# Tomakomai CCS Demonstration Project of Japan

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Japan CCS Co., Ltd.



JCCS

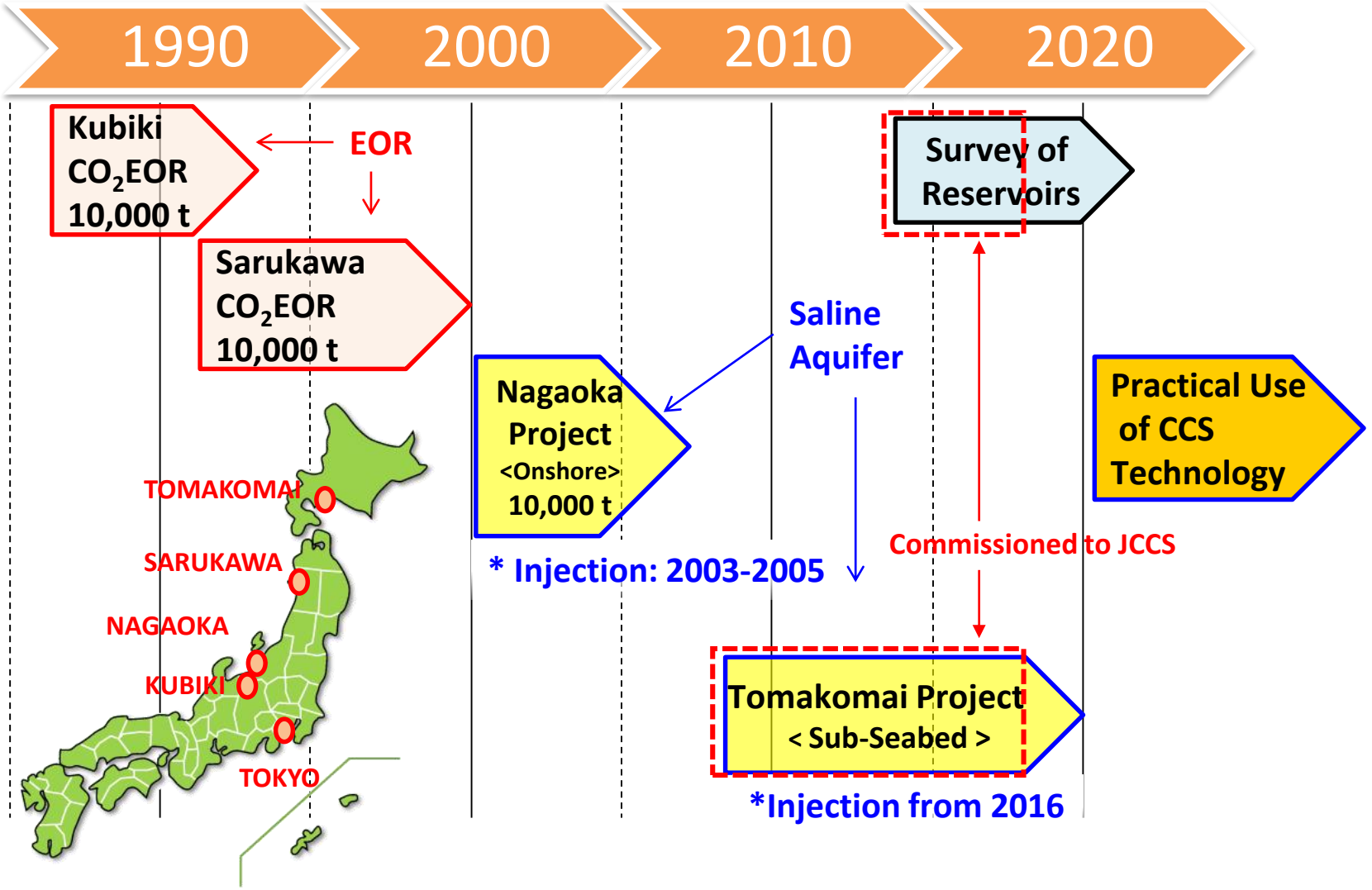
# Outline of Presentation

- **Overview of the Tomakomai Project and Capture Report**
- **Injection, Monitoring and Public Outreach**

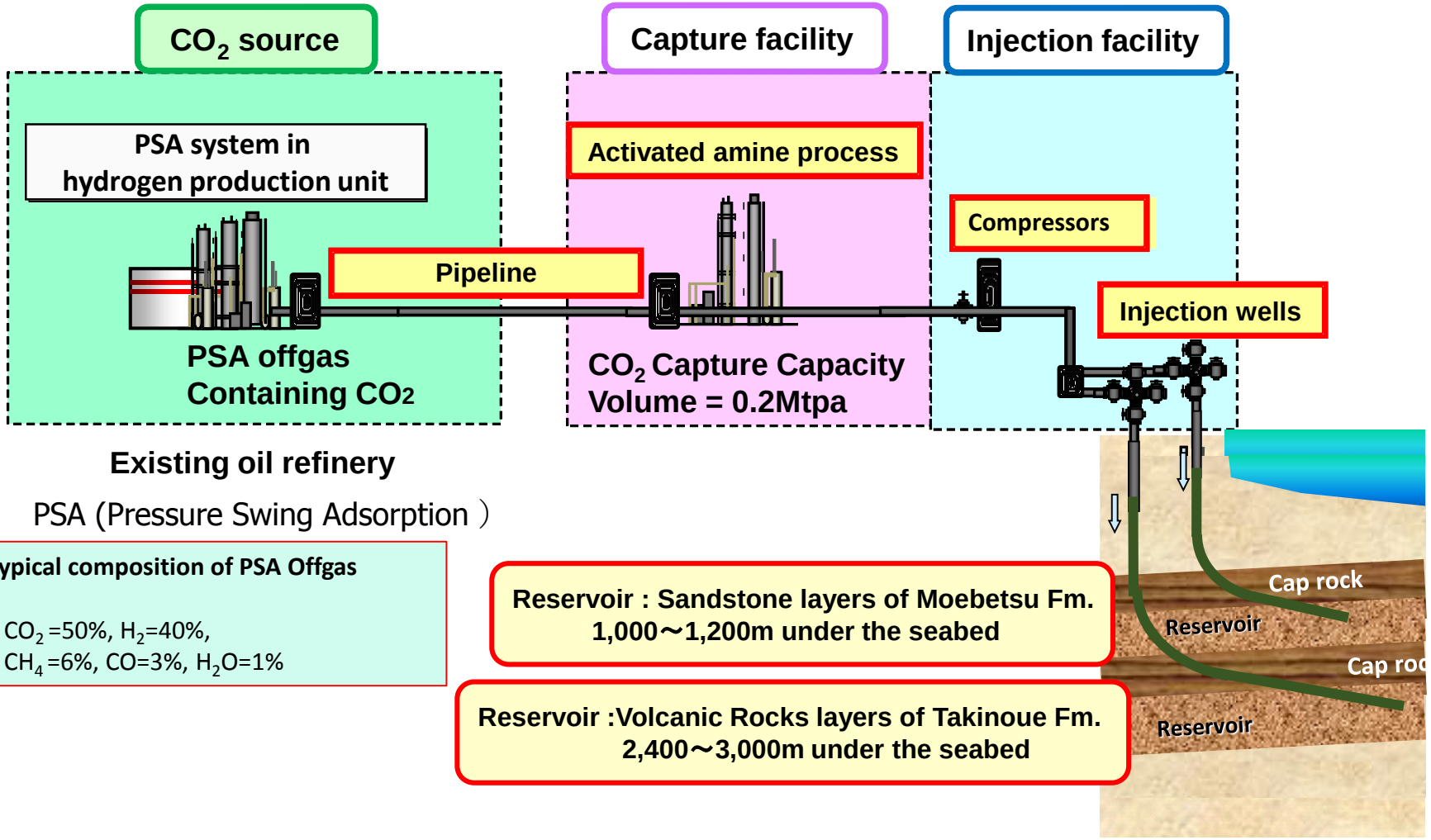
# Overview of the Tomakomai Project and Capture Report

# $CO_2$ Injection Projects in Japan

➢ Japan has promoted several $CO_2$ injection Projects.

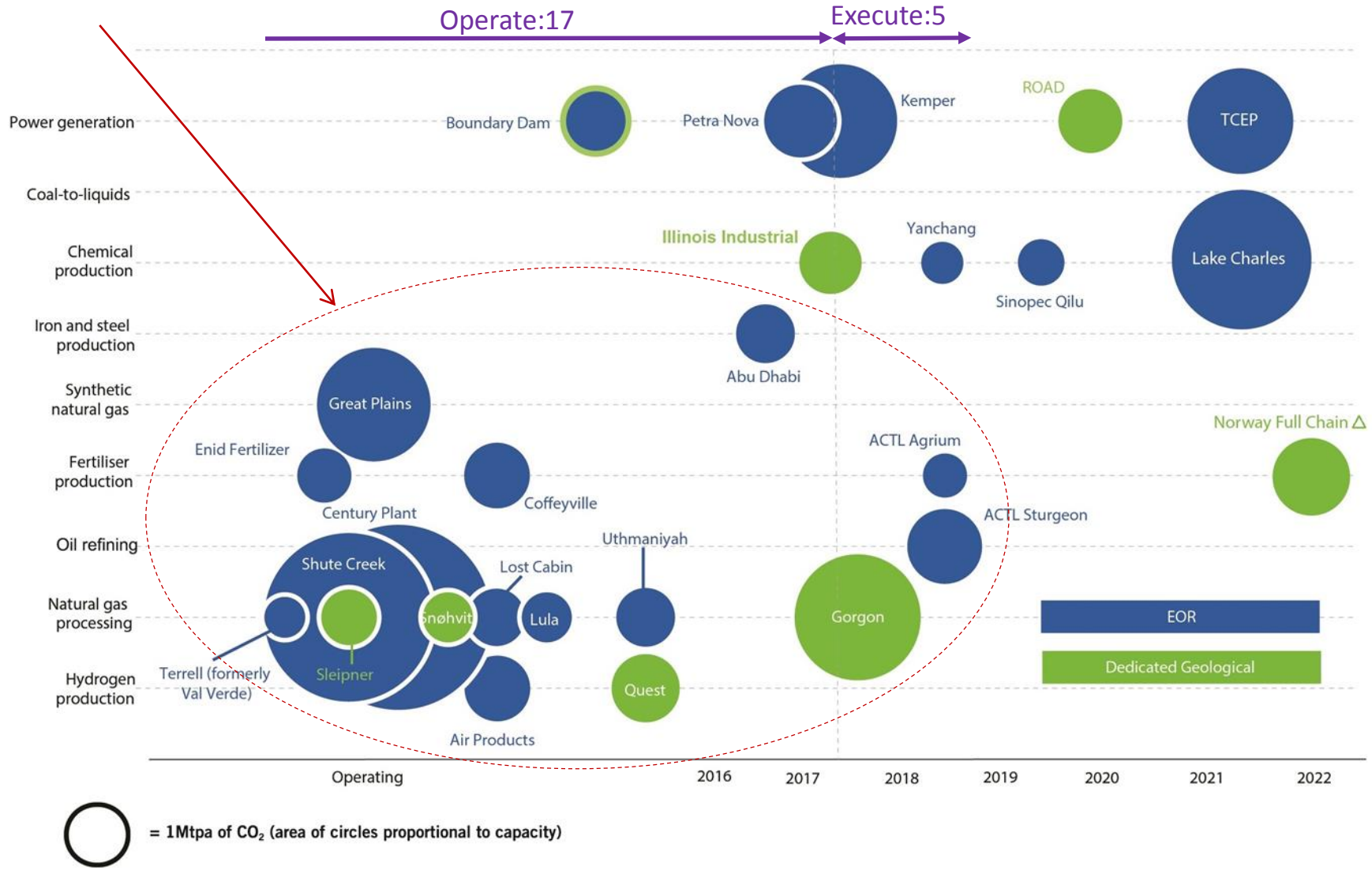


# Flow Scheme of CCS Demonstration Project



# World CCS Trend

Tomakomai Demonstration Project falls into “high pressure $CO_2$-containing gas with high $CO_2$ partial pressure” category.

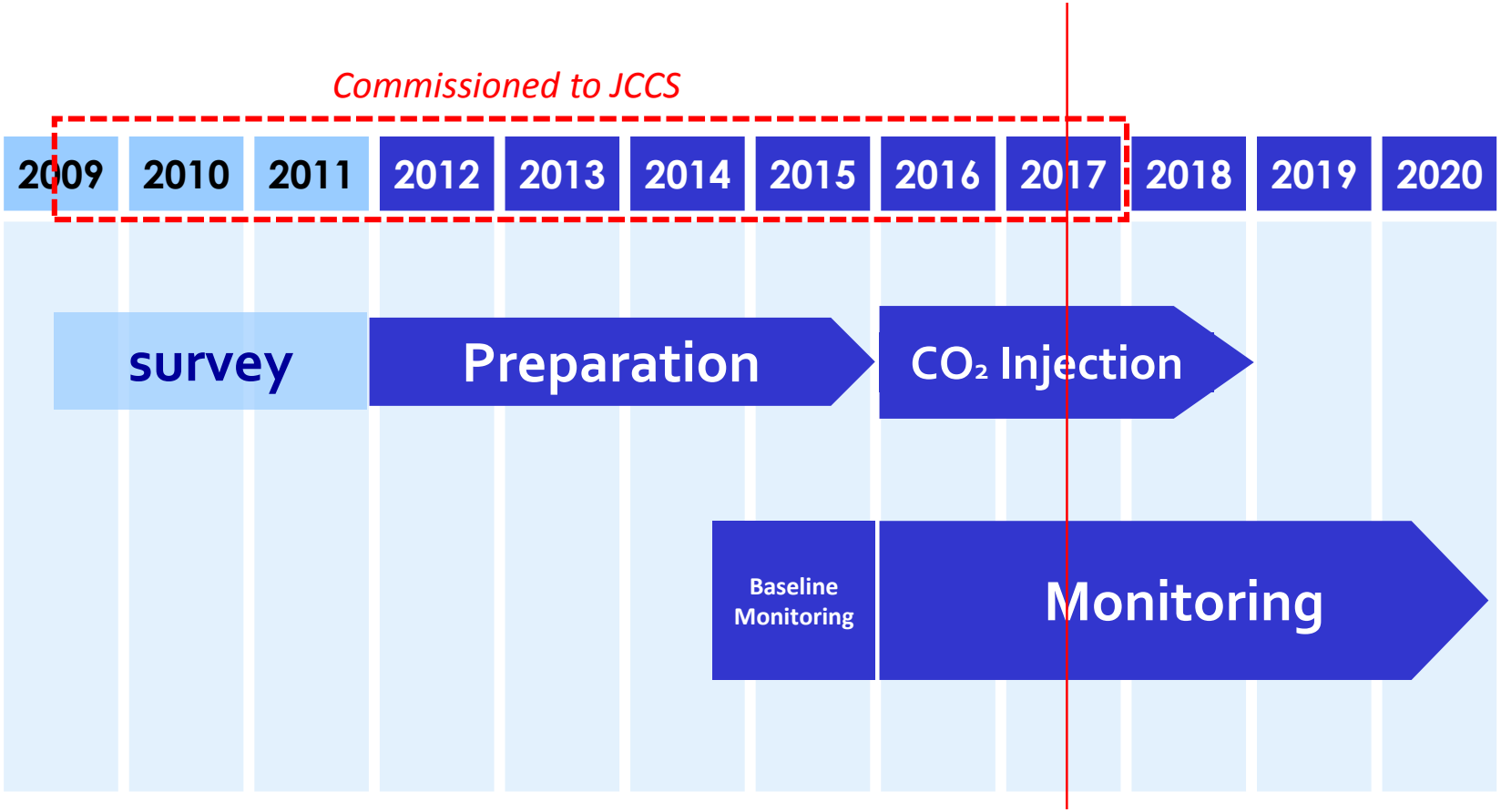



**Δ Feasibility studies assessed the possibility of $CO_2$ capture and storage from ammonia production, from cement production and from waste-to-energy sources**

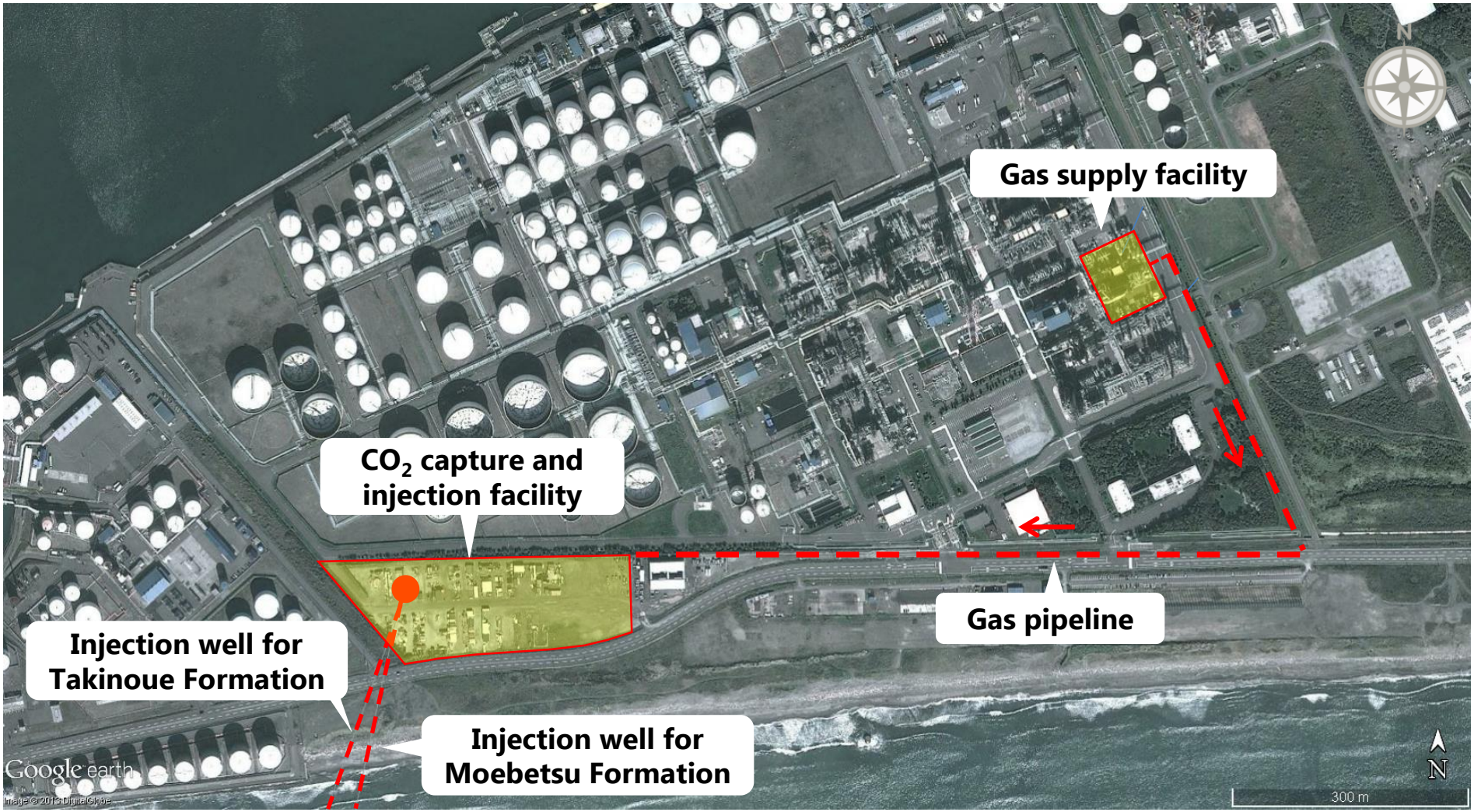
Source: GCCSI

Note in red and purple: added by JCCS

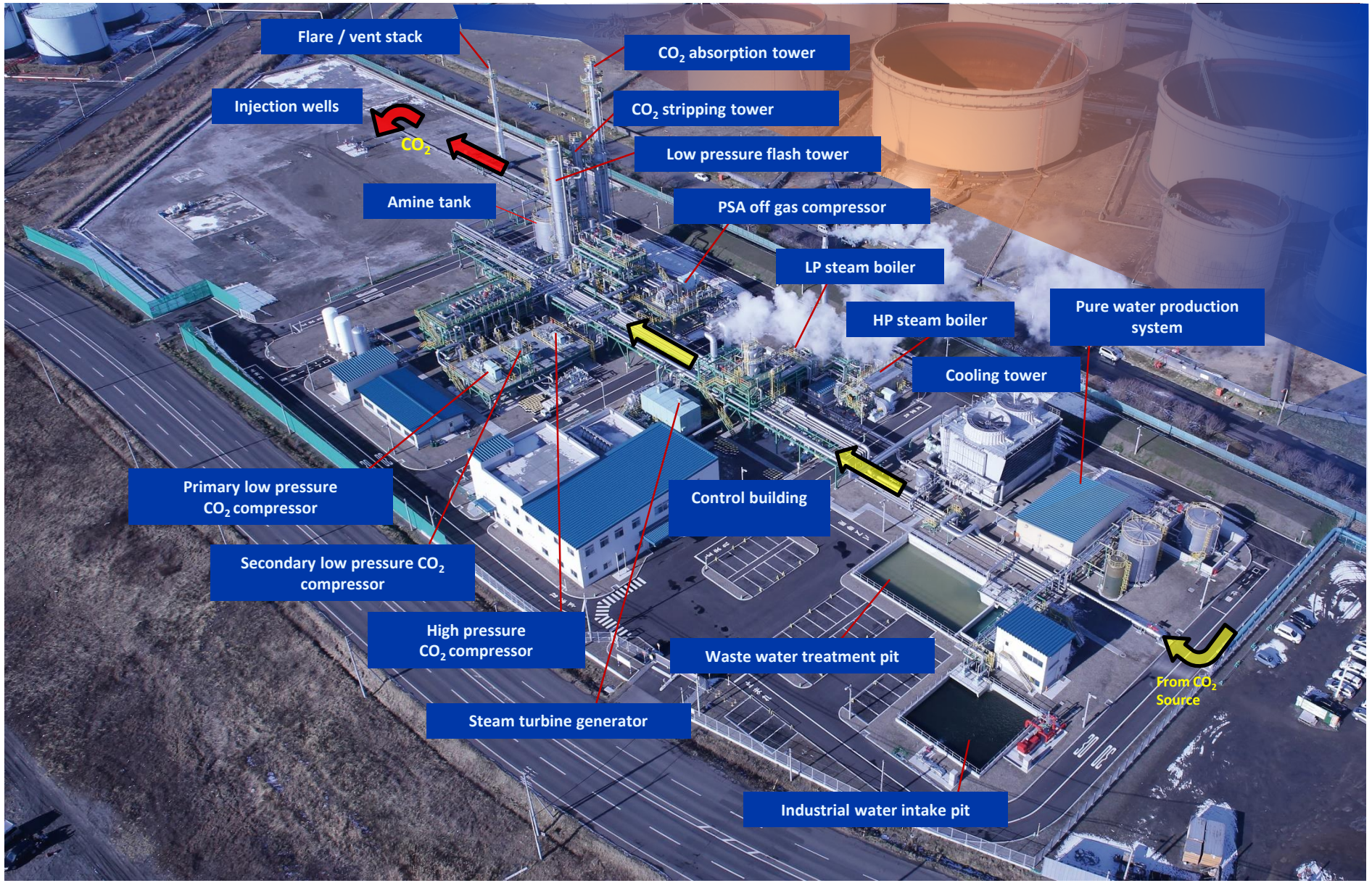
# Project Schedule



# Positional Relation of Onshore Facilities



# Aerial Photo of Capture and Injection Facilities



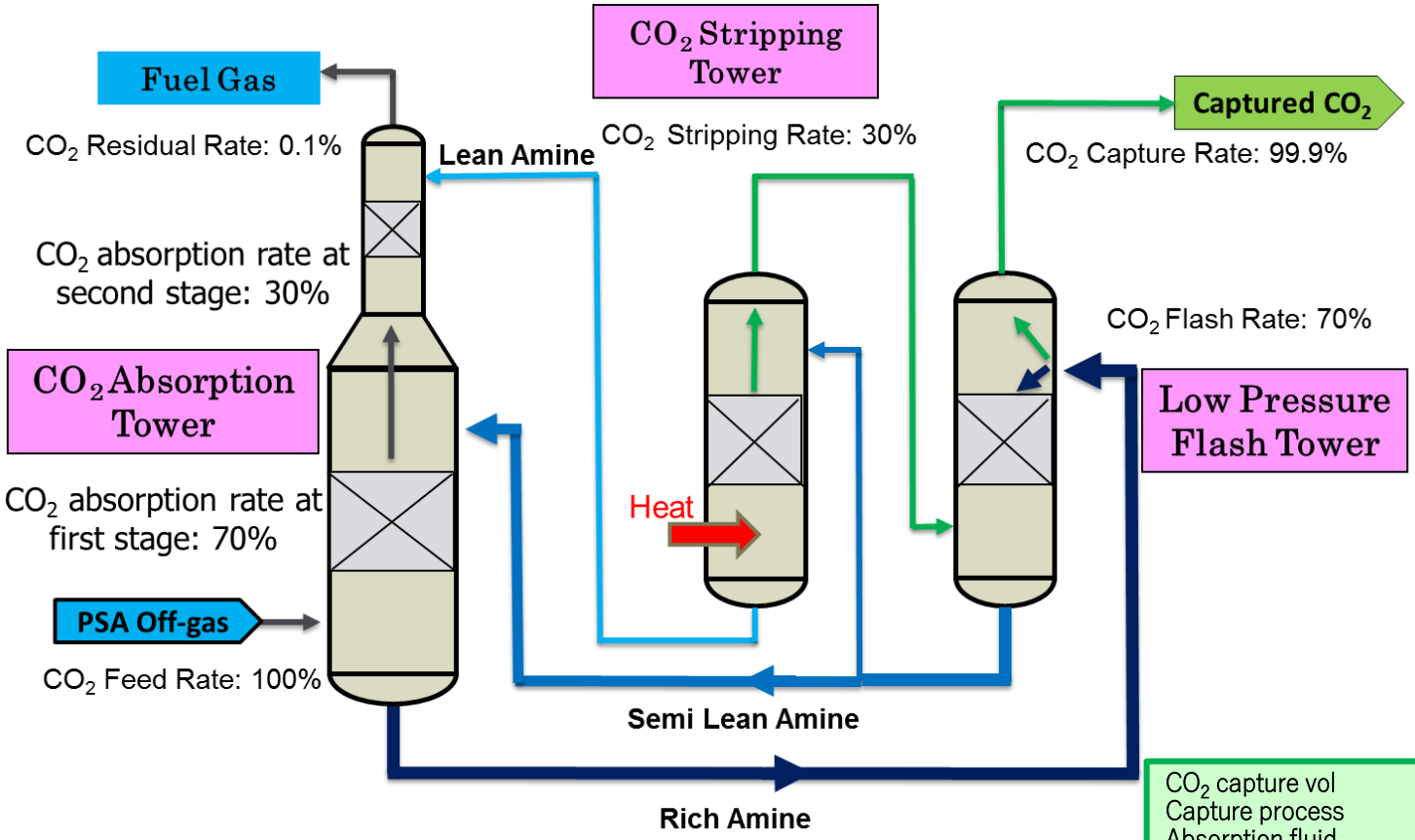
# $CO_2$ Capture Facilities and Compressors

# Control Room

DCS (Distributed Control Systems)

# Tomakomai $CO_2$ Capture Process

- In LPFT, $CO_2$ is stripped by depressurization; thermal energy of water vapor of $CO_2$ Stripping Tower is also utilized to strip $CO_2$
- Greater part of semi-lean amine from LPFT is returned to $CO_2$ Absorption Tower for $CO_2$ absorption; as only the remaining smaller portion is sent to $CO_2$ Stripping Tower, reboiler heat required can be reduced




| | | |
|---|---|---|
| $CO_2$ capture vol | : | 25.3 tonnes/hour (0.2Mtpa) |
| Capture process | : | 2-stage absorption + LPFT |
| Absorption fluid | : | Activated amine (BASF) |
| $CO_2$ purity | : | > 99% |
| $CO_2$ capture rate | : | > 99.9% |

# $CO_2$ Capture Energy

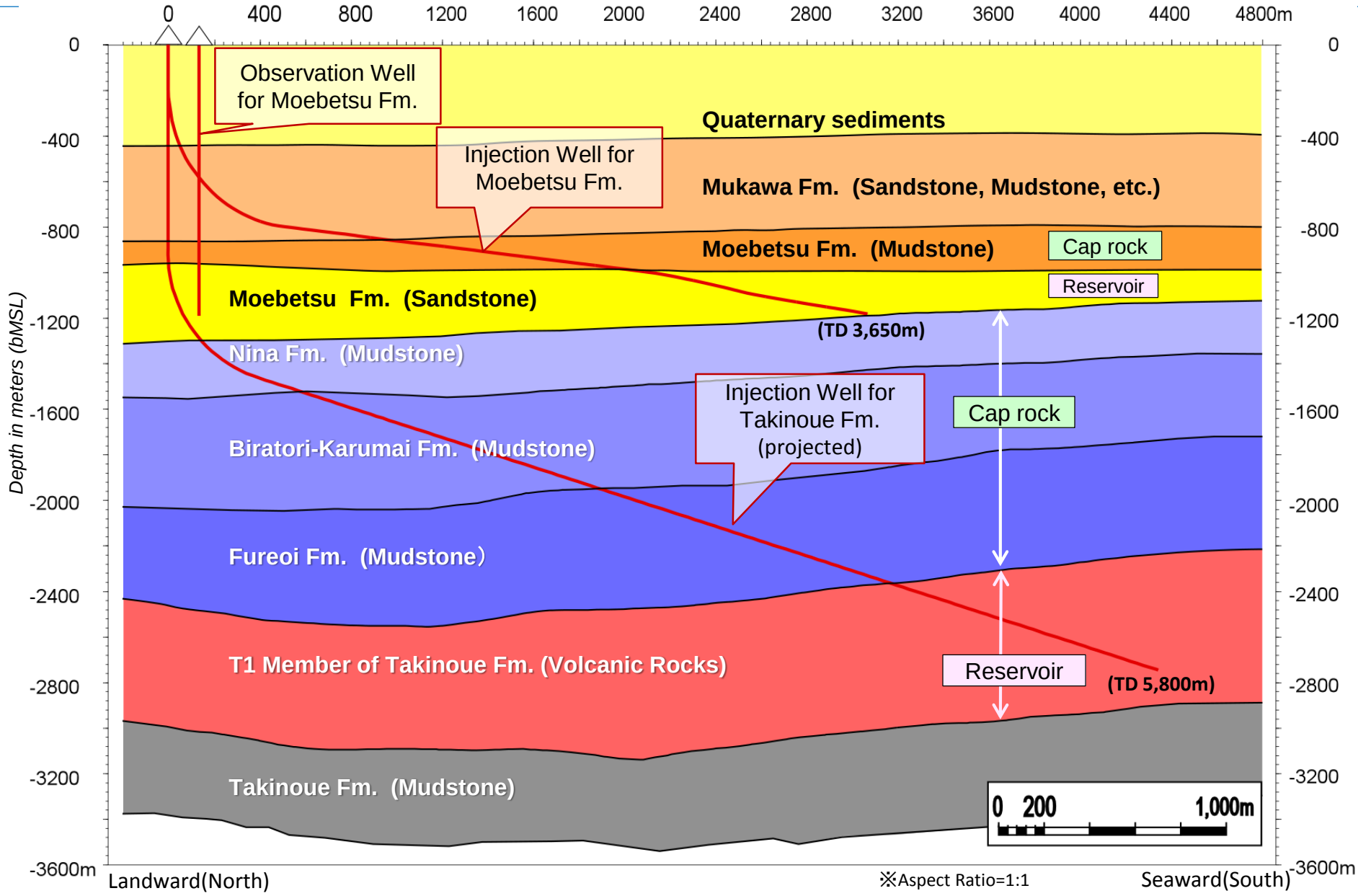
$CO_2$ capture energy (GJ/t-$CO_2$)
=heat energy + electric energy
where: heat energy =reboiler heat(steam) consumption(GJ/t-$CO_2$) / steam boiler efficiency
electric energy=pump electricity consumption(kWh/t-$CO_2$)
x electricity-heat conversion factor/ power generation efficiency
where: steam boiler efficiency=0.9
electricity-heat conversion factor=0.0036(GJ/kWh)
power generation efficiency=0.42(LHV)

Preliminary Figures

| | Max Load |
|---|---|
| Loading Factor 100%=25.3 t-$CO_2$/h | 100% |
| Heat energy (GJ/t-$CO_2$) | 1.03 |
| Electric energy (GJ/t-$CO_2$) | 0.17 |
| $CO_2$ capture energy (GJ/t-$CO_2$) | 1.20 |

# Injection, Monitoring and Public Outreach

# Schematic Geological Section



# Heads of Injection Wells

**Takinoue Injection Well**

**Moebetsu Injection Well**

**Prior to insulation**

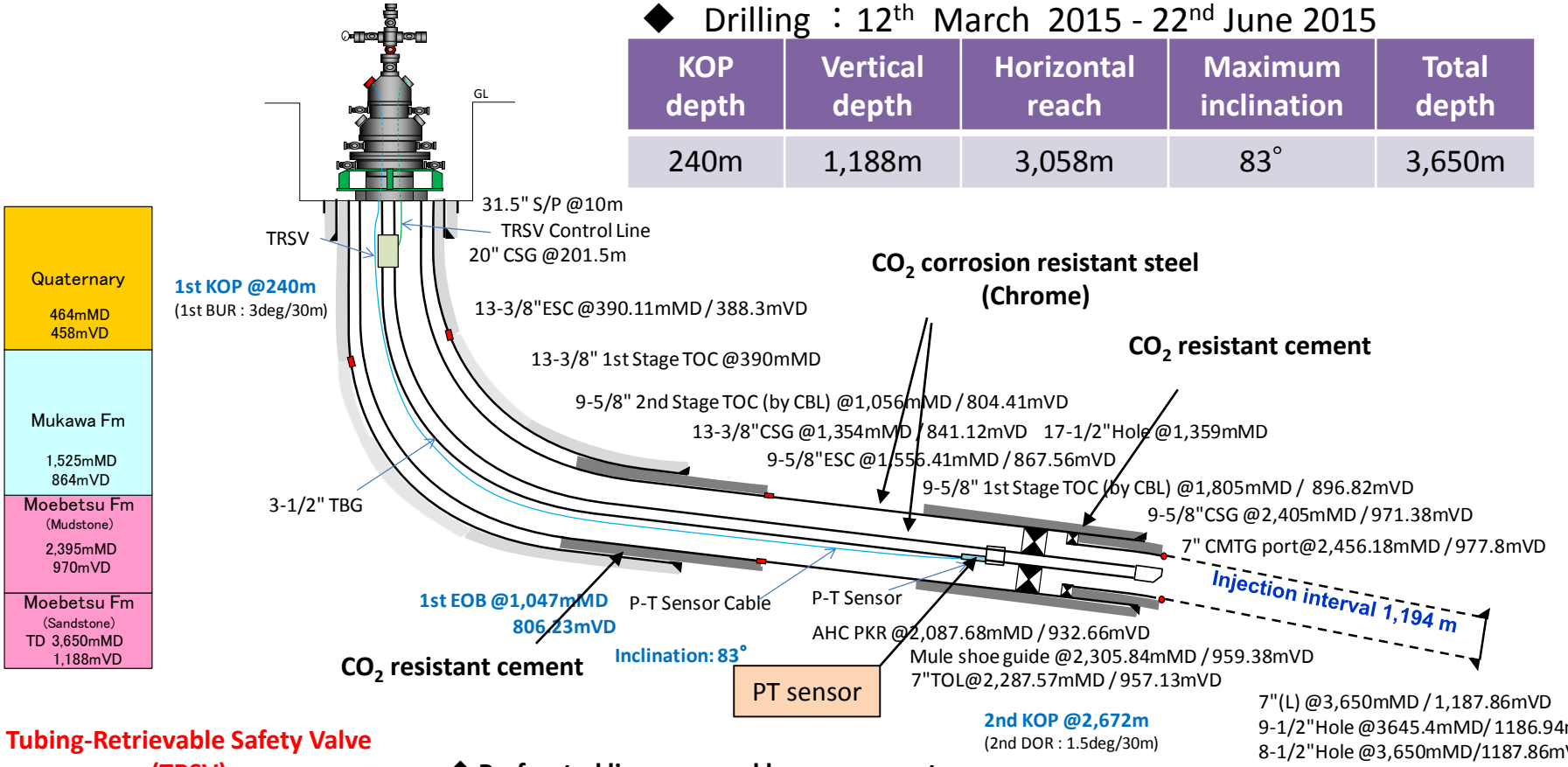
# Sea Surface Locations above Two Injection Points

Injection Points：
3km and 4km from sea coast

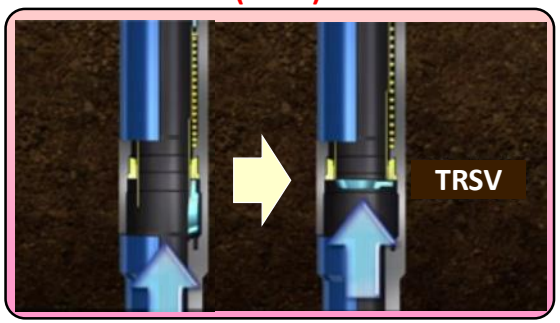
# Injection well for Moebetsu Formation

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

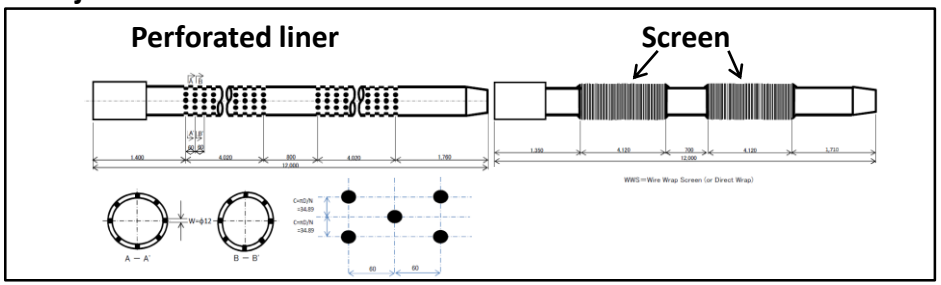
| KOP depth | Vertical depth | Horizontal reach | Maximum inclination | Total depth |
|---|---|---|---|---|
| 240m | 1,188m | 3,058m | 83° | 3,650m |



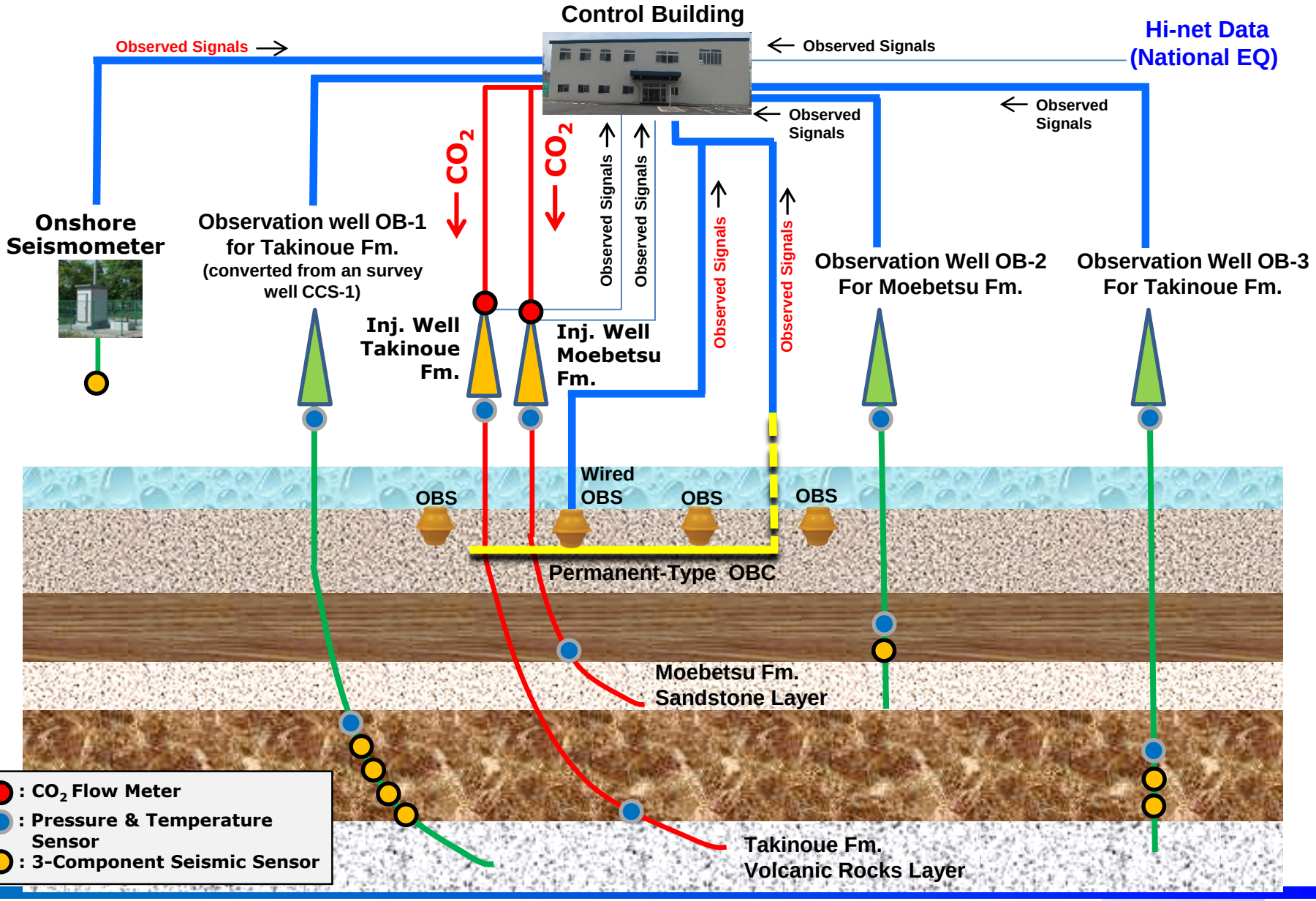

**Tubing-Retrievable Safety Valve (TRSV)**




◆ **Perforated liner covered by screens at injection interval**



# Conceptual 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 $CO_2$ under the seabed is regulated.

## 1. Survey Area

- 12 survey points in Tomakomai Port Area

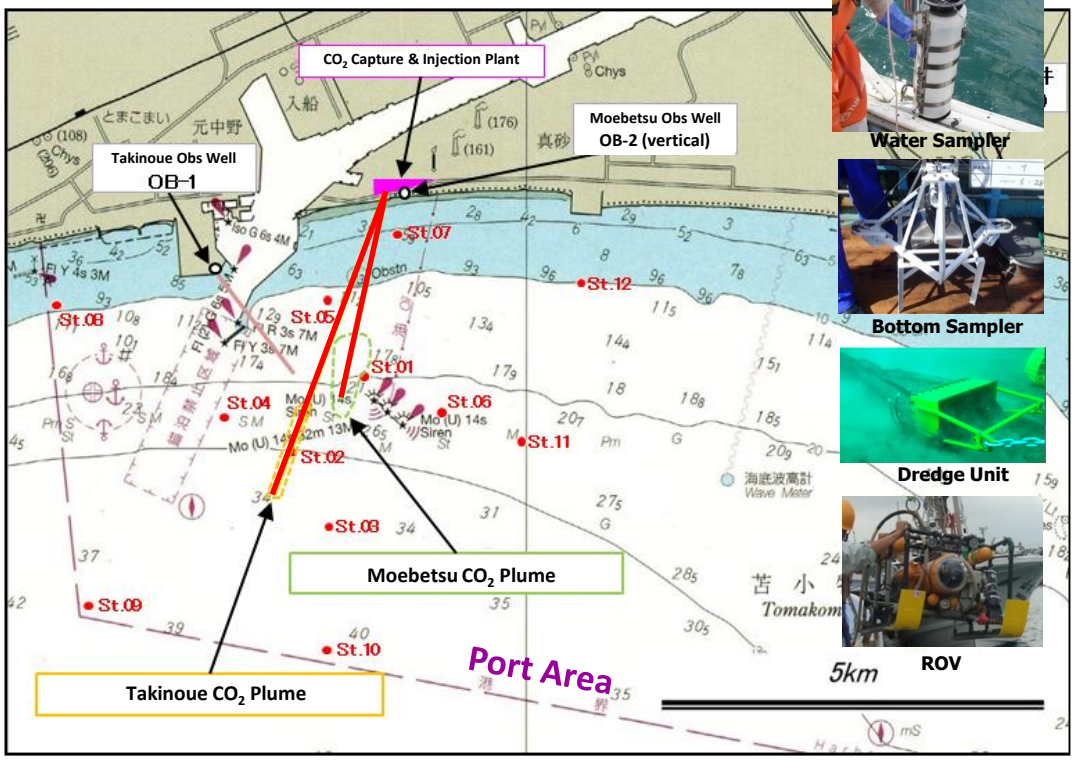
## 2. Methods of Survey

- 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 $CO_2$ injection
  - After $CO_2$ injection
- After demonstration operation

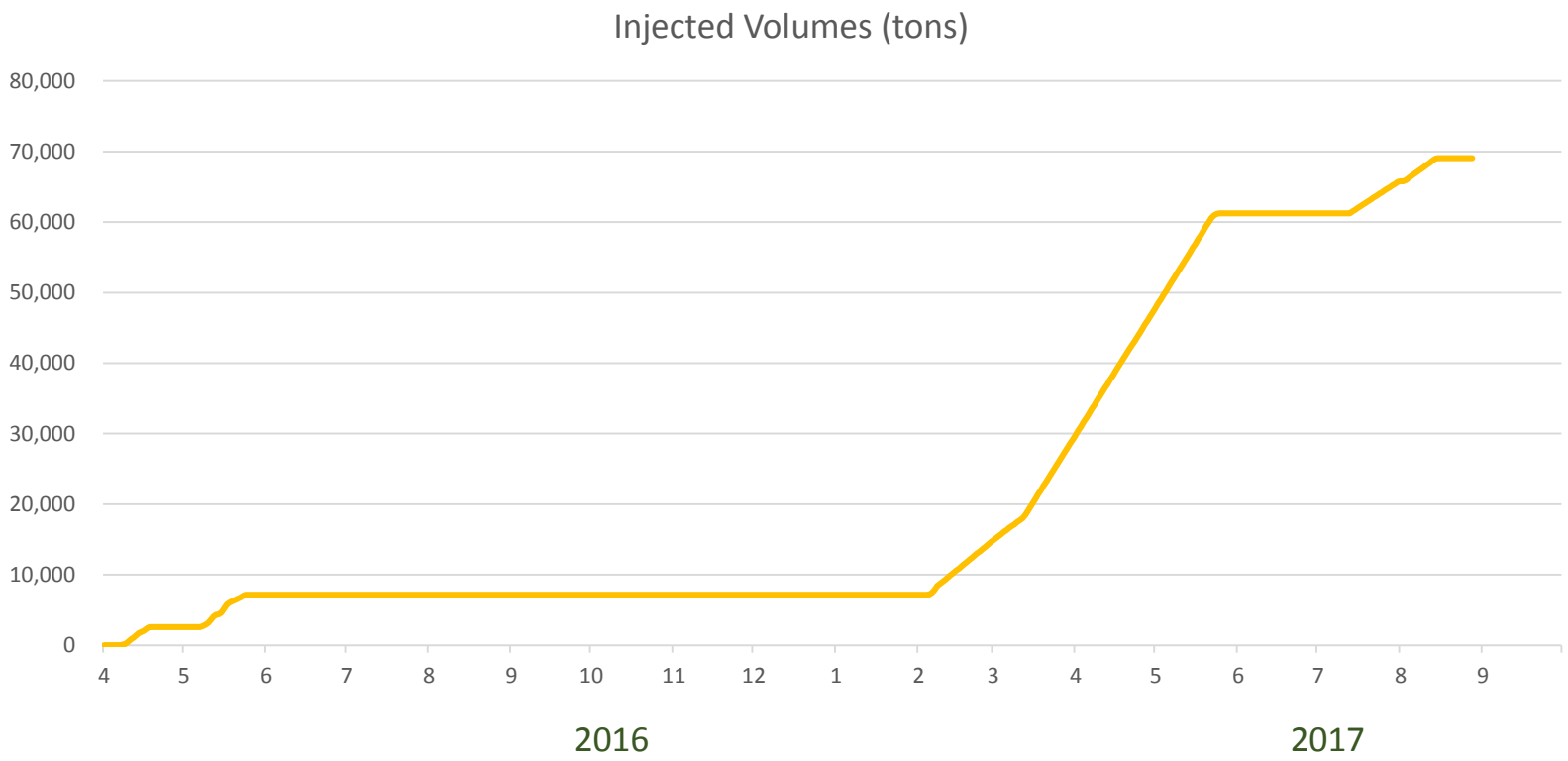
## Environmental Survey Points




St : Survey Point

Plotted on Japan Coast Guard nautical chart

# Injection Record




Note

1. Injection rate : 7.6~25.3 tons/hr (60,000~200,000 tons/year) , depends on the supply of $CO_2$ containing gas.
2. The bottom hole pressure was 9.2Mpa before injection and is 10Mpa during injection at the maximum injection rate.
3. The injection was stopped from June 2016 to July 2016 for the yearly maintenance of the oil refinery and CCS plant facilities.
4. The injection was stopped from August 2016 to February 2017 in order to conduct extra seawater surveys and to revise the marine environmental survey plan. After permission, the injection restarted on February 2017.

# Public Outreach Activities

## Public outreach is essential for CCS

Main results of a survey of Tomakomai citizens on CCS :

1.Information Disclosure
Thorough disclosure should be made.
Want to know more about CCS.
Need diligent and careful attention for local stakeholders.

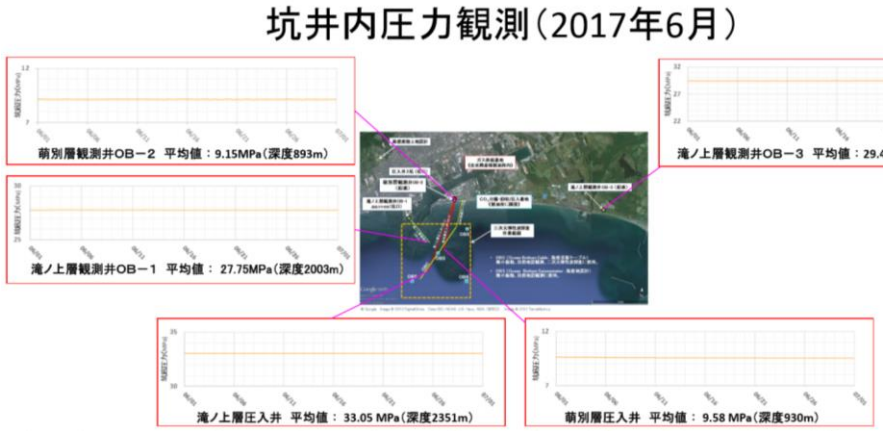
2.Safety
Need more information on the risk of $CO_2$ leakage.
Adequate attention should be paid to safety.

3.Dissemination to Young Generation
Participation of young generation in CCS forums is inadequate.
Information exchange events to encourage participation by young generation should be organized.

Our Public Outreach Activities

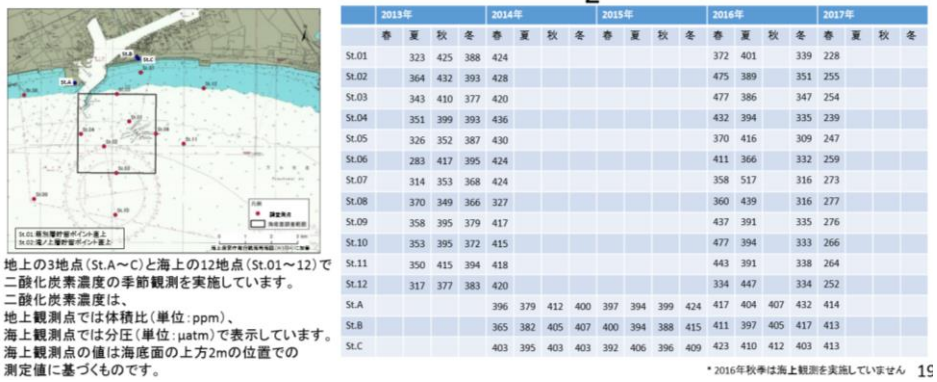
1.Released CCS DVD via website
2.Installed camera showing live construction site via website
3.Organizing panel exhibitions
4.Organizing annual CCS forums for citizens
5.Arranging site visits
6.Conducting lectures at universities
7.Arranging science classes for schoolchildren
8.Continuing information transmission through media
9.Disclosure of monitoring results of injection operations to citizens

# Information Disclosure on Website




**Bottom hole pressure in June, 2017**

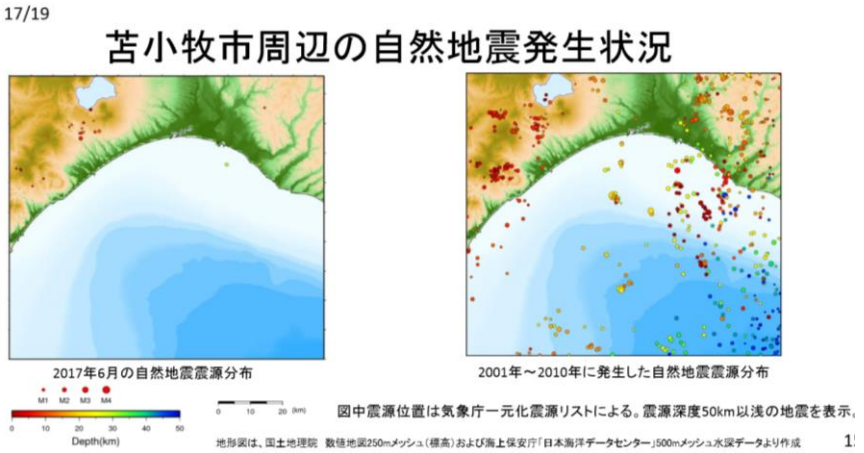
**$CO_2$ concentration of seawater in each season**




| | 2013年 | | | | 2014年 | | | | 2015年 | | | | 2016年 | | | | 2017年 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 春 | 夏 | 秋 | 冬 | 春 | 夏 | 秋 | 冬 | 春 | 夏 | 秋 | 冬 | 春 | 夏 | 秋 | 冬 | 春 | 夏 | 秋 | 冬 |
| St.01 | | 323 | 425 | 388 | 424 | | | | | | | | 372 | 401 | | 339 | 228 | | | |
| St.02 | | 364 | 432 | 393 | 428 | | | | | | | | 475 | 389 | | 351 | 255 | | | |
| St.03 | | 343 | 410 | 377 | 420 | | | | | | | | 477 | 386 | | 347 | 254 | | | |
| St.04 | | 351 | 399 | 393 | 436 | | | | | | | | 432 | 394 | | 335 | 239 | | | |
| St.05 | | 326 | 352 | 387 | 430 | | | | | | | | 370 | 416 | | 309 | 247 | | | |
| St.06 | | 283 | 417 | 395 | 424 | | | | | | | | 411 | 366 | | 332 | 259 | | | |
| St.07 | | 314 | 353 | 368 | 424 | | | | | | | | 358 | 517 | | 316 | 273 | | | |
| St.08 | | 370 | 349 | 366 | 327 | | | | | | | | 360 | 439 | | 316 | 277 | | | |
| St.09 | | 358 | 395 | 379 | 417 | | | | | | | | 437 | 391 | | 335 | 276 | | | |
| St.10 | | 353 | 395 | 372 | 415 | | | | | | | | 477 | 394 | | 333 | 266 | | | |
| St.11 | | 350 | 415 | 394 | 418 | | | | | | | | 443 | 391 | | 338 | 264 | | | |
| St.12 | | 317 | 377 | 383 | 420 | | | | | | | | 334 | 447 | | 334 | 252 | | | |
| St.A | | | | | 396 | 379 | 412 | 400 | 397 | 394 | 399 | 424 | 417 | 404 | 407 | 432 | 414 | | | |
| St.B | | | | | 365 | 382 | 405 | 407 | 400 | 394 | 388 | 415 | 411 | 397 | 405 | 417 | 413 | | | |
| St.C | | | | | 403 | 395 | 403 | 403 | 392 | 406 | 396 | 409 | 423 | 410 | 412 | 403 | 413 | | | |

**Location of the epicenter and magnitude of earthquakes near Tomakomai**

**June, 2017** **2001~2010**



# Numbers of Visitors to Tomakomai CCS Demonstration Center

# Public Outreach Activities in 2016

① **Panel Exhibitions:** 5 times in Sapporo, Tomakomai and neighboring towns

② **Site Visits:** total number of visitors: 2,013 (154 groups) from universities, research associations, local government, etc.

③ **Environmental Exhibitions:** “Eco-Pro* 2016”, “2016 Global Warming Prevention Exhibition” in Tokyo

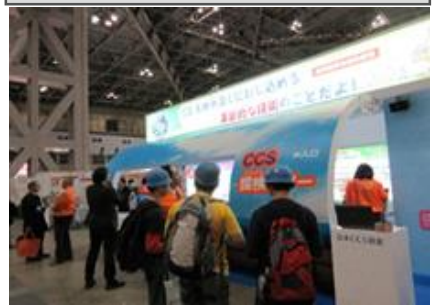
④ **Kids Science Rooms:** games and experiments to learn about global warming, $CO_2$ and CCS (total of 2 times in Tomakomai)

⑤ **CCS Forum:** March 4, 2017 in Tomakomai (attendance: 312)

① Panel Exhibitions

② Site Visits

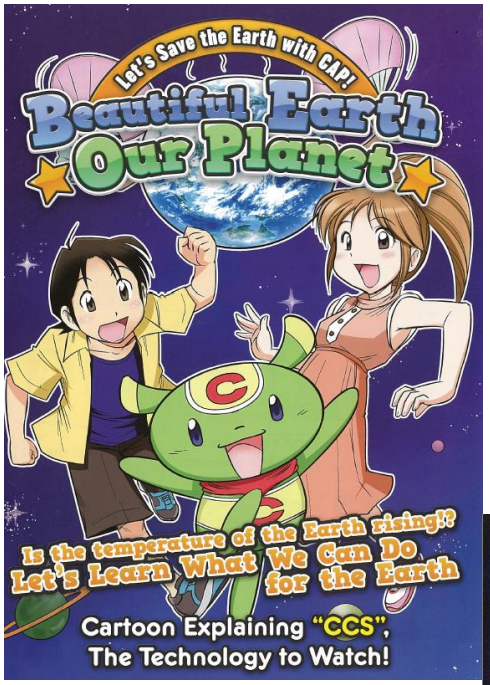
③ Env. Exhibitions



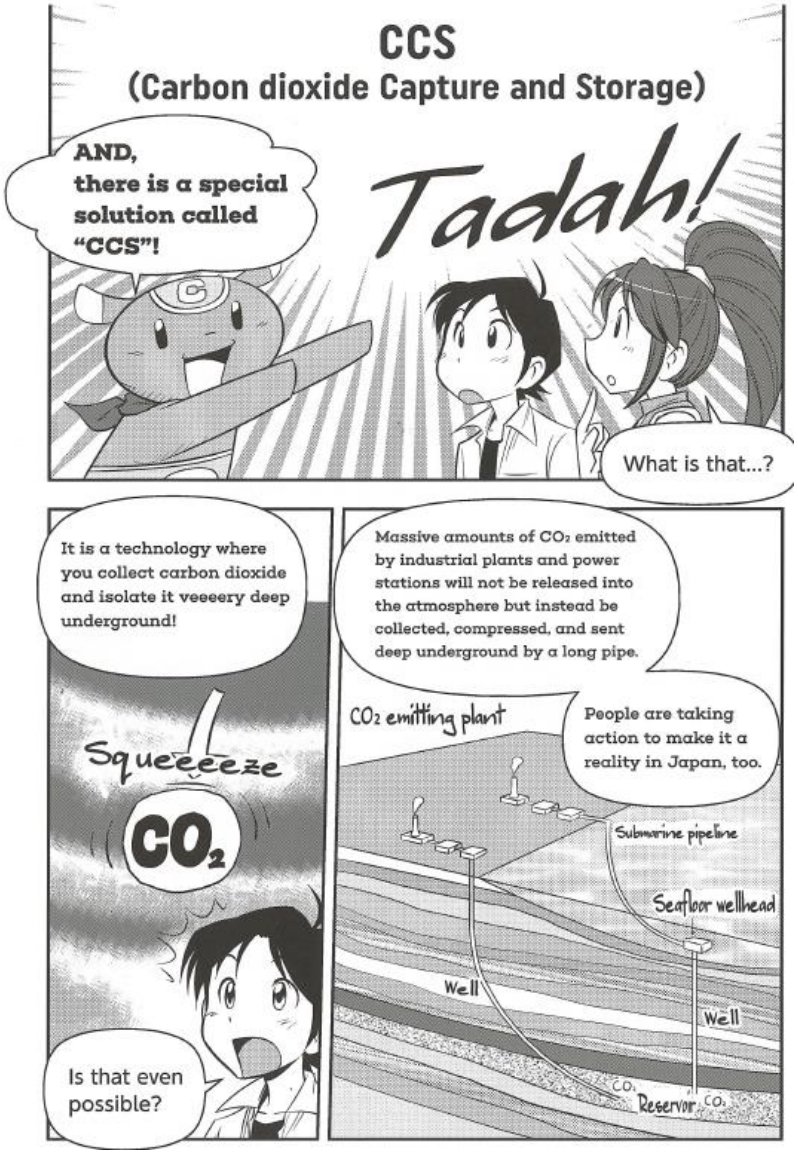
④ Kids Science Rooms

⑤ CCS Forum


# Comics for Young Generation







# Project Summary

- 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
  - Energy efficient two-stage $CO_2$ capture system
  - Deviated injection wells from onshore site into offshore reservoirs with elongated injection interval
  - Extensive monitoring system
- Extensive stakeholder engagement
  - Maintaining close communications with Tomakomai fishery cooperative, local government
- JCCS conducts international activities for knowledge sharing of CCS worldwide

# JCCS Company Profile and CCS Project Framework

## Company Profile

**Date of Incorporation: May 26, 2008**

**Business Description:**
**Implementation of CCS demonstration project and investigation for potential storage sites in Japan**

**Capital: 243 MM JPY**

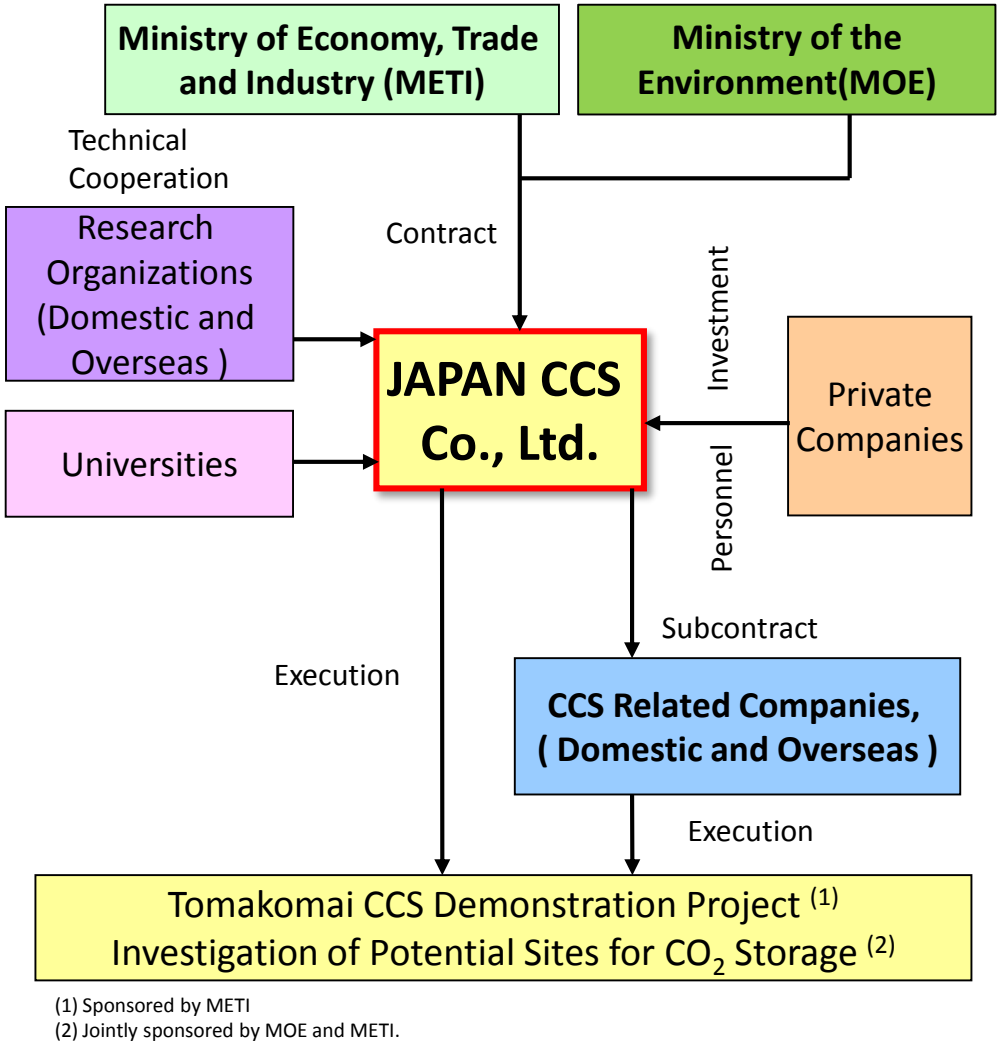
**Shareholders: 35 companies**
**11 electric power, 5 engineering, 4 petroleum, 3 petroleum resource developing, 4 general trading, 2 iron and steel, 2 city gas, 1 chemical, 1 non-ferrous metal and cement, 1 steel pipe, 1 special trading**

**President: Shoichi Ishii, JAPEX**

**Directors: 8 representing the shareholders' industries**

**No. of Staff: approx. 100**

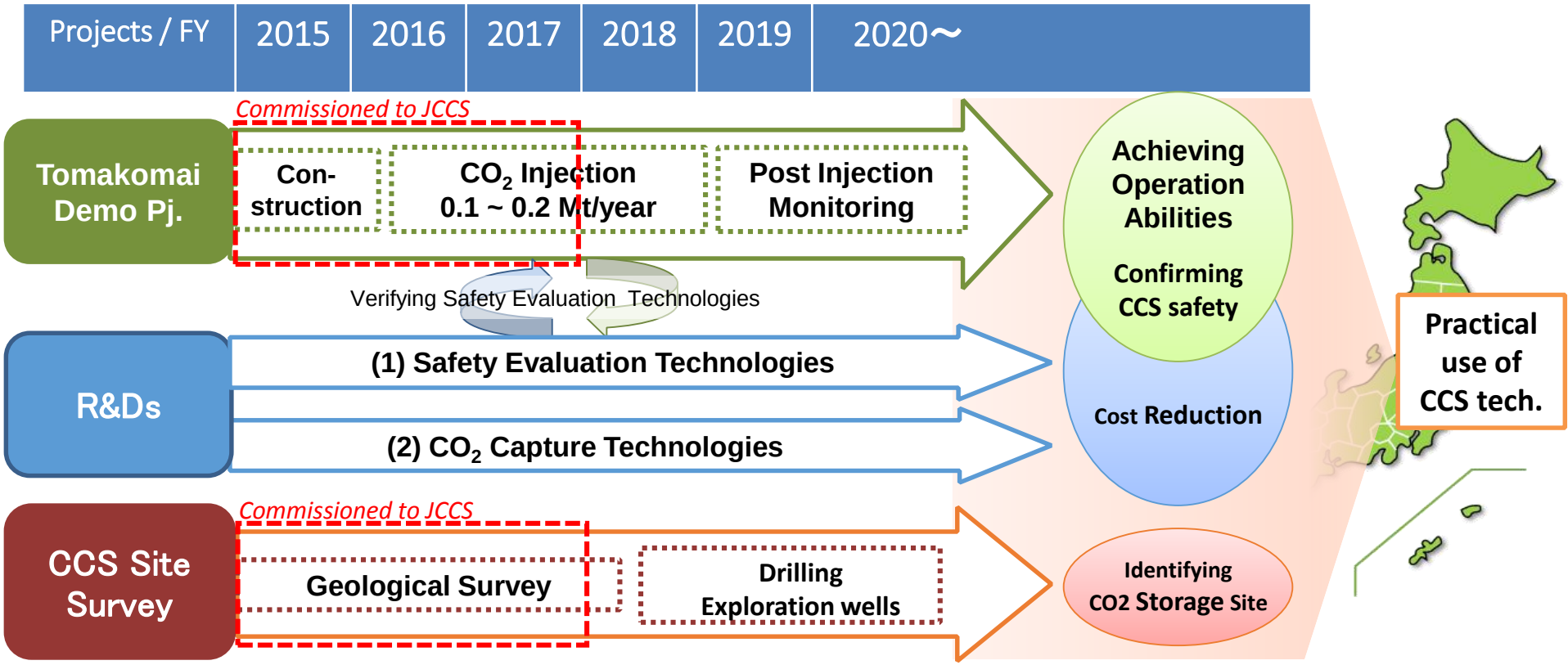
## Project Framework - Functions of JCCS




(1) Sponsored by METI
(2) Jointly sponsored by MOE and METI.

# Overview of CCS Project in Japan

- Aiming at the practical use of CCS technology around 2020, METI conducts Tomakomai Demonstration Project, R&D projects of elemental technologies for CCS, and survey for potential CO2 storage site.




Source: METI; notes added by JCCS

# CCS Site Survey Project

- It is necessary to identify CO2 storage sites for CCS deployment in Japan.
- Target : Specifying at least 3 sites by 2021 through seismic & drilling exploration.

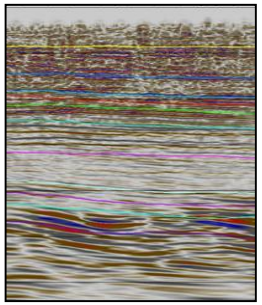
*Commissioned to JCCS*

| Year | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 ～ |
|---|---|---|---|---|---|---|---|

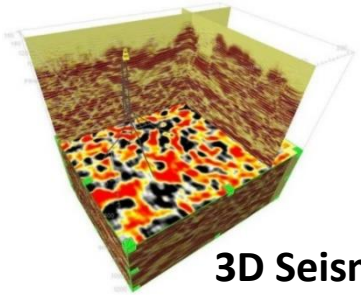
**Investigation on Potential $CO_2$ Storage Site and Capabilities**

**2D Seismic Survey & Data Analysis**

**2D Seismic Data**



**3D Seismic Survey & Data Analysis**



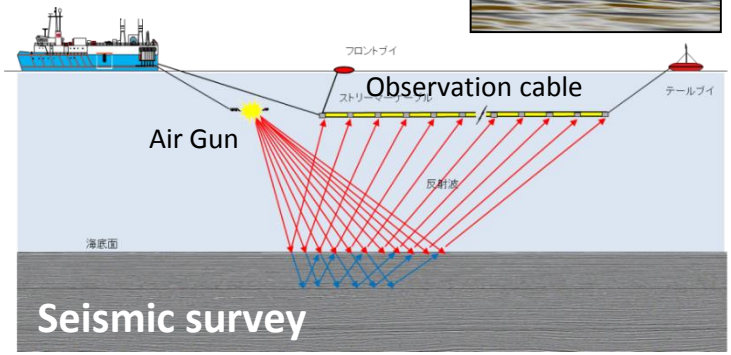
**3D Seismic Data**

**Drilling wells**



**Selection of Storage Sites**

**Drilling Exploratory Wells, & Evaluation**





*Source: Ministry of Economy, Trade and Industry (Japan)*

# Positional Relation of Injection & Monitoring Systems

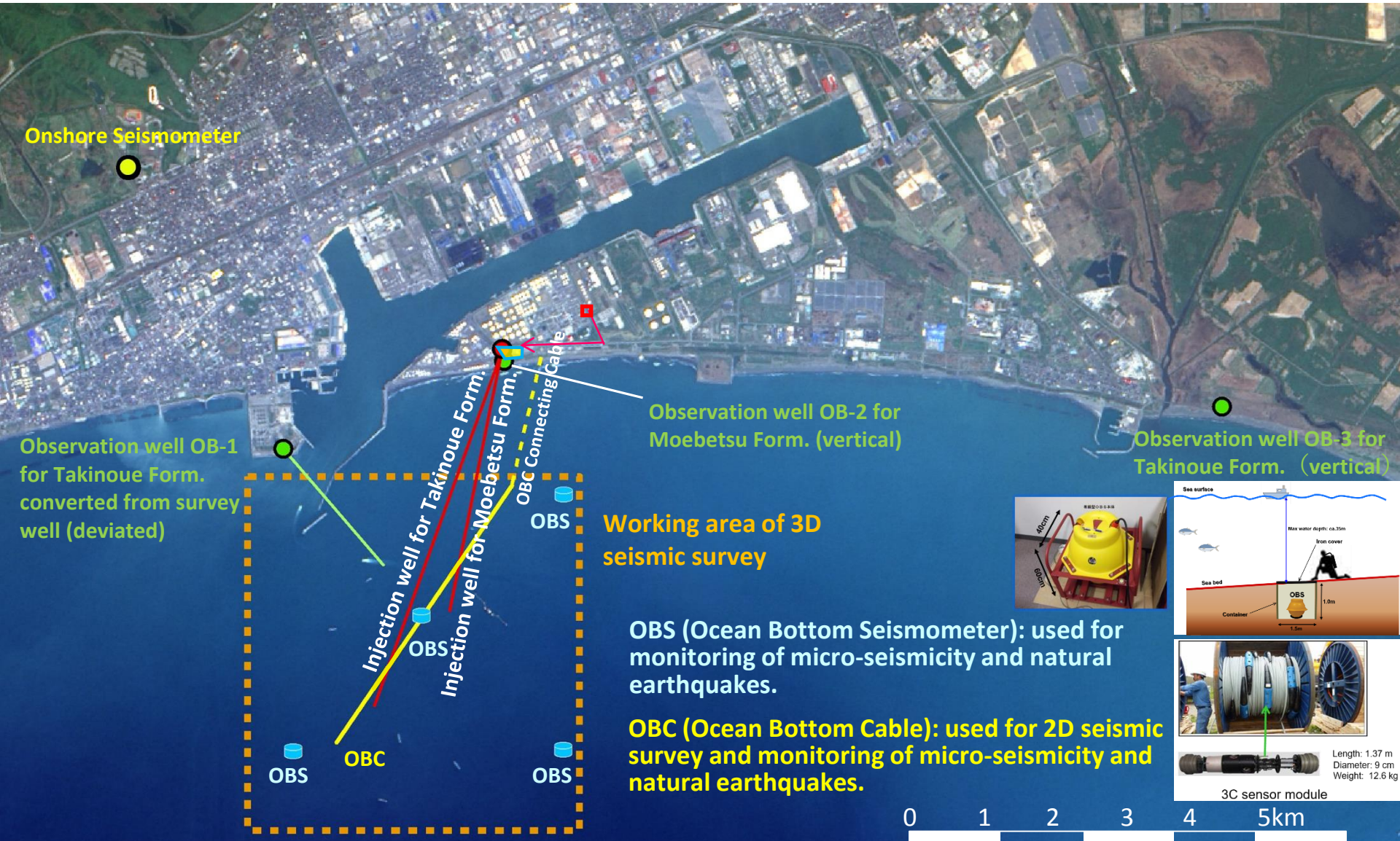



Image: LC81070302016141LGN00, courtesy of the U.S. Geological Survey, text by JCCS

# $CO_2$ Containing Gas from Gas Supply Facility