DEVELOPMENT AND APPLICATION OF REX-CO2 TOOL FOR CCS WELL RE-USE ASSESSMENT

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REX-CO2 re-using existing wells

The project REX-CO2 is funded through the ACT programme (Accelerating CCS Technologies, Horizon2020 Project No. 299681). Financial contributions made from ADEME (FR); Ministry of Economic Affairs and Climate Policy (NL); Gassnova and RCN (NO); UEFISCDI (RO); BEIS, NERC, and EPSRC (UK); and US-DOE (USA) are gratefully acknowledged. The contents of this publication reflect only the author's view and do not necessarily reflect the opinion of the funding agencies.

Presentation outline

1. Introduction of the REX-CO_2 project
2. Development of the well screening tool
3. Application of the screening tool in case studies
4. Preliminary observations

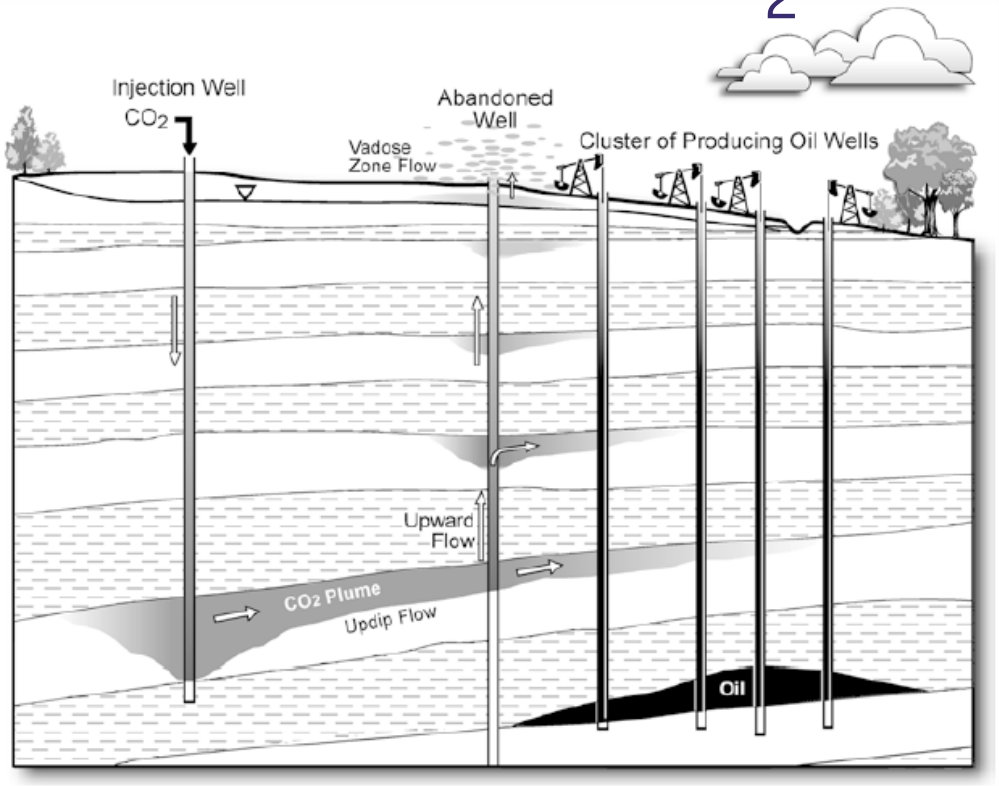
REX-CO2 project planning and objective

- International research project, funded through the ACT (Accelerating CCS Technologies) programme (http://www.act-ccs.eu/)
- Duration: September 2019 – August 2022
- Project website: https://rex-co2.eu/

Main objective:

*provide **decision makers** with **mechanisms and information** to **evaluate re-use potential** of existing oil and gas wells for safe CO_2 storage*

Motivation: safe CO_2 storage



Ref.: Gasda, Bachu and Celia, 2004

Ref.: TexasMonthly, 2022 Jan 12

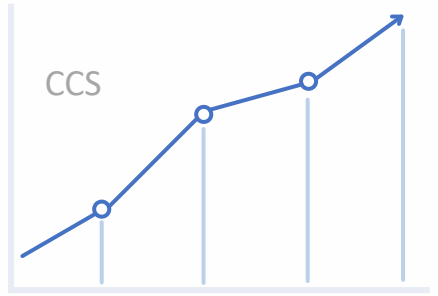
"The most important human activity in regard to leakage potential is well drilling"
(Gasda, Bachu and Celia, 2004)

Motivation: need for CCS

CCS could play important role to reach climate goals

IEA Sustainable development scenario: CCS should grow from 40 Mtpa today to over 5,200 Mtpa by 2050 (IEA, 2020)

- Many HC fields approach end of life → planned for decomissioning
  - Potential future CCS sites
- Reusing existing infrastructure (incl. wells) option to upscale CCS and reduce CO_2 emissions



Challenge: All wells have to be assessed → time consuming and prone to inconsistency/incompleteness

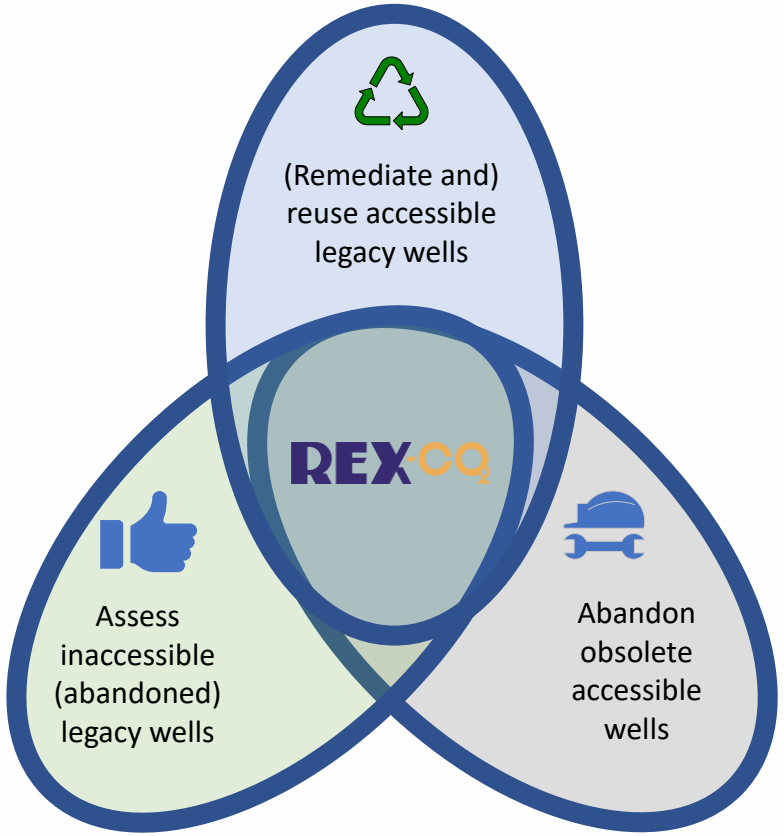
A structured & independent well screening process is required

Ambition

Enable early project phase well screening

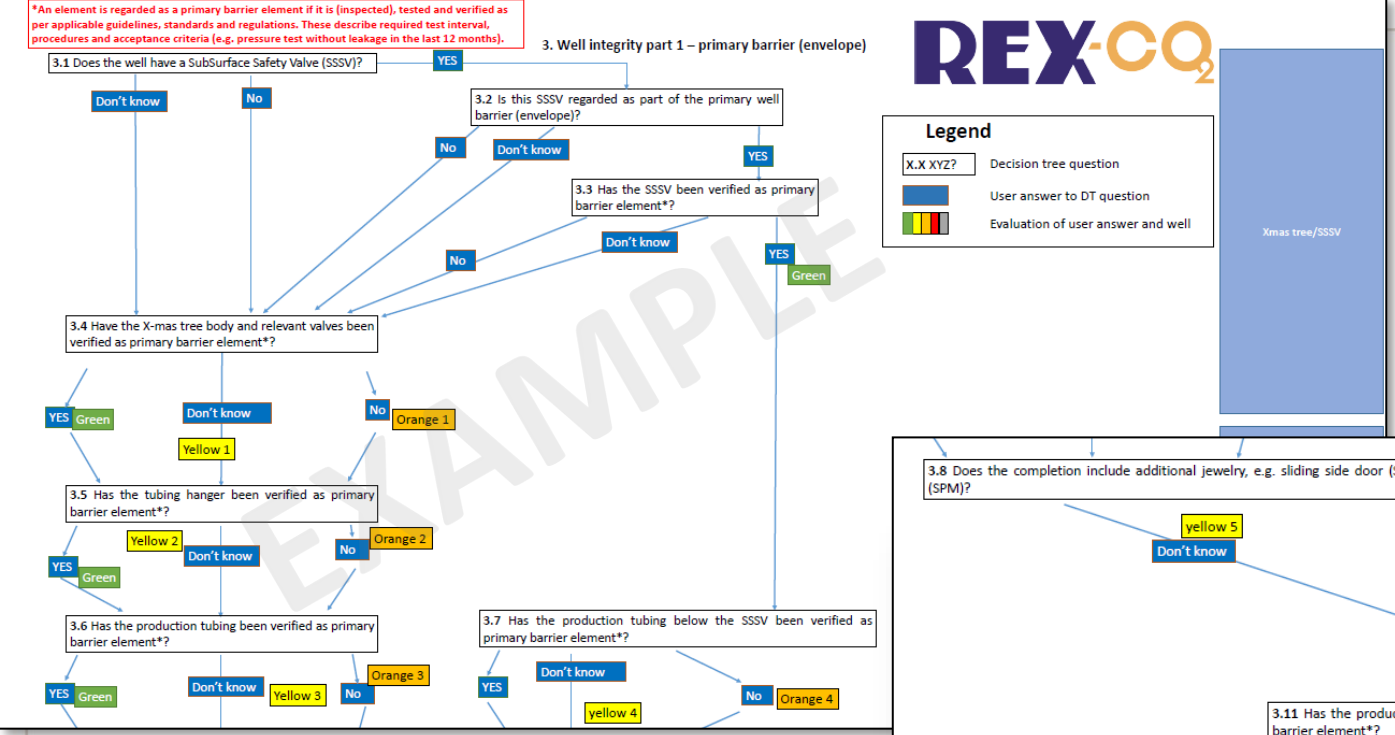
- Initial assessment CO_2 storage complex well integrity
- Aid decision making and CCS strategy development
  - Select reservoir and well candidates
- Allow optimised capacity planning
- Facilitate safe well re-use and CCS uptake

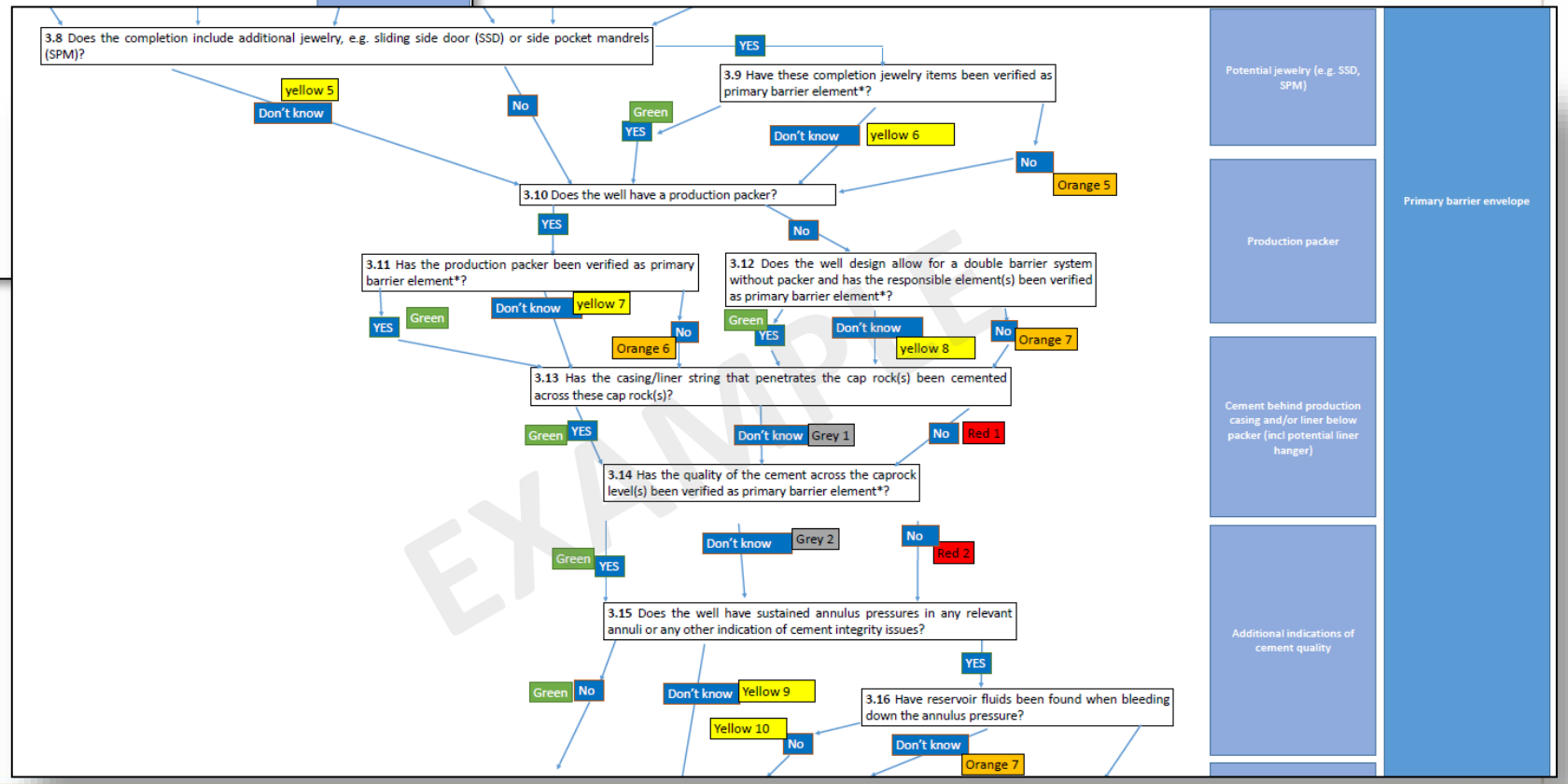
Based on reference projects, standards and guidelines



Well screening

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

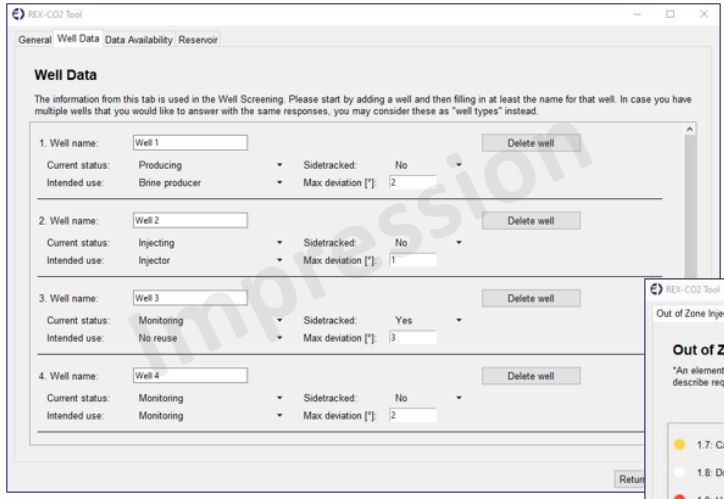


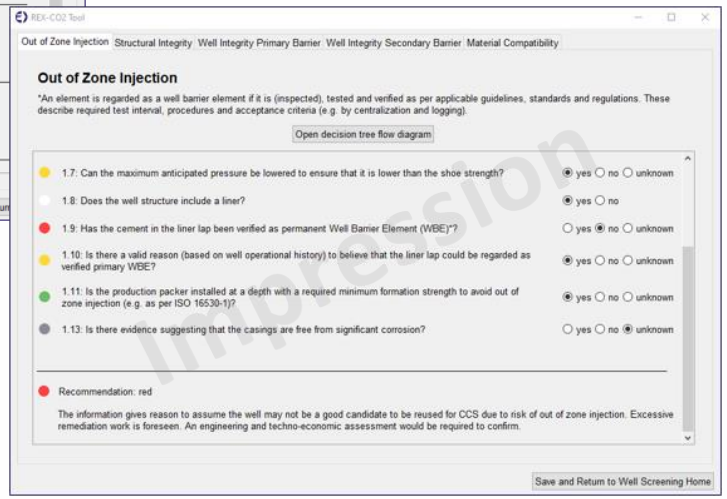


Five pillars

1. Out of zone injection
2. Structural integrity
3. Well integrity (primary)
4. Well integrity (secondary)
5. Material compatibility

REX-CO2 tool impression



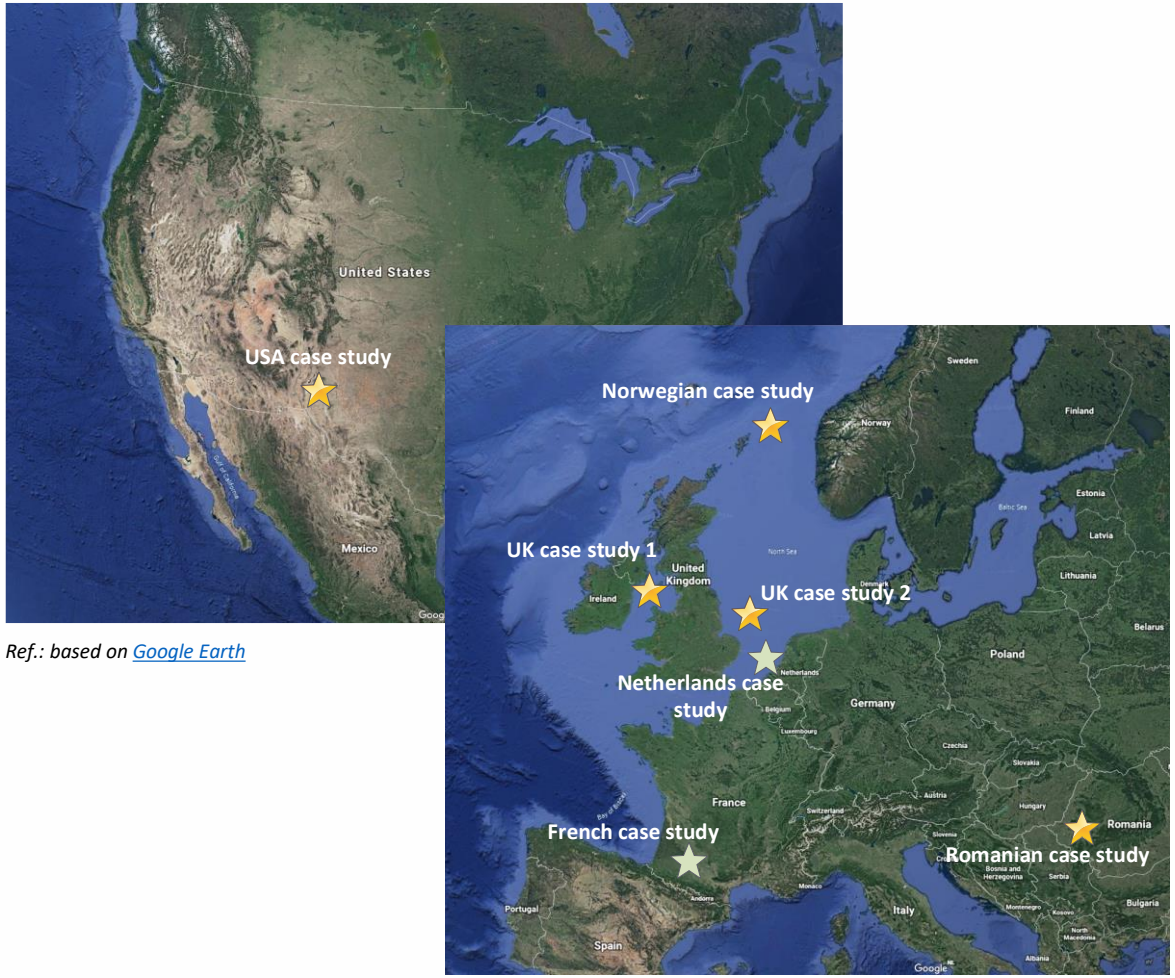


Well evaluation results

Results of well screening provided in the form of traffic light recommendations

Recommendation	Explanation
	Based on the screening **no or only minor remediation could be expected** for the well in its current state
	Based on the screening **moderate remediation or additional verification efforts could be expected** or a risk management strategy could be prepared for the well in its current state. One could think of remediations that do not require a workover rig, e.g. wireline or coiled tubing interventions
	Based on the screening **severe remediation** or a **comprehensive risk management strategy** on retrievable/replaceable items could be expected. One could think of remediation work that requires a rig or workover unit, e.g. to recomplete the well or abandon obsolete sidetracks
	Based on the screening **severe remediation** or a **comprehensive risk management strategy** on non retrievable/replaceable items could be expected. One could think of remediation work on annular cement or cemented casings; e.g. cement repairs or other technically challenging operations
	Critical information is missing for the tool. It is advised to look for additional data, acquire additional data (e.g. by running logs) or look for offset data and then revisit the tool

Application: national well re-use case studies



Ref.: based on Google Earth

- Location: on- and offshore
- Applications: CCS 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

Porthos – P18-2

Downhole conditions:

- Initial pressure 375 bars
- Current pressure: 20 bars

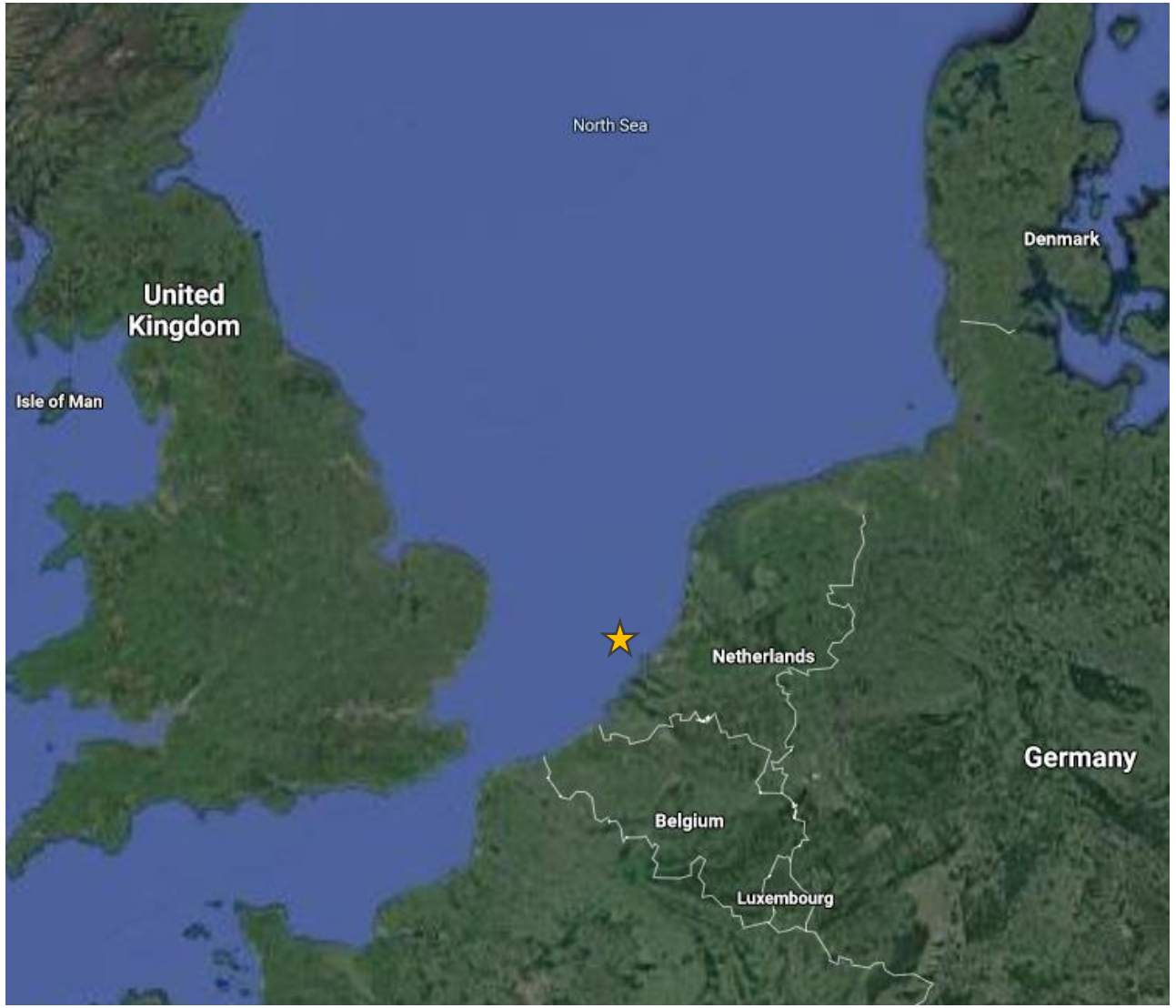
Storage capacity:

- 32 Mt of CO_2 @ 351 bars
- 32.2 Mt of CO_2 @ 375 bars

6 well legs penetrate caprock, 4 intended for reuse

Expert evaluation:

All wells intended for reuse have potential to be used as CO_2 injectors safely if identified risks are properly mitigated



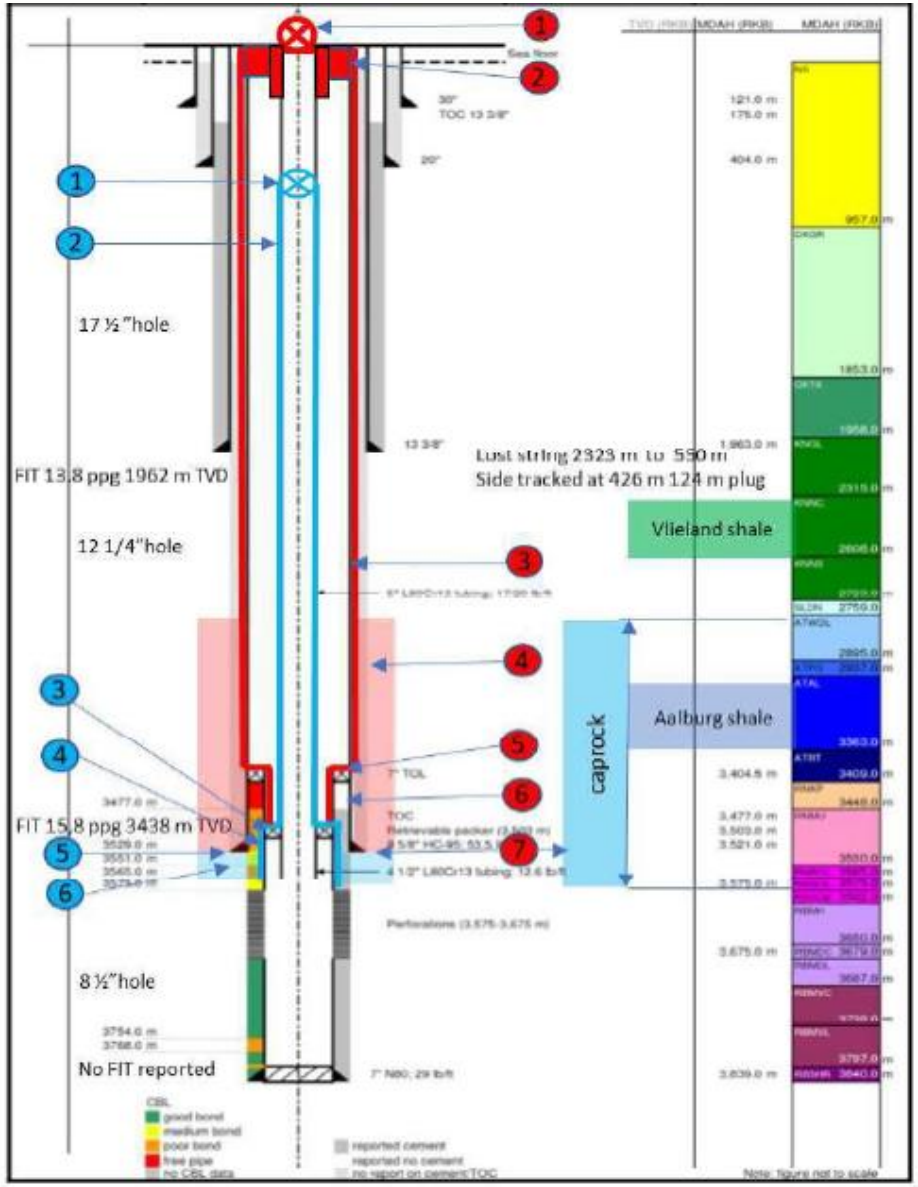
Ref.: based on Google Maps

Porthos example well screening

Category	Current status	Remediated
Out of zone injection		
Structural integrity		
Well integrity primary barrier		
Well integrity secondary barrier		
Material compatibility		

- **Observations**
  - Main issue with liner cement
  - Materials not compatible for new application

✓ Porthos evaluation is in line with expert assessment



Ref.: Neele, et al., 2019

Preliminary observations (based on NL, UK and US case studies)

- Results in line with expert assessments in validation cases
- Systematic approach to screen wells consistently (<1 hour)
- Highly dependent on data availability and quality
  - Strong recommendation: gather new data
- User friendly tool
- Traffic light results helpful for users

	Out of zone injection	Structural integrity	Well integrity primary barrier	Well integrity secondary barrier	Material compatibility
P18-02-A-01					
P18-02-A-03ST2					
P18-02-A05ST1					
P18-2A6					
P18-2A6-ST					

	Out of zone injection	Structural integrity	Well integrity primary barrier	Well integrity secondary barrier	Material compatibility
P18-02-A-01 (W)					
P18-02-A-03ST2 (W)					
P18-02-A05ST1 (W)					
P18-2A6 (W)					

Project consortium

No.	Organisation	Country	Type of organisation
1	TNO (coordinator)	Netherlands	R&D
2	BGS	UK	R&D
3	BP	UK	Industry, O&G operator
4	Chevron	USA	Industry, O&G operator
5	CO_2Club	Romania	NGO
6	EBN (stakeholder role)	Netherlands	Industry, O&G operator
7	Equinor AS	Norway	Industry, O&G operator
8	GeoEcoMar	Romania	R&D
9	IFPEN	France	R&D
10	IKON	UK	Industry, SME
11	IRO (stakeholder role)	Netherlands	Branch Organization of O&G service companies
12	LANL	USA	R&D
13	NAMR (stakeholder role)	Romania	National Authority for CO_2 geological storage
14	NEPTUNE Energy	Netherlands	Industry, O&G operator
15	Oil & Gas Authority-OGA (stakeholder role)	UK	National Authority for CO_2 geological storage
16	ReStone AS	Norway	Industry, SME
17	SINTEF	Norway	R&D
18	Wintershall Dea	GER / NL	Industry, O&G operator
19	Vallourec Tubes	France	Industry, tubular manufacturer

References

- Gasda, S.E., Bachu, S. & Celia, M.A., 2004; *Spatial characterization of the location of potentially leaky wells penetrating a deep saline aquifer in a mature sedimentary basin*. Env Geol 46, 707–720 https://doi.org/10.1007/s00254-004-1073-5dsa
- TexasMonthly, 2022; *A Forgotten Oil Well Births a 100-Foot Geyser in West Texas (by Russell Gold)* (link)
- IEA, 2020, *Energy Technology Perspective; Special Report on Carbon Capture Utilisation and Storage* (link)
- Google Earth (link)
- Google Maps (link)
- Neele, F., et al., 2019; *CO2 storage feasibility in the P18-2 depleted gas field (TNO 2019 R11635)*

REX-CO2

re-using existing wells

Thank you for your attention

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