METI
Ministry of Economy, Trade and Industry

AMEICC
SINCE 1998

Japan’s Visions and Actions toward Hydrogen Economy and Relevant Technology

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Chief Representative of AMEICC Secretariat

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Self Introduction

Name: Ryosuke FUJIOKA

Career Experience

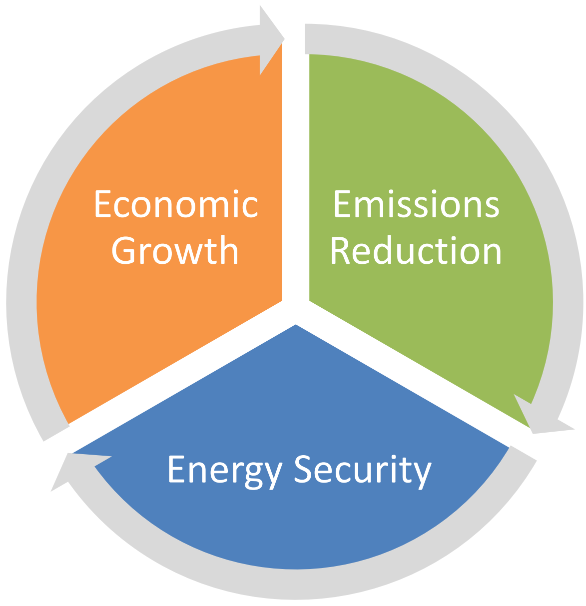
- **2013** Join Ministry of Economy, Trade and Industry (METI) of Japan
- **2016** Electricity Market Office at ANRE (Agency for Natural Resources and Energy)
- **2019** International Affairs Divisions (ANRE)
- **2020** Hydrogen and Fuel Cell Strategy Office(ANRE)
- **2022** AEM-METI Economic and Industrial Cooperative Committee（AMEICC） Secretariat

Green Transformation (GX) 's Three Principles

Triple breakthrough

Japan aims to simultaneously achieve

- Emissions Reduction
- Economic Growth
- Energy Security

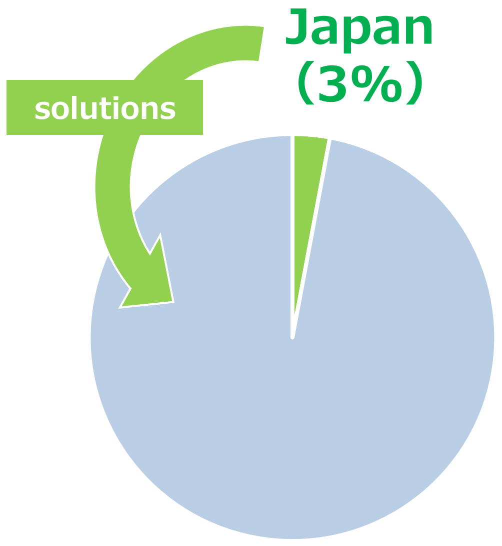


One goal, various pathways

Toward our common goal of achieving net zero, we will make practical energy transitions through various pathways depending on the circumstances of each country.

Solution to the world

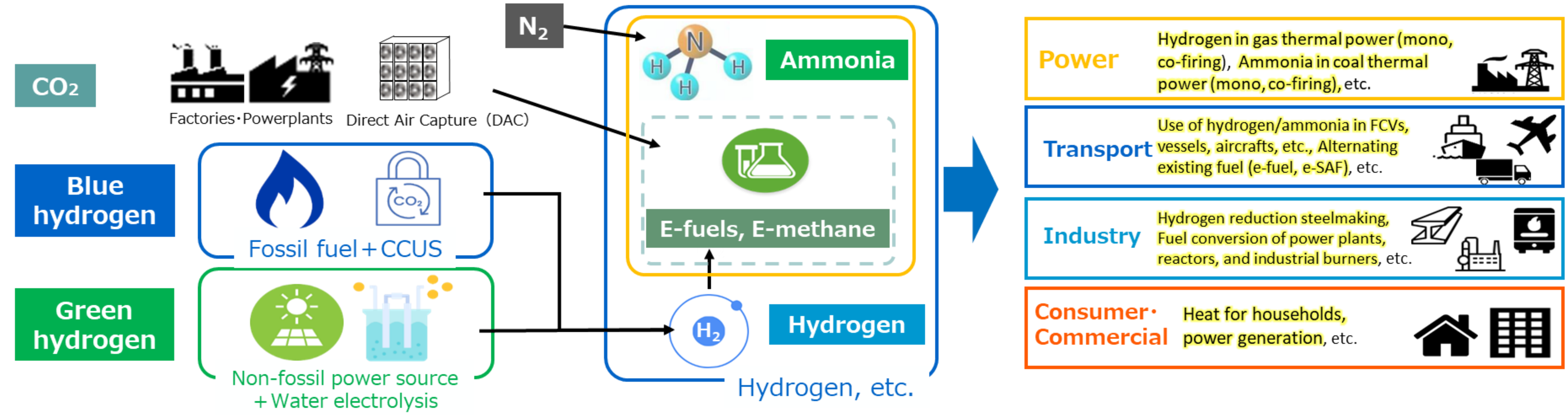
Japan will decarbonize itself, but also contribute to global decarbonization by providing solutions outside Japan.



Importance of hydrogen and its derivatives for GX

- Towards carbon neutrality by 2050, hydrogen and its derivatives (i.e. ammonia, e-methane, and e-fuels) are attracting attention as a **clean fuel and feedstock expected not only to be produced from multiple sources but also to be used in various applications**.
- In particular, they are expected to be used in sectors including **"hard-to-abate" sectors such as steel and chemicals where decarbonization is difficult due to few alternative technologies,** in the mobility sector, and in power generation.

Supply and Demand of Hydrogen, etc.



Japan’s Hydrogen Policy Trends

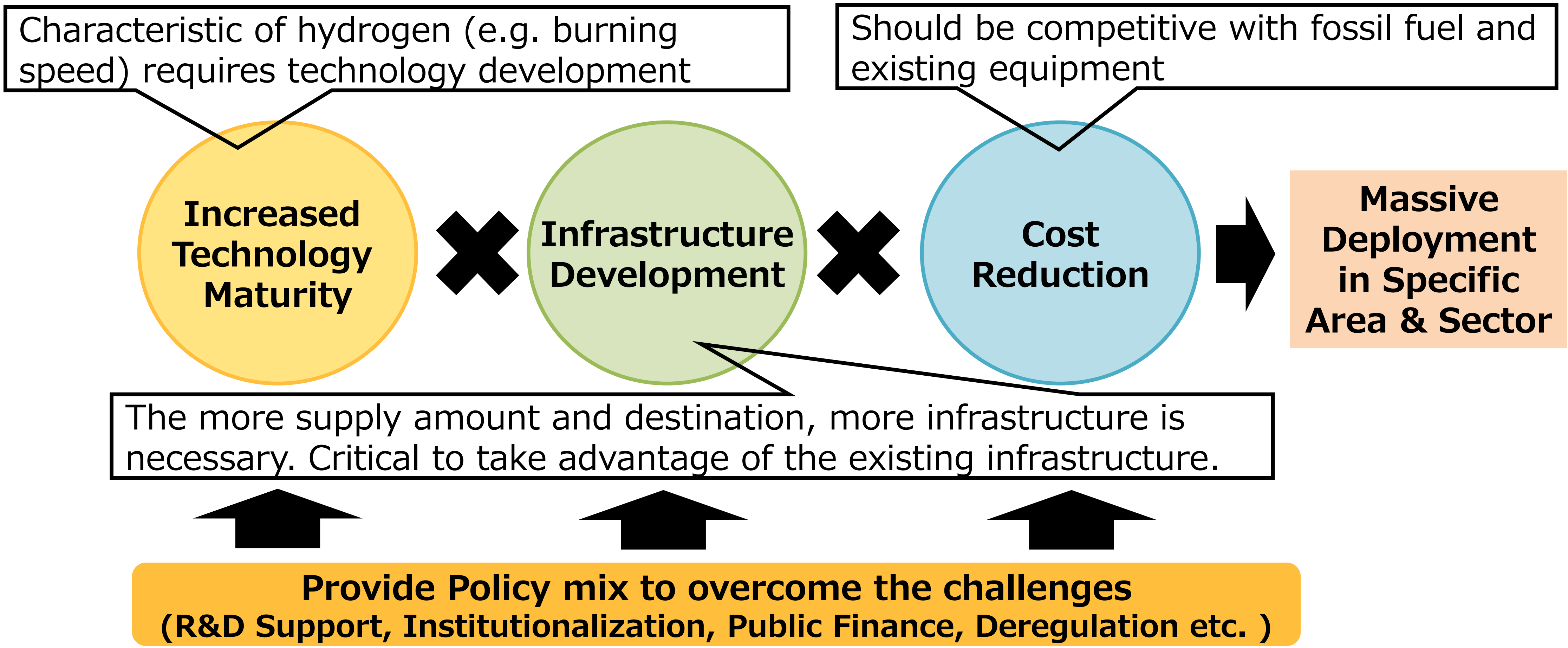
- Japan was **the first country to formulate a national hydrogen strategy**, in 2017, which was then revised in 2023.
- **Declared “2050 carbon neutrality” goal in 2020** and hydrogen positioned as one of the priority areas in the Green Growth Strategy in 2020.
- Establishment of the Green Innovation Fund of approximately ¥2 trillion* in 2021, and **hydrogen-related projects were selected as the first project using the fund**.
- Hydrogen as key elements of the strategy under **the Green Transformation Promotion Act** in 2023.
- Enacted **the Hydrogen Society Promotion Act** in 2024 (enforced on October 23, 2024).

Milestones

2017	2020	2021	2023	2024
・Basic Hydrogen Strategy	・2050 CN Declaration ・Green Growth Strategy	・Green Innovation Fund ・Revised Strategic Energy Plan	・GX Promotion Act ・Revision of Basic Hydrogen Strategy	・Hydrogen Society Promotion Act

Paths to Massive Deployment of Hydrogen

- There are three challenges to overcome for massive deployment of hydrogen: **①Increase Technology Maturity, ②Develop Infrastructure, and ③Reduce Cost through economy of scale and improved operational efficiency**.
- As the situation is different among regions and sectors, it is important to **come up with the policy mix suitable for filling the gap between ideal and real situations**.



Ref. Development of Hydrogen Supply Chain

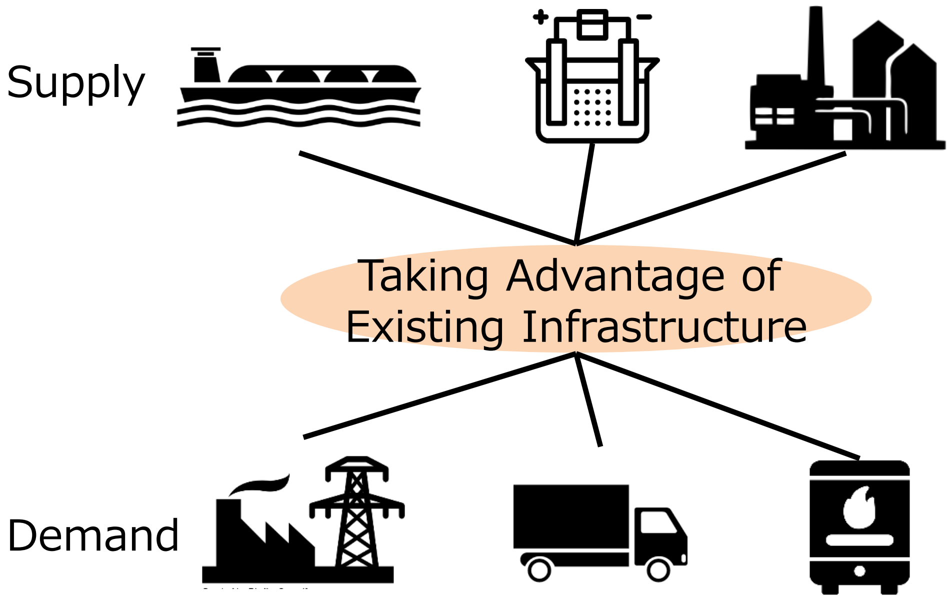
- Japanese industrial sector have technical strength throughout the entire supply chain; **"Production"**, **"Transportation"**, and in **"Utilization"**.
- In addition to demonstrations Japanese government are now **supporting mass-production** in order to **take advantage of economy of scale, leading to the further cost reduction**.

	Production	Transportation (store)	Utilization
Core Technologies	・Water electrolysis ・Membrane	・Transportation（LH2, MCH, etc.）	・Fuel cell system/vehicle/truck ・Power generation
Key Players	<Water electrolysis> **Asahi Kasei, Toyota, Toshiba ESS, Kanadevia, Toray** ThyssenKrupp (Germany) Siemens Energy (Germany)	<Liquefied hydrogen carrier> **Kawasaki Heavy Industries** HD KSOE (South Korea) GTT (France)	<Fuel cell> **Toyota, Honda** Daimler (Germany) Hyundai (South Korea) <Power generation> **Mitsubishi Heavy Industries, IHI** Siemens Energy
Strengths (Japan)	Safe and stable operation of water electrolysis and innovative material development	Conducted the world's first demonstration of large-scale hydrogen transportation	Leads technological development of fuel cell and is top class in number of patents

Development of Social Implementation Model

- It is difficult to massively invest in hydrogen related infrastructure now as **the long-term hydrogen demand is not predictable**.
- To reduce the risk and take advantage of existing infrastructure, it is crucial to **develop a model area where hydrogen supply chain is close to accumulated demand**.
- Through developing the model, **we can reduce the hydrogen cost and accumulate knowhow in an efficient and effective manner** and could easily deploy the model to wider area later.

Two Types of Social Implementation Model



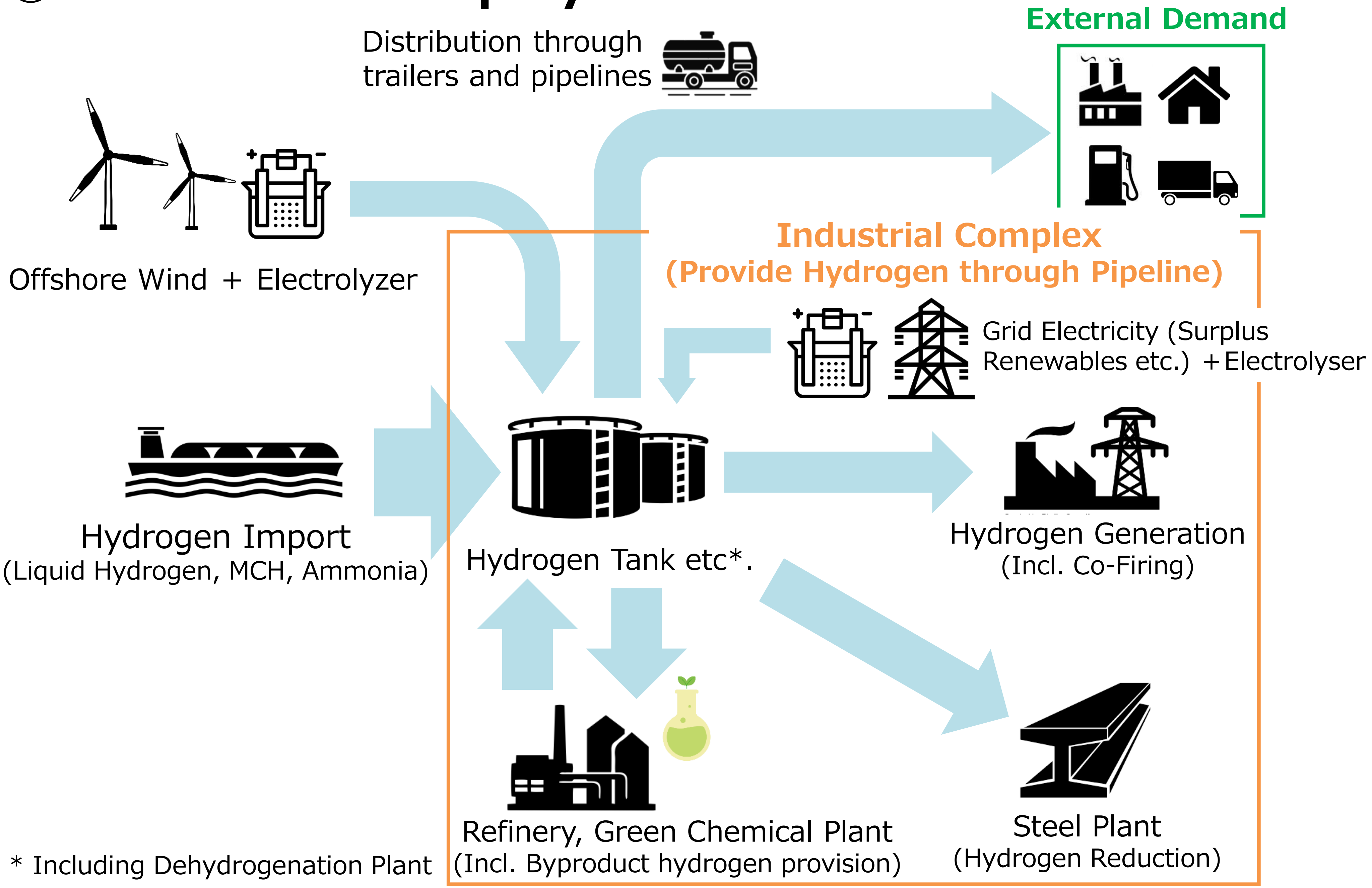
①:Centralized Deployment of Coastal Area

❑ Provide massive amount of hydrogen to power plant and industrial sectors at industrial complex

②:Decentralized System with Electrolyser

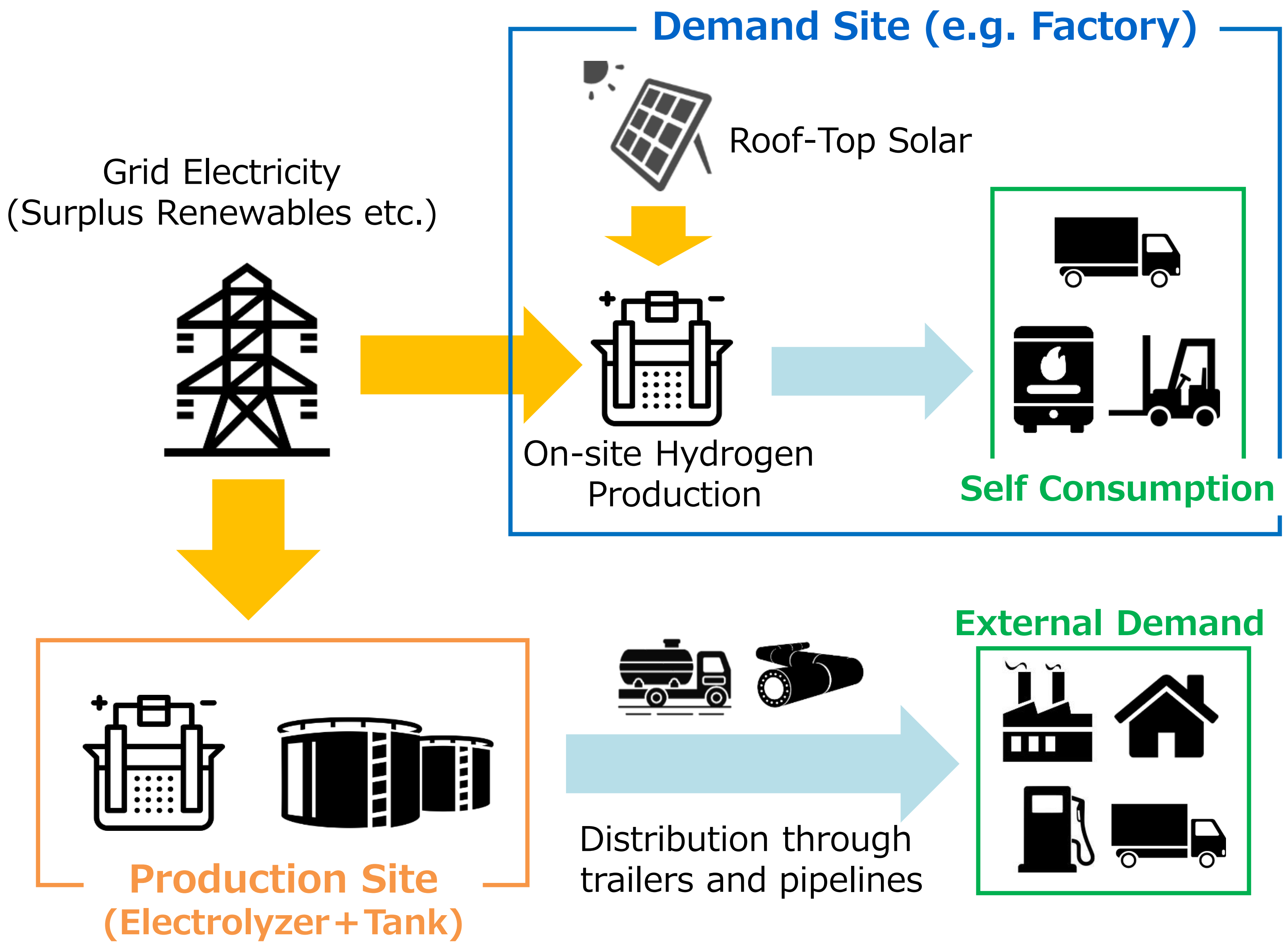
❑ Produce hydrogen from renewables and consume it onsite or provide to very close hydrogen demand (e.g. industry or transportation)

Model①: Centralized Deployment of Coastal Area



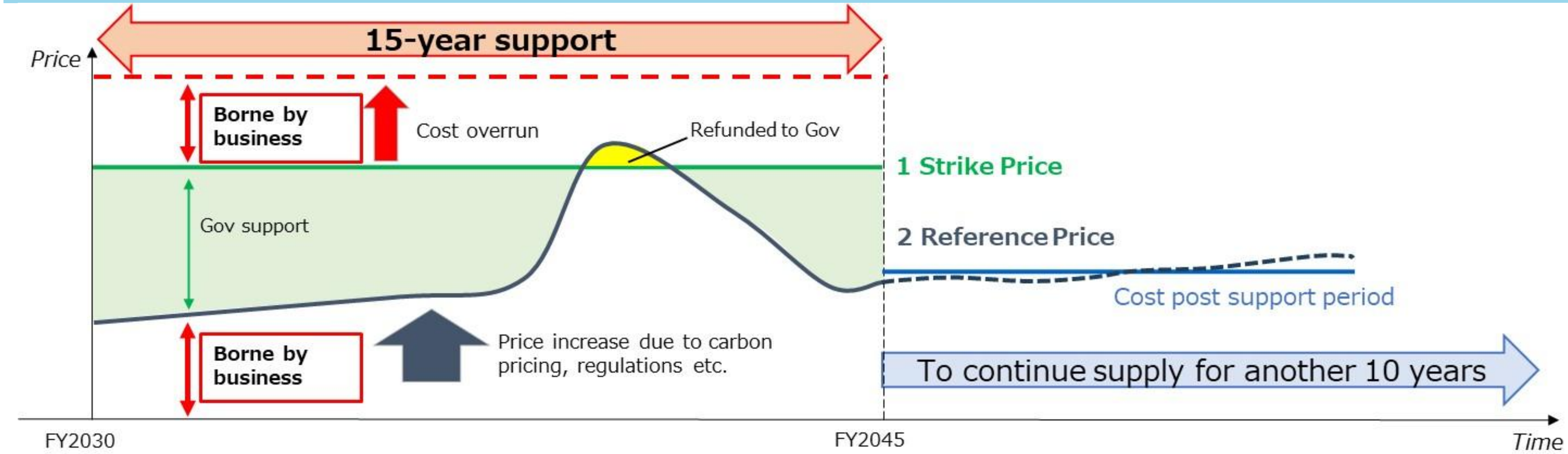
* Including Dehydrogenation Plant

Model②:Decentralized System with Electrolyser



Support measure ① Focusing on the Price Gap

- The government plans to **<u>provide a 15-year support to suppliers who aim to develop a commercial-scale supply chain of low-carbon hydrogen and its derivatives</u>** which meets Japan's primary energy policy and GX policy **<u>through CFD (Contract for Difference) scheme</u>**.



Key requirements

・**Supply to users including in hard-to-abate sectors**, such as steel and chemical industries.
・**Start supply by FY2030 and must continue for another 10 years** following the support period.

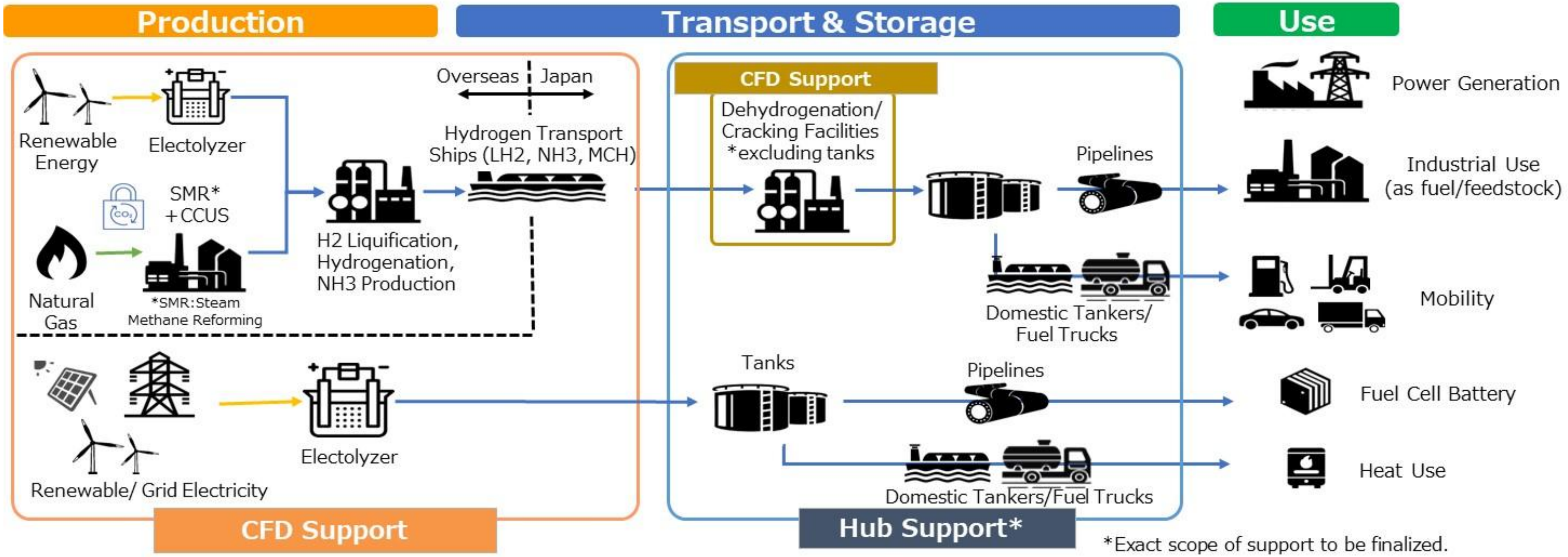
* In the approval process, business plans are to be reviewed holistically from Japan's energy and GX policy perspectives

Application Acceptance Period

・**Start: November 22,2024 Deadline: March 31, 2025**

Support measure ② Hub Development Program

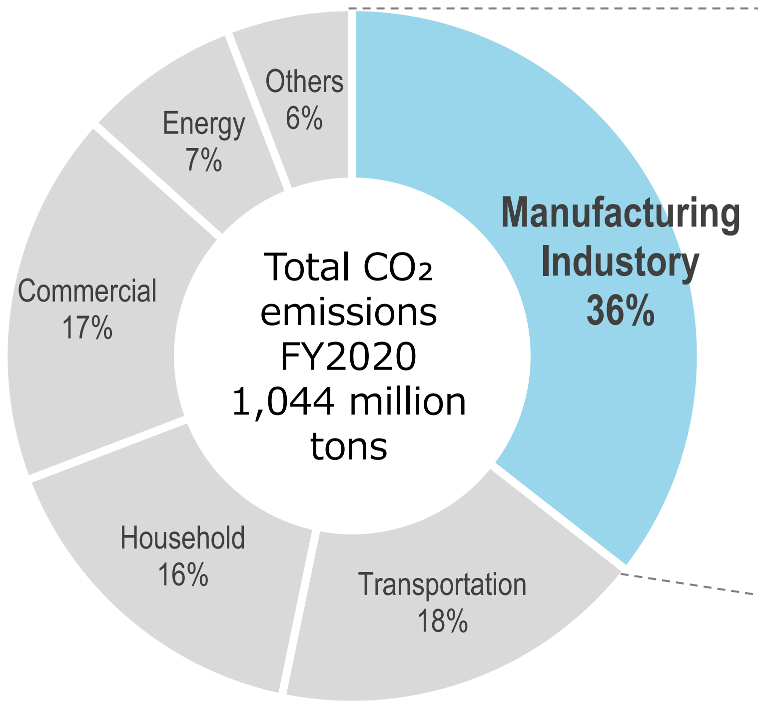
- **The Hub Development Program** supports the **establishment of infrastructure which leads to large-scale expansion of the use of low-carbon hydrogen and its derivatives** and widely benefits a variety of companies, with an aim to stimulate demand creation and the efficient buildout of hydrogen supply chains.
- The Program will subsidize a portion of the CAPEX for developing "**facilities necessary to transport low-carbon hydrogen from the receiving terminal to the point of actual use by consumers** and **used by multiple companies** (e.g. shared pipelines and tanks)"



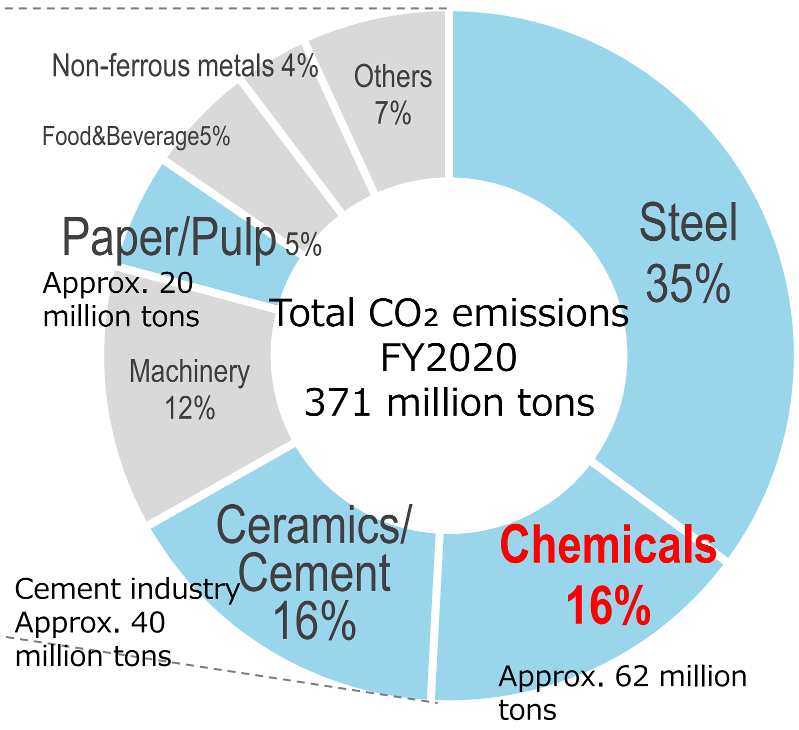
Current Condition of CO_2 Emissions in the Japanese Materials Industry

- **The manufacturing industry accounts for 36%** of **CO_2 emissions** in Japan.
- **The materials industry—including steel, chemicals, ceramics/cement, and paper/pulp industries—accounts for more than 70%** of CO_2 emissions in the manufacturing sector.

Domestic sector-specific CO_2 emissions[1, 2]



Industry-specific CO_2 emissions in the manufacturing sector [3]



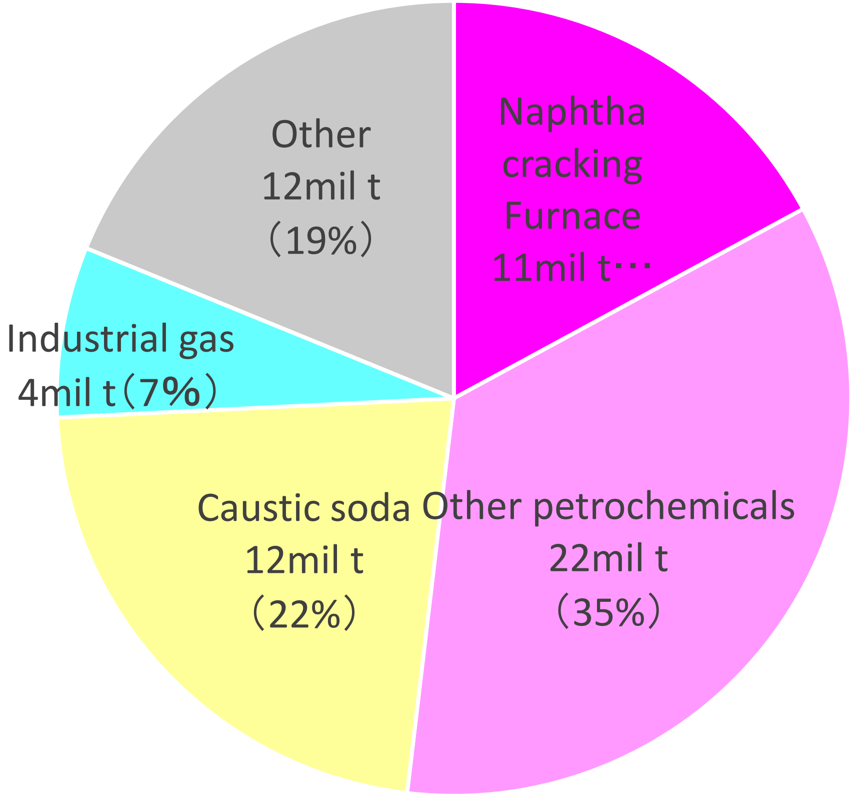
1: Data on sector-specific CO_2 emissions [after distributing electricity and heat] is used.
2: For the manufacturing sector, the sum of "energy sources/industry/manufacturing industry" and "non-energy sources/industrial processes, and use of products"
3: For the chemical sector, the sum of "energy sources/chemistry (including petroleum and coal products)" and "non-energy sources/chemical industry;" for the ceramic and cement sectors, the sum of "energy sources/ceramics and earth and stone products (cement calcination)" and "non-energy sources/mineral industry"

Source: Prepared based on the revised values of the "Data on Greenhouse Gas Emissions in Japan" (FY1999 to 2020) published by the National Institute for Environmental Studies

How to Decarbonize Chemical Industry

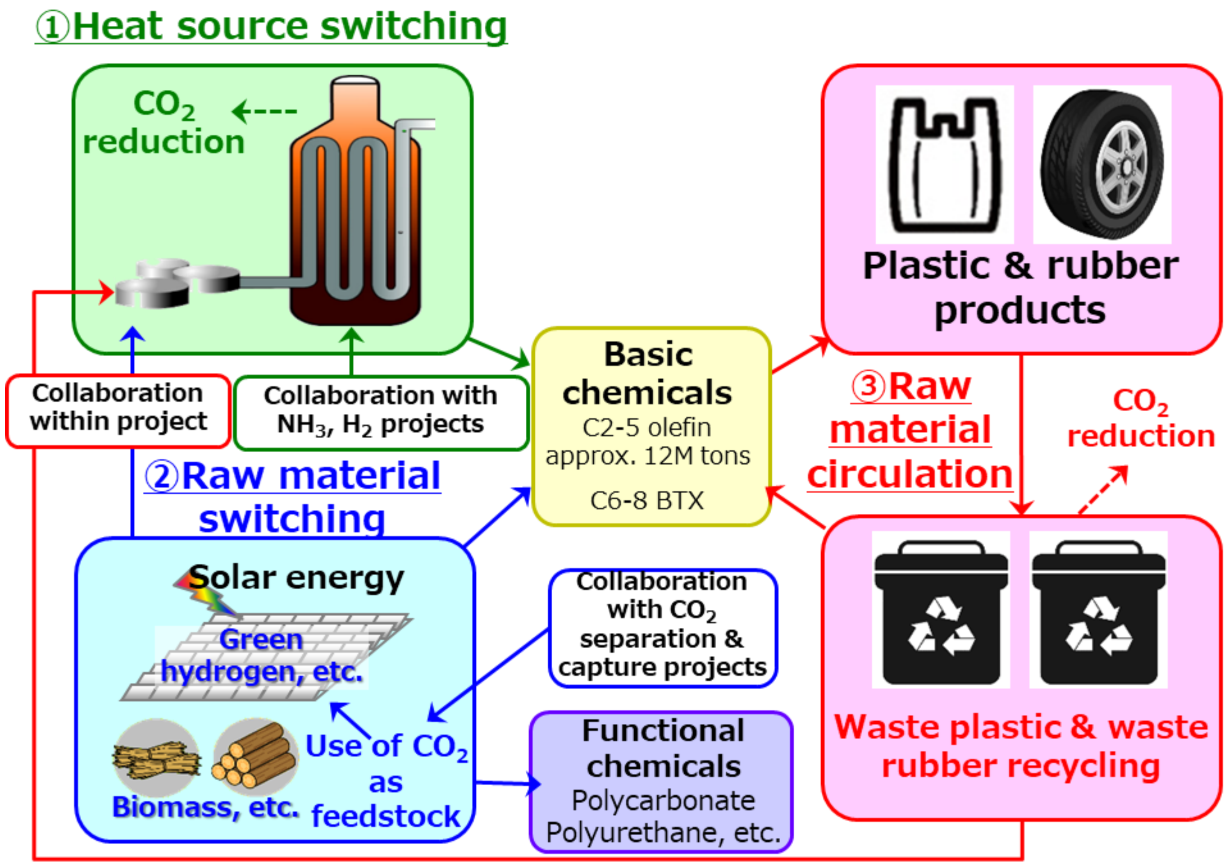
- Japanese chemical industry aims to become carbon neutral **by switching heat sources**, **switching raw materials**, and **circulating raw materials**.

Details of the energy-derived emissions in the chemical industry (FY2020)



In addition, burning plastic products generates about **16 Million tons of CO2 annually**.

Basic principles to decarbonize chemical industry



Source: Prepared from the Green Innovation Fund Social Implementation Plan

Development of Plastic Raw Material Manufacturing Technology Using CO2 and Other Substances (Maximum Government Funding: 126.2 Billion Yen)

: Hydrogen-related Projects

[R&D Item 1]
Development of technology to sophisticate naphtha cracking furnaces through carbon-free heat sources

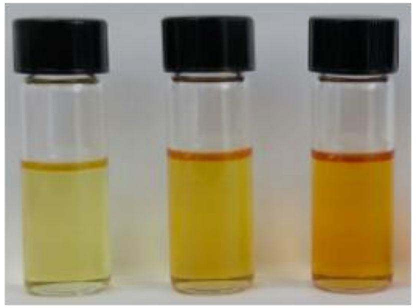
- Currently, **the heat source is off-gas (methane, etc.)** generated from naphtha cracking furnaces.
- This project aims to develop the world's first technology to **convert** the heat source of naphtha cracking furnaces **to carbon-free ammonia**.

Converting the heat source for the naphtha cracking furnace to ammonia at a temperature of 850°C

[Aim to reduce CO_2 emissions by around 70%]

[R&D Item 2]
Development of technology to manufacture chemicals from waste plastics and rubbers

- Develop **technology for manufacturing plastic raw materials, such as ethylene and propylene, from waste plastics and rubber**.
- Manufacture with a yield of 60 to 80% and aim to **reduce CO_2 emissions during manufacturing to about half of the conventional level**.



Oil from cracking waste plastics
(Plastic raw materials)

[Aim to reduce CO_2 emissions by around 50%]

[R&D Item 3]
Development of technology to manufacture functional chemicals from CO_2

[Aim to Generate CO_2 Raw Materials]

- **Aim to replace some fossil-derived materials with CO_2** when synthesizing polycarbonate, polyurethane, and other functional chemicals.
- Also work on **improving functionality, such as electrical, optical, and mechanical properties**.

High-performance polycarbonate
(Camera lends)

[R&D Item 4]
Development of technology to manufacture chemicals from alcohol

[Manufacture from green hydrogen and CO_2]

- Improve catalyst yield for **manufacturing olefins, such as ethylene and propylene, from methanol (MTO)** to 80–90%.
- For artificial photosynthesis, aim to **develop a photocatalyst that achieves both high conversion efficiency and excellent mass productivity** for practical application.

MTO demonstration

Large-scale demonstration of photocatalytic panels

Ref. Image of GX Deployment Support in the Chemical Industry

- Providing **governmental support** for **potential leading projects** that may address these challenges to **promote GX in the chemical industry** and **produce green high-value-added chemicals**, thereby **maintaining and strengthening global competitiveness**.

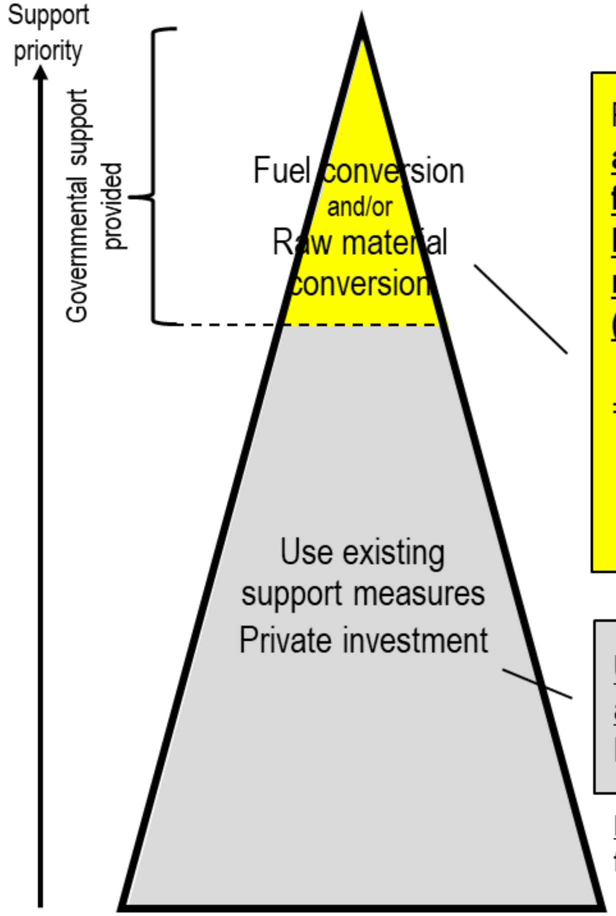
R&D

Acceleration of GX technology based on both decarbonization leveraging existing technologies and R&D outcomes

GI Fund

- Ammonia fuel-type cracking furnace
- Functional plastics manufacturing using CO_2 as a raw material
- Manufacturing raw materials for chemicals from artificial photosynthesis and other methods

etc.



Provide support for projects that **generate internationally competitive high-value-added chemicals**, while (1) **converting the heat source for naphtha cracking furnaces** and **the fuel for coal-fired power**—both sources of CO_2 emissions—**to hydrogen, ammonia, and other substances (fuel conversion)**; (2) **shifting from naphtha-derived raw materials** to **waste plastics and biomass as raw materials (raw material conversion)**; and implementing other decarbonization initiatives

⇒ Considering the decrease in domestic demand for ethylene and other basic chemicals, provide particularly intensive support for projects that serve as **a foundation for structural conversion**, such as **promoting decarbonization while facilitating the restructuring of optimal industrial complexes**

Utilize existing support measures, such as energy-saving subsidies, and accelerate private investment for cases where coal-fired power is simply converted to LNG or for raw material conversion initiatives with low CO_2 reduction rates.

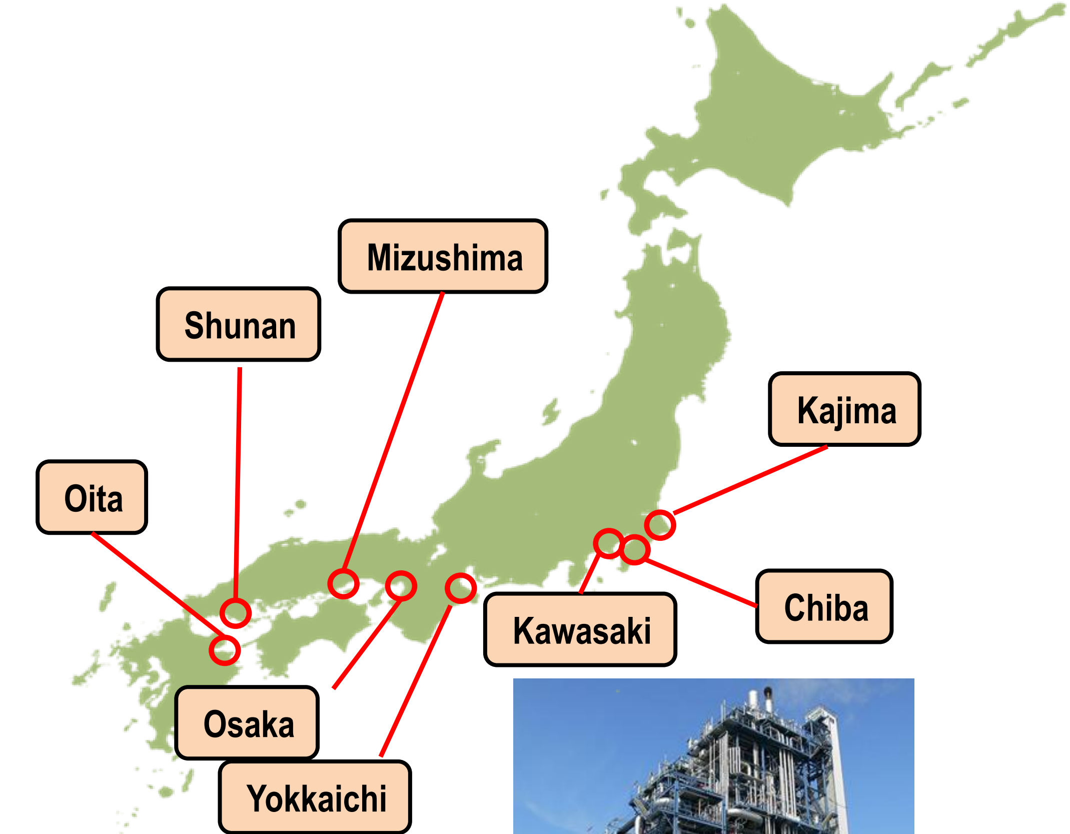
Horizontally expand the outcomes of government-supported initiatives to accelerate private investment for decarbonization

Ref. Locations of Petrochemical Complexes and Ethylene Manufacturing Facilities

- The petrochemical industry uses crude oil-derived naphtha as a raw material, **leading to the formation of industrial complexes adjacent to oil refining facilities**. Currently, **12 naphtha cracking furnaces are in operation** at complexes across eight regions.

Cate-gory	Region	Company name	Production capacity (10,000 tons/year)	Operation commenced
In Operation (12 furnaces in 8 regions)			Total 616.2	
	Kajima	Mitsubishi Chemical	48.5	Jun. 1992
	Chiba	Maruzen Petrochemical	48.0	Apr. 1969
		Keiyo Ethylene (Maruzen Petrochemical & Sumitomo Chemical)	69.0	Nov. 1994
		Mitsui Chemicals	55.3	Apr. 1978
		Idemitsu Kosan	37.4	Jun. 1985
	Kawasaki	ENEOS	40.4	Apr. 1970
		ENEOS (Former Tonen Chemical)	49.1	Jan. 1972
	Yokkaichi	TOSOH	49.3	Jan. 1972
	Osaka	Osaka Petro Chemical Industries (Mitsui Chemicals)	45.5	Apr. 1970
	Mizushima	Asahi Kasei Mitsubishi Chemical Ethylene (Mitsubishi Chemical & Asahi Kasei)	49.6	Jun. 1970
	Shunan	Idemitsu Kosan	62.3	May 1968
	Oita	Resonac Holdings	61.8	Apr. 1977
Operation discontinued			Total 110.1	
	Kajima	Mitsubishi Chemical	34.3	Nov. 1970
	Chiba	SUMITOMO CHEMICAL	31.5	Jan. 1970
	Mizushima	Asahi Kasei	44.3	Apr. 1972
Total			726.3	

(Note) The ethylene plants that have discontinued operations were shut down in the following years (number of years in operation).

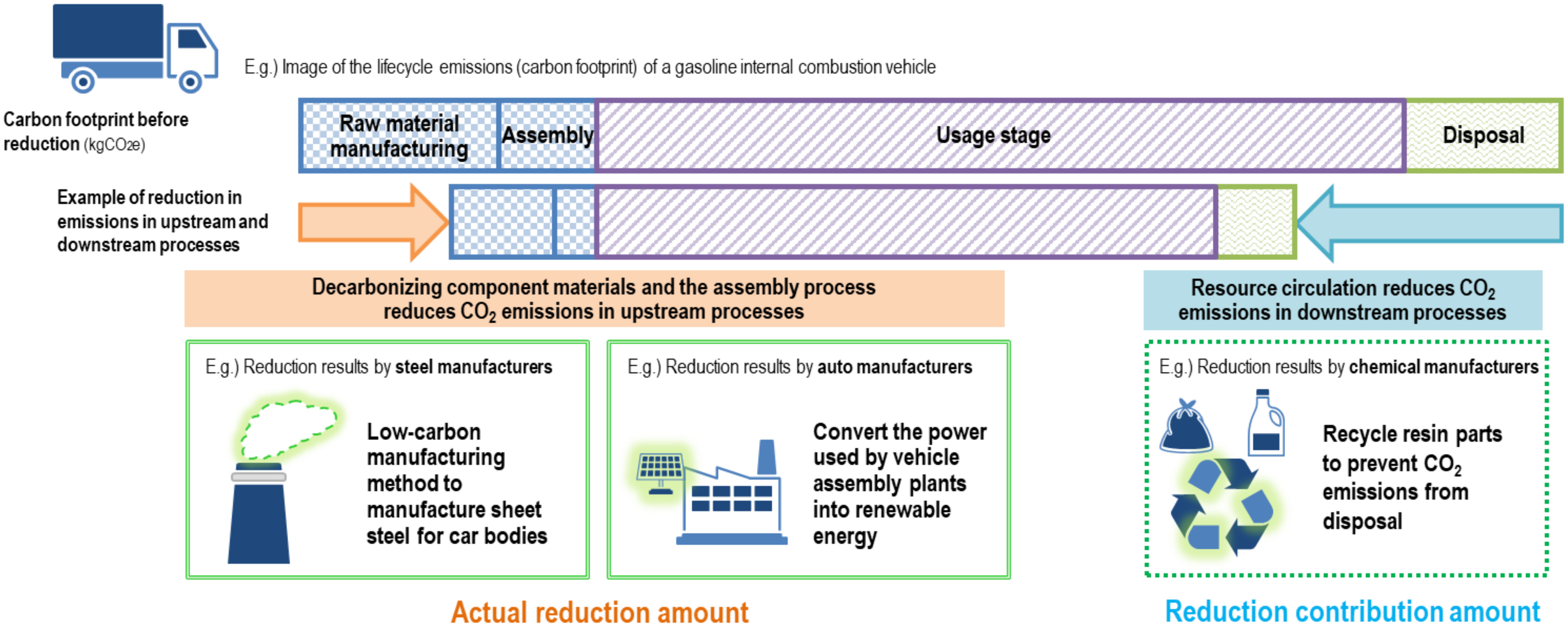


As of January 2023

Ref. Visualizing Emission Reduction Efforts and Providing Incentives

- In promoting decarbonization in the manufacturing industry, there is an issue where CO_2 reductions achieved in upstream processes—such as raw materials, assembly, and other stages—and in downstream processes like recycling and resource circulation **are not incorporated into the decarbonization evaluation of finished goods**. This has resulted in **difficulty in forecasting the return on costly decarbonization investments**.

- Evaluation indicators are set based on **the reduction of emissions per product unit (actual reduction amount)** achieved by reducing emissions within the company, as well as on **the reduction of emissions per product unit (reduction contribution amount)** achieved by reducing emissions throughout the entire lifecycle, even if outside the company. Doing so will visualize GX value and standardize evaluation criteria internationally, thereby **creating a market environment where products with GX value are preferred**.



(Reference) Study Group on the GX Product Market for Creating Demand to Strengthen Industrial Competitiveness and Achieve Emission Reductions

Summary

- Hydrogen can be **produced from various sources** and **can be utilized to multiple sectors including hard-to-abate sectors including chemical industry** as a clean energy and feedstock.
- Japan have been **focusing on the potential of hydrogen** and **have been strongly supported for a long time** by various measures including formulating a national hydrogen strategy for the first time in the world.
- In order to achieve carbon neutrality with hydrogen under a huge uncertainty, it is important to develop a model area where hydrogen supply chain is close to accumulated demand, leading to **reducing hydrogen cost and accumulate knowhow in an efficient and effective manner**.
- Based on the principle, Japan has recently **enacted the Hydrogen Society Promotion Act** and started new policies such as the CFD (Contract for Difference) and Hub Support Program.

- Chemical industry is the main CO2 emitting source in Japan, and to decarbonize the sector, it is necessary to **switch heat sources**, **switch raw materials**, and **circulate raw materials.**
- Several **R&D projects are underway to utilize hydrogen and its deliverables in chemical industry as clean energy or feedstock**. Yet, **deploying proven technologies are as important as the development of new technologies** to quickly decarbonize the industry.
- In addition to the cost reduction of clean hydrogen and green chemicals, it is also critical to **visualize the value of CO2 reduction at LCA level with some incentives** for consumers to select green products leading to create new markets.

Thank you!