Tomakomai CCS Demonstration Project
– Key Results –

Daiji Tanase
Japan CCS Co., Ltd.

8th International Workshop on Offshore Geologic CO_2 Storage,
20 - 21 April 2026, Bergen, Norway

Overview of the project

- First large-scale CCS demonstration project in Japan
- Location: Tomakomai City, Hokkaido Prefecture
- Commissioned by: New Energy and Industrial Technology Development Organization (NEDO)
- Contractor: JCCS

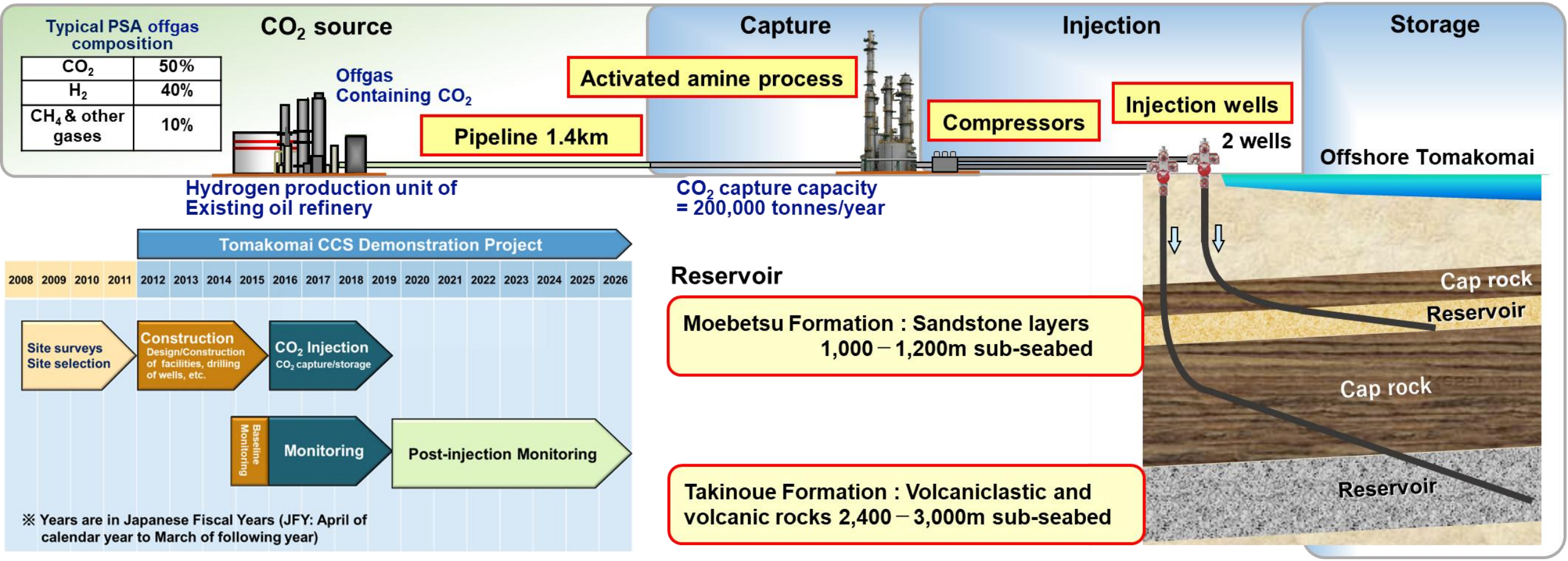
CO_2 storage area

CO_2 capture and injection facilities

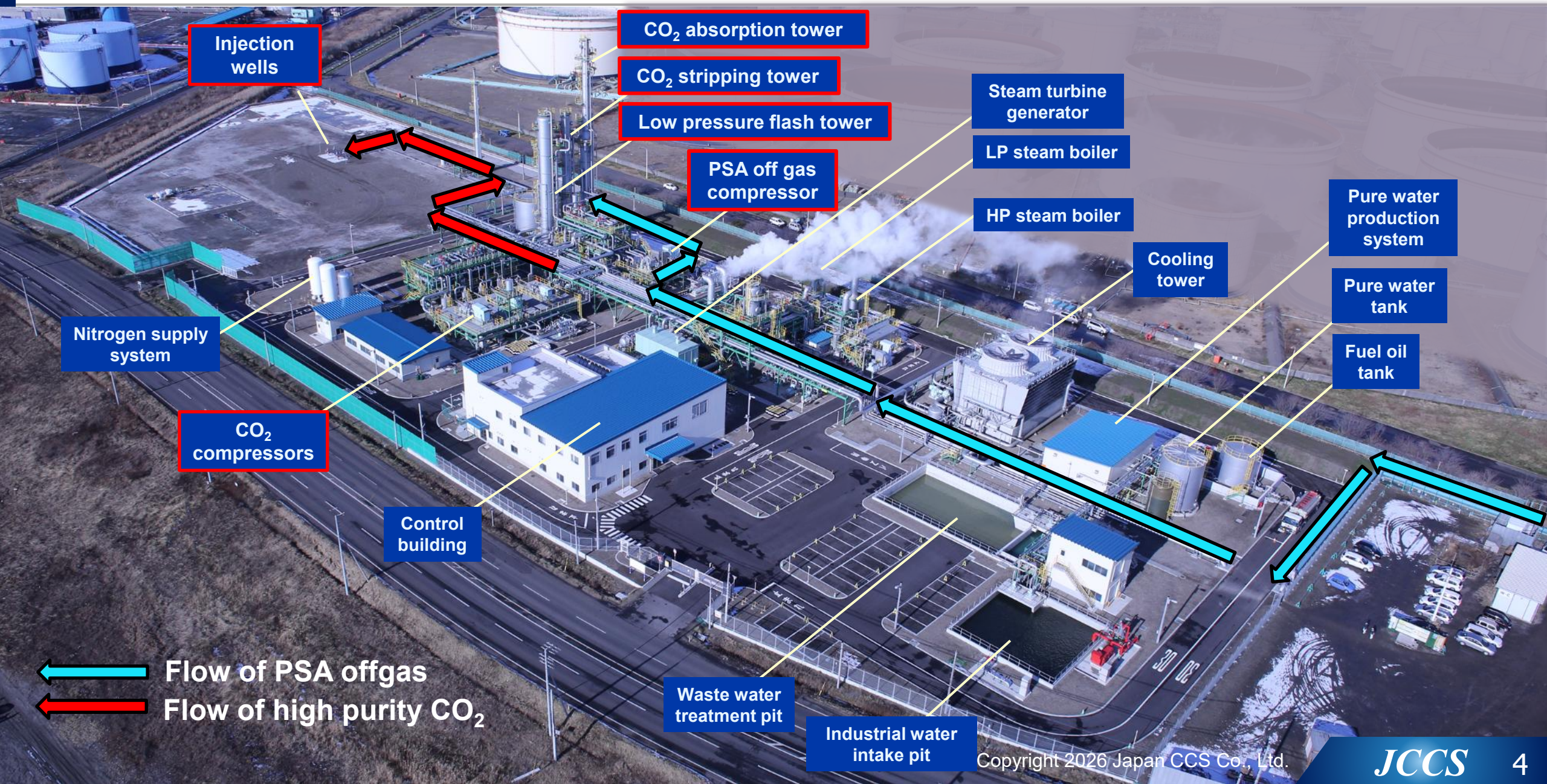
CO_2 source: Oil refinery

Project scheme and schedule

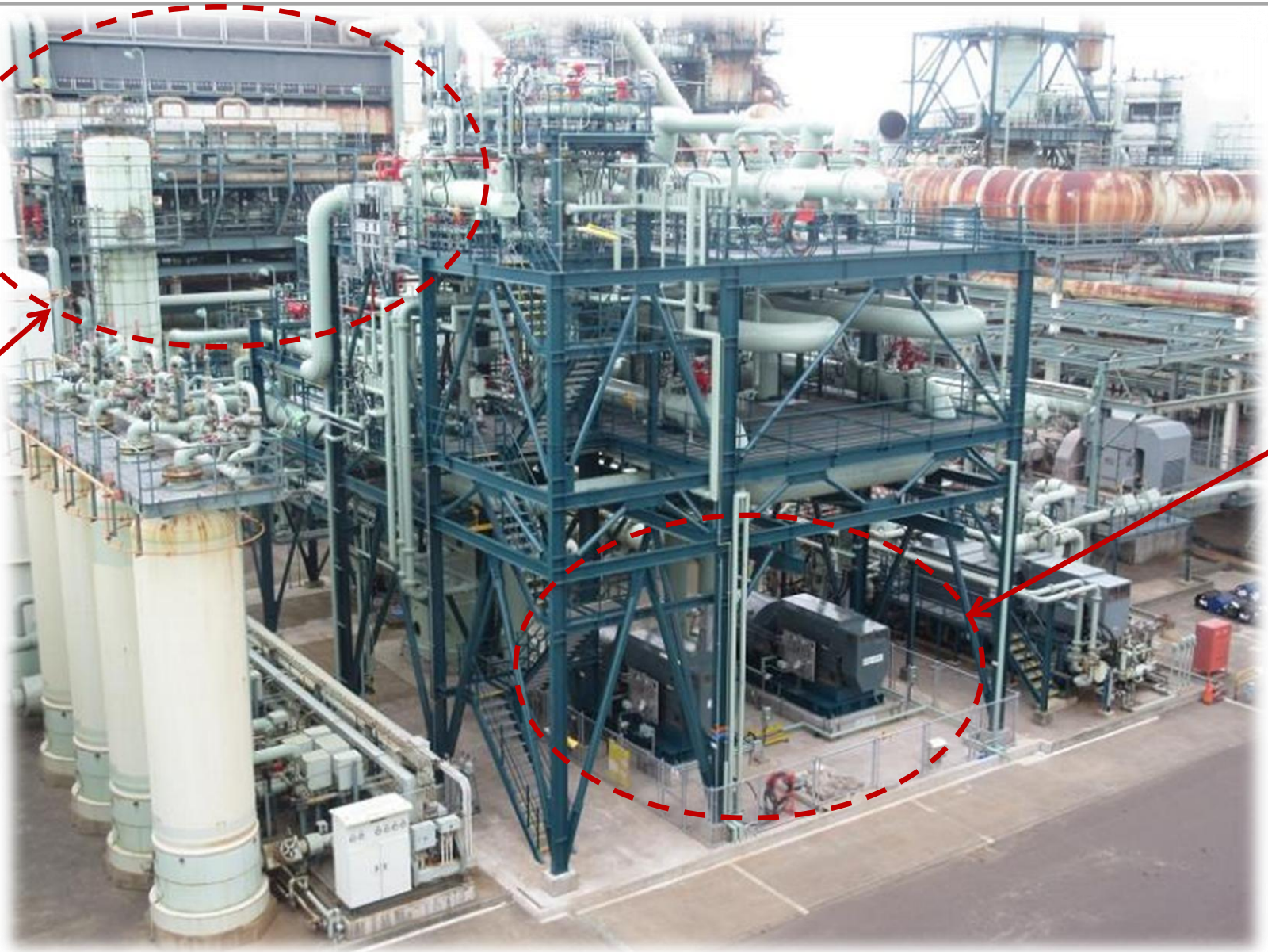
- The CO_2 source is a hydrogen production unit of an oil refinery.
- A portion of PSA (Pressure Swing Adsorption) offgas containing approximately 50% CO_2 generated by a hydrogen production unit is transported by 1.4 km pipeline to the CO_2 capture facility.
- After CO_2 capture and compression, the CO_2 is injected into two offshore subsurface reservoirs.



CO_2 capture and injection Project facilities (flow of CO_2)



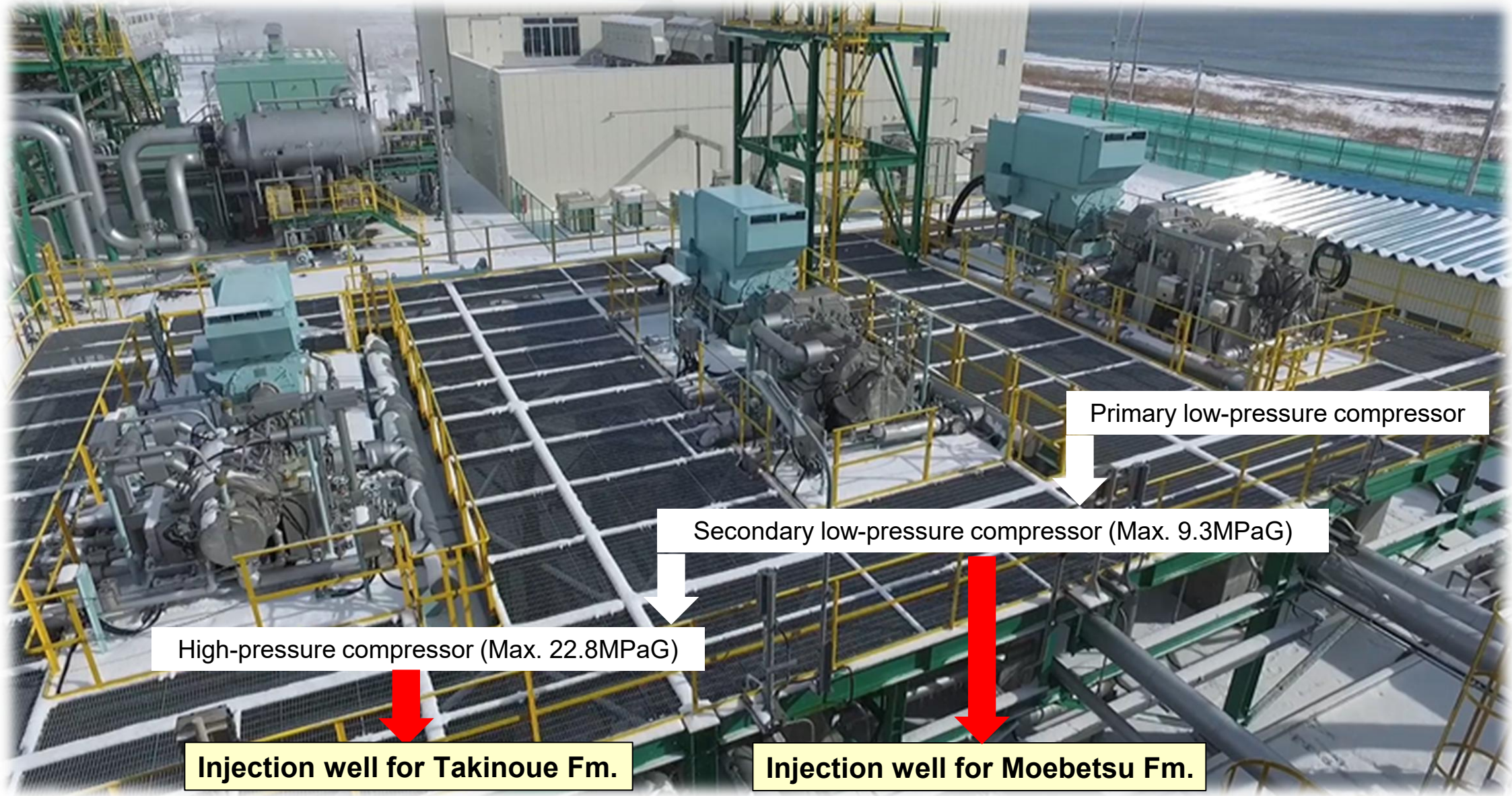
CO_2 Source: Hydrogen production unit and PSA offgas blower



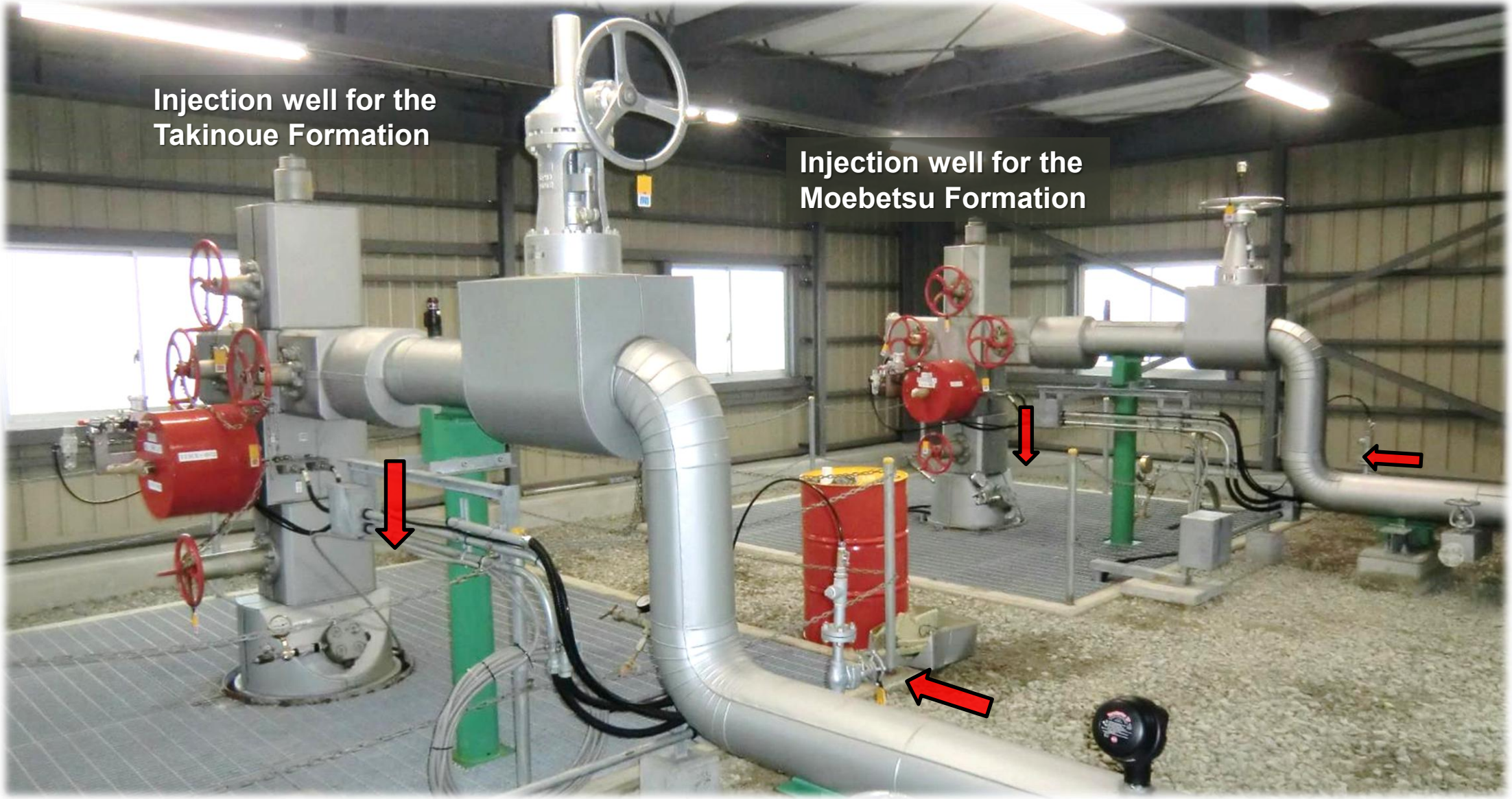
PSA offgas pipeline

PSA offgas compressor and CO_2 capture facility

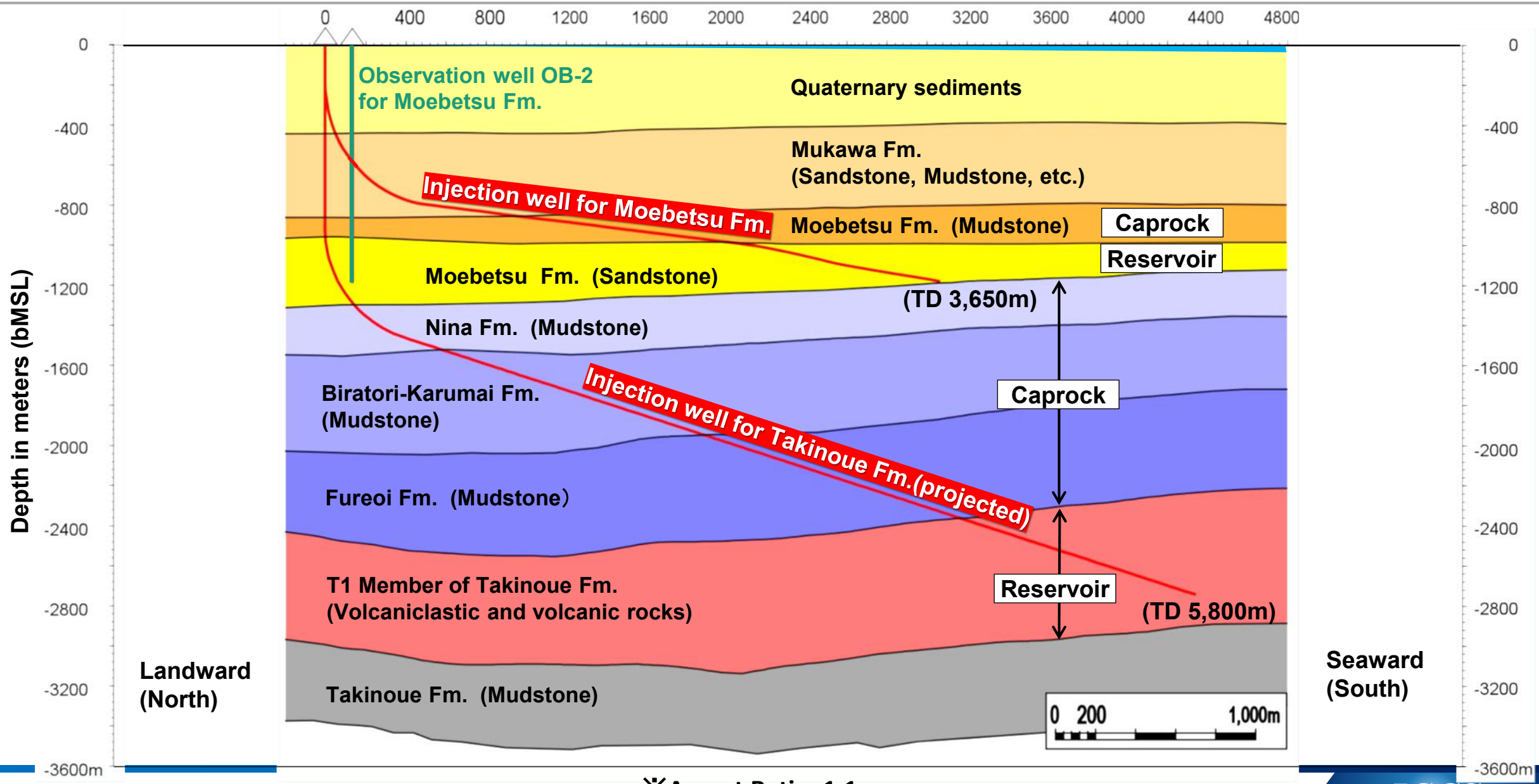
CO_2 compressors



CO_2 injection wells



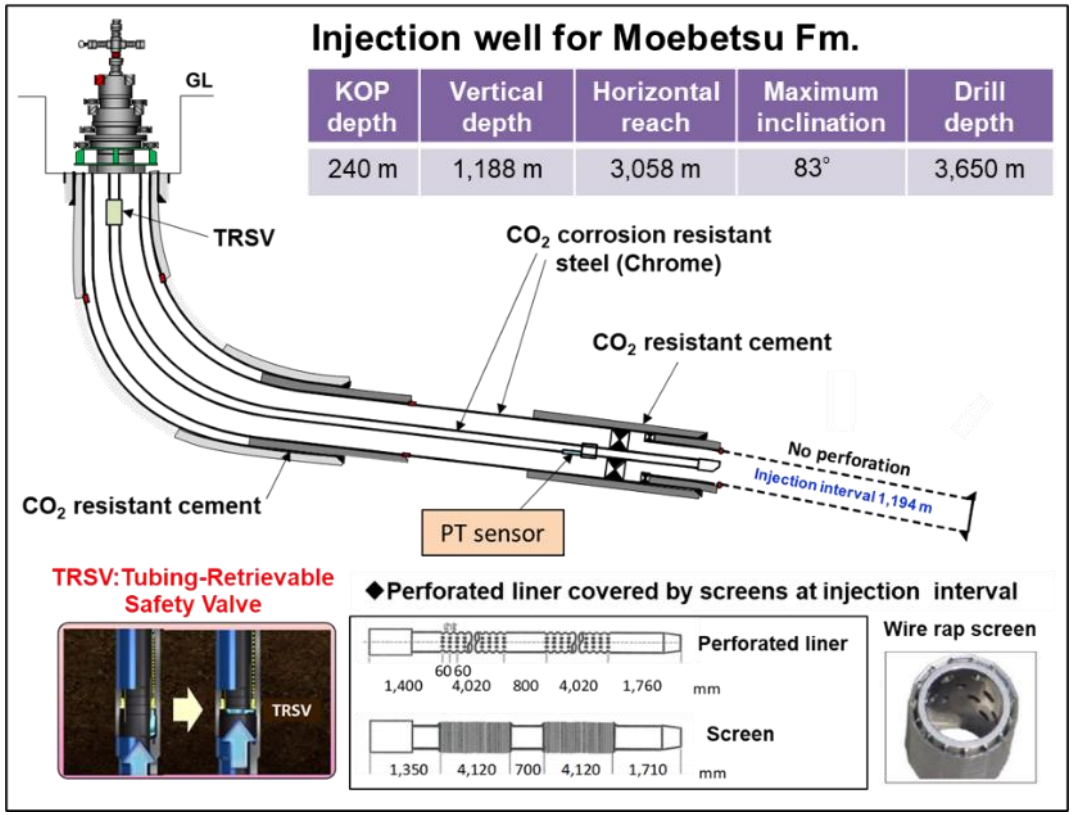
Geological cross section

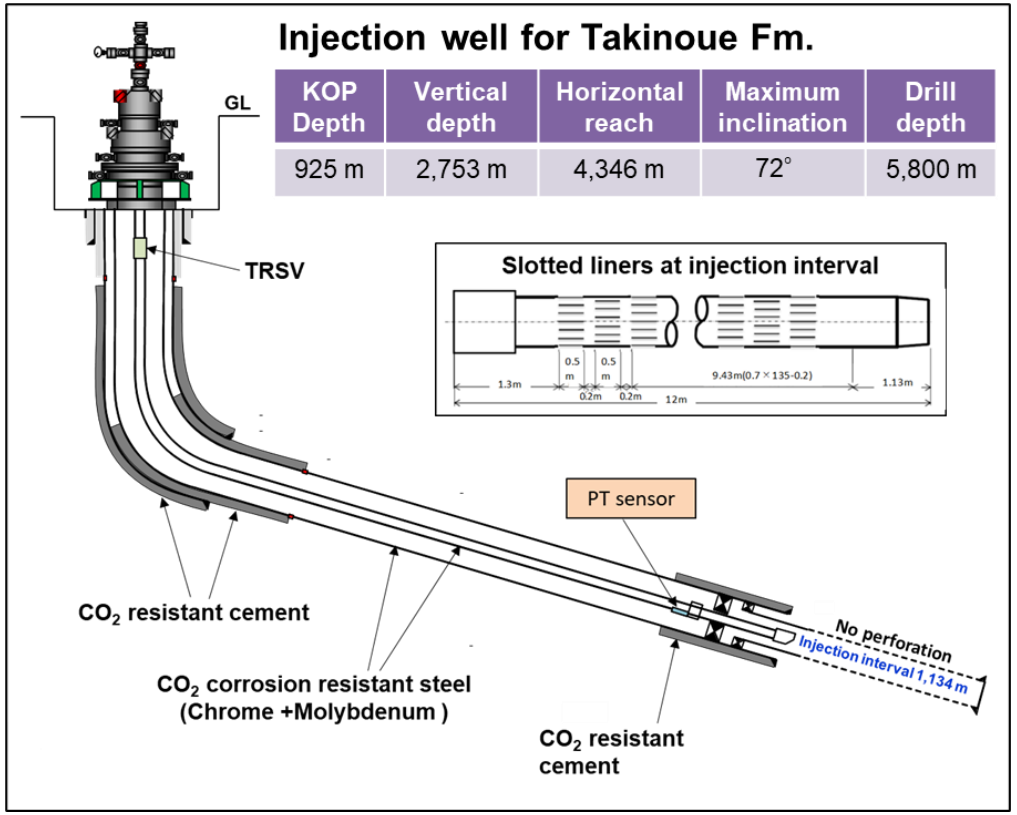


※Aspect Ratio=1:1

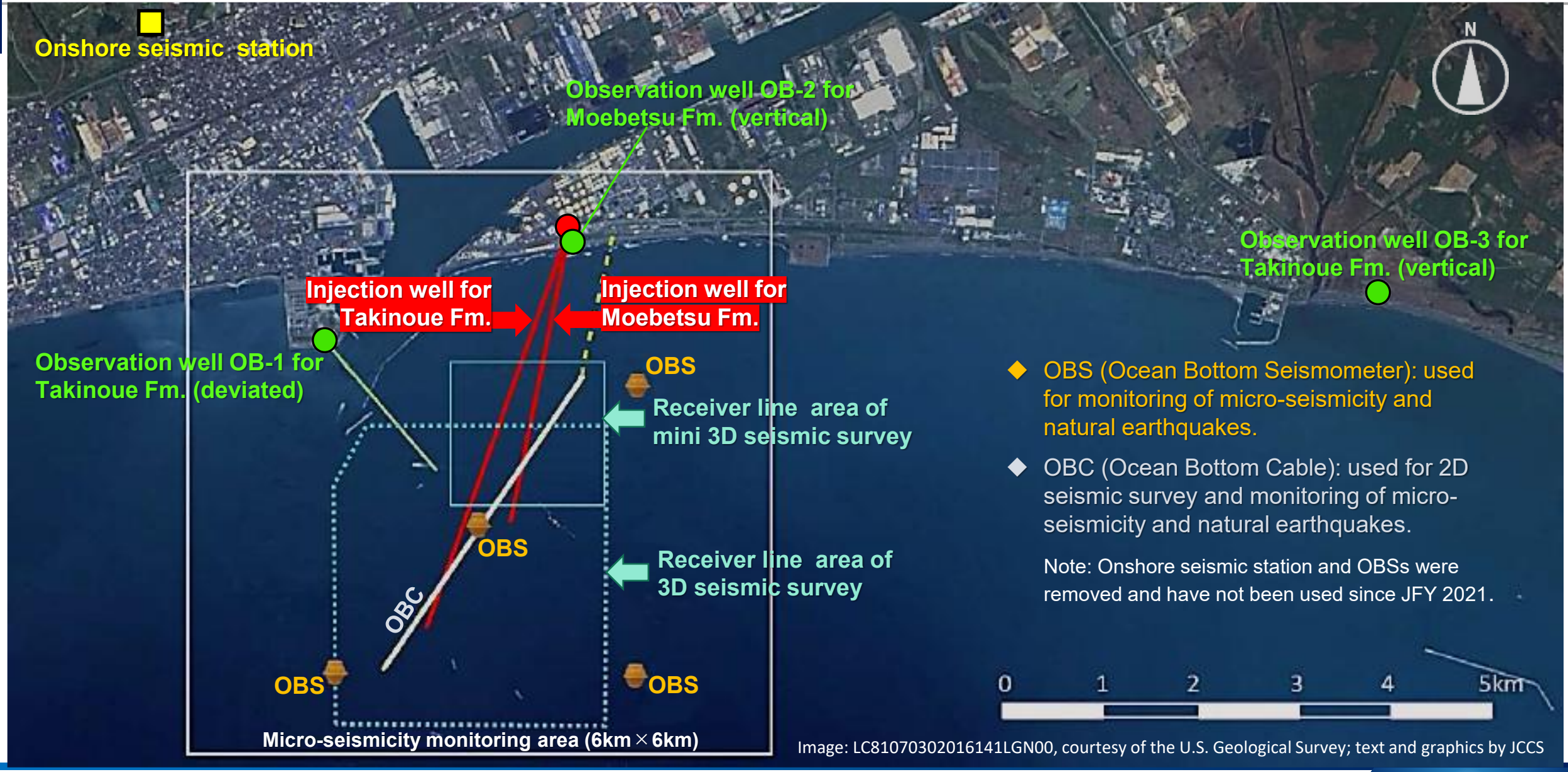
Schematic diagram of injection wells

- The captured CO_2 is compressed and stored 3-4km offshore in two sub-seabed reservoirs at different depths – Moebetsu and Takinoue formations by two independent injection wells.
- Deviated CO_2 injection wells drilled from onshore to offshore sub-seabed
  - Cost reduction of drilling, operation and maintenance
  - No disturbance on marine environment and harbor operation
- Injection interval length exceeding 1,100m to enhance injection efficiency





Layout of monitoring system

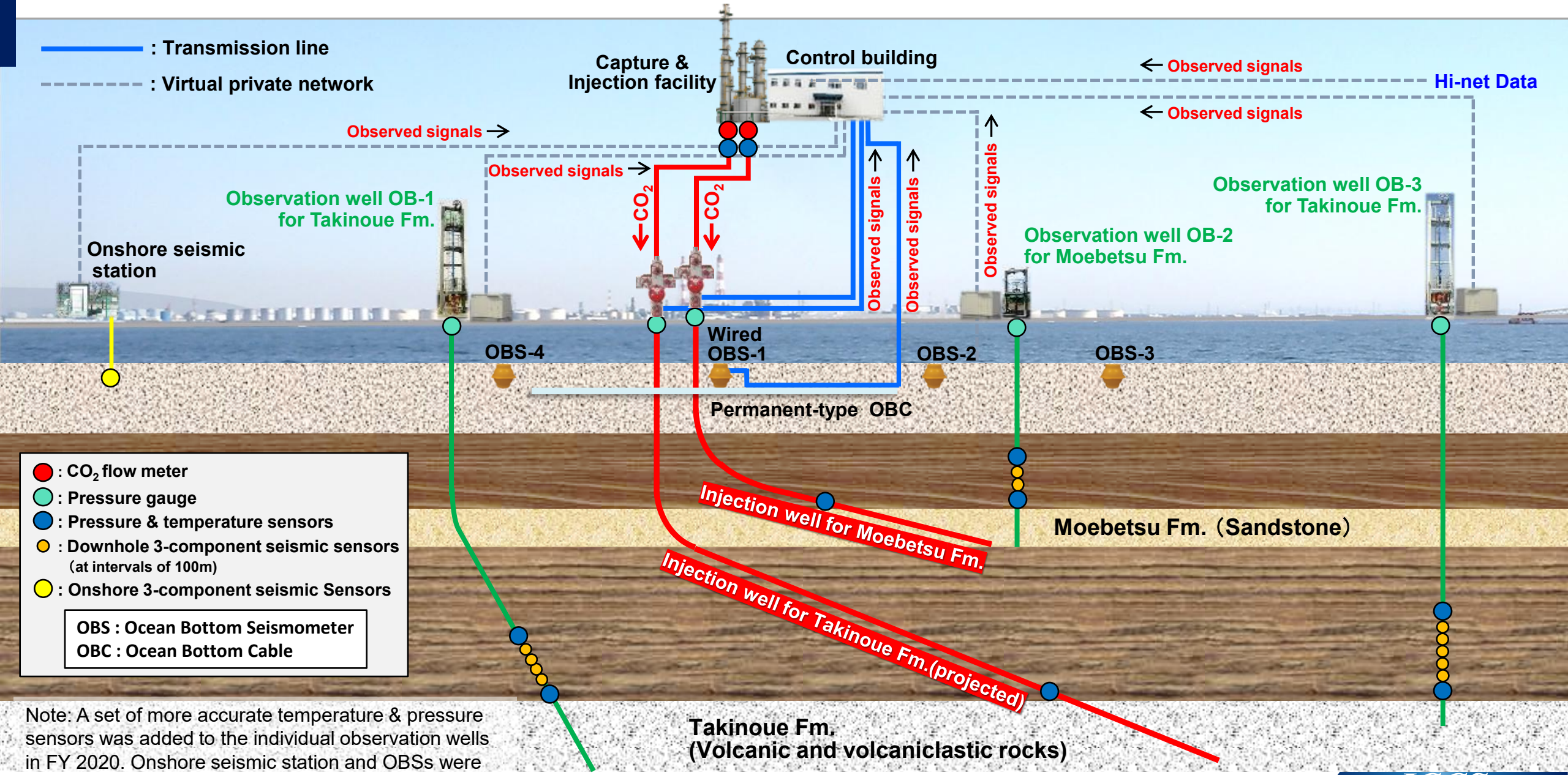


- OBS (Ocean Bottom Seismometer): used for monitoring of micro-seismicity and natural earthquakes.
- OBC (Ocean Bottom Cable): used for 2D seismic survey and monitoring of micro-seismicity and natural earthquakes.

Note: Onshore seismic station and OBSs were removed and have not been used since JFY 2021.

Image: LC81070302016141LGN00, courtesy of the U.S. Geological Survey; text and graphics by JCCS

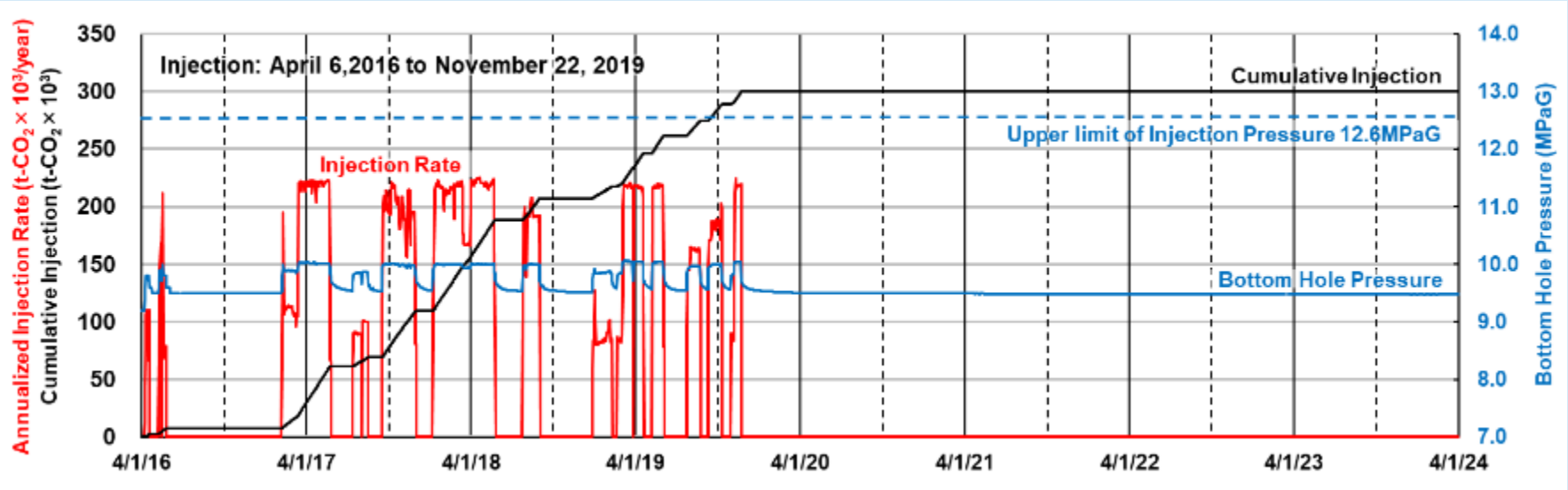
Schematic diagram of sensors deployed for monitoring



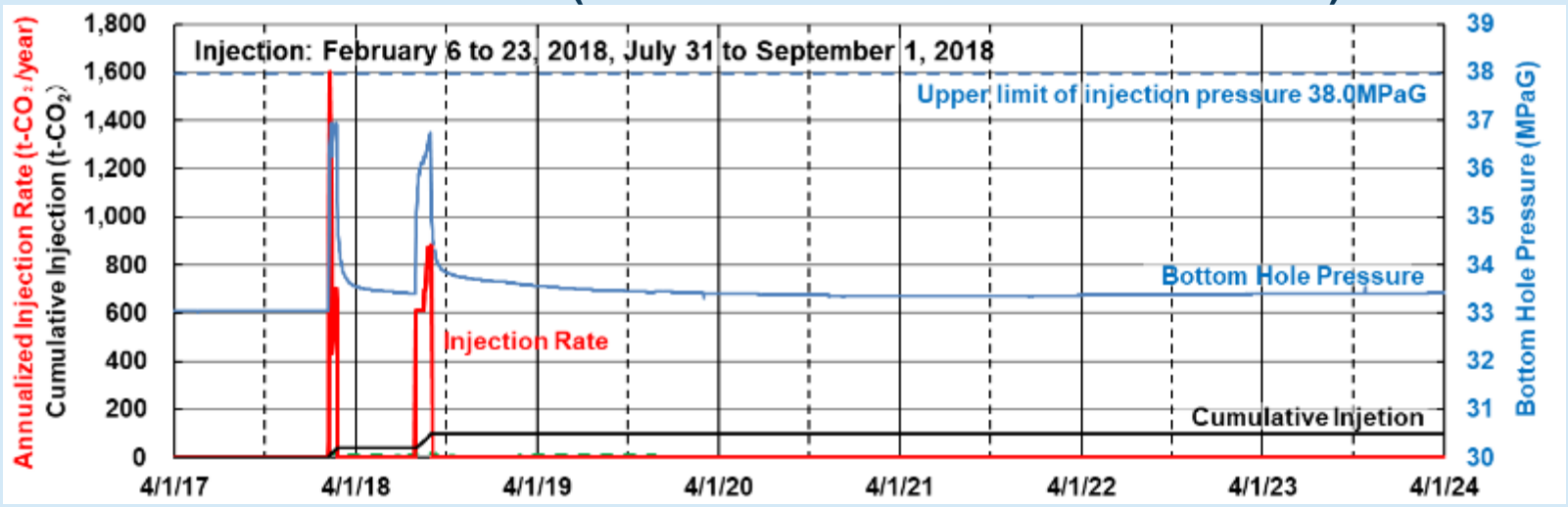
Note: A set of more accurate temperature & pressure sensors was added to the individual observation wells in FY 2020. Onshore seismic station and OBSs were removed and have not been used since JFY 2021.

CO_2 injection record

Moebetsu formation (sandstone layers)



Takinoue Formation (volcanic and volcaniclastic rocks)

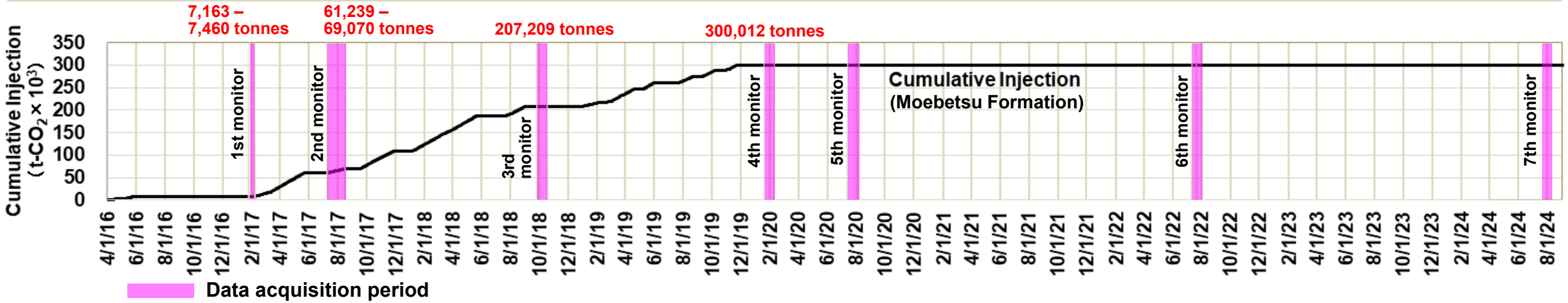


- Achieved 300,110 tonnes cumulative CO_2 injection into two reservoirs
  - Moebetsu Fm. 300,012 t
  - Takinoue Fm. 98 t

Seismic surveys: Implementation record

- Following the baseline 2D and 3D surveys, seven monitor seismic surveys have been carried out, which are a combination of 2D, 3D and 2D plus mini-3D surveys.

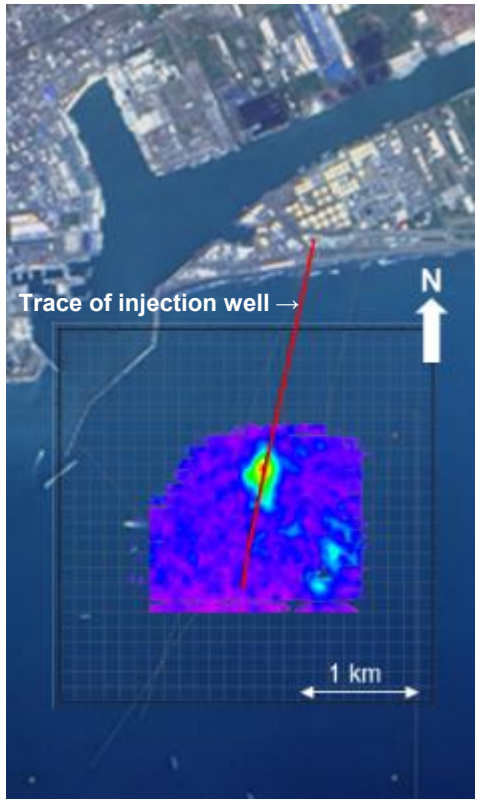
Type of survey		Fiscal year	Data acquisition period	Cumulative injection		Results	
				Moebetsu	Takinoue	Moebetsu	
Baseline	3D	JFY 2009	October – December 2009	0 tonnes	0 tonnes		
Baseline	2D	JFY 2013	August 2013	0 tonnes	0 tonnes		
1st monitor	2D	JFY 2016	January 25 – February 6, 2017	7,163 – 7,460 tonnes	0 tonnes	Anomalies were detected	No anomalies
2nd monitor	3D	JFY 2017	July 9 – August 17, 2017	61,239 – 69,070 tonnes	0 tonnes	Anomalies were detected	No anomalies
3rd monitor	2D + mini-3D	JFY 2018	September 26 – October 18, 2018	207,209 tonnes	98 tonnes	Anomalies were detected	No anomalies
4th monitor	2D + mini-3D	JFY 2019	January 19 – February 9, 2020	300,012 tonnes	98 tonnes	Anomalies were detected	No anomalies
5th monitor	3D	JFY 2020	July 13 – August 6, 2020	300,012 tonnes	98 tonnes	Anomalies were detected	No anomalies
6th monitor	mini-3D	JFY 2022	July 11 – 21, 2022	300,012 tonnes	98 tonnes	Anomalies were detected	
7th monitor	mini-3D	JFY 2024	July 14 – 21, 2024	300,012 tonnes	98 tonnes	There is no clear change in the anomalies observed in the 6th and 7th monitor surveys	



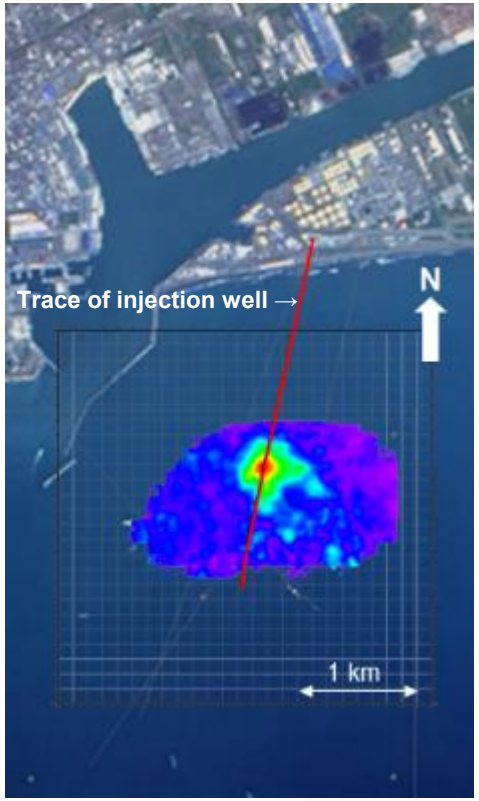
3D seismic survey results：RMS amplitude of difference of reflected waves

- 3D seismic surveys at cumulative CO_2 injection of approx. 65,000, 207,000 and 300,000 tonnes into the Moebetsu Formation detected anomalies, indicating evolution of the CO_2 plume.

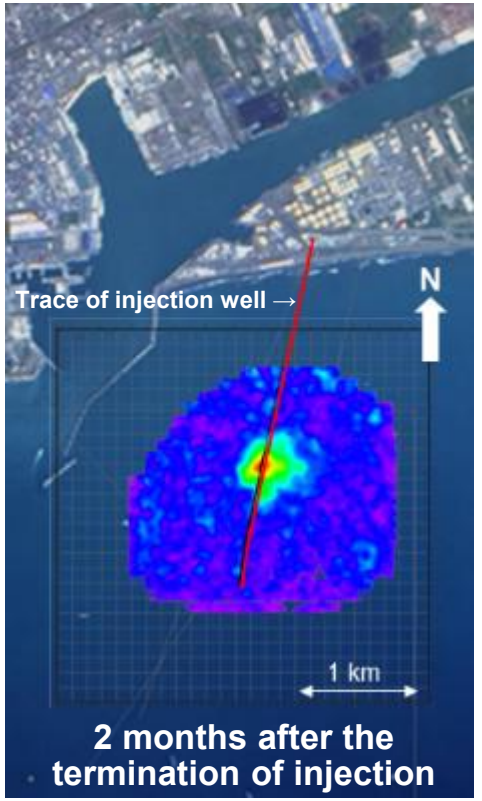
2nd monitor survey:
About 65,000 tonnes



3rd monitor survey:
207,209 tonnes

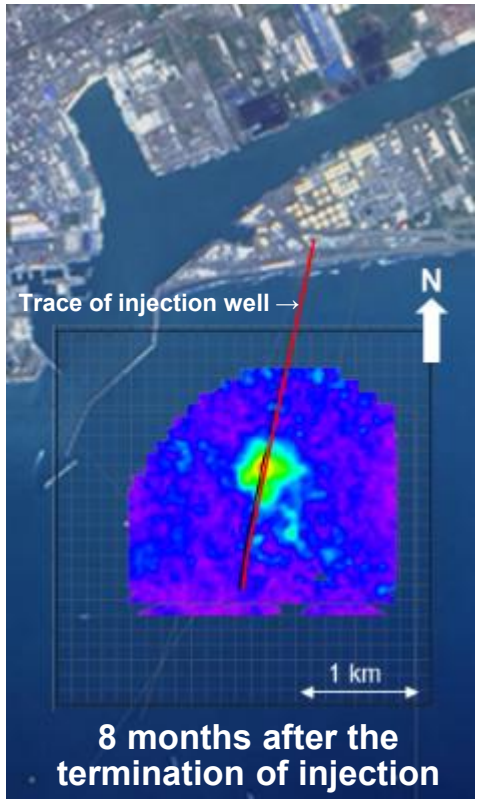


4th monitor survey:
300,012 tonnes



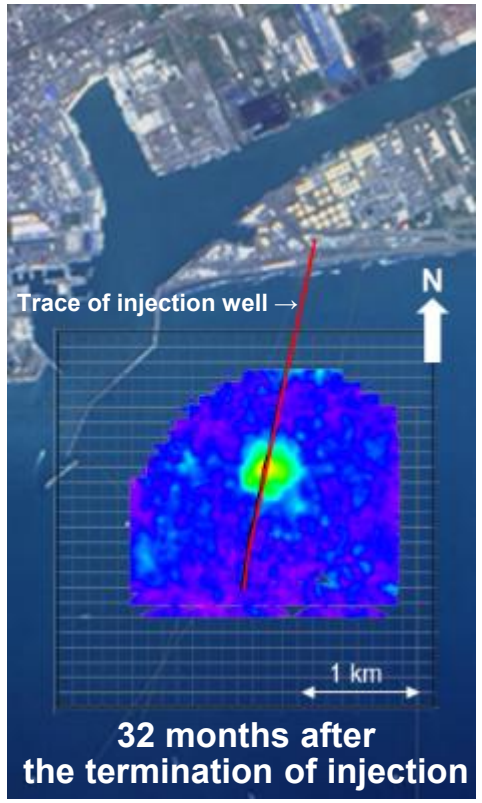
2 months after the termination of injection

5th monitor survey:
300,012 tonnes

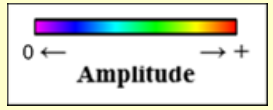


8 months after the termination of injection

6th monitor survey:
300,012 tonnes



32 months after the termination of injection

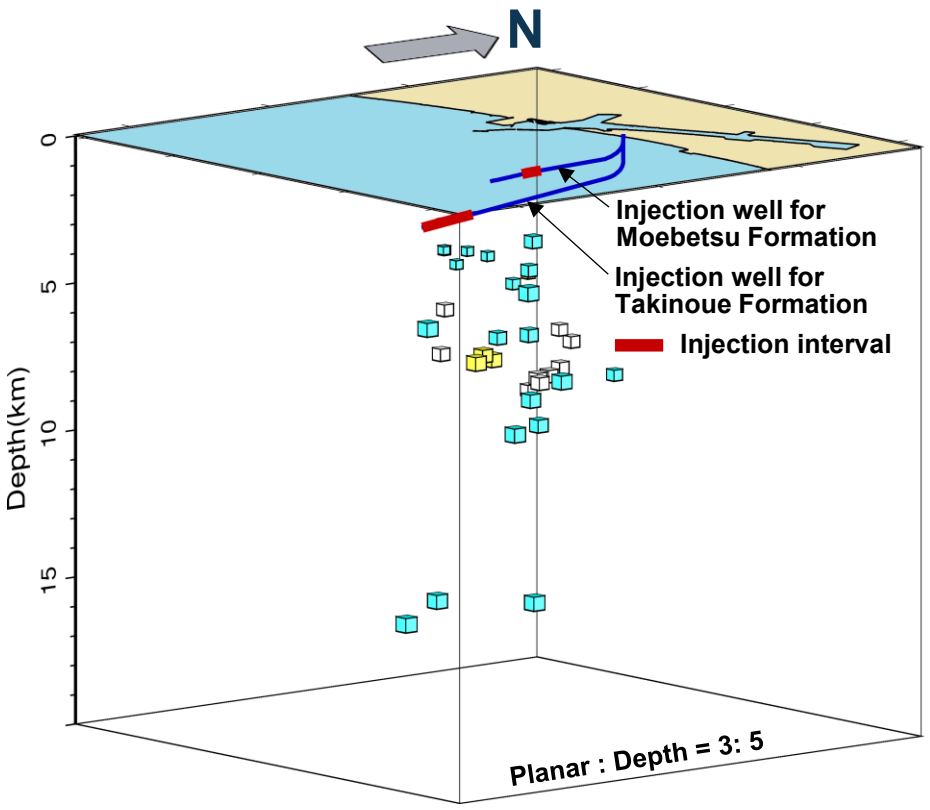


RMS (Root Mean Square) amplitude of the difference of monitor and baseline surveys within the reservoir interval (970 to 1050 msec)

Image: LC81070302016141LGN00, courtesy of the U.S. Geological Survey; text and graphics by JCCS

Results of micro-seismicity monitoring

3D view of hypocenters of events



Pre-injection events
Events during injection
Post-injection events ※Detectability: Mw ≥ - 0.5

List of events

Pre-injection events

No.	Date	Estimated Depth	Mw
1	4/09/2015 15:03	6.64 km	0.14
2	4/13/2015 14:00	5.97 km	0.14
3	4/17/2015 07:06	8.17 km	0.20
4	4/17/2015 07:09	8.19 km	0.19
5	4/17/2015 07:13	8.33 km	0.28
6	4/17/2015 07:18	7.57 km	0.17
7	5/10/2015 08:27	8.59 km	-0.04
8	8/10/2015 19:08	6.76 km	0.23
9	8/20/2015 23:20	8.18 km	0.44

Events during injection

No.	Date	Estimated Depth	Mw
10	8/02/2017 13:35	7.80 km	0.50
11	8/02/2017 13:36	7.78 km	0.33
12	8/02/2017 13:55	7.70 km	0.33

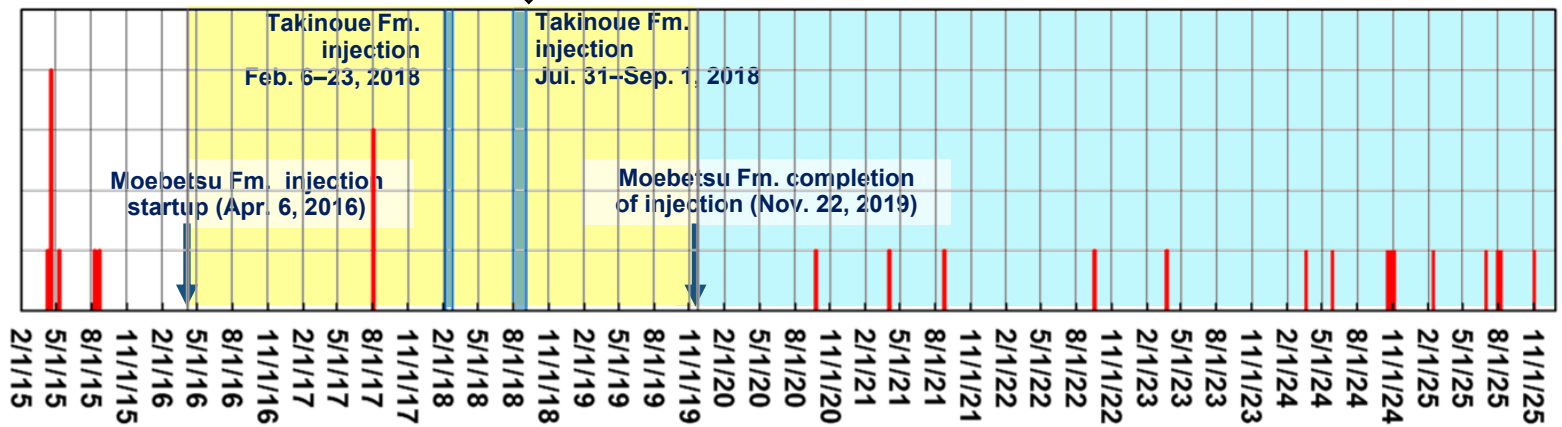
Post-injection events

No.	Date	Estimated Depth	Mw
13	9/24/2020 11:53	5.86 km	0.59
14	4/01/2021 04:23	7.45 km	0.23
15	8/24/2021 16:03	6.50 km	0.13
16	9/18/2022 14:04	4.35 km	0.12
17	3/22/2023 10:26	8.37 km	0.43
18	3/20/2024 22:43	5.15 km	0.59
19	5/27/2024 23:04	5.73 km	- 0.35
20	10/15/2024 7:25	5.02 km	-0.05
21	10/24/2024 17:20	15.83 km	0.56
22	11/4/2024 2:05	9.55 km	0.62
23	2/12/2025 12:00	8.72 km	0.56
24	6/29/2025 7:12	9.87 km	0.33
25	7/28/2025 22:52	15.70 km	0.65
26	8/6/2025 1:53	16.28 km	0.74
27	11/2/2025 2:42	8.09 km	-0.11

Histogram of events

Hokkaido Eastern Iburi Earthquake
Mw 6.6 (Sept. 6, 2018)

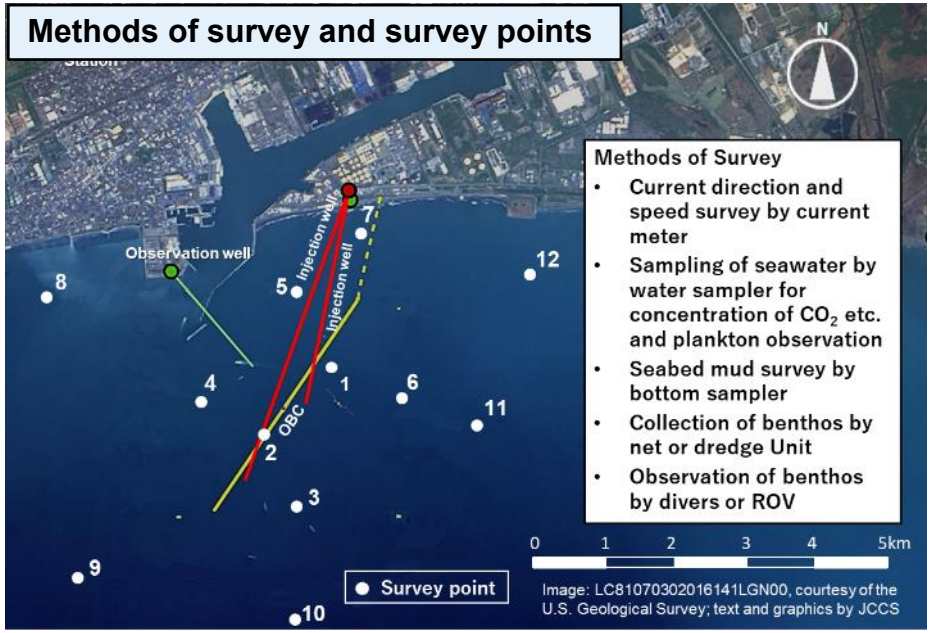
Period : Feb. 1, 2015 – Dec. 31, 2025



Marine environmental surveys according to the monitoring plan submitted to MOE

- Marine environmental surveys have been conducted under the five-year injection permit (FY2016–2020 and FY2021–2025) from Ministry of the Environment (MOE) which requires the implementation of a “monitoring plan” approved by MOE.

Methods of survey and survey points

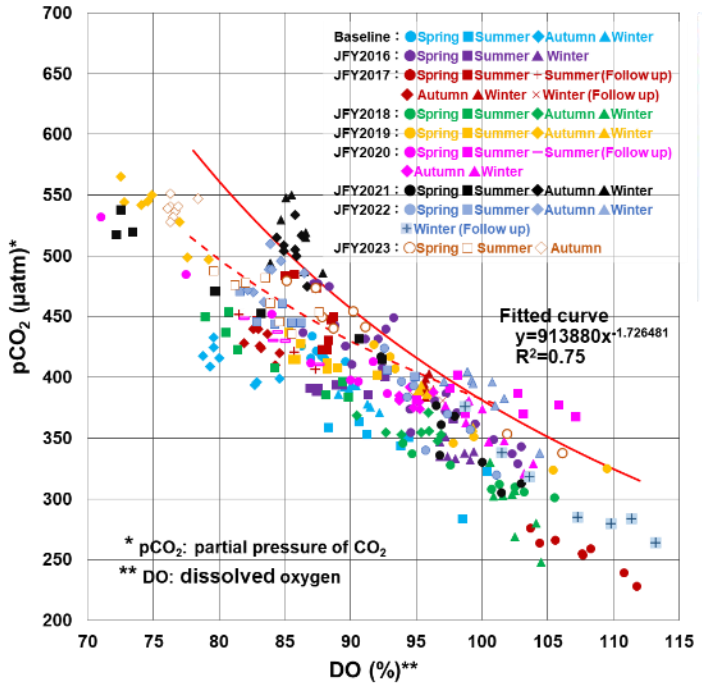


Water sampler

Bottom sampler

ROV

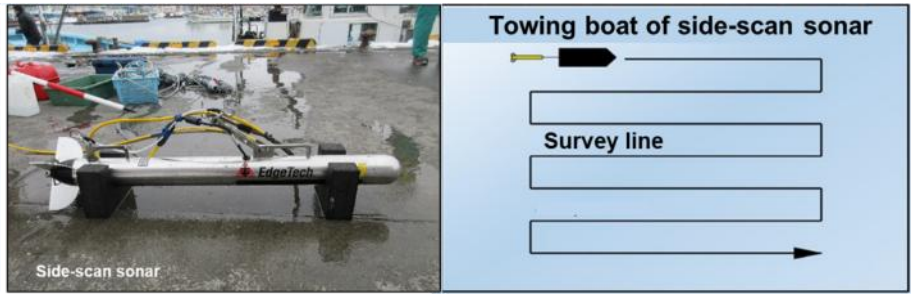
Threshold line: Upper limit of 95% prediction interval



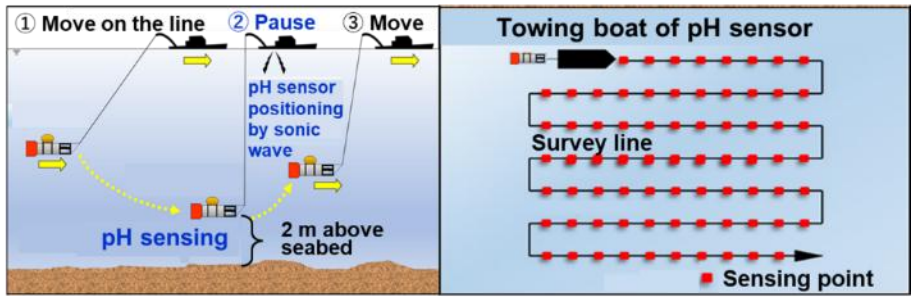
Initial threshold line using baseline data

Current threshold line using data of baseline and Feb. 2017 to Feb. 2018

Follow-up surveys: in case of exceedance over the threshold line



Side-scan sonar survey



Towed pH sensor survey

➢ Future Outlook

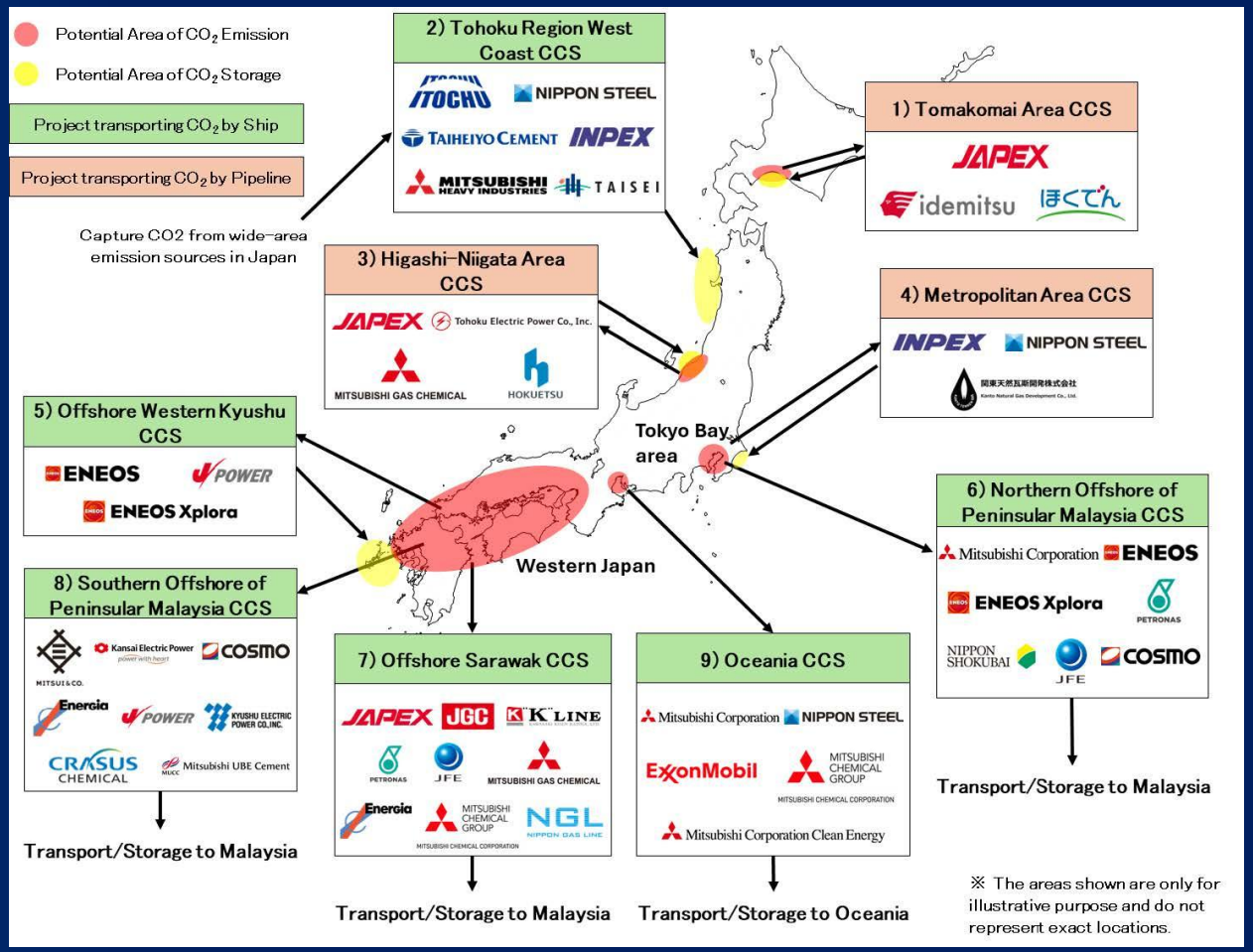
NEDO Project
R&D and Demonstration of CO_2 Ship Transportation (June 2021 – Ongoing)

EXCOOL/ NEDO, Sanyu Kisen

Demonstration ship ”EXCOOL”

- **R&D and demonstration of technologies for CO_2 liquefaction, storage, loading, unloading, and marine transportation under optimal temperature and pressure conditions for safe, low-cost and large-volume transportation.**

Advanced CCS Projects Selected by JOGMEC (2024 - Ongoing)



https://www.jogmec.go.jp/english/news/release/release_00268.html

- **Storage sites: 5 for domestic storage, 4 for overseas storage**
- **Basic engineering design for CCS value chain (PreFEED/FEED)**
- **Assessment on CO_2 storage potential including exploratory drilling**

Summary

Results and Lessons Learned

- Operation of full chain CCS system from capture to storage conducted successfully, target of 300,000 tonnes of CO_2 injection achieved. Monitoring operations being continued.
- CO_2 capture process comprising two-stage absorption system with low pressure flash tower achieved significantly lower capture energy than conventional system
- Deviated injection wells from onshore site into offshore reservoirs saved drilling cost, avoided disturbance of marine environment and harbor operation
- Safety and reliability of CCS system demonstrated through monitoring including seismicity observation, marine environmental surveys and seismic surveys.

Looking Ahead

- R&D and Demonstration of CO_2 Ship Transportation and Advanced CCS Projects are in progress

Thank you for your attention

Japan CCS Co., Ltd. would like to express thanks to Ministry of Economy, Trade and Industry (METI), New Energy and Industrial Technology Development Organization (NEDO) for kind permission to disclose information.

Japan CCS gave the following papers on the Tomakomai Project at GHGT-16 and GHGT-17 which are available on SSRN.
https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4285926
https://papers.ssrn.com/sol3/papers.cfm?abstract_id=5071127

JCCS
Japan CCS Co., Ltd.
http://www.japanccs.com/