

# ERA-ACT ANNUAL KNOWLEDGE SHARING WORKSHOP 2019

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

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November 5/6<sup>th</sup> 2019, Athens, Greece



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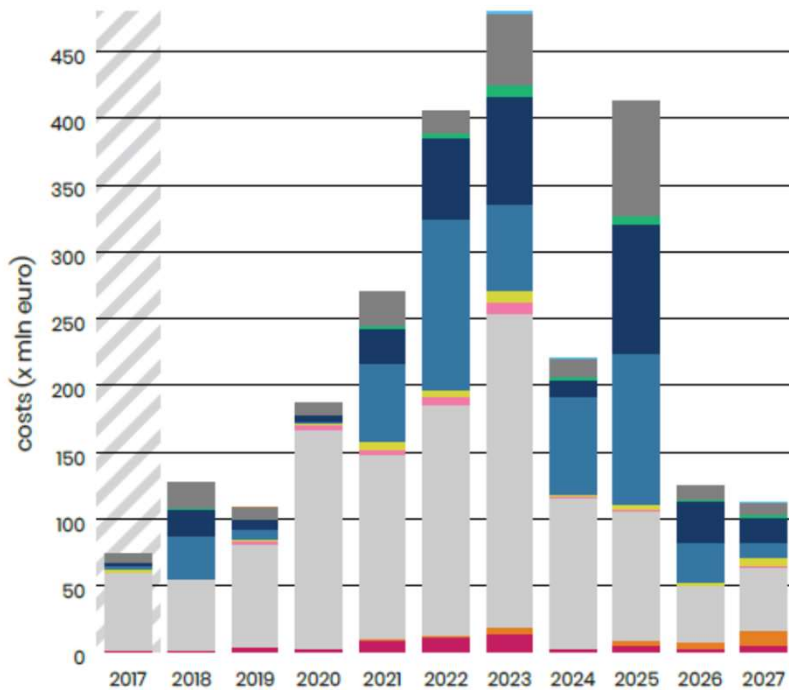
**REX-CO<sub>2</sub>**  
re-using existing wells

# Motivation

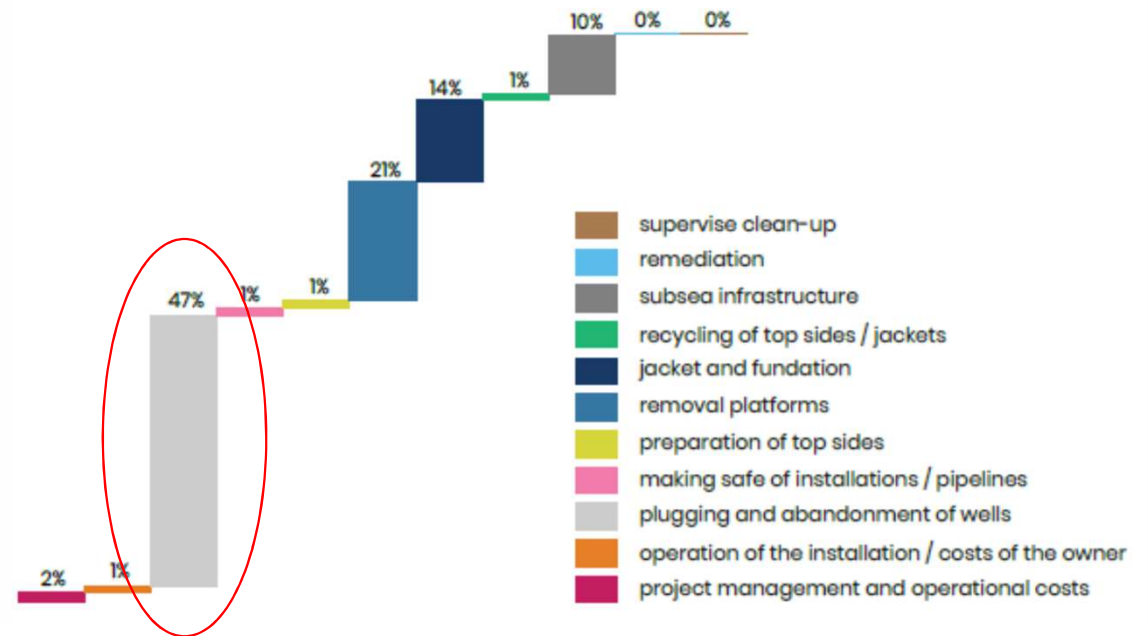
- In mature hydrocarbon basins many fields approach their end of their planned life. Existing infrastructure needs to be decommissioned with tremendous efforts and at high costs
- Substantial savings could be realized by re-using these wells
- Existing wells in these assets present both opportunity and challenges
- Knowledge of the potential for re-use of wells is currently limited, and key infrastructure is at risk of being decommissioned
- No (automated) qualification process exists

# Decommissioning costs – NL (EBN, 2018)

Annual costs for offshore decommissioning



Total decommissioning costs offshore per category



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

**The overall objective of REX-CO<sub>2</sub> is to provide decision makers with mechanisms and information to evaluate re-use potential of existing oil and gas well infrastructure**

- Development of a well re-use assessment and screening-tool (WP2)
- Determining the impact of previous well operations on wellbore materials and workover or remediation actions required for reuse (WP2-4)
- New well remediation technologies and assessing the impact of well re-use on material properties through laboratory experimentation (WP3)
- Demonstrate potential value of well re-use applications by performing assessments on multiple storage sites (WP4)
- Develop a technical best practice recommendation document (WP5)
- Regulatory, environmental and public acceptance aspects of well re-use for CCUS (WP6)

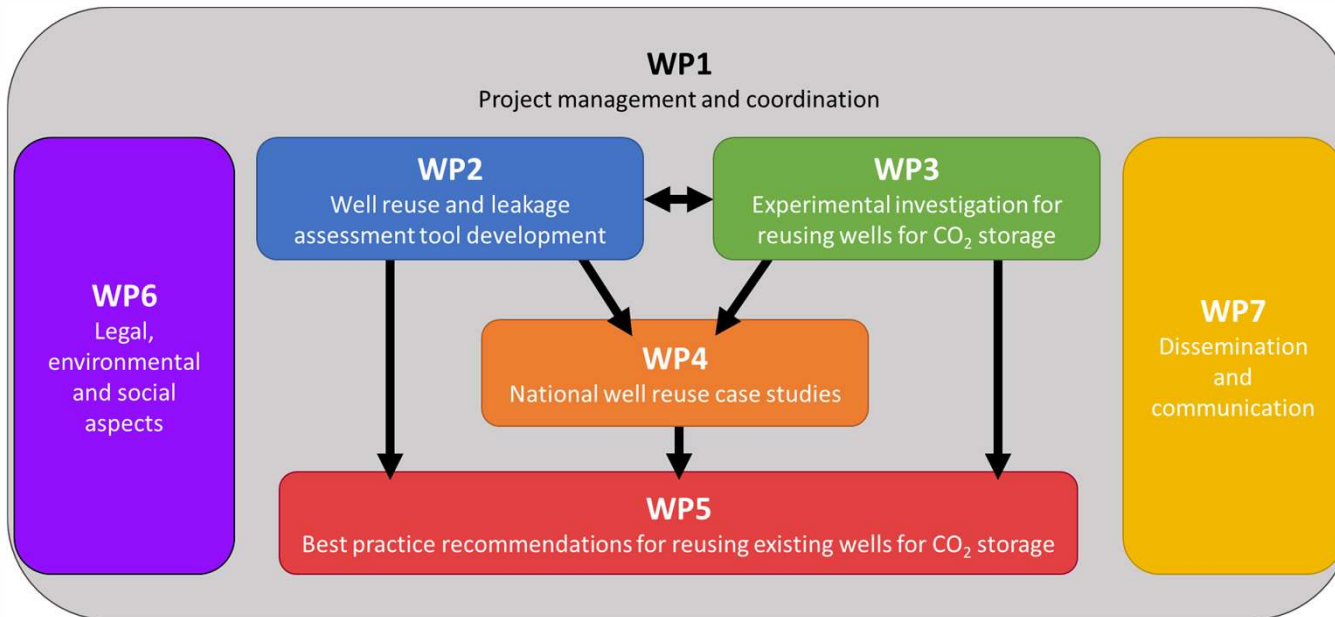
# The consortium



No.	Organisation	Country	Type of organisation
1	TNO (coordinator)	Netherlands	R&D
2	SINTEF	Norway	R&D
3	ReStone AS	Norway	Industry, SME
4	LANL	USA	R&D
5	Chevron	USA	Industry, O&G operator
6	UKRI-BGS	UK	R&D
7	IKON	UK	Industry, SME
8	GeoEcoMar	Romania	R&D
9	CO <sub>2</sub> Club	Romania	NGO
10	IFPEN	France	R&D
11	Equinor AS	Norway	Industry, O&G operator
12	BP	UK	Industry, O&G operator
13	NAMR (stakeholder role)	Romania	National Authority for CO <sub>2</sub> geological storage
14	Oil & Gas Authority- OGA (stakeholder role)	UK	National Authority for CO <sub>2</sub> geological storage
15	IRO (stakeholder role)	Netherlands	Branch Organization of O&G service companies
16	EBN (stakeholder role)	Netherlands	Industry, O&G operator

- 12 research partners
- 4 stakeholder parties
- 6 Nations
- 6 R&D organizations
- 2 SMEs
- 2 national authorities
- 1 branch organization
- 1 NGO
- 4 operators

# Project structure



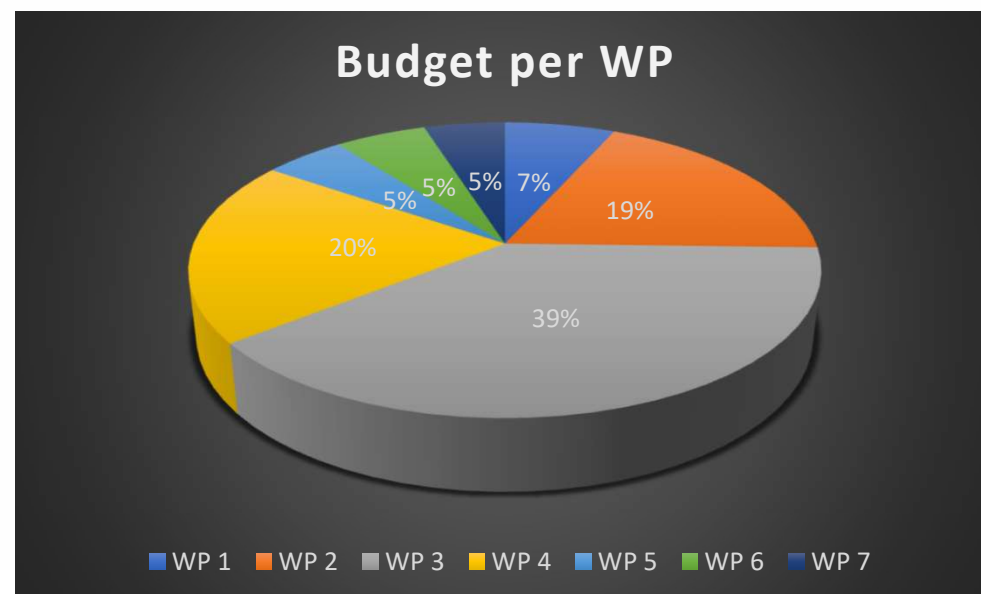
## Leads:

- WP1 TNO: Jens Wollenweber
- WP2 LANL: Rajesh Pawar
- WP3 SINTEF: Torbjorn Vralstad
- WP4 TNO: Kaj van der Valk
- WP5 UKRI-BGS: John Williams
- WP6 GEOECOMAR: Alexandra Dudu
- WP 7 TNO: Logan Brunner



# Project information

- Project duration: September 1<sup>st</sup> 2019 – August 31<sup>st</sup> 2022
- Total budget: €3.525.468
- ERA-ACT Funding: €2.533.121
- 33 Deliverables
  - Six in the first 6 months
- 19 Milestones



# WP2 Well re-use and leakage assessment tool development

- Create a publicly available well screening tool to enable identification of wells suitable for re-use.
- Update the tool and demonstrate its effectiveness by testing with existing well data sets.

**Results**

Below are the results for the selected scenario. There is a summary section, leakage results section, and debonding results section.

*Note: For each of the charts below, you can click on one of the legend items to remove it from the chart.*

**Summary**

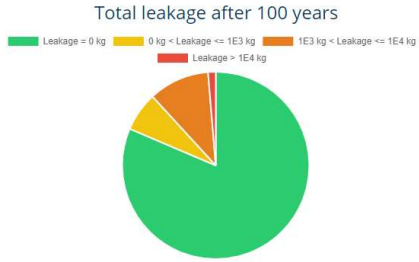
Most likely debonding:  
100 < x <= 250 mu  
62.1 %

Most likely leakage rate after 10 years:  
Leakage = 0 kg/s  
85.29 %

Most likely leakage rate after 100 years:  
Leakage = 0 kg/s  
79.86 %

Most likely total leakage after 100 years:  
Leakage = 0 kg  
81.4 %

**Total leakage after 100 years**



Leakage Category	Percentage
Leakage = 0 kg	81.4 %
0 kg < Leakage <= 1E3 kg	
1E3 kg < Leakage <= 1E4 kg	
Leakage > 1E4 kg	

**Bayes-I Well Tool**

**A Bayesian Approach to Well Integrity**

Welcome to the Bayes-I (Bayesian Integrity) Well Tool. This tool is intended to assist with the risk assessment of wells that might be impacted by microannuli, formed over the lifetime of the well, and into the abandonment and post-abandonment phases.

[Go to tool](#)

Brunner et al., 2019

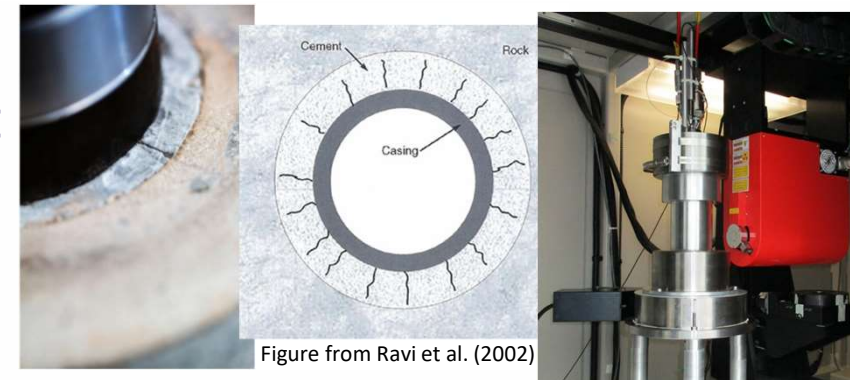


## WP2 “Portfolio”

- Few projects and studies report on assessment of well reuse for CCS: ACORN (ERA-ACT, UK-focused), Malaysia (Raza et al, 2017).
- IEA-GHG (2018) study on infrastructure reuse including wells.
- Existing relevant tools:
  - MiReCOL: Well Mitigation & Remediation Evaluation Tool (Brunner & Neele, 2017)
  - Bayes-I Tool: Wellbore integrity assessment (Brunner et al., 2019)
  - Open IAM: NRAP’s well leakage risk assessment tool (NRAP, US-DOE)
  - NRAP’s well leakage tool (NRAP, US-DOE)

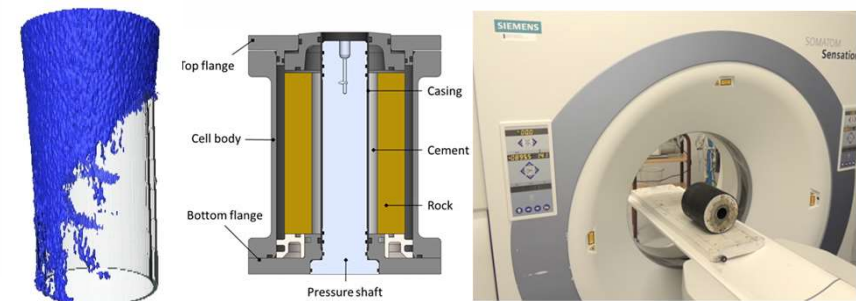
## WP3 Experimental investigation for re-using wells for CO<sub>2</sub> storage

- Integrated laboratory and numerical modelling program to assist in the assessment of existing wells and to provide strategies for remediating well leakage
- Improve understanding of well re-use operations
- Provide input data for risk assessment tools and case studies



Picture from SINTEF

Figure from LANL

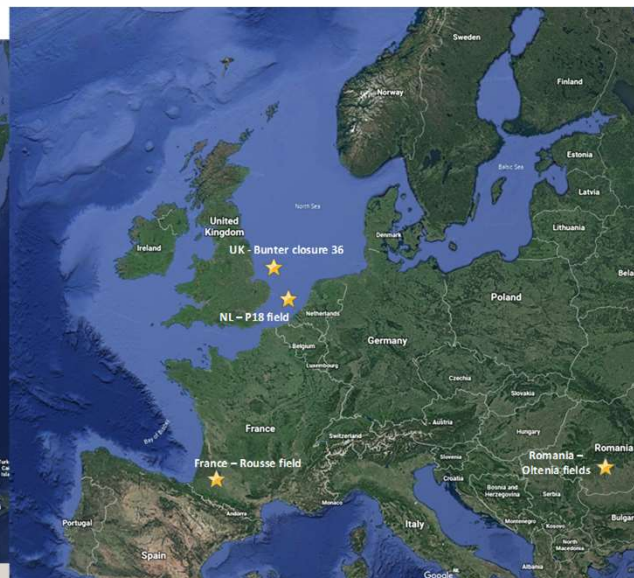
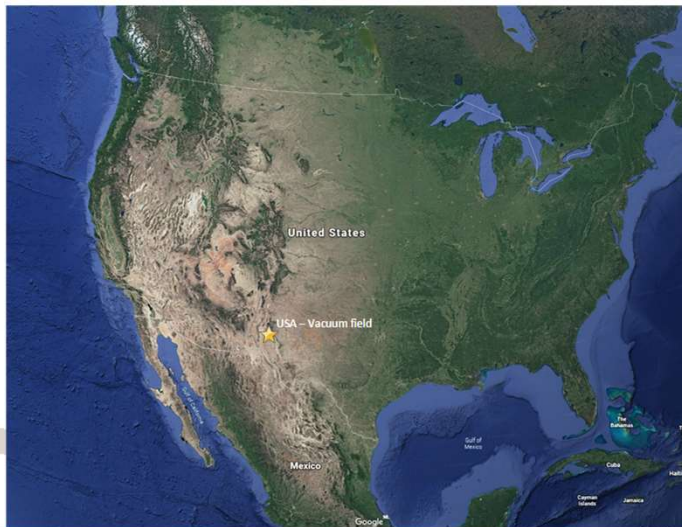


Figures from SINTEF

# WP4 National well re-use case studies

Provide a detailed evaluation of activities required to ensure safe and economic CO<sub>2</sub> storage in the selected fields, including cost-benefit analysis for selected cases.

- Development of re-use procedures tailored to specific well designs across a portfolio of different sites.
- Application and verification of the developed tool on selected fields in the partner countries.
- Provision of dry-run examples for re-use assessment of selected fields in partner countries in compliance with national legal requirements as determined in WP6.



- Location: Onshore – offshore
- Application: CCS – EOR
- Depths: 1500 – 5000 m
- Reservoirs: Sandstone – Carbonate reservoirs
- Reservoir type: Depleted oil field – depleted gas field
- Capacity: 37 - 280 Mt CO<sub>2</sub>

# WP5 Best Practice Recommendations

- Enable operators to develop effective strategies, benchmarked against technical best practice
- Ensure the efficiency of CCUS permitting
- Promote safeguarding of critical infrastructure for re-use for CCUS projects
- Provide stakeholders with knowledge of the legislative and environmental frameworks governing the re-use of existing well infrastructure

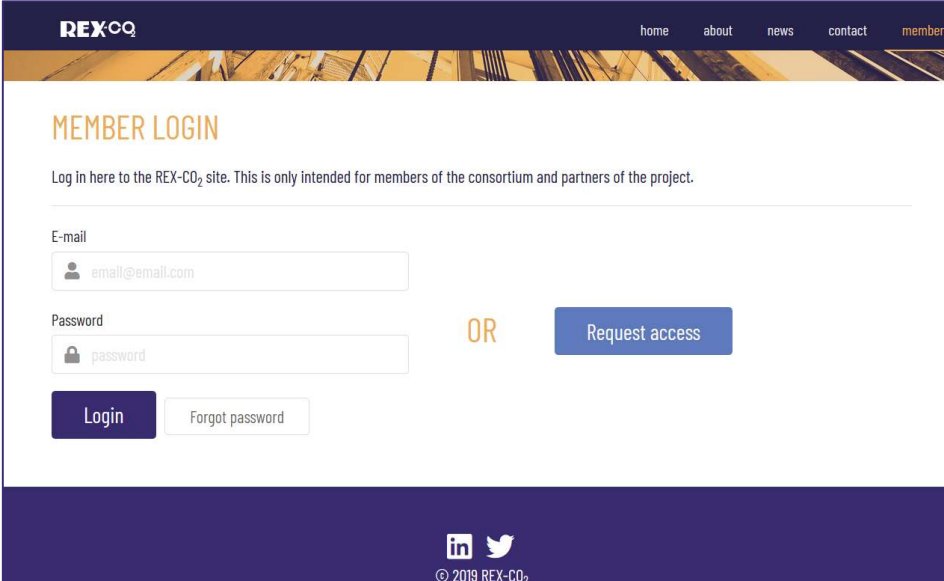
## WP6 Legal, environmental and social aspects

- Non-technical aspects that influence the implementation of well re-use application, from regulatory (legal) aspects to public acceptance
  - Assessment of national legal frameworks
  - Guidelines for permitting process
  - Recommendations for environmental frameworks
  - Public perception and acceptance of well re-use for CCS



# WP7 Communication and Dissemination

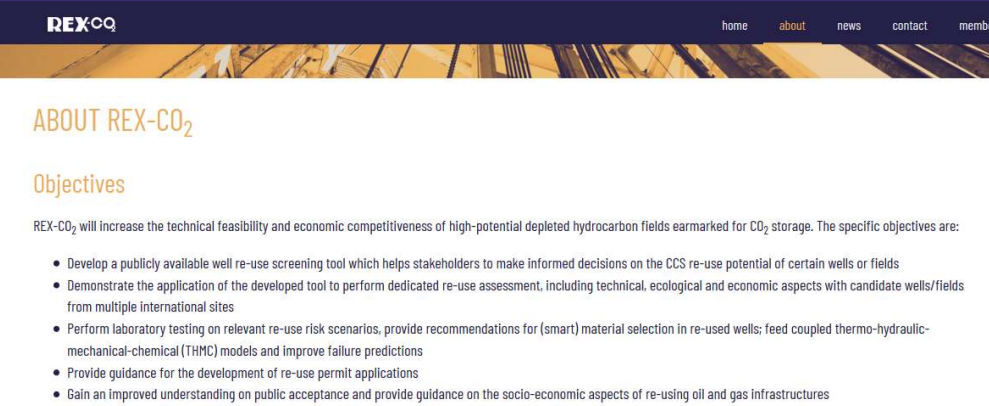
- Website – <https://www.rex-co2.eu>
- Social media: Twitter, LinkedIn
- Webinars, workshops
- International collaboration



The screenshot shows the 'MEMBER LOGIN' page of the REX-CO2 website. The page has a dark blue header with the REX-CO2 logo and navigation links for 'home', 'about', 'news', 'contact', and 'members'. Below the header is a banner image of an industrial site. The main content area is white and contains the following elements:

- MEMBER LOGIN** (Section Header)
- Text: "Log in here to the REX-CO<sub>2</sub> site. This is only intended for members of the consortium and partners of the project."
- E-mail input field with placeholder "email@email.com"
- Password input field with placeholder "password"
- OR separator
- Request access button (blue)
- Login button (dark blue)
- Forgot password link (white)

The footer is dark blue and contains social media icons for LinkedIn and Twitter, along with the copyright notice "© 2019 REX-CO<sub>2</sub>".



The screenshot shows the 'ABOUT REX-CO<sub>2</sub>' page of the REX-CO2 website. The page has a dark blue header with the REX-CO2 logo and navigation links for 'home', 'about', 'news', 'contact', and 'members'. Below the header is a banner image of an industrial site. The main content area is white and contains the following elements:

- ABOUT REX-CO<sub>2</sub>** (Section Header)
- Objectives** (Section Header)
- Text: "REX-CO<sub>2</sub> will increase the technical feasibility and economic competitiveness of high-potential depleted hydrocarbon fields earmarked for CO<sub>2</sub> storage. The specific objectives are:"
- List of objectives (bullet points):
  - Develop a publicly available well re-use screening tool which helps stakeholders to make informed decisions on the CCS re-use potential of certain wells or fields
  - Demonstrate the application of the developed tool to perform dedicated re-use assessment, including technical, ecological and economic aspects with candidate wells/fields from multiple international sites
  - Perform laboratory testing on relevant re-use risk scenarios, provide recommendations for (smart) material selection in re-used wells; feed coupled thermo-hydraulic-mechanical-chemical (THMC) models and improve failure predictions
  - Provide guidance for the development of re-use permit applications
  - Gain an improved understanding on public acceptance and provide guidance on the socio-economic aspects of re-using oil and gas infrastructures





# Key challenges

- Provide proper evaluation of the well conditions and transfer of experimental results into screening tool and best practice recommendations
- Expectation management regarding the tool (level of detail)
- Minimizing the chance of “abusing” the online re-use tool
- Involvement of “remote” industry stakeholders

## Status – A successful start

- Partners are committed to start working from September 1<sup>st</sup> 2019 (although Consortium Agreement has not been signed yet)
- Well-prepared Kick-off Meeting, Utrecht 29/30<sup>th</sup> October 2019
- Established Management and WP teams
- Submitted communication (D7.1) and data management plan (D1.1) in month 2
- Website online and first newsletter in month 3





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

re-using existing wells

Thank you for your attention

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



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