# REX-$CO_2$ PROJECT OVERVIEW 2022.06.09

## REX-$CO_2$ Re-using Existing wells for $CO_2$ storage operations


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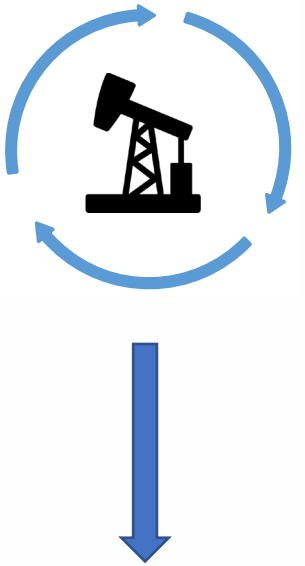
# What is REX-CO2?

Re-using Existing wells for CO2 storage operations

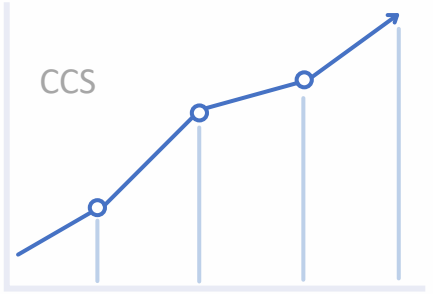

- International research project, funded through the 2nd call ACT (Accelerating CCS Technologies) programme (http://www.act-ccs.eu/)
- 6 Countries: Netherlands (Project lead); USA, France, UK, Norway, Romania
- 19 partners (R&D; Branch Organisation; national authorities; Operators)
  - 3 new partners 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



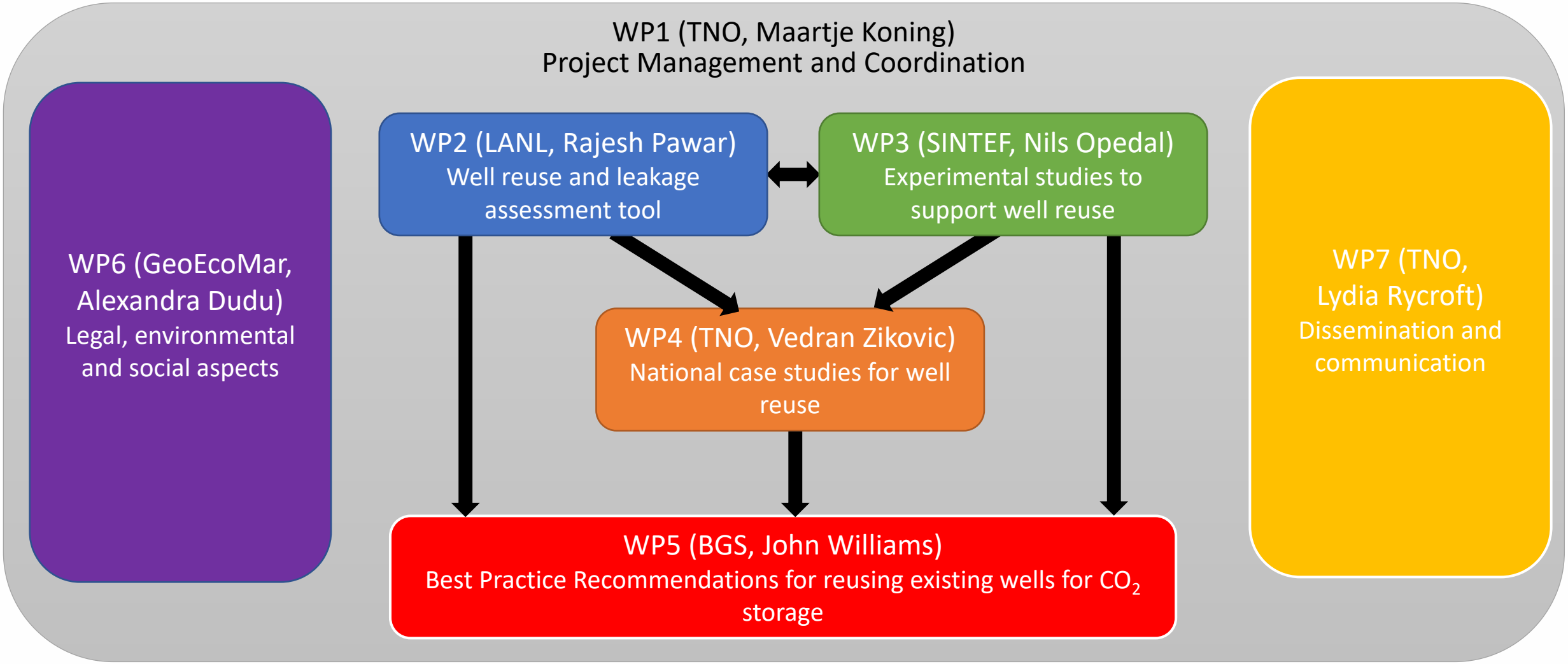
- Objective: Screening methodology (not an engineering solution)




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

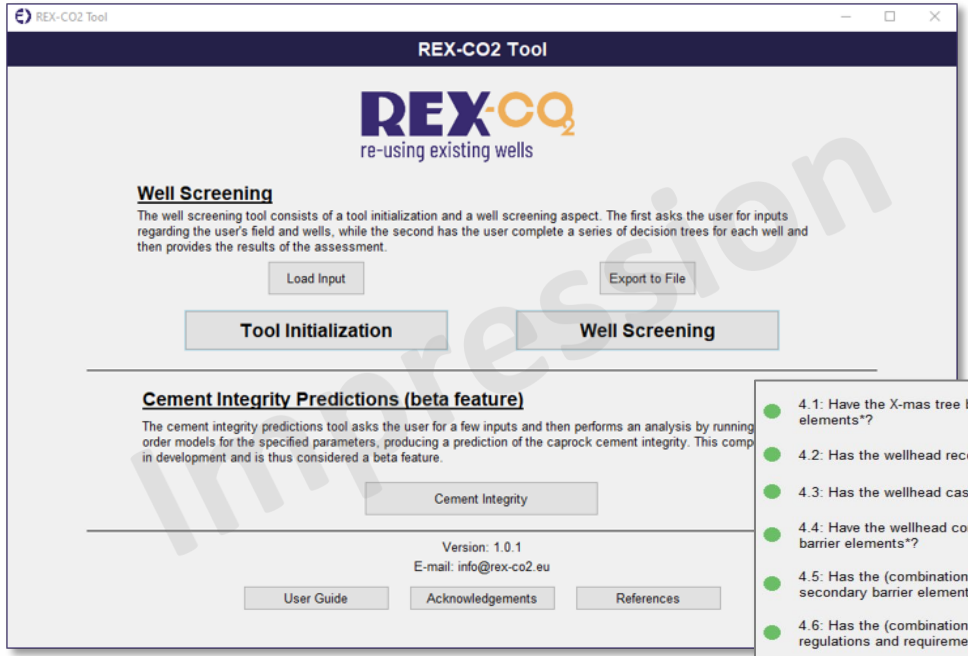
**A structured & independent well screening process is required**

# Objective of REX-$CO_2$: Provide decision makers with mechanisms and information to evaluate re-use potential of existing oil and gas well infrastructure



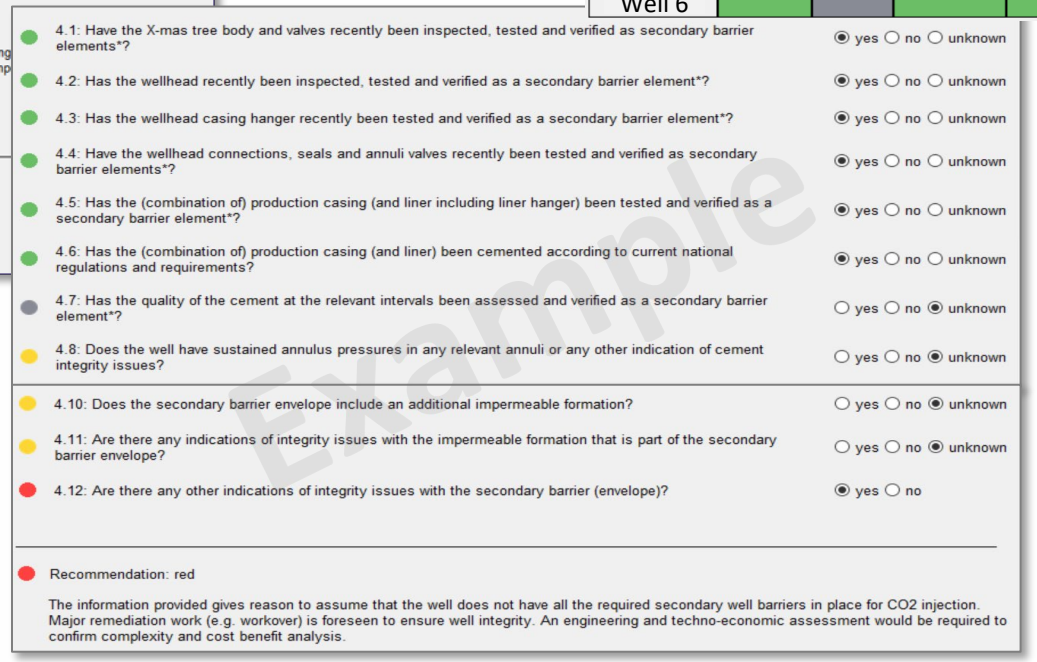
# REX-CO2 Well Screening Tool

| Category | Data |
|---|---|
| **Reservoir and caprock** | Target formation |
| | Caprock |
| | Current and expected pressure and temperature |
| | In-situ fluid composition |
| | Production history |
| **Well construction and history** | Drilling history and completion |
| | Well design and configuration |
| | Workover history |
| | Side-tracks |
| | Cement composition |
| | Cement evaluation logs |
| **Well integrity record** | 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 |



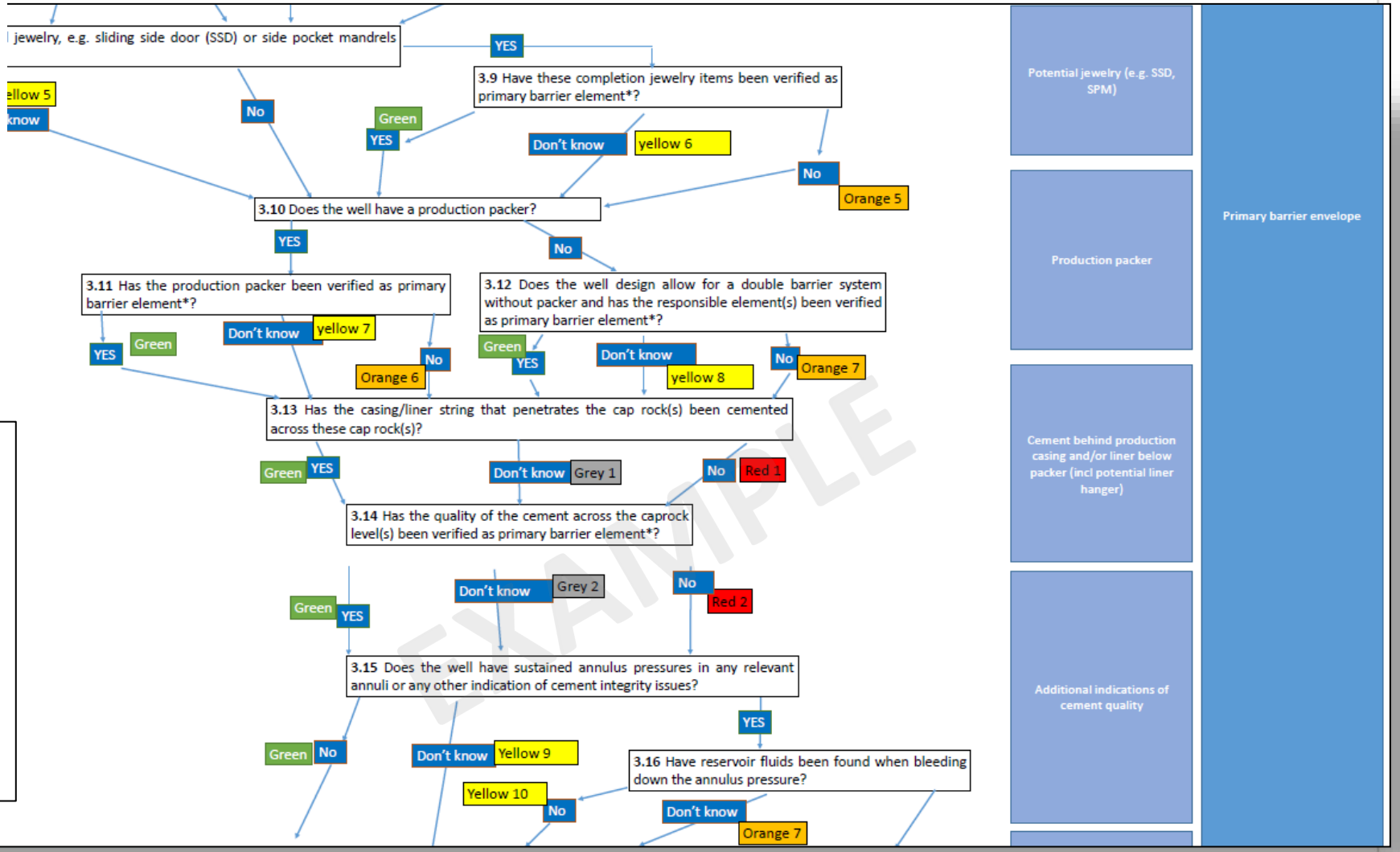

| Recommendation | Explanation |
|---|---|
| | **No or only minor remediation could be expected** |
| | **Moderate remediation or additional verification efforts could be expected** |
| | **Severe remediation** or a **comprehensive risk management strategy** on retrievable/replaceable items could be 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 $CO_2$ loss
2. Structural integrity
3. Primary well barrier
4. Secondary well barrier
5. Material compatibility

# Application of Tool: case studies

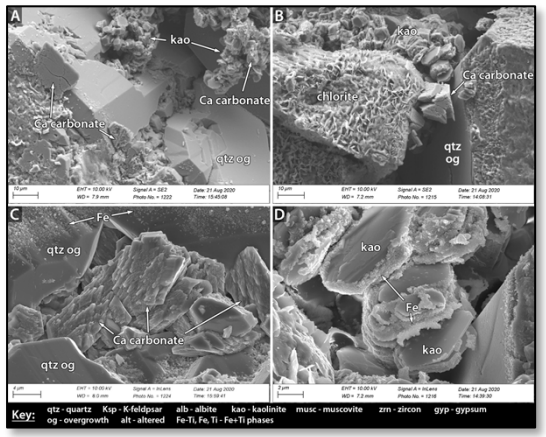

*Ref.: based on Google Earth*

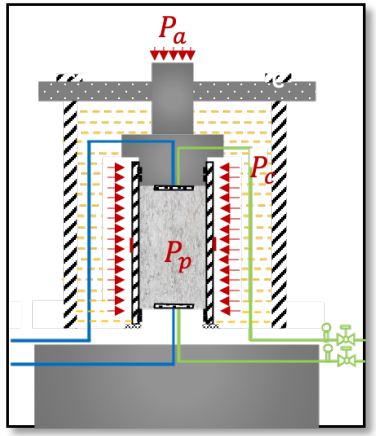
| Case study name | Country | Onshore/offshore | Type | Reference |
|---|---|---|---|---|
| **P18-2 (Porthos)** | Netherlands | Offshore | Depleted gas field | Zikovic and van der Valk (2021) |
| **Vaccum** | USA | Onshore | $CO_2$-EOR field | Chen (2021) |
| **Gullfaks Sør and Visund** | Norway | Offshore | Oil fields | Grimstad et al., (2022) |
| **Bunter Sandstone Closure 36** | UK | Offshore | Saline aquifer | Williams and Hoskin (2021) |
| **Hamilton** | UK | Offshore | Depleted gas field | Williams and Hoskin (2022) |
| **Rousse** | France | Onshore | Depleted gas field and pilot $CO_2$ storage site | Guy and Cangemi (2022) |
| **Salonta** | Romania | Onshore | Depleted gas field (abandoned) | Dudu et al., (2022) |

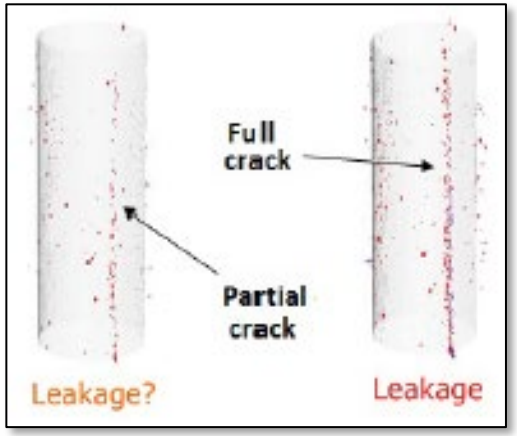
- Location: on- and offshore
- Applications: Saline, depleted gas and $CO_2$ EOR
- Depths: 1400-5000 m
- Reservoir rock: sandstone and carbonate
- Reservoir type: gas field, oil field, saline aquifer
- Reservoir capacity: 37 – 280 Mt $CO_2$
- Number of available wells: >100

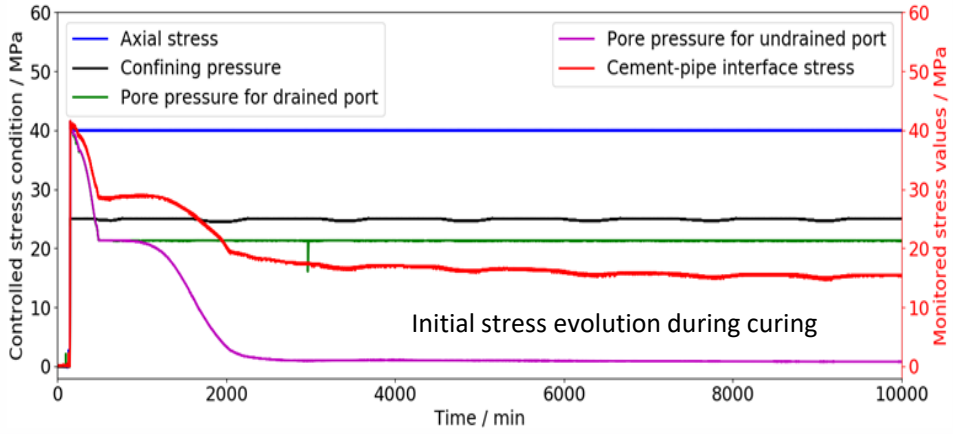
# Experimental investigations for re-using wells for $CO_2$ storage

- Provide experimental data that describe how well degradation and well design influence potential re-use as $CO_2$ 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-CO2

re-using existing wells

## Thank you for your attention

https://www.rex-co2.eu

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