METI
Ministry of Economy, Trade and Industry

CCUS in Japan

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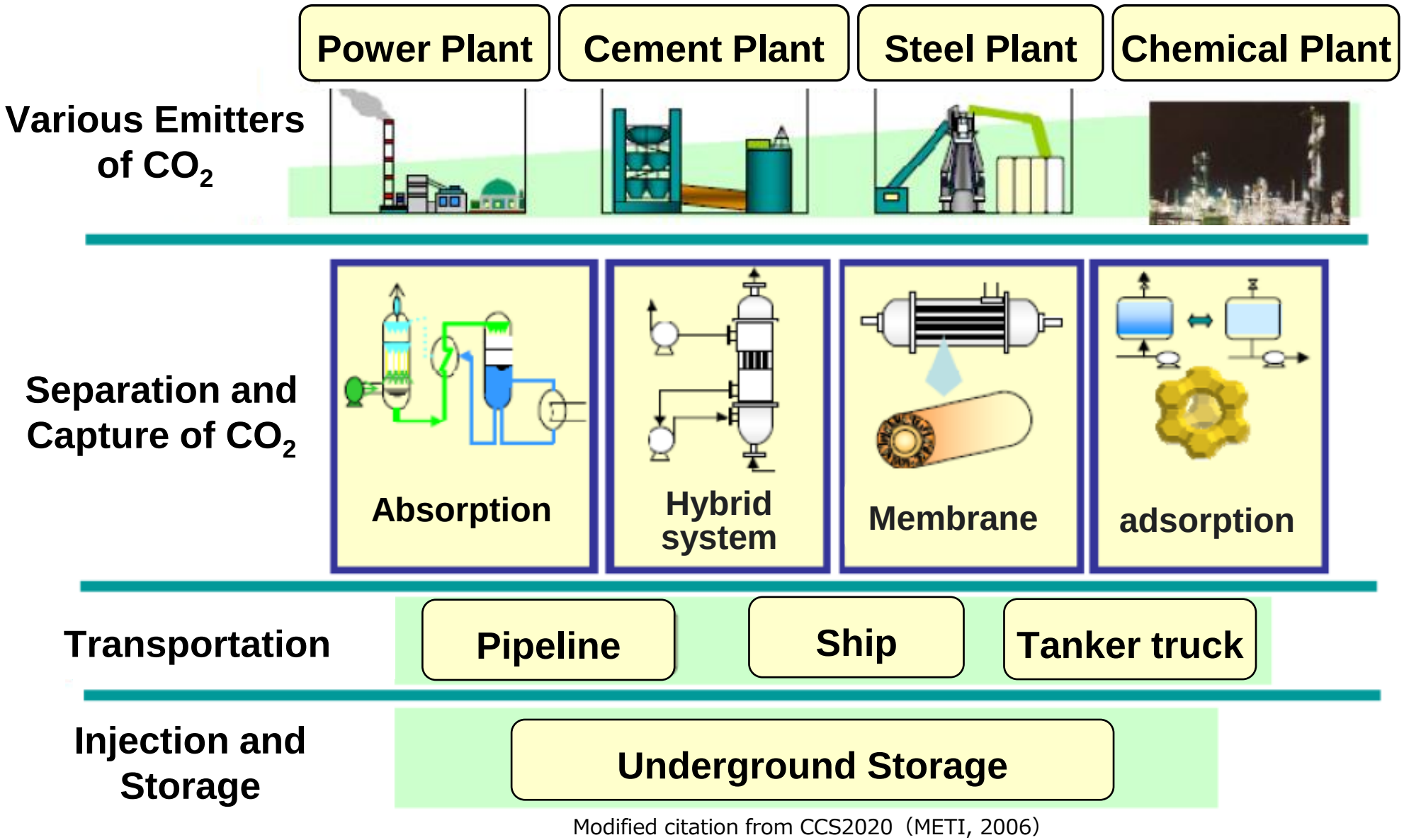
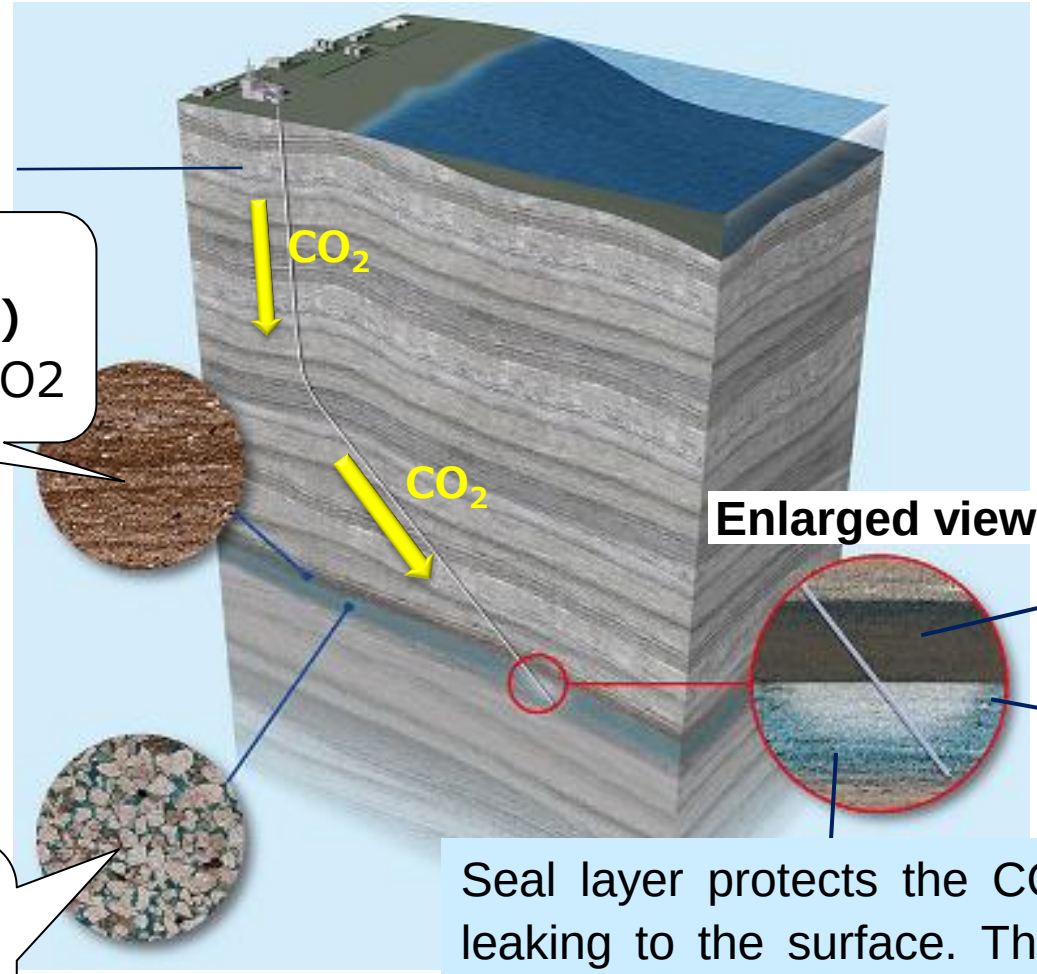
Carbon dioxide Capture and Storage (CCS)



Modified citation from CCS2020（METI, 2006）

Mechanism of CO2 Underground Storage

Various emitters



Reservoir type
- **Deep saline aquifer**
- **Depleted oil & gas reservoir**

Seal layer (mudstone etc.)
Seal layer keeps CO2

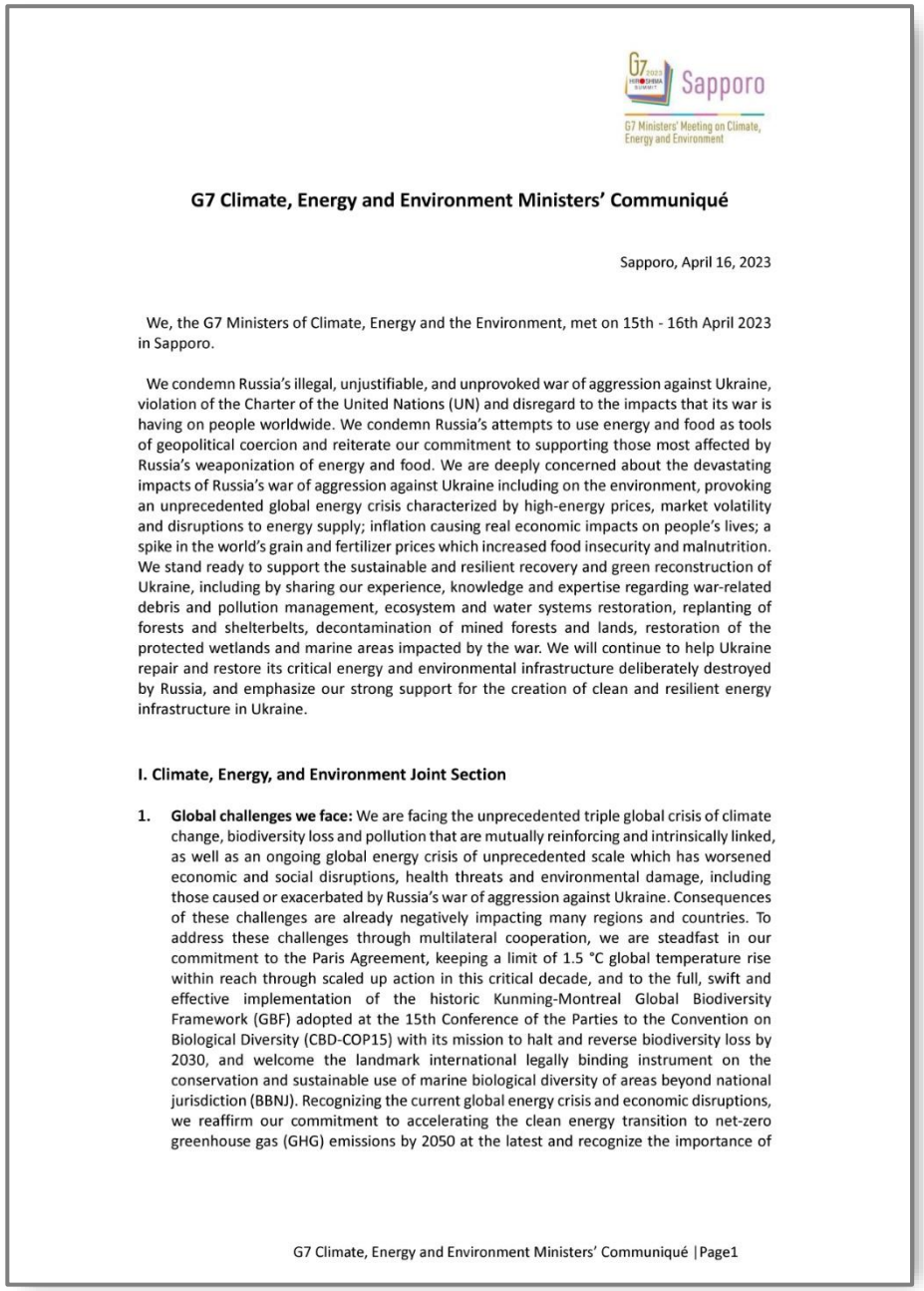
Enlarged view

Reservoir (sandstone, etc.)
Suitable layer for CO2 storage

Seal layer protects the CO2 in the reservoir from leaking to the surface. Therefore, CCS requires a formation structure with the seal layer above the reservoir.

CO2 is stored in the spaces between the particles in the rock.

G7 Climate, Energy and Environment Ministers' Communiqué



Sapporo
G7 Ministers' Meeting on Climate, Energy and Environment

G7 Climate, Energy and Environment Ministers' Communiqué

Sapporo, April 16, 2023

We, the G7 Ministers of Climate, Energy and the Environment, met on 15th - 16th April 2023 in Sapporo.

We condemn Russia's illegal, unjustifiable, and unprovoked war of aggression against Ukraine, violation of the Charter of the United Nations (UN) and disregard to the impacts that its war is having on people worldwide. We condemn Russia's attempts to use energy and food as tools of geopolitical coercion and reiterate our commitment to supporting those most affected by Russia's weaponization of energy and food. We are deeply concerned about the devastating impacts of Russia's war of aggression against Ukraine including on the environment, provoking an unprecedented global energy crisis characterized by high-energy prices, market volatility and disruptions to energy supply; inflation causing real economic impacts on people's lives; a spike in the world's grain and fertilizer prices which increased food insecurity and malnutrition. We stand ready to support the sustainable and resilient recovery and green reconstruction of Ukraine, including by sharing our experience, knowledge and expertise regarding war-related debris and pollution management, ecosystem and water systems restoration, replanting of forests and shelterbelts, decontamination of mined forests and lands, restoration of the protected wetlands and marine areas impacted by the war. We will continue to help Ukraine repair and restore its critical energy and environmental infrastructure deliberately destroyed by Russia, and emphasize our strong support for the creation of clean and resilient energy infrastructure in Ukraine.

I. Climate, Energy, and Environment Joint Section

1. **Global challenges we face:** We are facing the unprecedented triple global crisis of climate change, biodiversity loss and pollution that are mutually reinforcing and intrinsically linked, as well as an ongoing global energy crisis of unprecedented scale which has worsened economic and social disruptions, health threats and environmental damage, including those caused or exacerbated by Russia's war of aggression against Ukraine. Consequences of these challenges are already negatively impacting many regions and countries. To address these challenges through multilateral cooperation, we are steadfast in our commitment to the Paris Agreement, keeping a limit of 1.5 °C global temperature rise within reach through scaled up action in this critical decade, and to the full, swift and effective implementation of the historic Kunming-Montreal Global Biodiversity Framework (GBF) adopted at the 15th Conference of the Parties to the Convention on Biological Diversity (CBD-COP15) with its mission to halt and reverse biodiversity loss by 2030, and welcome the landmark international legally binding instrument on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction (BBNJ). Recognizing the current global energy crisis and economic disruptions, we reaffirm our commitment to accelerating the clean energy transition to net-zero greenhouse gas (GHG) emissions by 2050 at the latest and recognize the importance of

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Key sentence

68. Carbon Management :

- We recognize the need for monitoring and analyzing the potential for and expanding geologic storage infrastructure and planning for CO2 transport, including the potential for regional Carbon dioxide Capture and Storage (CCS) hubs in line with social acceptance.

- We will co-operate to promote development of export/import mechanisms for CO2.

- Considering the evolving nature of these technologies, we recognize that CCU/carbon recycling and CCS can be an important part of a broad portfolio of decarbonization solutions to achieve net-zero emissions by 2050, and Carbon dioxide Capture, Utilization(CCU)/carbon recycling technologies, ・・・

G7 2023 HIROSHIMA SUMMIT Sapporo
G7 Ministers' Meeting on Climate, Energy and Environment

History of Japanese CCS Projects

2000 — 2011 — 2016

10k t-CO_2 (1.5years)

300k t-CO_2 (3 years)

Societal implementation

Fundamental Research (Nagaoka CCS PJ)

- Subsurface monitoring
- Numerical simulation

Practical research & developments (Tomokomai Demonstration PJ)

- Safety management tech. for large-scale CCS
- Effective injection into large-scale reservoirs
- Promotion of Public Acceptance

Fundamental Tech. Developments (Post –monitoring of Nagaoka CCS PJ)

- Core sample tests
- Migration modeling (faults, wells)
- Numerical simulations
- Eval. of the env. impact on offshore areas
- Fiber-optic monitoring
- Geological modeling technology

Japan’s Long-Term Roadmap

Japan’s Long-Term Roadmap

[Basic principles]

To implement CCS systematically and rationally to promote the sound development of CCS business in Japan with minimal social costs, thereby contributing to the development of Japan's economy and industry, securing a stable energy supply, and the achievement of carbon neutrality.

[Objectives]

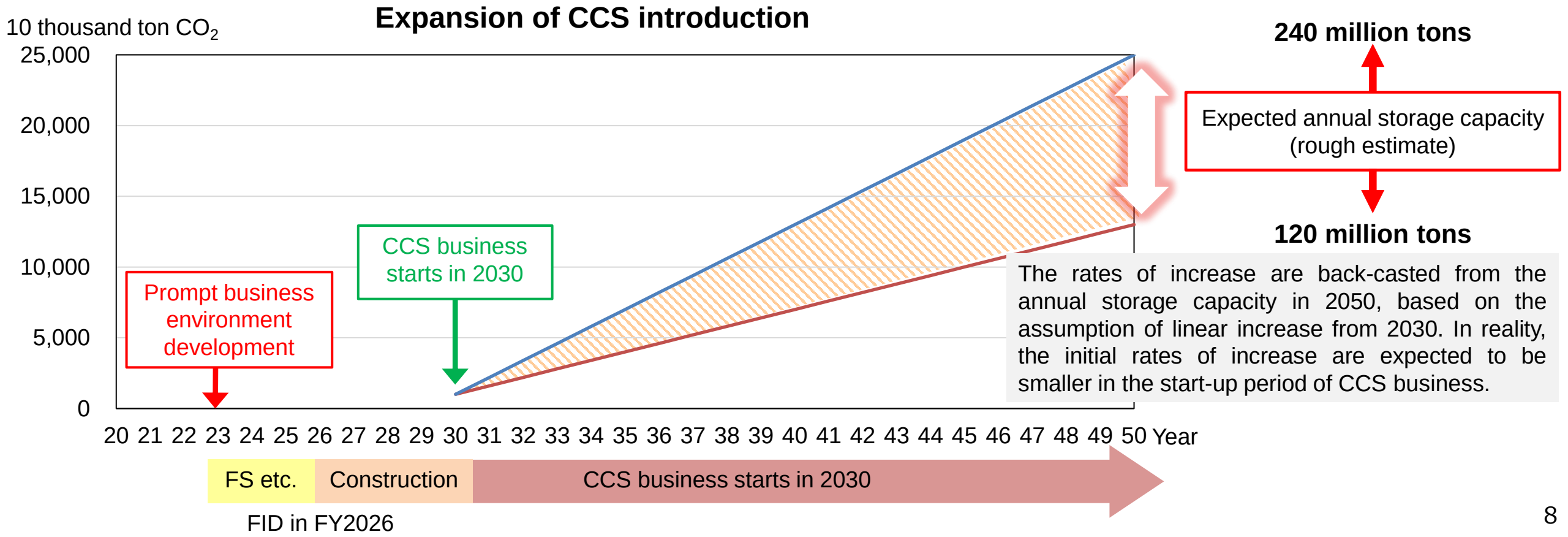
A business environment for commencement shall be prepared by 2030, involving cost reduction, public understanding, overseas CCS promotion, and CCS Business Act legislation, **based on the rough estimation of enabling CO_2 storage of about 120 to 240 million tons as of 2050, and full-scale CCS business shall deploy after 2030**.

[Specific actions]

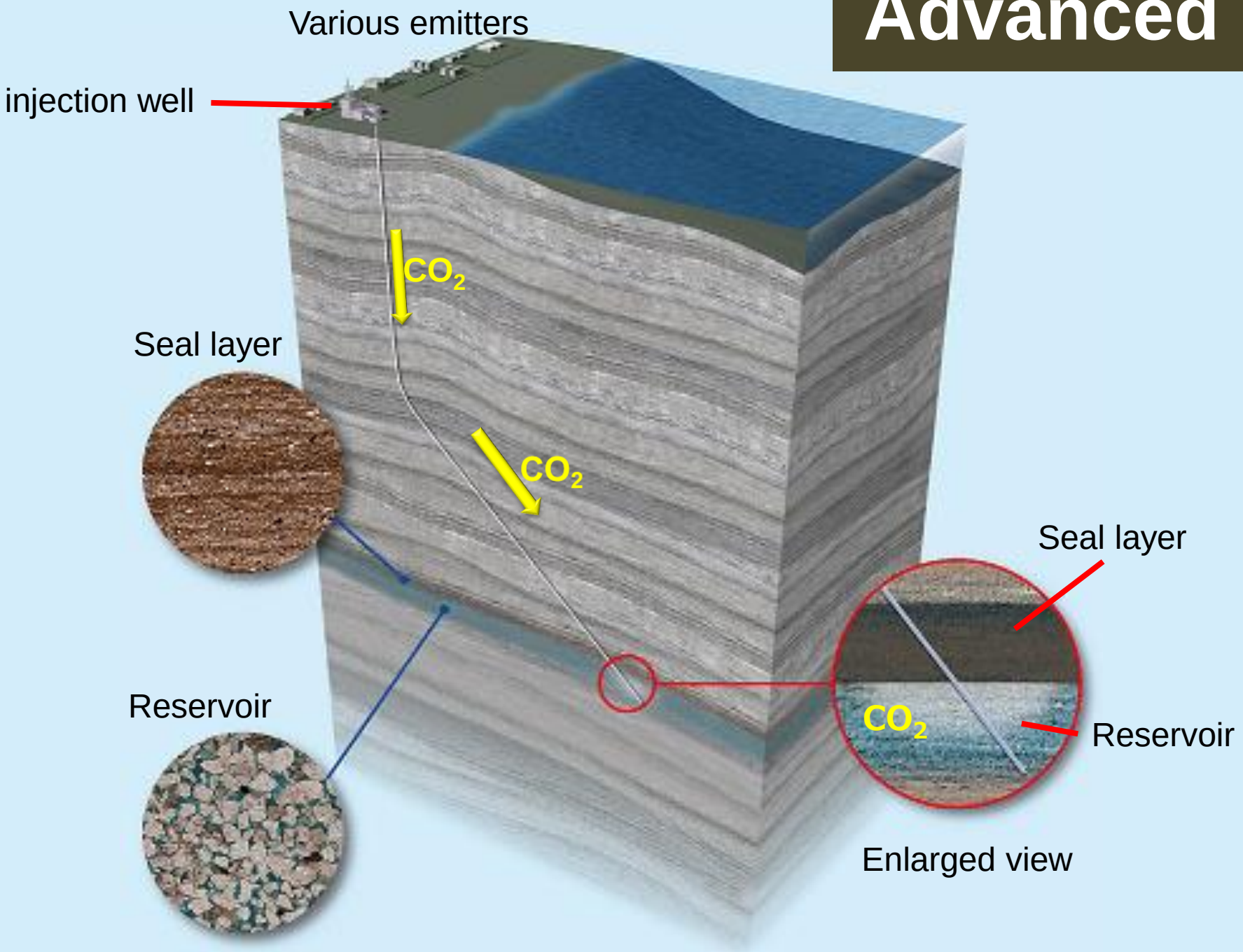
(1) Government support for CCS business
(2) Efforts for reducing CCS costs
(3) Promotion of public understanding of CCS business
(4) Promotion of overseas CCS business
(5) Examination for the development of the CCS Business Act (tentative name)
(6) Formulation and review of the CCS Action Plan

The necessity of developing business environment toward the start of CCS business by 2030

- Based on IEA trial calculation, **estimated annual storage capacity of Japan's CCS can be roughly estimated at 120 to 240 million tons in 2050** (about 10-20% of current emissions). Supposing CCS is introduced in 2030, the annual storage capacity needs to increase by 6–12 million tons every year during the 20 years until 2050.
- **There are concerns that postponing the introduction of CCS in 2030 will make it difficult to secure the annual storage capacity necessary to achieve 2050 Carbon Neutrality.**



Advanced CCS Program



Purpose of advanced CCS program

- To secure annual storage of 120-240 million tons of CO2 by 2050, A business model for CCS that can cross-sectoral should be established at an early stage. Thus, Japanese government selected “Advanced CCS projects” led by operators and will actively support them.
- This supporting program will establish various CCS business models by supporting projects with different combinations of CO2 source, transportation methods and CO2 storage areas. Furthermore, it aims to secure 6-12 million tons of CO2 storage per year by 2030.
- This year, this program will provide support for the analysis of this geologic data and feasibility study.

Possible types of CO2 source, transport methods, and CO2 storage areas

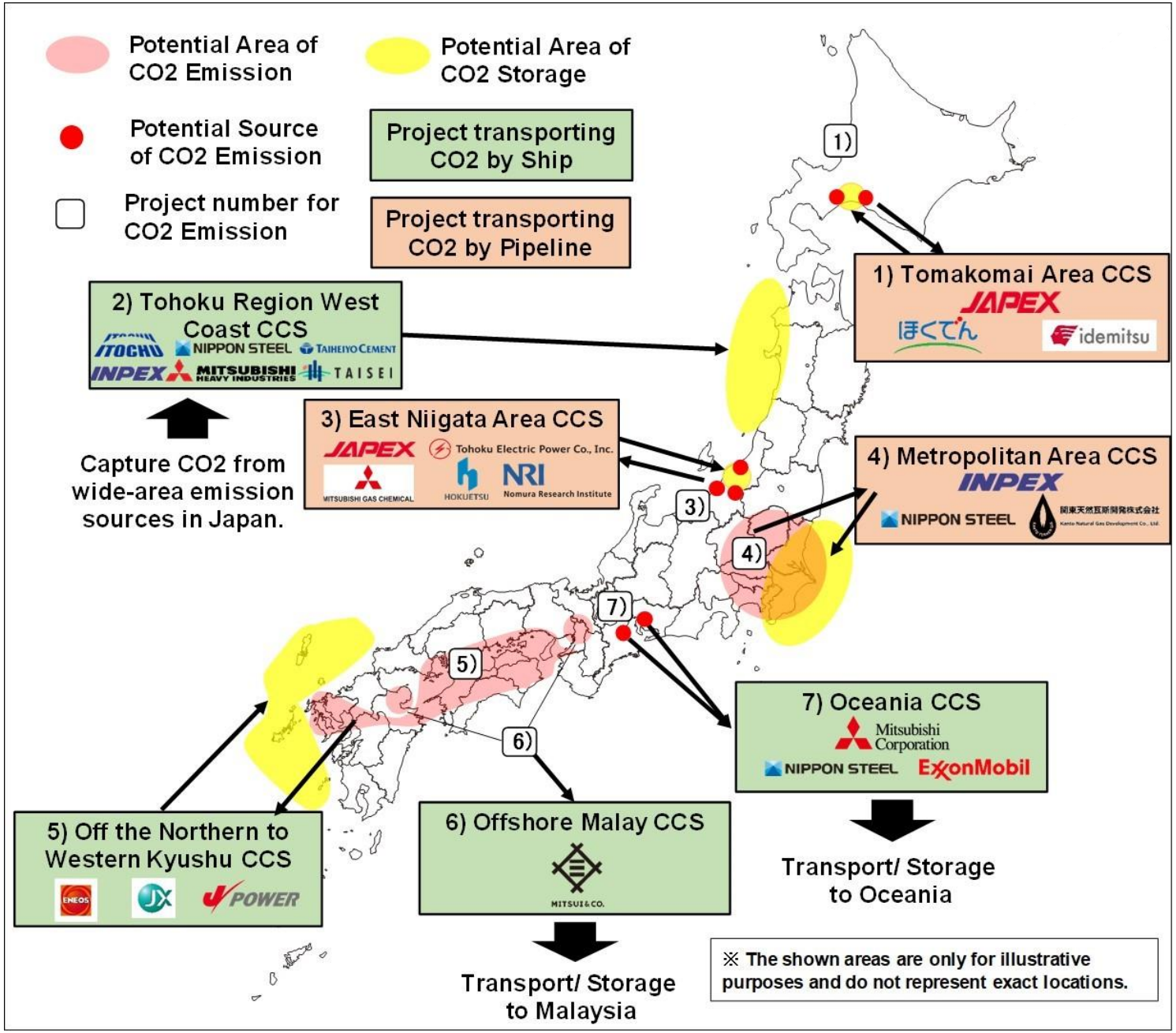
CO2 sources	Transport methods	CO2 storage areas
Thermal power plant Steel plant Chemical plant Cement plant Paper plant Hydrogen plant etc.	Pipeline Ship	Onshore Near shore Offshore

Overviews of Selected Advanced CCS Projects

- On June 6, Seven CCS projects was selected as Advanced CCS project (including two oversea export projects) which was considered CO2 source, transportation methods, storage areas.
- Selected project target a wide range of industries such as electric pawer, oil refineries, steel, chemical, pulp/paper, and cement, and capture CO2 emitted from various regions in Japan.
- The total estimated annual storage of CO2 in 2030 is about 13 million tons (including 30% exported overseas).

Storage areas	CO2 Sources	Transportation methods	Types of storage site
①Tomakomai Area CCS JAPEX, Idemitsu Kosan, Hokkaido Electric power	Oil refinery, electric power plant	Pipeline	Onshore depleted gas fields and/or Near shore
②Tohoku region west coast CCS ITOCHU Corp., Nippon Steel, Taiheiyo Cement, Mitsubishi Heavy Industries, ITOCHU Oil Exploration, INPEX, Taisei Corp.	Steel plant, Cement plant	Ship, Pipeline	Near shore
③East Niigata Aria CCS JAPEX, Tohoku electric power, Mitsubishi Gas Chemical Company, Hokuetsu Co, Nomura Research Institute.	Chemical plant, Paper plant, electric power plant	Pipeline	Onshore depleted gas fields ～ Near Shore
④Metropolitan Aria CCS INPEX, Nippon Steel, Kanto Natural Gas Development	Steel plant, others	Pipeline	Near Shore
⑤Northern to Western Offshore CCS ENEOS、JX Nippon Oil & Gas Exploration、J-Power	Oil refinery, electric power plant	Ship, Pipeline	Offshore
⑥Offshore Malay CCS Mitsui & Co.	Oil refinery, Chemical plant, others	Ship, Pipeline	Oversea project (Malaysia)
⑦Oceania Mitsubishi Corp., Nippon Steel, ExxonMobil	Steel plant, others	Ship, Pipeline	Oversea project（Oceania）

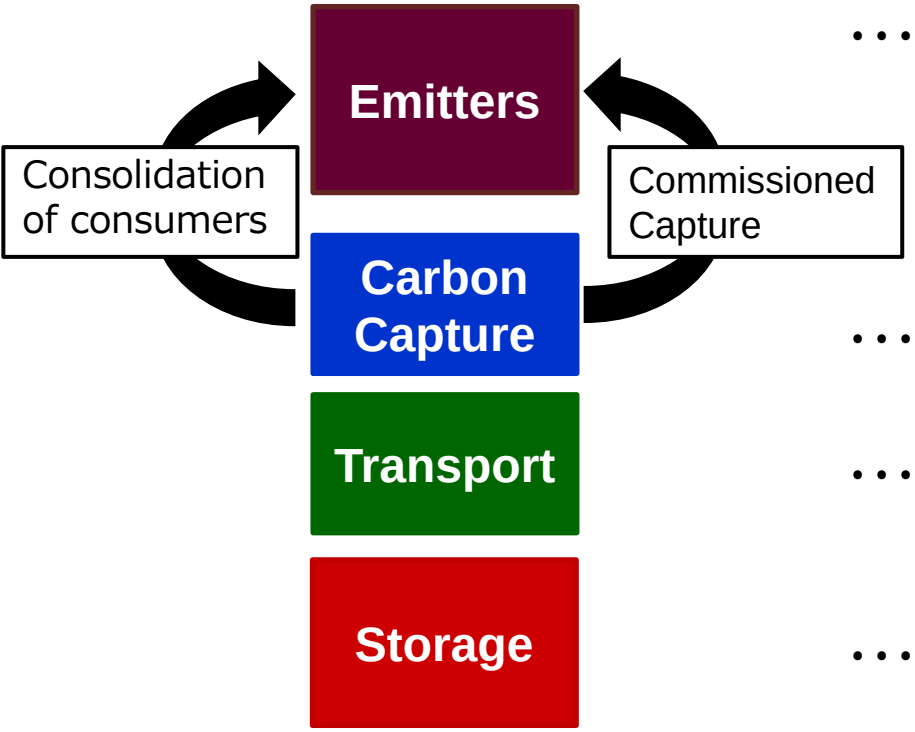
Locations of the selected projects and companies



Lessons from Advanced CCS Program

- T & S companies requires several hundreds million dollars and high technologies to install. The number of potential entrants would be limited.
- In order to install Carbon Capture process and transportation, “Aggregator” for emitters is necessary to foster by promoting outsourcing. Some public utilities companies to think to enter.
- In CCS, quantities of CO2 to transport would be more than 100 times. Primary transport would be pipelines and shipping would fill the regional gap.

CCS System and its challenges



・・・ In Japan there are around 7,500 factories to consume more than energy equivalent to 3,000kl annually

- ・Large class facilities ： couples of 100k – million ton
- ・Middle class facilities：couples of 10k – 100k ton
- ・Small class facilities ：～ couples of 10 K ton

・・・ “Aggregation business” to covers Carbon Capture needs
- Covering potential users and accept outsourcing of capture

・・・ Smooth installation of pipelines and liquified shipping
Pipelines are required to cover the general requirement

・・・ Expansion of its capacity and sustainable discovery of potential

Liquefied CO2 Shipping Demonstration Project

A demonstration project for long-haul transportation from emission sources to places suitable for storage will be carried out to establish liquefied CO2 shipping techniques.

Liquefied CO2 Shipping Demonstration Project

In the hub and cluster plan for CCS, liquefied CO2 ship transportation is an important technology for transporting CO2 which is captured at distant emission sources.

Route examples

Maizuru Power Station (Coal fired power plant)

- Capture
- Coal fired power plant

Osaki CoolGen (IGCC)

- Capture
- Carbon Recycling R&D base

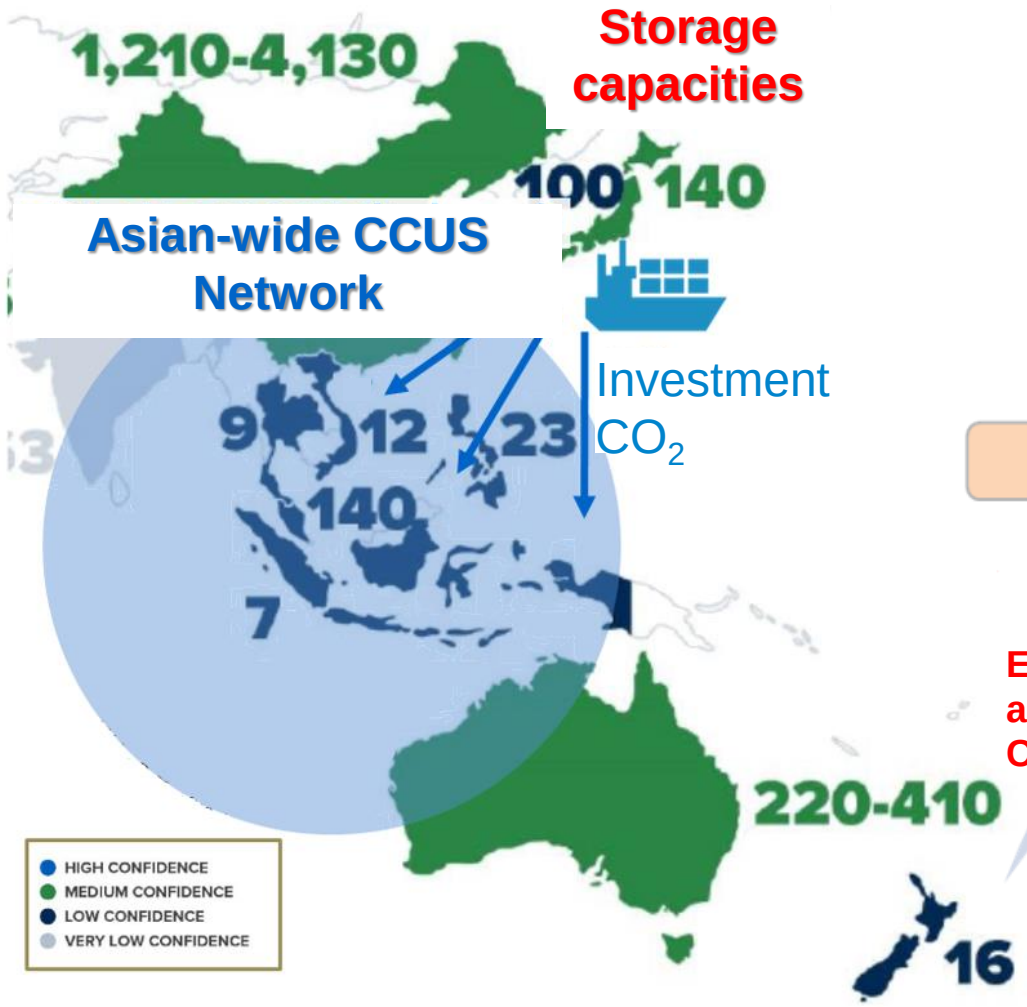
Tomakomai CCS demonstration

- Storage and monitoring
- Tomakomai CCS/CR hub

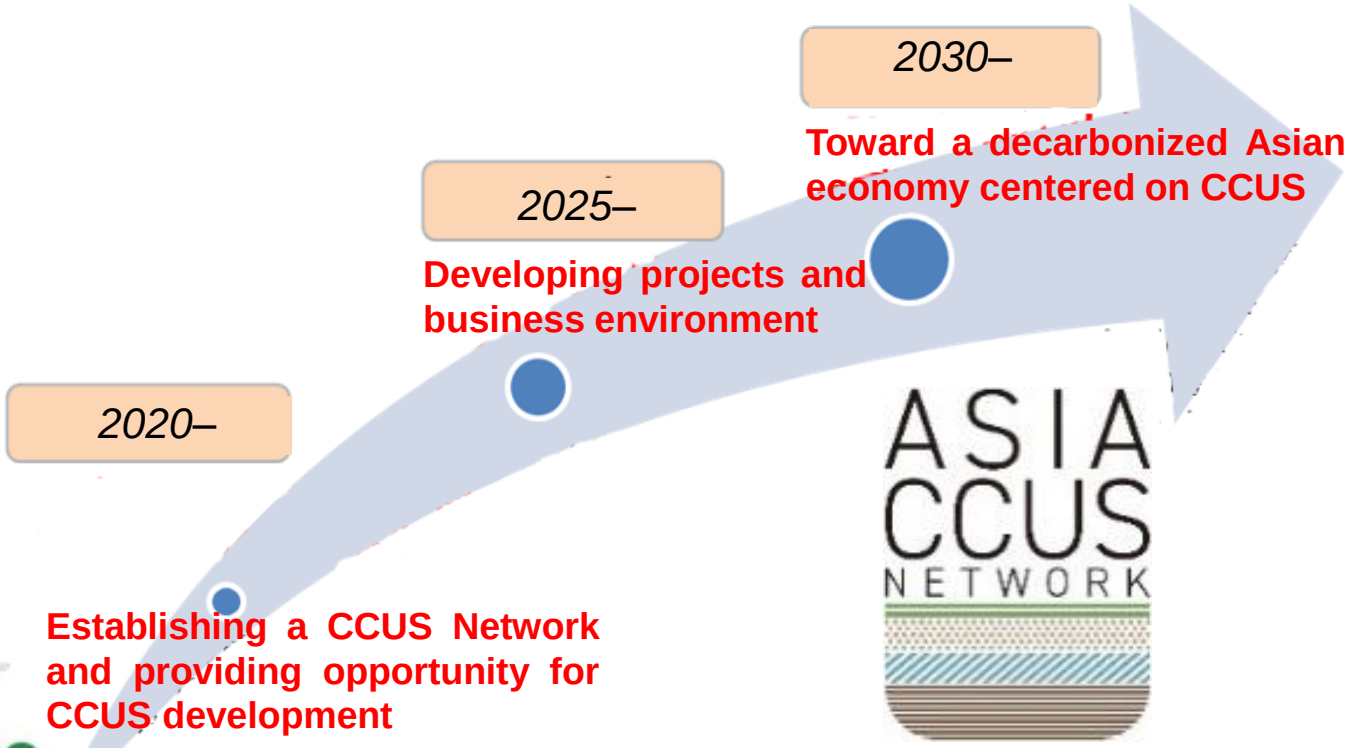
Demonstration transportation of CO2 will start in 2024

Building Asian-wide CCUS Network

In June 2021, **the Asia CCUS Network (ACN), an international industry-academia-government platform, was established as part of AETI**. **It aims to share knowledge and develop a business environment for CCUS utilization throughout Asia** where large-scale CO_2 storage potential is expected.



Note) Figures indicate storage capacities.
Unit: Billion tons (Survey by GCCSI)



AUS, BD, INA, JPN, MAS, PH, SGP, THA, US, VN, KHM, LAO, MMR, IND

Japan's contribution toward CCS value chain

- Japan is the only economy that has various technology related to the CCS value chain, such as CO2 capture, transport and storage.

CO2 capture

Liquefied CO2 transport ship

CO2 pipeline

Storage/Total engineering

[Engineering]

MITSUBISHI HEAVY INDUSTRIES — Global No.1 Provider for exhausted gases (70% of global market) and Provided for Petra Nova

NIPPON STEEL ENGINEERING — Provided for Steel Makers and Coal-fired power plants.

CHIYODA CORPORATION — Delivered PCC facility as EPC contractor, New technology development under NEDO project

[Engineering]

MITSUBISHI HEAVY INDUSTRIES

Low Temperature Low Pressure First mover in the world

[Shipping Company]

MOL Mitsui O.S.K. Lines — Invested in Larvik Shipping

"K" LINE KAWASAKI KISEN KAISHA, LTD. — Provides for Northern Lights

[Manufacturing]

NIPPON STEEL — Provides Seamless Pipe for CO2 Injection well of Northern Lights

[Engineering]

JFE Engineering Corporation

NIPPON STEEL ENGINEERING

[Engineering]

JGC — Designed "Tomakomai" Demonstration PJ

CHIYODA CORPORATION — Delivered CCS facilities for LNG plants in Qatar