Legacy Wells in CCS

Risks and opportunities

18 May 2026

ebn

State Energy Company
of the Netherlands

Agenda

- **The Porthos Project**
  - Re purposing wells
- **Legacy Wells**
  - Abandonment
  - Risk Assessment

Responsible **CO_2 storage**

The Porthos project

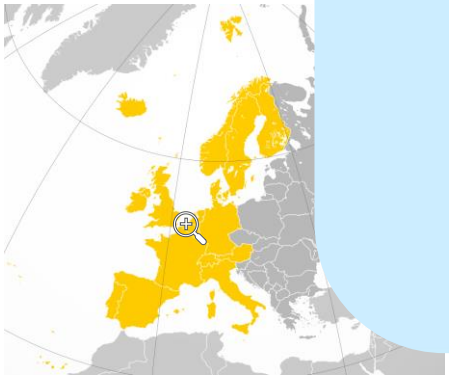
Porthos project

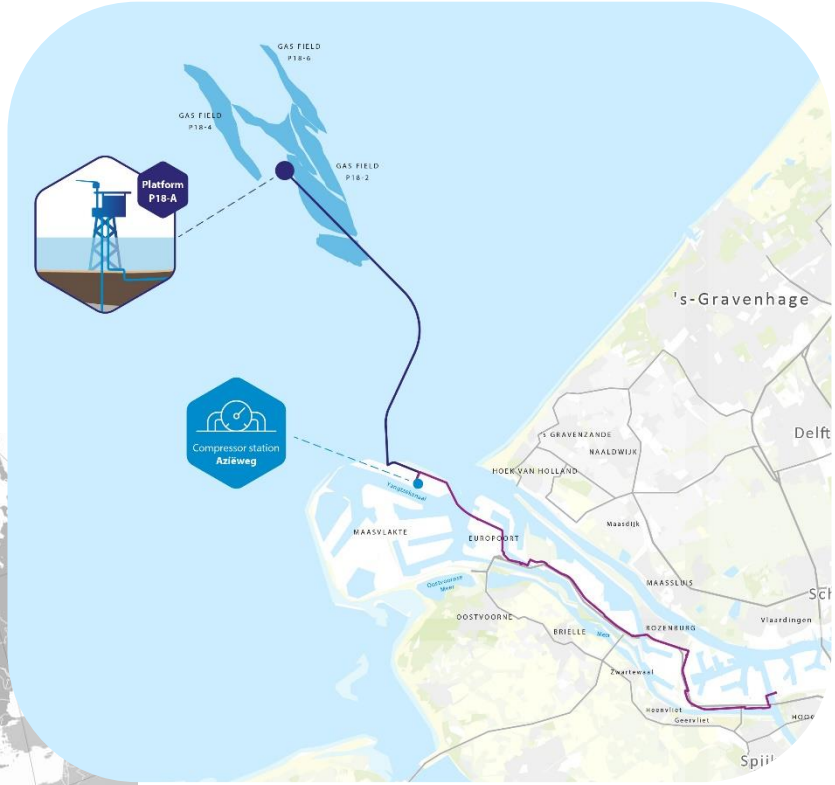
What?

- Collector pipeline through Rotterdam port area
  - Length: ~ 30 km ; Diameter: 108 cm
- Compressor station on the Maasvlakte
- Offshore pipeline to platform on the North Sea
  - Isolated HP Pipeline
  - Length: ~ 22 km
  - Diameter: 40 cm
- Storage in depleted gas fields P18
- Process control for operations

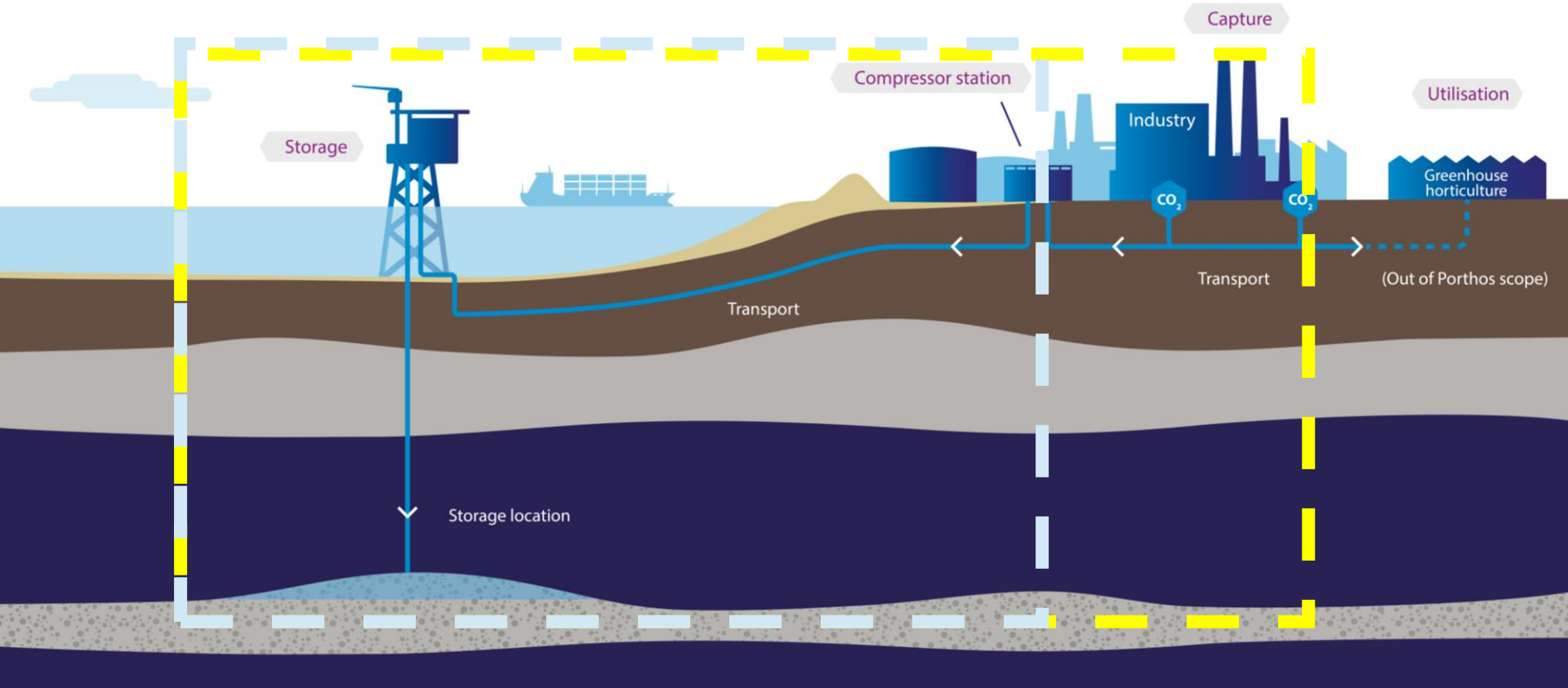
Volumes:

- Capacity fields: ~ 37 Mton
- Storage: ~ 2.5 Mton per year





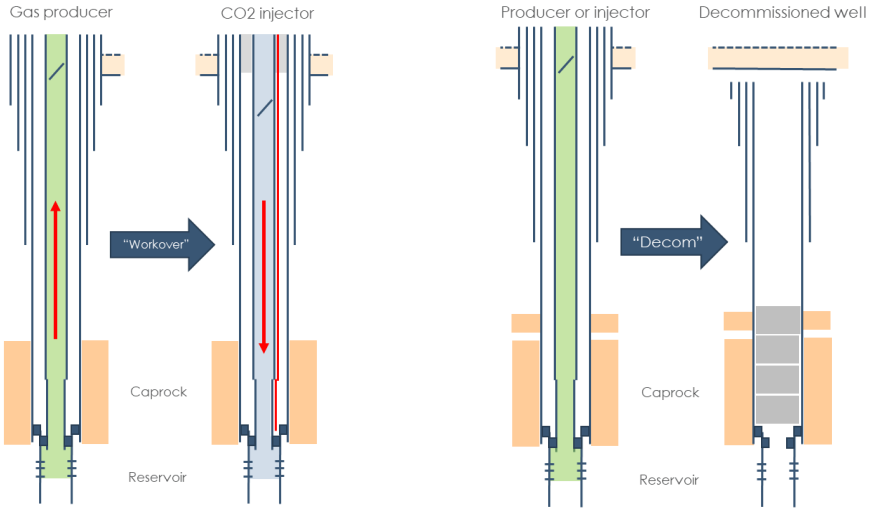
The Porthos system

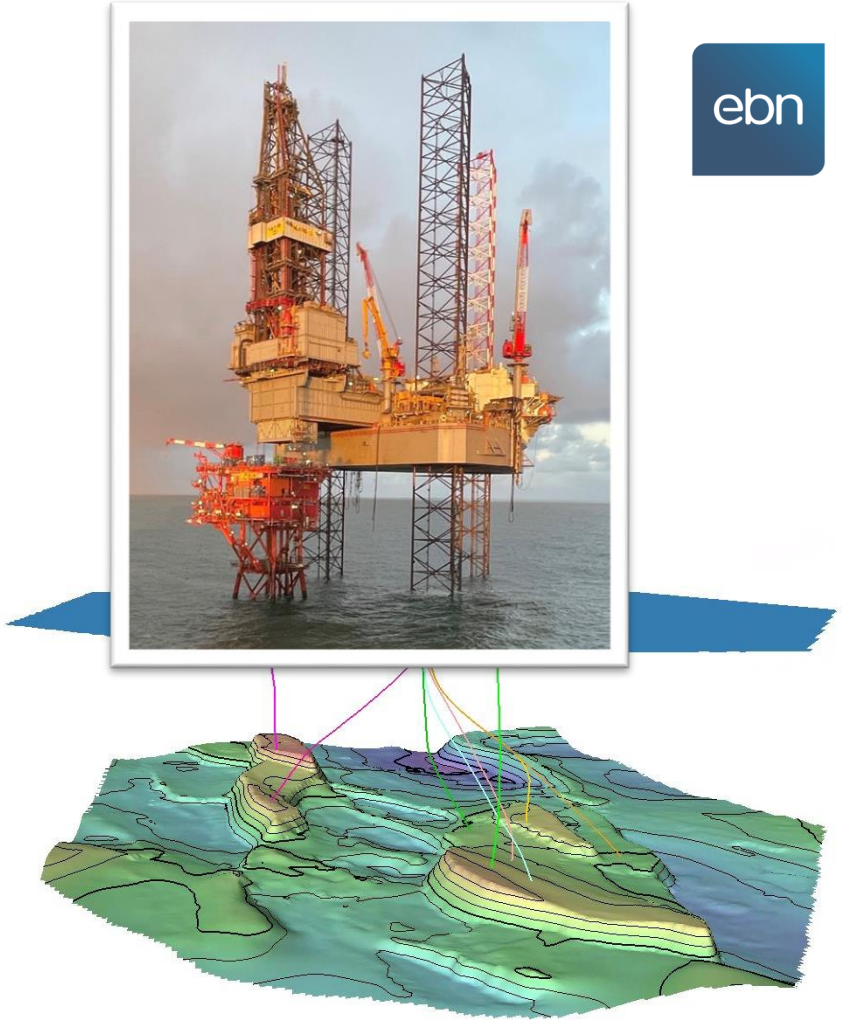


Porthos Well Scope

Porthos Workover scope :

- ❑ **4 platform wells: convert to CO2 injector**
- ❑ 2 platform wells: suspend / decommission
- ❑ 2 off-platform wells: decommission





Responsible CO_2 storage

Legacy Wells

Legacy Wells

Legacy: something transmitted by or received from an ancestor or predecessor or from the past.

Opportunity:

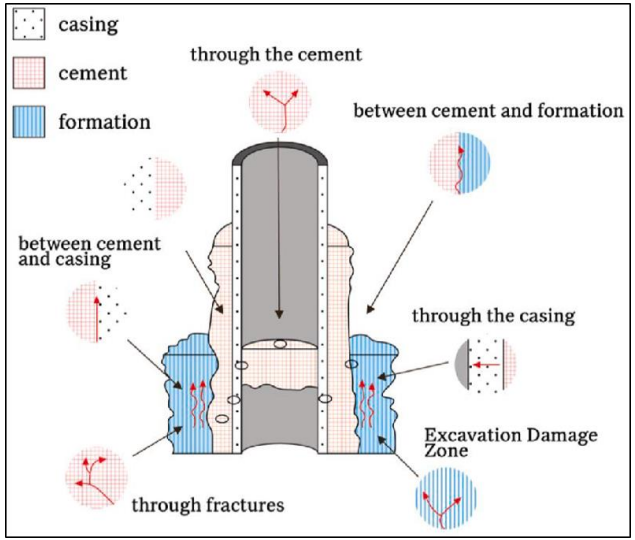
- Wells that can be used in the development of a CCS project

Risk:

- Wells that penetrate the caprock and form a potential leak path

Legacy Wells

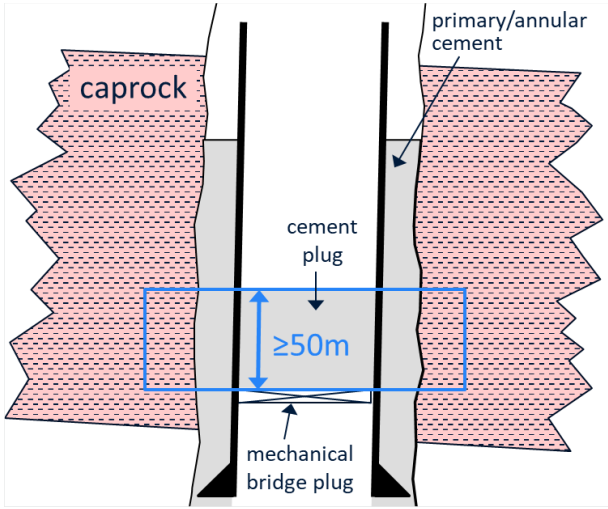
- Effective long-term containment of CO2 in the storage complex.
- Caprock is a proven effective seal, focus is directed at the wellbores
- Long-term well integrity depends on:
  - initial well completion
  - abandonment operations.
- Aqueous CO2 could chemically interact with well materials, potentially leading to material degradation.
- Requirements stipulated by the mining regulations for oil and gas wells

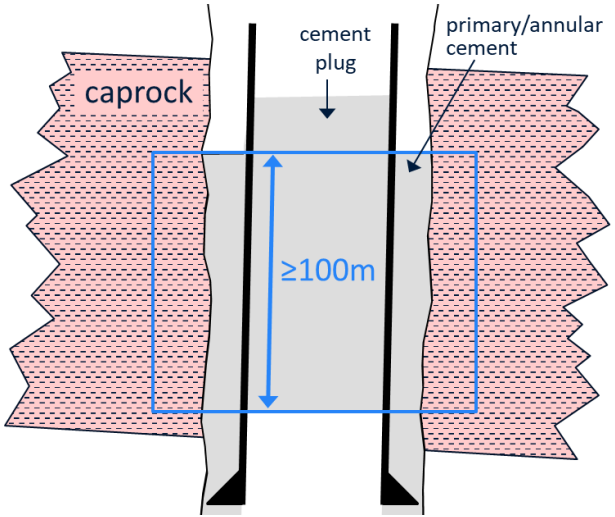


Dutch sector: SODM – NOGEPA 45

Formation-to-formation (wall-to-wall) barrier across the caprock, consisting of

- An abandonment cement plug,
- A single or multiple casing and/or liner string(s)
- A single or multiple primary cement sheath(s).





Risk Assessment

Criteria 1

Code	Cement plug	Annular cement	Formation-to-formation barrier[1]
	verified[2] cement plug length across caprock exceeding minimum required length[3].	well-bonded annular cement across caprock exceeding minimum required length[3], as demonstrated by cement bond log.	overlap of plug and well-bonded annular cement across caprock exceeding minimum required length[3], as demonstrated by cement bond log.
	N/A	well-bonded annular cement across caprock exceeding minimum required length[3], as inferred from cementing operations reports.	overlap of plug and bonded annular cement across caprock exceeding minimum required length[3], as inferred from cementing operations reports.
	verified[2] cement plug length across caprock less than minimum required length[3].	well-bonded annular cement across caprock less than minimum required length[3].	overlap of plug and well-bonded annular cement across caprock less than minimum required length[3].

	Category 0	Wells that did not penetrate the storage reservoir and therefore are out of scope.
	Category 1	Wells currently accessible along their entire length.
	Category 2	Wells currently partially accessible; interventions can reach the caprock.
	Category 3	Inaccessible wells with formation-to-formation seal exceeding minimum required length across the caprock, as demonstrated by available cement bond logs.
	Category 4	Inaccessible wells with formation-to-formation seal exceeding minimum required length across the caprock, as inferred from cementing operations reports.
	Category 5	Inaccessible wells with formation-to-formation seal less than minimum required length across the caprock.

Example assessment

From Dutch sector

cluster	well name	drilled	2023 well status	cement plug			solid base	annular cement quality across RBSM + RBSR						annular cement quality across ZEH						formation-to-formation barrier/overlap				well integrity category	casing/tubing collapse/ shear
								9 5/8" section		7" section		5" section		9 5/8" section		7" section		5" section		caprock + annular cement		caprock + annular cement + cement plug			
				interval (mMD)	length (mMD)	formation	depth (mMD)	interval (mMD)	length (mMD)	interval (mMD)	length (mMD)	interval (mMD)	length (mMD)	interval (mMD)	length (mMD)	interval (mMD)	length (mMD)	interval (mMD)	length (mMD)	interval (mMD)	length (mMD)	interval (mMD)	length (mMD)		depth (mMD)
			Plugged back & sidetracked	3637-3730	93	RO				3220-3449	229					3453-3580	127			3220-3580	360			1	3730
			Producing							3220-3449	229					3453-3580	127							1	
			Producing					NA	NA	NA	NA			1115-3458	2343	3458-3630	0			1115-3458	2343			1	
			Producing					NA	NA	NA	NA									3700-3725	25			1	
			Abandoned	3506-3633	126	ZEB/RO	3513	3042-3254	212					3254-3544	290					3541-3042	248	3506-3541	35	5	
			Abandoned	3151-3254	103	RBSR/RBSM	N	3093-3288	195	3198-3444	335					3444-3614	170			3093-3611	518	3151-3254	103	4	
			Abandoned	3021-3329	308	RBSM/ZE	N	2854-2902	48	2854-3090	236					3090-3501	411	3402-3447	35	3089-3447	358	3090-3329	239	4	
			Abandoned	3425-4011	586	RO/ZE	4011 TD	NA	NA	NA	NA	NA	NA	2436-2520	84	2491-3527	1036			2436-3548	1112	3425-3527	102	4	
			Abandoned	2448-2540	92	ZE								2436-2520	84	2491-3527	1036			2436-3548	1112	2436-2540	104	4	
			Failed hole; not penetrating reservoir	2963-3048	102	RBS																		0	3048
			Failed hole; not penetrating reservoir	3055-3199	144	RBS	N	NA	NA	NA	NA	NA													0	3199
			Suspended							3365-3579	214					3579-3635.5	56.5	3602-3635	33					1	
			Suspended					NA	NA	NA	NA	NA	NA	3178-3689	515	3653-3665	12	NA	NA					1	
			Suspended	3993-3996	3	ZE	N	NA	NA	NA	NA	NA	NA	3805-3905	100	3610-4040	430	NA	NA	3805-3905	100	3993-3996	3	1	
			Suspended	3890-4410	520	RO/ZE	4410	NA		NA				3698-4019	318	3964-4034	70			3698-4034	336	3890-4034	144	1	
			Failed hole; not penetrating reservoir	NA	NA																			0	
			Abandoned	2912-3080	168	ZE	N	NA	NA					2900-3045	145			NA	NA	2900-3045	145	2912-3045	133	3	

Table 3 Well integrity status categories

	Category 0	Wells that did not penetrate the storage reservoir and therefore are out of scope.
	Category 1	Wells currently accessible along their entire length.
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	Category 3	Inaccessible wells with formation-to-formation seal exceeding minimum required length across the caprock, as demonstrated by available cement bond logs.
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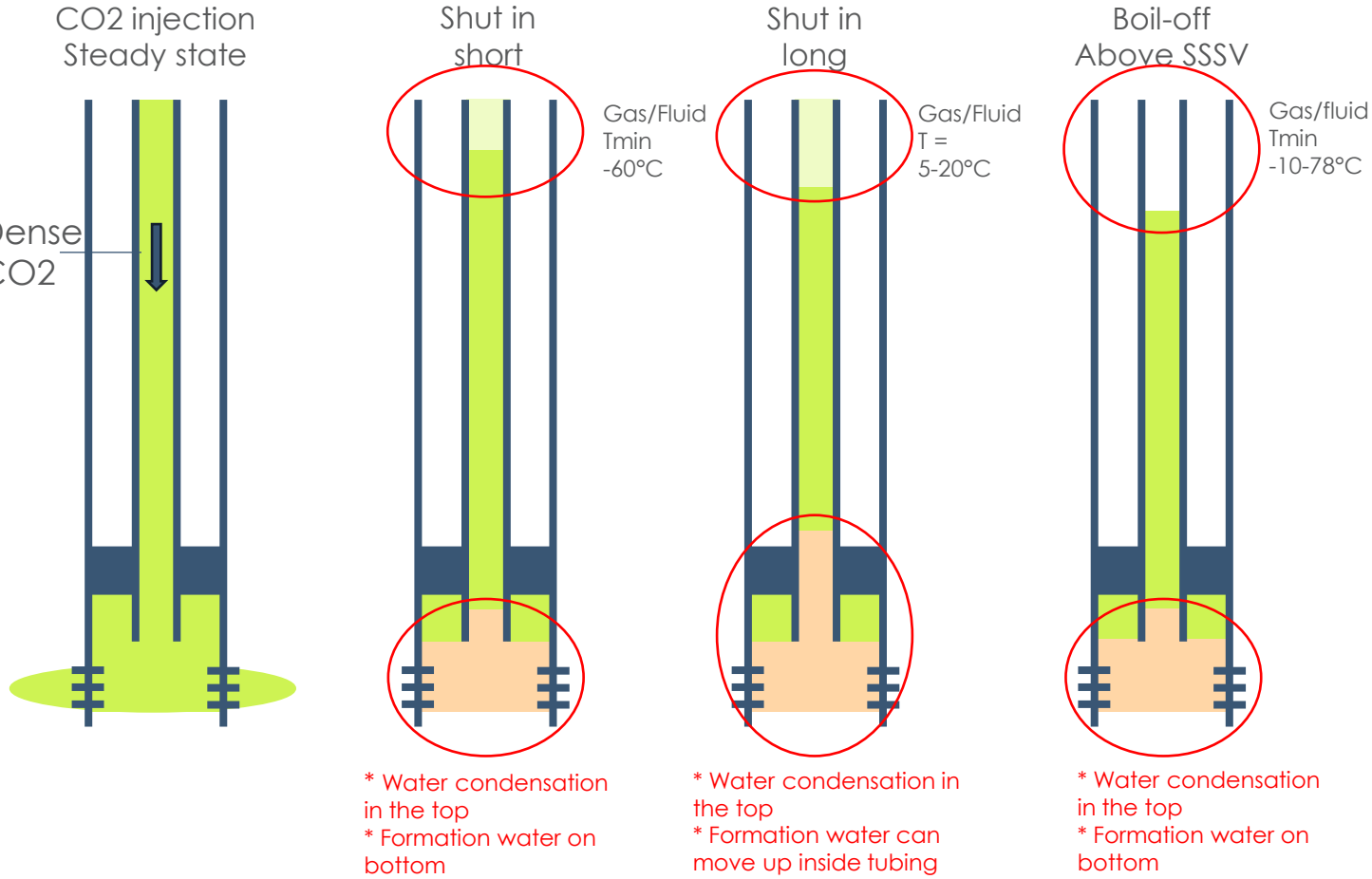
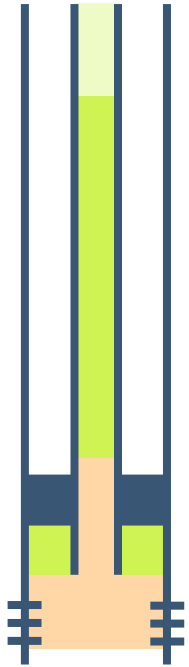
Back up

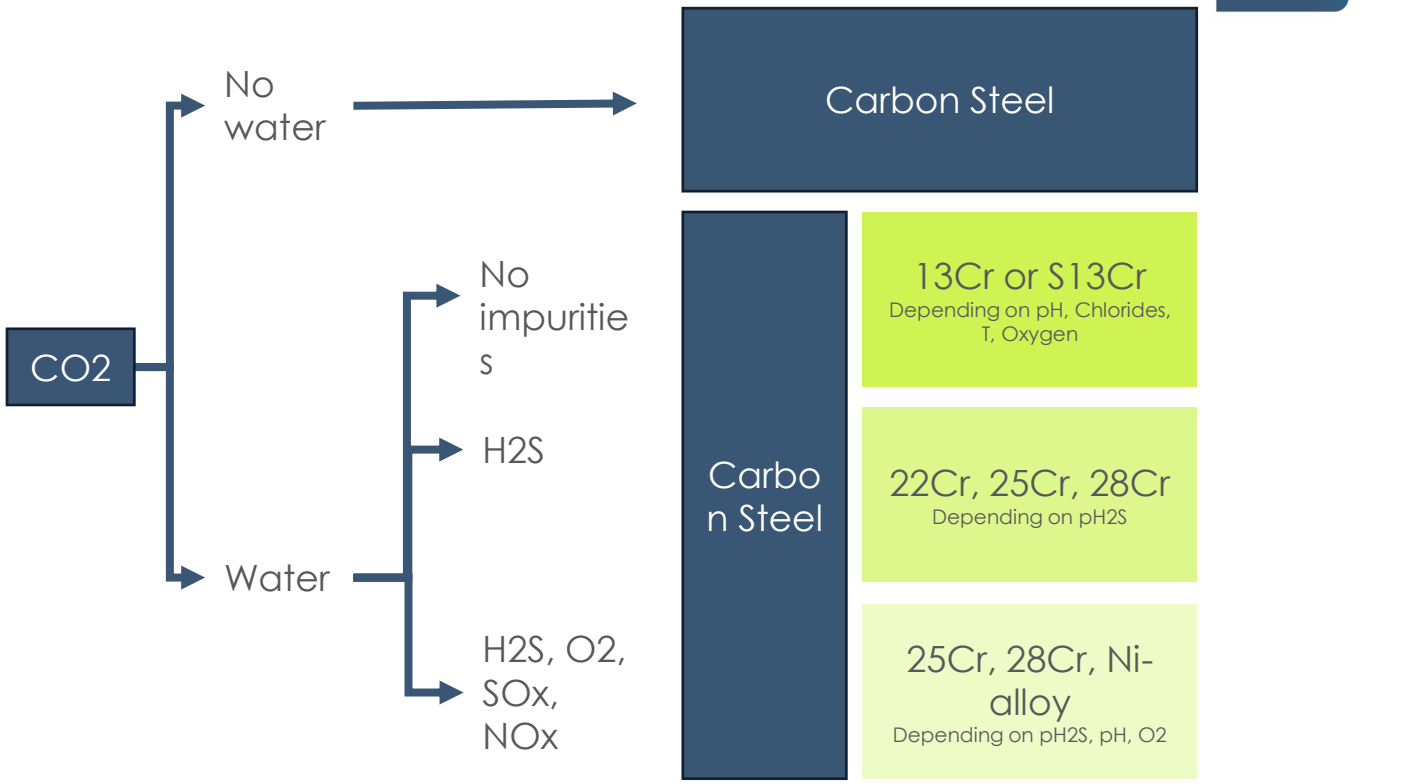
Q&A

CO2 well scenarios with corrosion risk



Material selection for flow-wetted tubulars





Corrosion

What do tests show?

GHGT-11

The long-term corrosion behaviour of abandoned wells under CO_2 geological storage conditions: (2) Experimental results for corrosion of casing steel

Shigeki Azuma[a*], Hiroyasu Kato[b], Yuuji Yamashita[c], Kazutoshi Miyashiro[c], Shigeru Saito[c]

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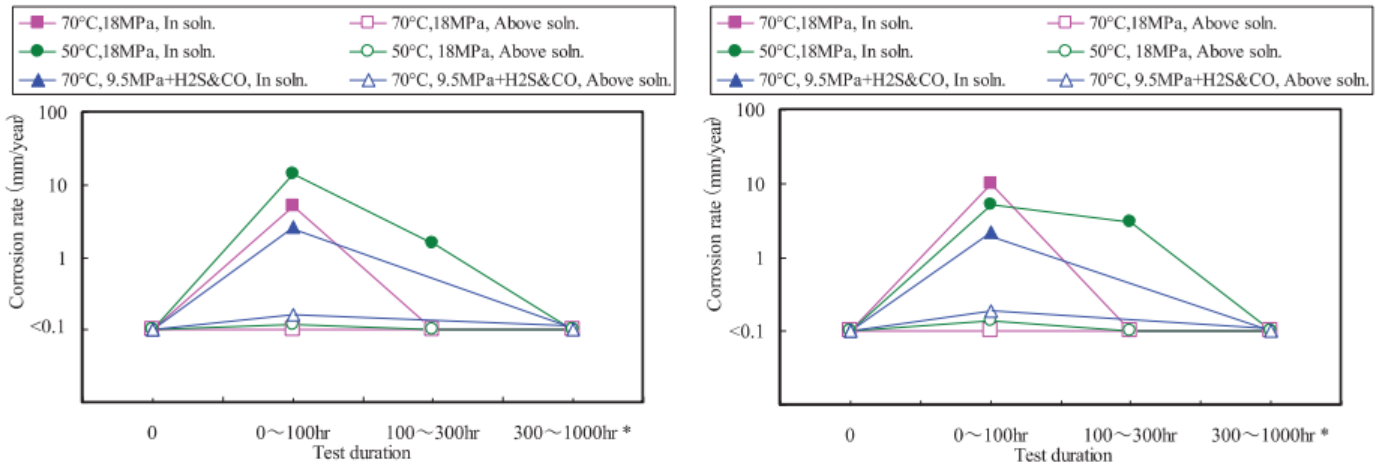
[b]Mitsubishi Materials Corporation, 1-297 Kitabukuro, Omiya-ku,Saitama, 330-8508, Japan
[c]Japan CCS Co., Ltd., Sapia Tower 19F, 1-7-12, Marunouchi, Chiyoda-ku, Tokyo, 100-0008, Japan



(a) J55 (b) N80

Fig. 8. Effect of test duration on corrosion rate of J55 and N80 specimens
(*: 100~1000 hours for the test with H_2S and CO)

> In (semi) static condition corrosion by carbonic acid seem to be a self-limiting process

Buffer zones

Can a small leak be absorbed by a buffer zone?

- Leaks, if they occur, are expected to be small
- For almost all future CO2 stores large sand bodies that can act as buffer zones are present
- Possible Work-flow:
  - Calculate maximum expected leak out of store
  - Identify buffer zones
  - Calculate expected CO2 penetration into buffer zone
    - CO2 goes fully into solution?
    - Some free CO2 remains, but properly trapped and dissolved over time
- No harmful effect on Environment
- Bow-Tie