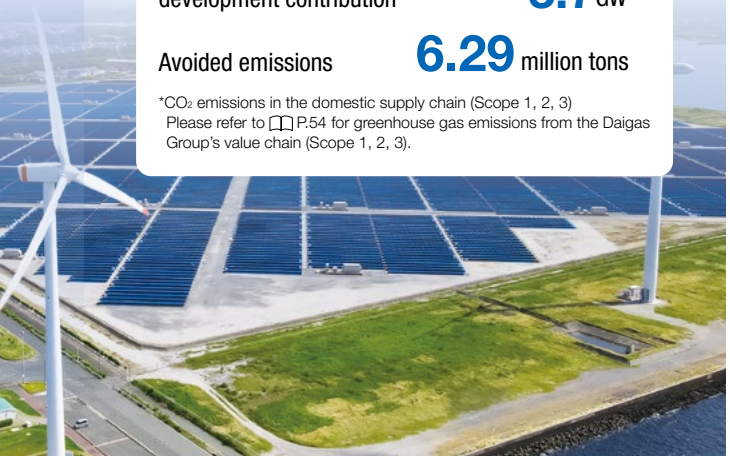
# Providing Carbon Neutral Energy

Working toward carbon neutrality in thermal energy, we will promote the widespread and advanced use of natural gas, a low-carbon energy. We will also accelerate the development of technologies such as e-methane and the construction of supply chains. To achieve carbon neutrality in electric energy, we will further develop renewable energy sources, aiming for a stable supply of electricity and zero emissions from natural gas-fired power generation. Furthermore, we will work on negative emissions that absorb and remove $CO_2$.

**FY2025.3 Results**

| | |
|---|---|
| $CO_2$ emissions of the Daigas Group | **23.44** million tons* |
| Percentage of renewables in our power generation portfolio in Japan | **30.4** % |
| Renewable energy development contribution | **3.7** GW |
| Avoided emissions | **6.29** million tons |

*$CO_2$ emissions in the domestic supply chain (Scope 1, 2, 3)
Please refer to P.54 for greenhouse gas emissions from the Daigas Group's value chain (Scope 1, 2, 3).



To achieve CN by 2050, the Daigas Group is taking a multifaceted approach to carbon neutrality in thermal energy, carbon neutrality in electric energy, and negative emissions. Each business unit is formulating specific plans to achieve the management plan targets for FY2031.3.

In the following pages, we report on the progress of technological development related to carbon neutral thermal energy and negative emissions initiatives, aimed at the 2024 to 2026 targets in the Medium-Term Management Plan 2026.

For other specific initiatives, please see Business Strategies by Segment.

| Accelerating initiatives | Main initiatives | Main targets* (2024–2026) |
|---|---|---|
| Carbon Neutrality in Thermal Energy | ● Conversion of coal and oil to natural gas and LNG P.40<br>● Advanced use of natural gas P.40<br>● Expansion of the use of natural gas<br>Expansion of sales of highly efficient energy-saving equipment P.40<br>Expansion of shale gas development and city gas business overseas P.43<br>Expansion of LNG bunkering business<br>● Development of innovative technologies such as e-methane and bio-methane<br>● Formulation of e-methane supply chain alliances | ● Avoided emissions<br>● Renewable energy development contribution<br>● Percentage of renewables in our power generation portfolio in Japan<br>● $CO_2$ emissions of Daigas Group<br>● $CO_2$ emissions reduction in the Group company offices and vehicles<br>● Promotion of e-methane practical application<br>● Promotion of methanation technology development |
| Carbon Neutrality in Electric Energy | ● Development of renewable energy sources P.41<br>Solar power: Promoting development and expanding use through collaboration with partners<br>Wind power: Promoting development and taking on the challenge of offshore wind power generation in Japan<br>Biomass: Promoting use and development<br>Storage batteries: Entering production of storage batteries that are installed alongside renewable energy sources to stabilize the power grid<br>● Advanced use of electricity P.41<br>Demonstrating VPP and advancing demand-supply management system<br>● Promotion of natural gas-fired power generation P.41<br>Utilizing natural gas-fired power generation, which is necessary as a coordinator, and promoting zero emissions | |
| Negative Emissions Initiatives | ● Establishment of a $CO_2$ value chain and Development of CCUS technology<br>● Investment and participation in forest carbon-offset projects | |

*Please see P.49 for more details of the targets.

Providing Carbon Neutral Energy

# Carbon Neutrality Initiatives in Thermal Energy

The following are the Daigas Group's initiatives in the development of diverse methanation technologies.

## Development of diverse methanation technologies

### ❶ Existing technology: Initiatives for practical application of Sabatier methanation technology

Jointly with INPEX CORPORATION, we are proceeding with the construction of a test facility plant in one of the largest technology development projects in the world for the commercialization of methanation*1, which aims to reduce the emissions of and effectively use $CO_2$. The plant is scheduled to start operation in FY2026.3. By FY2027.3, we will carry out demonstration to understand the reactive behavior of methanation, evaluate durability, and review scale expansion.

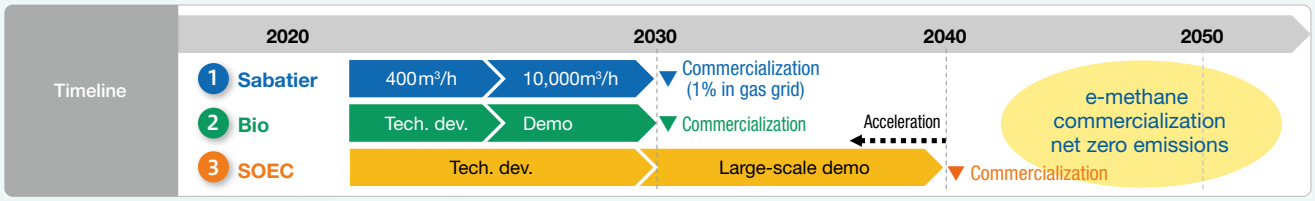
### ❷ Innovative technology: Promoting the development of biomethanation technology

From May to July 2024, we conducted a demonstration of e-methane production from food waste and renewable energy at the Osaka City Waste Incineration Plant (Maishima Plant), successfully achieving the target production of 5 m³/h of e-methane (methane concentration of 95% or higher). We started to demonstrate this technology*2 at the Osaka/Kansai Expo site from April 2025. Please refer to 🕮 P.30 for details.

### ❸ Innovative technology: Promoting the development of SOEC methanation technology*3

In June 2024, we completed the lab-scale testing equipment for SOEC methanation and commenced testing. In addition, bench-scale testing is scheduled to begin in FY2025.3. Moving forward, we plan to conduct bench-scale testing from FY2026.3 to FY2028.3 and pilot-scale testing from FY2029.3 to FY2031.3, and aim to achieve a top-level energy conversion efficiency (approximately 85–90%) in FY2031.3.

#### Roadmap for Social Implementation of Methanation Technology




*1 NEDO Grant Project: "Development of Carbon Recycling and Next-Generation Thermal Power Generation Technologies / Practical Utilization Technology Development for Effective Use of $CO_2$: '$CO_2$ Utilization Technology for Gaseous Fuels'"
*2 Ministry of the Environment Commissioned Project: "Project to Construct and Demonstrate a Model for Reducing the Cost of Hydrogen Supply by Utilizing the Existing Infrastructure (Fiscal Year 2023)"
*3 NEDO Green Innovation Fund Project: "Innovative Technology Development for Synthetic Methane Production: 'SOEC Methanation Technology Innovation Project'"

Sabatier methanation demonstration facility (under construction)

SOEC methanation bench-scale test facility (Completion in June 2025)

## Hydrogen and Ammonia Related Technologies

We are also engaged in the exploration, evaluation, and development of hydrogen and ammonia production and combustion technologies to meet our customers' needs.

- Successfully conducted a demonstration test of 30% hydrogen fuel co-combustion. (Daigas Energy Co., Ltd)
- Collaborated with overseas startups on technology evaluation and project development.(Koloma, Inc.: natural hydrogen)
- Developed technology for producing hydrogen from biomass. (Simultaneously producing electricity, hydrogen, and $CO_2$ using chemical looping combustion technology*4)

*4 NEDO-sponsored projects focused on the "Development of Technologies for Carbon Recycling and NextGeneration Thermal Power Generation/Development of Fundamental Technologies for Next-generation Thermal Power/ Development of technology for a poly-generation system with $CO_2$ separation/capture capabilities"

## Initiatives at the Expo 2025 Osaka, Kansai, Japan

The Daigas Group uses its advanced technology, including the demonstration of methanation technology, to contribute to realizing the theme of the Expo 2025 Osaka, Kansai, Japan, “Designing Future Society for Our Lives.”

©Expo 2025

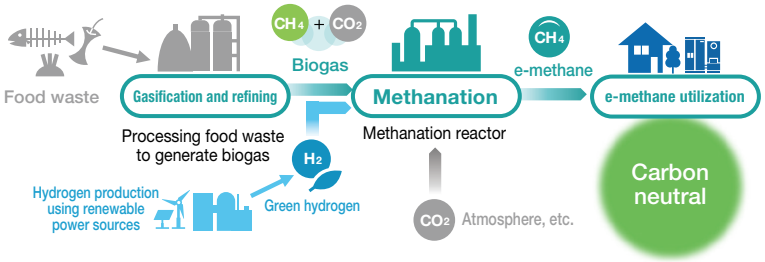
### Demonstration of methanation utilizing biogas

In March 2025, we completed construction of the e-methane production demonstration facility “Bakeru LABO” and obtained the first certification for “clean gas production facility”* for Osaka Gas. At this facility, demonstration experiments are being conducted to produce e-methane by synthesizing $CO_2$ produced by fermenting food waste generated at the venue and $CO_2$ contained in the air at the venue with green hydrogen through methanation. The produced e-methane is used in the Guest House kitchen at the venue and in city gas consuming equipment such as gas cogeneration facilities. After this demonstration project, while scaling up the methanation facilities, we aim to introduce a system that produces e-methane from renewable energy-derived hydrogen and $CO_2$ contained in biogas derived from food waste to waste incineration plants and food processing plants mainly in the Kinki region by 2030.

*Certification of clean gas production facility: Our company has been certified under the Clean Gas Certificate Program, which was launched in April 2024 as a “Biogas/E-methane Production Demonstration Facility at the Venue of Expo 2025 Osaka, Kansai, Japan.” This program will enable us to prove the environmental value of e-methane and biogas, and we plan to obtain certification for the equivalent amount of clean gas in the future.

Appearance of “Bakeru LABO”

Image of a facility tour




### Use of SPACECOOL® at the Expo 2025 Osaka, Kansai, Japan

SPACECOOL®, developed by Osaka Gas, has been adopted as a membrane material for the gas pavilion at the venue. SPACECOOL® is a radiant cooling material with a unique optical design, which lowers the indoor temperature below the temperature outside without using energy. It is expected that the use of this material will lower the temperature inside the gas pavilion by a maximum of 10 °C in the summer. It not only keeps a comfortable temperature inside the pavilion but also reduces the load of air conditioning, which contributes to reducing $CO_2$ emissions.


Courtesy of Japan Gas Association

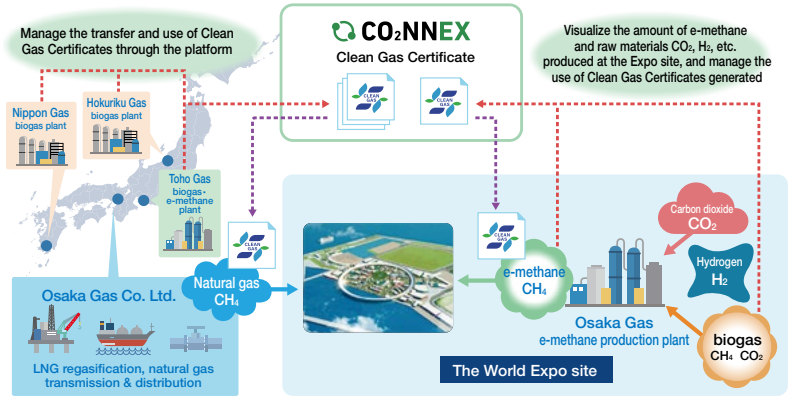
### Operation of $CO_2$NNEX® that enables the transfer of environmental value of e-methane

As more e-methane is supplied in city gas, private operations have begun for clean gas certificates that can transfer the environmental value of e-methane and biogas, similar to non-fossil certificates for electricity. As the trading volume of e-methane and its environmental value will increase in the future, it will be necessary to have a system for transferring environmental value via clean gas certificates.

Osaka Gas and Mitsubishi Heavy Industries, Ltd., have developed $CO_2$NNEX®*, the first system in the city gas industry that enables the transfer of the environmental value of e-methane, and is operating this system at the Expo 2025 Osaka, Kansai, Japan. At the Expo, $CO_2$NNEX® is being used to transfer and use clean gas certificates obtained from e-methane and biogas produced nationwide to natural gas supplied by Osaka Gas, contributing to carbon neutrality within the Expo.

*$CO_2$NNEX is a registered trademark of Mitsubishi Heavy Industries, Ltd.

### $CO_2$NNEX® Clean Gas Certificate Transfer Initiative




Expo site image courtesy of Japan Association for the 2025 World Exposition

## Formation of Supply Chain Alliances

For the full-scale introduction of e-methane in 2030, the Daigas Group considers establishing diverse methanation technologies, developing renewable energy sources, and building a supply chain both in Japan and overseas, including the procurement of hydrogen and $CO_2$ in collaboration with customers.

For stable procurement in the future, we are identifying locations suitable for e-methane production, focusing our consideration on North America, South America, Australia, the Middle East, and Southeast Asia, where existing natural gas and LNG facilities can be used. In addition, we cooperate with energy companies in Asia and advance e-methane use not only in Japan but also in Asia.

In December 2024, we, together with seven leading companies (the initial members) in the energy sector, completed the establishment of the "e-NG Coalition"—the world's first international alliance targeting the global expansion of e-methane. Through this alliance, we aim to advance e-methane production projects, contribute to reducing greenhouse gas emissions, and promote decarbonization in the Asian region. Furthermore, by promoting the adoption of e-methane, we seek to help establish an international energy market and contribute to the economic growth of Japan and Asia as a new growth industry. The coalition is an international alliance that aims to facilitate a widespread use of e-methane worldwide and achieve a carbon neutral society by cooperating across country and industry borders.

**New energy industry for gas producing countries** — **Japan's carbon neutrality and energy security** — **Asia's carbon neutrality through emethane 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

e-NG COALITION

- An organization focused on establishing an international market for e-methane and related products, involving 24 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 July 2025)

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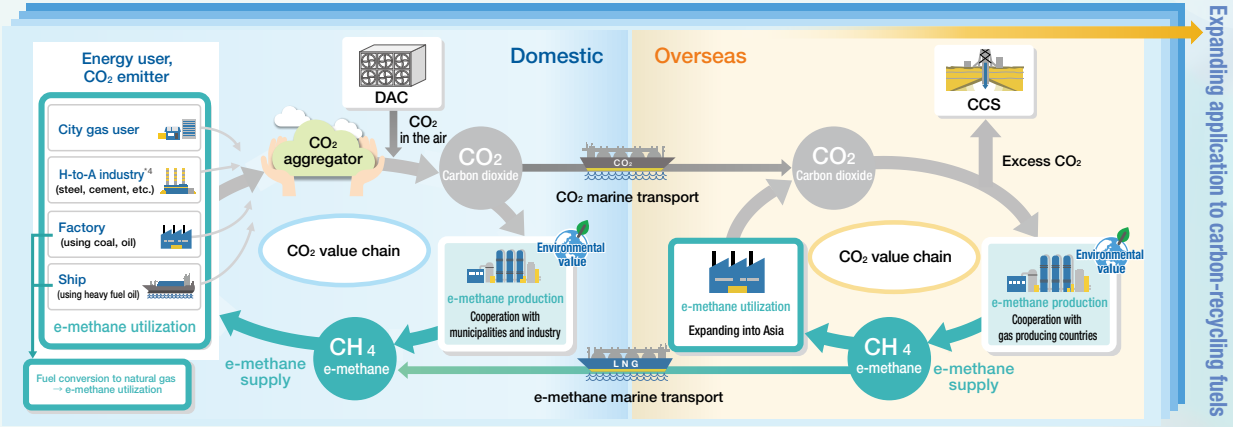
# Negative Emission Initiatives

The Daigas Group aims to achieve carbon negativity and is also working to reduce $CO_2$ emissions from industries where it is difficult to reduce $CO_2$ emissions, such as steel and cement. We will support our customers' reduction of $CO_2$ emissions and the sustainable growth of industry by introducing new technologies such as carbon dioxide capture and storage (CCS*1), carbon dioxide capture and utilization (CCU*2), and carbon credit businesses that contribute to $CO_2$ offsets.

## Initiatives for $CO_2$ Value Chain Development

The Daigas Group will act as an aggregator to collect $CO_2$ emissions from customers, including the steel, cement, and chemical industries, and will aim to build a $CO_2$ value chain by combining the production and supply of e-methane through CCU and negative emissions through CCS. We will develop a $CO_2$ management system ("$CO_2$NNEX®"*3) that will enable the management of clean gas certificates obtained from e-methane and visualization of $CO_2$ distribution and promote the expansion of its application to carbon-recycling fuels.



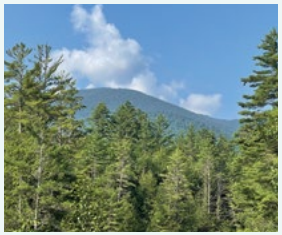

*1 Carbon dioxide capture and storage *2 Carbon dioxide capture and utilization
*3 $CO_2$NNEX is a registered trademark of Mitsubishi Heavy Industries, Ltd. *4 H-to-A industries: Industries where $CO_2$ emissions reduction is difficult (Hard-to-Abate)

## Initiatives to Improve Forests' $CO_2$ Absorption Capacity

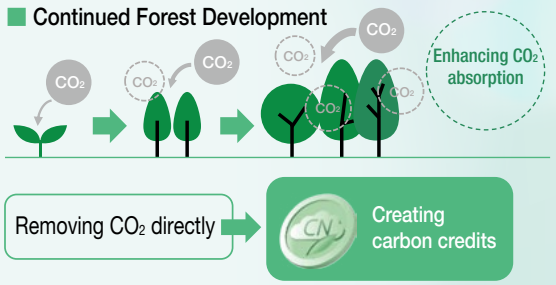
In July 2023, Osaka Gas announced its joint investment, along with nine other Japanese companies, in the East Climate Smart Forestry I ("the Fund") established by the Sumitomo Forestry Group.

By 2027, the pooled capital will have been invested in the acquisition and management of 130 thousand hectares of forest, primarily in North America. The Fund will contribute to the realization of a carbon-neutral society by generating new absorption of $CO_2$ and the production and trading of high-integrity carbon credits.* Approx. 90 thousand hectares of forest assets were acquired as of February 2025.

*Carbon credits are a means of offsetting carbon dioxide emissions that cannot be fully reduced through the use of renewable energy and energy-saving efforts.



An example of forests purchased by the Fund (Courtesy of Eastwood Forests, LLC)




## Initiatives to Assess the Quality of Carbon Credits using Generative AI

In March 2025, Osaka Gas launched GreenChecker, the world's first web service that uses generative AI to assess the quality of carbon credits.

For more details, please see the Sustainability Report 2025.