

Japan's Vision and Actions toward Hydrogen Economy

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Hiroki YOSHIDA

**Hydrogen and Fuel Cells Strategy Office
METI, JAPAN**

Japan's Strategies & Policies towards Hydrogen Economy

- Japan is the first country to formulate National Hydrogen Strategy.
- Prime Minister set 2050 carbon neutral declaration, and Japan positioned hydrogen as one of the priority areas in the Green Growth Strategy in 2020.
- Japan is trying to expand the amount of hydrogen introduction and reduce hydrogen cost through the Green Innovation fund projects and other measures.

Situation and status of strategy formulation

2017
National Hydrogen Strategy

2020
PM's 2050 CN Declaration
Green Growth Strategy

2021
Green Innovation Fund
Revised Strategic Energy Plan

Targets

□ Supply & Demand volume:

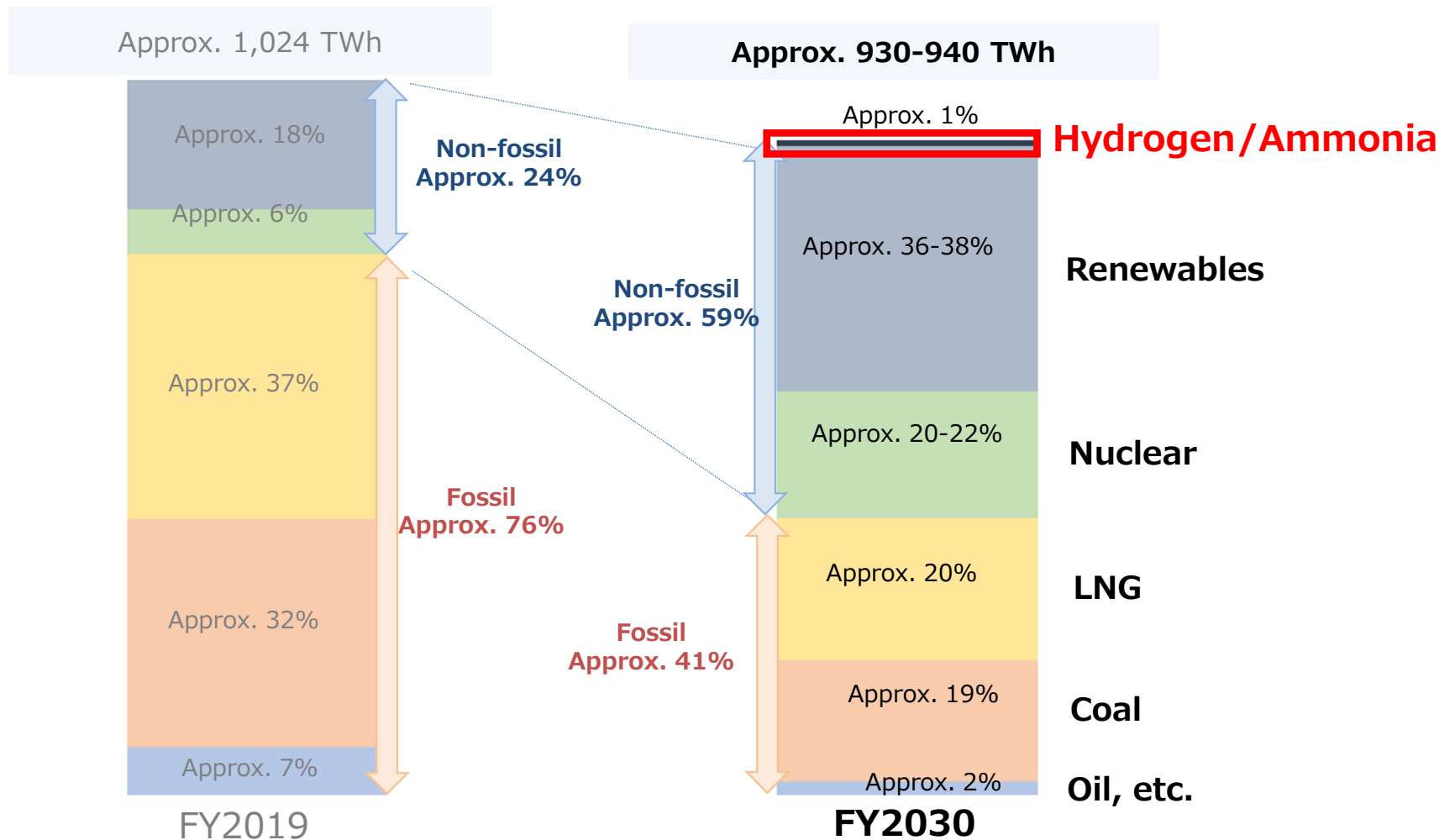
Current (Approx. 2Mt) → 2030 (Approx. 3Mt) → 2050 (Approx. 20Mt)

□ Hydrogen cost:

Current (JPY100/Nm³) → 2030 (JPY30/Nm³) → 2050 (Less than JPY20/Nm³)

Power Generation Mix in 2030

- The Strategic Energy Plan (revised in 2021) shows updated power generation mix target toward FY2030.
- 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.



Hydrogen Supply and Demand (Rough Roadmap)

Supply side

	Short term (-2025)	Mid term (-2030)	Long term (-2050)
Actual·Target Volume / Sources	Approx. 2 mil ton	Up to 3 mil ton	Approx. 20 mil ton
Existing Source (Byproduct, etc.)	Major supply source	Transition to Clean Hydrogen (Utilization of CCUS, etc.)	
Import (Blue, Green, etc.)	Demonstration phase	Establishment of global hydrogen supply chain on commercial basis	Expansion of scale through diversification
New Domestic Supply Source (Electrolysis, etc.)	Demonstration phase	Transition to commercial phase	Expansion of scale (incl. introduction of new technologies)

Demand side

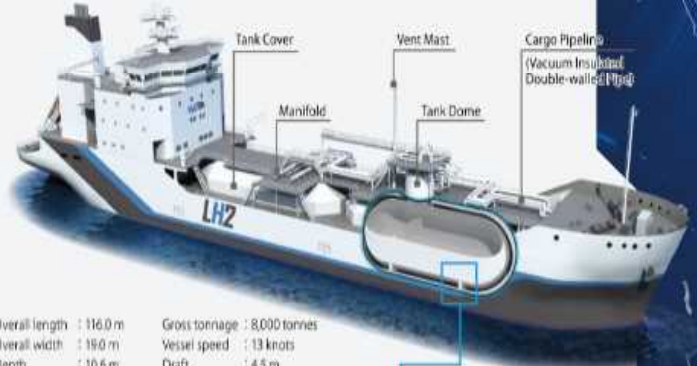
	Short term (-2025)	Mid term (-2030)	Long term (-2050)
Actual·Target Volume / Sectors	Approx. 2 mil ton	Up to 3 mil ton	Approx. 20 mil ton
Transportation	FCV, FC Bus + Introduction of FC Trucks	+ FC Ships etc.	+ Aircraft etc.
Power Generation	Stationary fuel-cells, Small gas turbines etc.	Commercialization of large size power generation	+ Using as the flexibility of power system
Industrial Sector	R&D, Demonstration phase (steel and chemical production process etc.)		H2 reductant steelmaking, green chemical etc.
Heat Demand (industrial/commercial /residential)	Demonstration phase / Commercialization in limited areas		Expansion of scale (through cost reduction and infrastructure development)

Global Hydrogen Supply Chain 1: Liquefied Hydrogen

Liquefied Hydrogen Carrier

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

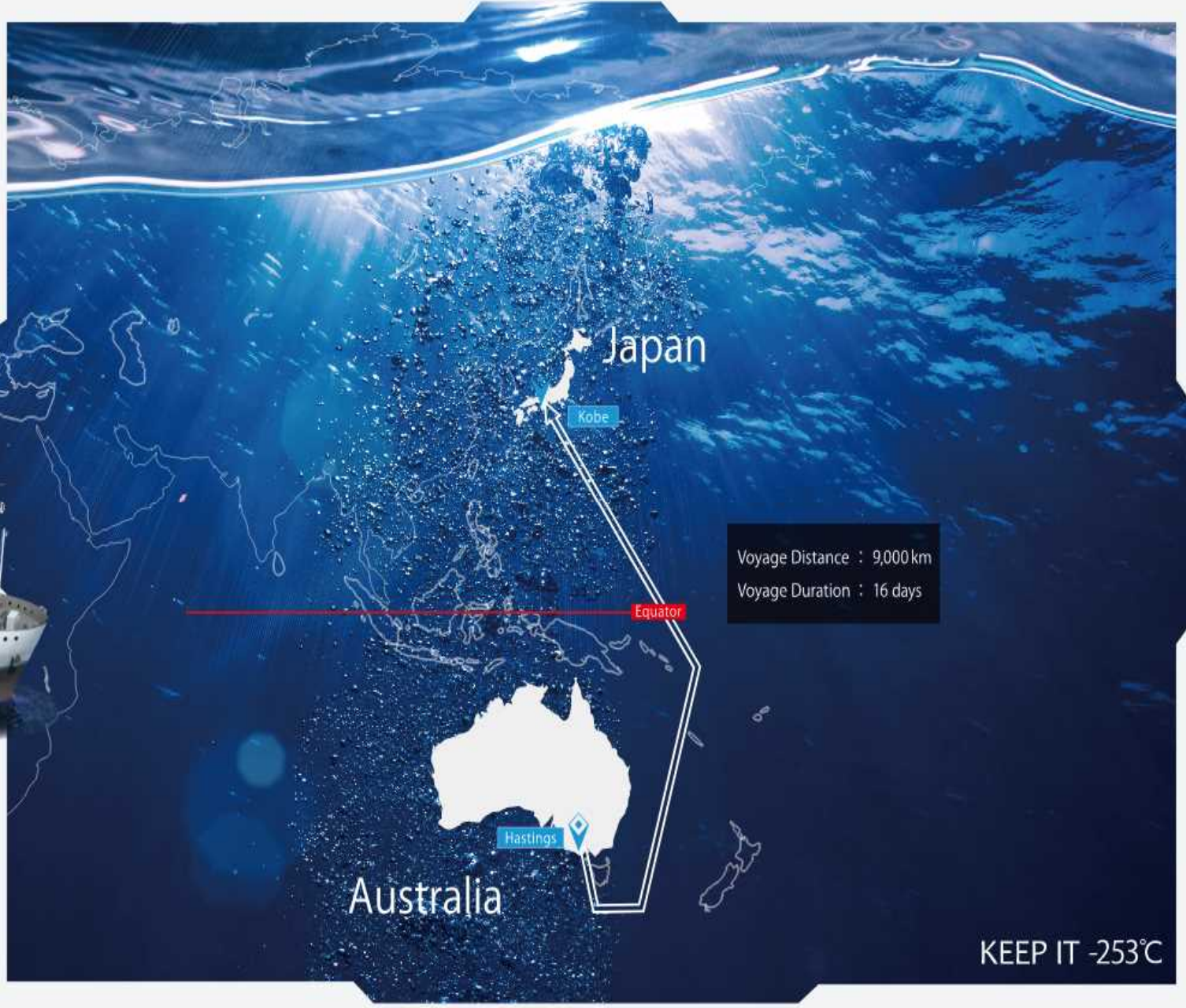
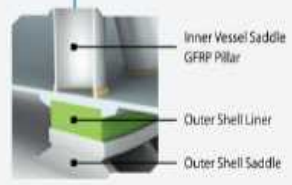
Using existing technologies for construction of LNG marine carriers and for land transportation and storage of liquefied hydrogen, a new cargo containment system with cryogenic temperature and accumulated pressure to specifically transport liquefied hydrogen on a marine carrier has been developed. Our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



KEEP IT -253°C

Global Hydrogen Supply Chain 1: Liquefied Hydrogen

- Liquefied Hydrogen Carrier completed the world's first maritime transport (AU→JPN) in February 2022, including liquefied hydrogen loading and unloading.
- Followed by a large-scale demonstration project※ aimed at commercialization by FY2029.

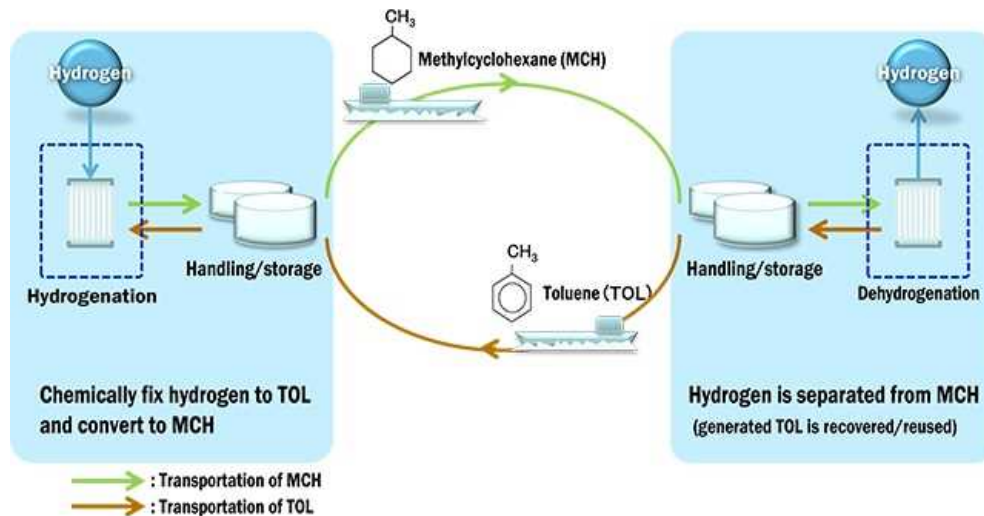
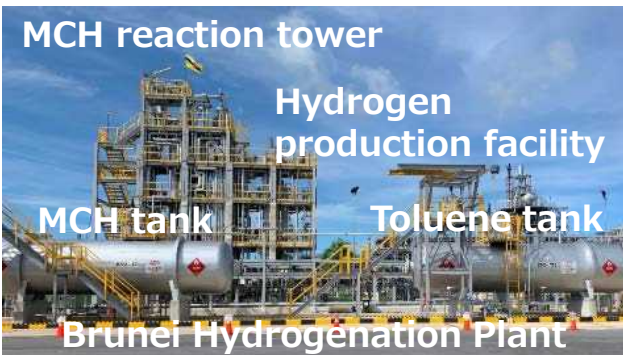
※Fund: up to 2.3 billion USD; Capacity size: 128 times the size of the demonstration vessels



Global Hydrogen Supply Chain 2: MCH (Methylcyclohexane)

- An int'l hydrogen supply chain using MCH as the hydrogen carrier in the demonstration project was completed in June 2020. (Brunei-JPN)
- Followed by a large-scale demonstration project* aimed at commercialization by FY2030 & 2 separate MoUs.
※Fund: up to 0.7 billion USD

MCH Hydrogenation and Dehydrogenation Plant completed



(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.



(Malaysia) ENEOS Corporation signed a MoU with SEDC Energy Sdn Bhd and Sumitomo Corporation to consider collaboration for the establishment of a CO₂-free hydrogen supply chain using renewable energy and will commence a feasibility study in January 2021.

Domestic Hydrogen Production: Electrolyser

- Demonstration project in Fukushima using large-scale electrolyser already in operation in 2020 (10MW).
- Currently, a larger demonstration project* is underway to further increase size, improve operation and reduce costs.

*Fund: up to 0.7 billion USD

Alkaline electrolyser plant in Fukushima



Source: Toshiba Energy Systems & Solutions Corporation

PEM electrolyser plant in Yamanashi



Source: Yamanashi Pref

Hydrogen Use in Transportation sector

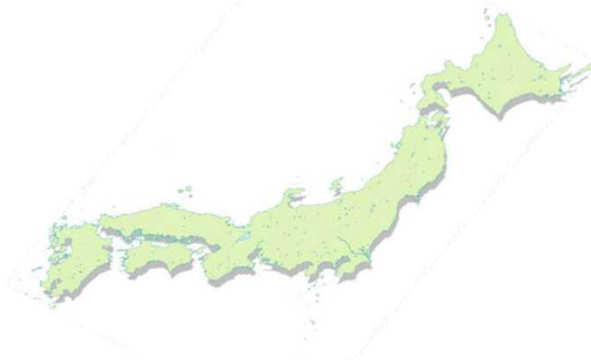
- Currently approx. **7,250 FCVs** and **158 hydrogen refueling stations (HRS)** are installed (as of March 2022).
- **FC Truck and FC Train are under demonstration.**

FCV and HRS

New "MIRAI" launched at the end of 2020



Approx. 7,250 vehicles



Hydrogen refueling station: 158 locations

FC truck



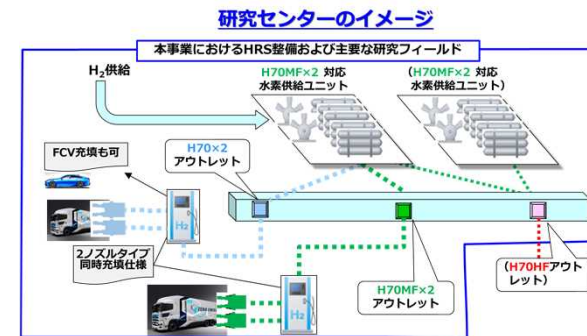
Fukushima Prefecture and TOYOTA are preparing to start FC truck demonstration project including refueling timing management.

Developing high-speed refueling protocol for Heavy Duty Vehicles.

FC train



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



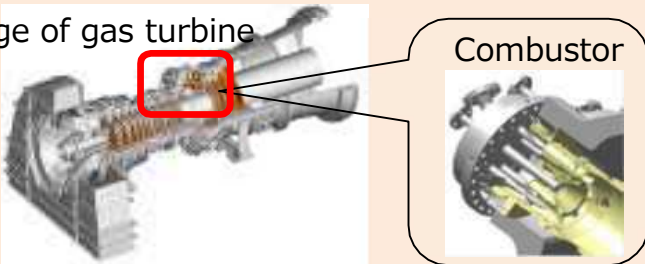
Hydrogen Use in Power sector and Industrial sector

- Japan has been a world leader in hydrogen power generation technology. Projects are underway for both large and small turbines.
- Hydrogen boiler has already had deployment case. Some companies, such as tire-manufacture, are considering deploying hydrogen boiler to their factory for carbon neutral.

500 MW class

Achieving hydrogen co-firing rate of 20% in 2018. → Single fuel power generation is under progress.

The image of gas turbine



1MW class

Achieving combined heat and power supply to urban areas using hydrogen exclusively in 2018. → High-efficiency dedicated hydrogen single fuel power generation is under progress.



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

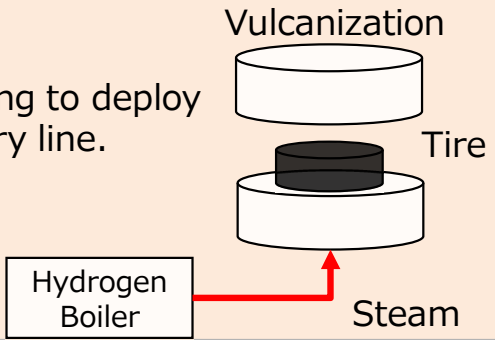
Hydrogen Boiler

Hydrogen boiler deployment case



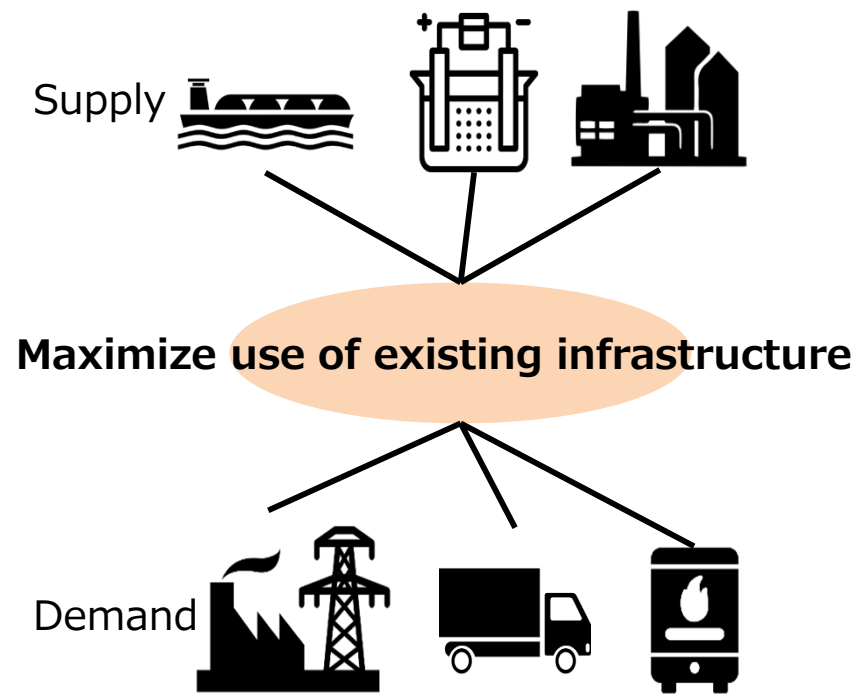
Source: Miura co., Ltd.

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 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.



Ex. 1: Large-scale use in port areas, etc.

- Intensive utilization of large-scale hydrogen supply (e.g., imported hydrogen, etc.) in industrial complexes with power generation and industrial sectors

(Ex. Kawasaki, Chubu)



Ex. 2: Local production (using electrolyser) and consumption

- Hydrogen produced by the electrolyser using renewable energy is used for the heat demand of the plant or for consumption in the surrounding area.

Fukushima



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

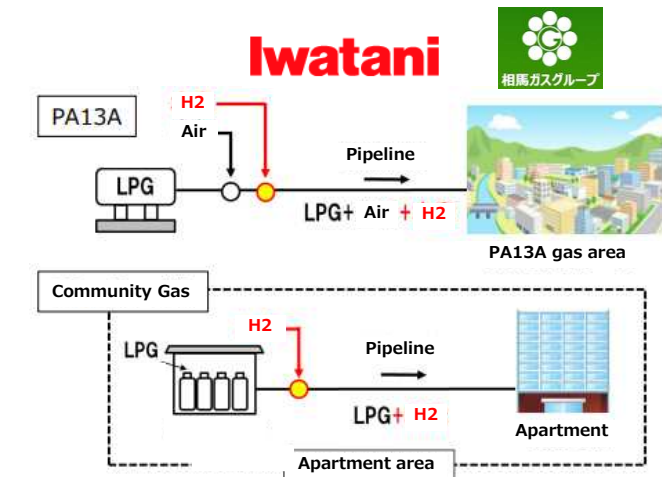
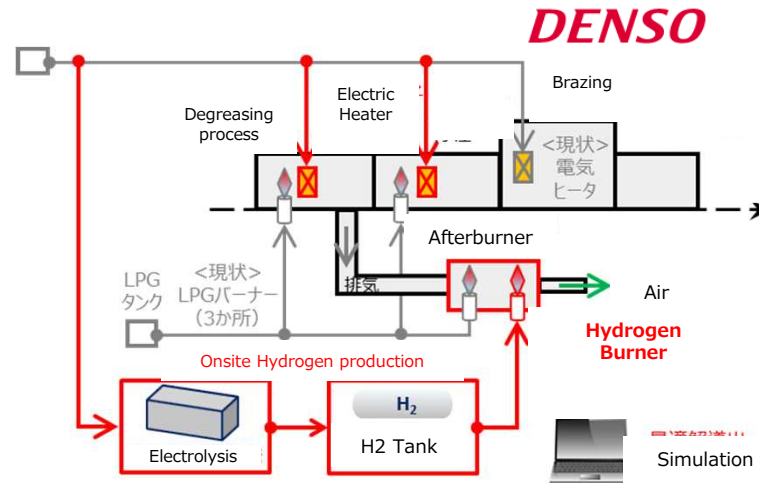
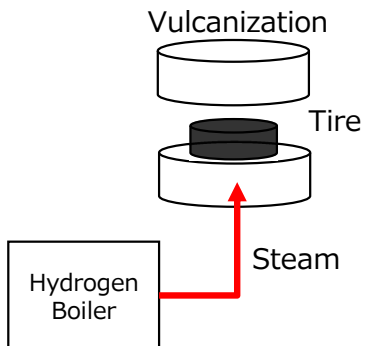
Development of electrolysis with renewable energy at **Fukushima Hydrogen Energy Research Field (FH2R)**



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



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

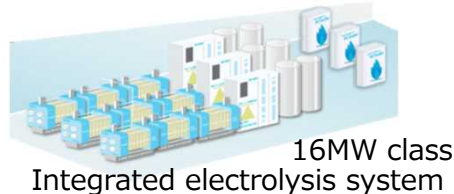
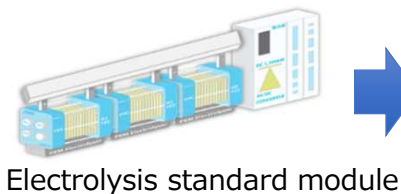
Yamanashi prefecture has developed renewable energy power plant and hydrogen technology many years.



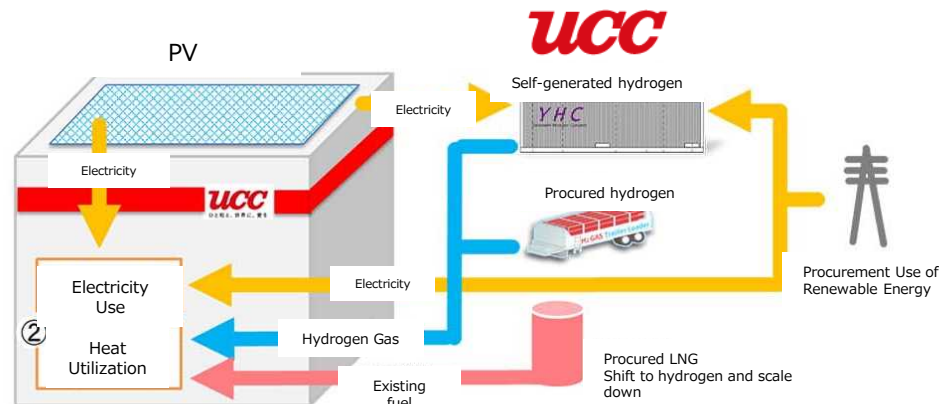
Yamanashi University is doing hydrogen related R&Ds, such as electrode catalyst for high-performance, cost-reduction, etc.



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.



Bold New Support Measures for Commercialization

- Minister Hagiyuda established a new subcommittee for hydrogen policy in March.
- The subcommittee examines ways to expand the introduction and **commercialization of hydrogen and ammonia**, focusing on the **price difference with existing fuels** and the state of infrastructure development.
- **PM Kishida** stated in his April speech that he would take **"bold support measures"** regarding hydrogen policy.



“I recognize that the transition to hydrogen-based society will be the key to decarbonization.”

“I would like to take bold support measures in line with the goal of achieving carbon neutrality in collaboration with the public and private sectors regarding the scale of investment to promptly expand the introduction of hydrogen from both aspects of hydrogen supply and demand.”

Hydrogen Energy Ministerial Meeting (HEM)

- Japan launched the Hydrogen Ministerial Meeting (HEM) in 2018.
- HEM is the most ideal meeting for hydrogen-related ministers and top executives to express and discuss directions to build hydrogen society and future initiatives.
- HEM 2022 will be held in late of September 2022.



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

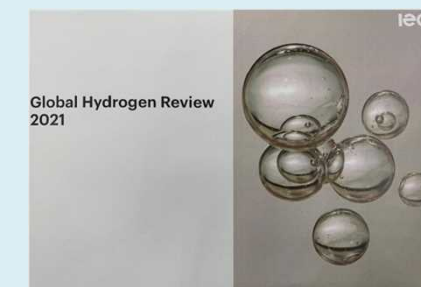
- Harmonization of Regulation, Codes and Standards
- Joint Research and Development
- Study and Evaluation of Hydrogen's Potential
- Education & Outreach

2021

30 representatives from countries, region and organizations
3200 registrations



**SHARED POLICY DIRECTIONS
 IEA GLOBAL HYDROGEN REVIEW**



Thank you for your kind attention!