Go! ガステナブル

THE JAPAN GAS ASSOCIATION

e-methane

- Contributing to mitigate GHG emission -

September 26th, 2023

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Japan Gas Association

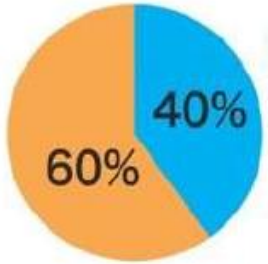
Established: 1947
Members: approx. 200
No. of customers: 27 million
Gas volume: approx. 40 BCM
Gas pipeline extension: approx. 260 thousands km
Area coverage: 6%

https://www.gas.or.jp/en/


1872 Yokohama

Japan's city gas industry was one of the first in the world to import and commercialize LNG for city gas supply in 1969. Town Gas.

Town Gas to City Gas
Why natural gas? Sulfur Free, High Calorific Value (40MJ/Nm3), Low carbon emission among fossil fuels.



City Gas

FY2021 LNG import 71.46 million tons

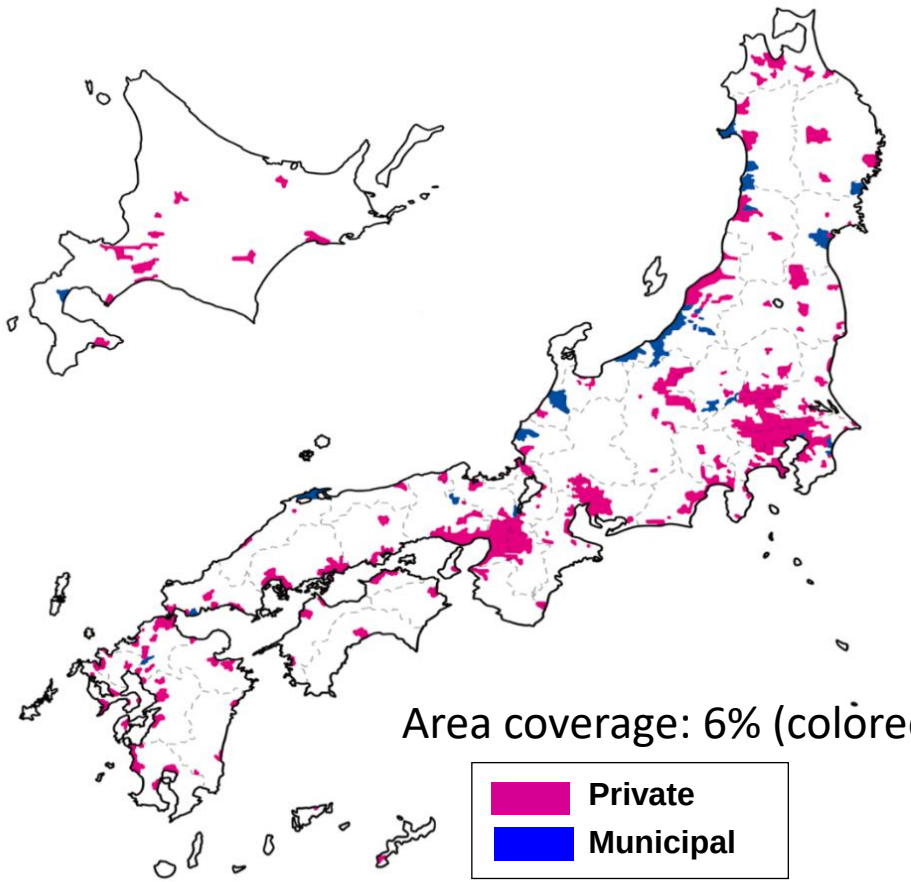
Power generation etc.


1969
First LNG cargo to Japan from Alaska (Negishi LNG receiving terminal) (Polar Alaska)) Tokyo Gas Co.,

37 years town gas to city gas

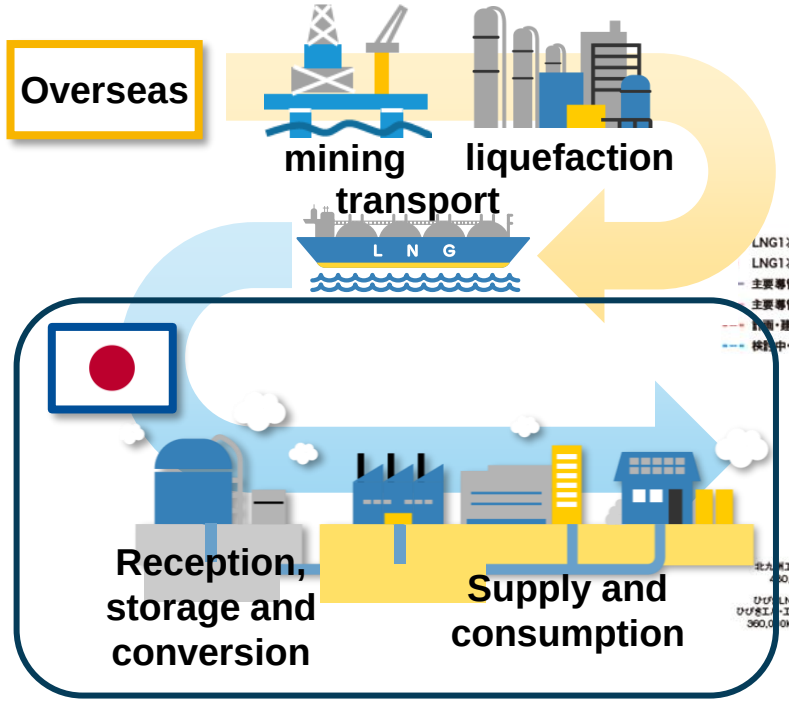
Conversion effort - Cola/oil gas to natural gas.
Visiting every home adjusting, replacing every gas equipment, safety inspection.

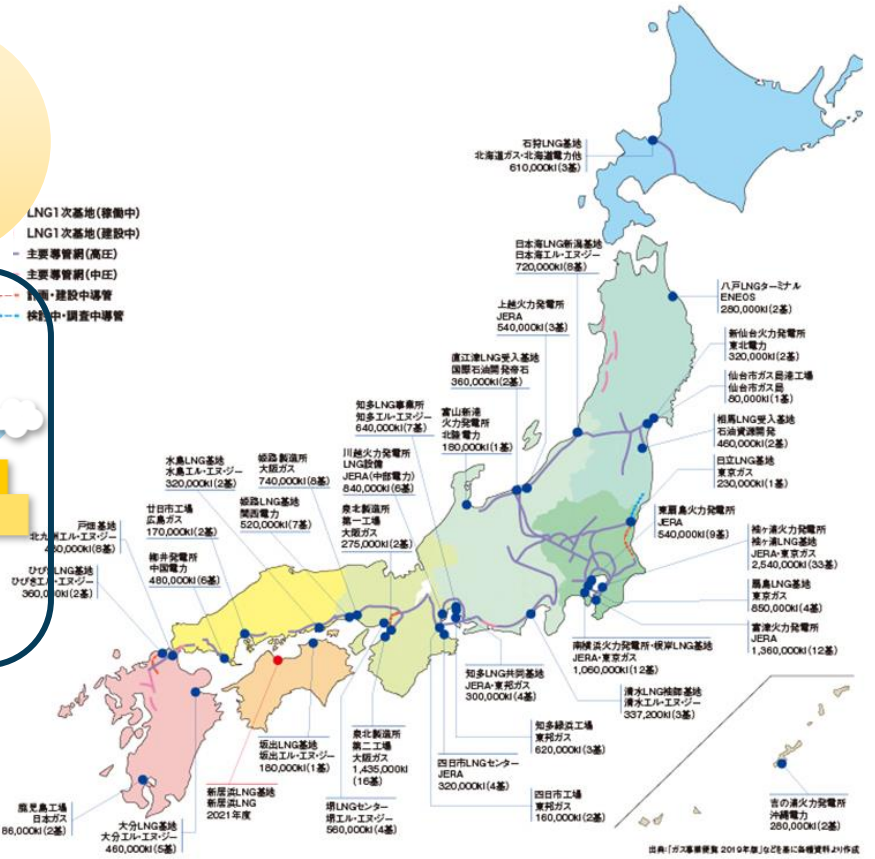
City gas infrastructure



Area coverage: 6% (colored area)

Private
Municipal





出典：日本のLNG基地は「The LNG industry, GIIGNL Annual Report 2019」を基に各種資料より作成、主要導管網は「総合資源エネルギー調査会基本政策分科会第1回システム改革小委員会資料」を基に各種資料より作成

■ Pipeline Extension FY 2016

264,475km(100%) = 227,095(86%) + 34,993(13%) + 2,387(1%)

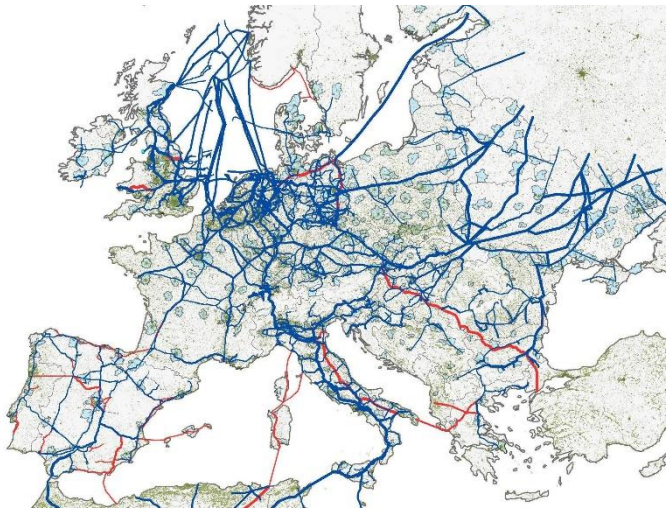
Low	Mid	High
Under 0.1MPa	1MPa-0.1MPa	Over 1MPa

■ LNG Terminals

37 LNG terminals along the coast of Japan.

21 of them are wholly or partly owned and operated by gas utilities.

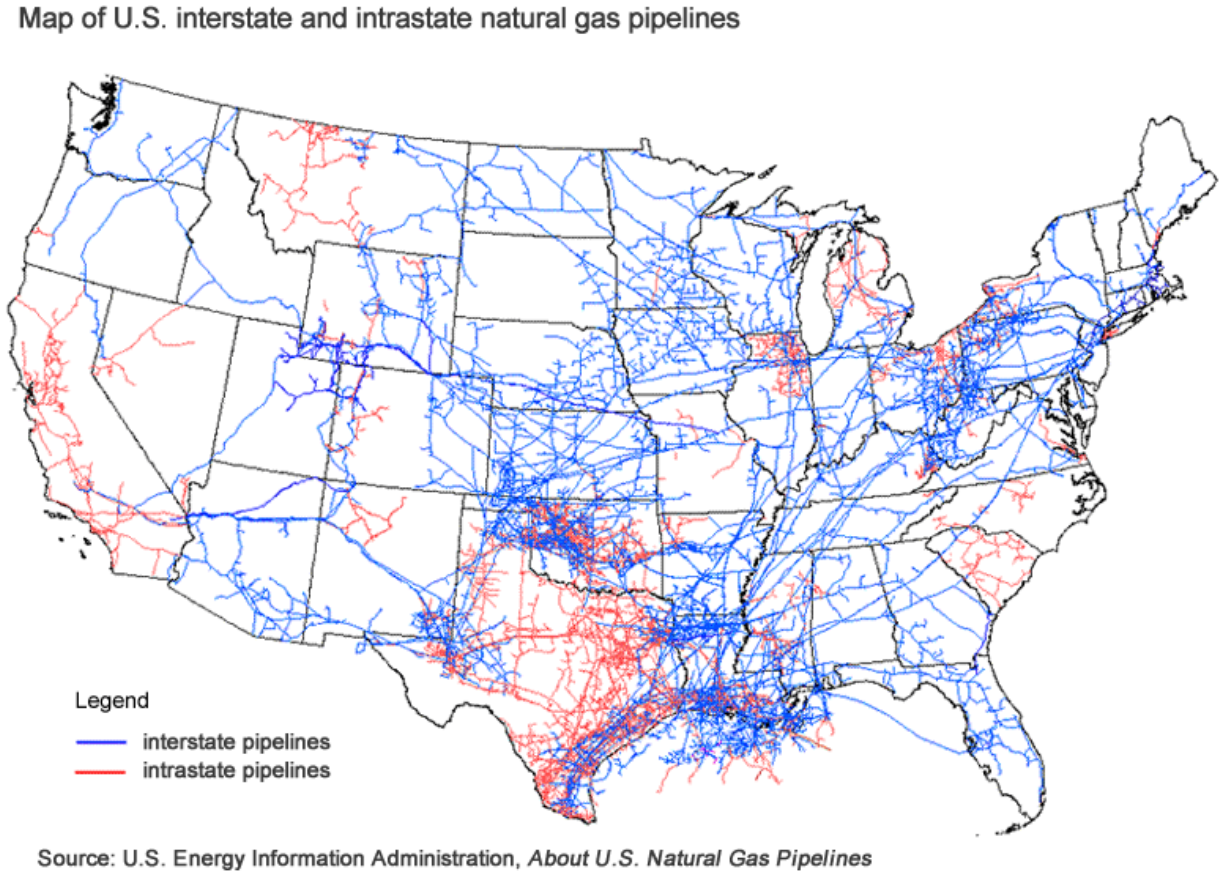
Gas Pipeline Extension - EU-Japan-US



Italy 280,000km
UK 280,000km
Germany 475,000km

Europe 2,080,000km
(48)

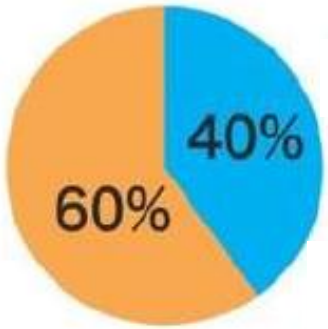
Japan 264,475km
(6)



Source: U.S. Energy Information Administration, *About U.S. Natural Gas Pipelines*

US 4,320,000km
(100)

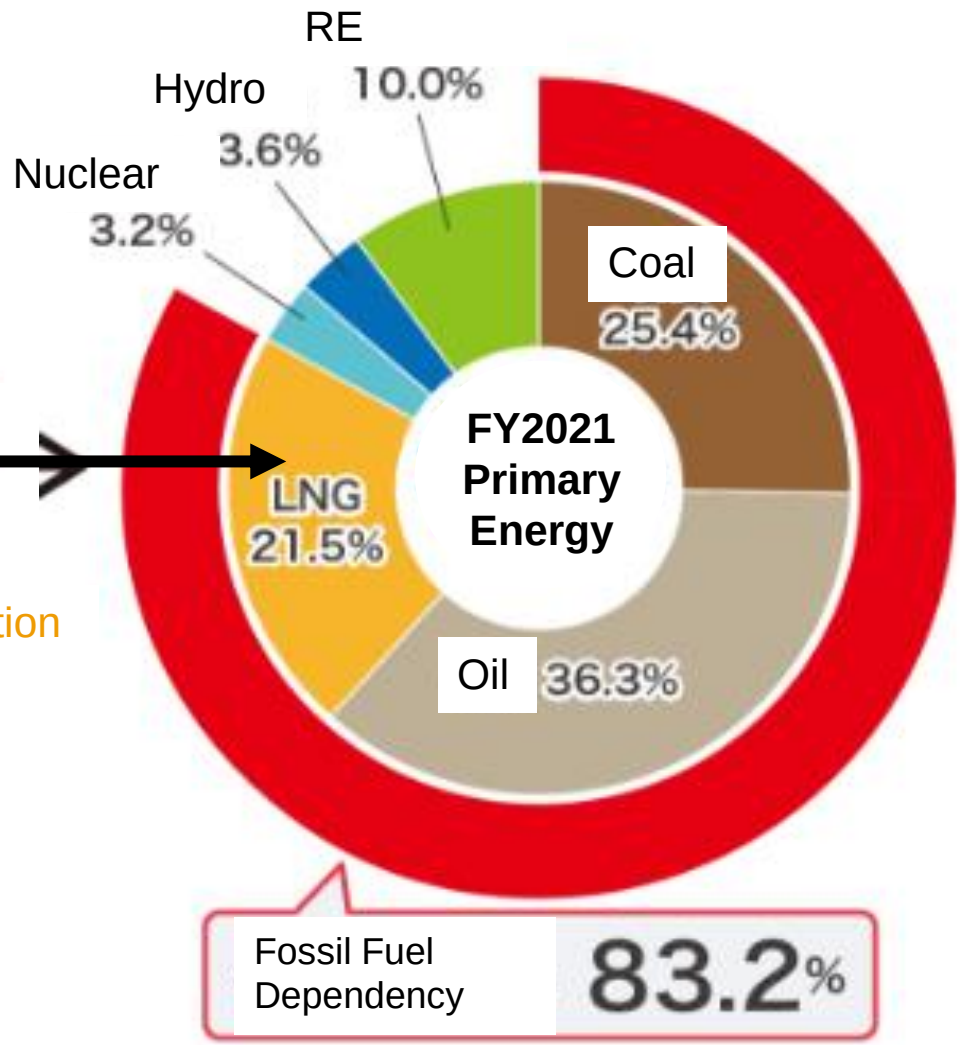
City gas in Japan's energy mix ….



City Gas

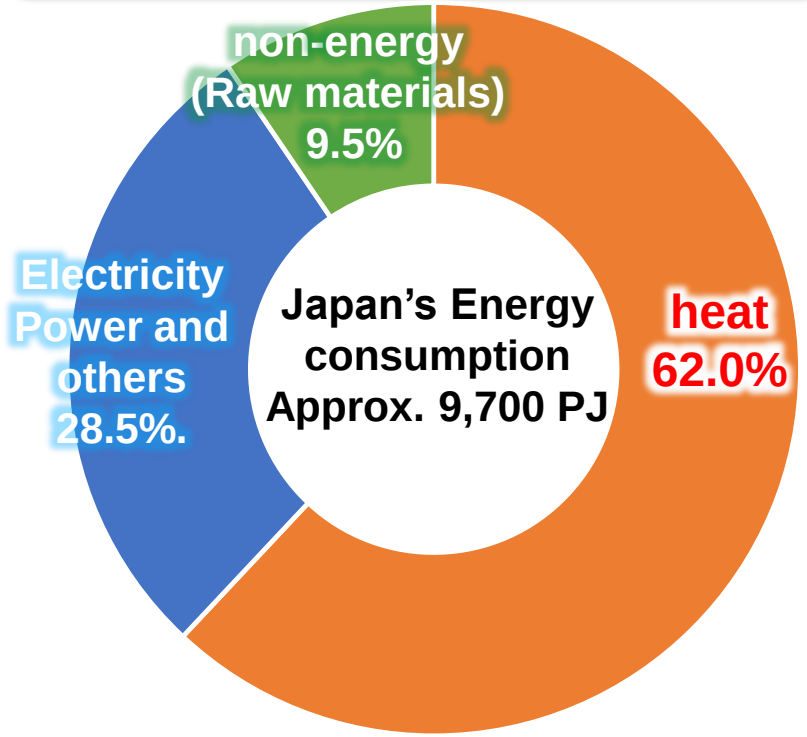
Power generation etc.

FY2021 LNG import
71.46 million tons



https://www.enecho.meti.go.jp/about/pamphlet/energy2022/001/

Importance of thermal sector



*Prepared by the Japan Gas Association based on the 2020 Energy White Paper.

JGA's 2050 Net Zero Vision
city gas emission factor 2.21kg-CO2/m3 > 0.00kg-CO2/m3

2020 Oct. Prime Minister announced Japan will target Net-Zero Emission by 2050

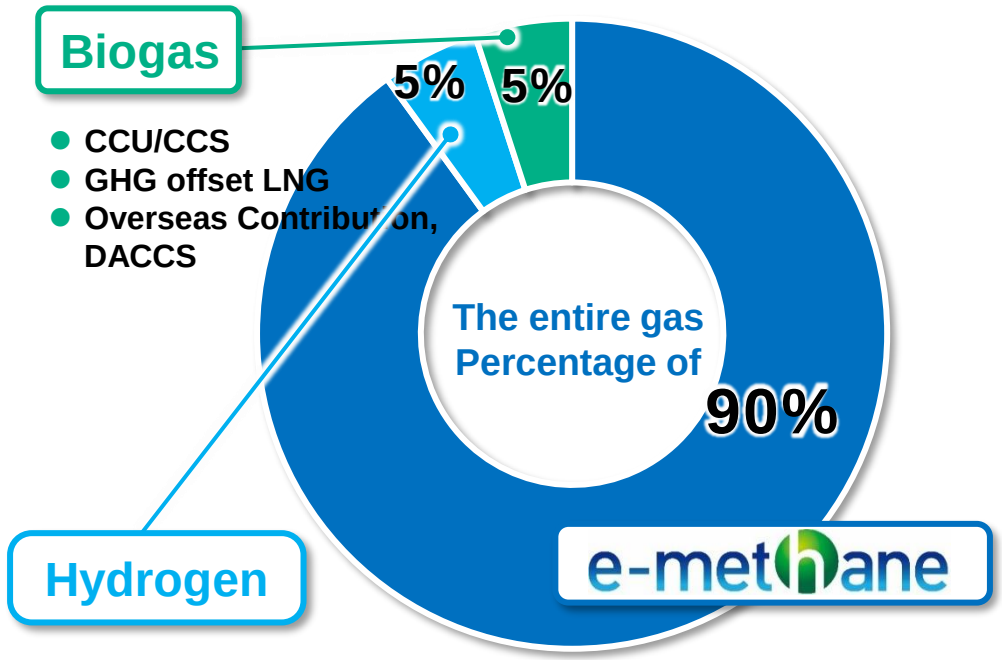
2020 Nov. Japan Gas Association announced that gas industry will aim NZE by 2050

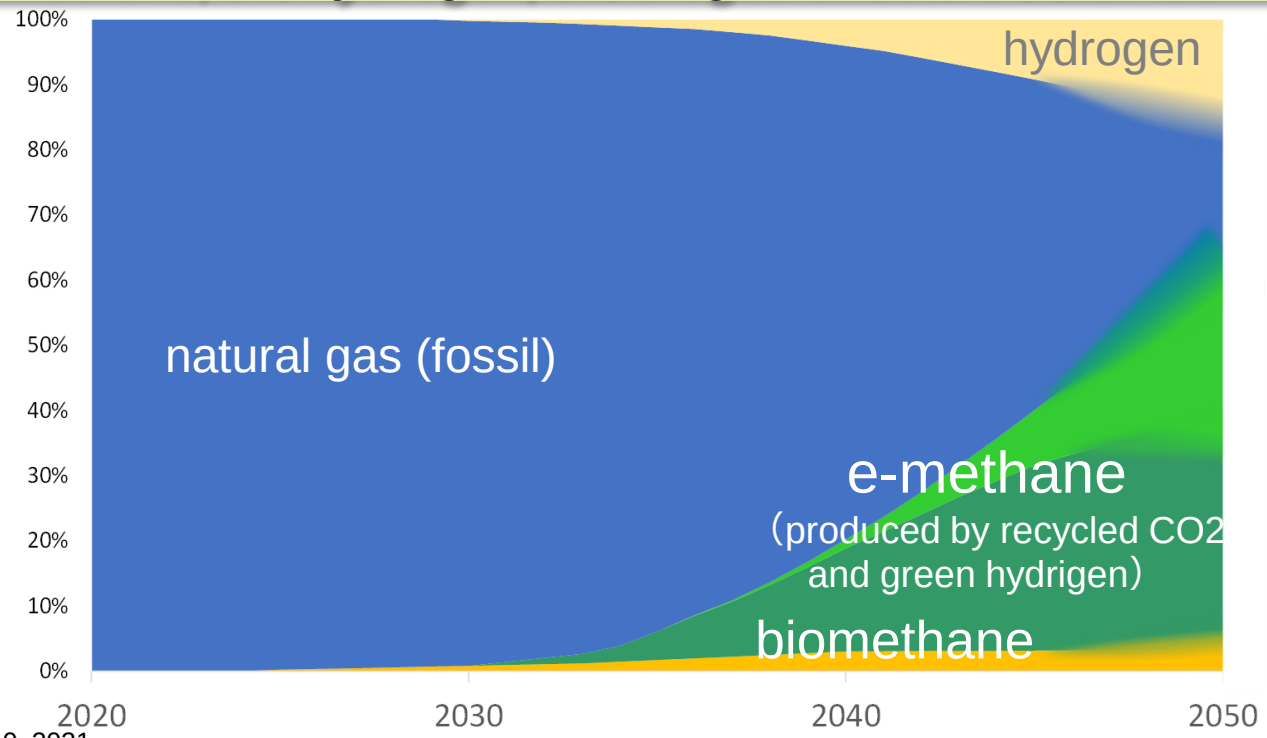
2030 **In June 2021**

Establish e-methane value chain, initiating e-methane import, 1% e-methane admixture

2050

Achieving City Gas Net Zero: 90% e-methane, 5% hydrogen, 5% biogas/offsets/CCU/DACs





Source: "Carbon Neutral Challenge 2050 Action Plan" published by Japan Gas Association on June 10, 2021.

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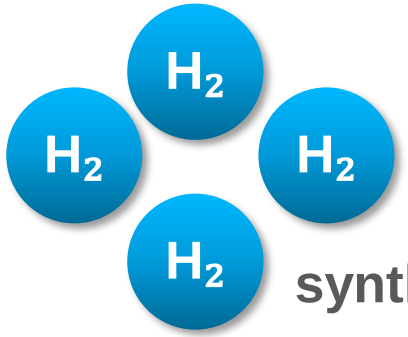
What is e-methane?

- Methane synthesised and produced from hydrogen and CO2 is called **e-methane.**
- Combustion (use) of e-methane **does not increase overall CO2 concentration.**

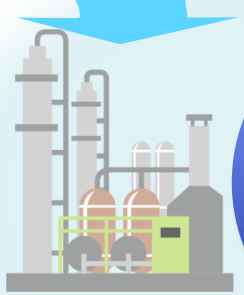
Methanation

$4H_2 + CO_2 \Rightarrow CH_4 + 2H_2O$

hydrogen　carbon dioxide　methane



synthesis



e-methane（CH_4）

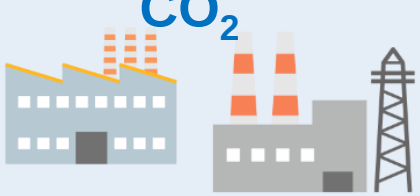
supply

City Gas Pipelines

emission

CO_2

recovery



CO_2 emitted from e-methane combustion is originally captured CO_2 from exhaust gases and/or atmosphere, it does not increase CO_2 in the atmosphere

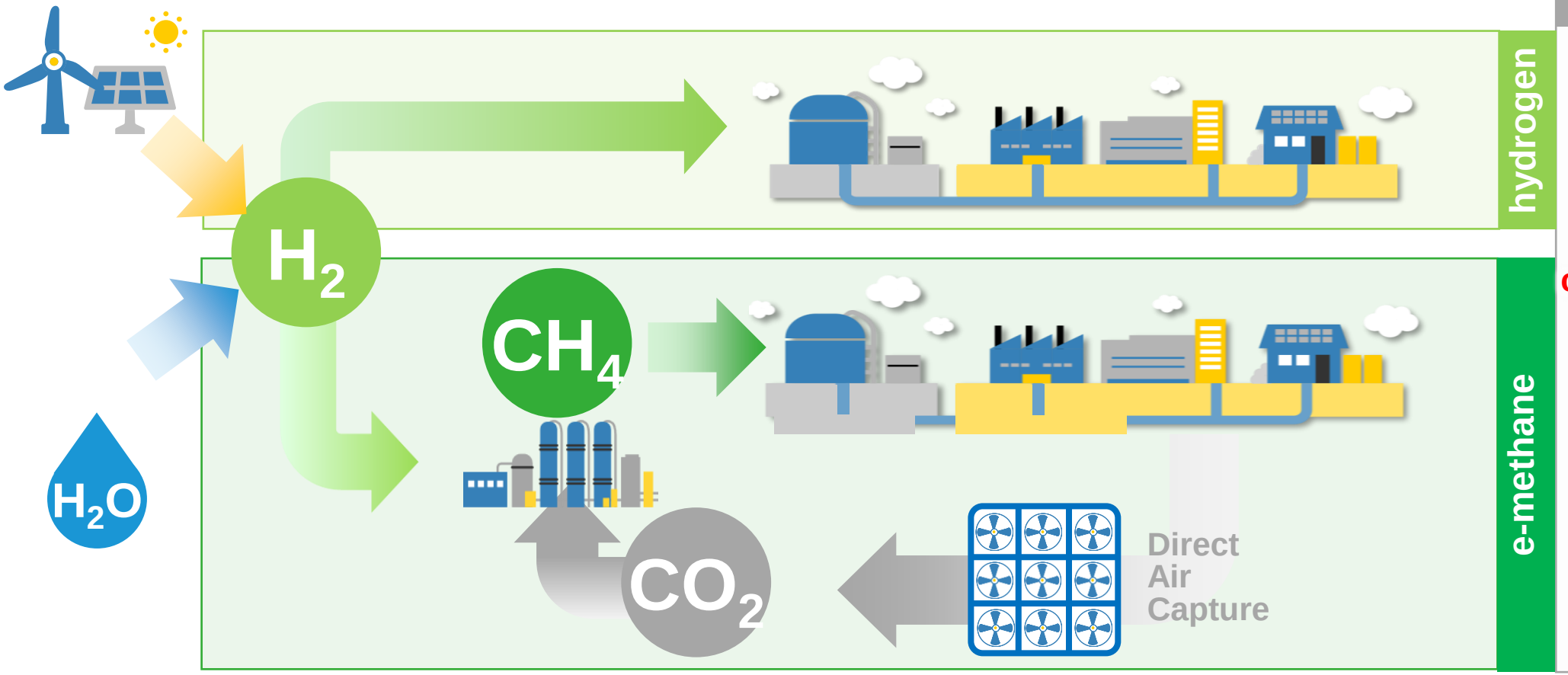
CO_2 recovery=emissions

CO_2

e-methane's CO2 emission

CO2 for e-methane production

- ✓ Captured from atmosphere (DAC)
- ✓ CO2 associated with biogas production
- ✓ CO2 captured from flu gas (transition period)



GHG emissions

zero

0

Total CO2 concentration in the atmosphere

=

zero

0

Why e-methane?

- Infrastructure, value chain in place
- Seamless and smooth transition to carbon neutrality – “natural gas” to “e-methane” gradual admixture

hydrogen

New facilities needed / New safety standards

electrolysis Consumption | Production | Transport | Receiving/storage | Supply

New gas equipment for 27 million customers

e-methane

Production

Only new methanation plants are required
Production technology is already available

Existing facilities / Safety standard in place

Liquefaction | shipping | Receiving/Storage/regasification | Supply | Consumption

Gas equipment at 27 million customers can be used as they are.

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Establishing commercial production Technology, improve efficiency

- Based on established technology, **Sabatier reaction, further developments are underway to improve efficiency and to enable scalable production.**

2022 2030 2050

Capacity

400 m3/h
world's largest

Tens of thousands - m3/h
Commercial scale
(international)

Efficiency

Sabatier reaction
$CO_2+4H_2 \rightarrow CH_4+2H_2O$

hybrid savatier
recovering and using Sabatier's reaction heat

Co-electrolysis technology (SOEC, PEMCO2 reduction)
direct production from power and H2O

bioreactor

Expected Share

natural gas

hydrogen
90%

1%

e-methane

Sources: Tokyo Gas website, NEDO website, Japan Gas Association Extracted and partly modified from 'Carbon Neutral Challenge 2050'.

Efforts to establish e-methane commercial production technology and e-methane value chain.

Small Scale

INPEX

Succeeded in producing 8Nm³/h e-methane at Nagaoka, Niigata Site

TOKYO GAS

Initiated 12.5Nm³/h e-methane production demonstration in Yokohama since March 2022.

Mid Scale

IHI

JFE スチール 株式会社

- IHI signed contract with JFE Steel in Dec 2022 to build 500Nm3/h e-methane production plant by FY2024.

Large Scale

INPEX

OSAKA GAS Daigas Group

Commercial scale e-methane production demonstration

- From second half of FY 2024, 400Nm³/h scale e-methane production plant will be in operation
- Initiate study on building 10,000Nm³/h, 60,000Nm³/h scale plants

Mitsubishi Corporation

TOKYO GAS

OSAKA GAS Daigas Group

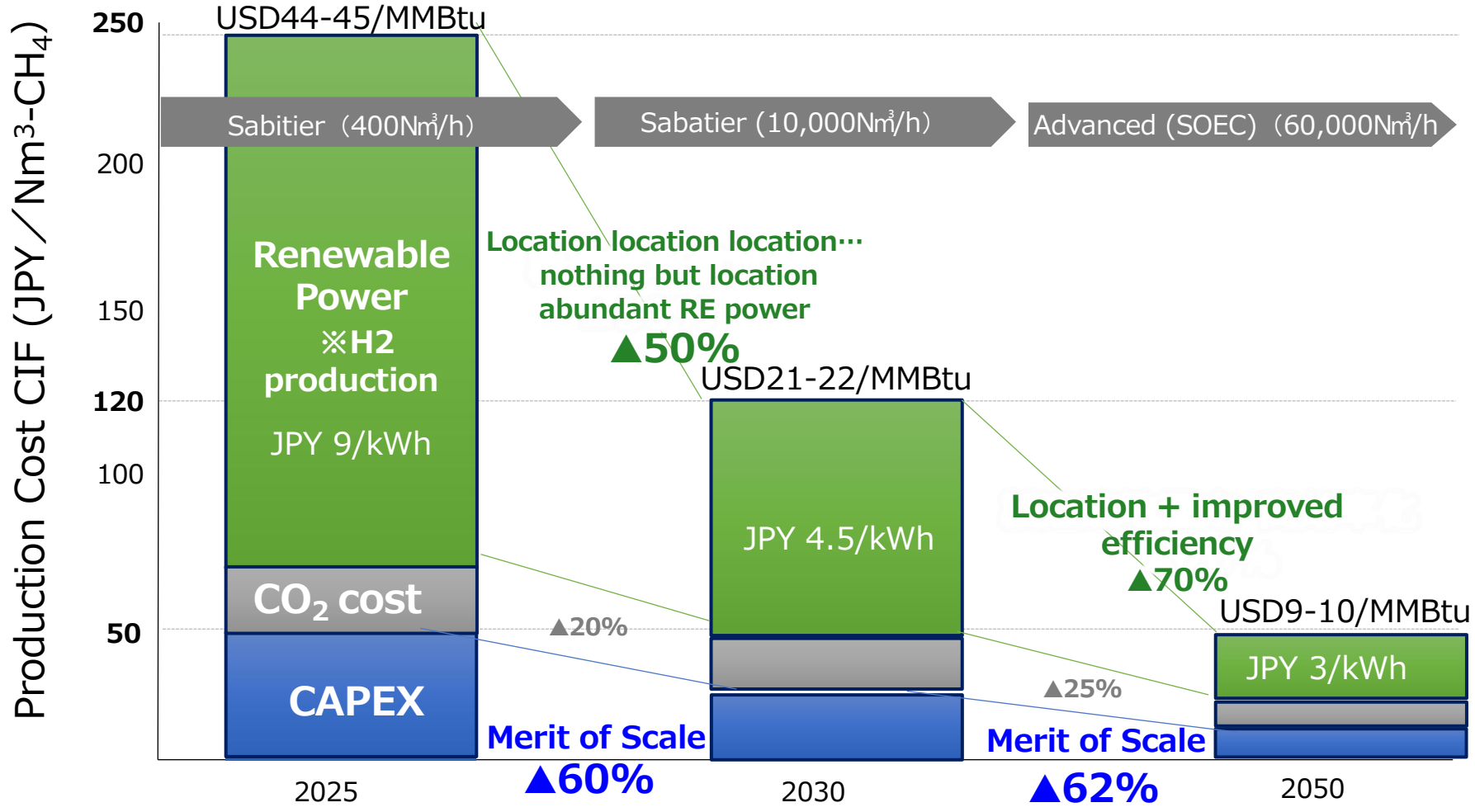
TOHO GAS

FS of establishing e-methane supply chain in the US.

- Work with local partners to locate e-methane plant site, procure feedstocks (H2, CO2) and export e-methane to Japan.
- Export.
- Aims to produce and import(export) 180 MCB-CH4/yr (130 thousands tons-CH4) to Japan in FY2030. (TG, OG, TG). FEED in FY2024, FID in FY2025.
- Carry out FS in other prospective regions (North Ameica, Australia, Middle East etc.) for commercial

Bring down production cost

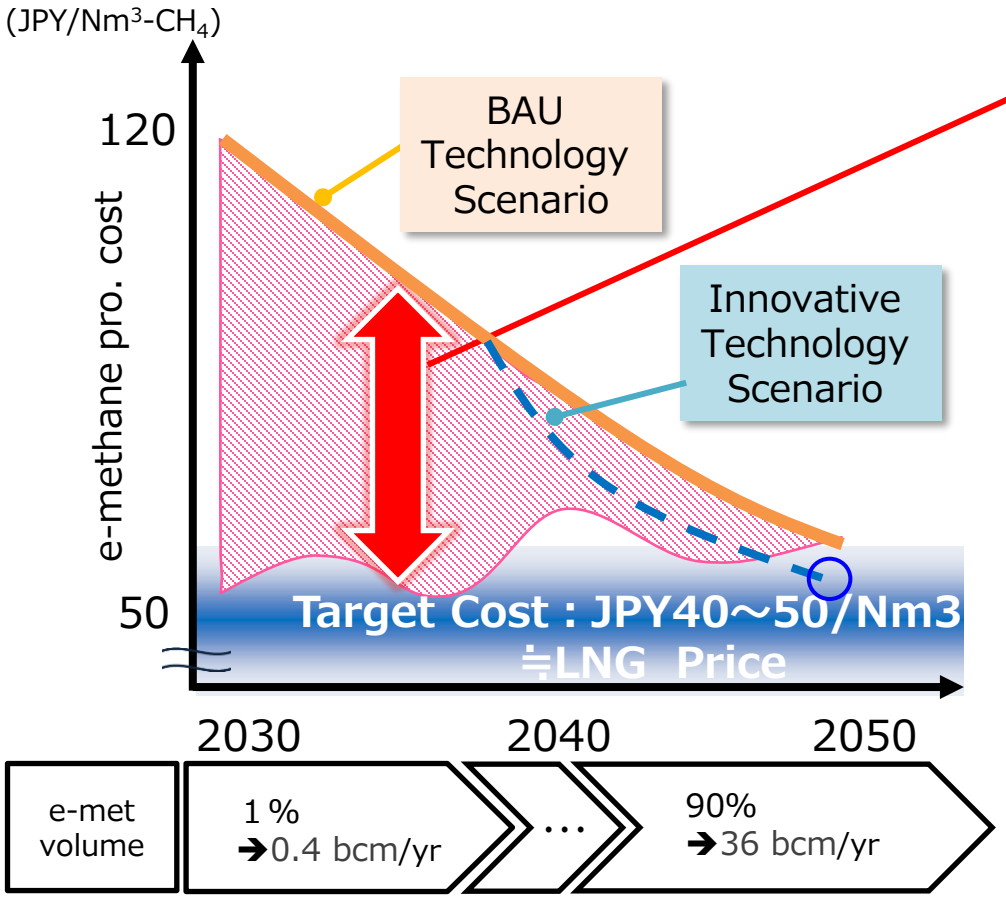
Bring down cost to equivalent of LNG by 2050



出典：第3回 海外メタネーション事業実現タスクフォース 日本ガス協会説明資料（2022年7月13日）より抜粋
一部修正

Filling the price gap – transition period (2030-2050)

e-methane production cost trajectory



Policy needed to fill the price gap LNG vs e-methane

Subsidy

e-methane vol. ×（Pro. Cost – ref. cost ）

2030 JPY 28 bil.-32 bil.
USD 200M – 230M (USD/JPY 140)

Target supply & Cost

	2030	2050
Volume	0.4 bcm/yr (28mil.t/yr)	36bcm/yr (25mil.t/yr)
Production Cost（CH_4）	JPY120/Nm3 (USD21-22 MMBtu)	JPY40-50/Nm3 ≒LNG Price (USD7-9 MMBtu)

City gas companies' commitment and projects

2030 commitment

Tokyo Gas 1% e-methane (approx. 80 MCM) by 2030
Osaka Gas 1% e-methane (approx. 60 MCM) by 2030
Toho Gas Establish e-methane supply chain by 2030 to introduce 1% or more e-methane

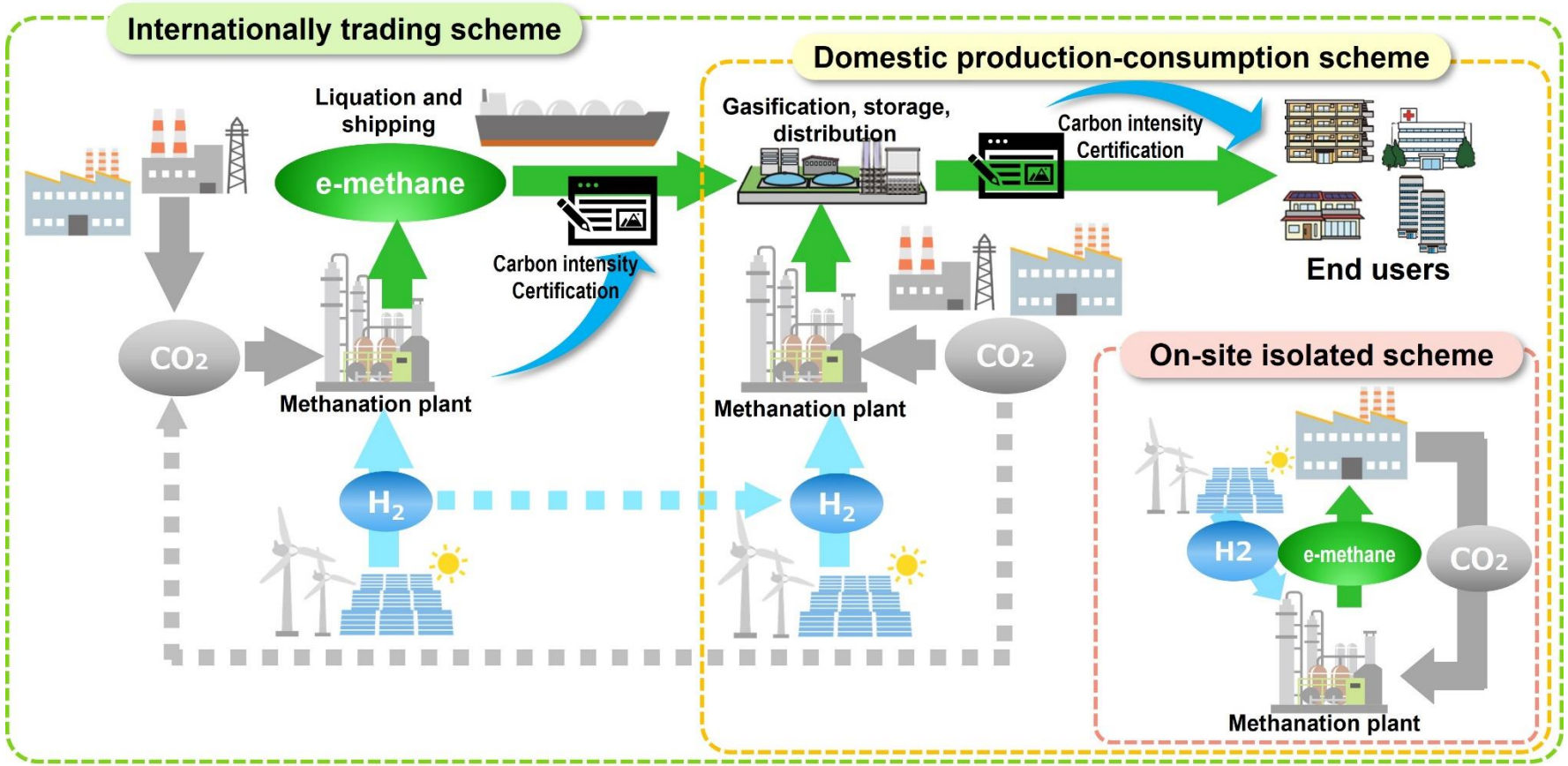
Project in progress

	Project		Volume	feedstock
	Cameron PJ	Mitsubishi, Tokyo Gas, Osaka Gas, Toho Gas	130k tons/yr	Green H2, CO2 captured from flu gas
	US Midwest PJ	Osaka Gas,Tallgrass Green Plains	Max 200k tons/yr	blue H2, bio CO2
	Australia PJ	Osaka Gas, Santos	60k tons/yr	Green H2, CO2 captured from flu gas
	Malaysia PJ	Osaka Gas, PETRONAS IHI	60k tons/yr	Biomass
	Peru PJ	Osaka Gas, Marubeni, Peru LNG	60k tons/yr	Green H2, CO2 captured from flu gas

FY2023
FEED
↓
FY2025
FID
↓
FY2030
Commissioning
Full operation

Establishing GHG counting rules and guidelines for e-methane

There is no international GHG counting guideline or rules for CCU fuels trade cross boarders.
CCU fuels are traded cross boarders Lack of these rules (CCU rules) will discourage **investment and deployment.**



Establishing GHG counting rules and guidelines for e-methane

- **There are global discussions** on needs for CO2 emission accountings for CCUs, synthetic fuels such as e-methane.
- To promote the use of synthetic fuels, e-methane energy users shall not be accountable for CO2 emission associated with me-ethane as e-methane carbon are already accounted for or are removed from atmosphere.

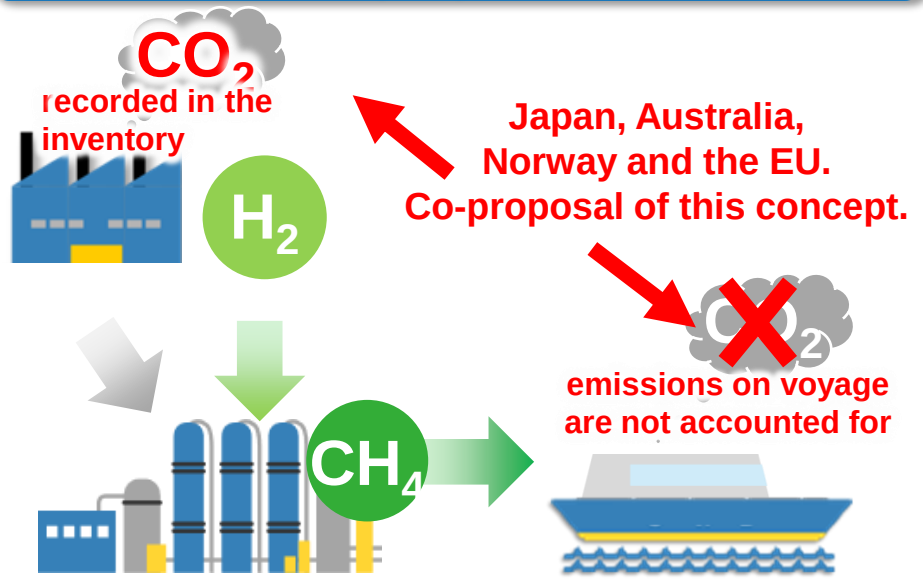
Renewable fuels of non-biological origin (RFNBO) Recycled Carbon Fuels (RCF)

$$E = e_i + e_p + e_{td} + e_u - e_{ccs}$$

E	=	Total GHG emissions from synthetic fuel use
e_i	=	GHGs in raw materials. **The same amount of GHGs emitted from factories and other sources can be deducted if captured.**
e_p	=	GHG emissions from production processes
e_{td}	=	GHG emissions from transport.
e_u	=	GHGs emitted from combustion during consumption
e_{ccs}	=	GHGs stored underground.

Source: European Commission, 'Methodology RNFBOs and RCFs (Draft), (May 2022).

International proposals at the IMO



Source: International Shipping 2050: Toward Carbon Neutrality from the Public-Private Council on Carbon Neutrality

In both cases users are not accountable for physically emitted CO2

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US　American Gas Association　Net-Zero Emissions Opportunities for Gas Utilities

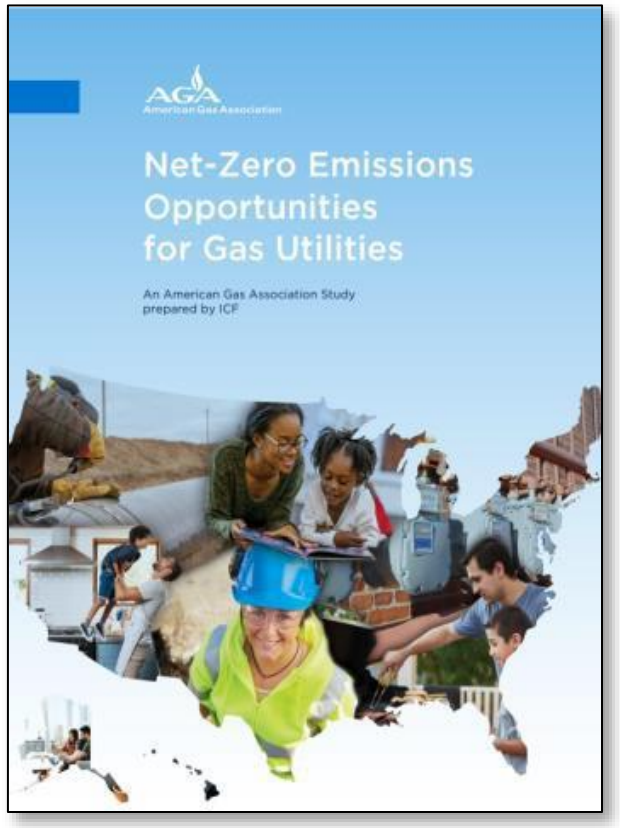
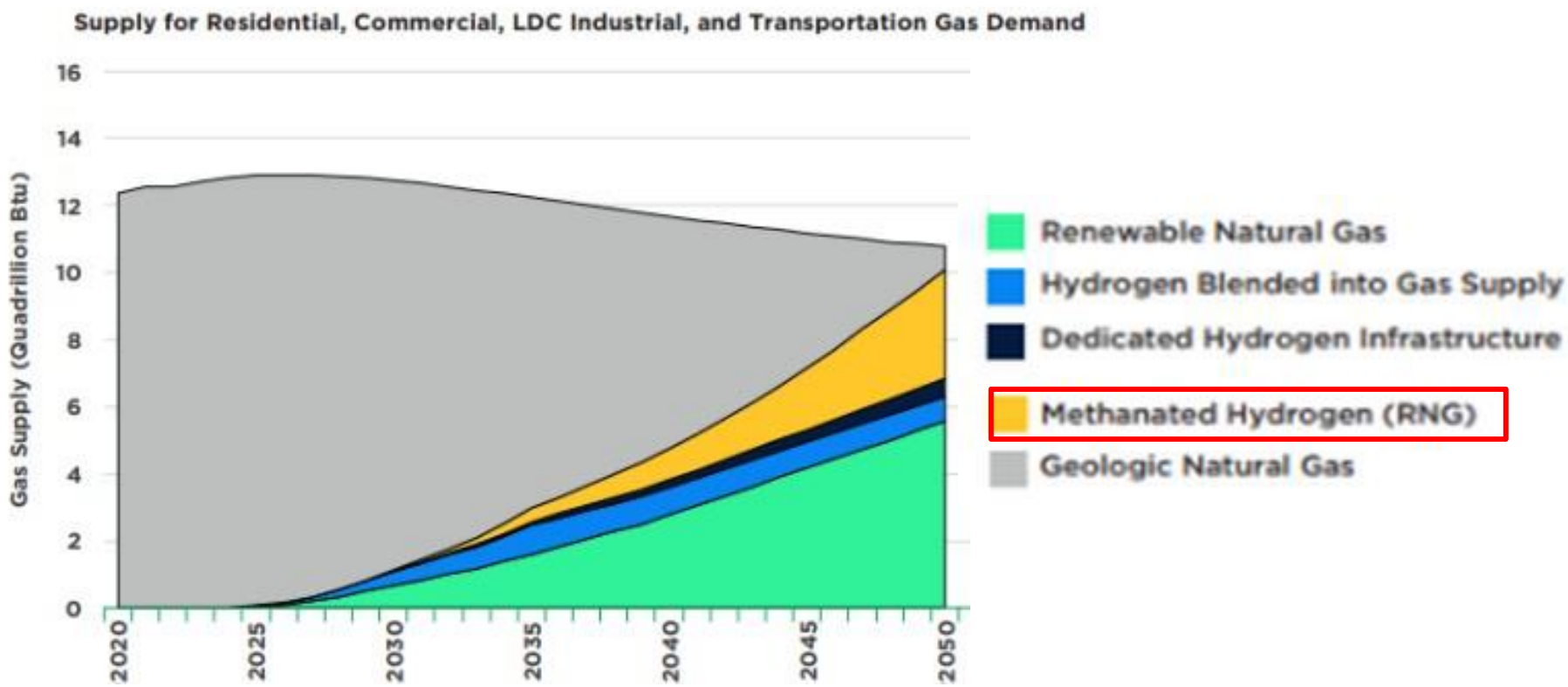


Exhibit E.S. 8 – Utility Customer Gas Supply Mix



Source： American Gas Association 「Net Zero Emissions Opportunities for Gas Utilities」 （Feb. 8th, 2022)

France New gases: energy transition for the gas industry

New gases: energy transition for the gas industry

Francegaz

The methane gas industry has five technological and innovation building blocks

Anaerobic digestion: methane by fermentation

Pyrogasification: methane by thermal treatment of carbonaceous waste

Hydrothermal gasification: methane by aqueous treatment at high temperature

Methanation: methane from CO2 and hydrogen

The use of fossil gas coupled with carbon capture and storage

	Potential	Realistic production trajectory		
		2030	2040	2050
Methanisation	190 TWh	49 TWh	100 TWh	135 TWh
Pyrogazeification	180 TWh	6 TWh	30 TWh	90 TWh
Hydrothermal Gazeification	100 TWh	2 TWh	25 TWh	50 TWh
Methanation	120 TWh	3 TWh	30 TWh	60 TWh
Total	>> 335 TWh	60 TWh	185 TWh	335 TWh

Source: New gases: energy for our territories Francegaz

https://www.eic.cat/gfe/docs/31883.pdf

e-methane projects in EU

Various e-methane pilot projects in EU
Green Hydrogen + CO2 from various sources, Gas pipeline injection

Source: compiled from CO2 Value Europe database by JGA As of March 2022)

COLUMBUS
（Belgium 2020-）

JUPITER 1000
（France 2016-2021）

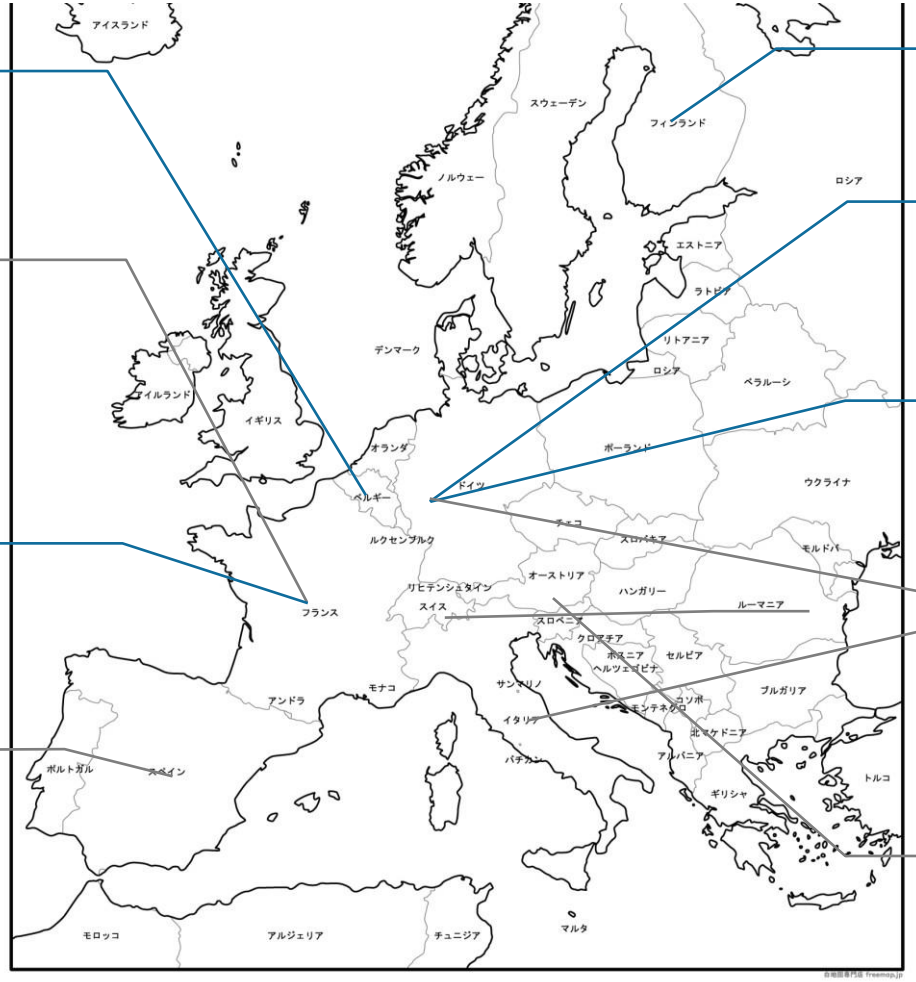
25Nm3/h
CO2 from steel mill, Green H2

Méthycentre
（France 2018-）

12.5Nm3/h
E-methane and biomethane

LIFE CO2 TO FUEL
（Spain 2019-2021）

製鉄時に発生するCO_2を回収し利用。



Carbon2x
（Finland 2022-）

Audi e-gas project
（Germany 2013-）

e-methane 1,000t/yr

Bio-UGS
（Germany 2020-）

Store &Go
（Germany others 2016～2020年）

e-methane 40 Nm³/h Power-To-Gas
、CCUS、DAC etc.

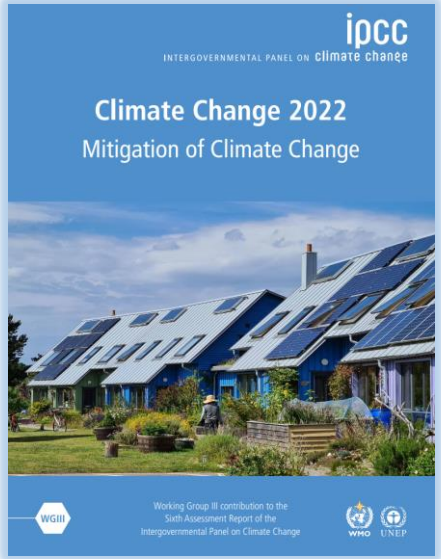
Underground sun conversion
（Austria 2018-2020）

e-methane 30Nm3/h

in operation

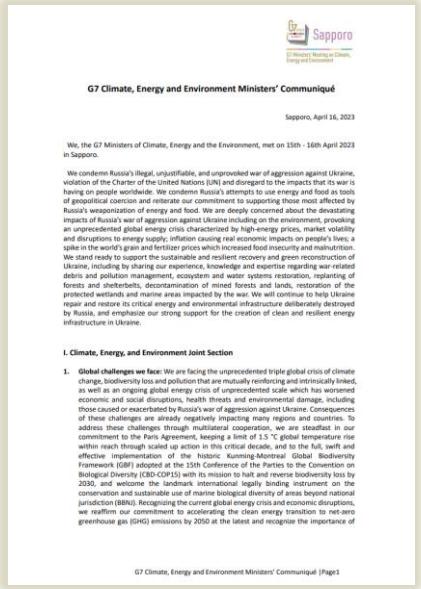
Supporting e-methane in ipcc report and at G7 discussion

IPCC Report Sixth Assessment Report of the Intergovernmental Panel on Climate Change Mitigation (AR6) WGIII (April. 2022)



"Electricity can be used to generate hydrogen… **For greater compatibility with existing gas systems and appliances, the hydrogen can be combined with captured carbon dioxide to form methane…**"

G7 2023 Hiroshima Summit
Sapporo
G7 Ministers' Meeting on Climate, Energy and Environment


Sapporo

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

G7 Climate, Energy and Environment Ministers' Communiqué |Page1

G7 Climate, Energy and Environment Ministers' Communiqué

Sapporo, April 16, 2023

"Carbon dioxide Capture, Utilization(CCU)/carbon recycling technologies, including recycled carbon fuels and gas(RCFs) such as e-fuels and **e-methane, also can reduce emissions with existing infrastructure from industrial sources…**"

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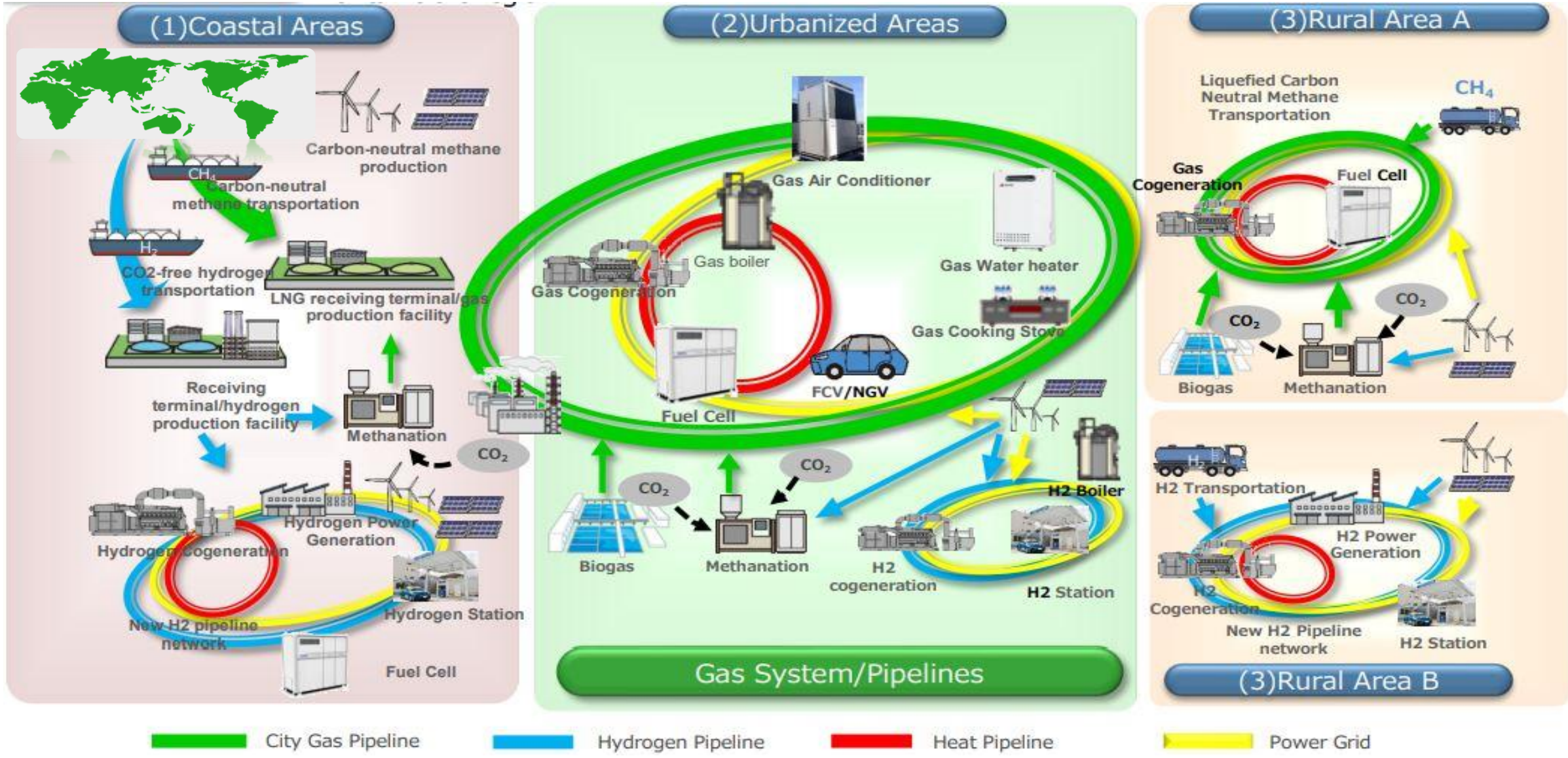
Takeaways

- Fifty years have passed since the introduction of LNG to the Japanese gas supply industry, and the industry has entered a period of new challenges of decarbonization.
- The advantages **of e-methane** derived from renewable power sources and recycled CO2 is explained for Japan's geographically isolated circumstances.
- During the transition period (2030-2050), for social implementation, Japan’s gas industry challenges to develop rules for e-methane to count and allocate CO2 emission in the supply chain and harmonize them with existing international rules.
- A Platform is also needed to manage tracking information of certified environmental value.

Gaseous energy in 2050



e-methane

Thank you

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