Social Implementation of Synthetic Methane to Achieve Carbon Neutrality

2022/3/25

Tokyo Gas Co,. Ltd.

Tokyo Gas's Steps Toward Achieving Carbon Neutrality by 2050

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- **Tokyo Gas will contribute to the carbon neutrality by 2050 through the following three perspectives and measures:**
  (1) Decarbonization/green transformation(GX), (2) Improving resilience of energy supply, and (3) Effective utilization of existing infrastructure. Digital technologies are actively and effectively used in all measures.
- **From the perspective of minimizing additional social costs, synthetic methane is an effective solution for the mid to long-term active decarbonization measure of gas energy**

Perspectives & Means

⊖ Decarbonization/GX

Innovation and Perspective of Heat Utilization

- **Power sector** : Expansion of renewable energy and greening thermal power plant
- **Heat utilization sector** : Advanced Energy Usage, CCU・CCS, and employment of **Synthetic methane and hydrogen**

⊖ Resilience

Strength toward Disaster

- Diversification of energy sources and multiplexing of energy networks
- Integration of supply-side and demand-side (use of digital technology)

⊛ Effective utilization of existing infrastructure

Minimizing additional social costs

- Continue to leverage existing infrastructure throughout the city gas and LNG supply chain by decarbonizing gas energy with synthetic methane

LNG value chain and existing infrastructure

Procurement → **Transportation** → **Production of city gas** → **Distribution** → **Sales**

Volume of LNG procurement

12.6 Mt

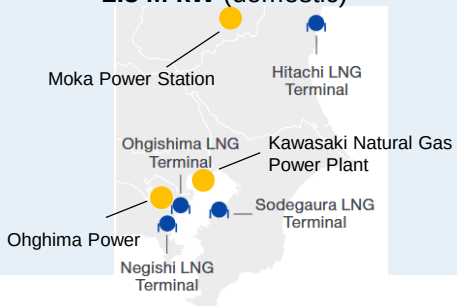
- for city gas **6.9** Mt
- for wholesale, power generation **3.8** Mt
- for other uses **1.9** Mt

Owned and managed vessels

13 ships

Natural gas-fired power plant

2.8 M kW (domestic)



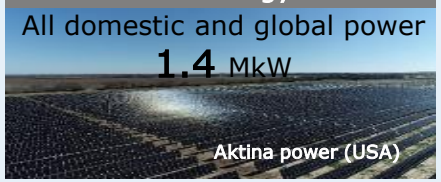
LNG terminal and pipeline network

4 terminals & pipelines over **60,000** km

Digital technology

renewable energy source

All domestic and global power **1.4** MkW



City gas

sales to **8.8** M and supply to **11** M customers

Electricity

Number of retail electricity sales **2.95** M customers

さすてな電気

octopus energy

As of 2021 March（Only number of electricity customers, as of 2022 March）

Group Management Vision and Initiatives for Carbon neutrality

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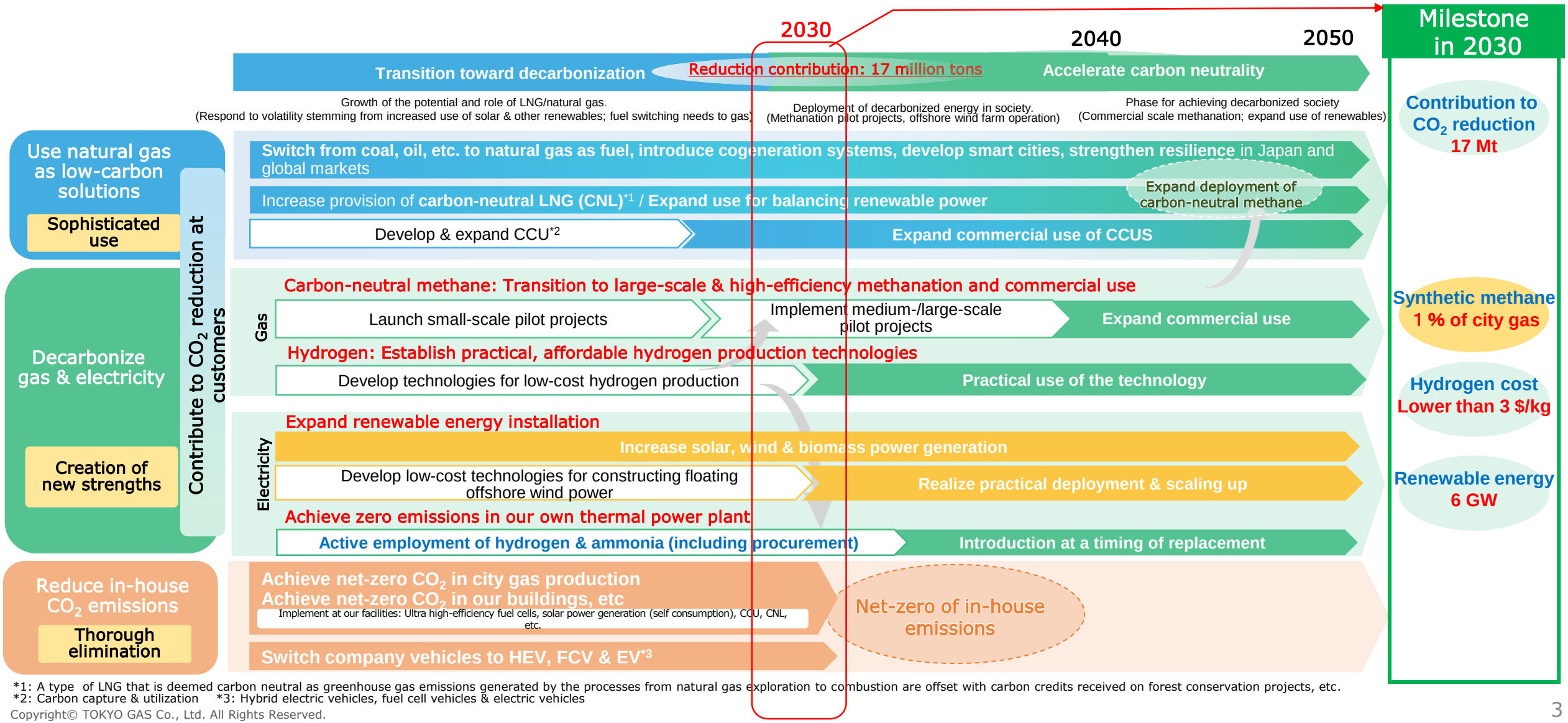
- **Further accelerate actions in order to achieve "net zero CO_2 emissions.**
- **As part of our challenge decarboning gas, we have set a new target of 1% synthetic methane of our city gas supply by 2030.**



*1: A type of LNG that is deemed carbon neutral as greenhouse gas emissions generated by the processes from natural gas exploration to combustion are offset with carbon credits received on forest conservation projects, etc.
*2: Carbon capture & utilization *3: Hybrid electric vehicles, fuel cell vehicles & electric vehicles

Promotion of hydrogen supply chain(production, supply, and utilization)

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- **Promoting overall hydrogen supply chain development in Japan and overseas to expand the hydrogen business.**
- **Considering on-site hydrogen production and utilization in Japan, and transportation of hydrogen from overseas to Japan by energy carriers like synthetic methane, NH_3, liquefied H_2, chemical hydride.**
- **Hoping to work with partners to enter the green hydrogen market in Japan and overseas, which is expected to grow in the future.**

Production

Development of low cost water electrolzer

- Low-cost water electrolysis technology required for green hydrogen production is under development.
- Considering the use of this technology for methanation and new hydrogen businesses.

Continuous production line for low-cost electrolysis cell stack

Onsite H_2 production

- Small to large hydrogen production equipment has been developed to meet a wide range of hydrogen demand for industrial users.

Supply chain of synthetic methane

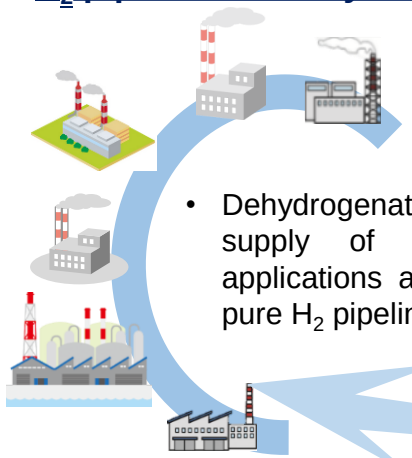
Transportation

Local hydrogen network

- Construction and operation of pipelines dedicated to hydrogen in HARUMI FLAG*

*Plan to redevelop the former site of the Tokyo 2020 Olympic and Paralympic Village

H_2 pipelines in Tokyo bay areas



- Dehydrogenate from energy carriers and supply of H_2 to power generation applications and industrial applications via pure H_2 pipelines.

Utilization

Energy supply using H_2 local network

- In Harumi area, heat and power will be supplied using fuel cells.

H_2 refueling station（4 stations）

- Toyosu Station supplies carbon-neutral hydrogen* and has the highest annual hydrogen refilling volume and frequency in Japan.

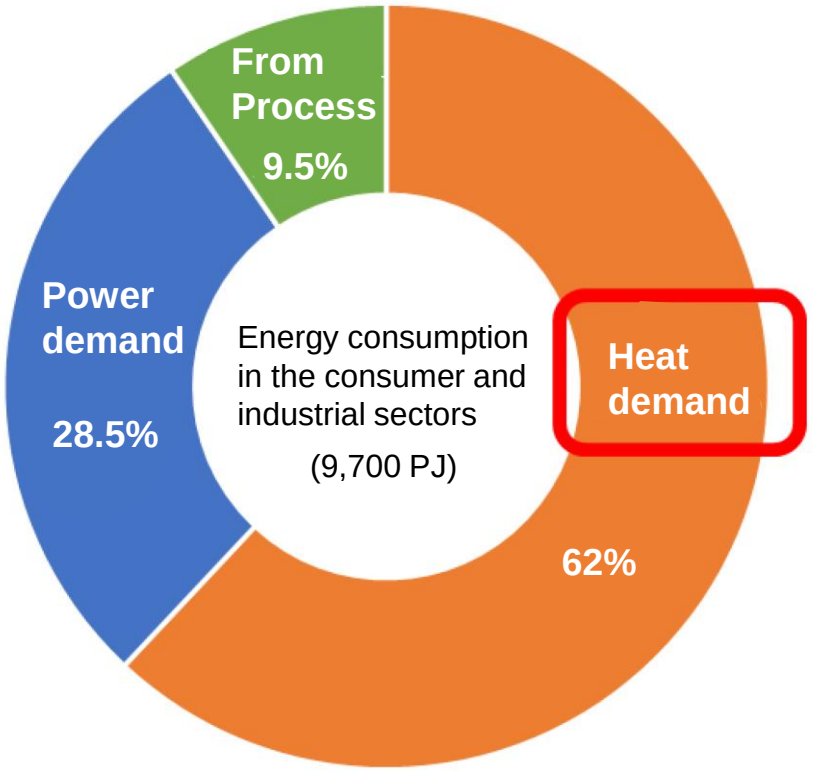
*Hydrogen produced using CNL as raw material (electricity used is 100% renewable energy)

Utilization of synthetic methane and H_2

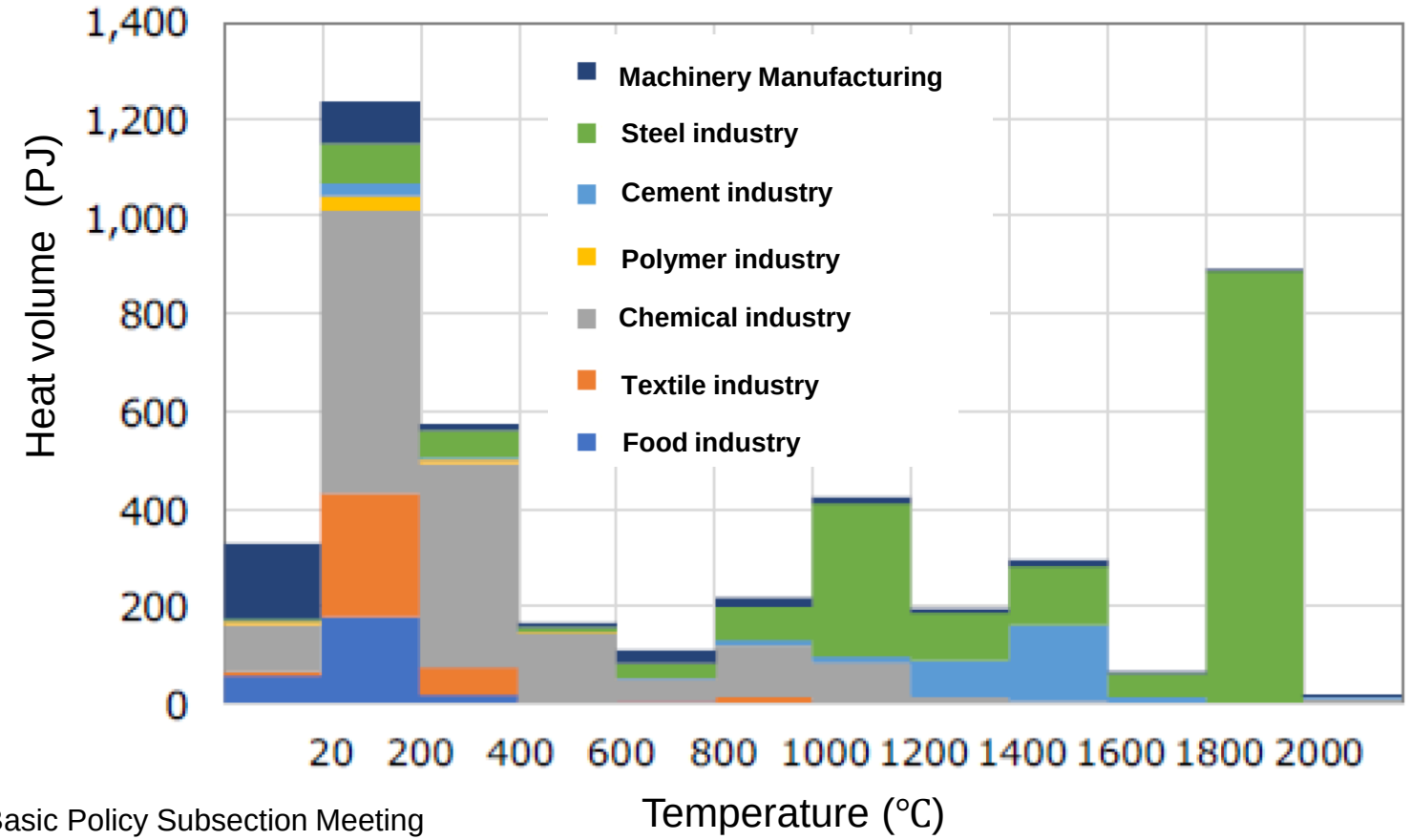
Heat demand and the importance of its decarbonization

- **Heat demand accounts for 60% of Japan's energy consumption in the commercial and industrial sectors. It is difficult to meet the high-temperature heat demand of the industrial sector by only electrification.**
- **To achieve carbon neutrality by 2050, decarbonization of the heat demand sector is important, and decarbonization of gas, which supplies heat energy to the demand side, will play a major role.**

Energy Consumption by Use in the Commercial and Industrial Sectors



Heat demand in the industrial sector by temperature range



*presented by METI at Basic Policy Subsection Meeting

CO_2 recycling through the use of synthetic methane

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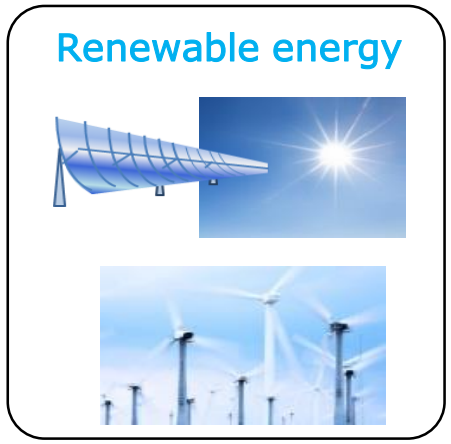
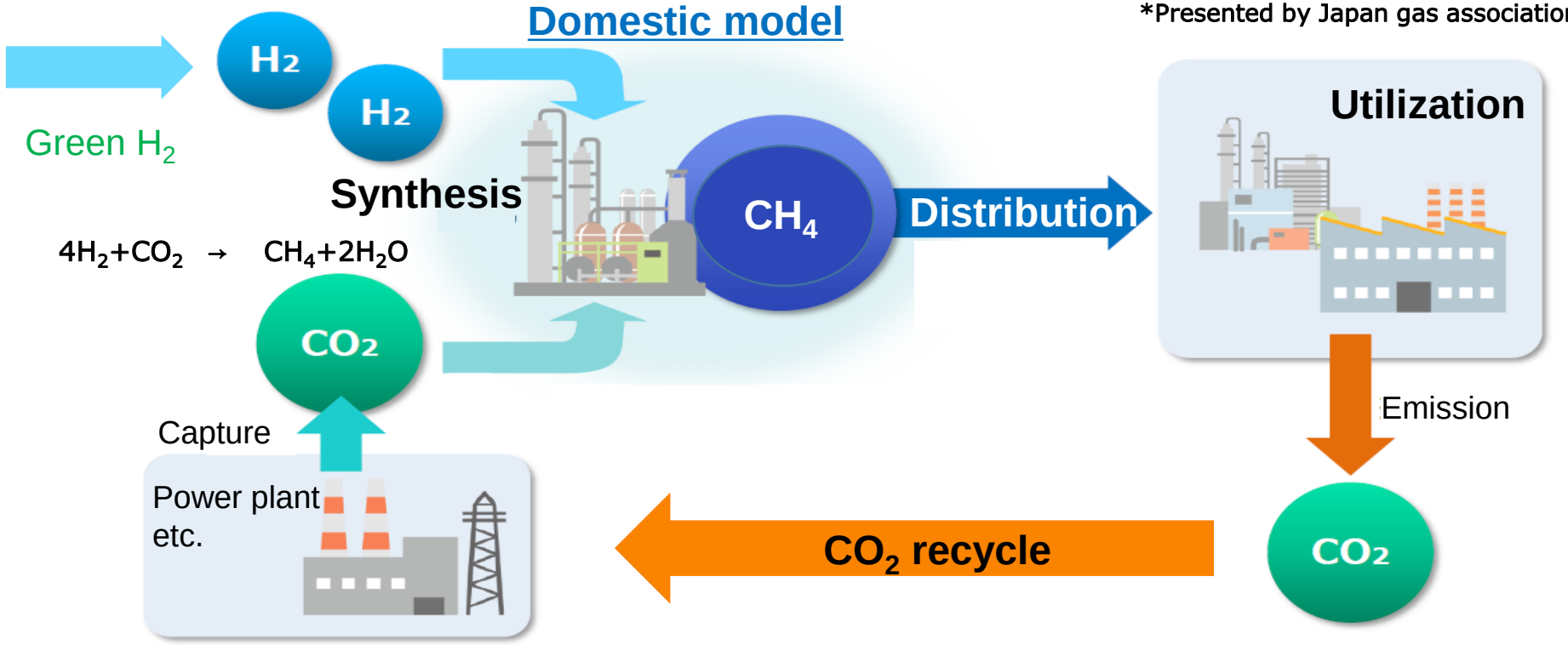
- Synthetic methane is produced by reacting hydrogen with CO_2 recovered from factories or thermal power plants.
- The utilization of synthetic methane does not increase CO_2 in air overall.
- The advantage of synthetic methane is that existing infrastructure (LNG facilities, gas pipelines, gas equipment, etc.) can be used without any modification and additional costs.

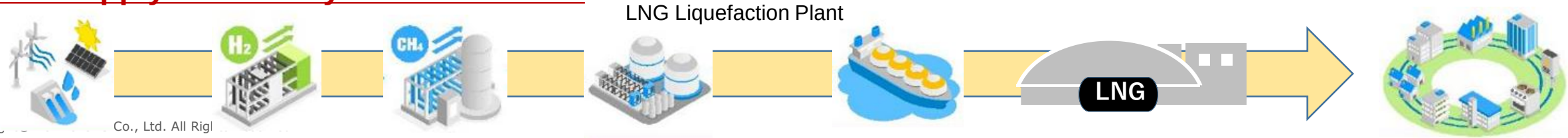
Domestic model

*Presented by Japan gas association





Global supply chain of synthetic methane



Roadmap for social implementation of synthetic methane (1% adoption by 2030)

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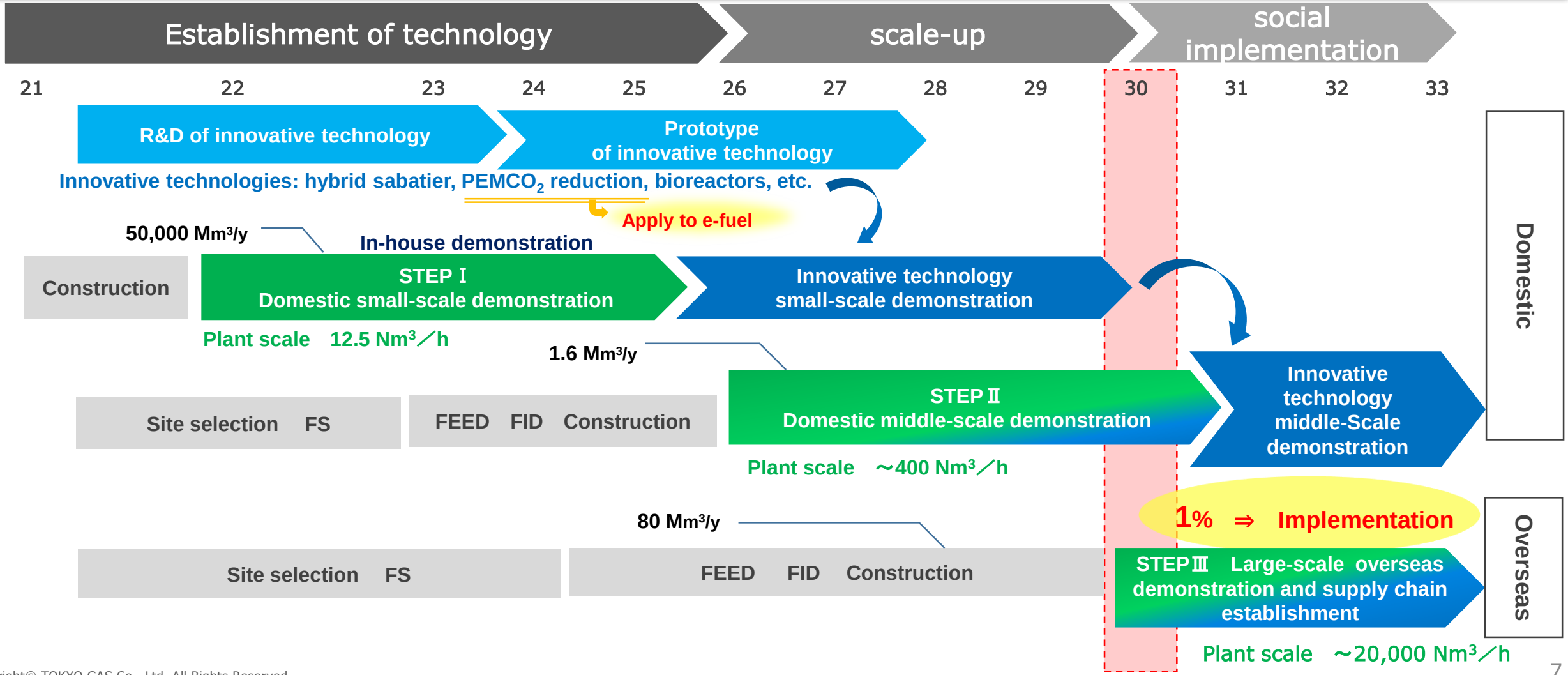
- Utilizing existing **methanation** technology, conduct a small-scale demonstration (Step I, ～50,000 m^3/y) from the end of FY 2021 and a middle-scale demonstration (Step II, approximately ～ 1.6 million m^3/y or equivalent) in the late 2020s.
- We will also promote the development of innovative methanation technologies for future cost reduction and realize the introduction of 1% synthetic methane (approx. 80 Mm^3/y) in 2030 through a large-scale overseas demonstration (Step III).



Social Implementation Initiatives of Synthetic Methane

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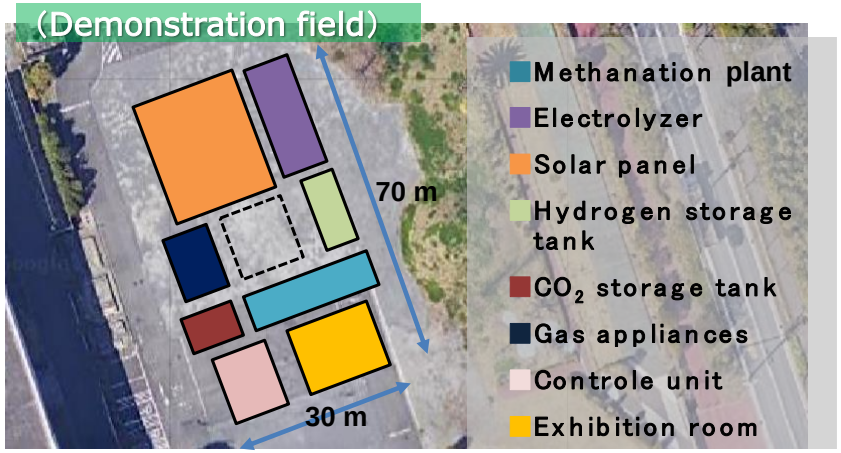
- **Small-scale demonstration : We have started a small-scale demonstration experiments of technology and collaboration for regional carbon-neutrality, and will acquire the skill and know-how for scaling up to mid-scale.**
- **Mid-scale demonstration : We will promote social implementation through conduit injection of the produced synthetic methane, on-site utilization, and regional cooperation toward large-scale production overseas.**

Small — Demonstration at Tokyo Gas's facilities (12.5 Nm^3/h) and regional collaboration

✓ **Period** : Since March 2022 small-scale demonstration in Yokohama has started.
- Regional collaboration with Yokohama City facilities, etc. is undergoing

✓ **Feature** :
- Electricity: Optimization of renewable energy and grid power
- CO_2: Receive and utilize CO_2 from neighboring facilities.
- Others: Linkage of recycled water, **biogas** (digestion gas), **CO_2,** etc. with surrounding facilities of **Yokohama city.**

✓ **R&D:** Existing technologies (Sabatier) will be tested and innovative technologies will be also developed.

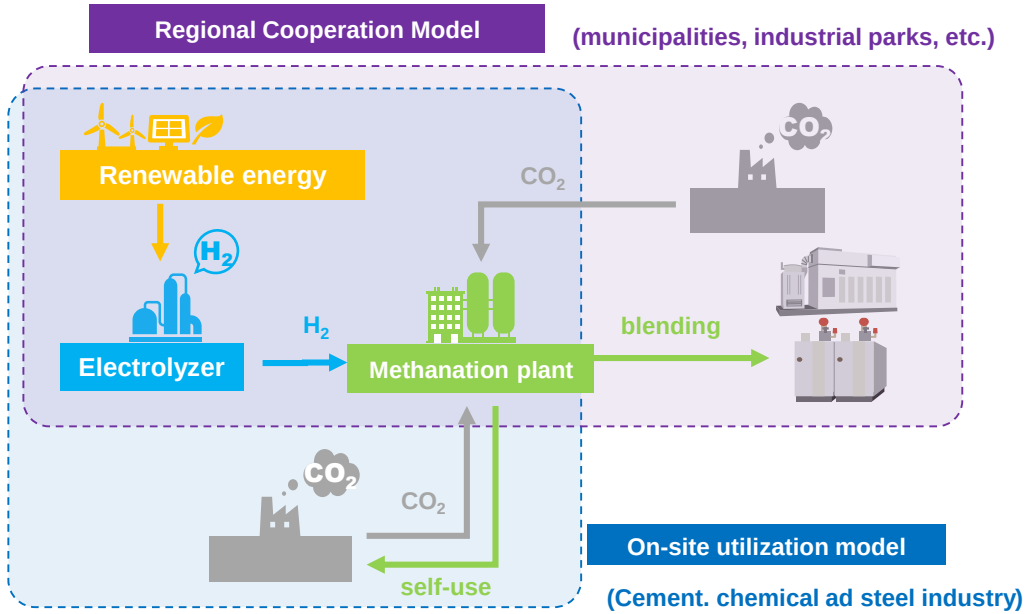


Middle — Domestic regional cooperation and on-site use (100 Nm^3/h scale)

✓ **Period** : Middle-scale demonstration + regional collaboration and on-site use demonstration planned from mid-20s.

✓ **Feature** : Production and utilization, and pipeline injection are planned for optimal utilization of resources in industrial areas, large consumers and specific regions in Japan.

✓ **Examples** : Employment of synthetic methane in cement, chemical and steel plants.



Key points to implement synthetic methane in society in 2030

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- **We will introduce synthetic methane equivalent to 1% of city gas by 2030.**
- **Key points are ⊖ R&D (large scale of synthetic methane) ⊜ Partnership ⊛ Institutional design and Public support.**

Commitment of Tokyo Gas

- **Aiming to introduce 1% by 2030 has been set as one of the main measures to achieve the corporate vision to reach carbon neutrality by 2050 as soon as possible.**
- **Multiple actions across the company groups to achieve the goals.**

Focusing points

⊖ R&D (scale-up)

- **Cost reduction by various technology options**
- **Development of innovative technologies for methanation and hydrogen production**
  - ✓Also in related technologies synthetic methane: CCUS, DAC
- **Technological verification through demonstration and with scale-up of plants**

⊜ Partnership

- **Extensive partnerships with leading domestic and international players**
  - ✓ Collaboration and portfolio management across city gas industry
  - ✓ Supply chain development (trading companies, NOCs, IOCs and other LNG companies, customers, local governments)
  - ✓ Engineering collaboration and open innovation (manufacturers, research institutions, start-ups, etc.)

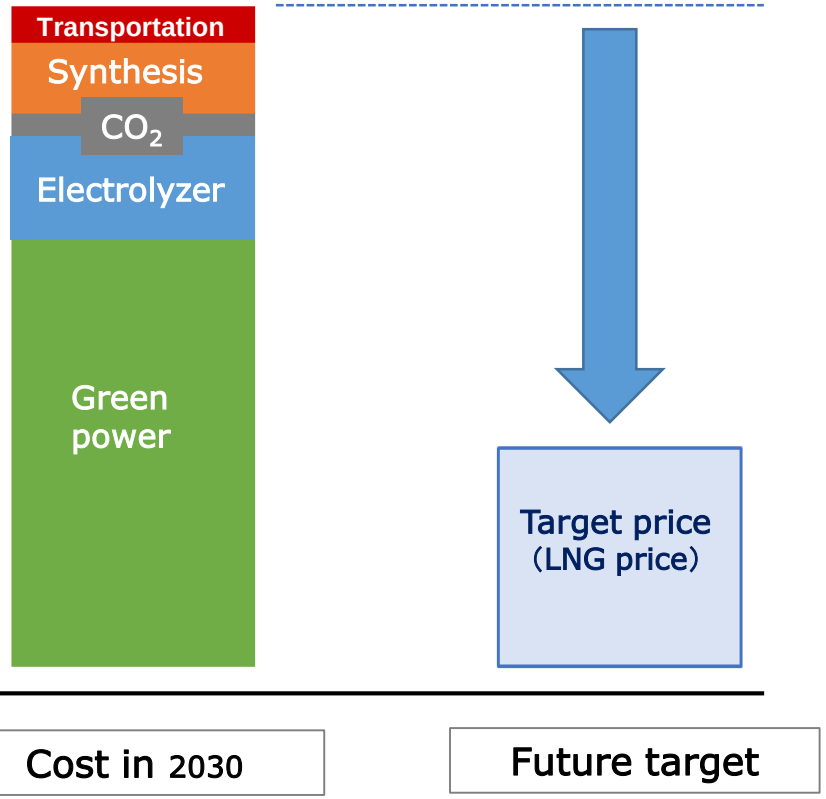
⊛ Institutional design and Public support

- **Ongoing support for technology development according to phase, including elemental technology development, demonstration testing, and social implementation**
- **Institutional Design for Establishing the Environmental Value of Synthetic Methane**
- **Public support for social implementation, design of incentives for customers to use synthetic methane, etc.**

Cost Image of Synthetic Methane and Challenges and Actions for Social Implementation

- **The cost of synthetic methane in 2030 is estimated still much higher than the target price (equivalent to LNG price), even assuming lower the cost of electrolyzer and the securing of inexpensive renewable power from overseas.**
- **To expand the introduction of synthetic methane, it is necessary to reduce costs through innovation and to bridge the price gap between synthetic methane and LNG through multiple measures.**

Cost Image of Synthetic Methane



Issues

Technologies that contribute to improve energy conversion efficiency and lower equipment costs.	1, 2
Technologies to produce hydrogen from green electricity at higher efficiency and lower cost.	1, 2
Procurement of inexpensive renewable electricity for green hydrogen production.	2
Public support to bridge the gap between synthetic methane and current LNG price.	3
Return of the environmental value of the produced synthetic methane to user.	3

Measure

1 Innovative R&D

- ✓ Low-cost hydrogen production technology
- ✓ Innovative methanation technology
- ✓ Other technologies related to synthetic methane value chain

2 Partnership

- ✓ Collaboration across and beyond the gas industry
- ✓ Collaboration with research institutions and start-ups
- ✓ Customers, trading companies, engine manufacturers, different industries, local governments, etc.

3 Institutional design and support

- ✓ Institutional Design for Establishing the Environmental Value of Synthetic Methane
- ✓ Public support for social implementation

Ooverseas methanation sites, large-scale demonstration, and supply chain establishment

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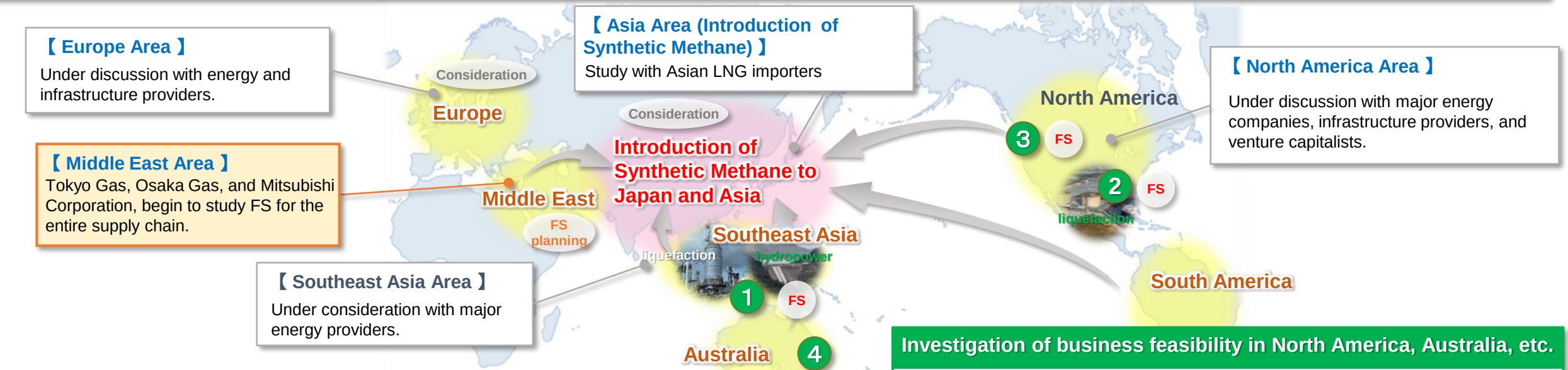
- **We are currently working with local energy companies and trading companies on feasibility studies in Malaysia, North America, Australia, and other regions.**
- **In addition, we are exchanging information on synthetic methane, hydrogen carriers, biogas, and other initiatives with a wide range of overseas energy companies to accelerate partnership actions toward the decarbonization of gaseous energy and its implementation in society.**
- **The LNG market in Southeast Asia is expected to a further growth. We are looking for an opportunity to support the introduction of synthetic methane in those Asian market through cooperation among respective parties (operators etc).**



Investigation of business feasibility in Malaysia

【Players】 **Petronas, Sumitomo Corporation, and Tokyo Gas**

【Items】 FS to establish a supply chain to produce synthetic methane in **Malaysia** and introduce it to Japan.

【Status】 ・ Initial cost estimates with engineering firms are being planned.

・ Candidate site：Bintulu 1

Investigation of business feasibility in North America, Australia, etc.

【Players】 **Mitsubishi Corporation, Tokyo Gas**

【Items】 FS of the entire supply chain for synthetic methane production, liquefaction, and transportation in North America and Australia

【Status】 ・ Initial cost estimates have been performed in **North America** (U.S. and Canada) 3

・ Start detailed studies with an engineering company for use in liquefaction terminal such as Cameron, etc. 2

・ Initial cost estimation will begin in Australia in the future. 4

Summary

- **In order to carry through responsible transitions toward a carbon neutral society, we will continue to implement the most appropriate ways and hydrogen carriers, considering the time frame and technology maturity, while advancing the smart use of natural gas and the introduction of carbon-neutral LNG in the immediate future.**

- **In the future, we will contribute to local and global carbon neutralization as a decarbonizing energy player in the thermal demand sector and create new decarbonization model originating from Japan. With such, we can play a role in the construction and social implementation of a synthetic methane/hydrogen value chain from Japan to other Asian countries with the cooperation of all concerned parties and stakeholders.**

- **Furthermore, our decarbonization challenge in the thermal demand sector is not only with synthetic methane(methanation) but through innovation and collaboration with other industries to seek for other wider fields such as synthetic fuels(e-fuels, etc.) with which we have high technological affinity.**