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TOHO GAS

Toho Gas Group

2050 Carbon Neutrality Initiative

July 2021

Toho Gas Co., Ltd.

1. Introduction

- Since the company's foundation in 1922, Toho Gas has supported customers' lives and business in the Chubu region through energy supply, and has grown together with the region.

- In our main line of city gas operations, we have successively changed the basic material for this business from coal-sourced to petroleum, and now currently to natural gas, the fossil fuel with the least environmental impact. Through this and through developing and encouraging adoption of high-efficiency gas equipment, **we have been actively engaged in reducing environment impact**.

- Meanwhile, amid the current worldwide growing sense of urgency regarding global warning, Japan has announced governmental policies aimed at achieving carbon neutrality by 2050, and as an energy operator, we are called upon to effect massive change, and we see ourselves as facing a turning point in the times.

- Grounded on such an awareness, and with **a strong determination to pioneer a new era** from here on out to contribute to the sustainable growth of the Chubu region as a total energy provider, the Toho Gas Group set out to show to stakeholders **the orientation of the Group's response**.

Contents

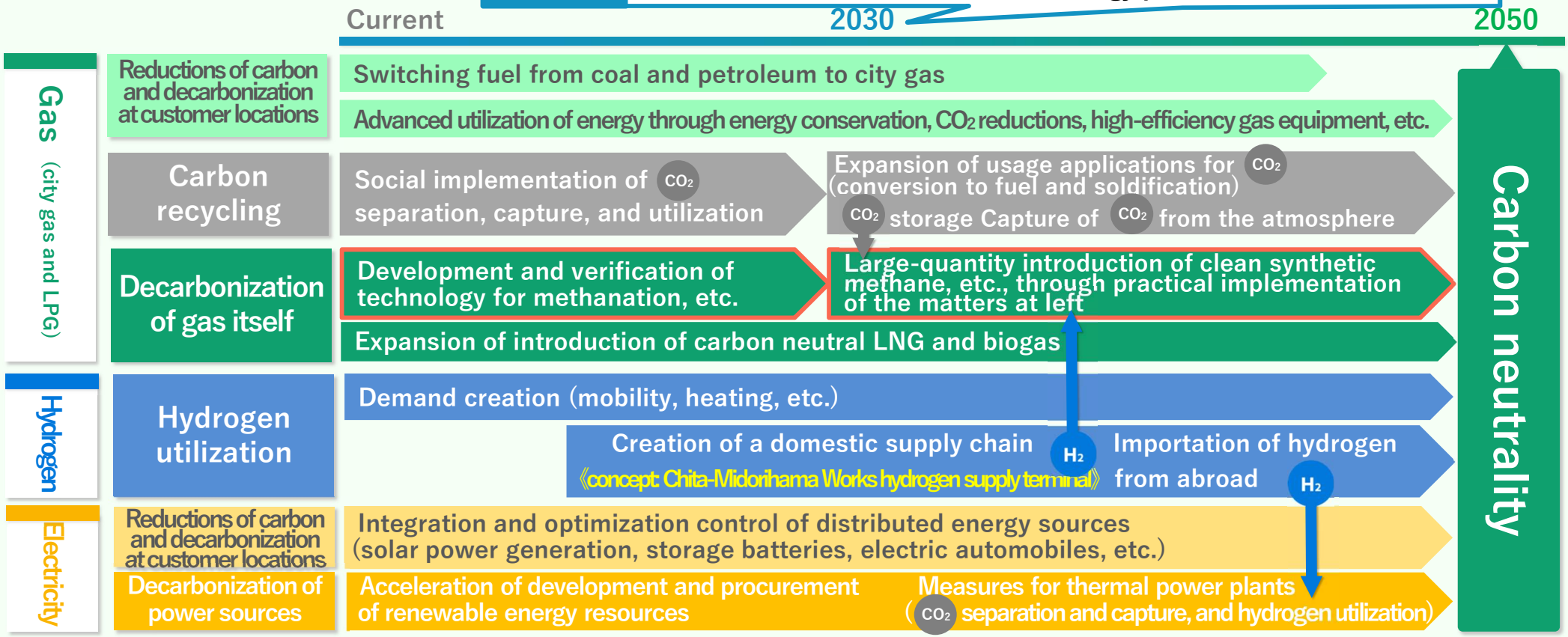
2. Initiatives Geared Toward Achieving Carbon Neutrality

- Toho Gas is accelerating efforts from where we are now to reduce carbon and even **achieve decarbonization at customer locations**, and along with this, we have turned our attention to technical innovation for **utilizing hydrogen and in carbon recycling**, and are connecting this to future **decarbonization of gas itself**.
- Through combinations of diverse means, including decarbonization in electrical power sources and the like, **we are tackling the challenge of achieving carbon neutrality in our entire value chain, including customer locations, in 2050.**

Vision for Achievement

Targets

- Amount of contribution to CO_2 reduction : -3 million tonnes※1
- Gas carbon neutrality ratio : 5% and over※2
- Handled amount of renewable energy power sources : 500,000kW



※1：Amount of contribution to CO2 reduction through business activities (FY2021 and after)　※2：Of gas sold, the ratio of gas for which carbon neutrality has been achieved (a diverse array of means are envisioned, such as methanation, etc., hydrogen utilization, biogas, carbon neutral LNG, carbon recycling, overseas contributions, and afforestation and forest protection)

《Glossary》 Methanation, etc.：Technology for producing methane, propane, and the like using hydrogen and CO2.　Carbon neutral LNG：Liquid natural gas for which greenhouse gases produced from extraction of underground natural gas through to consumption are offset by CO2 credits.　Carbon recycling：For this resource, this encompasses broad measures for CO2 separation, capture, utilization, storage, and the like.

3. Basic Approach (1) Pursuit of the Best Mix of Energies

- The "3E+S" perspective continues to be crucial in energy supply, and in achieving carbon neutrality, the balance of stable supply and economy **- that is to say, the best mix of energies - is essential.**

《Glossary》3E＋S：The basic principles of Japan's energy policy, which are energy security, economic efficiency, environmental protection, and safety.

- By effectively utilizing **a rugged pipeline infrastructure** together with taking advantage of **the favorable affinity of gas and renewable energy**, we are pursuing the best mix of a wide variety of energies and helping to strengthen **the resilience of the region**.

Ruggedness of Gas Infrastructure

Need for Preparation Against Frequent Natural Disasters

- **Increasing Intensity of Wind and Flood Damage**

July 2018：Heavy rains (western Japan and elsewhere)
September 2018：Typhoon Jebi, Typhoon Trami
September 2019：Typhoon Faxai, Typhoon Hagibis
July 2020：Heavy rains (Kyushu and elsewhere)

- **Frequent Occurrence of Major Earthquakes**

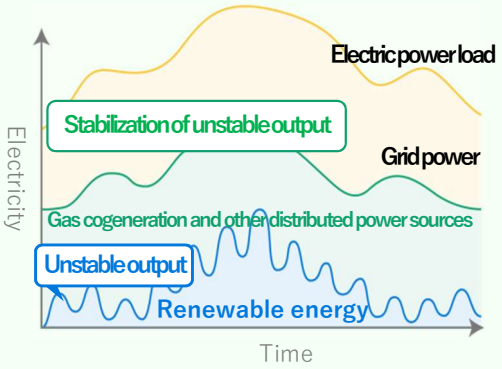
March 2011：Tohoku earthquake and tsunami
April 2016：Kumamoto earthquake
June 2018：Osaka earthquake
September 2018：Hokkaido Eastern Iburi earthquake

Adoption of earthquake-resistant pipes

As a preparation measure for natural disaster, securing multiple energy sources utilizing a rugged gas pipeline infrastructure is effective.

Affinity of Gas and Renewable Energy

Utilization of Coordination Capabilities for Cogeneration, Etc.



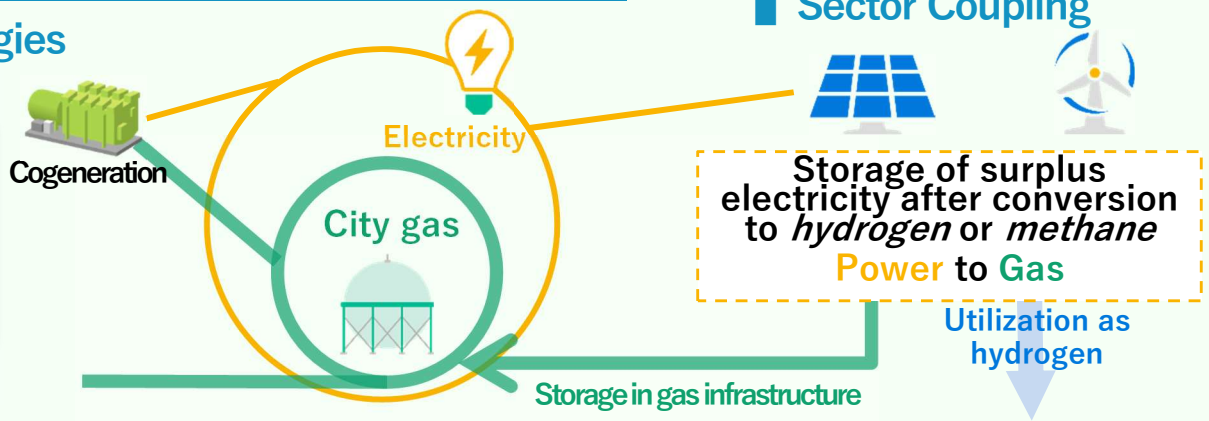
- Storage batteries, etc., combined with cogeneration for utilization as adjustment power to augment renewable energy power sources for which output is unstable
- Popularization and promotion of renewable energy, avoiding restrictions on renewable energy output

Strengthening of regional resilience through the best mix of energies

Pursuit of the Best Mix of Diverse Energies

- Promotion of collaboration and integration for gas and electricity by combining cogeneration, renewable energy, and the like and utilizing the storage capabilities of gas infrastructure
- Contribution to the popularization and promotion of renewable energy as well as to local production and local consumption of energy and to regional resilience

Sector Coupling

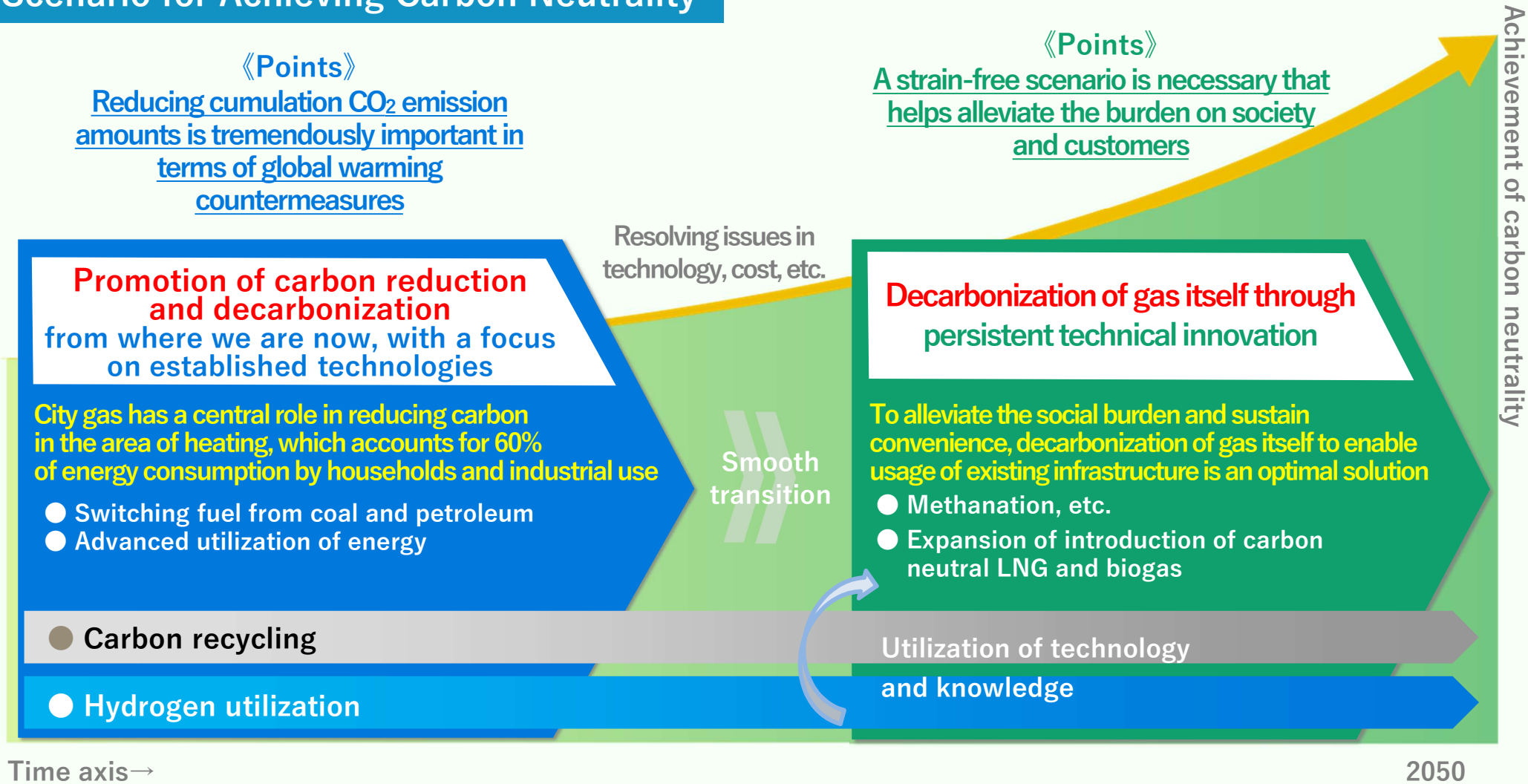


《Glossary》Sector Coupling：Energy financing across multiple areas, such as electricity and heating.

3. Basic Approach (2) Smooth Transition to Carbon Neutrality

- To achieve carbon neutrality, innovative technical development is a requirement, and tremendous time and costs become necessary to overcome this.
- Consequently, we believe that if we first steadily press ahead with **reducing carbon and decarbonization using established technology**, it will become possible to make a smooth transition to carbon neutrality **by achieving decarbonization of gas itself in the future.**

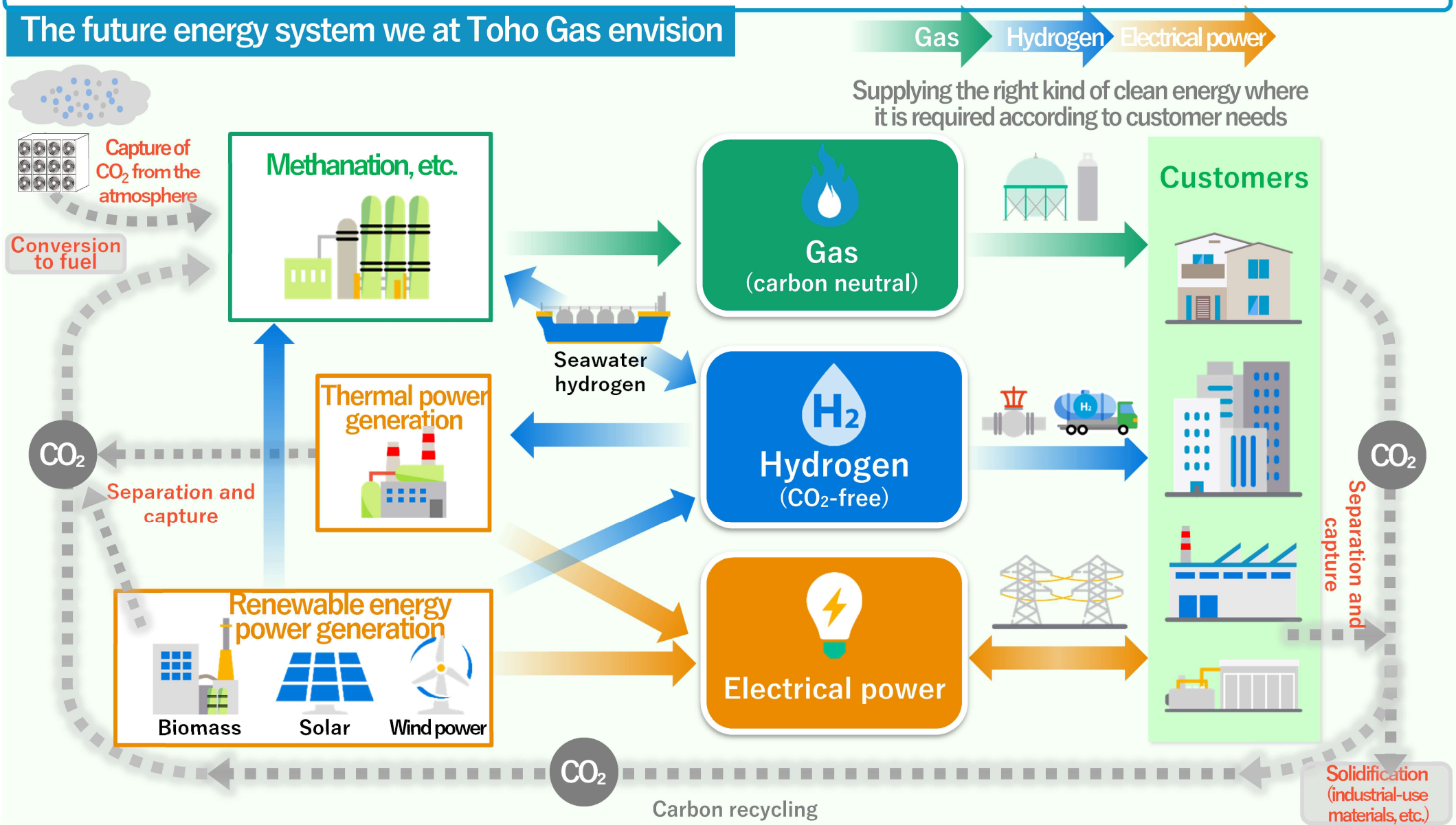
Scenario for Achieving Carbon Neutrality



4. Portrait of the future

- Through broad-based collaboration with all concerned, Toho Gas aims to create an energy system that contributes to carbon neutrality, **with the pivot being the three types of energy of gas (city gas and LPG), hydrogen, and electricity**.
- We will continue to contribute to realizing a sustainable society and to the further development of the Chubu region.

The future energy system we at Toho Gas envision



5. Specific Initiatives (1) Gas ①Reductions of carbon and decarbonization at customer locations

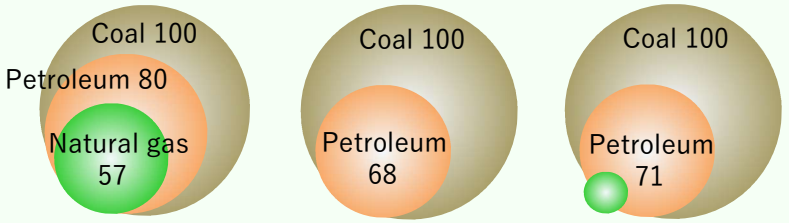
- The Chubu area is a prominent industrial region, and because coal and petroleum are both still heavily used in high-temperature thermal applications, **switching the fuel type from these to environmentally friendly city gas** accelerated reductions in carbon.
- Further, in conjunction with such conventional efforts as **energy conservation and advanced utilization of energy**, we are also promoting such new initiatives as **carbon recycling and hydrogen**, supporting carbon reduction and decarbonization at customers in a thoroughgoing way.

Switching fuel types for thermal demand

Coal and petroleum ▶ City gas

《Reference：Environmental characteristics by fuel type (indicators)》

CO_2 (carbon dioxide) | SO_X (sulfur oxides) | NO_X (nitrogen oxides)

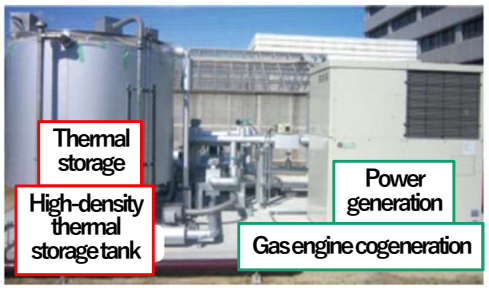


Source：Japan Gas Association website

Energy conservation and advanced utilization of energy

Energy-saving diagnosis

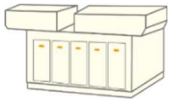
Development and improvement of burners



Effective utilization of heat
(thermal storage materials developed in-house)

【Distribution power generation】

ENE FARM (for residential use)



Cogeneration (for commercial use)

- Energy savings, CO_2 savings
- Support for ZEHs and ZEBs
- Resilience and renewable energy procurement capabilities
- Distributed resource utilization

Carbon recycling

※For details, refer to P7

CO_2 separation, capture, and utilization at customer locations

Combustion and CO_2 emissions

Separation membranes, absorbent materials, etc.

Carbonated beverages, dry ice

Conversion to fuel (methane, etc.)

Solidification (commercial-use materials, etc.)

Utilization

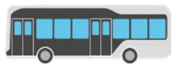
Hydrogen utilization

※For details, refer to P9・10

Expansion and acceleration of applications

【Current】

Passenger cars



Buses

Centered on mobility in the consumer-use area

【Henceforth】

- Industrial and transport vehicles
- Power generation applications
- Partial replacement for thermal demand
- Conversion to fuel (methane, etc.)

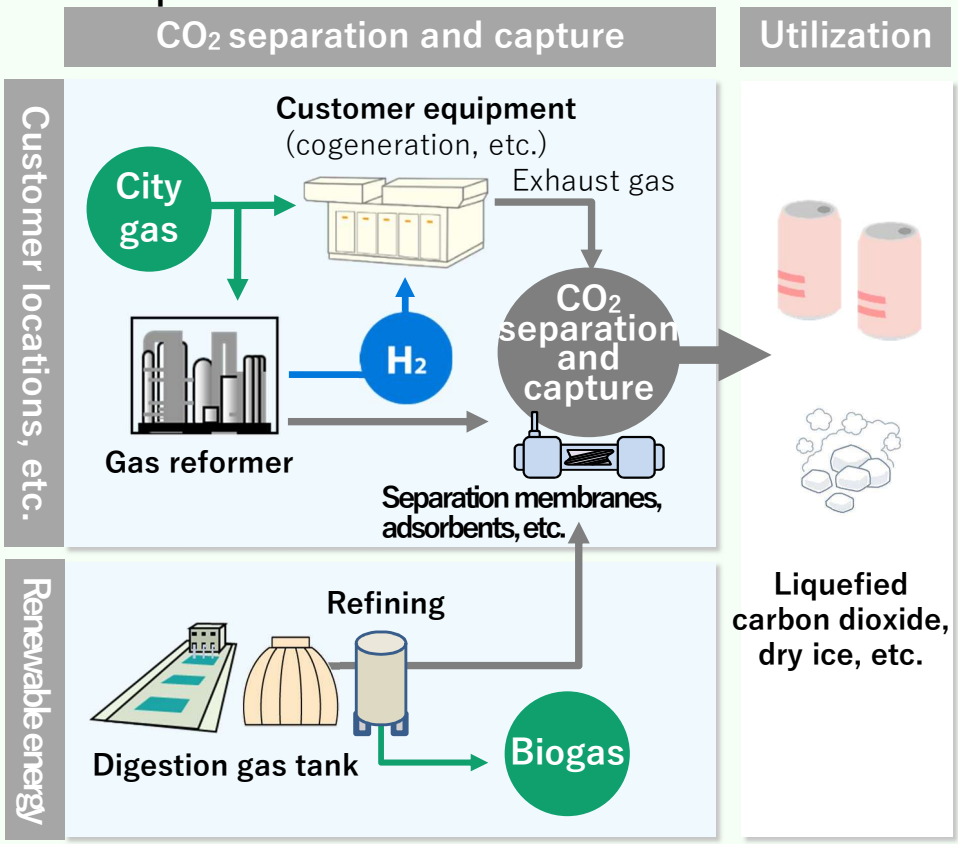
《Glossary》 ZEH・ZEB：These refer to zero-energy houses and zero-energy buildings – structures whose aim is to realize zero annual net consumption of primary energy in combination with renewable energy and the like.

- Toho Gas was **quick to turn attention to technical development for CO_2 separation and capture**, and we will continue to **enhance our technical capabilities from the perspective of CO_2 utilization (conversion to fuel and solidification) and storage**.
- As a means of carbon reduction that we can carry out right now, we are **socially implementing carbon recycling to separate, capture, and utilize CO_2** at customer locations, and in the future we will also **take up such challenges as direct capture from the atmosphere and expanding usage applications**.

Domains Where Our Aim is Early Social Implementation

Structuring carbon recycling involving separation, capture, and utilization

On-site verification and attention to development of new separation membranes and adsorbents

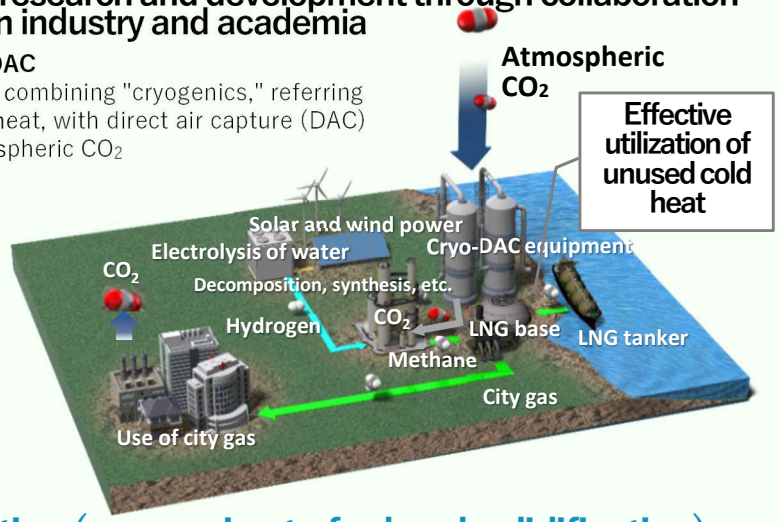


Technical Development for the Future

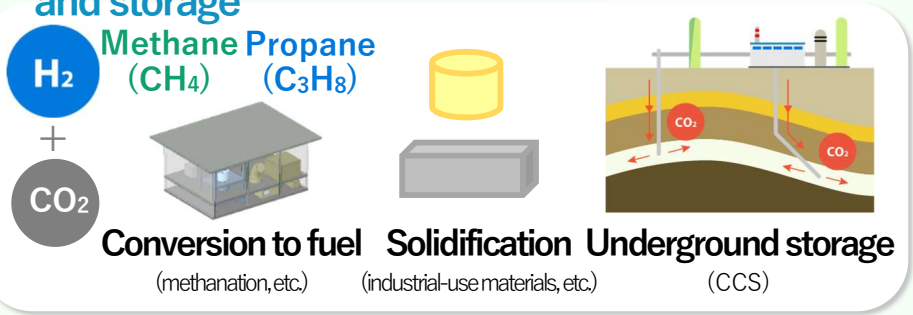
Direct capture of CO_2 from the atmosphere utilizing cold heat

Start of research and development through collaboration between industry and academia

※ Cryo – DAC
Coinage combining "cryogenics," referring to cold heat, with direct air capture (DAC) of atmospheric CO_2



Utilization (conversion to fuel and solidification) and storage

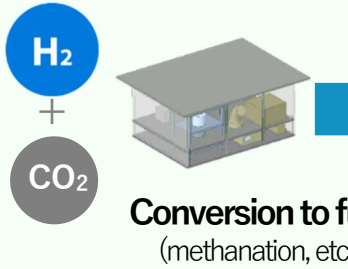


5. Specific Initiatives (1) Gas ③Decarbonization of Gas Itself

- Aiming for **the practical implementation of methanation technology and the like and the large-quantity introduction of clean synthetic methane** and similar substances, through broad-based alliances we are devoting effort to such matters as verification geared toward resolving such issues as greater high efficiency and lower costs.
- For **carbon neutral LNG and biogas** for which the start of introduction has already been completed, we will work to further expand the amounts handles and achieve decarbonization of gas itself through diverse means.

Practical Implementation of Methanation, Etc.

We will start city gas manufacturing utilizing methanation technology by 2030.

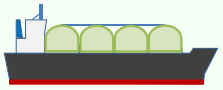


【Issues】
- Greater high efficiency and lower costs
- Lower costs of equipment and operation
- Reduction of procurement costs for hydrogen and CO_2

【Short-term】
Verification at discrete domestic sites
(Sewage treatment sites, customer locations, etc.)

【Medium-term】
Stepwise domestic and overseas expansion
(Shipping and receiving bases, etc.)

Introduction of Carbon Neutral LNG



LNG importation

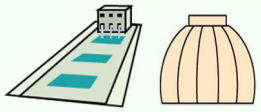
Offsetting the CO_2 in the value chain when importing LNG

Afforestation and forest protection, etc.

Supply of clean gas

Efforts made in parallel with evaluation-system establishment as well as popularization and expansion, and expansion of choices for customers

Utilization of Biogas



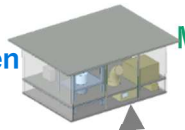
Sewage treatment sites, etc.
(existing and newly developed)

〈Methanation verification〉

Renewable Energy electricity, etc.

Water electrolyzers, etc.

Green hydrogen



Methanation equipment

Methane

CO_2 capture and utilization

Refining

Biogas
(after refining)

Utilization other than city gas

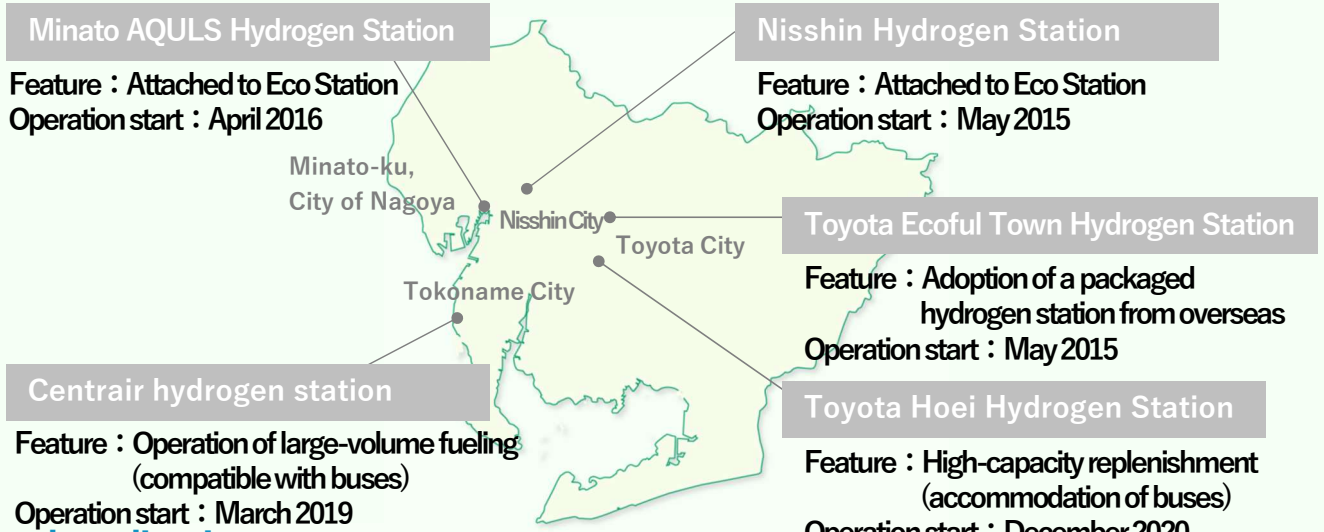
5. Specific Initiatives (2) Hydrogen ①Demand creation : Mobility applications

- In the Chubu area, the utilization of hydrogen as a mobility application is progressing, and to help drive the spread of fuel cell automobiles, Toho Gas has been proactively endeavoring to prepare hydrogen stations.
- Along with continuing to work expand hydrogen station facilities and reduce costs, we will press on with **expanding infrastructure by also making full use of cross-sectional frameworks in the industry to move toward expanding vehicle types and application to include industrial vehicles, transport vehicles, and others.**

Expansion of Mobility Demand

Preparation of hydrogen stations (5 sites under operation)

Toyota Hoei Hydrogen Station
(the most recent preparation project)



Minato AQULS Hydrogen Station
Feature：Attached to Eco Station
Operation start：April 2016

Nisshin Hydrogen Station
Feature：Attached to Eco Station
Operation start：May 2015

Toyota Ecoful Town Hydrogen Station
Feature：Adoption of a packaged hydrogen station from overseas
Operation start：May 2015

Centrair hydrogen station
Feature：Operation of large-volume fueling (compatible with buses)
Operation start：March 2019

Toyota Hoei Hydrogen Station
Feature：High-capacity replenishment (accommodation of buses)
Operation start：December 2020

Support for expansion of vehicle types and applications

【Current】

Passenger cars

Buses

【Henceforth】

Port cargo vehicles

Forklifts

Trucks

《Future deployment》

- **Contribution to securing hydrogen supply means at discrete sites of customers possessing industrial and transport vehicles**
- **Tackling to challenge of expanding hydrogen demand cross-sectionally in the industry through such means as the Chubu Region Hydrogen Utilization Study Group* in which we participate**

* Composed of private enterprises devoting effort to hydrogen utilization. Conducts examination of such matters as the supply chain and demand potential in the Chubu region, and discusses the feasibility of large-scale utilization of hydrogen.

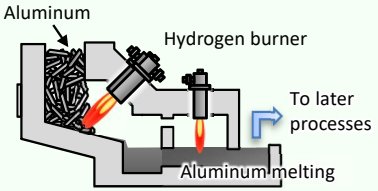
5. Specific Initiatives (2) Hydrogen ①Demand creation : Further expansion of applications

- Toho Gas has even heretofore been devoting effort to the development of technology relating to hydrogen combustion and of mixed-combustion technology for city gas and hydrogen. Through further technical development, we will turn our efforts toward application expansion and practical implementation for the areas of heating and the like.
- Also, **in the phase II development for Minato AQULS** that is now under discussion, we are delineating a plan for the practical implementation of hydrogen technology.

Application Expansion to Heating and Other Fields

Hydrogen combustion

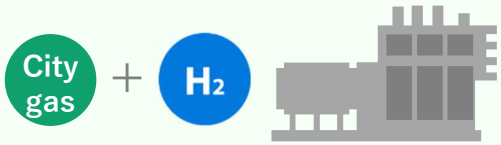
We are devoting effort to new development for burners, and to cost reduction and practical implementation.



Japan's first example of hydrogen combustion technology in single-end radiant-tube burners

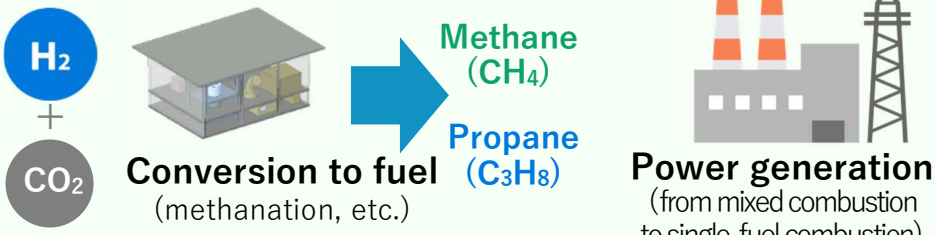
Together with industrial-use customers, the start of verification of adoption of hydrogen in aluminum-melting furnaces, etc.

Mixed combustion of city gas and hydrogen



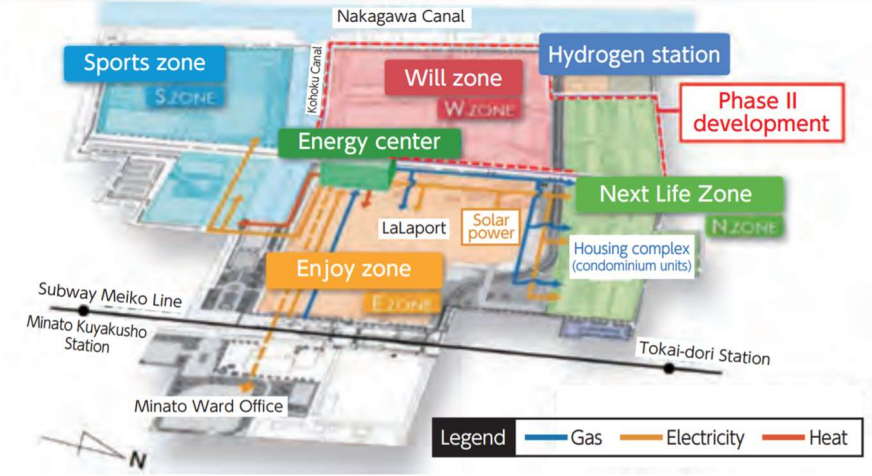
Together with a multidiscipline industrial-technology research institute, the start of basic research into hydrogen mixed combustion for cogeneration

Fuel (gas) and power-generation applications



Minato AQULS Phase II Development Plan

In phase II development, we are aiming to architect a smart town that combines various technologies such as hydrogen and renewable energy, and achieve carbon neutrality in energy supply.



Note: The layout plan diagram is the concept at the current stage, and may be subject to change.

Technologies and systems under consideration for adoption

《 Hydrogen-related》

- Pure hydrogen fuel cell batteries
- Mixed combustion of city gas and hydrogen, etc.

《 Others 》

- Renewable energy and storage cells
- ZEHs and ZEBs
- Energy management (Visualization and demand response)

5. Specific Initiatives (2) Hydrogen ②Supply chain creation

- To accommodate the vigorous hydrogen utilization needs of the Chubu region, we are driving **the spread and expansion of hydrogen in the Chubu region through the early actualization of a planned change to a hydrogen supply terminal at the Chita-Midorihama Works and the creation of a hydrogen supply chain.**

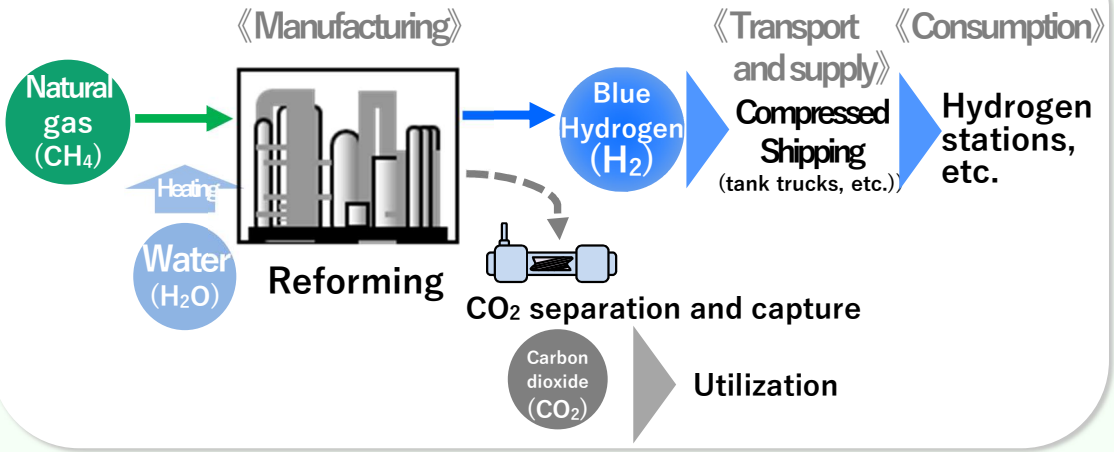
Planned Change to Hydrogen Supply Terminal at the Chita-Midorihama Works

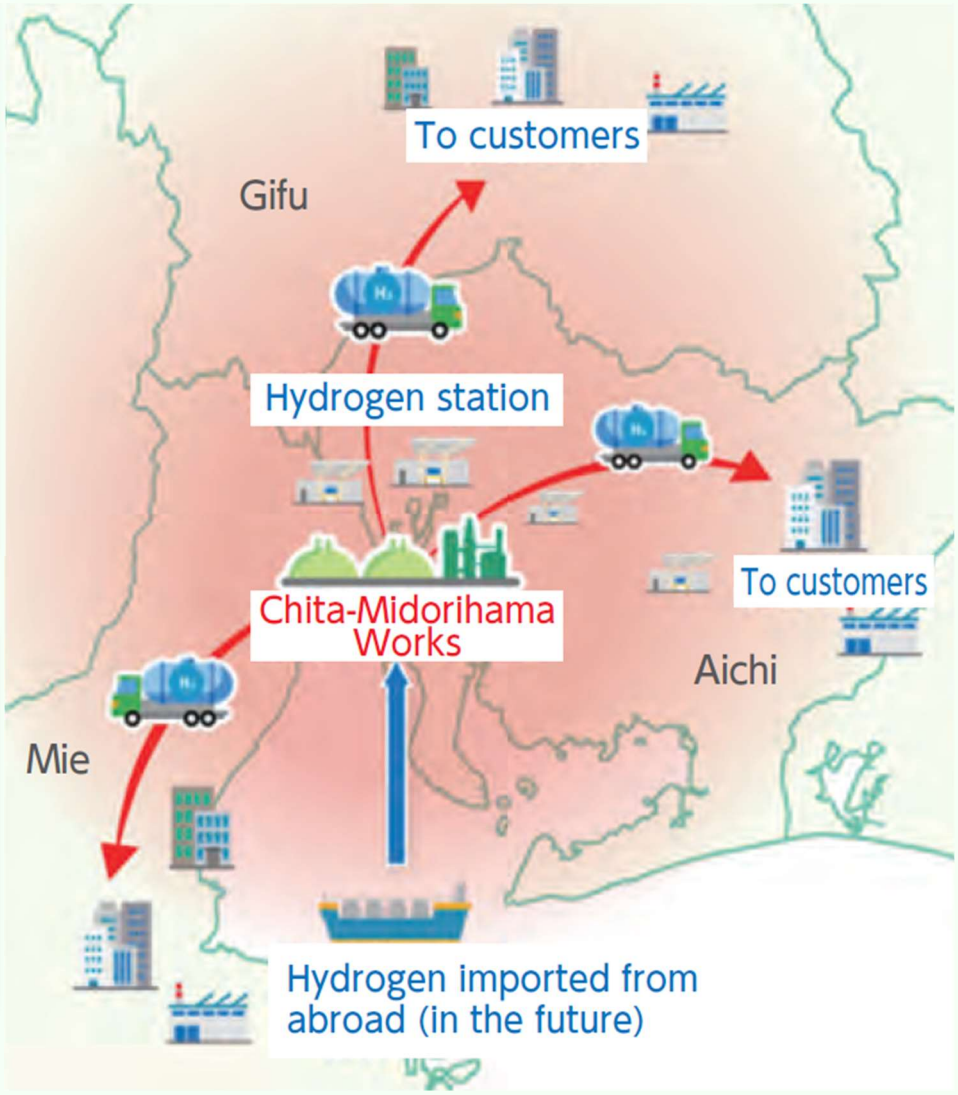
① **Combine hydrogen manufacturing in Japan by reforming natural gas, carbon recycling technology, and other feasible technologies and use what we have to provide means to accommodate growing need for hydrogen at an early date**

② **Perform transportation to demand locations using tank trucks, etc., together with also taking up the challenge of pipeline supply via local network**

③ **Aim to become a receiving terminal for hydrogen imported from abroad**

Artist's concept of the hydrogen supply chain for the present

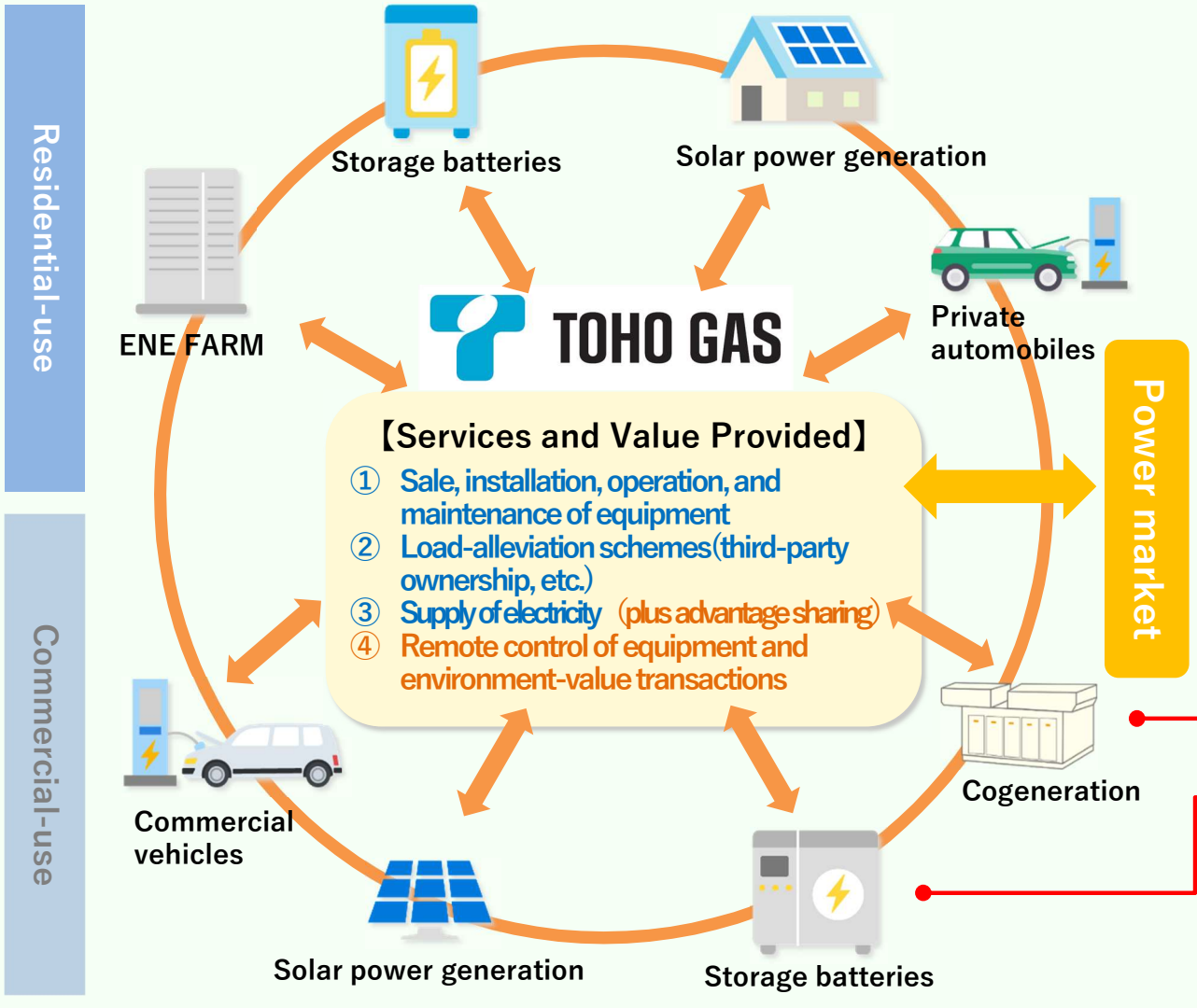




5. Specific Initiatives (3) Electricity ①Reductions of carbon and decarbonization at customer locations

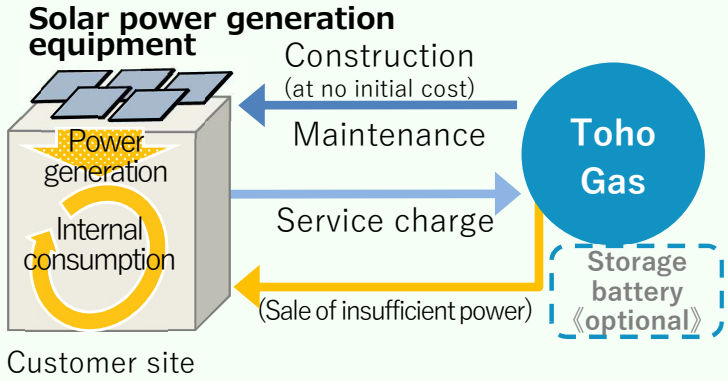
- Together with **encouraging the popularization of diverse distributed energy sources, including solar power generation, storage batteries, electric automobiles, and more, by integrating in the controlling these utilizing digital technology** and achieving mutual flexibility for electricity and environmental values, we aim to offer services that achieve both creating of advantages for customers and efficient energy usage.

Artist's Concept of Augmentation of Electrical Services



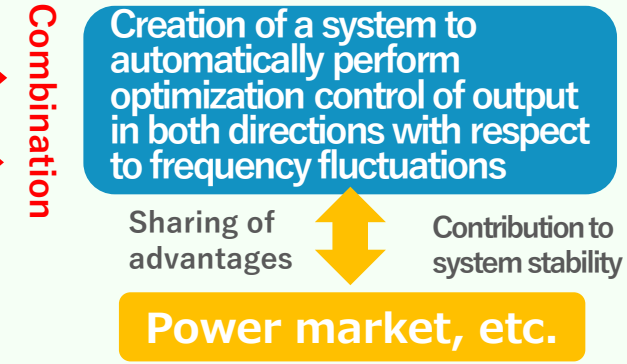
Step 1
Encouraging the popularization of distributed energy sources

- **On-site service for solar power generation**



Step 2
Remote equipment operation service

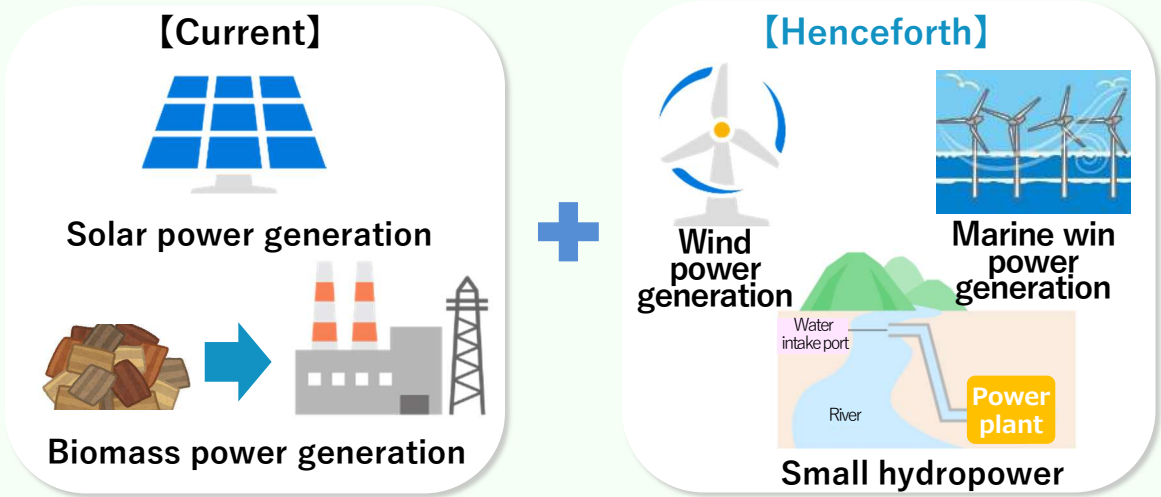
- **High adjustability** (verification stage)



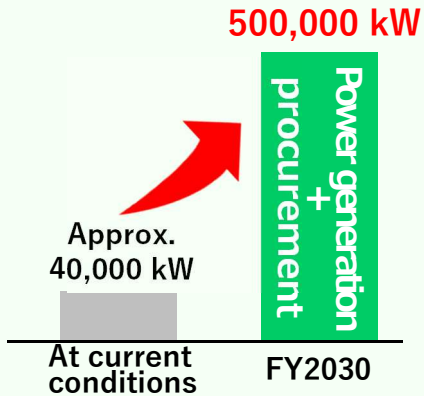
- With an eye to decarbonizing our own power sources, **we devoting effort to the development and procurement of renewable energy power sourced and to their diversification.**
- Through cooperation with local governments and other entities and such means as regional electricity business, we are endeavoring to utilize latent renewable energy resources in local regions and contribute to resolving local issues through local production and local distribution of energy and strengthened resilience.

Expansion of Renewable Energy Power Sources

Diversification of types of power sources



Expansion of the handled amount of renewable energy power sources



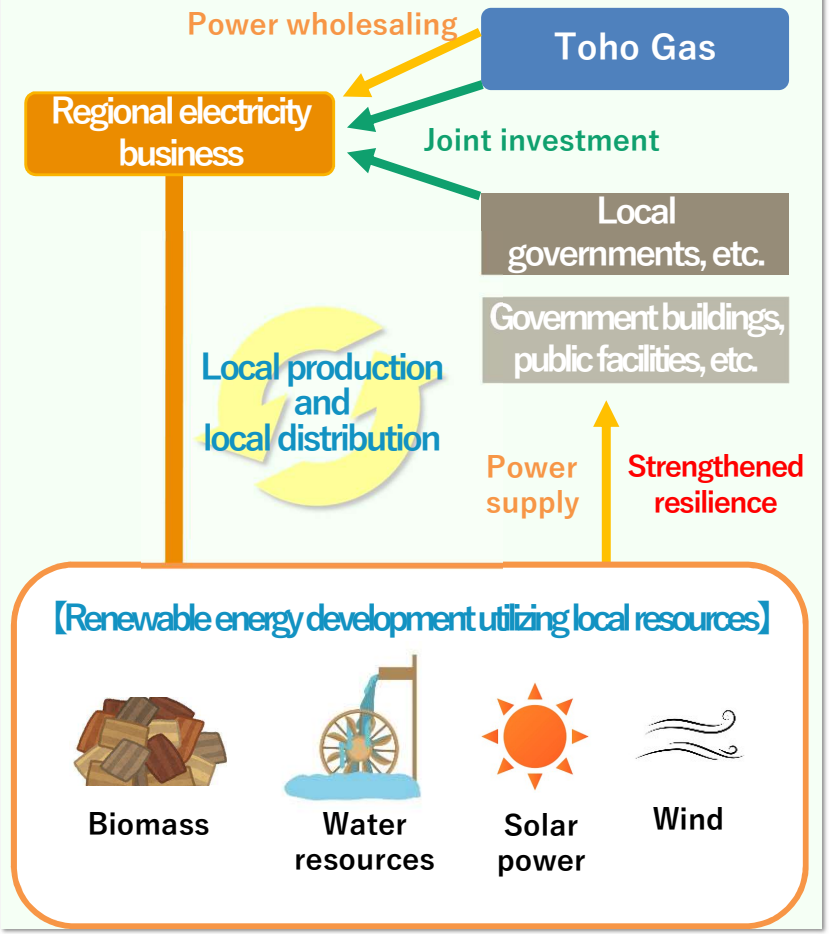
FY2030 target

Raise the handled amount of renewable energy power sources* to 500,000 kW

*The handled amount of renewable energy power sources includes power sources developed and owned domestically and overseas, feed-in tariff (FIT) scheme power sources, and procurement.

Power Source Development Contributing to Local Production and Local Distribution

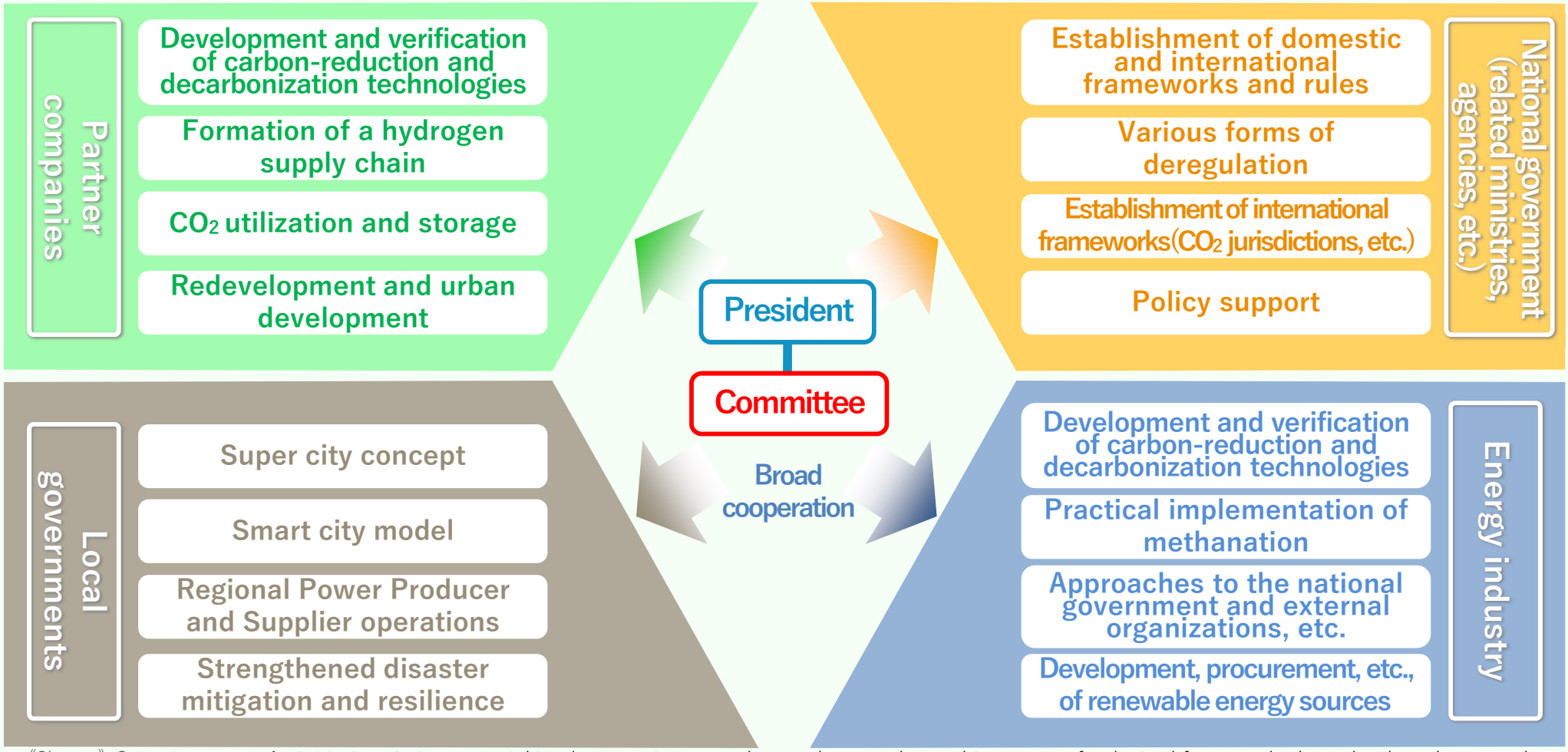
Together with achieving local production and local distribution of electricity utilizing local resources, it contributes to the resolution of local issues



6. Strengthened Cooperation Geared Toward Achievement

- To enhance the effectiveness of these initiatives, alliances with the gas industry and individual partner companies as well as cooperative relationships with the national government, local governments, and the like are essential, and to this end, we are **seeking out broad external cooperation**.
- Within the company we have also **newly established a committee under the direct control of the president**, and are forging ahead with initiatives as a united effort by the Group.

Broad External Cooperation and In-house Systems



《Glossary》 Super city concept : An initiative aiming at social implementation geared toward antecedent achievement of a desired future to be brought about by around 2030 through the national government, local regions, and private operators working in concert

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