

Tomakomai CCS Demonstration Project

CSLF TECHNICAL GROUP MEETING

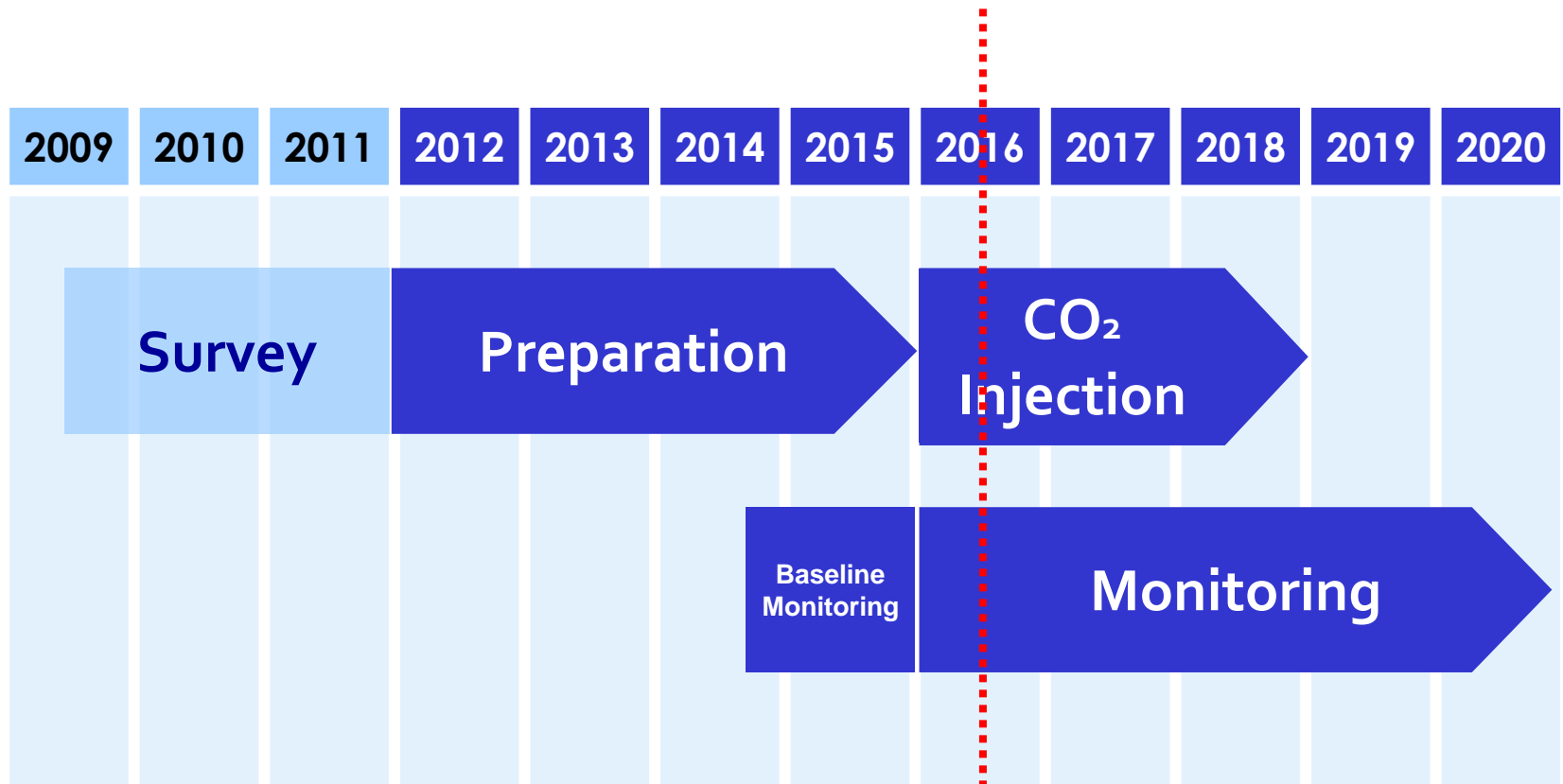
October 4, 2016

Japan CCS Co., Ltd. (JCCS)

Overview of Tomakomai Demonstration Project



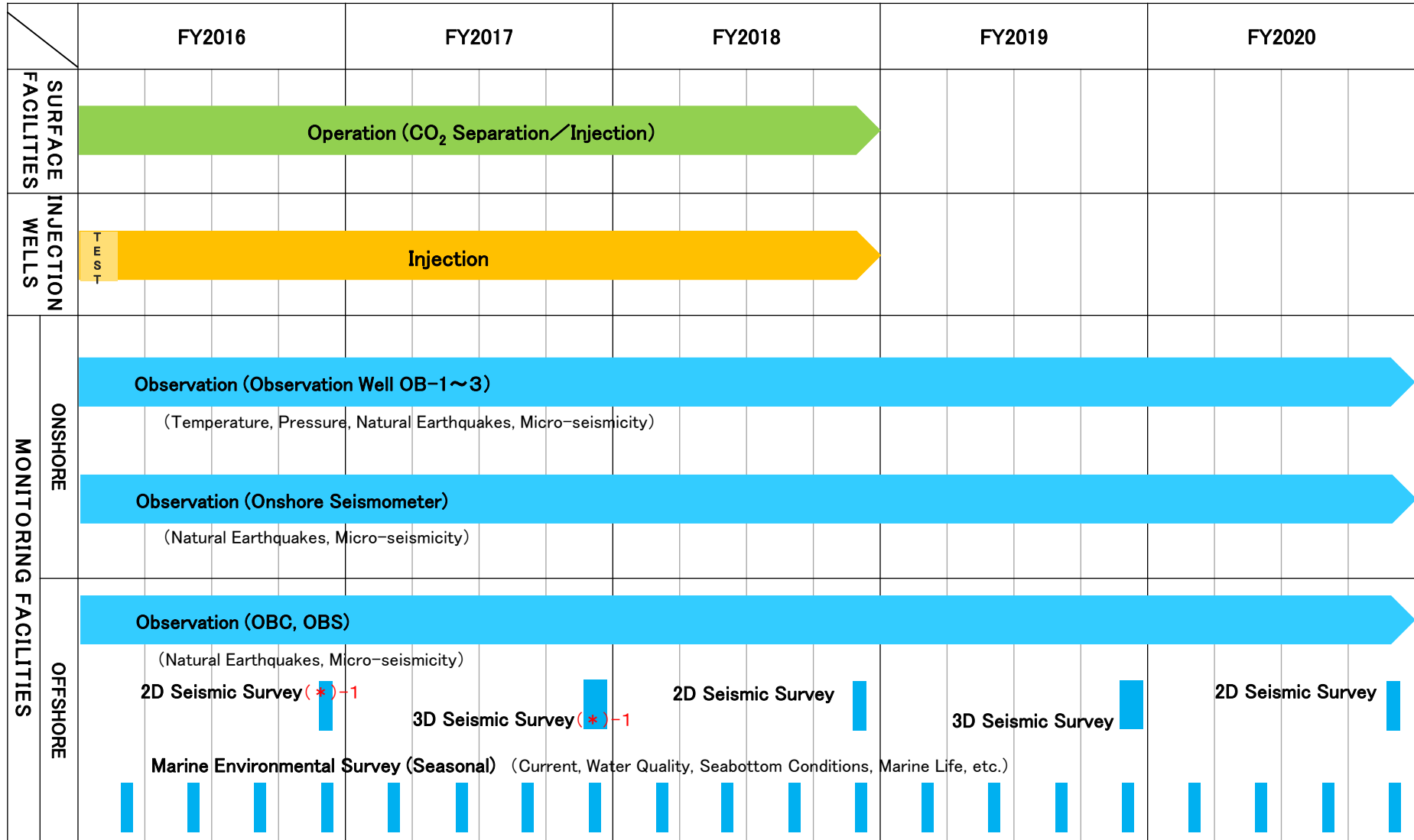
Tomakomai CCS Demonstration Project Schedule



※Years are in Japanese Fiscal Years (April of calendar year thru March of following year)

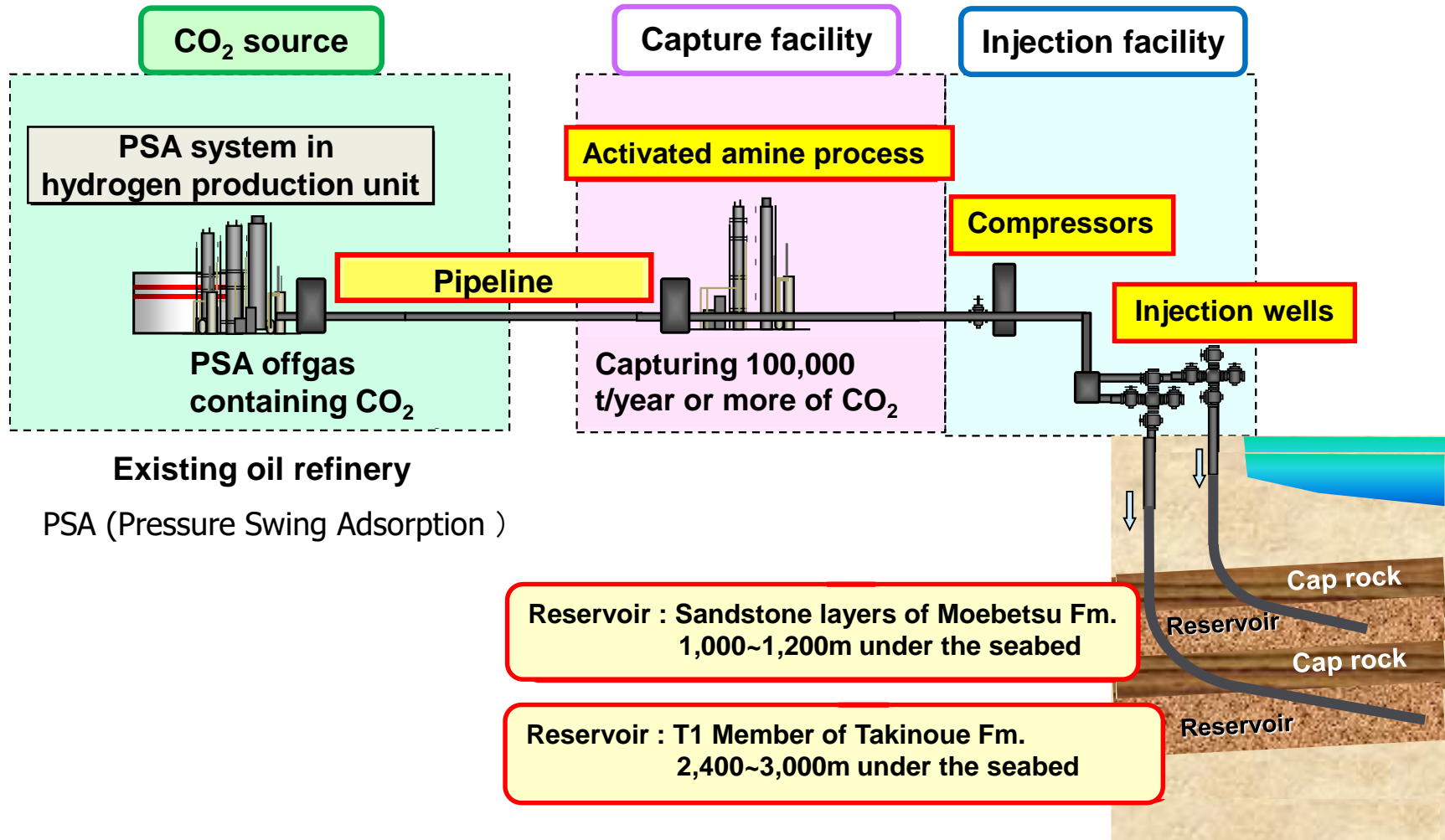
Demonstration Project Operation Schedule

As of May 2016



(*)-1 2D•3D Seismic Survey: survey method utilizing seismic reflection waves discharged from a seismic source of a seismic exploration vessel in order to delineate the subsea geological structure and/or formation characteristics. In this case, the data acquired is used to estimate the CO₂ storage distribution by 2D cross sections or arbitrary planal diagrams in 3D space.

Flow Scheme of CCS Demonstration Project



【Project Goal】

- Demonstrate the technical viability of a full cycle CCS system from capture to injection and storage in saline aquifers on a practical scale, contributing to the establishment of CCS technology for practical use by 2020 and future deployment of CCS projects in Japan

【 Objectives】

- In order to demonstrate technical viability, safety and reliability of CCS system;
 - Capture and inject 100,000 tonnes/year or more of CO₂ for 3 years
 - Monitor by the installed monitoring system and surveys for 5 years

【Tasks】

- Prepare capture and injection facilities, injection wells with a design capacity of 200,000 tonnes of CO₂ per year
- Prepare monitoring systems and gather data for geological storage and seismicity
- Estimate CO₂ behavior in the reservoirs by analysis of seismic and well data
- Confirm that existing technologies adopted in the system work properly and efficiently
- Confirm effectiveness of site selection guideline of METI by demonstrating no CO₂ leakage
- Establish guidelines for building and improving geological models
- Prepare technical standards of operation and safety for practicalization of CCS technology
- Share information and data obtained from the project with the public and relevant community groups in order to increase awareness and understanding of the benefits and viability of CCS

【 Outcomes】

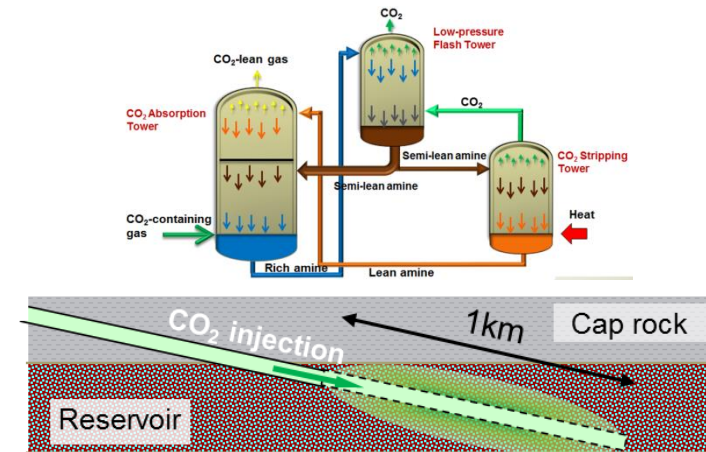
- Confirmation of the technical viability of a full CCS system in Japan
- Clarification of technical and social areas to be improved or solved for commercialization
- Mitigation of public concerns about earthquakes
 - Natural earthquakes do not influence or negatively impact stored CO₂
 - CO₂ injection does not cause any perceptible increase in earth tremors
- Enhancement of awareness and understanding of CCS technology and its benefits

【Other Considerations】

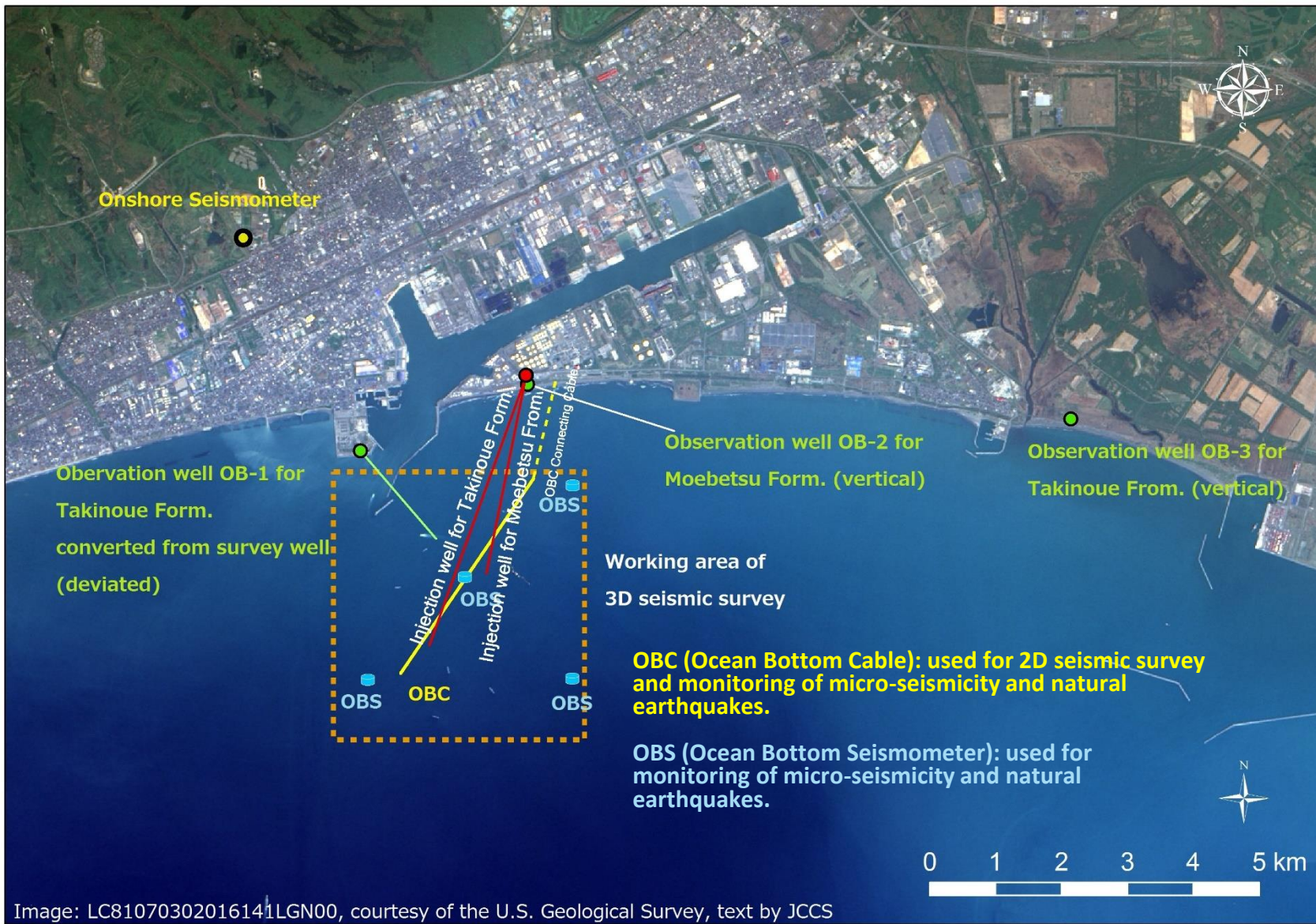
- Verification of onshore to offshore injection model
 - Lower drilling and maintenance costs
 - Securing public acceptance for offshore storage may be easier than onshore
 - Potentially smaller impact on environment in worst case leak scenario
 - Applicability to island nations

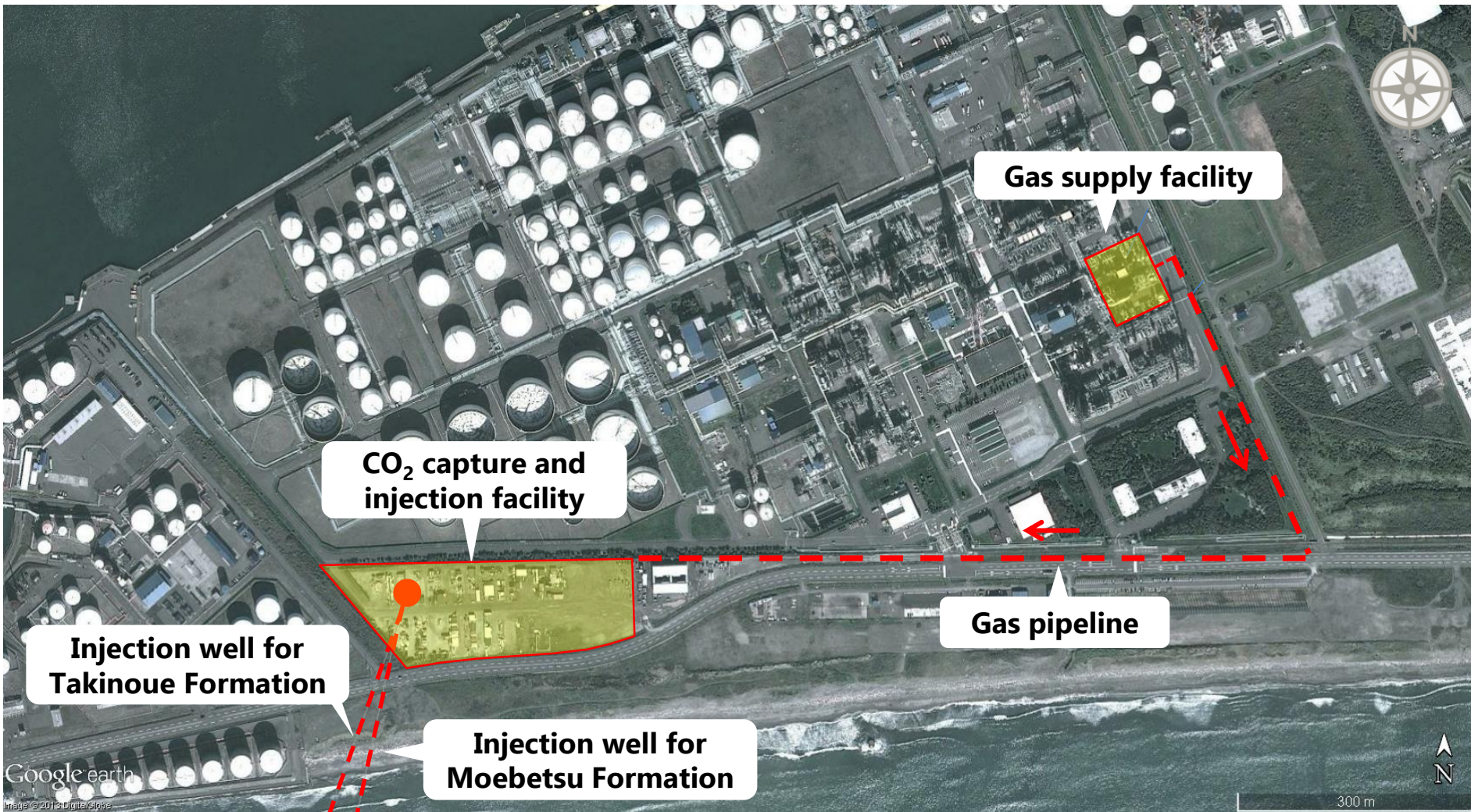
Main Features of Tomakomai CCS Project

- First full cycle CCS system deployed in Japan
- Two-stage CO₂ capture system providing for low energy consumption
- Deviated CO₂ injection wells drilled into offshore reservoirs from an onshore site.
- Injection interval length exceeding 1,100m to enhance injection efficiency
- Extensive monitoring system to address concerns about earthquakes
- CO₂ storage governed by Japanese law reflecting London 1996 Protocol
- First case of CCS near urban area requiring extensive stakeholder engagement



Positional Relation of Injection & Monitoring Systems

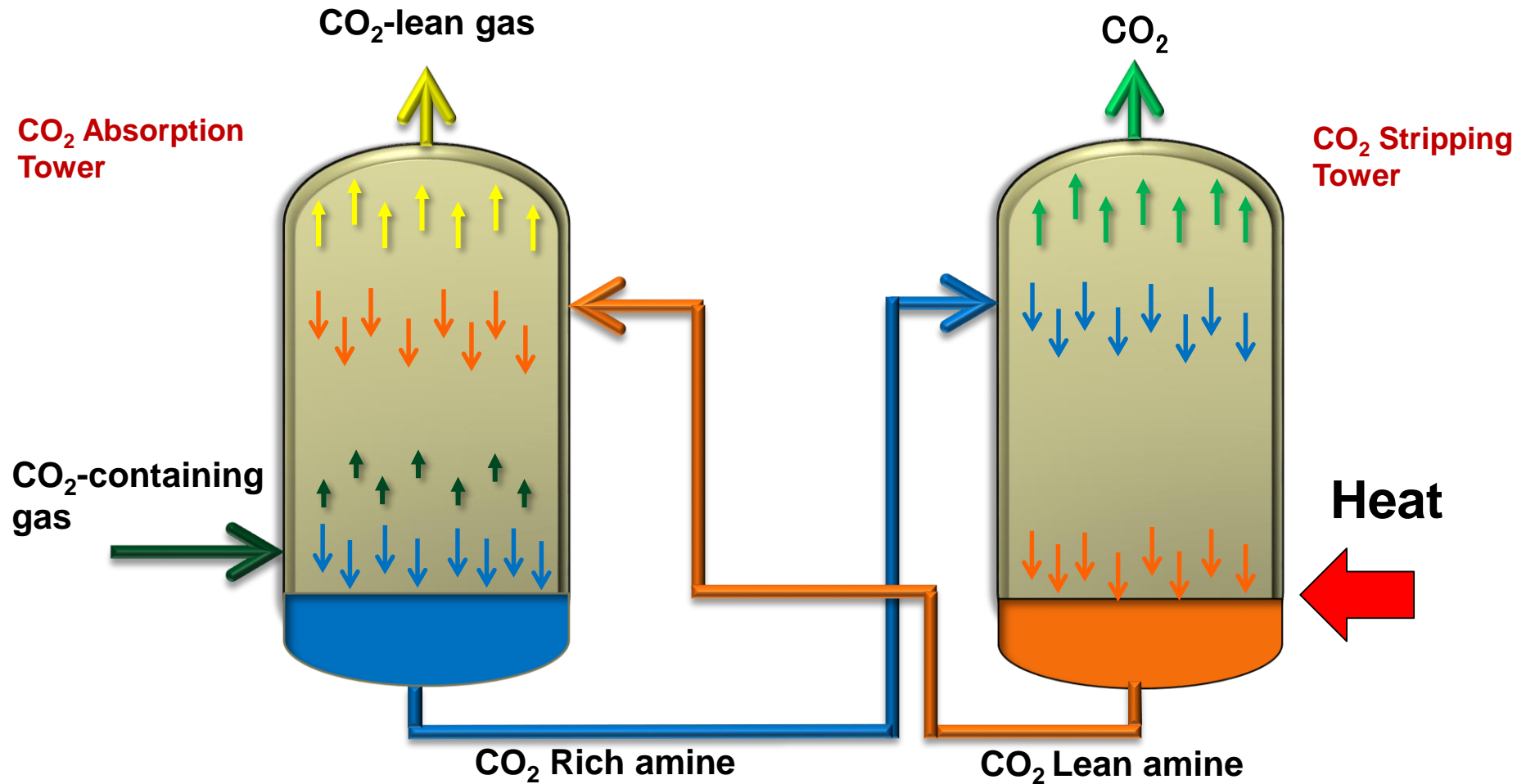




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Bird's Eye View of Capture and Injection Facilities¹¹

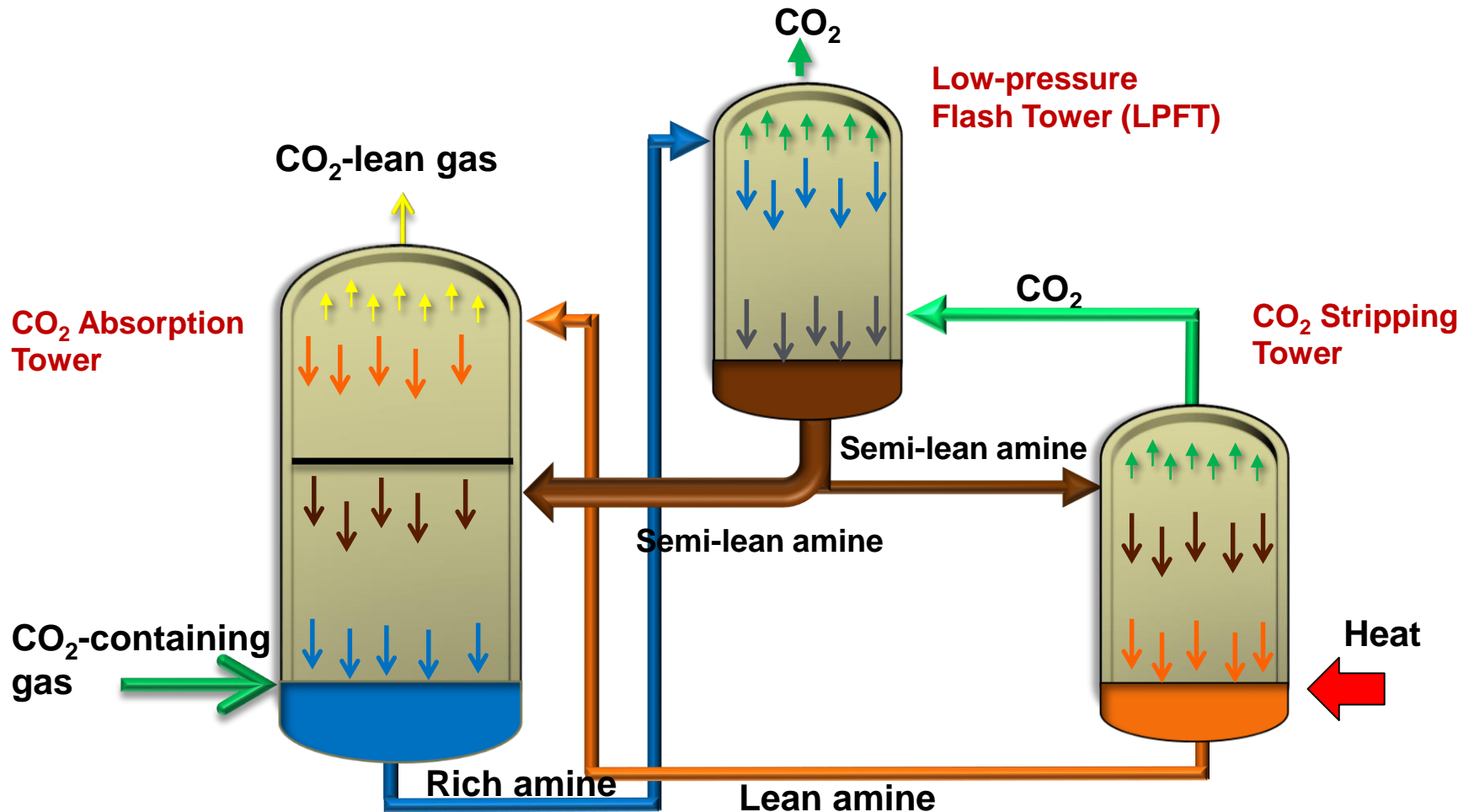




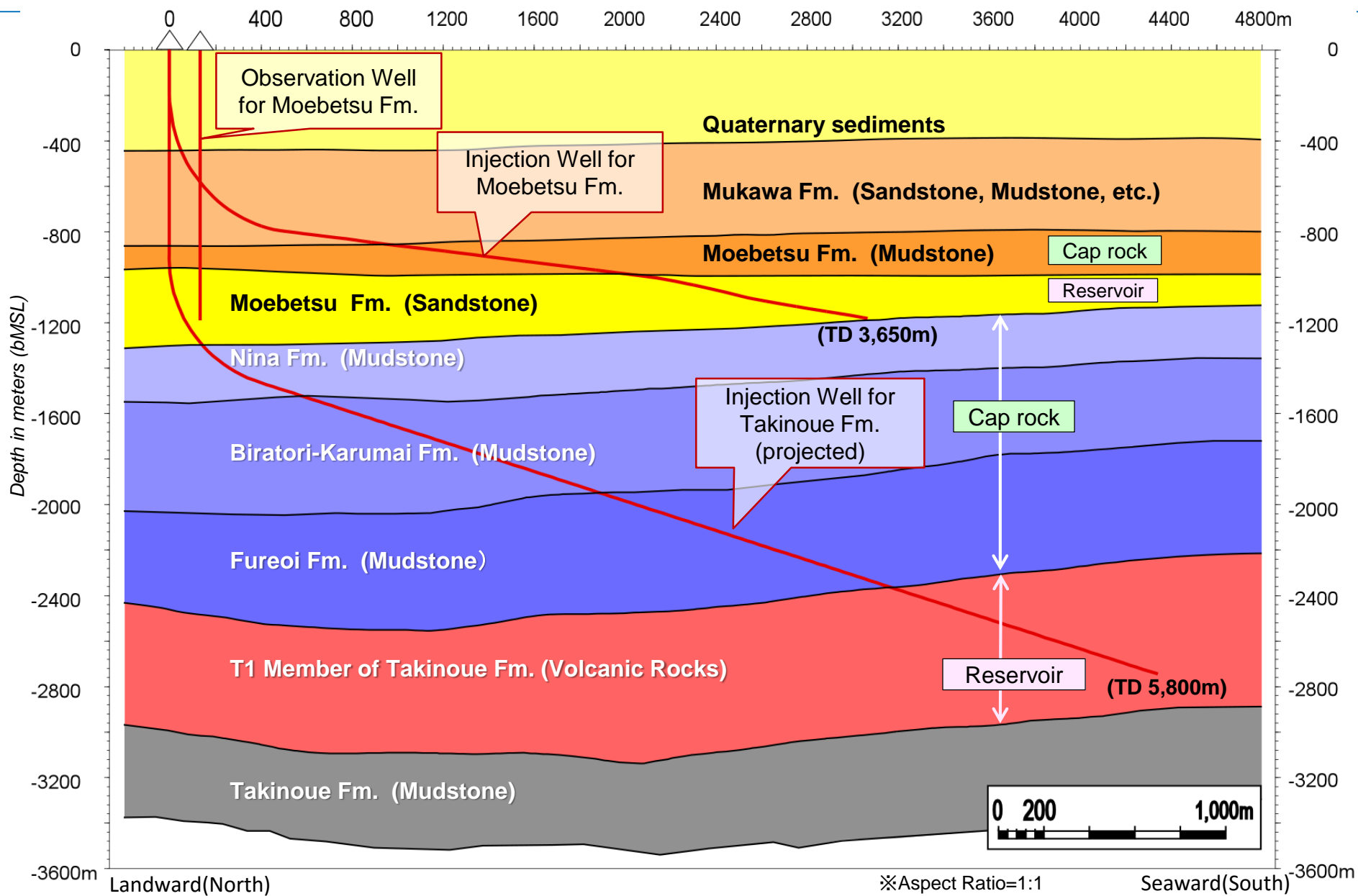
- In LPFT, CO₂ is stripped by depressurization; thermal energy of water vapor of CO₂ Stripping Tower is also utilized to strip CO₂
- Greater part of semi-lean amine from LPFT is returned to CO₂ Absorption Tower for CO₂ absorption; as only the remaining smaller portion is sent to CO₂ Stripping Tower, reboiler heat required can be reduced



If pressure of gas containing CO₂ and partial pressure of CO₂ are relatively high, amine reboiler heat consumption is only 1/3~1/2 of conventional capture process



Schematic Geological Section

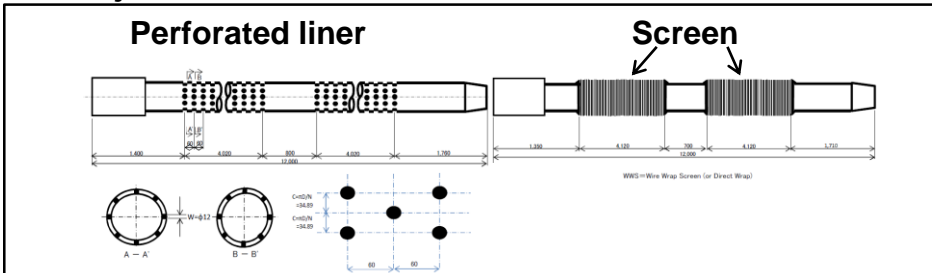
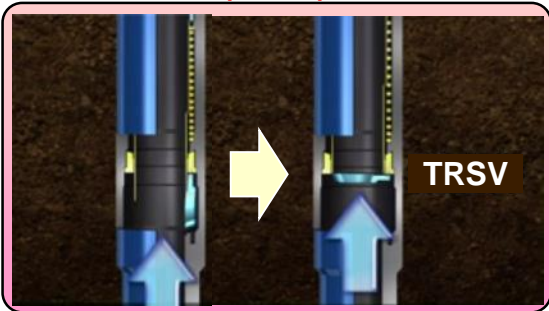
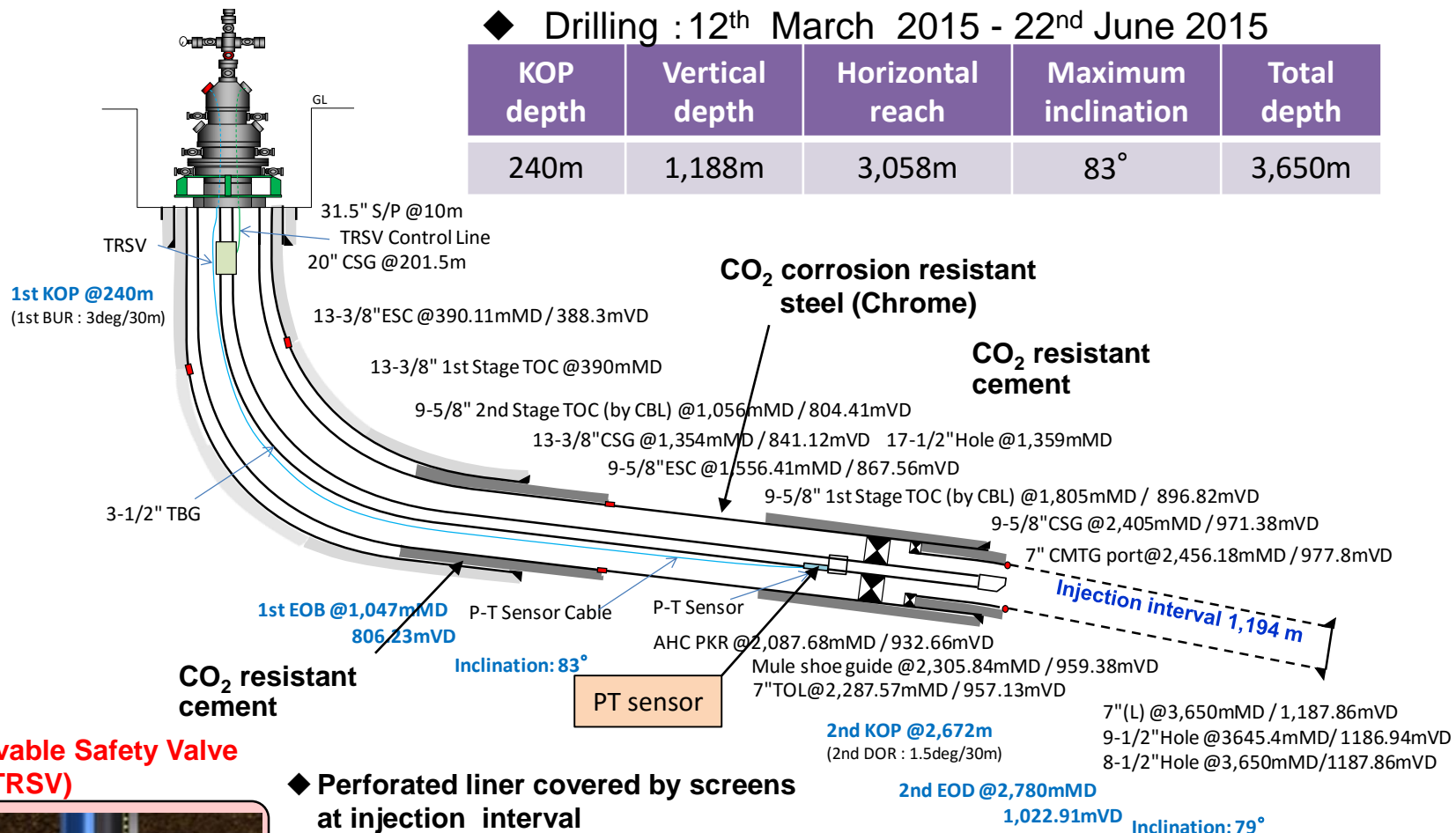


Injection well for Moebetsu Formation

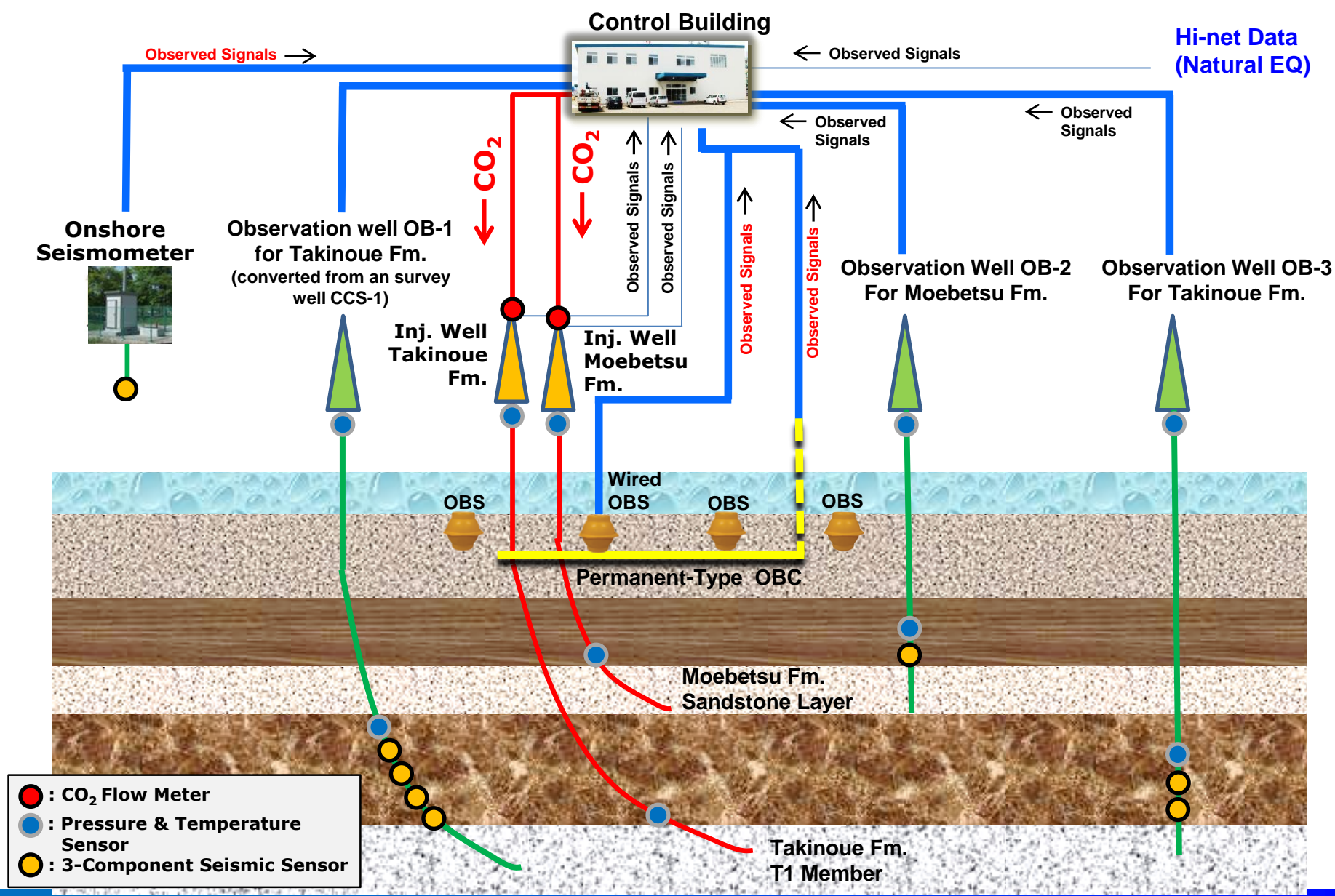
◆ Drilling : 12th March 2015 - 22nd June 2015

KOP depth	Vertical depth	Horizontal reach	Maximum inclination	Total depth
240m	1,188m	3,058m	83°	3,650m

Quaternary	464mMD 458mVD
Mukawa Fm	1,525mMD 864mVD
Moebetsu Fm (Mudstone)	2,395mMD 970mVD
Moebetsu Fm (Sandstone)	TD 3,650mMD 1,188mVD



Schematic Diagram of Monitoring System



Marine Environmental Survey

Marine environment shall be surveyed based on “**Act on Prevention of Marine Pollution and Maritime Disaster**” by which geological storage of CO₂ under the seabed is regulated.

1. Survey Area

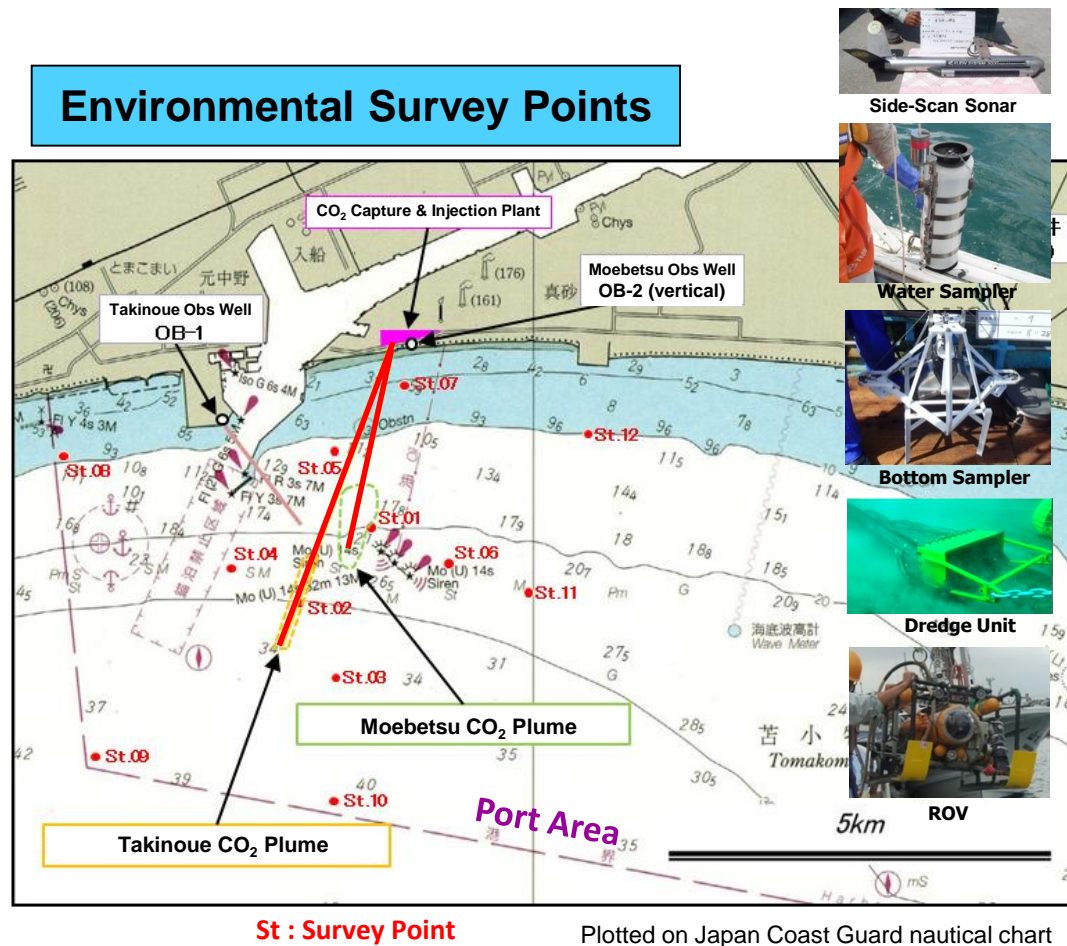
- 12 survey points in Tomakomai Port Area

2. Methods of Survey

- Seabed survey by Side-Scan Sonar and Sub-bottom Profiler
- Current direction and speed survey by Current Meter
- Sampling of seawater by Water Sampler for concentration of salt etc. and plankton observation
- Seabed mud survey by Bottom Sampler
- Collection of benthos by Net or Dredge Unit
- Observation of benthos by divers or ROV

3. Surveys in Three Stages

- During EPC period
- During demonstration operation
 - During CO₂ injection
 - After CO₂ injection
- After demonstration operation



Tomakomai CCS Promotion Association

2008 Establishment of Japan CCS
 2009 3D seismic survey offshore Tomakomai
 2010 **Establishment of Tomakomai CCS Promotion Association**
 2012 Commencement of Tomakomai CCS Demonstration Project

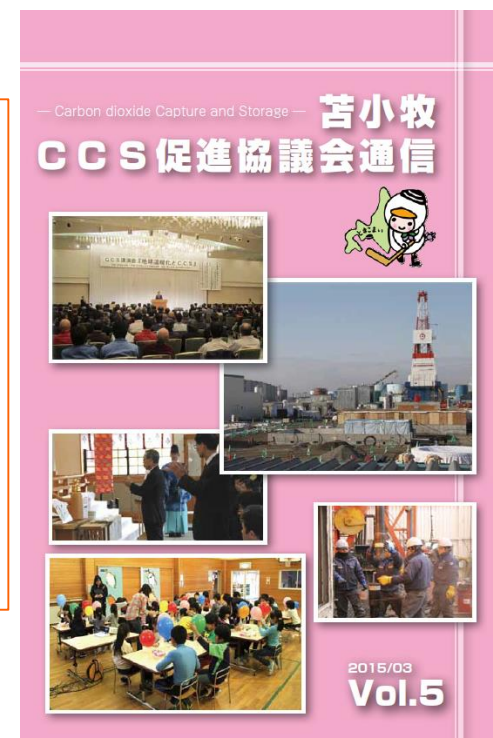
Tomakomai CCS Promotion Association

Activities : 1) Attraction of CCS Demonstration Project to Tomakomai
 2) Information communication to Tomakomai citizens on CCS, etc.

Chairman : **Tomakomai City Mayor**

Members : **All major corporations** in Tomakomai and industrial associations,
Tomakomai Fishery Cooperative

Secretariat : **Tomakomai City**



Annual publication



Construction site visit by members

Conclusion

- Full cycle CCS system from capture to storage is in operation; objective is to develop practical CCS technology by around 2020
 - Demonstrate safety and reliability of CCS system
 - Remove concerns about earthquakes
- Unique features of project
 - Efficient two-stage capture system
 - Deviated injection wells from onshore site into offshore reservoirs
 - Extensive monitoring system
- Test results indicate superior injectivity of shallow reservoir
- Extensive stakeholder engagement being undertaken
 - Maintaining close communications with Tomakomai fishery cooperative, local government

Thank you for your attention.

<http://www.japanccs.com/>

