



Ministry of Economy, Trade and Industry

Japan's CCUS / Carbon Recycling Policy

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Basic Policy for Realization of Green Transformation (GX)

(GX Promotion Act, May 2023)

Government support will be provided for upfront investment of 20 trillion yen (= \$153.8 billions*) (such as in hydrogen/ammonia, renewable energy, and energy efficiency improvement) with a view to achieving carbon neutrality by 2050, while strengthening industrial competitiveness and realizing economic growth, aiming for more than 150 trillion yen (= \$1.2 trillions*) of public and private investment over the next 10 years.

A "Growth Oriented Carbon Pricing Concept" is to be embodied and implemented.

- ① Government support for bold upfront investment by issuing "GX Economic Transition Bonds" (20 trillion yen over the next 10 years)
- ② **Introduction of carbon pricing to give incentives for GX investment**
 - (1) Full-scale operation of emissions trading system in high emission industries [from FY2026].
+ Allowance auctioning is phased in gradually to **power generation companies** [from FY2033]
 - (2) Introduction of a carbon levy on fossil fuel importers [from FY2028]
- ③ Strengthen financial support through public-private partnership

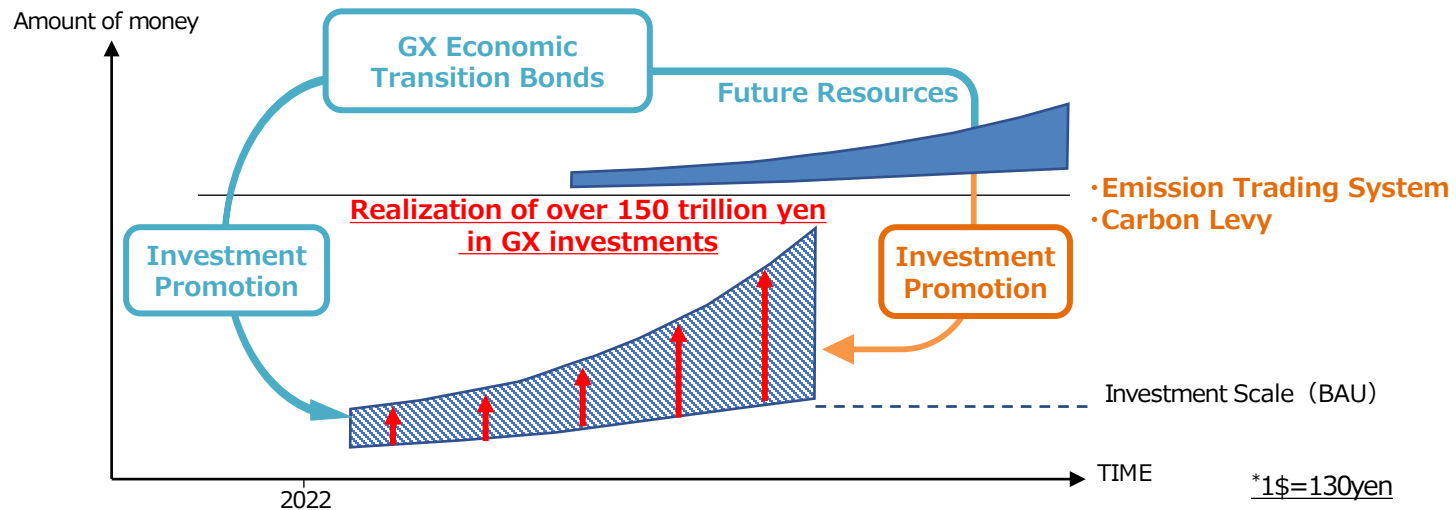
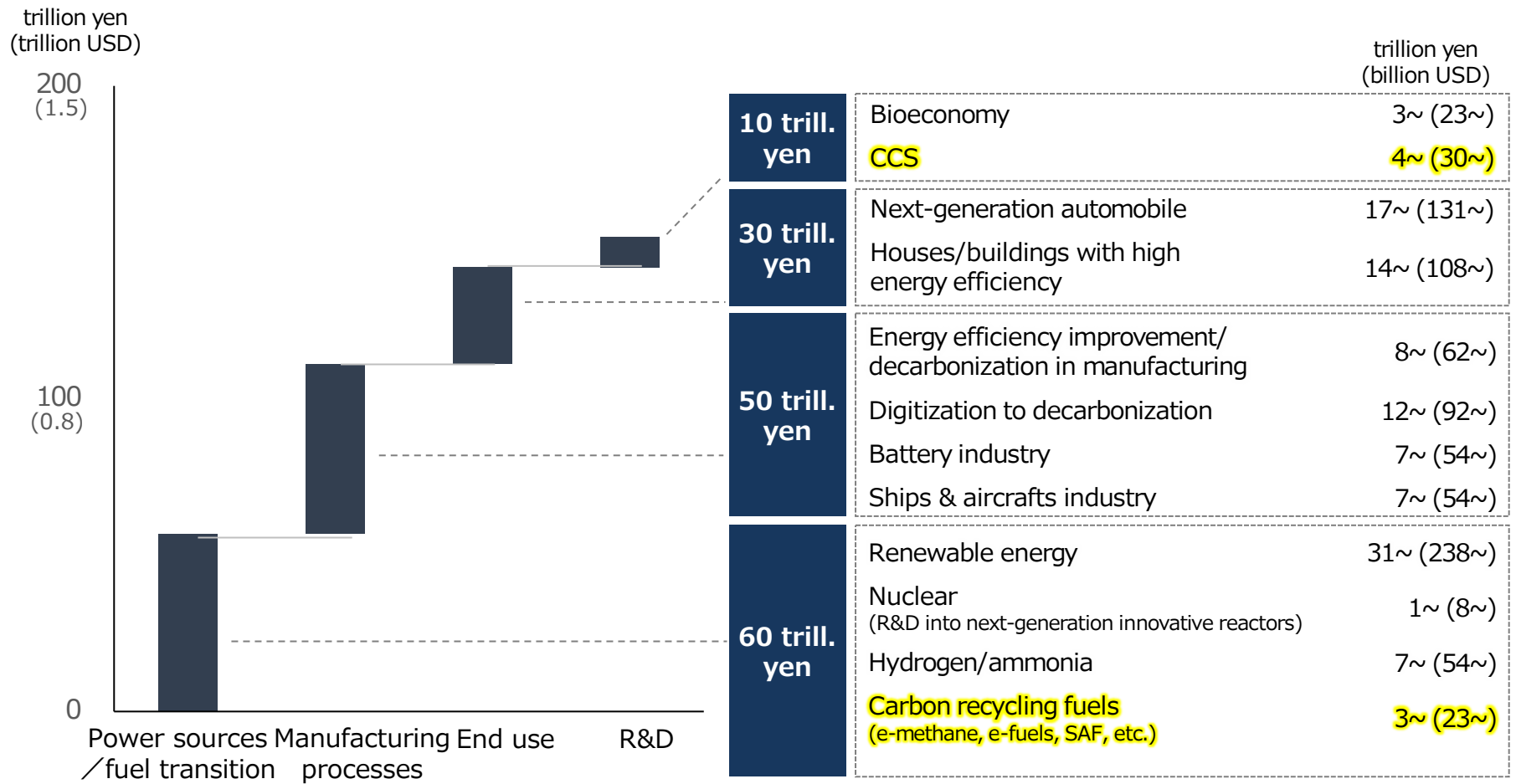


Image of public/private investment to realize Green Transformation (GX)

(GX Implementation Council on Dec. 12, 2022)



*Approximate values based on certain assumptions

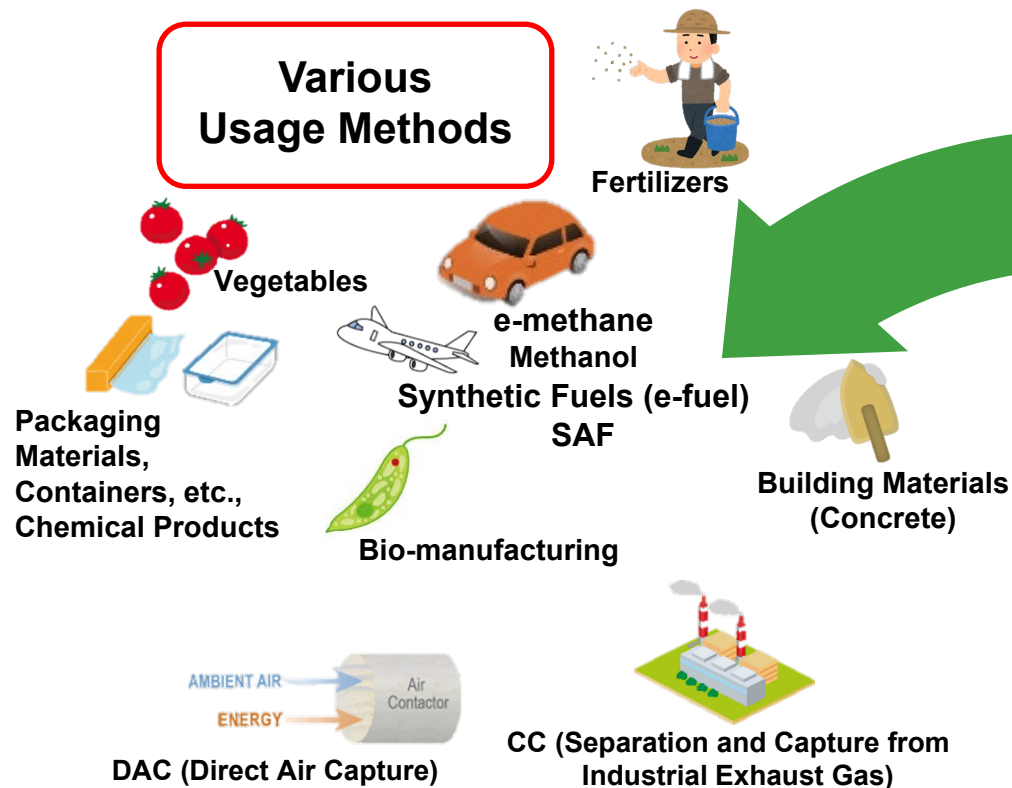
*1\$=130yen

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Concept of Carbon Management (CCU - Carbon Recycling/CCS/CDR)

Various Usage Methods



Potential for CO₂ Circular Use Through Carbon Recycling (Estimated)
Maximum approximately 200 million to 100 million tons (by 2050)

Carbon Recycling Technologies

Catalyst development, artificial photosynthesis, algae utilization, biomass utilization, methanation, concretization, plant factories, etc.

Capture (CC/BECC/DAC)

CCS

**Direct Utilization
EOR
(Enhanced Oil Recovery)**

CCU/Carbon Recycling: initiatives by Japanese Companies

Chemical / Mineral products

E-methanol, E-methane, E-fuel/SAF

EU/Europe

CCU technology: Sekisui Chemical and ArcelorMittal

Carbon Credit: Mitsubishi Co. and South Pole

China

E-methanol (sales): Marubeni and MFES

E-Methane (F/S): Hitachi Zosen in the Yulin ETDZ

ASEAN

<Malaysia>

- **E-methane** (F/S): Sumitomo Co., Tokyo Gas and Petronas.

<Thailand>

- **E-methane:** Nippon Steel Engineering and local cement factories

<Indonesia>

- **CCU technology:** Chiyoda Corporation and Pertamina

<Singapore>

- **E-SAF** (joint R&D): IHI and the Institute of Science and Technology

- **E-methane** (F/S): Osaka Gas and a local company.

Canada

Low-carbon concrete:

Mitsubishi Co. and Carbon Cure

Carbon capture and conversion to Potassium carbonate: Tokyo Gas and CleanO2

Australia

Carbon Calcium Fixation:

Itochu, Taisei Co. and MCI
E-methanol (F/S): Mitsubishi Gas Chemical and Cement Australia

E-methane

- Osaka Gas and Santos (detailed studies)
- INPEX and CSIRO (F/S)

E-fuel/SAF (F/S): Toyo Engineering and Sojitz

United States

CCU aggregate for concrete:

Mitsubishi Co. and Blue Planet

Bio CCU technology:

- Mitsui & Co. and LanzaTech (ethanol)
- Sekisui Chemical and LanzaTech at Iwate Pref.
- Mitsubishi Heavy Industries has invested in Symbiata Factory

E-methanol: Mitsui & Co. and CERANIZE

E-methane (F/S)

- Tokyo Gas, Osaka Gas, Toho Gas, Mitsubishi Co.
- JERA
- Osaka Gas with bio-derived CO₂

E-Fuel: Mitsubishi Heavy Industries has invested in Infinium

DAC: Tokyo Gas has invested in Global Thermostat

Peru

E-methane (F/S): Osaka Gas and Marubeni

Middle East

<Saudi Arabia>

E-methanol (F/S): Mitsui & Co. and Saudi Aramco

The Significance of CCU/Carbon Recycling

< If fossil fuels are used as usual: Base Case >

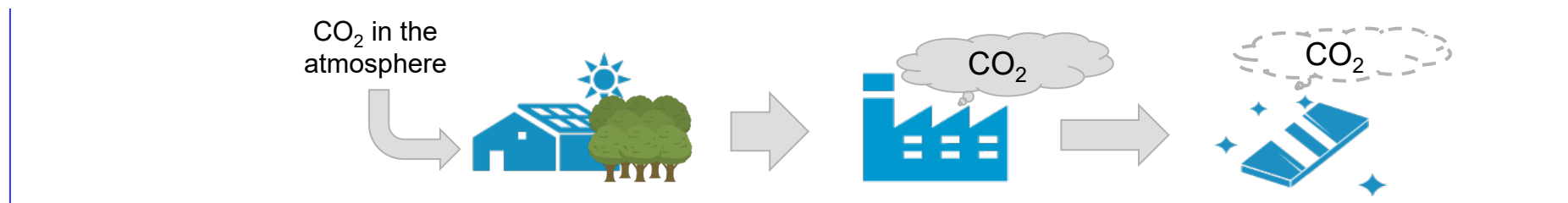


When comparing these systems as a whole, the emissions in the latter case are more suppressed.

< If CO₂ is captured and recycled >

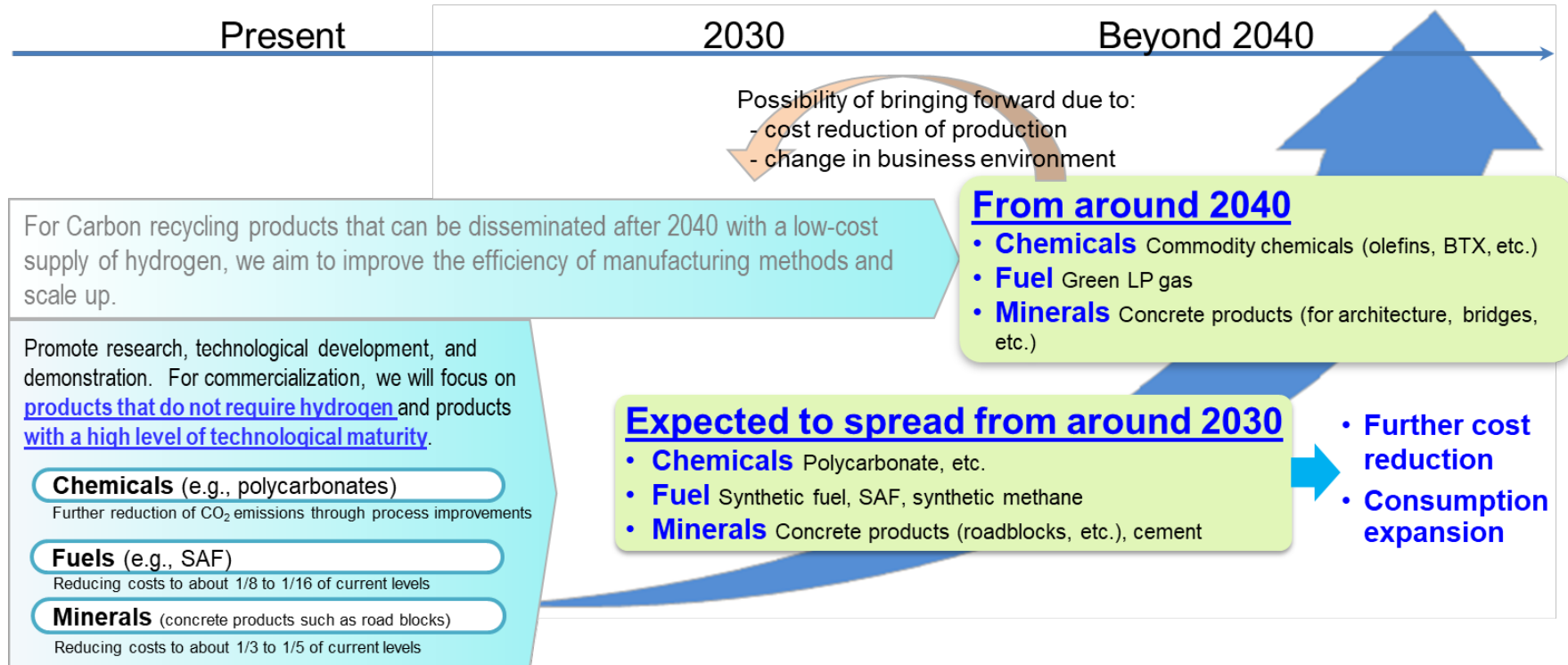


< If ambient CO₂ is captured using DAC or bio-tech and recycled (Ideal state for 2050) >



Carbon Recycling Roadmap (2023)

- Based on cost projection of CO₂ capture technology and hydrogen in Japan, the roadmap illustrates important technologies with cost and efficiency target.
- The Roadmap also identified issues to be examined for commercialization.



< Issues to be examined >

- Creating CO₂ supply chain and viable CCU industry (ex. CCU at chemical complex, on-site of cement/steel industry)
- Promoting International project with CO₂ accounting
- CCU startup ecosystem

Green Innovation Fund projects on Carbon Recycling

- Utilizing **Green Innovation Fund**, NEDO supports carbon recycling technologies for five areas, including CO₂ capture technology and Recycled carbon fuel
FY 2020 Supplementary budget: USD 3.8 billion (513.2 billion yen).

(1) Concrete / Cement

Concrete production

- Develop technology for maximizing the volumes of CO₂ absorption and fixation concrete and achieving public implementation.



Cement production

- Develop cement production processes that capture almost limestone-derived CO₂ and achieving public

(5) CO₂ capture technology

- The challenge is to reduce the energy cost to capture CO₂.
- Working on innovation of separation materials, and reduce costs and strengthen international competitiveness.

(2) Recycled Carbon Fuel

Synthetic fuel

- Further improve efficiency of the entire manufacturing process.

SAF

- Develop SAF production technology and achieve the production cost of USD 0.7-1.5 per liter (100-200yen/L).

Synthetic methane

- Develop highly efficient methane synthesis by integrally performing water electrolysis reaction and methane synthesis reaction.

Green LPG

- Develop catalysts and synthetic methods that are the basic technology for producing green LPG.

(3) Chemicals

- Develop chemicals manufacturing technology (artificial photosynthesis) from green hydrogen and CO₂, and naphtha decomposition furnace technology by making the carbon-free heat source.



Large-scale demonstration of photocatalyst panel

(4) Bio manufacturing

- Develop and improve microorganism design platform technology
- Develop biomanufacturing technology using microorganisms, such as hydrogen bacteria that use CO₂ as raw material.

R&D and demonstration base at Osaki-kamijima, Hiroshima

- R&D and demonstration base at Osaki-kamijima island (Hiroshima) promotes public im
plementation of Carbon Recycling technologies.



Coal Gasification Facility

Facility for CO₂ Separation and Capture



R&D and demonstration base
for Carbon Recycling

Algae Research Area



Demonstration and
R&D area



Basic research area



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CCS 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 CO₂ storage of about 120 to 240 million tons as of 2050, and full-scale CCS business shall deploy after 2030.

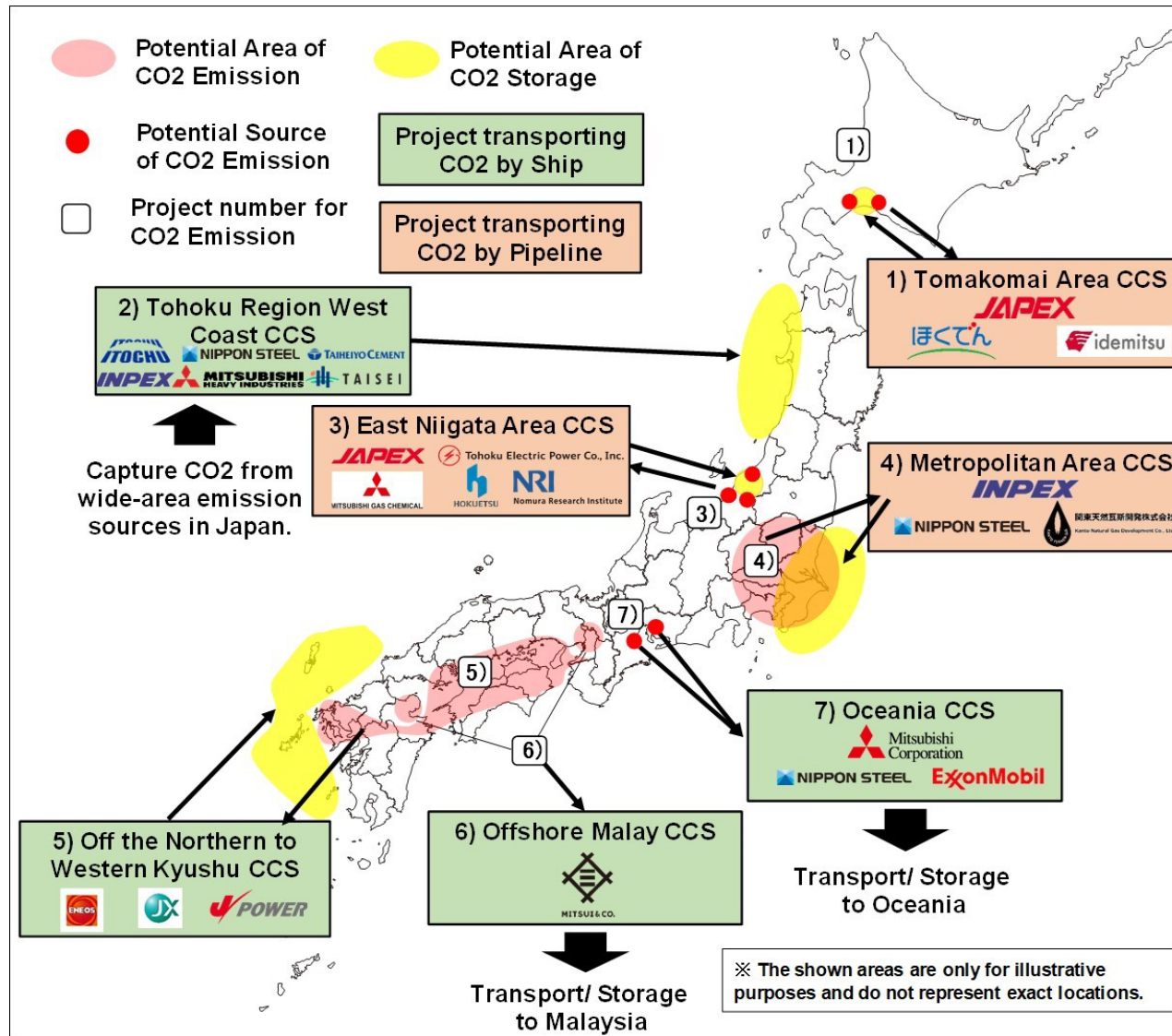


[Specific actions]

- (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

Advanced CCS Program Projects

- Program aims to establish CCS business models by supporting projects with different combinations of CO₂ source, transportation methods and CO₂ storage areas. It aims to secure 6-12 million tons of CO₂ storage per year by 2030.



Japan's contribution toward CCS value chain

- Japan is the only country 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** Invested in Larvik Shipping
Mitsui O.S.K. Lines

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

[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

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 CO₂ storage potential is expected.

