



Daigas Group
Energy Transition 2050

Introduction

- **The Daigas Group** announced its ambitious **Carbon Neutral Vision**, which outlines initiatives aimed at achieving carbon neutrality by 2050. Additionally, the Group unveiled its specific approaches and strategies to drive the energy transition, drawing on insights gained from new initiatives, as detailed in its **Energy Transition 2030**.
- Since then, we have actively pursued future-focused initiatives by **developing various renewable energy power sources, launching multiple e-methane production projects, and advancing innovative technologies to facilitate carbon-neutral efforts**.
- At the same time, due to **rising international geopolitical risks**, such as Russia's invasion of Ukraine and escalating tensions in the Middle East, we are facing a growing demand for **achieving both energy supply stability and carbon neutrality**.
- In light of the **acceleration of our future-oriented activities** and the **evolving landscape of the energy business**, we have formulated **Energy Transition 2050**, which presents more detailed **energy transition roadmap** for achieving carbon neutrality by 2050 and outlines solutions for **co-creating value for a sustainable future*** with stakeholders.

Carbon Neutral Vision (released in January 2021)
Announcing the Group's ambition to achieve carbon neutrality by 2050, focusing on thermal and electric energy

[> See the material](#)

Energy Transition 2030 (released in March 2023)
Presenting specific initiatives and solutions for energy transition toward 2030

[> See the material](#)



* Value for a sustainable future: The new value the Daigas Group co-create with stakeholders for resolving social issues, such as achieving a low carbon/carbon neutrality, establishing lifestyles and businesses adjusted to the new normal, and enhancing resilience of customer and society

Our Commitment to Energy Transition 2050

The world is currently at a critical juncture in its transition toward a **carbon-neutral (CN)** future, where people will embrace **new lifestyles**. We stand at the threshold of **creating a beautiful planet for future generations**.

The Daigas Group is tackling the challenge of **reducing CO₂ emissions** with its stakeholders by promoting energy transition through various pathways, such as **next-generation energy sources**, including hydrogen, and increased use of **renewable energy**, all aimed at achieving carbon neutrality by 2050.

Transitioning to new energy sources requires not only **safety** but also **supply stability** that remains resilient against natural disasters, such as typhoons and earthquakes. Additionally, it demands a consistent enhancement of **environmental sustainability** while considering **economic efficiency**.

By following these **principles**, we strive to **co-create new CN value** that addresses social issues alongside our stakeholders. Our aim is to promote **well-being-focused lifestyles** and **the advancement of sustainable businesses**.

The road ahead may not be easy, but we are embracing the **challenge** as we move forward in line with **the Daigas Group's aspiration**:

**Secure peace of mind today,
build sustainable lifestyles for tomorrow.**



Contents

1. Comprehensive Overview of Carbon-Neutral Strategy	1	Daigas Group's Strategy for Energy Carbon Neutrality	P. 5
	2	Fundamental Principle for Energy Supply	P. 6
	3	Energy Transition Scenarios	P. 7
	4	Daigas Group's Roadmap to Low-Carbon and Carbon-Neutral Energy	P. 8
	5	Key Indicator for Assessing Society-Wide CO ₂ Emissions Reduction	P. 9
	6	Daigas Group's Roadmap to CO ₂ Emissions Reduction	P. 10
2. Low-Carbon and Carbon-Neutral Energy Initiatives	1	Pathways to Carbon Neutrality in Thermal Energy	P. 12
	2	e-methane: Key Fuel for Carbon Neutrality in Pipeline Gas Supply	P. 13
	3	Reducing CO ₂ Emissions with e-methane	P. 14
	4	Driving Transition with Natural Gas and e-methane	P. 15
	5	Seamless Transition to Carbon Neutrality in Pipeline Gas Supply	P. 16
	6	e-methane Supply Chain Development	P. 17
	7	Renewable Energy Expansion Initiatives	P. 18
	8	Best Mix of Renewable Energy and Zero-Emission Thermal Power	P. 19
	9	Negative-Emission Initiatives	P. 20
	10	Development of New CO ₂ Value Chain	P. 21
	11	Advancement of Carbon-Neutral Technologies	P. 22
3. Daigas Group's Solutions for Customers	1	The Three Pillars of Daigas Group's Carbon-Neutral Solutions	P. 24
	2	Energy Solutions for C&I Sector: Resolving Business Challenges	P. 25
	3	Energy Solutions for C&I Sector: D-Lineup	P. 26
	4	Energy Solutions for Residential Sector: Best Mix of Power and Gas	P. 27
	5	Energy Solutions for Transportation Sector	P. 28
	6	Ensuring Stable Energy Supply through Virtual Power Plants	P. 29
	7	Solutions for Community Co-Creation	P. 30

1. Comprehensive Overview of Carbon-Neutral Strategy

Energy Transition 2050



Daigas Group's Strategy for Energy Carbon Neutrality

- During the energy transition, where society aims for carbon reduction and decarbonization, we are committed to fulfilling our role as an integrated energy company by contributing to society. We aim to accelerate our initiatives to achieve carbon neutrality in heat and electricity, as well as **negative emissions***1, in light of **S+3E***2.

Achieving Carbon Neutrality

Daigas Group



Carbon Neutrality in Electric Energy

- Expansion of renewable energy sources and use (solar, wind, and biomass)
- Enhancement of stability in energy supply with storage batteries
- Zero emissions from thermal power plants



Negative Emissions

- Large-scale CCS*4 using CO₂ captured from H-to-A industries*5 and other sources in Japan and overseas
- Sustainable forest development and management to remove CO₂ directly
- Effective use of carbon credits, tailored to the specific needs of customers



Carbon Neutrality in Thermal Energy

- Natural gas supply to ensure stability in energy supply and reduce carbon emissions
- Carbon neutrality through seamless transition from natural gas to e-methane
- Promotion of e-methane through international collaborations, such as e-NG*3 Coalition
- Expansion of e-methane sources and use through innovation in SOEC methanation technology

Safety

+

Energy Security

Environment

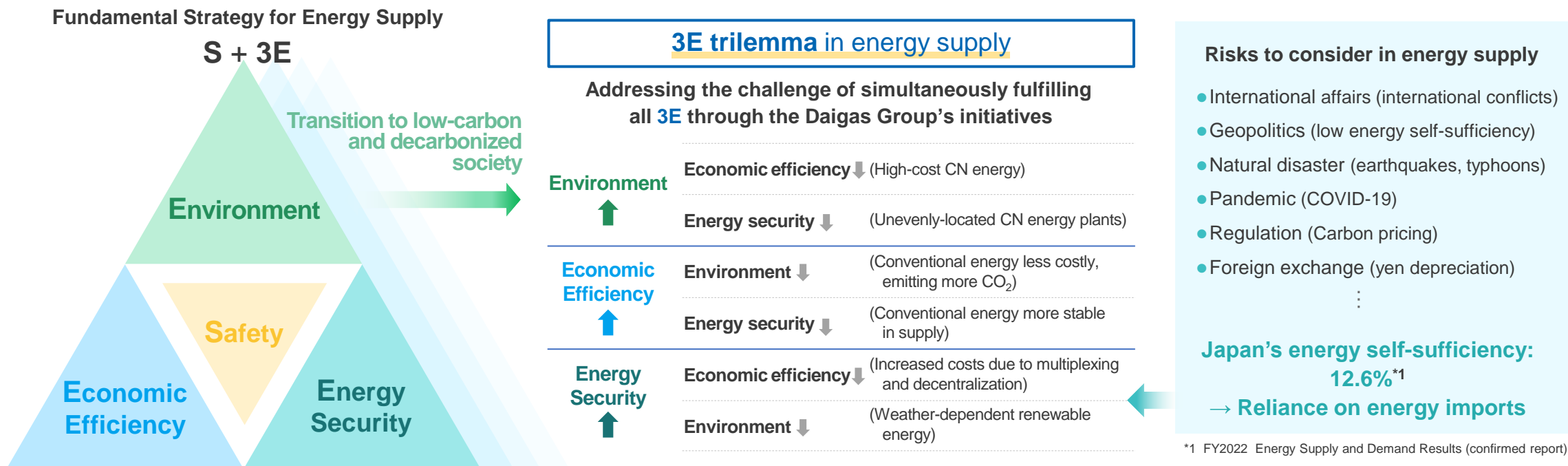
Economic Efficiency

*1 Negative emissions: A general term for technologies to capture and remove green house gases from the atmosphere *2 S+3E: Safety, Energy Security, Economic Efficiency, and Environment

*3 e-NG: electric natural gas, an alternative term for e-methane used in the U.S. and Europe *4 CCS: Carbon dioxide Capture and Storage *5 H-to-A (Hard-to-Abate) industry: Sectors in which CO₂ emissions reduction is challenging

Fundamental Principle for Energy Supply

- **Transitioning to a low-carbon/decarbonized society** requires diverse energy options in light of the **3E trilemma** of energy supply.
- Our fundamental principle: Ensuring **stable energy supply**, with **safety** as the cornerstone, and offering a wide range of **environmental** and **economic** options.



- Reducing costs and establishing **multiple locations** for **mass production** through **innovation** is crucial for the widespread adoption and growth of CN energy.
- Given the **3E trilemma** in energy supply, a successful transition to CN energy requires a **diverse range of options**.

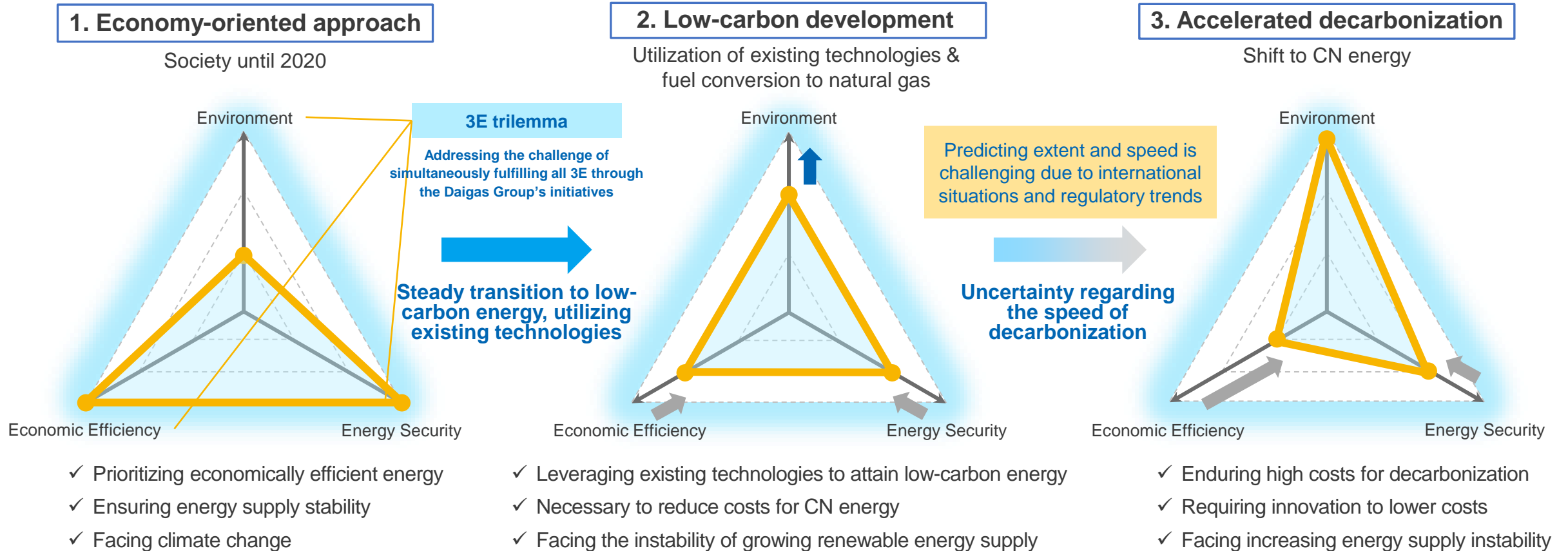
**Daigas Group
Fundamental Policy**

Ensuring **stable energy supply**, with **safety** as the cornerstone, to provide uninterrupted energy access, even during severe winters, extreme heat, or natural disasters, and offering a range of **environmental** and **economic** options to meet the evolving needs of customers.

Energy Transition Scenarios

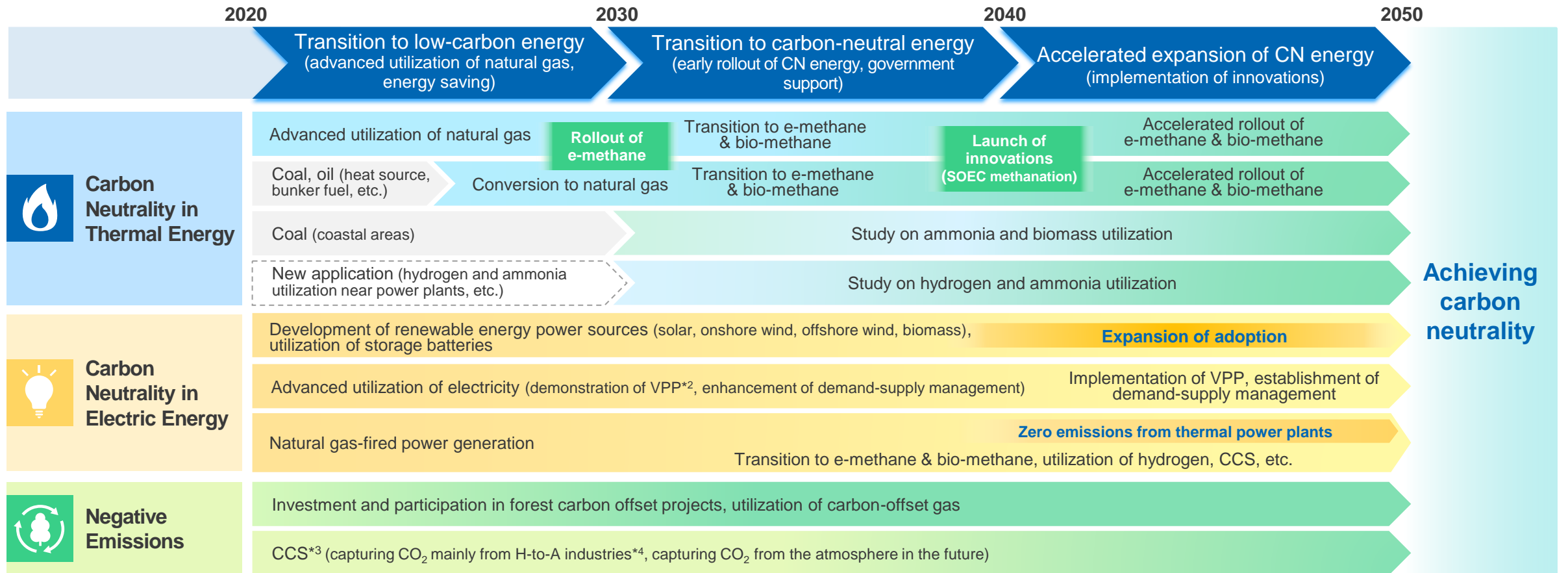
- **Forecasting** the rate and scope of decarbonization is **challenging** due to the dynamic business environment shaped by **international developments** and **regulatory changes**.
- The shift to CN energy **during society's transition to decarbonization** must consider the **social acceptance of costs** and the **advancements in technology**.
 →Pursuing **multiple energy transition scenarios** based on **3E trilemma** balance while **maintaining flexibility in energy options**

The balance of the 3E trilemma differs across scenarios.



Daigas Group's Roadmap to Low-Carbon and Carbon-Neutral Energy

- Driving the **energy transition** by **reducing carbon emissions** through energy savings and existing technologies until 2030, **shifting to carbon neutrality with CN energy** from 2030, and accelerating the growth of **CN energy through innovation** from 2040.
- Fulfilling our role as a comprehensive energy company in **achieving carbon neutrality** with stakeholders while delivering **optimal solutions** in light of **S+3E***1.



*1 S+3E: Safety, Energy Security, Economic Efficiency, and Environment

*2 Virtual Power Plant: Operating as a single power generation facility by integrating and controlling distributed energy sources through an aggregator, utilizing information and communication technology.

*3 Carbon dioxide Capture and Storage

*4 H-to-A (Hard-to-Abate) industry: Sectors in which CO₂ emissions reduction is challenging

Key Indicator for Assessing Society-Wide CO₂ Emissions Reduction

- **Fuel conversion** from coal and oil to natural gas is an **effective approach** for reducing CO₂ emissions and enhancing the carbon neutrality in thermal energy **during the transition period**.
- Although the increased use of natural gas significantly reduces CO₂ emissions across society, it leads to a rise in its supplier's supply chain CO₂ emissions.
- The Daigas Group **actively promotes and uses avoided emissions** as a key indicator for measuring society-wide CO₂ emissions reduction.

Avoided emissions Quantified emissions reduction through the company's products and services provided to others

Impact of fuel conversion from coal to natural gas on the CO₂ emissions of the Daigas Group, its customers, and society

Daigas Group

Proposal for fuel conversion →

Customers' Factories

- Fuel conversion substantially **reduces customers' CO₂ emissions**
→ **Reducing society-wide CO₂ emissions**
- Customers' consumption of natural gas supplied by the Daigas Group will lead to an **increase in the Daigas Group's CO₂ emissions**.

CO₂ emissions per unit of calorific value*1

Coal
100

→

Nat gas
55

-45%

Case 1

Asahi Kasei Corp. (Nobeoka)

-160,000/year of CO₂ emissions

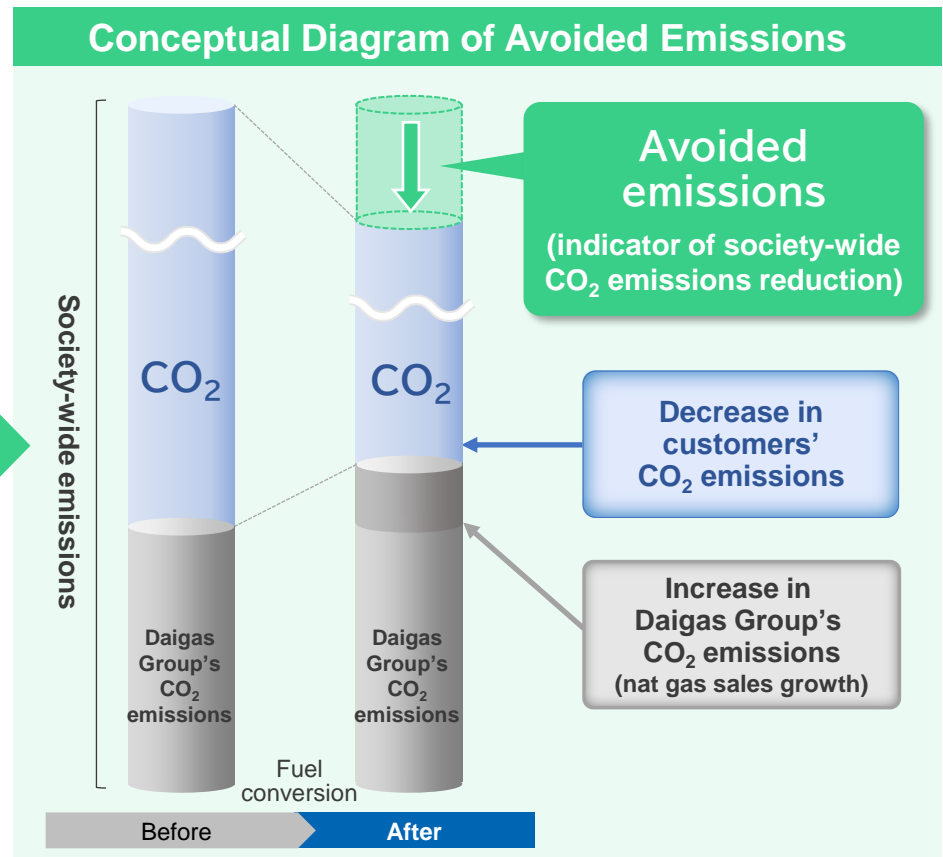
due to fuel conversion **from coal to nat gas** (thermal power)

Case 2

Toyobo Co., Ltd. (Iwakuni)

-80,000/year of CO₂ emissions

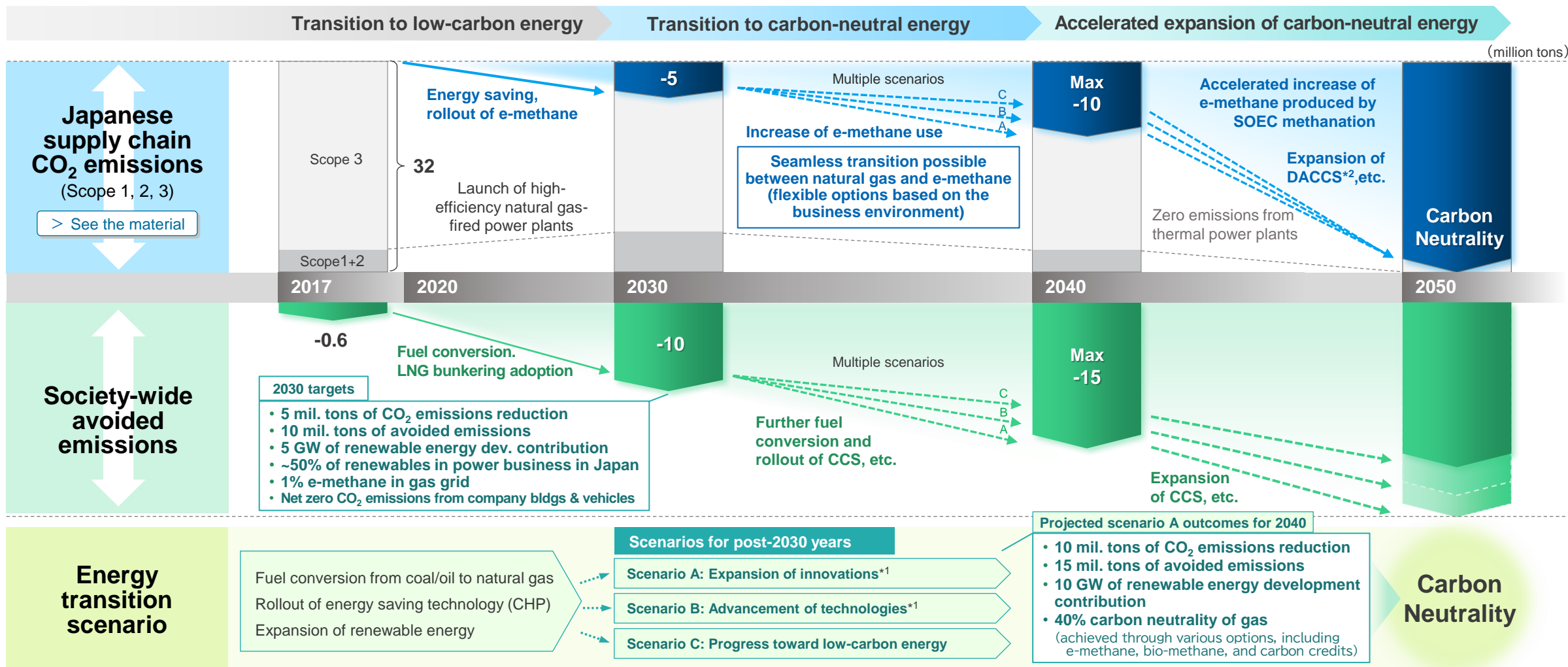
due to fuel conversion **from coal to nat gas** (thermal power)



*1 Based on the Ministerial Ordinance Concerning Calculation of Greenhouse Gas Emissions from Business Activities of Specified Emitters (Ministry of Economy, Trade and Industry and Ministry of the Environment).

Daigas Group's Roadmap to CO₂ Emissions Reduction

- Due to **uncertainties in the medium- to long-term business environment**, the Daigas Group has **formulated multiple scenarios**, with Scenarios A and B aligning with the national scenario*1



Responding flexibly to changing business. environment

The scenarios may be updated based on changes in business environment, affected by int'l situations, regulatory support, and other factors.

*1 Energy demand and supply outlook scenarios from Japan's Seventh Strategic Energy Plan

*2 Direct Air Carbon Capture and Storage: technology that combines DAC for separating and capturing CO₂ with CCS for underground storage

2. Low-Carbon and Carbon-Neutral Energy Initiatives

Energy Transition 2050

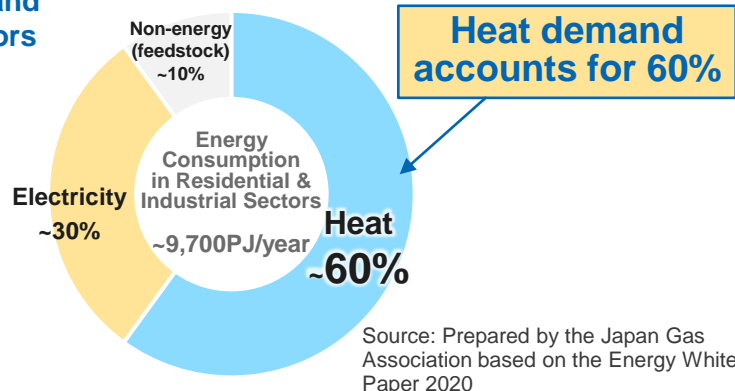


Pathways to Carbon Neutrality in Thermal Energy

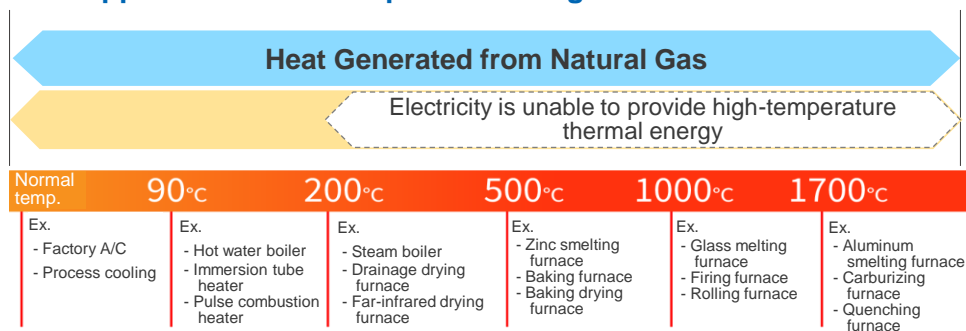
- **Hydrogen carriers***1 are vital for decarbonization, due to the **challenges of electrifying** the high-temperature thermal energy (**thermal energy** accounts for **60%** of Japan's energy consumption).
- **Hydrogen carriers** provides **multiple options for different utilization** depending on their characteristics, and **various pathways** exist for providing low-carbon and carbon-neutral thermal energy.

Types of Energy Utilization

Japan's Energy Consumption by Use in Residential and Industrial Sectors

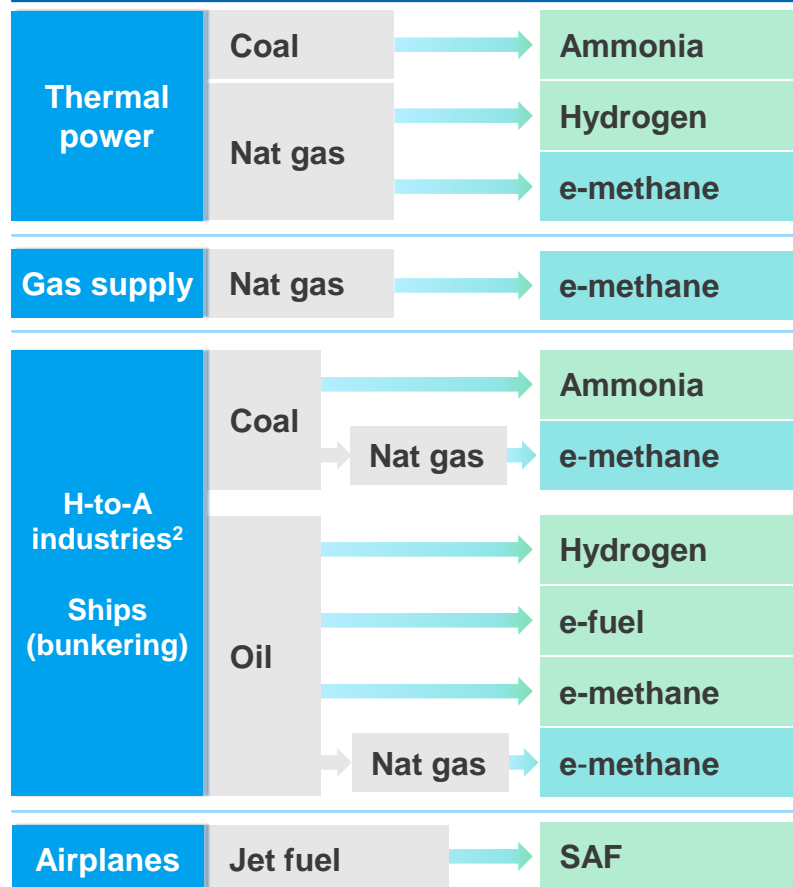


Heat Applications and Temperature Ranges



Source: Additions to Hydrogen and Fuel Cell Strategy Council data

Pathways to Low-Carbon & CN Thermal Energy



Hydrogen Carriers

H₂ Hydrogen [> See the material](#)

- Burns easily, zero CO₂ emissions
- Liquefaction temp.: -253°C (cf., natural gas: -162°C)
- Fast combustion (~8x faster than that of natural gas)

NH₃ Ammonia

- Coal combustion technology can be effectively employed
- Liquefaction temp.: -33°C (cf., natural gas: -162°C)
- Slow combustion (~half that of nat gas)

Carbon-Recycling Fuel

e-methane
e-methanol
e-fuel, SAF

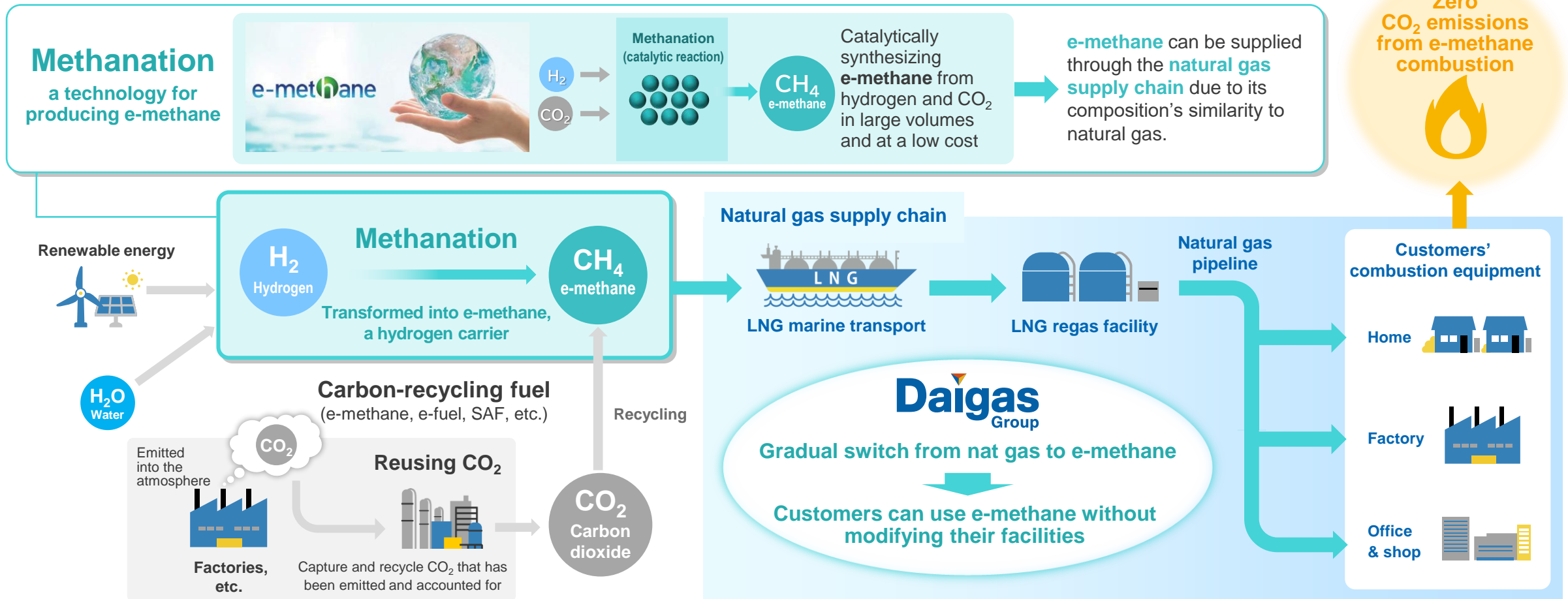
- Nearly identical composition to existing fuels
- Compatible with existing infrastructure and equipment
- Zero CO₂ emissions, as CO₂ is recycled

*1 It is a term that refers to "hydrogen etc.," which is defined as "hydrogen and its compounds, including ammonia and carbon-recycling fuel, such as e-methane, SAF, and e-fuel," in the Hydrogen Society Promotion Law.

*2 H-to-A (Hard-to-Abate) industry: Sectors in which CO₂ emissions reduction is challenging

e-methane: Key Fuel for Carbon Neutrality in Pipeline Gas Supply

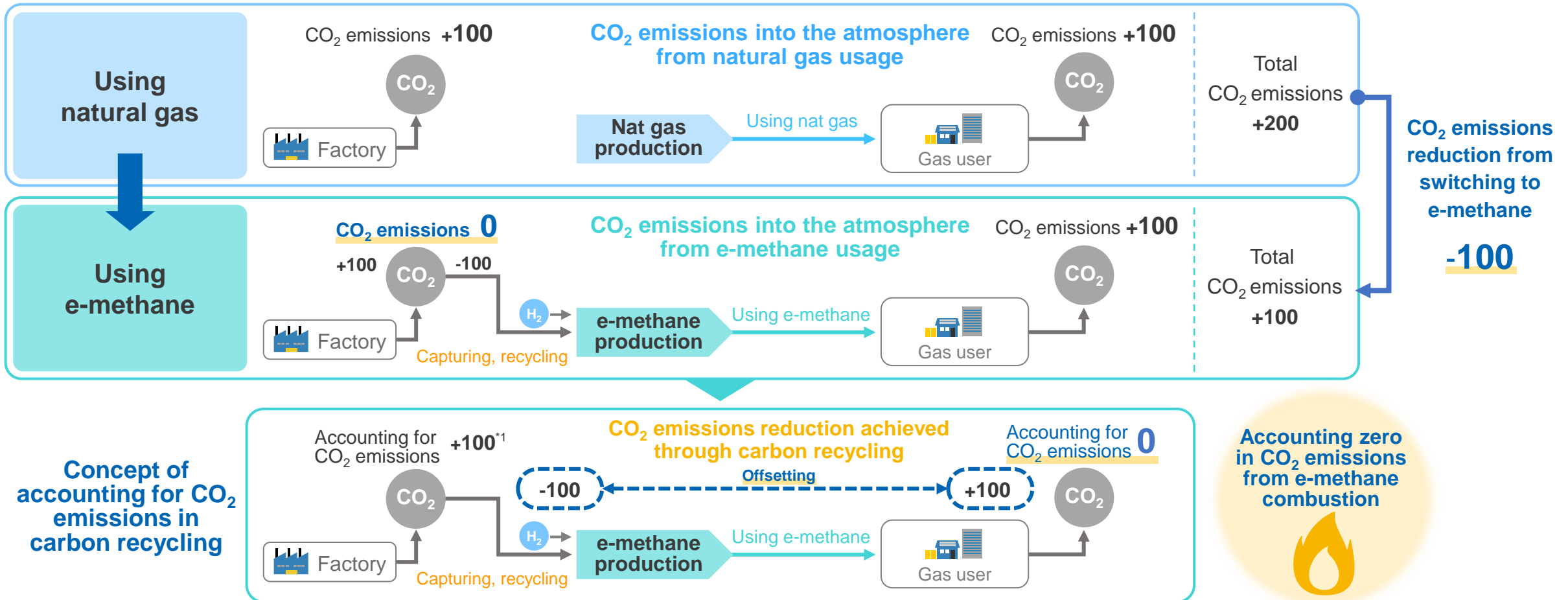
- **e-methane**, synthesized from hydrogen and recycled CO₂^{*1}, serves as a **hydrogen carrier** that can be distributed through the existing natural gas supply chain without any modifications due to its composition virtually identical to that of natural gas, unlike hydrogen, which has different physical properties, which makes itself incompatible with the existing infrastructure.
- Customers using natural gas **can easily switch to e-methane**, a carbon-neutral fuel, **without modifying their combustion equipment or facilities**.



*1 Assuming the use of bio-genic CO₂ and, in the future, CO₂ captured through DAC (Direct Air Capture) technology, which removes CO₂ directly from the atmosphere.

Reducing CO₂ Emissions with e-methane

- Switching customer fuel from **natural gas** to **e-methane** will lead to a substantial decrease in CO₂ emissions across society.
- The Daigas Group pursues **CO₂ emissions reduction across society with e-methane**, as a key strategy, **actively advancing its production and technology development**. (Carbon recycling allows customers **burning e-methane** to **achieve zero in accounting CO₂ emissions**.)



*1 We will explore cost reductions for Direct Air Capture (DAC) technology, which captures CO₂ directly from the atmosphere, and bio-genic CO₂ through innovation, aiming to reduce CO₂ emissions from +100 to zero by utilizing these CO₂ as feedstock.

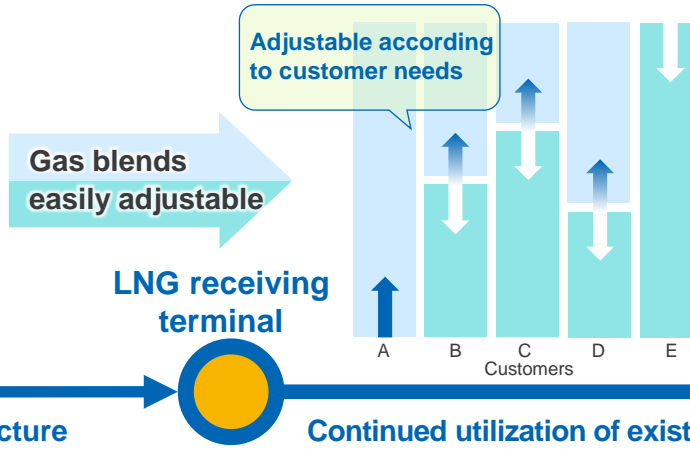
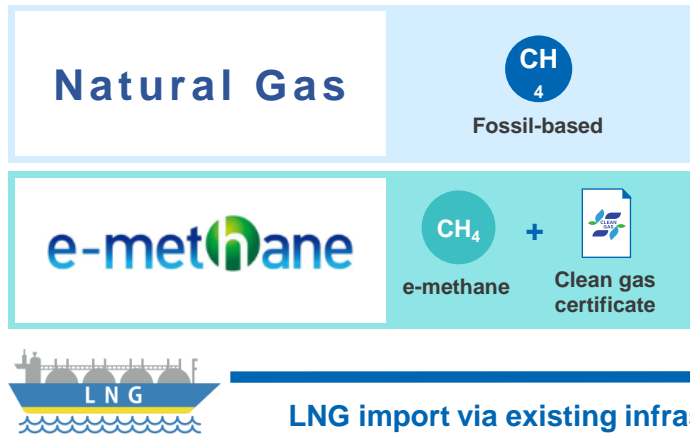
Driving Transition with Natural Gas and e-methane

- Substantially **reducing carbon emissions** through **fuel conversion** from coal and oil to **natural gas** and **mitigating environmental impact** through NOx and SOx emissions reduction.
- Additionally, pursuing carbon neutrality through a **seamless transition** from natural gas to **e-methane**, achieving a high level of economic efficiency and **energy supply stability** during the transition

	Coal, Oil	Natural Gas	e-methane
Environment	<ul style="list-style-type: none"> Substantial CO₂ emissions reduction through fuel conversion to natural gas Further CO₂ emissions reduction with high-efficiency energy-saving CHP Zero Sox emissions, significant NOx emissions reduction, environmental impact mitigation 	<p>In comparison to coal as 100</p>	<ul style="list-style-type: none"> Zero in accounting CO₂ emissions from burning e-methane by recycling CO₂ that has been emitted and accounted for Carbon neutrality in thermal power by switching fuels from natural gas to e-methane Certification and transfer of environmental value through the Clean Gas Certificate Program
Economic Efficiency	<ul style="list-style-type: none"> Long-term natural gas contracts to ensure supply stability, preventing energy supply interruptions during severe winters, extreme heat, or natural disasters, while also curbing price volatility 	<ul style="list-style-type: none"> Requiring no replacement of combustion equipment, enabling a seamless transition without altering existing operations due to e-methane's composition nearly identical to natural gas Lowering social costs through fuel conversion, enabling the continued utilization of existing infrastructure 	
Energy Security	<p>Stable prices through long-term contracts compared to volatile prices of spot contracts</p>	<ul style="list-style-type: none"> Ensuring high supply stability by distributing natural gas and e-methane simultaneously through existing infrastructure, enabling a temporary return to natural gas in case of e-methane supply shortages 	

Seamless Transition to Carbon Neutrality in Pipeline Gas Supply

- Delivering **blended supply** of **e-methane**, a hydrogen carrier, with **natural gas**, enabling easy **adjustments of the supply ratio** to meet the needs of customers who use **clean gas certificates**.
- Providing **early and area-wide** benefits of **hydrogen utilization** in the entire supply area through e-methane supply via natural gas pipeline network



Utilization of e-methane, a hydrogen carrier

Providing **early and area-wide** benefits of **hydrogen utilization** in the entire supply area

Conversion for different gas types was challenging

Coal-/Oil-based Gas

Significantly different gas types

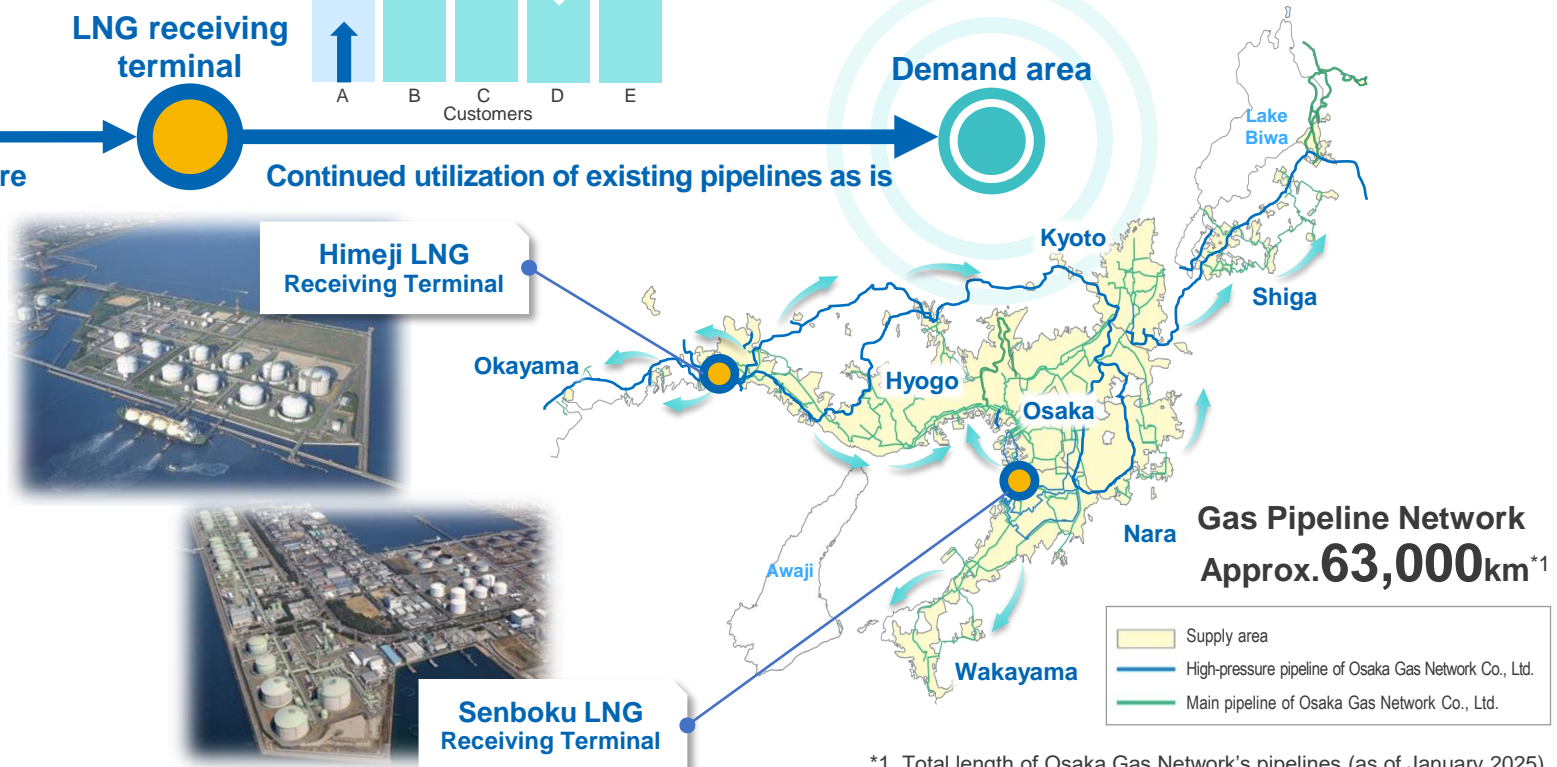
Natural Gas

e-methane

Seamless transition due to composition similarity between natural gas and e-methane

Osaka Gas' conversion to natural gas

- Houses : ~ 4.4 million
- Duration : 1975 to 1990
- Personnel : Max. ~3,000
- Gas devices : ~ 2,300 units



*1 Total length of Osaka Gas Network's pipelines (as of January 2025)

e-methane Supply Chain Development

- Aiming to **establish domestic and international e-methane supply chains** by **expanding e-methane usage in Japan toward 2050** and **providing it to other Asian countries to support their carbon neutrality** after achieving **1% e-methane in Japan's gas grid in 2030**
- Advancing **e-methane production projects** globally with diverse partners and leading in its **promotion** as a member of the **e-NG^{*1} Coalition**
- Pursuing **e-methane production to improve Japan's industrial competitiveness** and promoting e-methane production as a new growth industry to **drive economic growth in Japan and other Asian countries**

*1 e-NG: electric natural gas, an alternative term for e-methane used in the U.S. and Europe

New energy industry for gas producing countries

Japan's carbon neutrality and energy security

Asia's carbon neutrality through e-methane utilization

e-methane Supply Chain Development in Japan and Oversea

- **Energy security enhancement**
 - Utilizing existing natural gas and LNG infrastructure
 - Reducing geopolitical risks and ensuring stable supply through multiple sources across the world
- **Utilization promotion in Asia**
 - Engaging with energy providers in other Asian countries to promote e-methane utilization



Efforts for establishing international market



- An organization focused on establishing an international market for e-methane and related products, involving 19 companies from Japan, the US, and Europe, including Osaka Gas
- Aiming to increase the participation and sponsorship, enhance the international recognition of e-methane, and establish rules on trading and the environment

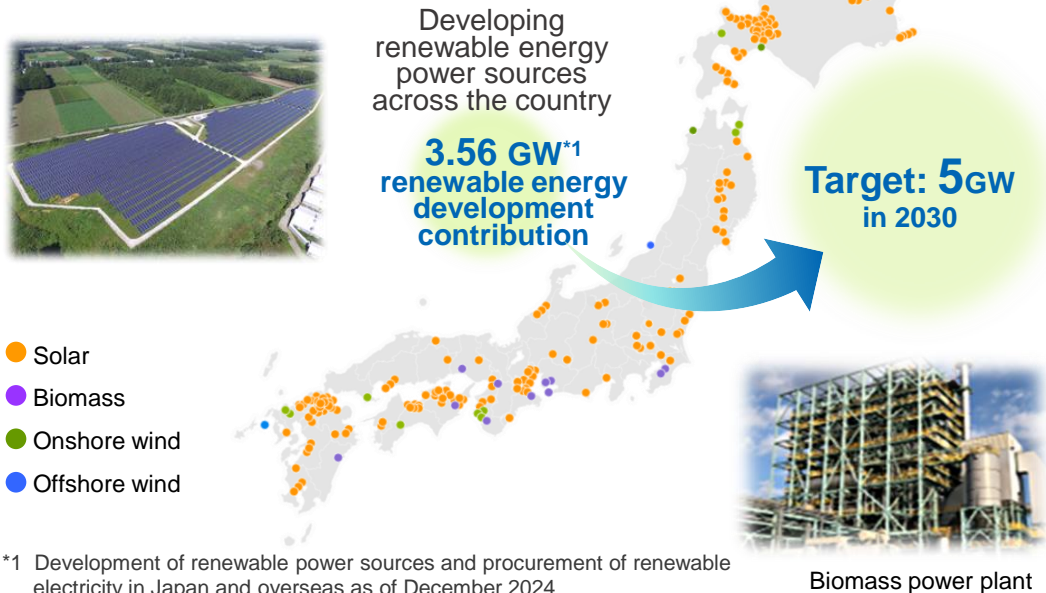
(Main collaborators as of the end of January 2025)

Renewable Energy Expansion Initiatives

- The Daigas Group has been engaged in renewable energy power generation businesses since 2004, **supporting renewable energy expansion in Japan and overseas** through the development and procurement of power derived from **solar, biomass, onshore wind, and offshore wind** energies, and has contributed to 3.56 GW*1 of renewable energy development.
- We aim to **further increase renewable energy** and **enhance the stability of power grid** through the advancement of **offshore wind projects** and **power storage businesses** to **achieve both carbon neutrality** by 2050 and **energy supply stability**.

Advancing Renewable Energy Development Nationwide

- Engaging in the renewable energy sector since 2004, **developing and owning over 400 projects in solar, biomass, onshore wind, and offshore**
- Further expanding renewable energy development in partnership with others and independently



*1 Development of renewable power sources and procurement of renewable electricity in Japan and overseas as of December 2024

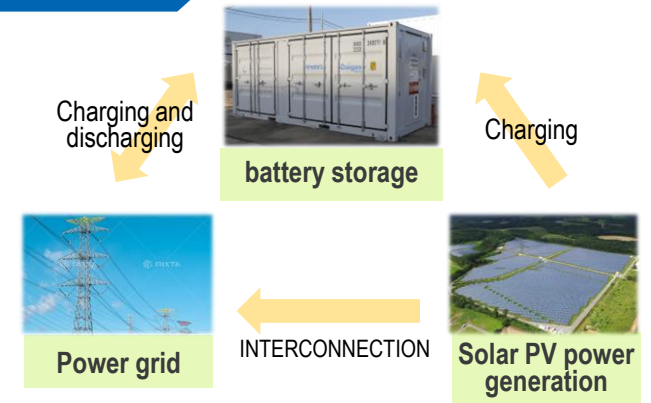
Operating in Offshore Wind Sector

- Collaborating with partners in one project near Murakami and Tainai Cities, Niigata (fixed-bottom, ~680MW) and another near Goto City, Nagasaki (floating, ~17 MW)
- Accelerating the growth of renewable energy by **taking on the challenge of developing offshore wind power**, which holds significant potential for Japan



Entering Storage Battery Business

- Engaging in the grid storage business since FY2023 to address the rising demand for grid power peak shift due to an increase of renewable energy (Senri and Takeo power storage facilities).
- Entering the business of **storage batteries, which will be installed with solar power units and other renewable sources** to support renewable energy development and power grid stabilization



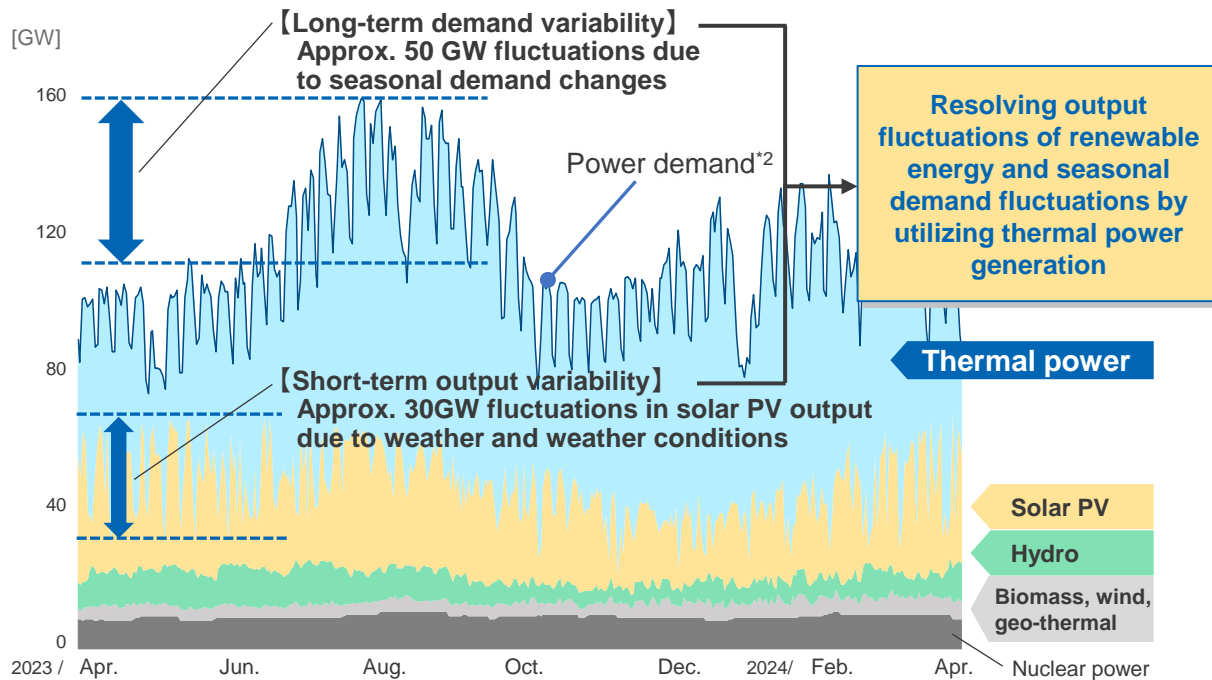


Best Mix of Renewable Energy and Zero-Emission Thermal Power

- As the share of intermittent renewable energy continues to increase, natural gas-fired power generation's flexible output capabilities will remain essential for ensuring a stable power supply.
- The Daigas Group provides electric energy with balanced **S+3E***1 through the best mix that includes **low-carbon natural gas-fired power**.
- We aim to achieve **zero emissions by 2050** with various solutions leveraging **natural gas-fired power plants in Senboku and Himeji**, our main power sources.

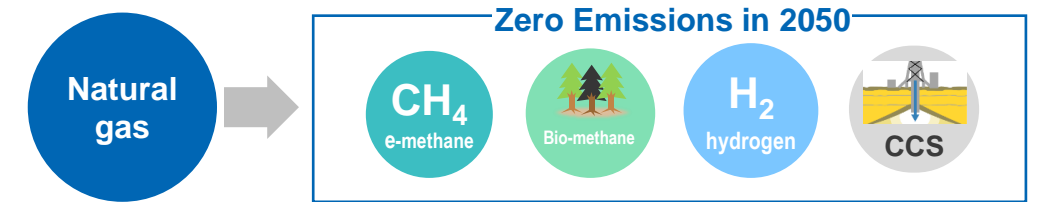
Thermal Power Generation, Which Balances S+3E

- Ensuring a stable electricity supply requires **aligning supply with demand**
- **Adjusting output with thermal power generation** to resolve power excesses and deficiencies caused by output fluctuations of renewable energy (e.g., solar PV) and seasonal demand fluctuations, thereby **achieving a balance between supply and demand**



Zero Emissions from Thermal Power Plants

- **Natural gas**, our primary fuel for thermal power generation, emits **about 50%** less CO2 than **coal**, playing a significant role in **promoting low-carbon energy**.
- Aiming to achieve **zero emissions** from thermal power generation, our main power source, by maximizing the potential of **e-methane, bio-methane, hydrogen, and natural gas + CCS, etc.**



Senboku Natural Gas Power Plant



Himeji Natural Gas Power Plant
(Rendering, including Unit 1 and 2 under construction, and Unit 3 in planning)

*1 S+3E: Safety, Energy Security, Economic Efficiency, and Environment

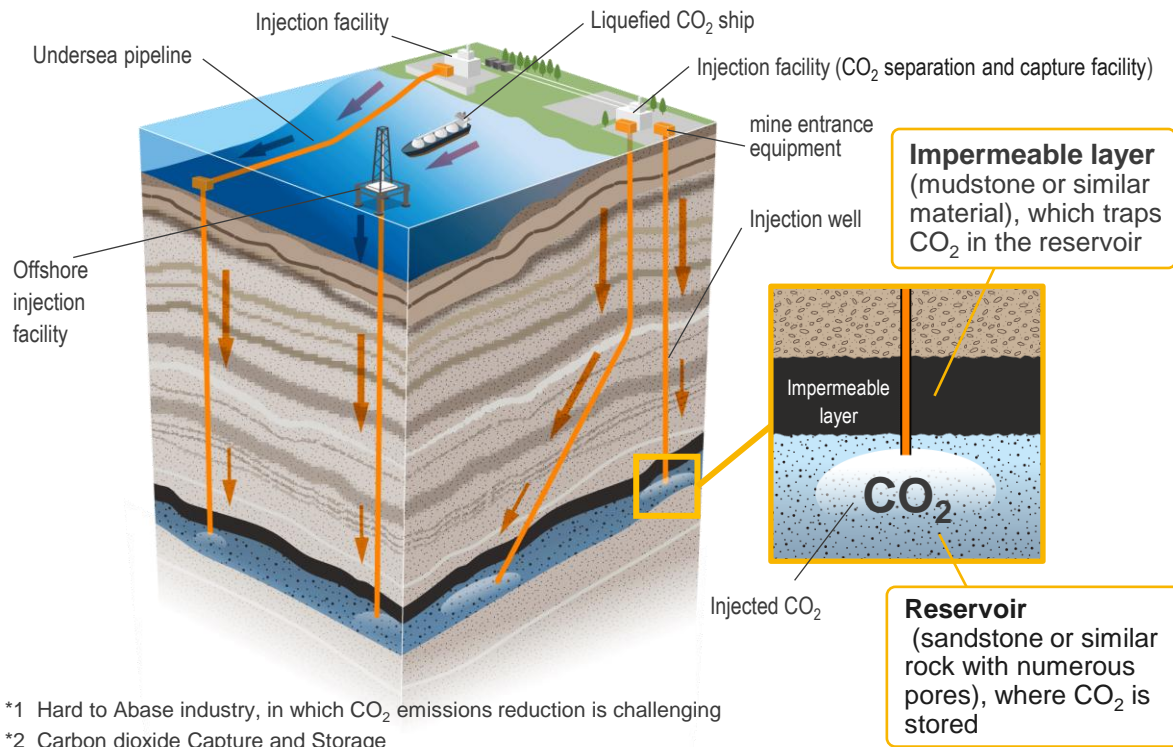
*2 Prepared by Osaka Gas using supply-demand results published by power transmission/distribution companies (excluding Okinawa).

Negative-Emission Initiatives

- The Daigas Group is working on **negative emissions** through **CCS^{*1}** and **forest carbon absorption** to effectively address substantial CO₂ emissions from **H-to-A industries^{*2}**, while also aiming for energy carbon neutrality. This approach will assist **customers in reducing CO₂ emissions** and promote the **sustainable growth of domestic industries**.

CCS

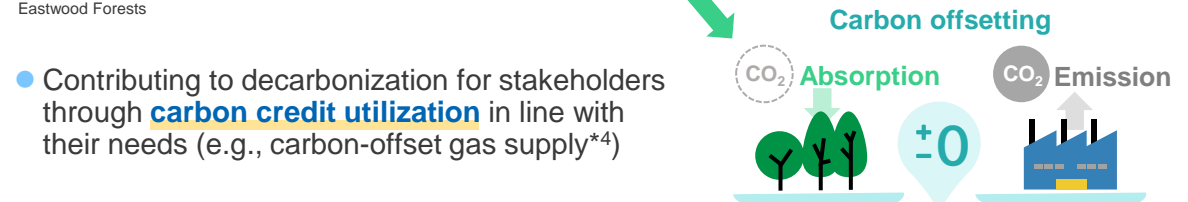
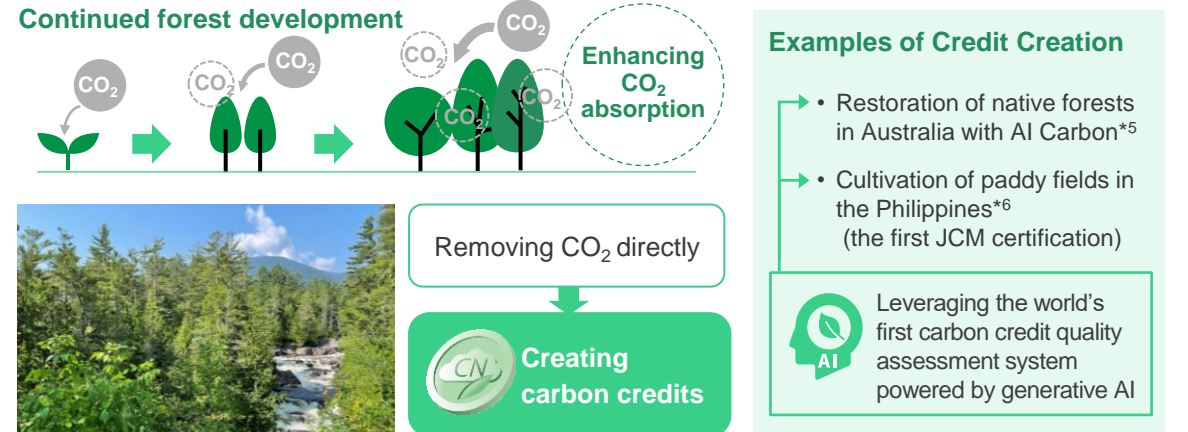
- Collaborating with customers to capture** and store CO₂ captured from factories, thermal power plants, and other sources, while considering the future implementation of DAC technology
- Storing** captured CO₂ (CCS) transported via pipelines and liquefied CO₂ ships, **in stable underground formations both in Japan and abroad** to reduce CO₂ emissions



*1 Hard to Abase industry, in which CO₂ emissions reduction is challenging
 *2 Carbon dioxide Capture and Storage

Forest Carbon Absorption, Carbon Credit

- Enhancing **CO₂ absorption and carbon fixation capabilities** through continued forest development and management, supported by **forest funds^{*3}**

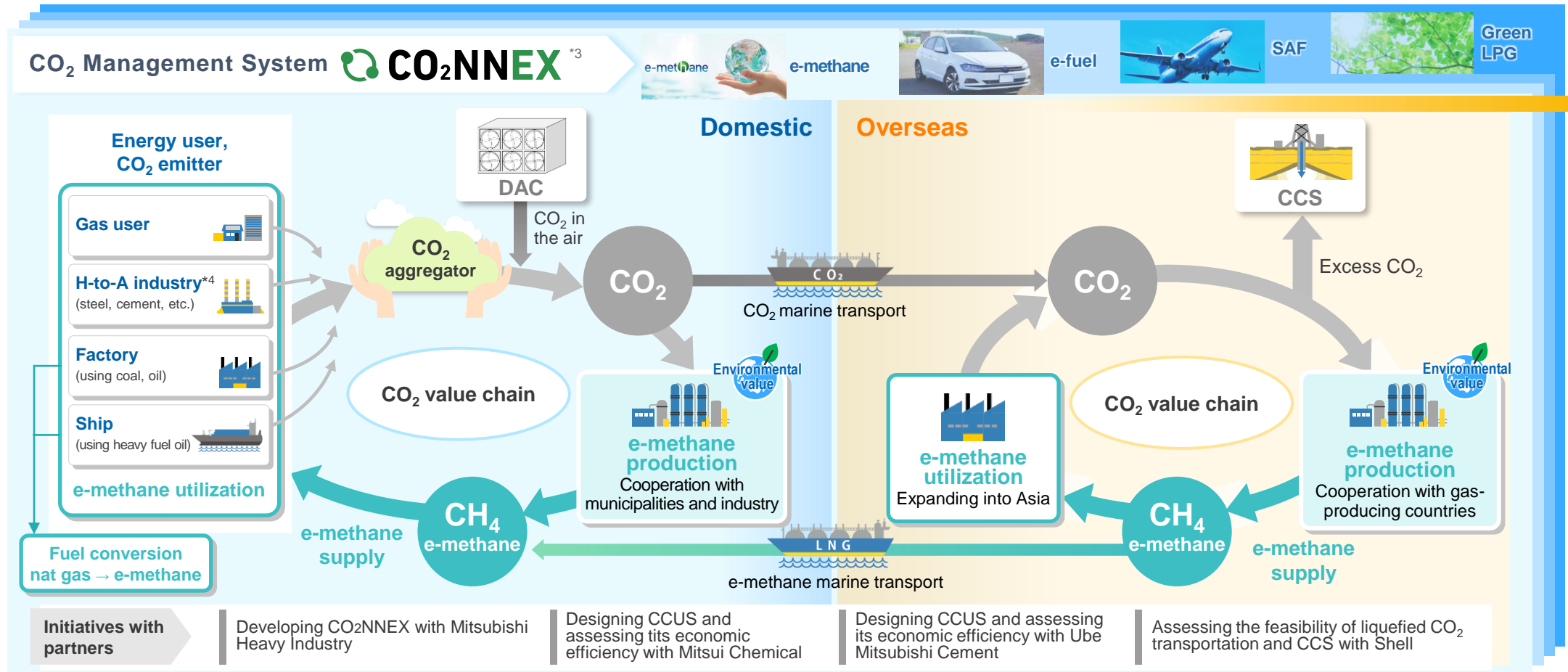


- Contributing to decarbonization for stakeholders through **carbon credit utilization** in line with their needs (e.g., carbon-offset gas supply^{*4})

*3 Eastwood Climate Smart Forestry Fund I: a fund jointly established by Sumitomo Forestry Group and 10 Japanese companies including Osaka Gas
 *4 Natural gas that is regarded as emitting no CO₂ on a global scale from its combustion due to carbon offset, where greenhouse gases produced throughout its life cycle—from drilling to combustion—are offset by CO₂ credits from environmental conservation projects in emerging countries
 *5 Australian Integrated Carbon Pty Ltd
 *6 Creating credits for methane emissions reduction by extending the mid-season drainage period in rice paddy cultivation

Development of New CO₂ Value Chain

- Aiming to establish a CO₂ value chain, where the Daigas Group **aggregates** CO₂ captured from industries, such as steel, cement, and chemicals, and implement **CCU***1 (e-methane production and supply) and **CCS***2 (negative emissions)
- Developing a **CO₂ management system** to manage the environment value of e-methane, visualize CO₂ distribution, and expand its application to **carbon recycling fuels**.



Expanding application to carbon-recycling fuels

*1 Carbon dioxide Capture and Utilization *2 Carbon dioxide Capture and Storage *3 CO₂NNEX: trademark owned by Mitsubishi Heavy Industry *4 Hard-to-Abase industry: industry, in which CO₂ emissions reduction is challenging

Advancement of Carbon-Neutral Technologies

- Strategically advancing technologies to **commercialize e-methane by 2030** through the scaled-up application of **Sabatier methanation** and **accelerating efforts to expand e-methane adoption starting in 2040** using high-efficiency **SOEC methanation**
- Collaborating with startups to advance **grid storage battery technologies and services**, aimed at **enhancing grid stability** when a large volume of renewable energy is introduced to the market.

Methanation

1 Sabatier methanation

Commercialization around 2030

- Scaling the existing technology, aiming at its early commercialization
- Implementing demonstration as joint NEDO project with INPEX*1

2 SOEC methanation

Acceleration around 2040

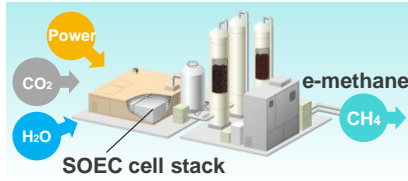
- Reducing energy costs through efficiency enhancement
- Combining SOEC co-electrolysis and methanation to enhance efficiency, Synthesizing methane from water and CO₂ directly
- Implementing demonstration as Green Innovation Fund project*2

3 Bio-methanation

- Promoting the local consumption of locally produced energy
- Effectively utilizing biogas derived from sewage sludge and kitchen garbage*3,*4
- Implementing demonstration at the Expo 2025 Osaka Kansai



Source: INPEX
Sabatier methanation demonstration facility under construction



Initiatives at Expo Osaka Kansai



Location of demonstration area



Demonstration facility at Expo Osaka Kansai (Rendering)

Hydrogen, Ammonia

Production

Transport, Storage

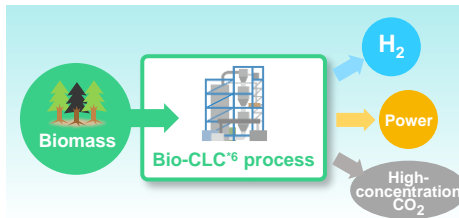
Supply, distribution

distribution

1 Producing hydrogen from biomass (Chemical looping combustion)*5

- Simultaneously producing low-cost green hydrogen, CO₂, and electricity

2 Enhancing effective combustion of hydrogen and ammonia



Storage Battery

Developing grid battery management/degradation diagnosis technologies

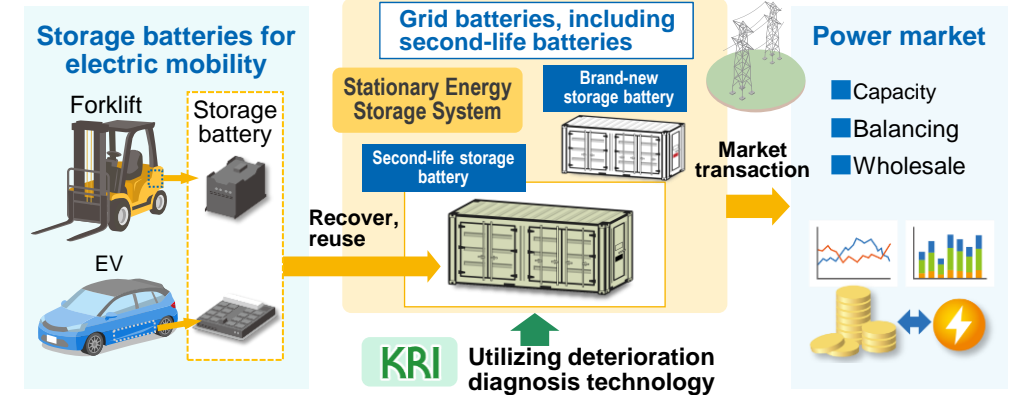
- Enhancing grid stability using low-cost second-life batteries

NExT-e Solutions

Daigas Group

Second-life battery utilization knowhow

Power trading knowhow



Negative Emissions

1 Direct Air Capture (from the atmosphere)

- Developing, exploring, and evaluating essential technologies for future negative emissions

2 Biochar

- Exploring and assessing technologies for CO₂ storage and soil enhancement through the carbonization of biomass and its geological storage

*1 NEDO-subsidized project, Development of Technology for Carbon Recycling and Next-Generation Thermal Power Generation/Development of Technology for Practical Use of CO₂ emission effective utilization, Development of Technology for CO₂ Utilization in Gaseous Fuels

*2 NEDO Green Innovation Fund, SOEC Methanation Technology Innovation Project for innovative technology development related to synthetic methane production *3 Sewerage application research, Ministry of Land, Infrastructure, Transport and Tourism

*4 Ministry of the Environment-commissioned Demonstration Project for Building a Model for Low-Cost Hydrogen Supply Using Existing Infrastructure *5 NEDO-commissioned project, Technological Development of CO₂ Separation and Recovery Type Poly-generation System *6 Chemical Looping Combustion technology

3. Daigas Group's Solutions for Customers

Energy Transition 2050

The Three Pillars of Daigas Group's Carbon-Neutral Solutions

The Daigas Group is working on carbon-neutral (CN) initiatives with stakeholders to co-create a **CN value for a sustainable future.**

For the Earth, society, and people, three pillars of our CN initiatives, we strive to develop and provide various solutions.



Energy for C&I sector

Energy for residential sector

Energy for transportation sector

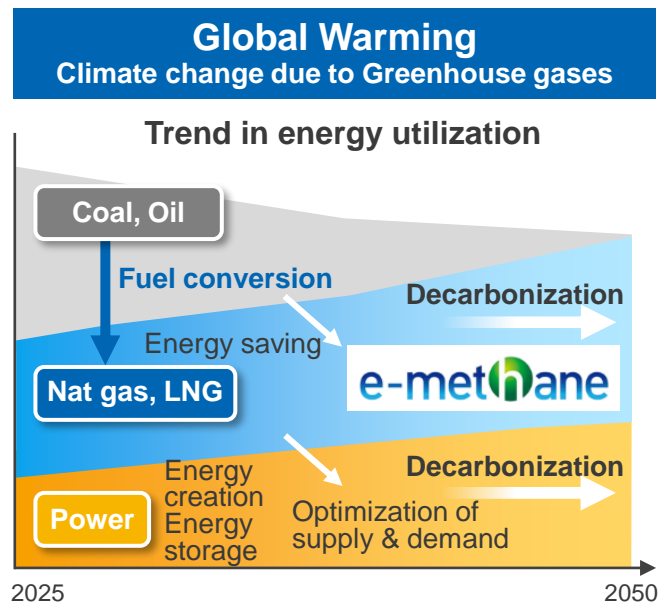
Regional co-creation



Energy Solutions for C&I Sector: Resolving Business Challenges

- Providing one-stop services **with customized value-added solutions** centered on **CN**, **3R**, and **DX** to **address** the diverse **business challenges** of commercial and industrial customers across Japan, including low-carbon energy and decarbonization of energy.

Business Challenges



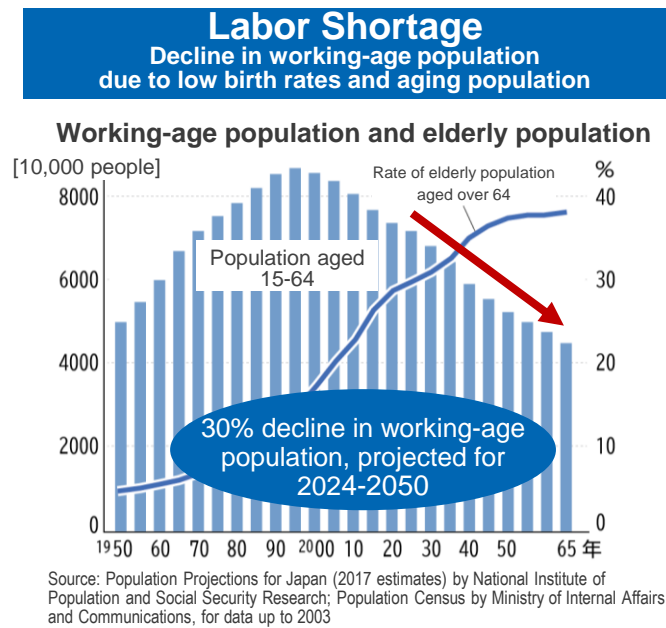
Environmental Pollution

Environmental degradation caused by waste

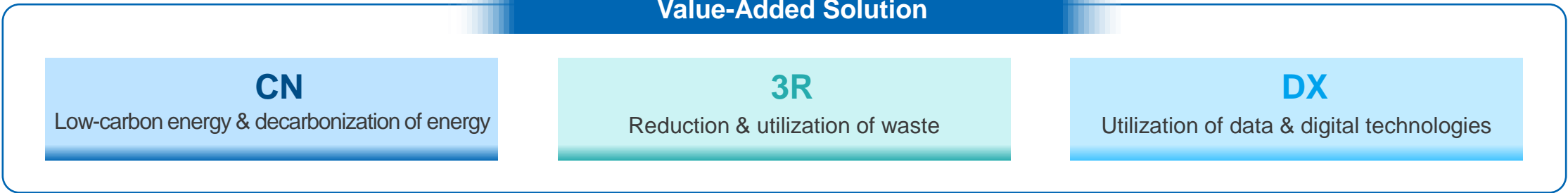
Aiming to achieve a circular society

Priority of waste disposal as defined in the Basic Law for Establishing a Circular Society

Priority	Waste generation control	Reduce
1	Waste generation control	Reduce
2	Reuse	Reuse
3	Recycle (Chemical and material recycling)	Recycle
4	Heat recovery (thermal recycling)	
5	Proper disposal	





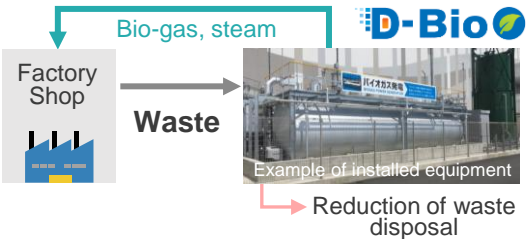
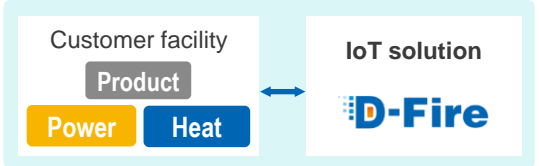
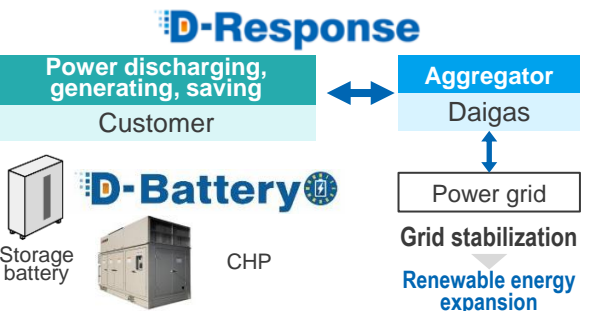
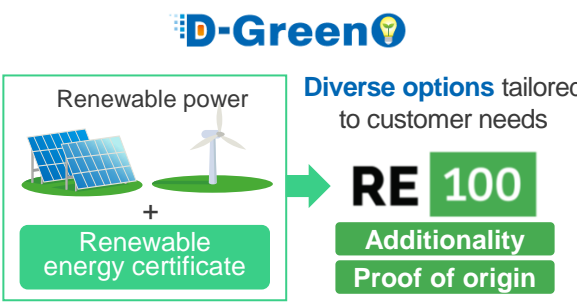
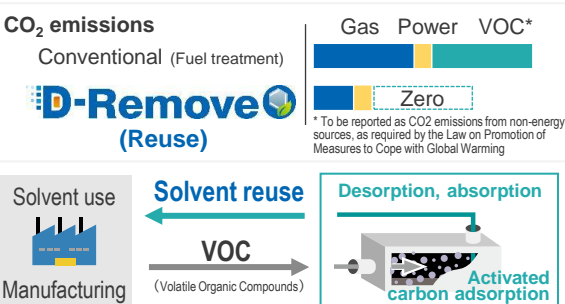

Value-Added Solution



Energy Solutions for C&I Sector: D-Lineup

- Providing a diverse range of value-added solutions for commercial and industrial customers under the **D-Lineup**. This offers **energy saving**, **energy storage**, and **business continuity planning (BCP) measures** through natural gas advanced application and storage battery utilization. It also includes **energy generation** from solar PV systems and food waste recycling, as well as **decarbonization support** using IoT data.

D-Lineup Solutions provided by Daigas Energy Co., Ltd.

CN low-carbon energy, decarbonization of energy		3R waste reduction and utilization		DX data and digital technology use	
Energy Conservation Natural gas advanced utilization CHP Energy saving by efficiently using waste heat generated during power generation Utilization of such waste heat for BCP measures in power outages 	Energy Generation On-site solar PV power generation D-Solar Adaptability of installation in challenging environment Waterproof roofs, open-air stands, carports, vertical structures, etc. 	Energy Generation Food waste reduction & recycling D-Bio Reuse of food waste for thermal energy 	IoT data acquisition & decarbonization support D-Fire Decarbonization consulting using IoT data on products and services 		
Energy Storage Optimization of demand and supply D-Battery·D-Response 	Integrated Solution for Renewable Energy Supply D-Green Diverse options tailored to customer needs 		Energy Saving Reuse of organic solvents D-Remove CO ₂ emissions Conventional (Fuel treatment) vs Zero 		Energy Saving Optimization through AI control D-Airing Air-Conditioning Solution Service achieving energy efficiency and comfort 

Energy Solutions for Residential Sector: Best Mix of Power and Gas

- Providing a new **value for a sustainable future**—resilience, sustainability, economic efficiency, safety, peace of mind, convenience, and comfort—by integrating **energy management** with the **best mix of electricity and gas** through **IoT**, all aimed at enhancing customers' **well-being** and fostering **next-generation smart lifestyles**.

Carbon-Neutral Best Mix of Power and Gas



Daigas Group's Next-Generation Smart Lifestyles

Resilience

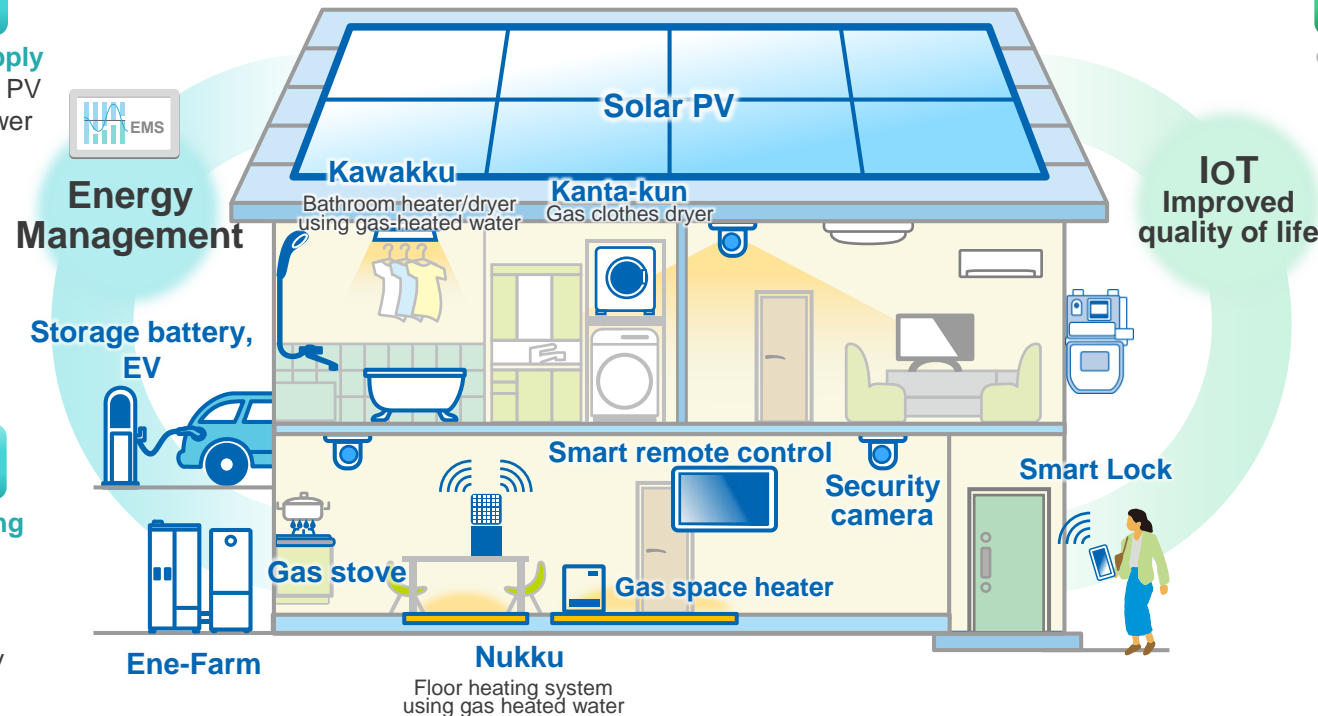
- Ensuring continuous and stable supply of energy (power and heat) from solar PV and Ene-Farm even in the event of power outages due to natural disasters

Sustainability

- Saving energy and providing solar energy, other renewable energy, and e-methane for a carbon-neutral lifestyle

Economic efficiency

- Optimizing energy use and enhancing economic efficiency through energy saving and management
- Effectively using surplus renewable power by combining renewable energy and storage batteries



Safety, Peace of Mind

- Offering lifestyle advice, weather forecast, and disaster information via voice and email, using Smapico and Smart Lock, along with security and monitoring services

Convenience

- Visualizing energy management and remotely controlling home appliances using smart remote controllers and smart phones

Comfort

- Providing comfort through the use of gas appliances (high heat and warmth of gas fire)

Energy Solutions for Transportation Sector

- Delivering **energy solutions** for **low-carbon and decarbonized transportation** by integrating **electric energy** (EV charging with renewable sources), **thermal energy** (e-methane supply for natural gas vehicles and LNG-fueled vessels), and **energy management services**.



LNG Bunkering*1 Business (Ship to Ship)

The diagram shows the LNG bunkering process: LNG loading at the terminal, transportation by an LNG bunkering vessel, and bunkering to an LNG-fueled vessel.

- At present, heavy fuel oil is the primary fuel employed by ships. The International Maritime Organization (IMO) aims to achieve zero greenhouse gas emissions around 2050.
- Many LNG-fueled vessels are expected to be delivered with the aim of reducing the carbon emissions of marine fuels. The Daigas Group aims for their carbon neutrality by replacing them with e-methane in the future.

Utilization of EVs for regional decarbonization and improved convenience and disaster preparedness

The diagram illustrates the utilization of EVs in two scenarios:

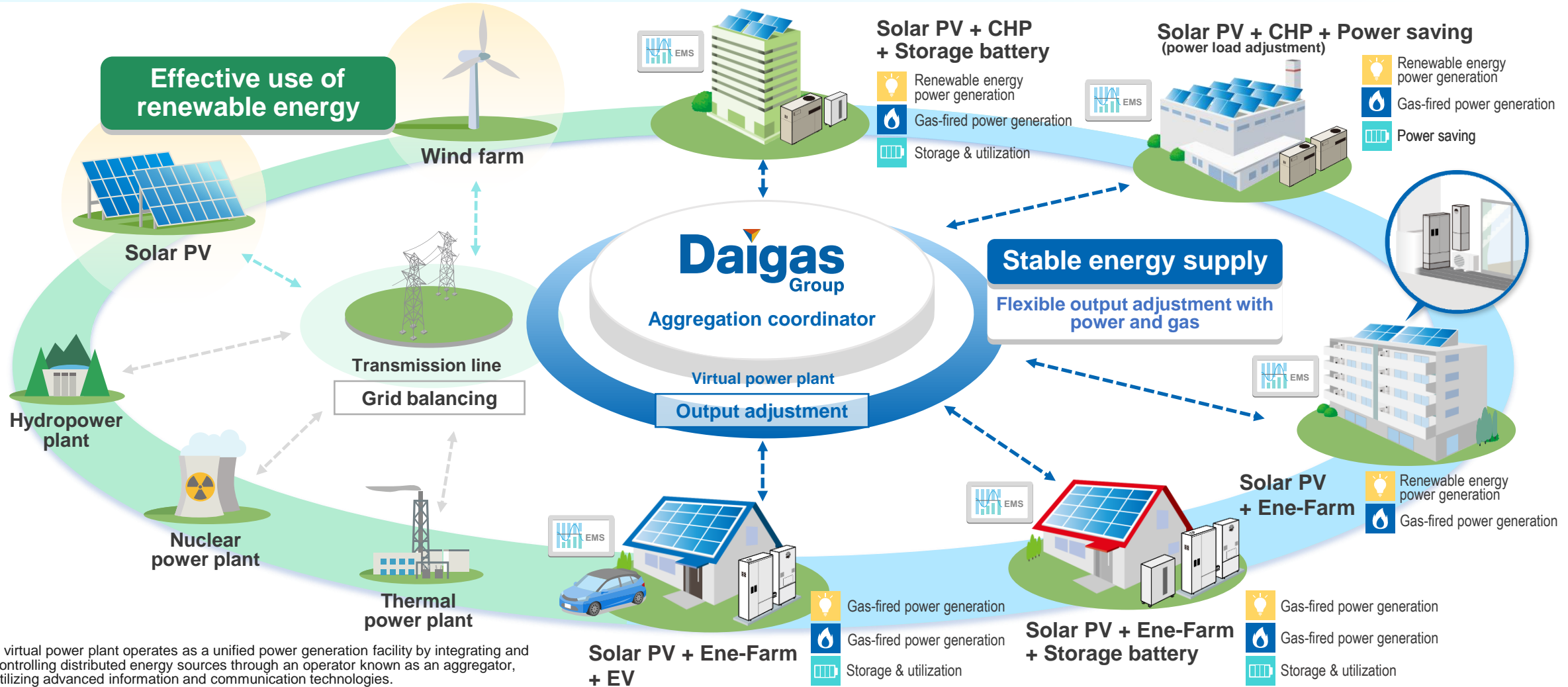
- Normal times:** Regional development and supply of renewable energy (Wind farm, Solar PV, Storage battery) lead to decarbonization (EV bus, EV), sharing, and improved convenience. This results in grid strain alleviation and prevention of renewable power output curtailment.
- Emergency (outage):** Renewable energy sources (Wind farm, Solar PV, Storage battery) provide enhanced disaster preparedness (EV, EV bus) and evacuation sites.

Energy management in coordination with renewable energy sources: Efficient energy utilization through integrated management.

*1 A method for supplying LNG as fuel from an LNG bunkering vessel to an LNG-fueled vessel that is either moored or anchored.

Ensuring Stable Energy Supply through Virtual Power Plants

- **Optimizing** the regional use of **power and gas** through energy management of individual buildings and **establishing a virtual power plant*¹** by aggregating energy available in the region to achieve the **effective use of renewable energy** and **the enhanced stability of energy supply**, regardless of season, time of day, or weather conditions.



*1 A virtual power plant operates as a unified power generation facility by integrating and controlling distributed energy sources through an operator known as an aggregator, utilizing advanced information and communication technologies.

Solutions for Community Co-Creation

- **Revitalizing the community** and **resolving their challenges** by leveraging our knowledge, know-how, and technology, aiming to **co-create** new value for a sustainable future with local residents to achieve **carbon neutrality** and **well-being-focused lifestyles** through **collaboration with academia, collaboration with municipalities, and community development.**

Collaboration with academia

Kyoto Univ.

Kansai Univ.

Ryukoku Univ.

Kyoto Sangyo Univ.

Inquiry-based learning for junior-high and high schools (collaboration with ATOMica)

Next-generation education for elementary schools (Osaka Gas Network)

Collaboration with universities

- Reviewing and researching energy use aimed at CN, developing green talent
- Ensuring local safety, including disaster countermeasures

Inquiry-based learning

- Providing inquiry-based learning programs on carbon neutrality

Next-generation education

- Developing next-generation education through visiting lectures on energy, environment, disaster prevention, and food



Received 2023 Encouragement Award for Companies Promoting Youth Experiential Activities



Achieving carbon neutrality and well-being-focused lifestyles

Collaboration with municipalities

Osaka City

Kobe City

Kyoto City

Sakai City

Toyonaka City

Takarazuka City

- Supporting renewable energy & energy saving efforts in regions leading in decarbonization
- Facilitating local energy production for local consumption & environmental policies
- coordination & cooperation in disaster response



- Sharing information on food and housing
- Showcasing comfortable lifestyles using gas, proving community events, cooking lessons, and seminars.

Community development



Developing environmentally-friendly ZEH*1 condominiums,*2 SCENES and URBANEX (Osaka Gas Urban Development)



Decarbonizing the Midosuji Area and enhancing its value through area management (Midosuji Community Development Network)



Greening Osaka Gas' experimental housing complex, NEXT21

Received the 44th Green City Award and won the 23rd Greening Technology Competition*3



Contributing to low-carbon energy, decarbonization, improved resilience, and resolving local issues through the participation in the SENBOKU Smart City Consortium

*1 Net Zero Energy House: a house that aims to achieve zero primary energy consumption balance for air conditioning, hot water supply, lighting, ventilation, etc. by improving the insulation and energy-saving performance of the house and generating energy with solar PV.

*2 Developed in some properties

*3 Received the Minister of Land, Infrastructure, Transport and Tourism Award at the 44th Green City Awards and the Chairman's Award at the 23rd Greening Technology Competition of the Urban Greenery Organization of Japan.

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Group