CCS/CCUS Business Briefing

CCS Business Strategy of JX Nippon Oil & Gas Exploration

August 28, 2024
Michitaka Miyama, General Manager,
CCS Project Department

JX Nippon Oil & Gas Exploration Corporation

AGENDA

1. Overview of CCS/CCUS Business

(1) What is CCS/CCUS?

(2) Current Status and Trends of CCS/CCUS Worldwide

(3) Current Status and Trends of CCS/CCUS in Japan

2. Current Status and Plans of our CCS/CCUS Business

(1) ENEOS Group's Carbon Neutrality Plan

(2) Our Strategy and Capabilities

(3) Progress of CCS/CCUS Projects in Japan and Overseas

(4) Challenges of the CCS Business and Our Strengths

1. Overview of CCS/CCUS Business

1.(1) What is CCS/CCUS?

Difference between CCS and CCUS

CCS (Carbon dioxide Capture and Storage)

➡CO2 is separated and captured, injected and stored underground.

CCUS (Carbon dioxide Capture, Utilization and Storage)

➡Utilization of the separated and captured CO2.

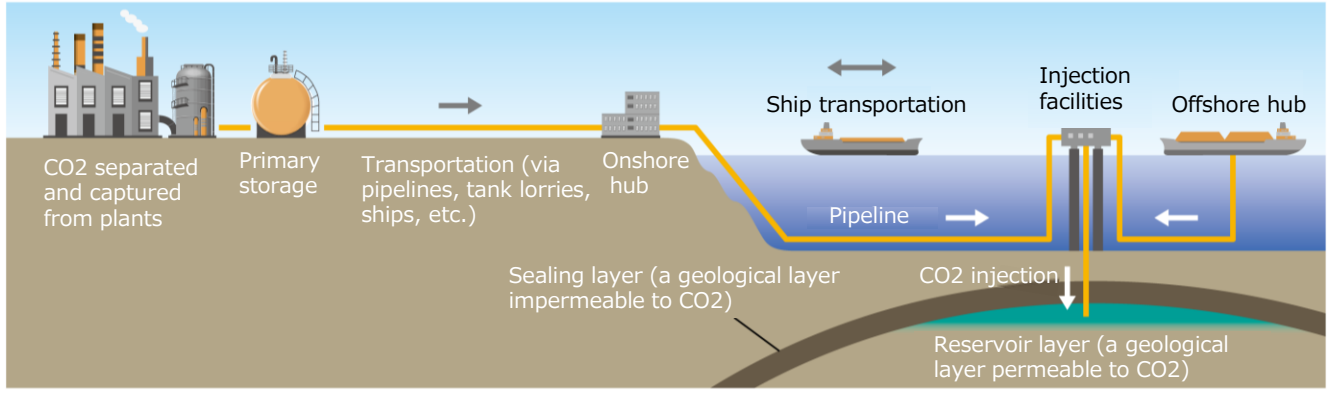
For example, **CO2-EOR (Enhanced Oil Recovery)** : CO2 is injected into the reservoir to increase the productivity of the oil field, while reducing CO2 emissions.

Expectations for CCS/CCUS

The International Energy Agency (IEA) reports that CCUS is estimated to account for 15% of the cumulative CO2 reductions by 2070, contributing to an annual reduction of 6.9 billion tons of CO2* at the time.

*As of 2023, a total of 41 projects (49 mmtpa storage scale) are in operation worldwide, and 351 projects (approx. 310 mmtpa) are under construction or planned.
(GCCSI - GLOBAL STATUS OF CCS 2023)

Overall image of CCS business
(for storage under the seabed)



1.(2) Current Status and Trends of CCS/CCUS Worldwide

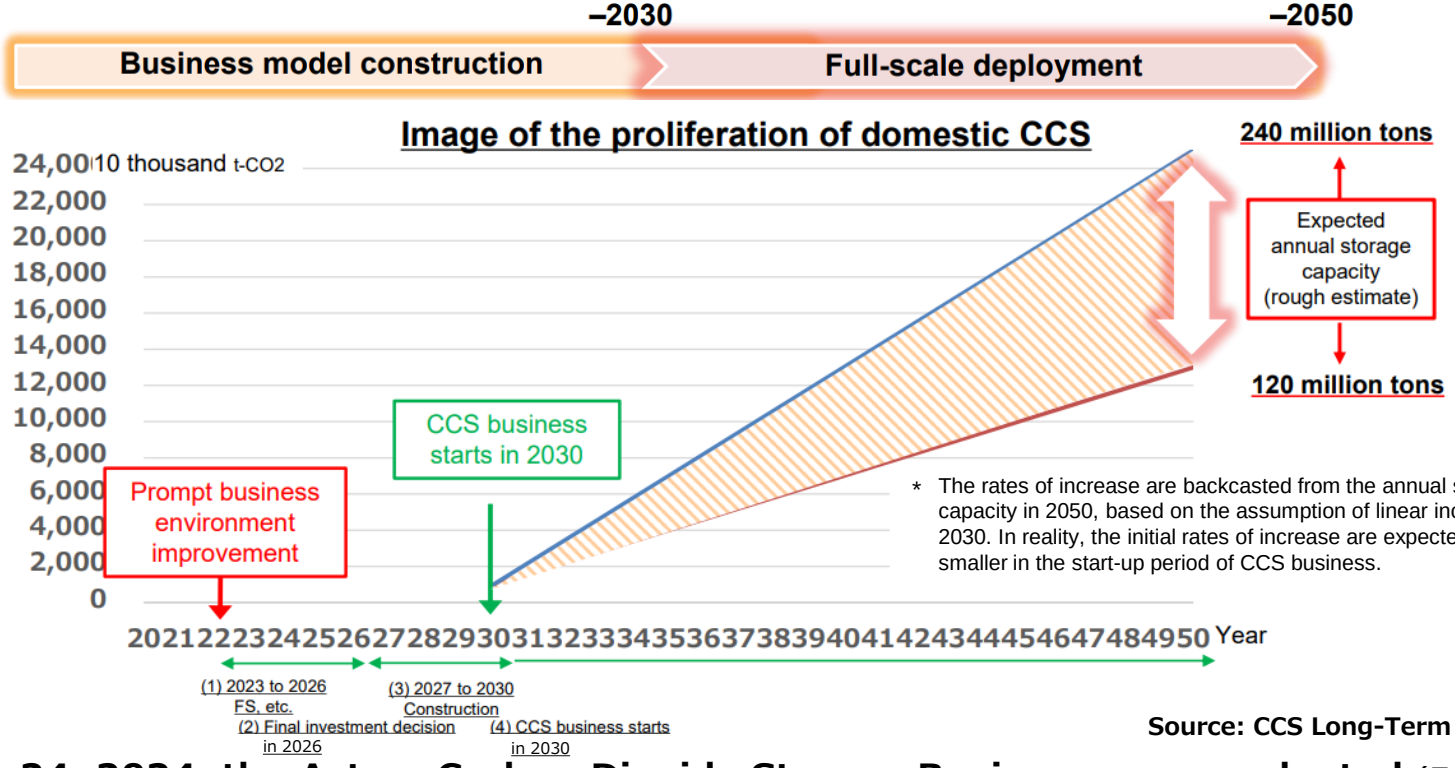
Support systems and project examples for CCS/CCUS projects in major countries

*Prepared based on publicly available materials, etc.

	UK	USA	Norway	Canada	Australia
CO2 Storage Target (/year)	2030: **20-30 mmt** 2035: **50 mmt**	2030: **170 mmt** (IEA CCUS Project Database Forecast)	2030: **5.5 mmt** (IEA CCUS Project Database Forecast)	2030: **15 mmt** (Minimum)	2035: **80 mmt**
Main Support Schemes	**-Contract for Difference (CfD) against carbon price**	**-CAPEX/OPEX Indirect Support** (IRA:Inflation Reduction Act - Tax Deduction)	**-CAPEX/OPEX direct support** -Carbon Tax Exemption	**-CAPEX/OPEX direct support** -Carbon Credits (Alberta)	**-Carbon Credits** (ERF: Emission Reduction Fund)
Budget scale of Support Measures	**Approx. 31 bil. yen** Industrial Decarbonization Strategy, '21/3 **Approx. 3.7 tri. yen** (CCUS Vision '23/12 20 years, for emitters)	**Approx. 53 tri. yen** (IRA total, estimated) **Approx. 1.7 tri. yen** (IIJA: Infrastructure Investment and Employment Act)	**Northern Lights** For the initially planned 800,000 tons **CAPEX: 80%** subsidy **OPEX: 95-80%** subsidy (10 years)	**N.A.**	**Approx. 250 bil. yen** (ERF)
Major Projects	**Industrial Decarbonization Strategy** HyNet North West CCS (England), Net Zero Infrastructure (Scotland), etc.	**Petra Nova PJ** (TX, our participation) -1.4 mmtpa-CO2 capture from coal-fired power + EOR	**Northern Lights PJ** (Participation of North Sea, Norway Government, Equinor, etc.) -1.5 mmtpa-CO2 for liquefaction, transportation and storage as part of the government's Longship PJ	**Quest CCS**(Alberta) -'15 Storage began, 1.0 mmtpa-CO2 captured from oil sands operations (subsidized by both federal/state)	**Gorgon Carbon Dioxide Injection Project** -CO2 storage of 4.0 mmtpa as part of the Gorgon LNG PJ in Western Australia

1.(3) Current Status and Trends of CCS/CCUS in Japan

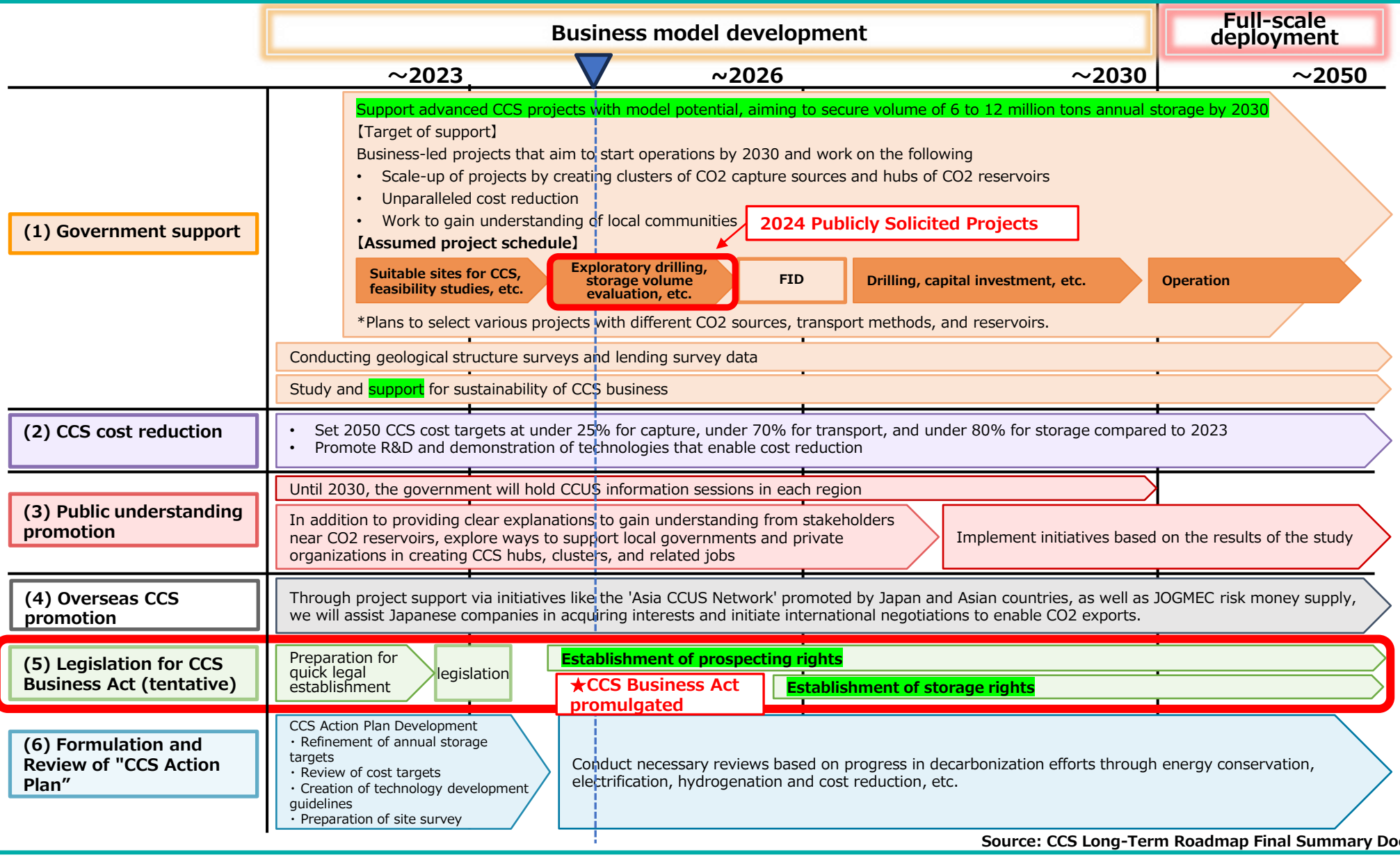
- **April 2021**
  Then-Prime Minister Suga announced a target to reduce CO2 emissions by 46% by 2030 compared to 2013 levels. (and take on the challenge to reach the 50% reduction level)
- **October 2021**
  Cabinet approved **Plan for Global Warming Countermeasures**, including a **46% reduction by 2030 and carbon neutrality** target **by 2050**.
- **January 2022 to March 2023 Long-Term Roadmap Study Group held**



Source: CCS Long-Term Roadmap Final Summary Document, some additions

- **May 24, 2024, the Act on Carbon Dioxide Storage Businesses promulgated** (Exploration: already enforced on August 5, 2024. Exploratory drilling: within 6 months of promulgation; storage and pipeline transportation: within 2 years of promulgation)

1.(3) Current Status and Trends of CCS/CCUS in Japan



Source: CCS Long-Term Roadmap Final Summary Document, some additions

1.(3) Current Status and Trends of CCS/CCUS in Japan

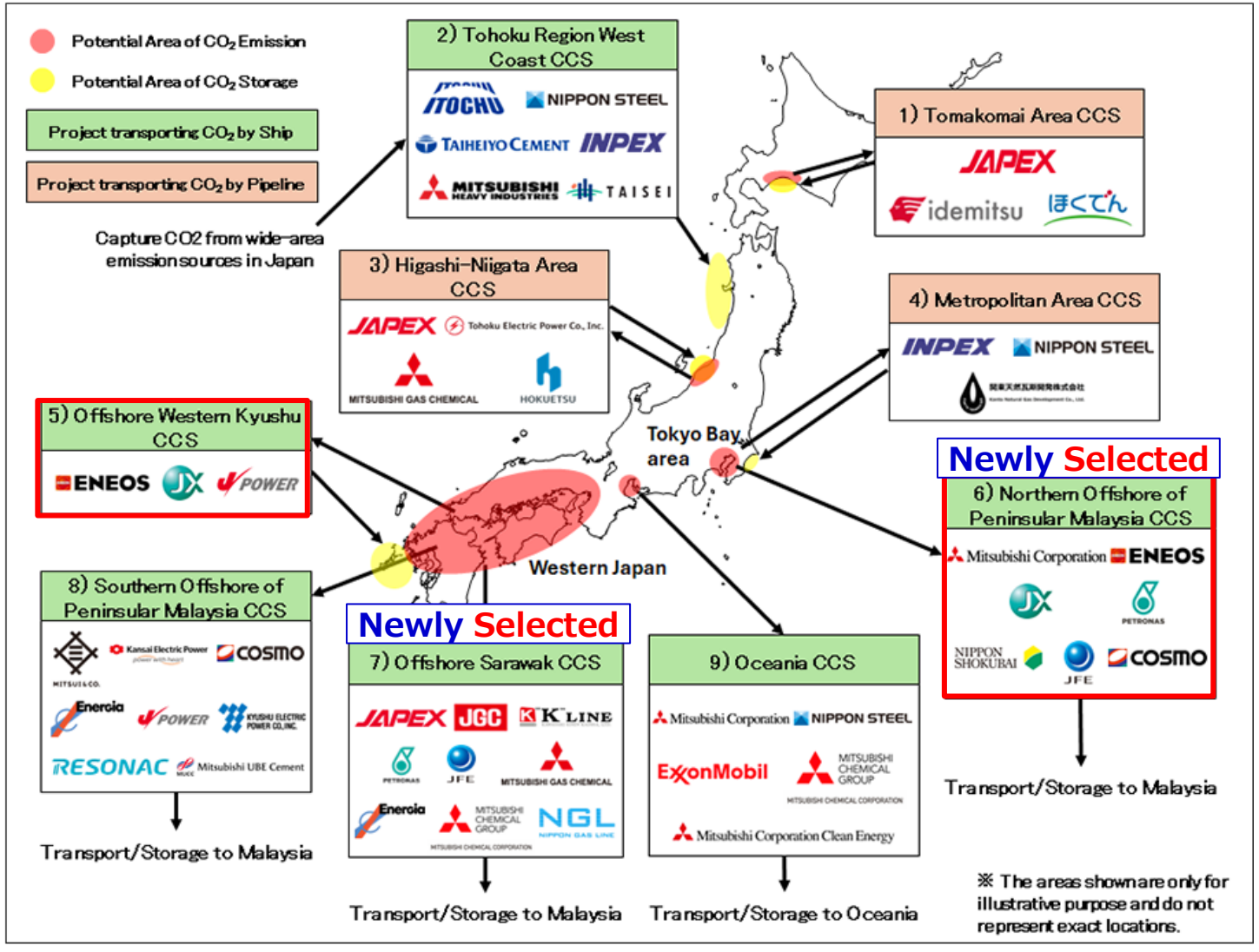
Tomakomai CCS Large-scale demonstration PJ

From Japan CCS Survey HP

・**Japan's first full-scale CCS project** as **National project,** it involves CO2 separation and capture, injection and storage and monitoring.
・Injection began in 2016, and by **November 2019**, **a cumulative total of 300kt of CO2** had been injected. Monitoring is currently underway.

Operator: Japan CCS Co., Ltd.
*Funded by Hokkaido Electric Power, JAPEX, ENEOS, and 30 other domestic power, oil, and engineering companies, totaling 33 companies.

JOGMEC 2024 Advanced CCS Projects (Selected Nine Role Model Projects)



Location of 9 Japanese Advanced CCS Projects and companies. The 9 projects plan to store approximately 20 million tons of CO2 per year.

Source: JOGMEC press release, June 28, 2024, some additions

2. Current Status and Plans of our CCS/CCUS Business

2.(1) ENEOS Group's Carbon Neutrality Plan (announced in May 2023)

Initiatives for the Realization of Carbon Neutrality

Pursue reduction of our greenhouse gas emissions while actively contributing to the reduction of greenhouse gas emissions of society

Policies on Initiatives for the Realization of Carbon Neutrality		ENEOS Measures
Reduction of our greenhouse gas emissions (Scope1+2)	Curbing greenhouse gas emissions	• Appropriate treatment of crude oil (according to demand) • **Efficiency improvement of manufacturing and businesses (energy conservation, fuel switching, utilization of renewable energy, etc.)** • Utilization of carbon credit
	Artificial fixation of CO_2	• **CCS (carbon dioxide capture and storage)** • New methods such as BECCS[1] and DACCS[2] utilizing CCS
	Increase of natural absorption of CO_2	• **Absorption by forests (afforestation and forest management,etc.)** • Other natural absorption methods (blue carbon and soil carbon fixation)
Contribution to the reduction of society's greenhouse gas emissions (Scope3,avoided emissions)	Contribution to the reduction of emissions in the energy area	• Pursuit of **energy transition(hydrogen, carbon-neutral fuels, renewable energy, etc.)**
	Contribution to the reduction of emissions in the materials and services area	• Pursuit of **circular economy (recycling, sharing, etc.)** • Expansion of supply of products contributing to **avoided emissions**

ENEOS Holdings, Inc.

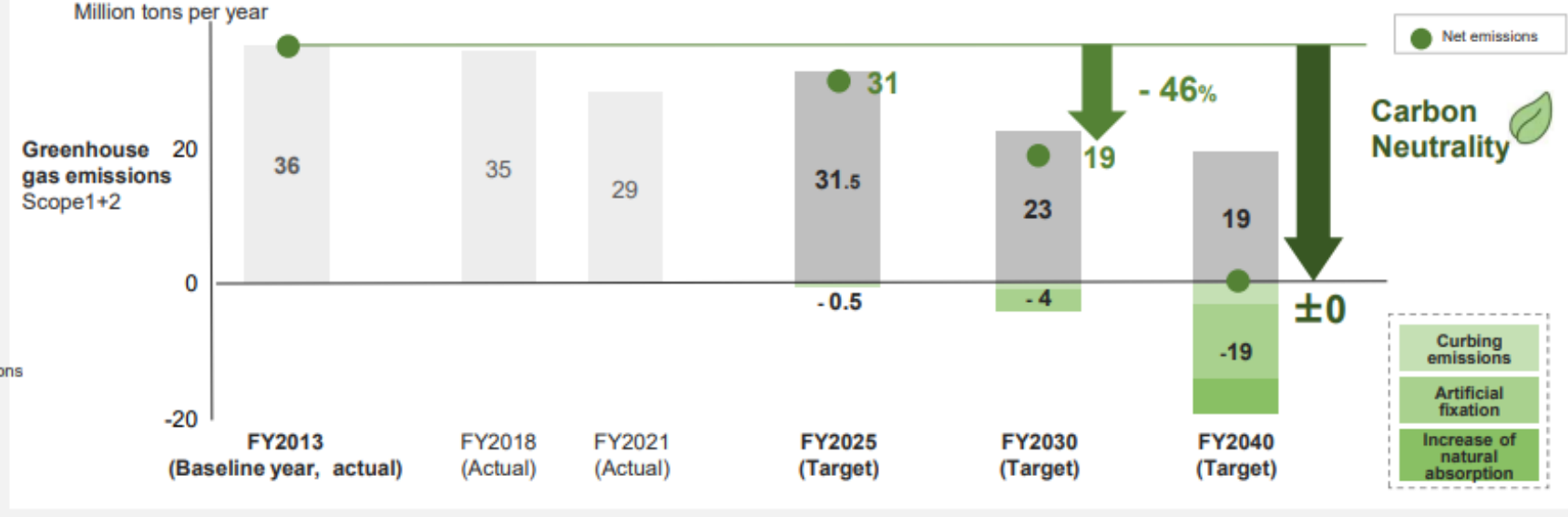
1 BECCS: Bio energy with carbon dioxide capture and storage
2 DACCS: Direct air capture with carbon dioxide capture and storage

2.(1) ENEOS Group's Carbon Neutrality Plan (announced in May 2023)

Roadmap for Reduction of ENEOS Group Greenhouse Gas Emissions

ENEOS Group Initiatives for the realization of carbon neutrality		FY2025	FY2030	FY2040
Greenhouse gas emission target (Scope1+2) Comparison with baseline year shown in parentheses		≦31 (-14%)	≦19 (-46%)	±0 (-100%)
Unit: million tons per year	Methane emissions[2] (Oil & Natural Gas E&P)	350 tons (-80%)	Less than 300 tons	
	Assumed emissions according to demand for fuel, etc.	31.5	23	19
Action	Curbing our greenhouse gas emissions: Energy saving, fuel conversion, etc.	- 0.5	- 1	- 3
Action	Artificial fixation of CO_2: CCS (carbon dioxide capture and storage), etc.	–	- 3	- 11
Action	Increase of natural absorption of CO_2: Forest absorption, etc.	-0.5 (create)	-2 (create)	- 5

Baseline year: FY2013
Greenhouse gas emissions: 36 million tons[1]



1 Figure revised from time of announcement in May 2022 (30 million tons) due to a change in calculation method for domestic emissions from the standard under the Global Warming Countermeasures Act to the GX-ETS standard.[3]

2 Methane emissions (FY2021):1,600 tons

3 No change in targets of transition-linked bonds (issued on June 15, 2022), however, changing FY2030 greenhouse gas emissions targets to 19 million tons from 16 million tons

2.(2) Our Strategy and Capabilities

・**Implement CCS by 2030. Build competitive advantage** by working ahead of competitors.
・**Contributing to the realization of social sustainability** through diverse business development with CCS by taking "**Two-pronged Approach**".

Axis to date

Conventional Oil and Gas E&P

Transition

Blue E&P
Previously discovered/ Undeveloped PJs

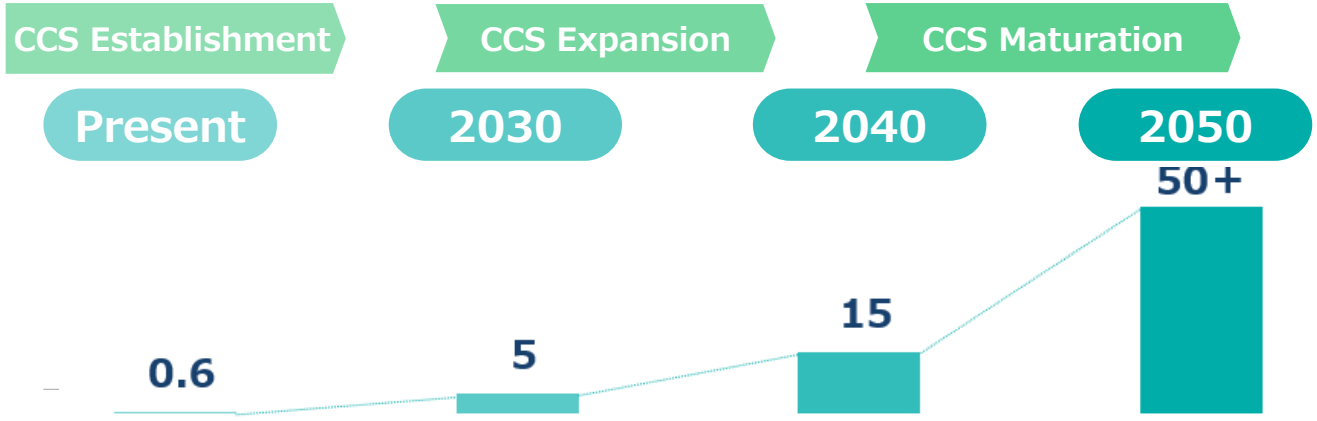
Axis onward

CCS

- Blue hydrogen, ammonia → **Production** — **Transportation** — **Sales**
- Blue Power → **Power generation**
- Negative carbon → **Biomass・DAC**
- Industrial CCS → **Hard-to-abate industries:** Power plants, Refineries, Steel mills, Cement plants, etc.
- **CO2 credit composition and market trading**

Annual CO2 storage target

(mmtpa-CO2)

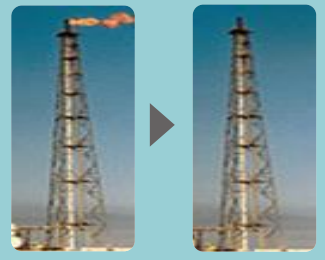


2.(2) Our Strategy and Capabilities

- CCS is **the most feasible decarbonization technology** because **existing E&P technologies are transferable**.
- It is widely anticipated as a key measure for **achieving significant CO2 reductions.**

2000

Zero Flare (UAE, Abu Dhabi)

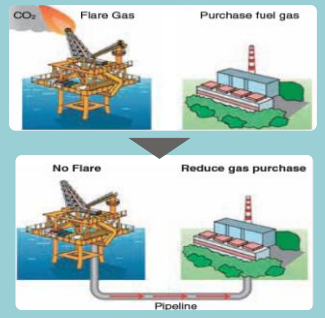


The first PJ in the ME to use sour gas as an injectant which achieved reduction of emissions of CO2 and H2S

- CO2 emissions reduction
- Oil production enhancement

2007

CDM Project (Vietnam)



The first CDM approval in the oil & gas industry in the world

- CO2 emissions reduction
- Oil production enhancement

2011

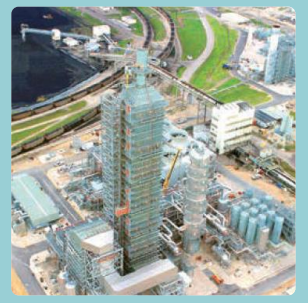
CO2-EOR Pilot Test (Vietnam)

The first offshore CO2-EOR in Southeast Asia

- CO2 emissions reduction
- Oil production enhancement

2017

Petra Nova CCUS Project (USA, Texas)

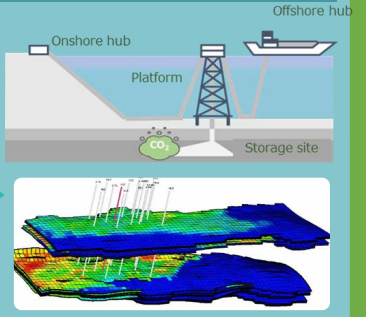


The world's largest post-combustion carbon capture-EOR project

- CO2 emissions reduction
- Oil production enhancement

2022~

Large-scale CCS Project (Japan)

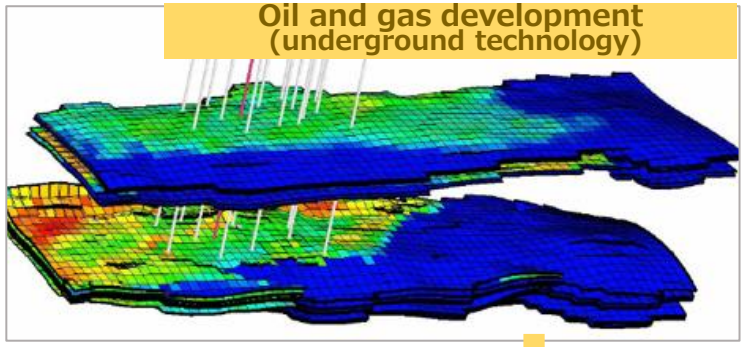


One of the first large advanced CCS projects in Japan aiming to start in 2030

- CO2 emissions reduction

2.(2) Our Strategy and Capabilities

Strengthening and building of the CCS value chain



JDC JAPAN DRILLING COMPANY

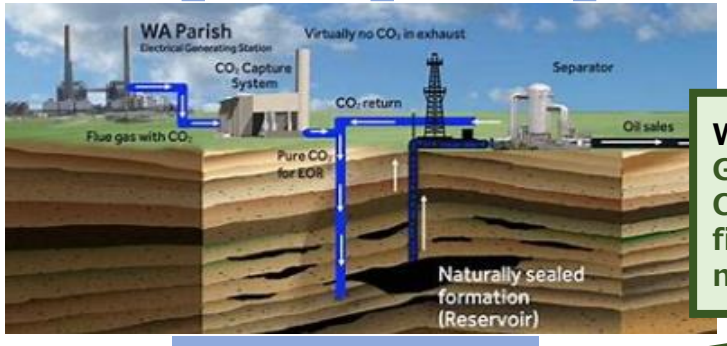
Participation in JX group adds injection well drilling technology and operational capacity, strengthening our CCS value chain (Owns 3 jack-up drilling rigs, 1 semi-sub rig)

Optimization of LCO2 transportation is handled through partnership with shipping companies

CO2 emission source	Separation and capture	Storage site selection	Injection well drilling	CO2 transportation	CO2 injection and storage	Monitoring

Petra Nova:
Knowledge acquisition for operation of separation and capture equipment (the world's largest plant for CO2 capture from flue gas)

Petra Nova (PNPH)



West Ranch

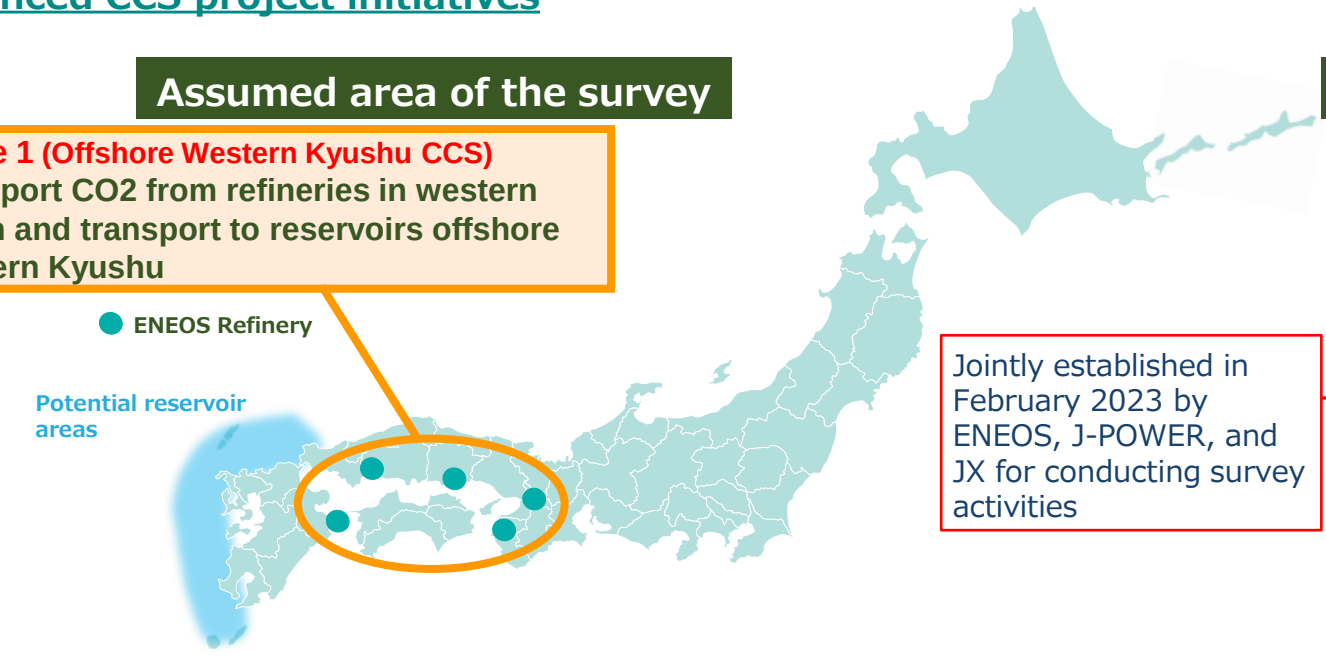
West Ranch Oil Field
Gain knowledge of supercritical CO2 pipeline transportation, oil field injection operations and monitoring

2.(3) Progress of CCS/CCUS Projects in Japan and Overseas

Status of advanced CCS project initiatives

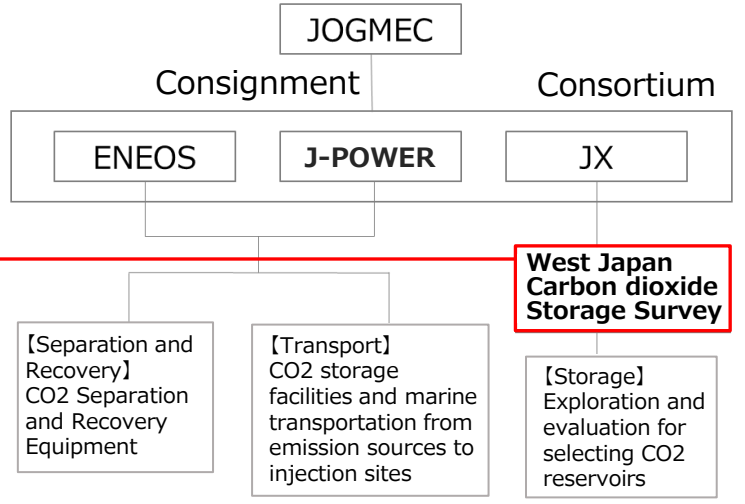
Assumed area of the survey

Phase 1 (Offshore Western Kyushu CCS)
Transport CO2 from refineries in western Japan and transport to reservoirs offshore Western Kyushu

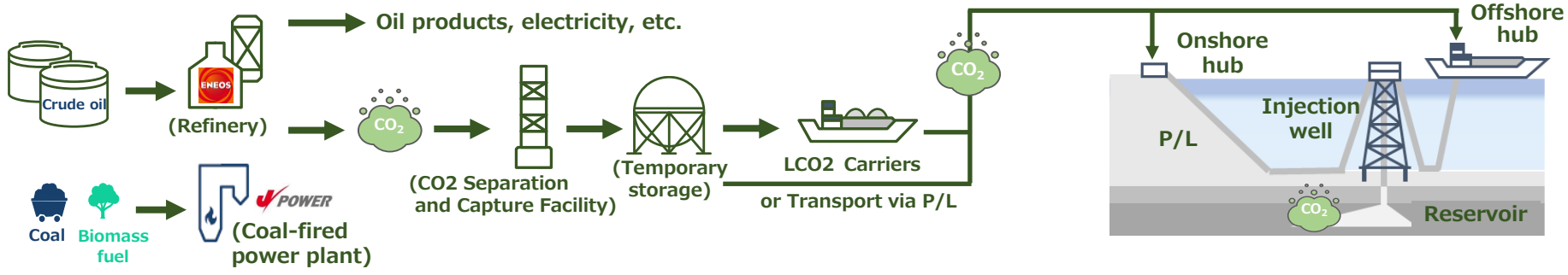


Survey Formation

Jointly established in February 2023 by ENEOS, J-POWER, and JX for conducting survey activities



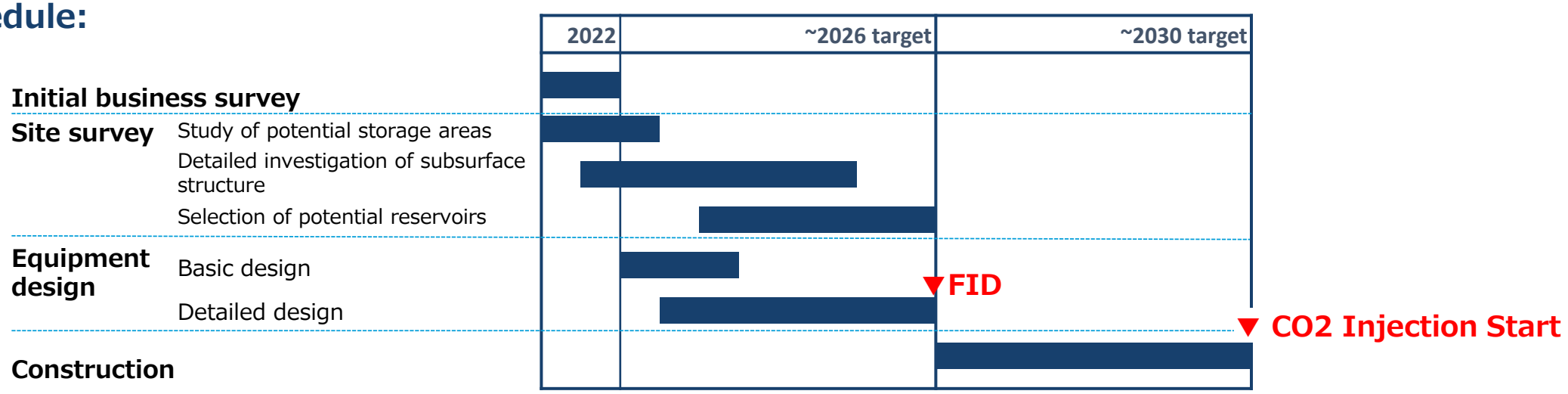
CO2 Capture from refineries and power plants / CO2 Transport / CO2 Storage



2.(3) Progress of CCS/CCUS Projects in Japan and Overseas

Offshore Western Kyushu CCS: schedule and challenges for implementation by 2030

Schedule:



Technical issues:

- **There are few oil and natural gas fields in Japan, and it is not easy to select stable and large-scale injection storage sites.**
- **Designing CO2 transportation to maximize and optimize profitability and safety, as well as optimizing storage monitoring accuracy, are also challenges.**

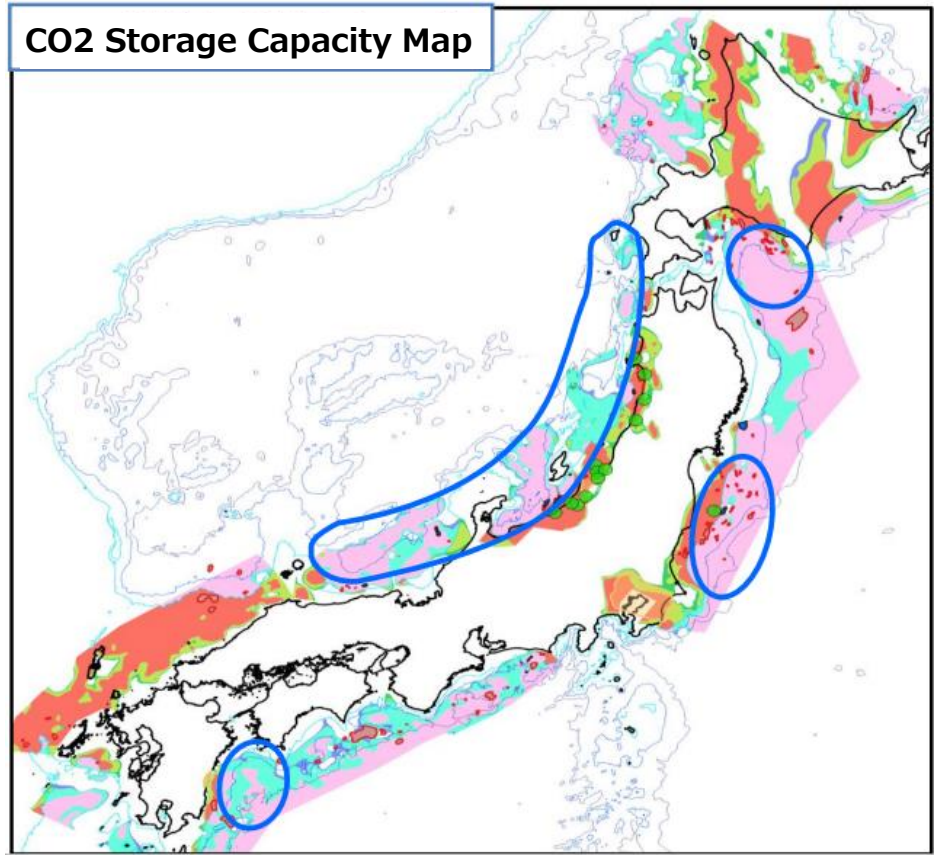
Time Constraints:

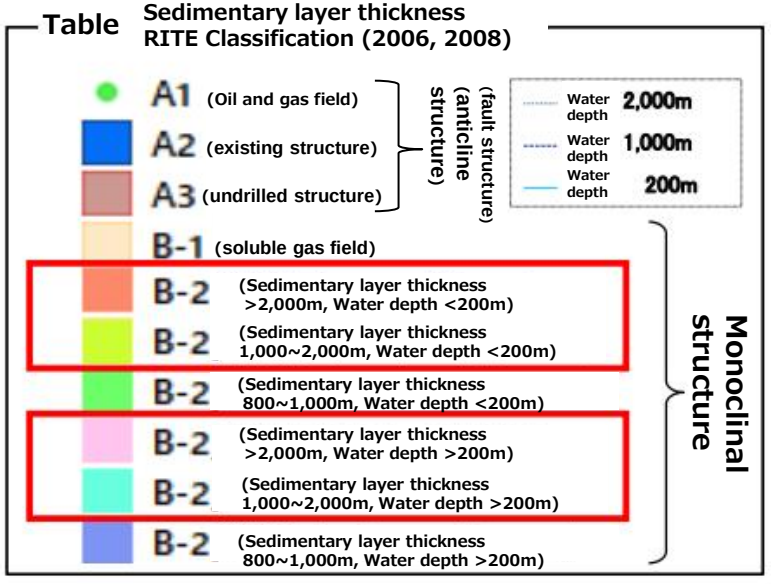
- **For implementation by 2030, the company must harmonize the scopes of CO2 capture, transport, and storage for FID by 2026. In addition, agreements with local government, community, fishery unions, etc. must be reached before the FID.**

2.(3) Progress of CCS/CCUS Projects in Japan and Overseas

Phase 2
Consider possibilities of transporting CO2 from domestic hard-to-abate industries and injecting to areas with high storage potential in the coastal waters of the Pacific and Japan Sea.

(Reference: Excerpts from the 4th CCS Long-Term Roadmap Study Group on April 20, 2022)





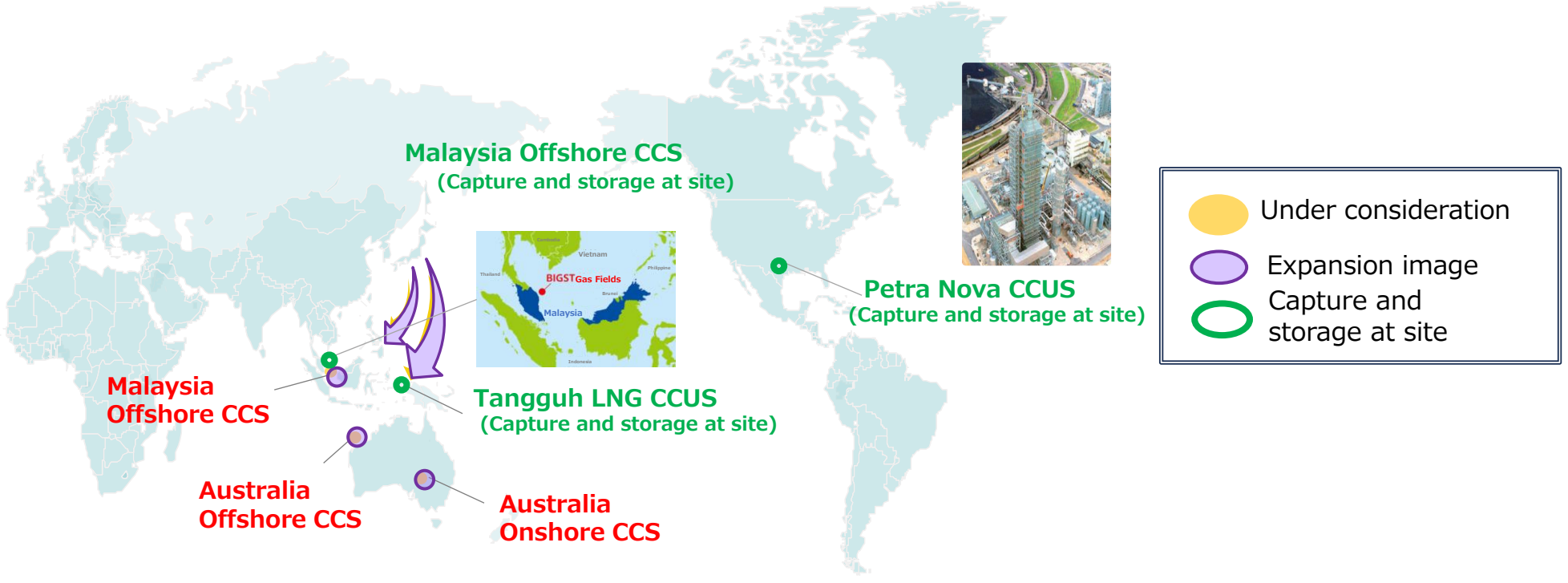
Based on the data from RITE in 2006 and 2008, edited by Japan CCS Co., Ltd. (JCCS).

○ Geological analysis area using 3D/2D detailed examination data.(Conducted within part of the ellipse. The size of the ellipse has no significance)

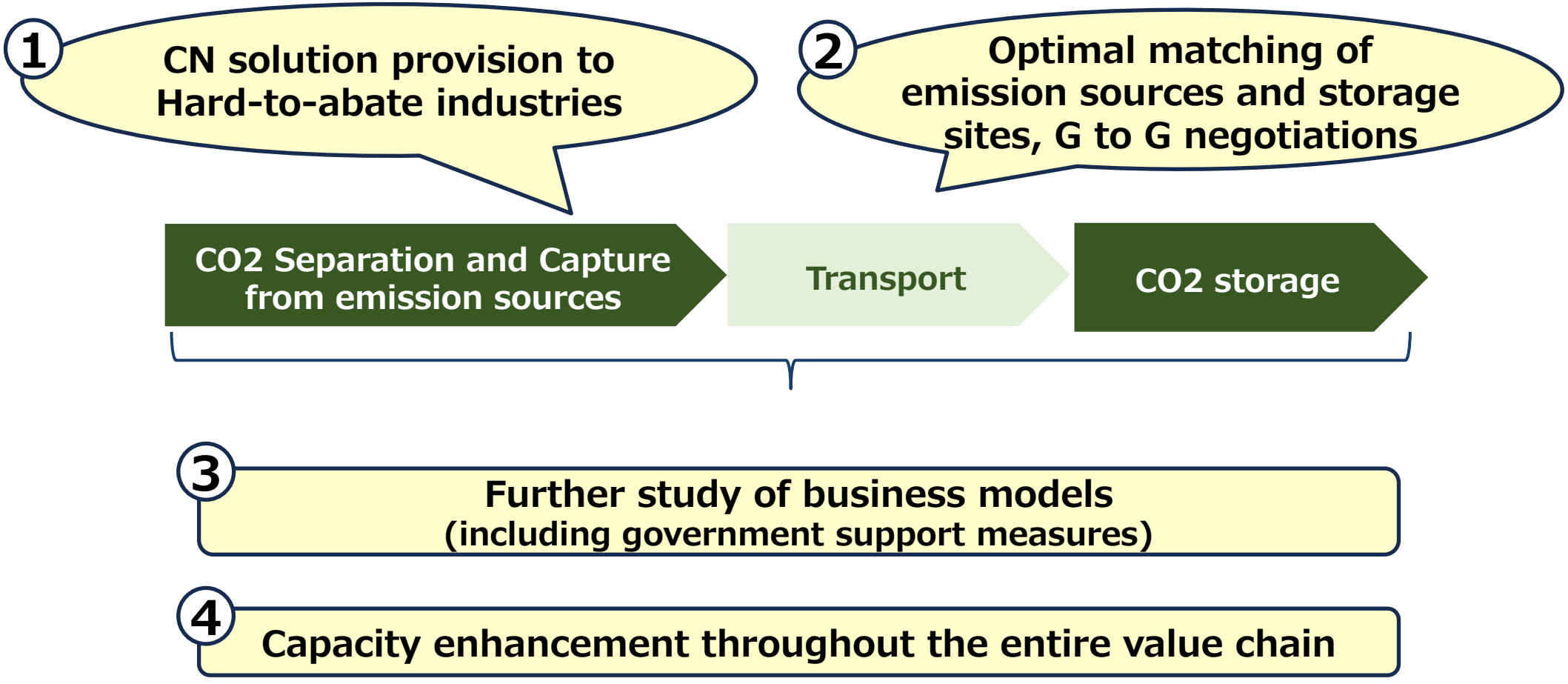
2.(3) Progress of CCS/CCUS Projects in Japan and Overseas

Status of Overseas CCS/CCUS Initiatives

- After **securing storage concession rights in Southeast Asia and Oceania**, we plan to transport CO2 from Japan and inject into suitable large-scale storage reservoirs (while domestic storage will be prioritized, overseas storage will supplement storage capacity limitations).
- Currently, specific projects are under consideration **in Malaysia, Australia**, etc.



2.(4) CCS Business Challenges and Our Strengths



2.(4) CCS Business Challenges and Our Strengths

(1) CN solution provision to Hard-to-abate industries = Mitigation of CO2 gathering risk

- Request for a national initiative to **create a system** where local governments and industrial complexes work together, **allowing emitters to stably and sustainably capture CO2 for long term.**

➡ **Seek a win-win relationship for emitters and storage operators** by maintaining essential industries in Japan and ensuring the smooth development of CCS infrastructure and operations.

(2) Optimal matching of emission sources and storage sites, G to G negotiations

- After the second movers, **optimal matching between emission sources and storage sites** will be necessary.

- For the selection of overseas storage sites and negotiations, emphasize **the need for G to G** leadership and coordination to protect national interests, rather than negotiations by individual consortium.

2.(4) CCS Business Challenges and Our Strengths

(3) Further study of business models (including government support measures)

- **For advanced CCS** projects where the business model has not yet been established, **extensive governmental support measures are** essential to successfully establish the CCS business.
- For projects after second movers, it is important to **establish a profitable scheme for storage operations** to ensure a reasonable return on private sector investments**.**

(4) Capacity enhancement throughout the entire value chain

- By 2030, **an early establishment of an environment is needed where contractors, vendors, and shipping companies can confidently make capital investments.**

➡**Enhance the capacity of the entire CCS value chain** by encouraging market entry and healthy business development for private companies.

2.(4) CCS Business Challenges and Our Strengths

Business opportunities in the value chain tied to the storage business

➡Actively seek new business opportunities outside of the storage business to generate revenue over the life of the project.

Selection and assessment of potential reservoirs

➢ Rig business (Already worked on)

Equipment (Basic/Detailed design)

EPC

➢ Supply of various materials (piping, casing, etc.)

➢ Platform construction business

To achieve 120 million tons in 2050, **400** injection wells will be needed, assuming 300K tons per well.
= 20 drilling business opportunities per year x 20 years

➢ Ship transportation business (Joint study for optimization underway)

CO2 transportation, injection and storage, monitoring

➢ Monitoring business for stored CO2 (Obligated under the CCS Business Law)

Thank you for your participation!

Reference: Recent CCS-Related Activities (News Releases from the End of Last Year)

August 9, 2024 Change of Company Name We are starting a new year with the new name, ENEOS Xplora

April 9, 2024 JX to Join Forces with Sumitomo Corporation at Large Scale SAF/BECCS Project in Louisiana

March 26, 2024 New Development Project for Gas Fields Using CCS Technology in Malaysia (BIGST Project) Execution of Production Sharing Contract and Joint Operating Agreement

March 21, 2024 JX, NYK, and KNCC Jointly Study Optimization of CO_2 Liquefaction and Storage Process

March 19, 2024 JX and Chevron Sign MOU for Collaboration on Development of CCS Value Chain

March 14, 2024 Establishment of the Social Cooperation Program “Creation of CCS Monitoring Center by Innovative Digital Technology”

March 1, 2024 JX Nippon, ENEOS, Mitsubishi Corporation and PETRONAS to Evaluate and Establish CCS Value Chains from Tokyo-Bay to Malaysia

February 28, 2024 Announcement of Organization Change (CCS Project (JAPAN) Department, ⇨ CCS Project Department, effective on April 1, **2024**)

February 5, 2024 JX and MOL Sign MoU for Development of Cross Border CCS Value Chain

December 15, 2023 Signing MOU with Santos Limited for Joint Study of CCS Value Chain between Japan and Australia