Feature

# Challenge to achieve Net-Zero $CO_2$

In the management vision, Compass2030, announced in November 2019, the Tokyo Gas Group declared it would take up three challenges, including that of "taking a lead in the effort to achieve Net-Zero $CO_2$." Then, in October 2020, more than a year later, the Japanese government declared the goal of realizing a carbon-neutral, decarbonized society by 2050. Six months later, in April 2021, the government made a further commitment to raise its reduction target for greenhouse gas emissions from 26% to 46% compared to the level in 2013. This is one of many examples of an accelerating move toward decarbonization seen in Japan and overseas.

With the aim of achieving our management vision, we are promoting the effective use of natural gas, the expansion of renewable energy sources, and the development of core element technologies for decarbonization, as we are committed to taking up the challenge to achieve Net-Zero $CO_2$ and leading the transition to a decarbonized society.

## Adding depth to business management with a further emphasis on ESG

**E Environment**

### Accelerate initiatives to achieve Net-Zero $CO_2$

1. Reduce $CO_2$ emissions on a global scale
2. Develop and commercialize technologies related to the management of hydrogen and $CO_2$

**S Social**

### Tackling social issues through value cocreation

1. Create sustainable communities
2. Provide services that address various urban lifestyle issues

**G Governance**

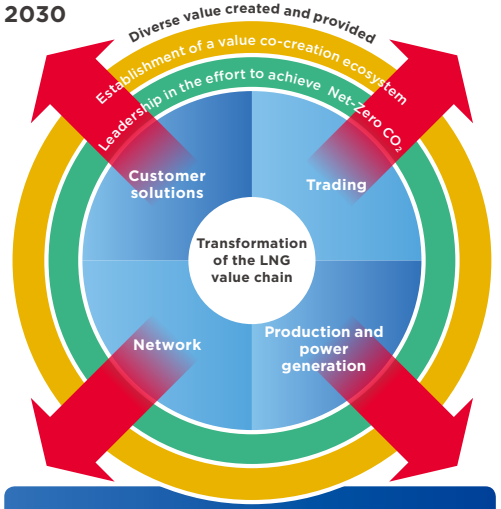
### Carrying out group formation reforms

1. Carry out management reforms
   (Improve management quality and transparency)
2. Reform the Group's organizational structure
   (Improve the earning power of each function of the value chain)

## Acceleration and achievement of the three challenges

- Challenge 1: Leadership in the effort to achieve Net-Zero $CO_2$
- Challenge 2: Establishment of a value co-creation ecosystem
- Challenge 3: Transformation of the LNG value chain

**2030**




**Utilization of the strengths of the Tokyo Gas Group in activities both in Japan and in global markets**

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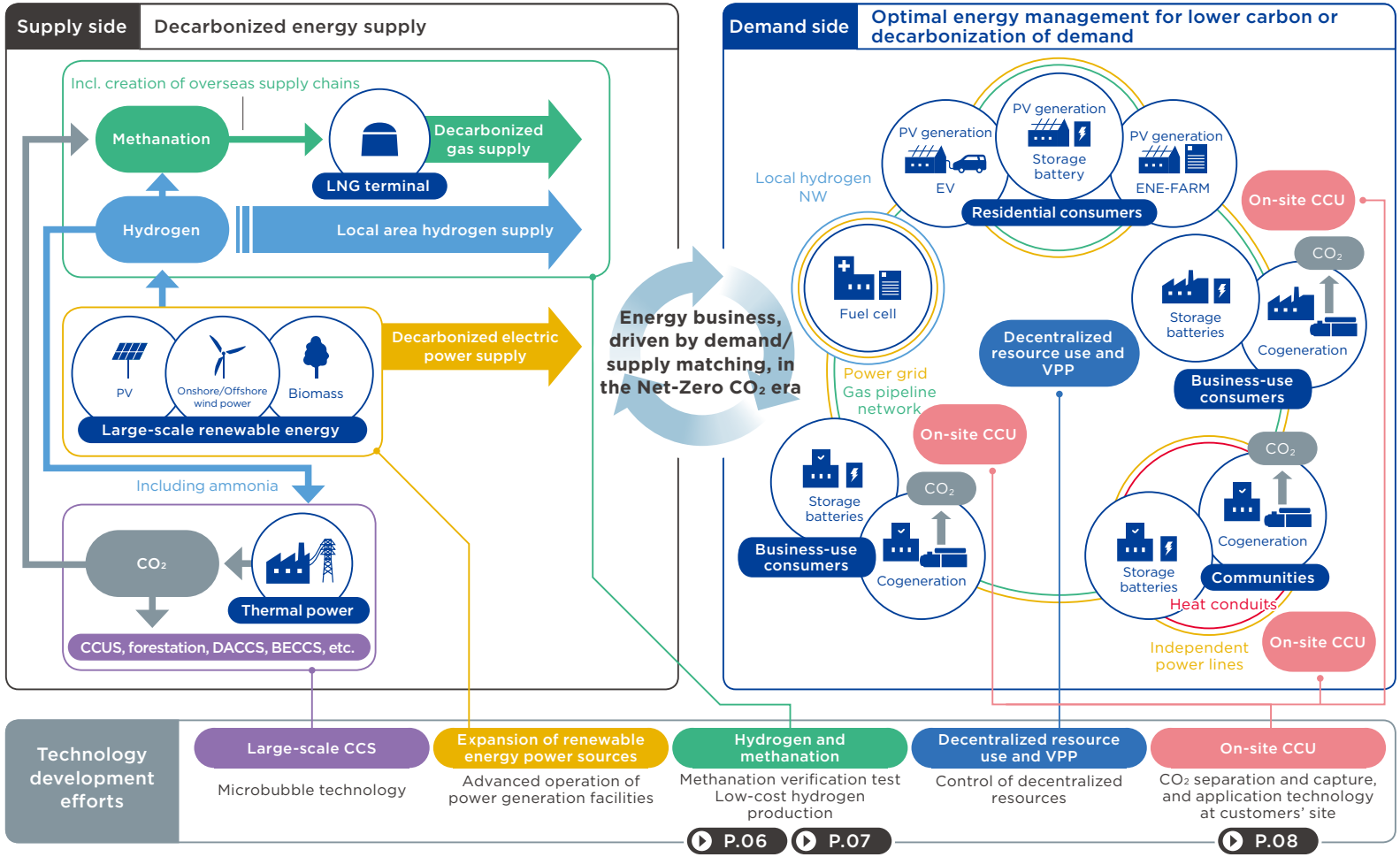
# Tokyo Gas Group's Net-Zero $CO_2$ vision and its technology development efforts

While it is difficult to predict the progress of future technology in detail at present, we believe that the strength of the Tokyo Gas Group is to manage the supply side and the demand side of energy in an integrated manner. By combining the supply of decarbonized energy (via the spread of decarbonized gas by methanation, local area hydrogen, and large-scale renewable energy use) with the demand side's optimal energy management (via VPP*1 using decentralized power sources including PV generation, storage batteries, and EV*2), we aim to realize Net-Zero $CO_2$ in a way that is unique to the Tokyo Gas Group.

*1: Virtual Power Plant (VPP) A mechanism that uses IoT to manage and control decentralized power sources, batteries, etc. as if they were a single power plant.
*2: Electric Vehicle (EV)




## Specific initiatives toward decarbonization

During the transition stage, steady reduction in $CO_2$ emissions is important. In addition to "expanded use of renewable energy in Japan and overseas," we are working on "shifting the energy source for city gas," as well as "energy saving through the use of natural gas, and advanced use of energy" as fast-acting measures to reduce $CO_2$, and "the use of CCU technologies at customers' sites" and "carbon neutral LNG initiatives" as decarbonization measures for gaseous energy.

Over the medium- to long-term, in addition to "$CO_2$ absorption and offsetting by means such as use of natural gas and CCUS," we will combine "initiatives on hydrogen and methanation for zero $CO_2$ emissions," which will enable effective use of our existing city gas infrastructure, in our efforts to achieve Net-Zero $CO_2$.

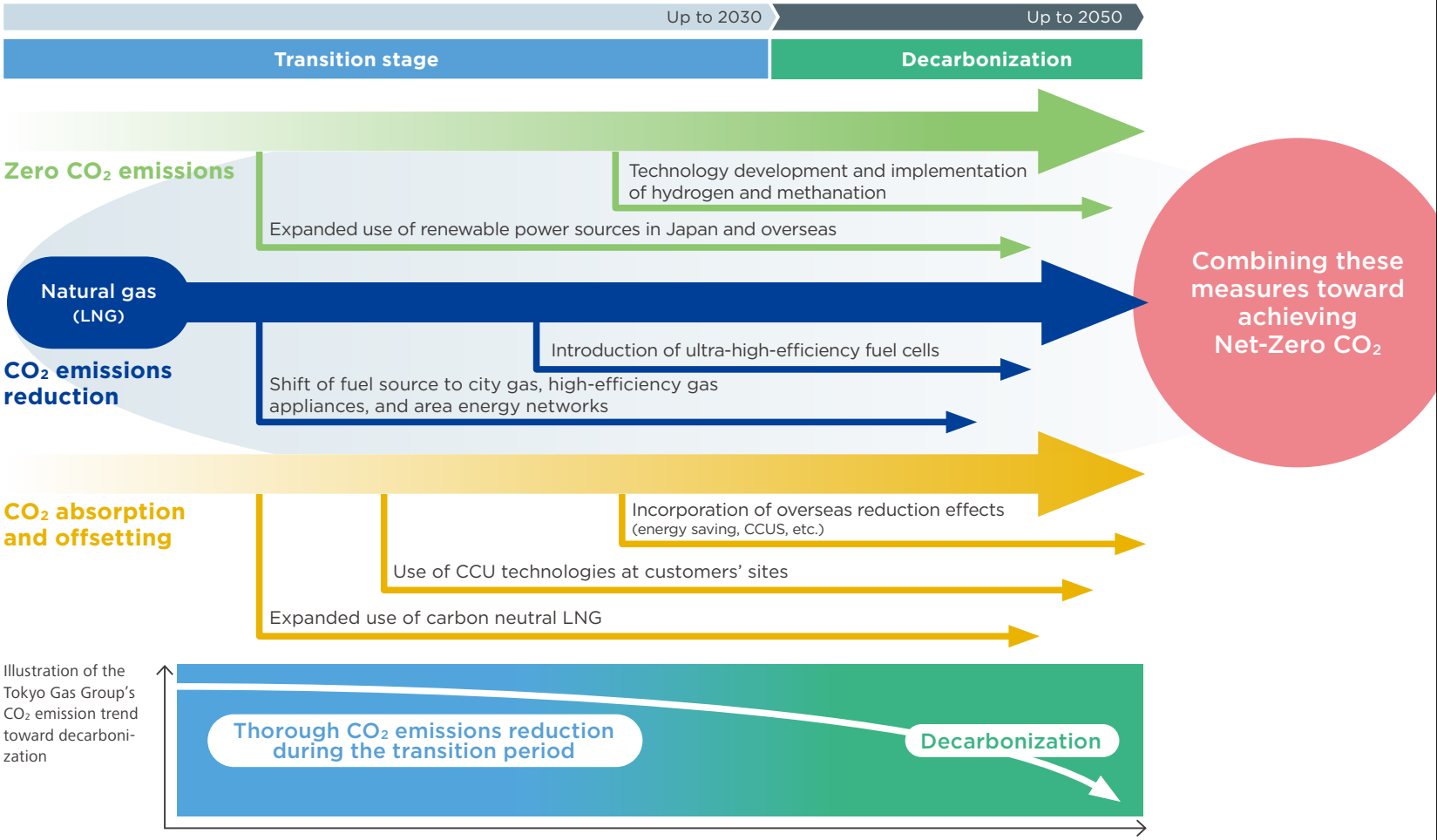






Illustration of the Tokyo Gas Group's $CO_2$ emission trend toward decarbonization

Hydrogen-related technology development

# Joint development of water electrolysis cell stack for low-cost green hydrogen production


## Challenges facing low-cost green hydrogen production by the water electrolysis method that Tokyo Gas is working on

1. Low-cost electric power procurement
2. Reducing cost of hydrogen production system
   - ▶ Reducing cost of water electrolysis device
     - ▶ Reducing cost of cell stack (material cost and manufacturing cost)

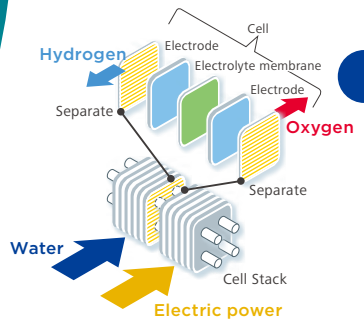
## Joint development with SCREEN Holdings, utilizing the strengths of Tokyo Gas

Tokyo Gas and SCREEN Holdings Co., Ltd. have agreed to jointly develop a "water electrolysis cell stack" and a "water electrolysis cell stack manufacturing device" with the aim of establishing within two years low-cost production technology for a water electrolysis cell stack, which accounts for a large portion of the production cost in a water electrolysis device. Tokyo Gas will use the technologies of material selection and performance/durability evaluation, accumulated in the development of residential fuel cells (ENE-FARM), and work on reducing the material cost. SCREEN will be in charge of developing the water electrolysis cell stack production technology and production equipment that applies continuous production technology using its proprietary roll-to-roll methodology*1. We will thereby work on drastically reducing the production cost, which had so far been difficult to achieve. Going forward, in conjunction with this development project, the two companies will undertake technological development for the systematization of this water electrolysis device to realize low-cost green hydrogen production. The goal is to further alleviate hydrogen production cost by quickly achieving*2 the hydrogen supply cost goal for 2030 of 30 yen/$Nm^3$-$H_2$, which is being promoted by the government.

## Utilization of technology development

Jointly with SCREEN, we will consider diverse possibilities to make use of the development outcome. If lower-cost production for a water electrolysis cell stack is realized, Tokyo Gas may potentially be able to produce low-cost hydrogen by itself, supply hydrogen to local areas, and use it as a material for methanation. Other possibilities may include technology licensing to system makers in Japan and overseas, and systemization and sale by ourselves or in alliance with a manufacturer.

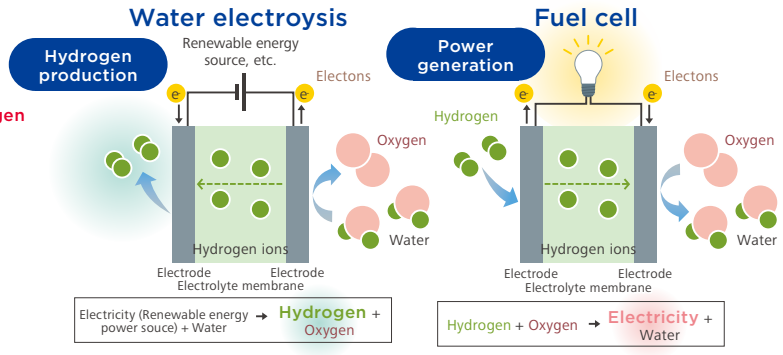
### Concept and basic composition of a water electrolysis cell stack



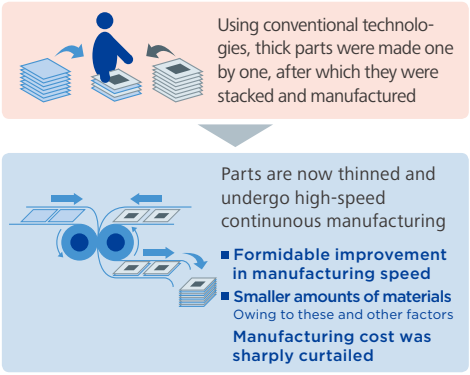

**What is a water electrolysis cell stack?**

It comprises of multiple stacks of thin parts (cells) that produce hydrogen and oxygen through water electrolysis (fuel cells have a reverse reaction).

### Summary of water electrolysis system hydrogen production methods (left) and fuel cell power generation method (right) (illustration)




### Low-cost production of a water electrolysis cell stack (illustration)




*1: A low-cost manufacturing process for functional films that consists of the continuous processing of film using a coating and other methods during the rewinding process of a long film substrate wound in a roll. In the current project, this manufacturing process will be used in the manufacturing of water electrolysis cell stacks.
*2: To achieve this goal, in addition to alleviating hydrogen production system costs through this development project, the realization of low-priced power procurement is also anticipated mainly through the growth of the renewable energy market.

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Methanation verification test

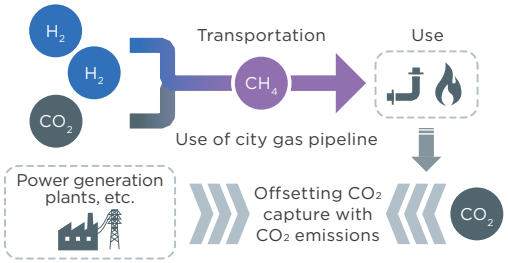
# Tsurumi District Carbon Neutral Collaboration Plan

## Overview of methanation

Methanation refers to the synthesizing of methane ($CH_4$): to use $CO_2$-free hydrogen produced or procured in Japan or from overseas, make it react with $CO_2$ emitted from power generation plants and other places, and capture it.

Supply of thermal energy using methanation has been positioned as one of the priorities in Japan's green growth strategy.

### Conceptual diagram of methanation




Source: Agency for Natural Resources and Energy

## Strengths of Tokyo Gas

As methane is the largest component of natural gas, we can use our existing infrastructure, including LNG ships, receiving terminals, pipelines, and the gas appliances of our customers, for the supply of decarbonized gas using synthetic methane. This means that we may not need to make a large investment.

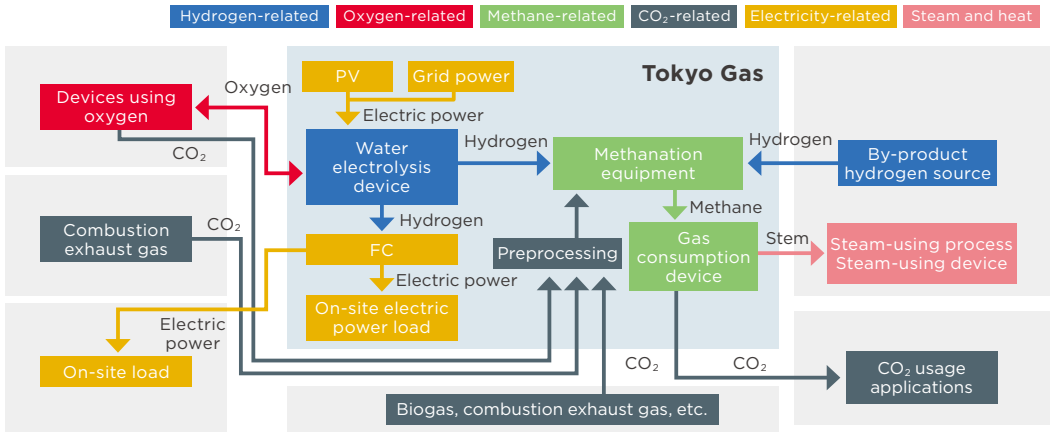
## Challenges involving methanation

The biggest challenge facing the use of methanation is to produce and procure hydrogen at a low price and in large quantities. Other challenges include securing low-cost $CO_2$ in large quantities, selection of an appropriate site, and larger-scale manufacturing.

## Tsurumi District Carbon Neutral Collaboration Plan and future initiatives

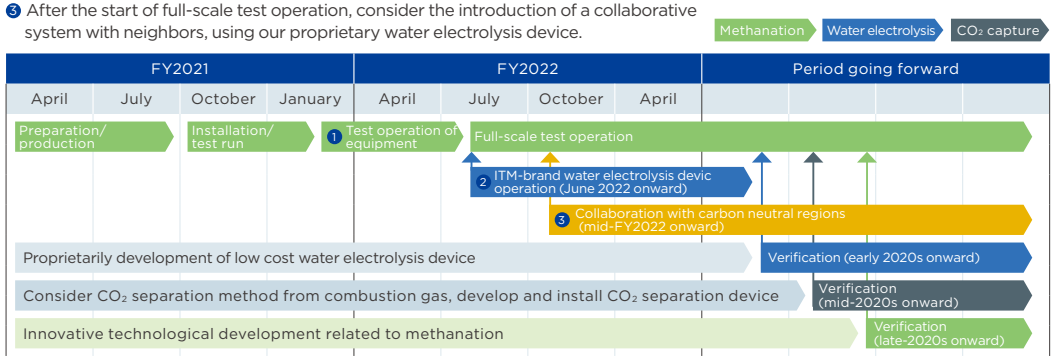
As the first step to use and adopt hydrogen and methanation, we will conduct a methanation verification test, using hydrogen produced from electric power by a water electrolysis device, at the Tokyo Gas site in Tsurumi-ku, Yokohama. We are also considering building a local production for local consumption model in cooperation with companies in Suehiro-cho, Tsurumi-ku and the City of Yokohama. Using the knowledge acquired from the verification test, we aim to potentially conduct a larger-scale verification test at our LNG terminal for commercialization and to create a supply chain.

### Illustration of Tsurumi District Carbon Neutral Collaboration




### Schedule of the verification test

❶ Start synthesizing of methane during fiscal 2021.
❷ Start full-scale verification testing after the ITM-brand water electrolysis device starts operation (June 2022).
❸ After the start of full-scale test operation, consider the introduction of a collaborative system with neighbors, using our proprietary water electrolysis device.



$CO_2$ management technology development

# CCU at customer's site

## Overview of CCU

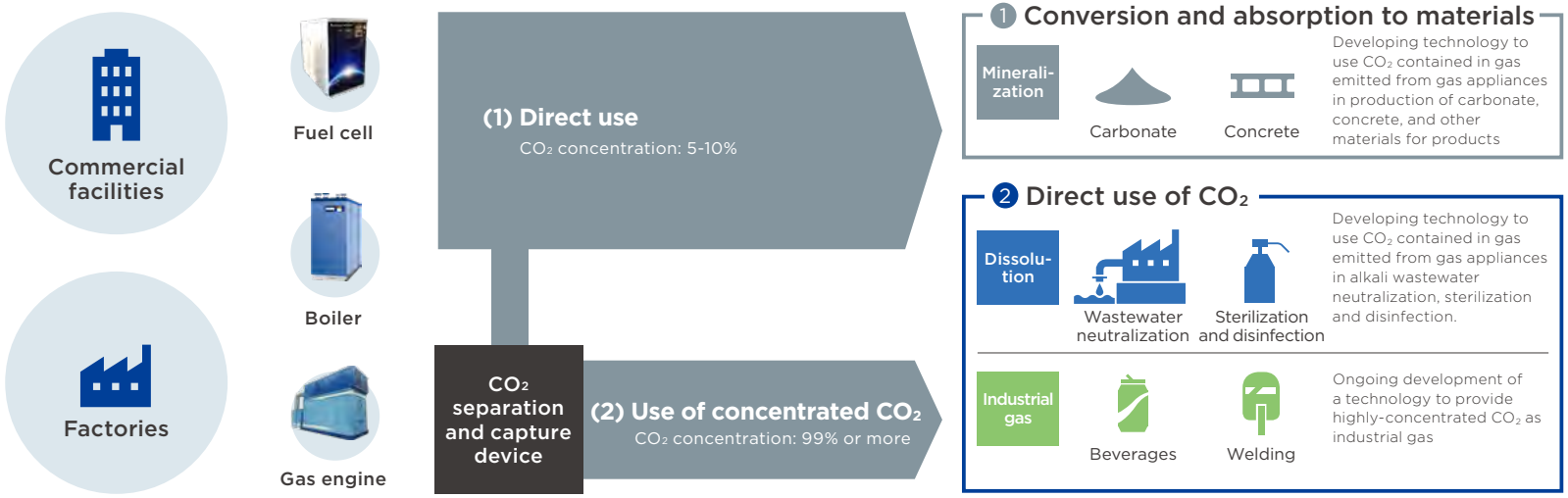
Carbon dioxide capture and utilization (CCU) refers to technology for separating out and capturing $CO_2$, which has been a focus of Japan's green growth strategy. The Tokyo Gas Group has been working on technology development for on-site CCU, meaning the use of $CO_2$ in gas emitted from a gas appliance at a customer's site. Major challenges in the practical application of CCU technology include matching with gas appliances and minimizing energy for $CO_2$ separation, capture, and utilization.

## Strengths of Tokyo Gas

With an emphasis on "Co-creation with customers," the Tokyo Gas Group has been making efforts to design, build, and operate an energy system that meets the needs of customers. We will make use of our accumulated advanced engineering capabilities concerning energy systems and users' know-how in making appropriate CCS system proposals to individual customers.

## Future initiatives

Our "on-site CCU service," which effectively uses emitted gas from gas appliances used at the customers' site, has already attracted a high level of interest from our customers, such as commercial facilities and factories. We will speedily develop technology in cooperation with other companies in Japan and overseas – open innovation. Through these efforts, we intend to differentiate ourselves and enhance our relationship with customers.



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# Progress and highlights of the Medium-term Management Plan

(Published date of press release)

## Renewable energy development

**Invested in Principle Power, Inc. in the U.S. (May 2020)**
Invested in Principle Power, which developed and owns proprietary floating system technology. The technology has significant offshore stability and is expected to be widely adopted in floating offshore wind projects around the world. Tokyo Gas will actively engage in the development of floating offshore wind projects in and out of Japan by utilizing the technology.

**Acquired a large-scale solar power project in the U.S. (July 2020)** P.37

**Acquired wood pellet biomass power generation facilities in Takaoka, Toyama Pref. and Ichikawa, Chiba Pref. (Aug. 2020)**
Acquired Fushiki Manyofuto Biomass Power GK and Ichihara Yawatafuto Biomass Power GK (approximately 126,000 kW).

**Joined a JV for offshore wind power projects in Japan (Nov. 2020)**
Joined Chiba Offshore Wind Inc. – a JV established by Shizen Energy and Northland Power Inc. – in 2019. With a target to achieve promising area designation for offshore wind power projects off the coastline of Chiba Prefecture, the development business is being promoted.

**Launched commercial operation of a mega-solar power plant in Iwakuni, Yamaguchi Pref. Domestic mega-solar power output reached 100,000 kW (July 2021)**
The Iwakuni-Yu Solar Power Plant (output: 23,490kW) started commercial operation in July 2021. The acquisition of the plant contributed to the Tokyo Gas Group's mega-solar power output reaching 100,000 kW.

(Published date of press release)

## Technology development of CCU, hydrogen, and methanation

**Released "suidel" small hydrogen generators with Tokyo Gas Chemical Co., Ltd. and MIURA CO., LTD. (Feb. 2021)**
Released "suidel" small hydrogen generators, targeting semiconductor, metal, chemical manufacturers as potential customers, in March 2021. Tokyo Gas' technologies for ENE-FARM have been utilized.

**Tokyo Gas and SCREEN Agree to Jointly Develop a Water Electrolysis Cell Stack for Low-cost Green Hydrogen Production (May 2021)** P.06

**World's 1st! Commence Manufacturing of $CO_2$-absorbing Concrete that Uses Exhaust Gas Emitted During the Use of City Gas Devices (July 2021)**
Agreed with KAJIMA CORPORATION to jointly develop technology to use $CO_2$-SUICOM®, a $CO_2$-absorbing concrete developed mainly by KAJIMA, and to absorb and solidify $CO_2$ contained in exhaust gas released when using city gas equipment.

**Plan to launch a methanation verification test within fiscal 2021 (July 2021)** P.07

(Published date of press release)

## Decarbonized energy supply

**Launched free solar power system provision service "Zuttomo Solar" (April and Sep. 2020)**
Launched free solar power system provision in collaboration with housing makers in 2019. The scheme is for a customer to use the electricity generated by the system, sell unused electricity to an electric power company, and sell the revenue to Tokyo Gas, based on a contract exchanged by the customer and Tokyo Gas.

**Began handling of the effective renewable energy electricity using FIT non-fossil fuel energy certificates (July 2020)**
Became Japan's first electricity retail operator that handles the effective renewable energy electricity using the FIT non-fossil fuel energy certificates with tracking information.

**Launched the "Hinatao Solar" energy service for condominiums and buildings (Oct. 2020)**
A subsidiary of Tokyo Gas, Hinatao Energy Co., Ltd. launched the "Hinatao Solar" energy service. The solar power generation system on the rooftops of our customers' condominiums and buildings is installed at Hinatao's expense with no initial investment by customers.

**Formed Strategic Alliance with UK-based Octopus Energy (Dec. 2020)** P.27

**Concluded power purchase agreement for non-FIT solar power plants with Renewable Japan Co., Ltd. (Feb. 2021)**
Concluded a power purchase agreement for non-FIT solar power plants with Renewable Japan, with the aim of expanding use of non-FIT renewable energy power sources. Renewable electricity is provided to environment-conscious customers, such as those participating in the RE100 global initiative.

**Establishment of a Carbon Neutral LNG Buyers Alliance (March 2021)** P.37
Exchanged Japan's first contract to supply carbon neutral LNG with Marunouchi Heat Supply Co. in Oct. 2019 and began to supply it to office buildings owned by Mitsubishi Estate Co. As of July 2021, more than 30 corporate customers have adopted carbon neutral LNG.

**Newly launched "Sasutena Denki," an electricity rate plan with 100% real renewable energy (June 2021)**
Created "Sasutena Denki," a 100% renewable energy electricity rate menu, which added a non-fossil certificate designated as renewable energy, for customers using low-voltage electricity in the Kanto area. Tokyo Gas will plant one tree for each customer contract, contributing to further $CO_2$ reduction.