Japan’s Long-Term Roadmap

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[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]

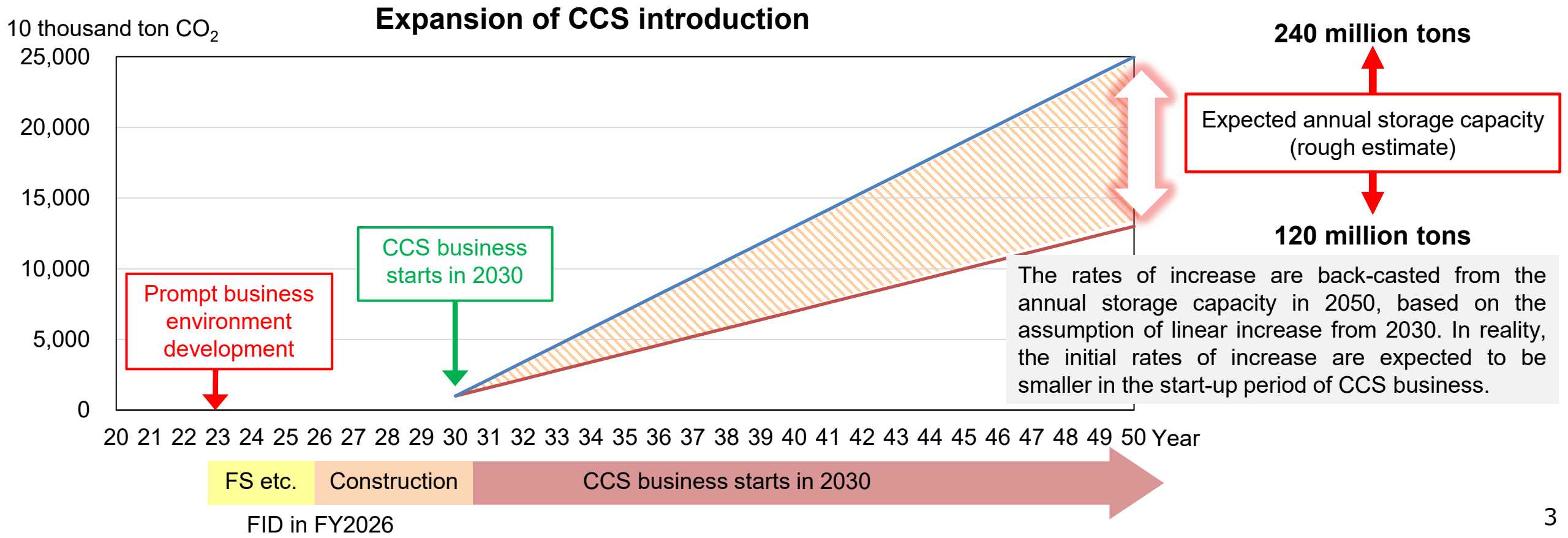
A business environment for commencement shall be prepared by 2030, involving cost reduction, public understanding, overseas CCS promotion, and CCS Business Act legislation, **based on the rough estimation of enabling CO_2 storage of about 120 to 240 million tons as of 2050, and full-scale CCS business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



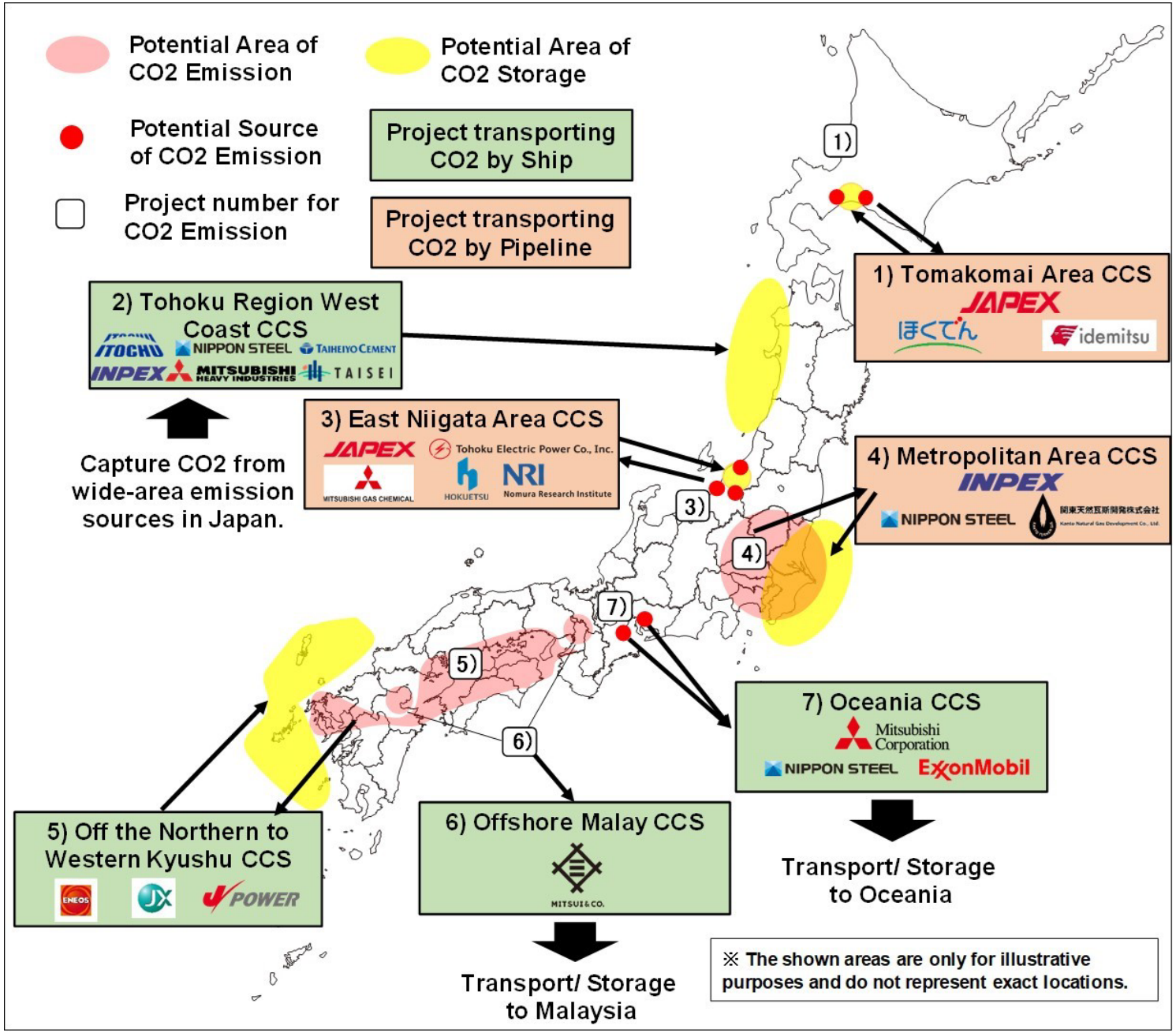
Purpose of advanced CCS program

- 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

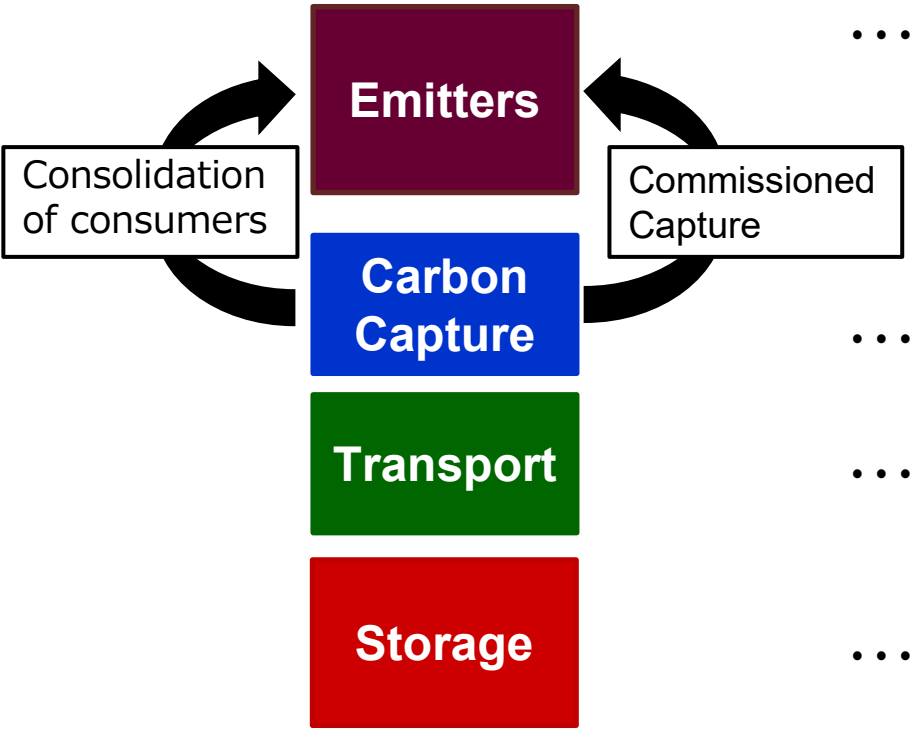
Locations of the selected projects and companies



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

Examination for the development of the CCS Business Act (tentative name)

Background of the study

CCS has not been commercialized until now: the reasons from legal viewpoints are as follows:

(1) The application of laws and regulations (e.g., Mining Act, Mine Safety Act) to the CCS business and **the rules to be complied with on the operators' side and the national supervision system were unclear**.

Note) Mining Act and Mine Safety Act apply to oil and natural gas production increases, which are technically common to CCS projects; however, it is unclear whether they apply to CCS projects.

(2) **There were no rules for arranging gas composition, and measuring, transporting, and providing the data** in the CCS value chain of CO_2 capture, transportation, and storage.

(3) **There was no mechanism to eliminate or prevent interference from third parties** to secure the stability of a long-term project.

(4) The development of CCS shall proceed while obtaining the understanding of residents; however, **there was no compliance with safety regulations, no mechanism for compensation for damage, and no clear explanation of what the operator should explain to residents**.

Note) In Japan's mining legislation, impacts on the surrounding environment are discussed in the preservation issues.

(5) In particular, **the safety and monitoring responsibilities of storage operators were unclear**. Also, **business viability could not be guaranteed** unless responsibility was extinguished.

Details of the measures

- **(1) Developing the CCS Business Act (new law) is urgent.**
- Based on the CCS value chain, **(2) the Act** should cover **capture, transportation, and storage**.
- In particular, **the storage business has many points in common with the oil and natural gas business**. Thus, measures, such as **(2) the institutionalization common to land and sea**, **(3) new establishment of storage business rights**, **(4) the establishment of a security system and clarification of liability for compensation (no fault liability)**, and **(5) limitations of monitoring responsibilities** shall be taken, referring to mining legislations.
- **A legal framework for CO_2 exports aimed at promoting overseas CCS** should be determined.
- **Captured CO_2 should be able to be sold to promote CCU/carbon recycling.**

【The value chain of the entire CCS business】