

# **Japan's vision and actions toward hydrogen-based economy**

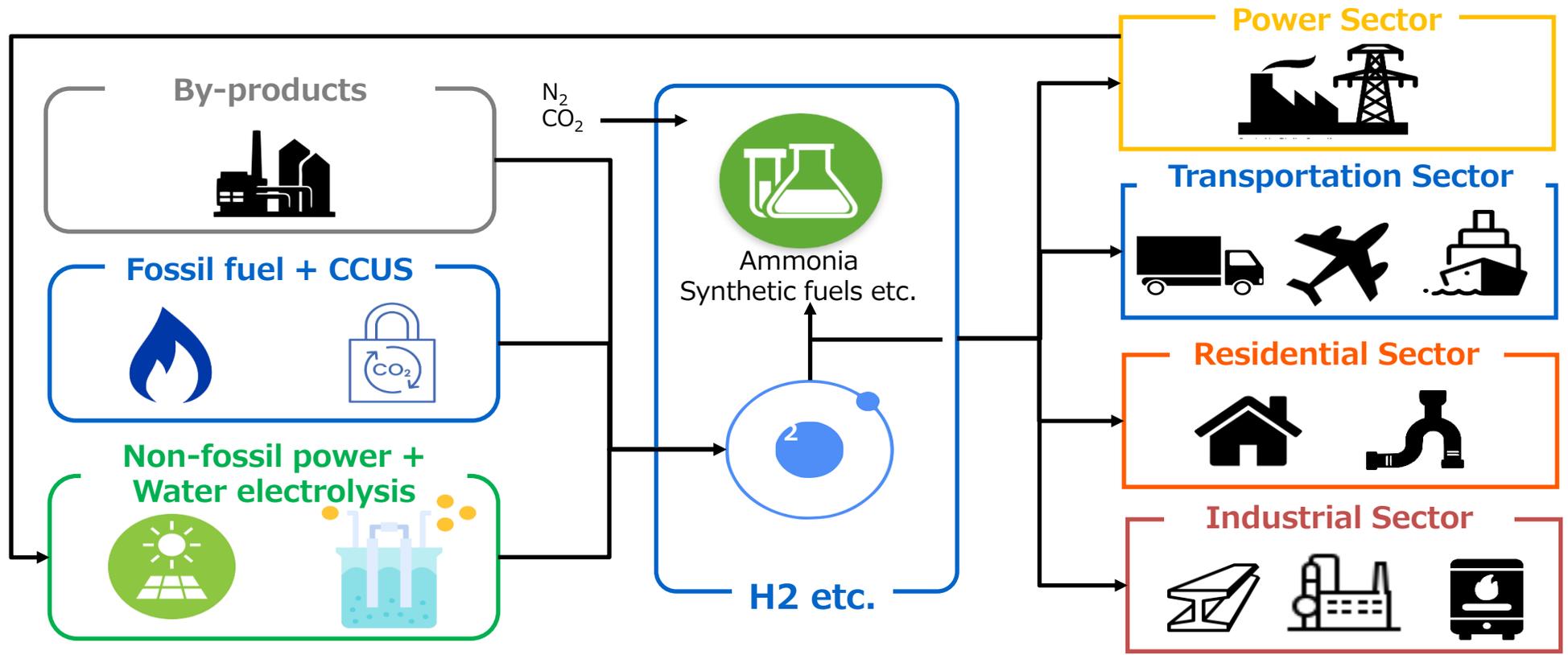
**April. 2022**

**Hydrogen and Fuel Cell Strategy Office**

**METI**

# H2 contribution to decarbonization

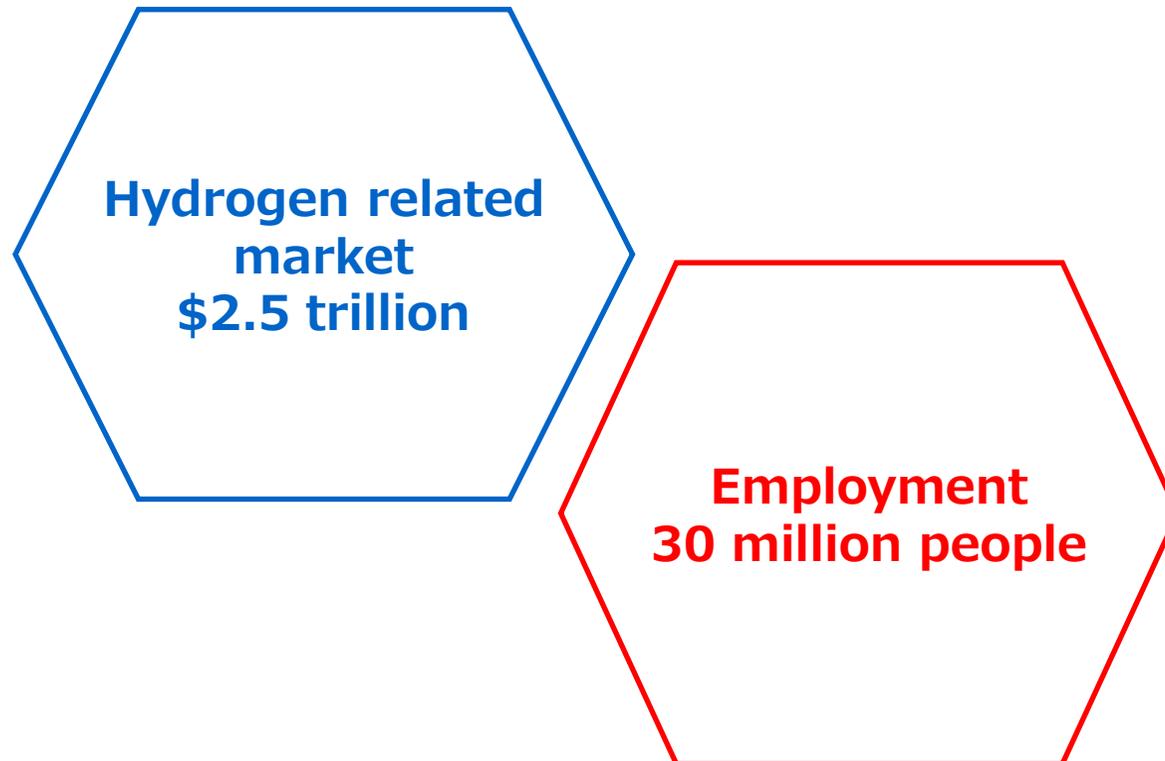
- **Hydrogen enables sector integration.** Renewable energy would be maximized by converting surplus electricity into hydrogen production, storage, and utilization.
- Hydrogen also **contributes to Japan's energy security** through domestic production and diversification of foreign suppliers from wide variety of resources.
- **Ammonia and synthetic fuels from hydrogen are also expected to be utilized** in accordance with their characteristics.



# Economic impact

- Hydrogen contributes to not only decarbonization, but also to make market and employment.
- Hydrogen has potential to make \$2.5 trillion hydrogen-related market and 30 million employment toward 2050.

## Global perspective toward 2050



# Japan's strategies/policies towards hydrogen economy

- Japan is **the first country to formulate National Hydrogen Strategy** in 2017.
- Prime Minister set 2050 carbon neutral declaration, and Japan had positioned **hydrogen as one of the priority areas in the Green Growth Strategy** in 2020. In addition, Japan is trying to **expand the amount of hydrogen introduction** and **reduce hydrogen cost** through the Green Innovation fund projects, other government budget projects, and private sector's self-fund projects.

## Situation and status of strategy formulation

**2017**  
Basic Hydrogen Strategy

**2020**  
PM's 2050 CN Declaration  
Green Growth Strategy

**2021**  
Green Innovation Fund  
Revised Strategic Energy Plan

## Targets

### □ Annual introduction (including fuel ammonia):

**Widely use in power generation, industry, transportation and other fields**

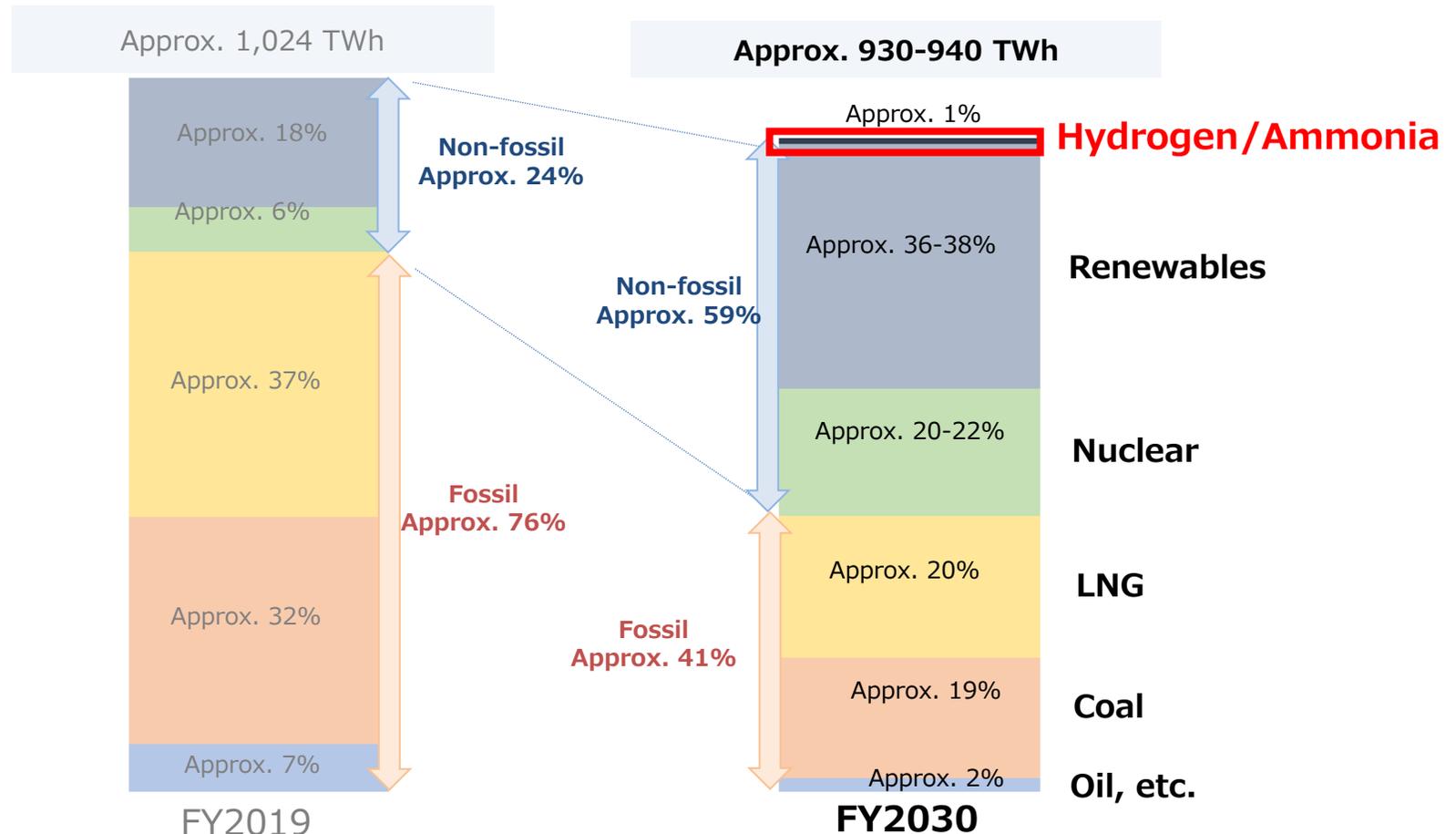
Current (Approx. 2Mt) → 2030 (Approx. 3Mt) → 2050 (Approx. 20Mt)

### □ Costs: Achieve a level comparable to fossil fuels in the long term

Current (JPY100/Nm<sup>3</sup>) → 2030 (JPY30/Nm<sup>3</sup>) → 2050 (Less than JPY20/Nm<sup>3</sup>)

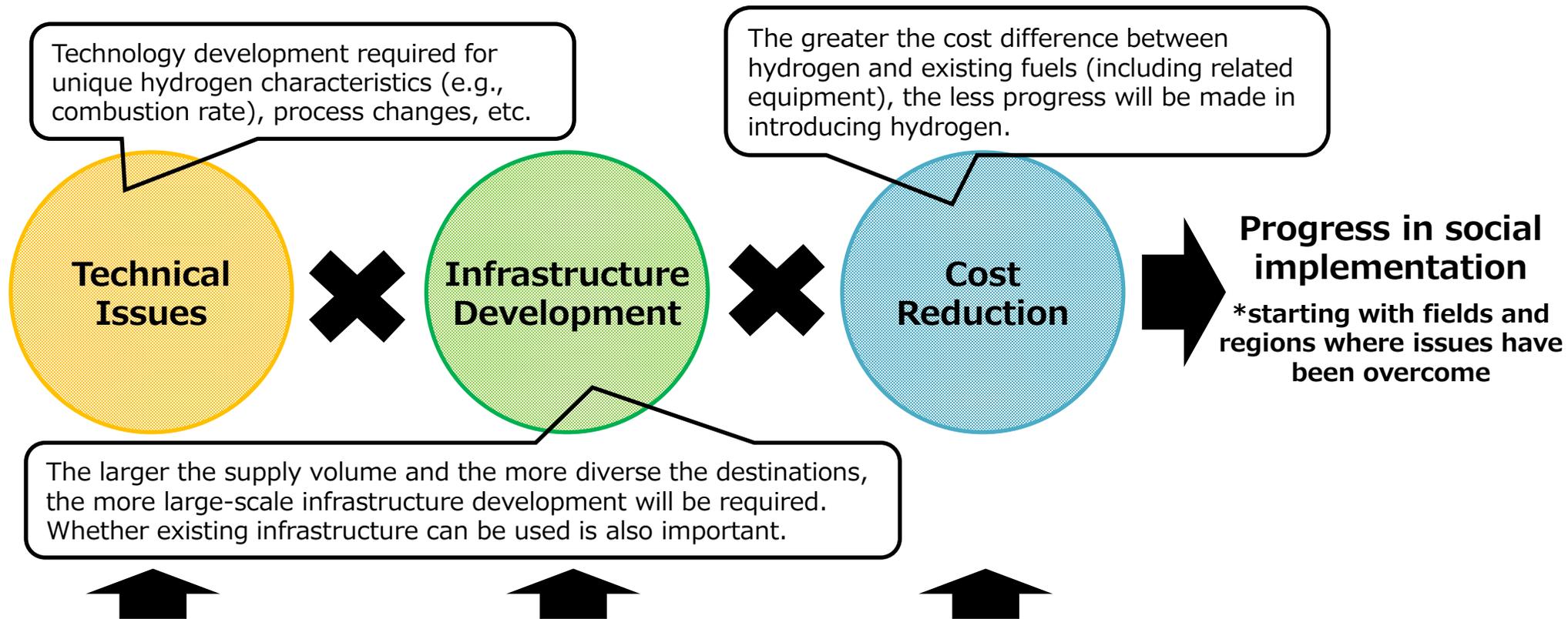
# Power generation mix in 2030

- The Strategic Energy Plan (revised in 2021) shows updated power generation mix target toward 2030.
- It requires improvement of more energy efficiency and renewable energy deployment. In addition, it **allocates 1% for hydrogen and ammonia in 2030 power generation mix.**



# Three important points for social implementation of hydrogen

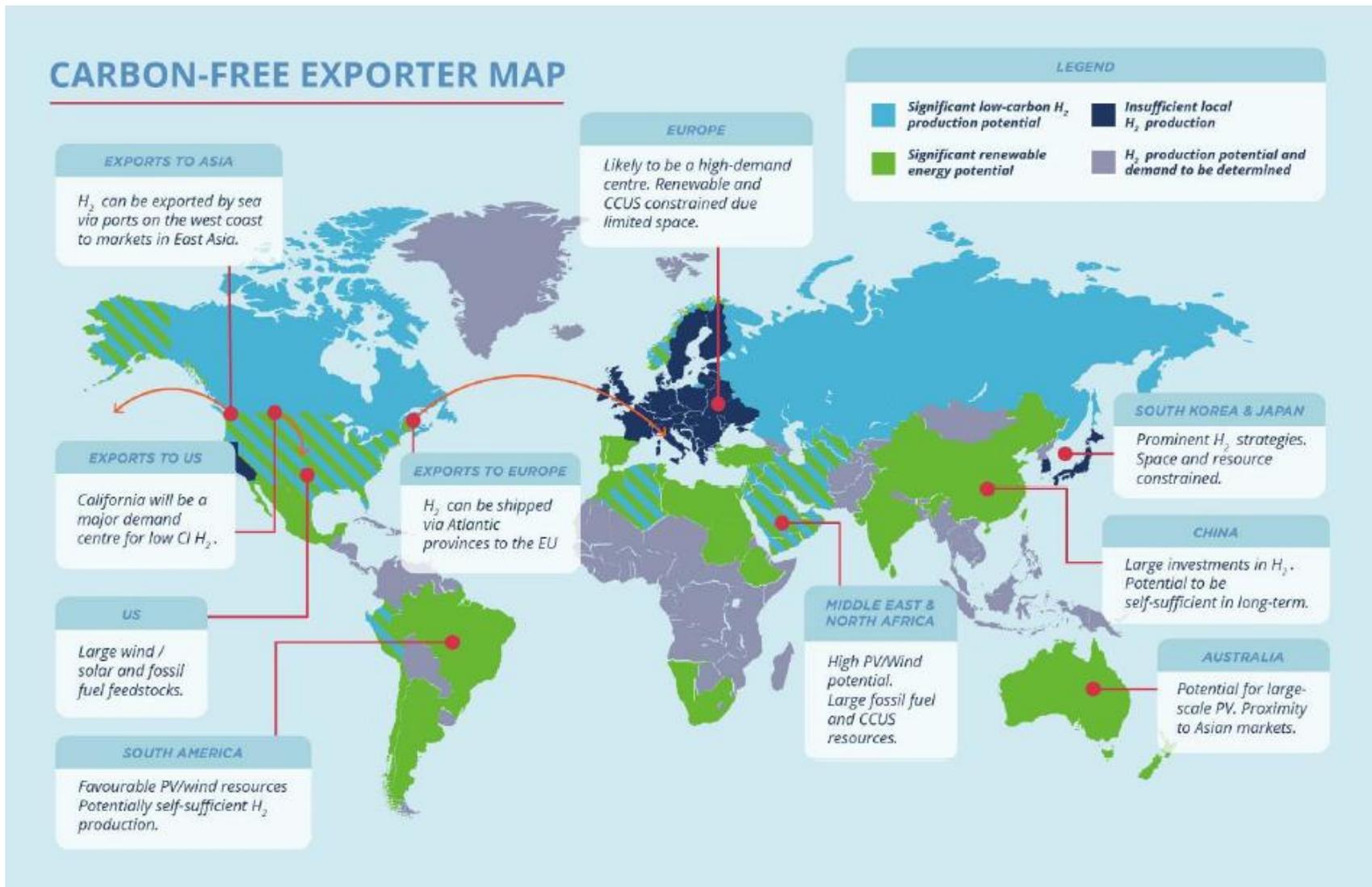
- In order to implement hydrogen in society, it is necessary to overcome three issues: **(1) Technical issues, (2) Infrastructure Development, and (3) Cost Reduction.** As R&D progresses and social implementation approaches, the issues to be addressed will shift to (2) and (3).



**Encourage issues solving through timely implementation of policy measures**  
(R&D support, institutional development, standardization, regulatory reform, public finance, etc.)

# Potential H2 exporters and importers

- We need to design/build global hydrogen supply chain bringing value to all countries.



# Global hydrogen supply chain 1: Liquefied hydrogen

- International transport project of liquefied hydrogen is under demonstration.  
\*conducted by CO2-free Hydrogen Energy Supply-chain Technology Research Association “HySTRA”
- Liquefied Hydrogen Carrier (Suiso Frontier), lignite gasifier (Australia), liquefaction loading terminal (Australia), and cargo handling terminal (Kobe) were developed, and demonstration operation has begun.

## The naming and launching ceremony of “Suiso Frontier”



The ceremony was held at Kawasaki Heavy Industries in Kobe on Dec 11, 2019

## Progress on other facilities

1. **Completion of lignite gasification facility**  
October 2020
2. **Completion of liquefaction terminal in Australia**  
June 2020
3. **Completion of Kobe cargo handling terminal**  
June 2020

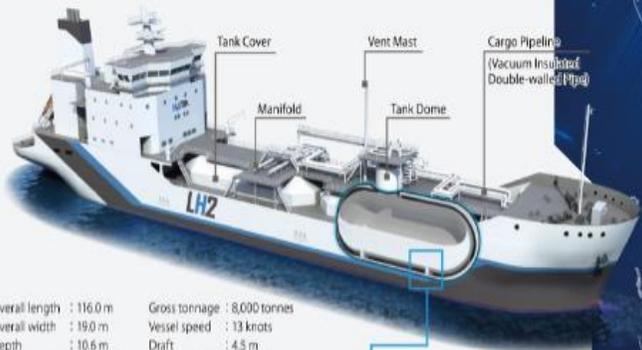


# Latest progress

## Liquefied Hydrogen Carrier

Technology to maintain a temperature of -253°C whilst traversing the Earth

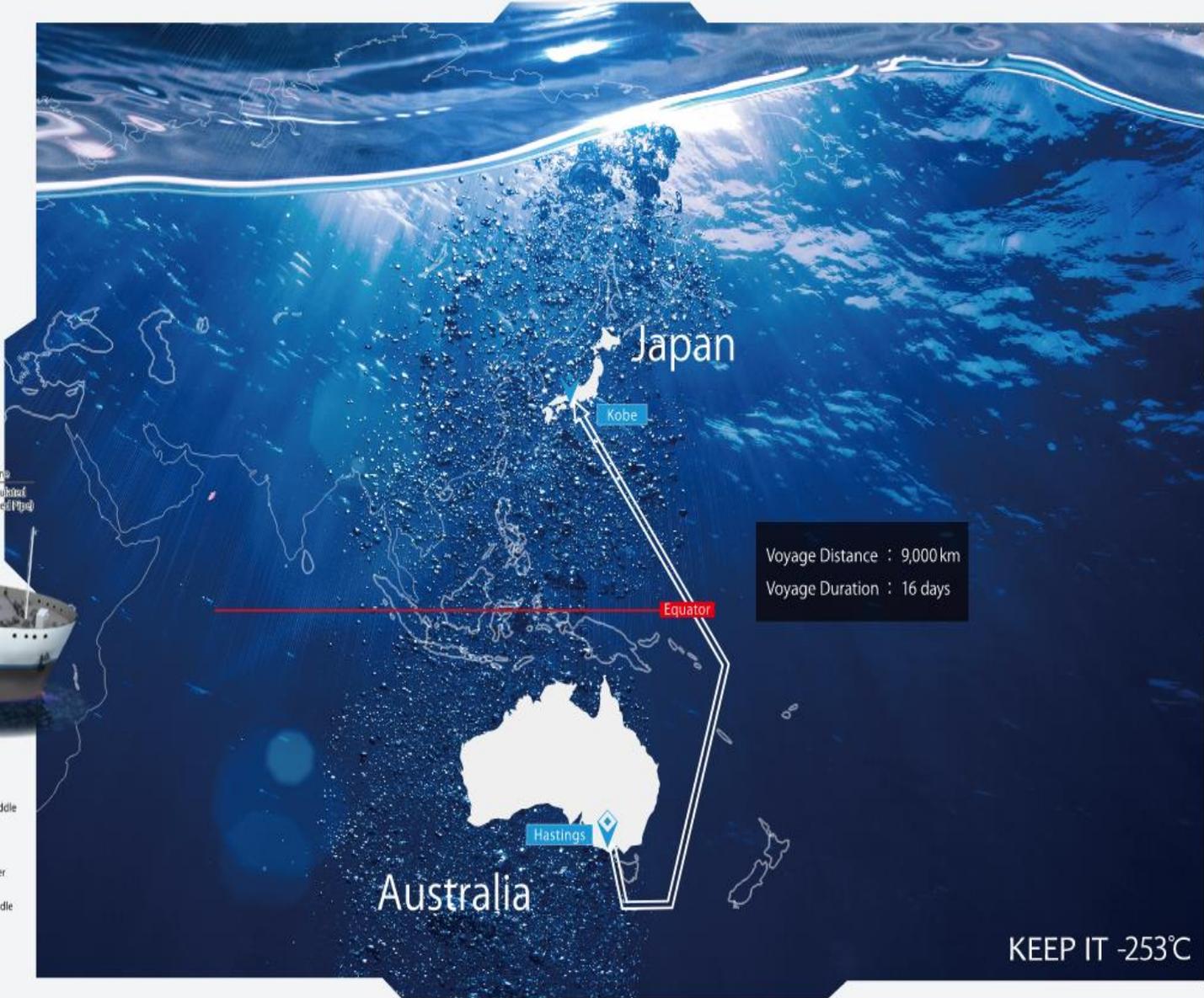
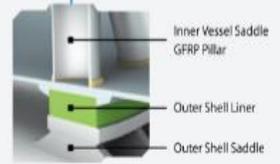
Using existing technologies for construction of LNG marine carriers and for land transportation and storage of liquefied hydrogen, a new cargo containment system with cryogenic temperature and accumulated pressure to specifically transport liquefied hydrogen on a marine carrier has been developed. Our aim is to establish technology for safe and efficient transportation of mass volumes of hydrogen.



Overall length : 116.0 m    Gross tonnage : 8,000 tonnes  
 Overall width : 19.0 m    Vessel speed : 13 knots  
 Depth : 10.6 m    Draft : 4.5 m  
 Maximum crew : 25 persons    Tank capacity : 1,250 kL

### Liquefied hydrogen tanks for marine transportation

A vacuum insulated double-walled structure provides ultimate insulation properties. Using glass fiber reinforced plastic (GFRP) for the support structure enables heat transfer to be reduced.



Voyage Distance : 9,000 km  
 Voyage Duration : 16 days

KEEP IT -253°C

# Latest progress

On January 20th, 2022 “Suiso Frontier”, which left the Liquefied Hydrogen Receiving Terminal “Hy touch Kobe” on December 24th, 2021, arrived at a Liquefied Hydrogen Loading Base in Hasting Port, Victoria, Australia.

We plan to return to Kobe from mid to late February after conducting liquefied hydrogen cargo handling tests and various equipment inspections in Australia.



On February 25, 2022, “Suiso Frontier” loaded with liquefied hydrogen derived from Australian Brown Coal returned to the Liquefied Hydrogen Receiving Terminal “Hy touch Kobe”

The world’s first long-distance voyage demonstration test has been finished. However, HySTRA will continue to carry out loading/Unloading test and Verification of acquired data, and continue the pilot demonstration project for establishing Hydrogen Energy Supply Chains.

# Global hydrogen supply chain 2: LOHC\*

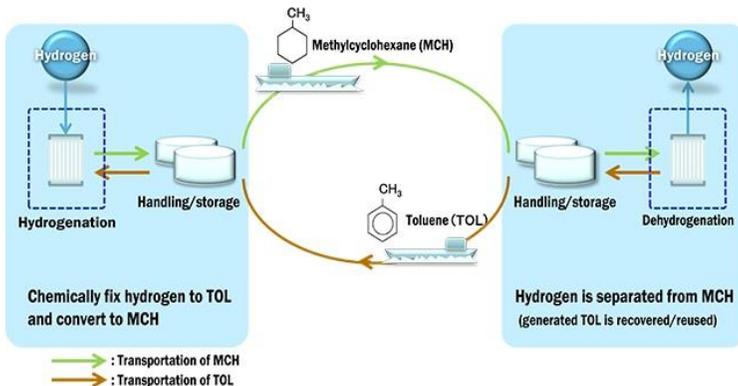
- International transport project of using methylcyclohexane (MCH) as a hydrogen carrier had been demonstrated.  
\*conducted by Advanced Hydrogen Energy chain Association for technology Development "AHEAD"
- Currently, **feasibility studies are being conducted between Japanese companies and Singapore / Malaysia.**

\*Liquid Organic Hydrogen Carriers (LOHC) are organic compounds that can absorb and release hydrogen through chemical reactions.

## Hydrogenation and dehydrogenation plant completed by AHEAD



At the hydrogenation plant, hydrogen and toluene are chemically converted to MCH, which is then shipped to Japan by sea and converted back to hydrogen and toluene at the dehydrogenation plant in Kawasaki.



## Current trends



**(Singapore)** Mitsubishi Corporation entered a MoU with its affiliate Chiyoda Corporation and five local companies on the joint development of a sustainable hydrogen economy in Singapore.

\*The five local partners are City Gas Pte Ltd, Jurong Port Pte Ltd, PSA Corporation Limited, Sembcorp Industries Ltd, and Singapore LNG Corporation Pte Ltd.



**(Malaysia)** ENEOS Corporation signed a MoU with SEDC Energy Sdn Bhd and Sumitomo Corporation to consider collaboration for the establishment of a CO<sub>2</sub>-free hydrogen supply chain using renewable energy and will commence a feasibility study in January 2021.

# Domestic hydrogen production: Water electrolyzer

- Japan is conducting large-scale water electrolyzer demonstration project in Fukushima Prefecture for **Improving the efficiency of hydrogen production** for commercialization, **Electrolyzer equipment cost reduction**, **Establishment of operational system** to respond to supply and demand for hydrogen.

## Demonstration at Fukushima Hydrogen Research Field (FH2R)



Source: Toshiba Energy Systems & Solutions Corporation



**10MW water electrolyzer**

Source: Asahi Kasei

# Hydrogen use in transportation sector

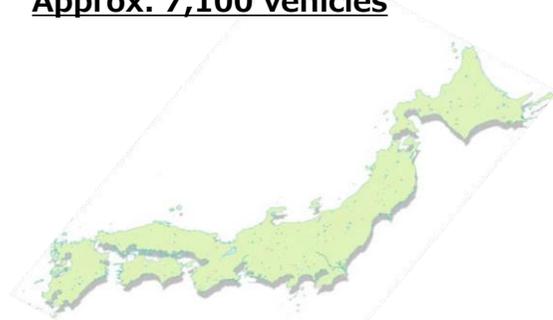
- Currently approx. 7,100 FCVs and 157 hydrogen refueling stations (HRS) are installed (as of Feb 2022). We will continue to **promote regulatory reform, technological development, and strategic development of HRS** toward the introduction of FCVs.
- **Hydrogen (fuel cells and engines) are expected to be used in commercial vehicles such as trucks** for long driving.

## FCV and HRS

New "MIRAI" launched at the end of 2020



**Approx. 7,100 vehicles**



**Hydrogen refueling station: 157 locations**

## FC truck

- ✓ Hino Motors will start inter-base transportation of parcel cargo between Haneda Chronogate and Gunma Prefecture from FY2022 using the FC truck it developed.



### Hydrogen usage (heavy truck)

- Approx. 80 times that of a passenger car (MIRAI)

### Challenges

- Inexpensive hydrogen supply (alternative to diesel)
- Development of large HRS

# Hydrogen use in power sector and industrial sector

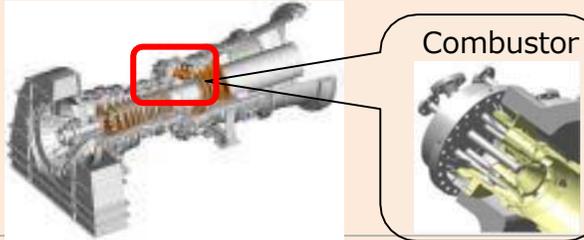
- Technology development and demonstration will be carried out in the fields of large-scale thermal power generation (500 MW class) and cogeneration for supplying heat and electricity (1 MW class). **Japan will contribute to the world's efforts to commercialize hydrogen power generation.**
- **Hydrogen boiler has already had deployment case. Some companies, such as tire-manufacture, are considering deploying hydrogen boiler to their factory for carbon neutral.**

## R&D for large-scale thermal power generation (500 MW class)

Development of technology for hydrogen co-firing in existing large-scale thermal power plants, **achieving a hydrogen co-firing rate of 20% by 2018.**



Technology development for hydrogen single fuel power generation is in progress from 2020.



## R&D for cogeneration for supplying heat and electricity (1MW class)

We have developed a technology that can freely co-fired hydrogen with natural gas from 0 to 100%.



From 2019, technology development for high-efficiency dedicated **hydrogen single fuel power generation** is in progress.



Hydrogen power generation facility (hydrogen CGS) constructed on Port Island in Kobe City

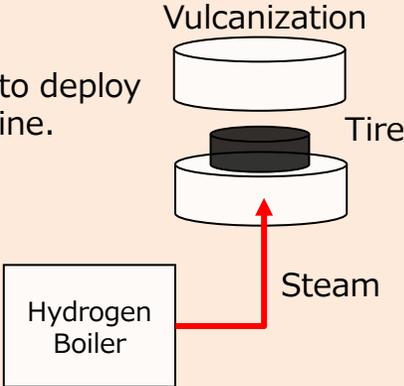
## Hydrogen Boiler

Hydrogen boiler deployment case



Source: Miura co., Ltd.

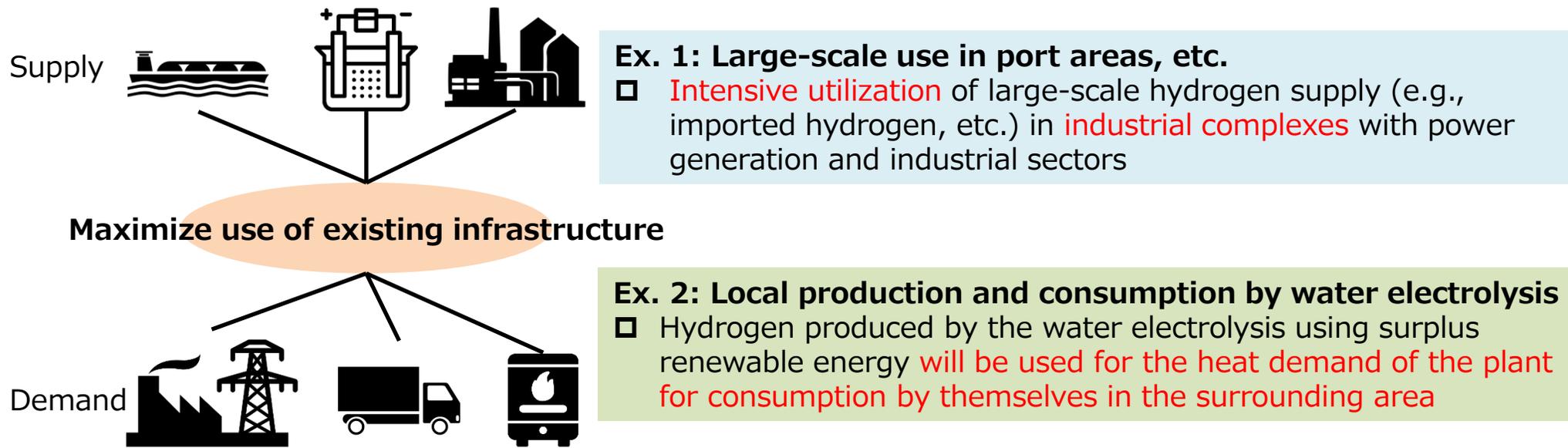
Tire-manufacture is considering to deploy hydrogen boiler at their factory line.



# Creation of implementation models

- It is desirable to encourage the utilization of hydrogen in regions where supply can be expanded with the use of existing infrastructure as a model. It is also better to have the demand and supply areas as close to each other as possible.
- By gathering knowledge, creating more models, and promoting the development of infrastructure in various regions, the social implementation of hydrogen can be efficiently promoted, and we will actively support the establishment of such models.

【Concept and model examples of hydrogen social implementation】

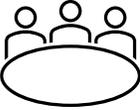


Linking supply and demand with minimal additional investment to efficiently reduce costs and accumulate knowledge

# Fukushima

## ◆ Fukushima hydrogen industry-academia-government collaboration committee

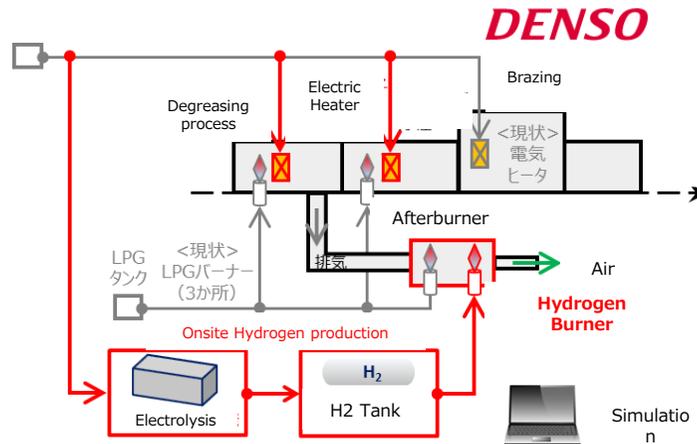
Fukushima Prefecture and Namie Town are using hydrogen and fuel-cell for public facilities.



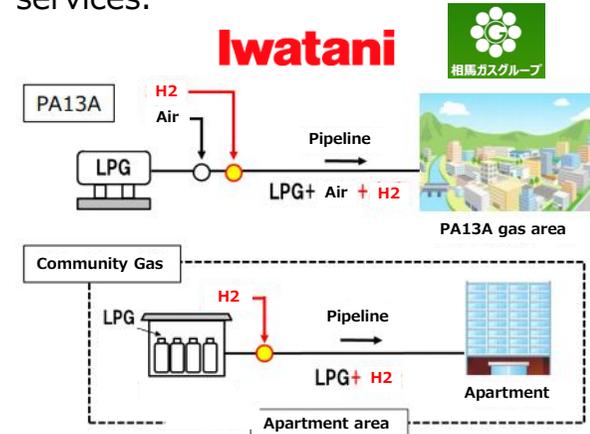
Development of electrolysis with renewable energy at Fukushima Hydrogen Energy Research Field (FH2R)



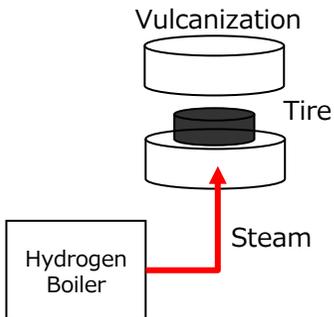
DENSO has started demonstration project for electric heaters and hydrogen burners in their production line



IWATANI and SOMA Gas Group have started to feasibility study for blending hydrogen into their gas services.

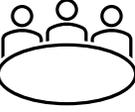


Sumitomo Rubber Industries has started demonstrate project for deployment of hydrogen boiler at their factory line.



# Yamanashi

## ◆ Yamanashi hydrogen and fuel cell related industry development committee



Yamanashi prefecture has developed renewable energy power plant and hydrogen technology many years.



Yamanashi prefecture, TORAY and TEPCO Energy Partner established Yamanashi Hydrogen Company (YHC) to provide "power to gas" service as output/outcome of demonstration projects.

Yamanashi University is doing hydrogen related R&Ds, such as electrode catalyst for high-performance, cost-reduction, etc.



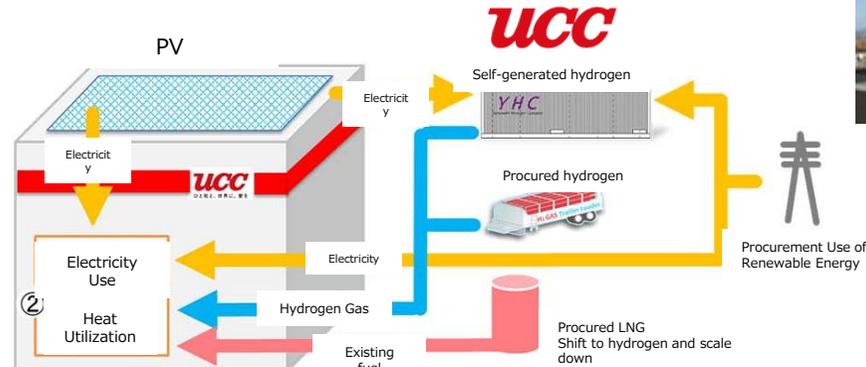
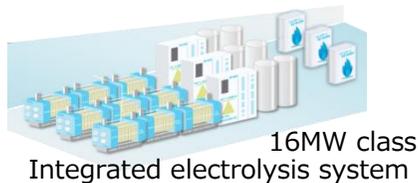
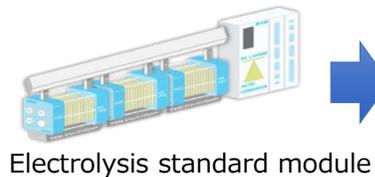
The Association of Hydrogen Supply and Utilization Technology (HySUT) provides human resource development service for hydrogen fueling station.



They start to develop 16MW class integrated electrolysis system and hydrogen boiler in cooperation with TORAY, Hitachi Zosen, SIEMENS Energy, KAJI Technology, MIURA.



UCC Ueshima Coffee has started demonstration project for hydrogen heat-use at their factory line in cooperation with Yamanashi prefecture, TEPCO Energy Partner, Toray and TOMOE.



# Other activities

Kawasaki Heavy Industries is demonstrating 1MW class hydrogen single fuel turbine including providing electricity and heat to district in Kobe.



**Kawasaki**  
Powering your potential

Kobe Steel has started feasibility study their steel factory decarbonization with using hydrogen.



**KOBELCO**

Tokyo Gas has started feasibility study on hydrogen demand potential and appropriate supply system in their service area.

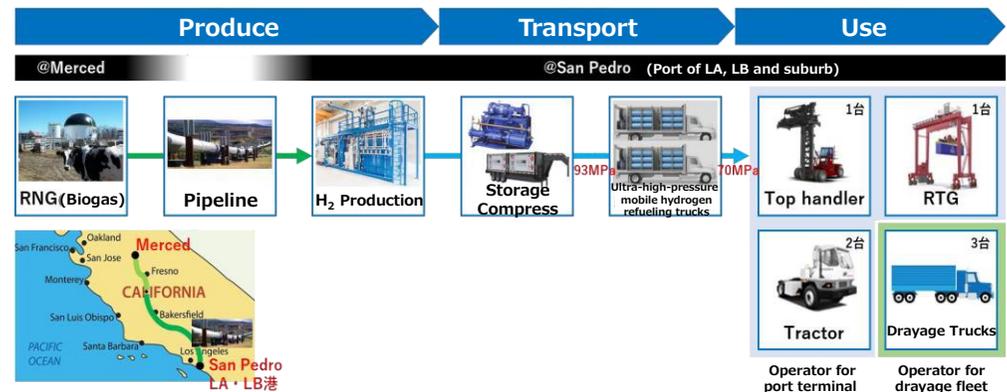
**TOKYO GAS**

East Japan Railway Company (JR East) has started Fuel cell train demonstration operation at their commercial line.



**JR EAST**

Toyota Tsusho, Hino Motors, Mitsui E&S has started demonstration project at Los Angeles port and Long Beach port in the United States.



**TOYOTA TSUSHO CORPORATION**

**HINO**

**MITSUI E&S**

# Note: Hydrogen Energy Ministerial Meeting (HEM)

- In 2018, Japan launched the Hydrogen Ministerial Meeting (HEM) to take the initiative in building a hydrogen society on a global scale. It has become a forum for ministers and top executives to meet and express their direction to build a hydrogen society and their future initiatives.
- One after another, countries have formulated their hydrogen strategies and announced them at HEM. The goals and paths for hydrogen use are becoming clearer.



## 2020

**23** representatives from countries, region and organizations  
**2800** registrations/**+10,000** views  
**GLOBAL ACTION AGENDA PROGRESS REPORT**

## 2019

**35** countries, region and organizations  
**600** attendees  
**GLOBAL ACTION AGENDA**

## 2018

**21** countries, region and organizations  
**300** attendees  
**TOKYO STATEMENT**

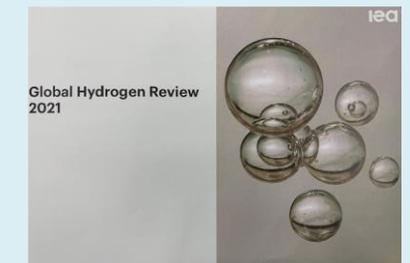
- Harmonization of Regulation, Codes and Standards
- Joint Research and Development
- Study and Evaluation of Hydrogen's Potential
- Education & Outreach

## 2021

**30** representatives from countries, region and organizations  
**3200** registrations

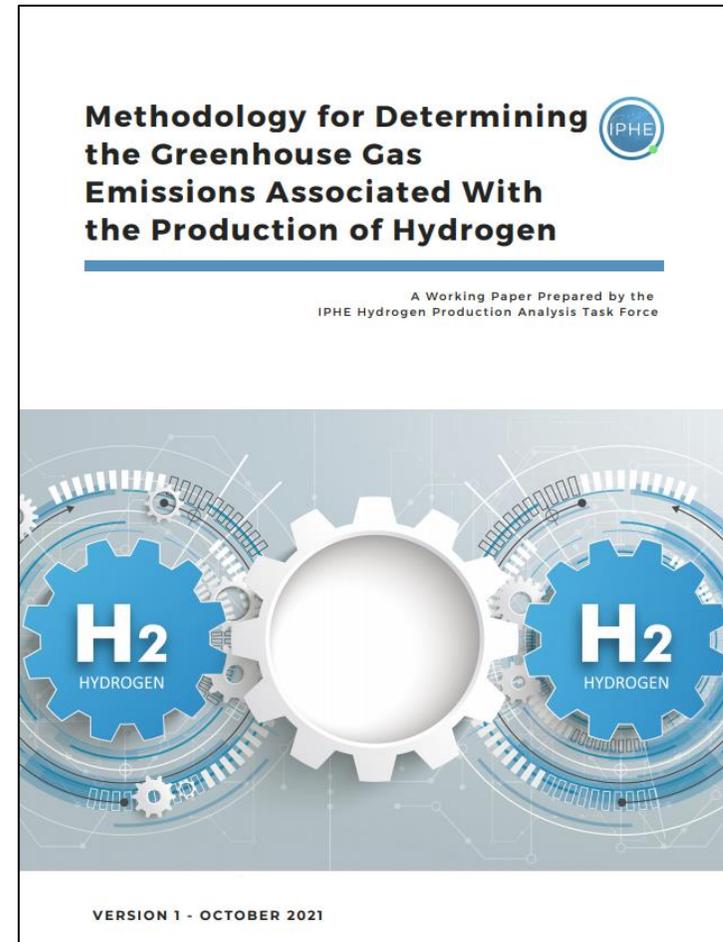


## SHARED POLICY DIRECTIONS IEA GLOBAL HYDROGEN REVIEW



# Ref: IPHE activities for international H2 supply chain

- IPHE published “Methodology for Determining the Greenhouse Gas Emissions Associated with the Production of Hydrogen” as a working paper, and they are continuing to develop relevant methodology associated with hydrogen-carrier and transportation.
- IPHE is also working on develop a discussion paper on “International Trade Rules for Hydrogen and its Carriers: Information and Issues for Consideration.”



**Thank you for your kind attention!**