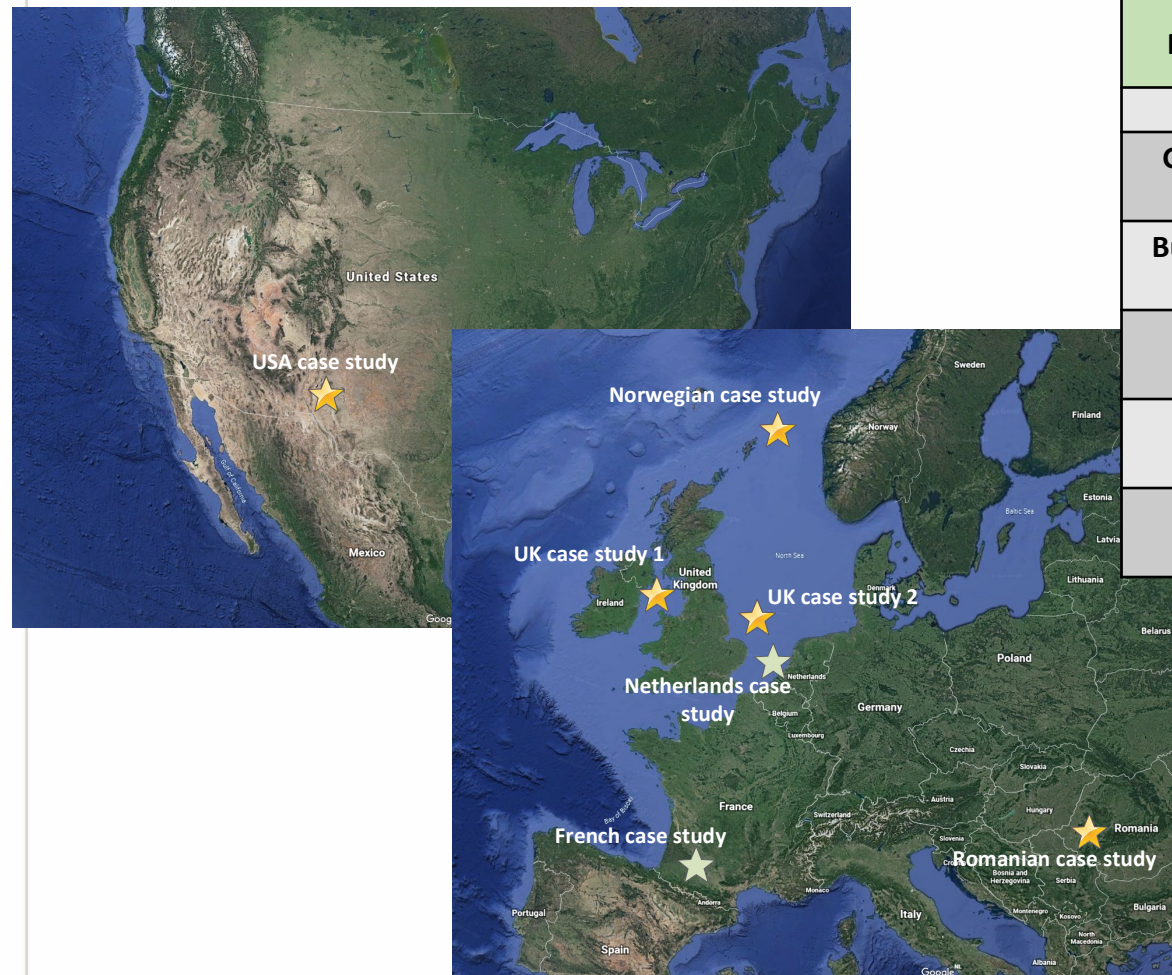
## The Five integrity components

1. Out of zone CO<sub>2</sub> loss
2. Structural integrity
3. Primary well barrier
4. Secondary well barrier
5. Material compatibility



# Application of Tool: case studies

Case study name	Country	Onshore/offshore	Type	Reference
<b>P18-2 (Porthos)</b>	Netherlands	Offshore	Depleted gas field	Zikovic and van der Valk (2021)
<b>Vaccum</b>	USA	Onshore	CO <sub>2</sub> -EOR field	Chen (2021)
<b>Gullfaks Sør and Visund</b>	Norway	Offshore	Oil fields	Grimstad et al., (2022)
<b>Bunter Sandstone Closure 36</b>	UK	Offshore	Saline aquifer	Williams and Hoskin (2021)
<b>Hamilton</b>	UK	Offshore	Depleted gas field	Williams and Hoskin (2022)
<b>Rousse</b>	France	Onshore	Depleted gas field and pilot CO <sub>2</sub> storage site	Guy and Cangemi (2022)
<b>Salonta</b>	Romania	Onshore	Depleted gas field (abandoned)	Dudu et al., (2022)

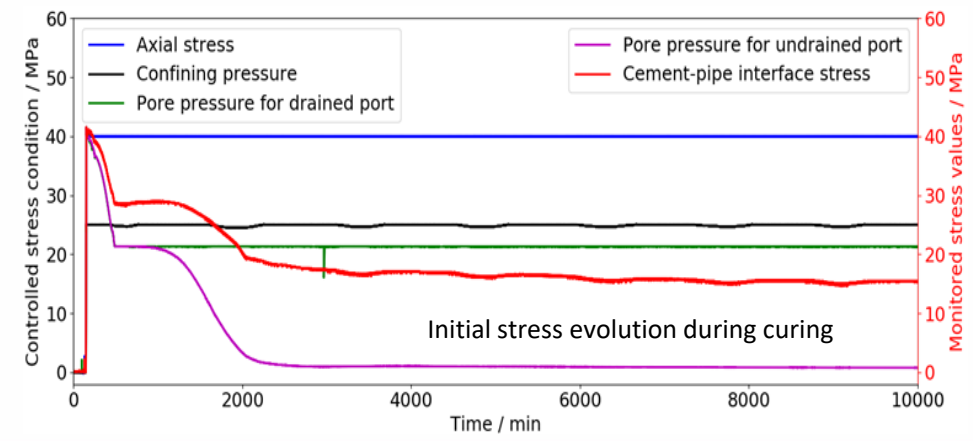
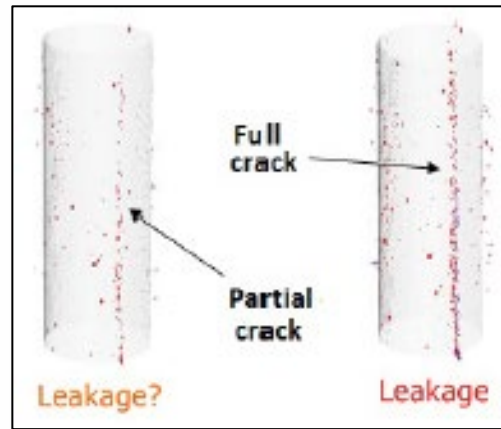
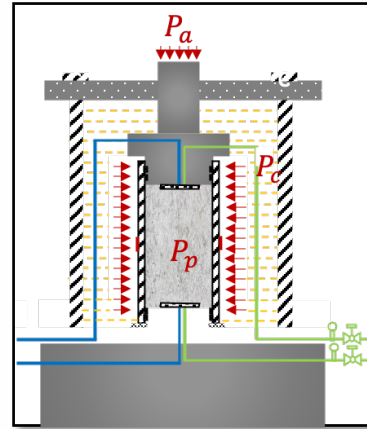
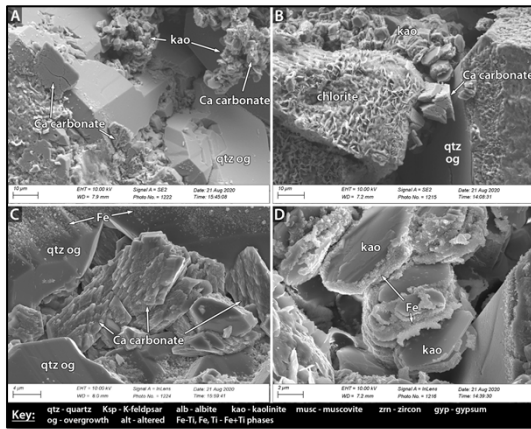


Ref.: based on [Google Earth](#)

- Location: on- and offshore
- Applications: Saline, depleted gas and CO<sub>2</sub> EOR
- Depths: 1400-5000 m
- Reservoir rock: sandstone and carbonate
- Reservoir type: gas field, oil field, saline aquifer
- Reservoir capacity: 37 – 280 Mt CO<sub>2</sub>
- Number of available wells: >100

# Experimental investigations for re-using wells for CO<sub>2</sub> storage

- Provide experimental data that describe how well degradation and well design influence potential re-use as CO<sub>2</sub> injectors
  - Self-healing of leakage pathways
  - Microbial Remediation
  - Bond strength between cement & steel
  - Mechanical behaviour & integrity of cement-rock systems & interfaces
  - Downhole cement state of stress
- To define boundary conditions at which well integrity could fail and/or be remediated





# Summary & take-away points

## Value of REX-CO2:

- Fast turn-around time & systematic approach to assess large number of wells
- Improved decision making, optimised capacity planning & cost savings when maturing CCUS opportunity
- Facilitate safe well re-use & CCS uptake

## • Case studies:

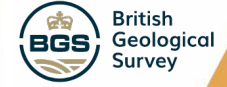
- Well Screening Tool results in line with Engineering Assessment
- Well intervention always required to re-purpose for CO2 injection

## • Experimental:

- Provides insights in fundamental well integrity processes
- Requirement for a (larger) data-base with actual and historic downhole data from different conditions

## • Permitting:

- Major differences in permitting & lack of specific legislation for well re-use
- Regulatory barriers expected: in case of time-gap between end of production and CO2 injection (liability?)
- Data sharing & early discussion between operators, regulators and future CO2 storage operators should be encouraged



# REX-CO<sub>2</sub>

re-using existing wells

Thank you for your attention

<https://www.rex-co2.eu>



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