

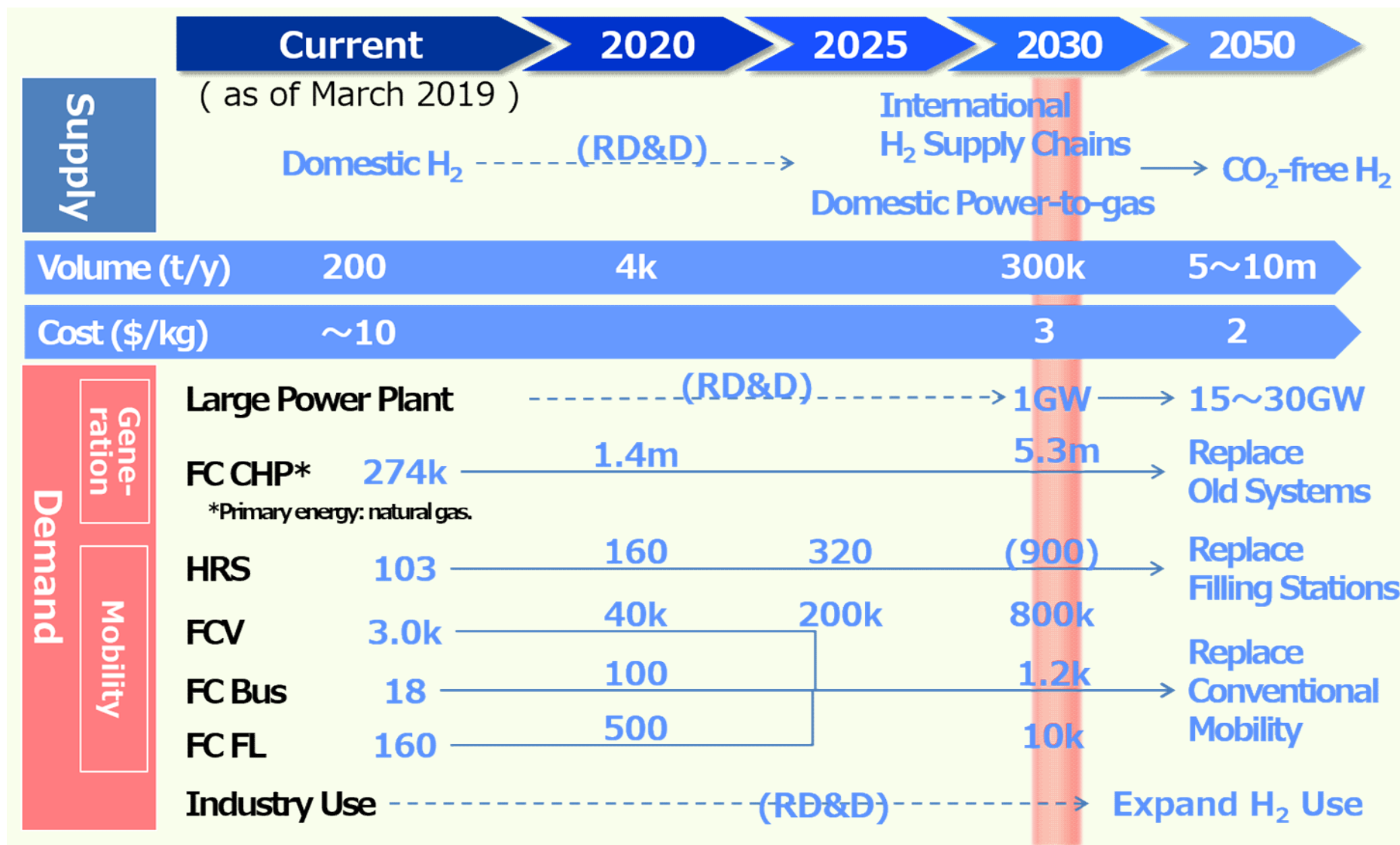
Japan's activity on hydrogen energy

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New Energy and Industrial Technology Development Organization (NEDO)

Policy: "Basic Hydrogen Strategy"



Source: Ministry of Economy, Trade and Industry

Strategic Roadmap for Hydrogen & Fuel Cells

		Goals in the Basic Hydrogen Strategy	Set of targets to achieve		Approach to achieving target
Use	Mobility	FCV 200k by 2025 800k by 2030	2025	<ul style="list-style-type: none"> Price difference between FCV and HV (¥3m → ¥0.7m) Cost of main FCV system (FC ¥20k/kW → ¥5k/kW Hydrogen Storage ¥0.7m → ¥0.3m) 	<ul style="list-style-type: none"> Regulatory reform and developing technology
		HRS 320 by 2025 900 by 2030	2025	<ul style="list-style-type: none"> Construction and operating costs (Construction cost ¥350m → ¥200m Operating cost ¥34m → ¥15m) Costs of components for HRS (Compressor ¥90m → ¥50m Accumulator ¥50m → ¥10m) 	<ul style="list-style-type: none"> Consideration for creating nation wide network of HRS Extending hours of operation
		Bus 1,200 by 2030	Early 2020s	<ul style="list-style-type: none"> Vehicle cost of FC bus (¥105m → ¥52.5m) 	<ul style="list-style-type: none"> Increasing HRS for FC bus
	Power	Commercialize by 2030	2020	<ul style="list-style-type: none"> Efficiency of hydrogen power generation (26% → 27%) ※1MW scale 	<ul style="list-style-type: none"> Developing of high efficiency combustor etc.
FC	Early realization of grid parity	2025	<ul style="list-style-type: none"> Realization of grid parity in commercial and industrial use 	<ul style="list-style-type: none"> Developing FC cell/stack technology 	
Supply	Fossil Fuel + CCS	Hydrogen Cost ¥30/Nm ³ by 2030 ¥20/Nm ³ in future	Early 2020s	<ul style="list-style-type: none"> Production: Production cost from brown coal gasification (¥several hundred/Nm³ → ¥12/Nm³) Storage/Transport : Scale-up of Liquefied hydrogen tank (thousands m³ → 50,000m³) Higher efficiency of Liquefaction (13.6kWh/kg → 6kWh/kg) 	<ul style="list-style-type: none"> Scaling-up and improving efficiency of brown coal gasifier Scaling-up and improving thermal insulation properties
	Green H ₂	System cost of water electrolysis ¥50,000/kW in future	2030	<ul style="list-style-type: none"> Cost of electrolyzer (¥200,000m/kW → ¥50,000/kW) Efficiency of water electrolysis (5kWh/Nm³ → 4.3kWh/Nm³) 	<ul style="list-style-type: none"> Designated regions for public deployment demonstration tests utilizing the outcomes of the demonstration test in Namie, Fukushima Development of electrolyzer with higher efficiency and durability

※In addition, promote development of guidelines and technology development for expansion of hydrogen use in the field of FC trucks, ships and trains.

Source: Ministry of Economy, Trade and Industry

Action Plan (mobility) on the RM

		Target to achieve	Approach to achieving target
Hydrogen Use (Mobility)	FCV	<ul style="list-style-type: none"> ● 200k by FY2025, 800k by FY2030 ● Achieving a cost reduction of FCV to the level of HV around 2025 (Price difference ¥3m → ¥0.7m) ● Reducing cost of main elemental technologies around 2025 (Fuel cell system around ¥20k/kW→¥5k/kW Hydrogen storage system around ¥0.7m → ¥0.3m) <p>Expansion of vehicle types for volume zones in FY2025</p>	<ul style="list-style-type: none"> • Sharing technical information and problems in a cooperation area among stakeholders • Developing technology for <u>reducing the amount of platinum used.</u> • Developing technology for <u>reducing of amount of carbon fiber in hydrogen storage systems</u>
	HRS	<ul style="list-style-type: none"> ● 320 by FY2025, some 900 by FY2030 ● Making HRS independent by the second half of the 2020s ● Reduction of cost for construction and operation by FY2025 (construction cost ¥350m→¥200m, operation cost ¥34m/year→¥15m/year) ● Setting of cost target for each component (Compressor ¥90m→¥50m High pressure vessels ¥50m→¥10m) 	<ul style="list-style-type: none"> • <u>Thoroughly integrate promotion of regulatory reform and technological development.</u> (Realization of self-service HRS, use of inexpensive steel material etc.) • <u>Consideration for nation wide networking of HRS</u> • Extending opening hours • Increasing of the number of HRS with gasoline station/convenience store
	Bus	<ul style="list-style-type: none"> ● 1,200 FC buses by 2030 ● Expansion of regions where FC buses run ● Reducing FC bus's price by half (¥105m→¥52.5m) ● Independent FC bus by FY2030 	<ul style="list-style-type: none"> • Developing technology for enhancing the fuel efficiency and durability of such vehicles • <u>Expansion of types other than city buses</u> • <u>Promotion of deployment of HRS for FC buses</u>
	Forklift	<ul style="list-style-type: none"> ● 10k FC forklifts by 2030 ● Expansion to an overseas markets 	<ul style="list-style-type: none"> • <u>Versatile deployment of fuel cell units</u> • <u>Promotion of maintenance of simple and easy to operate filling equipment</u>

※In addition, promote development of guidelines and technology development for expansion of hydrogen use in the field of FC trucks, ships and train.

Source: Ministry of Economy, Trade and Industry

Current status of Fuel Cell application



RD&D: Scaling-up

FHER FUKUSHIMA
HYDROGEN
ENERGY
RESEARCH
FIELD

10MW Electrolysis PtG Demo



Related Activities: Maritime application



"Raicyo (Ptarmigan) N"
 Tokyo University of Marine Science and Technology
 Gross tonnage: 9.1 tons
 The length of the ship: 12.60 meters
 Maximum speed at full load: 11 knots
 Fuel cell: PEFC 7 kW (3.5 kW x 2)
 Battery: Lithium ion 145 kWh (13.2 kWh x 11 pack)
 Propulsion motor: 90 kW (45 kW x 2)

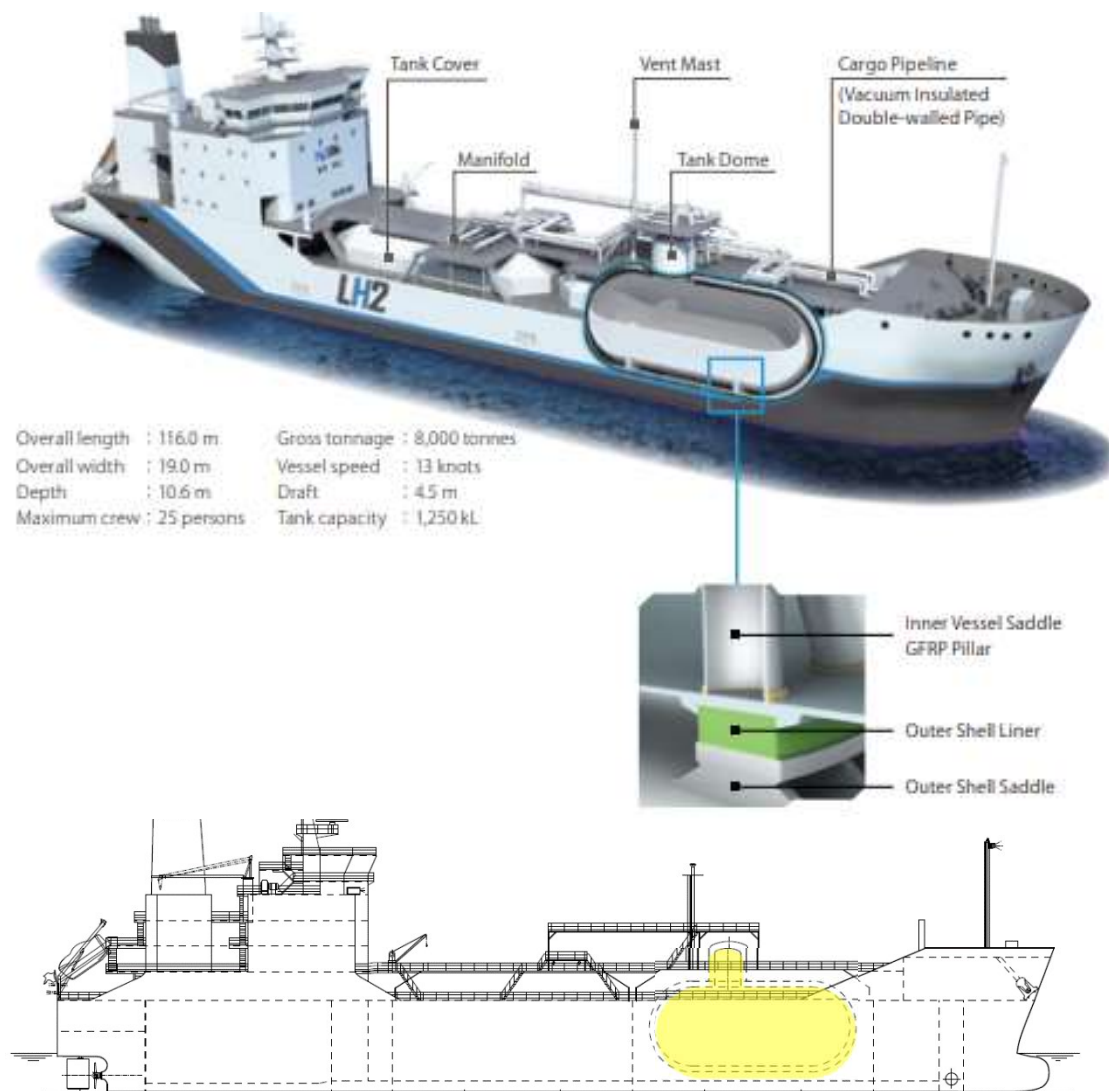
Source: Tokyo University of Marine Science and Technology



"PHEB-3" Osaka City University
 Gross tonnage: 2.6 tons
 The length of the ship: 9.6 meters
 Rated speed: 8 knots
 Battery: 24kWh (96V) 、 2.4kWh (24V) 、
 1.2kWh (12V)
 Propulsion motor: 12 kW (6 kW x 2)

Source: Osaka City University

Related Activities: Transportation

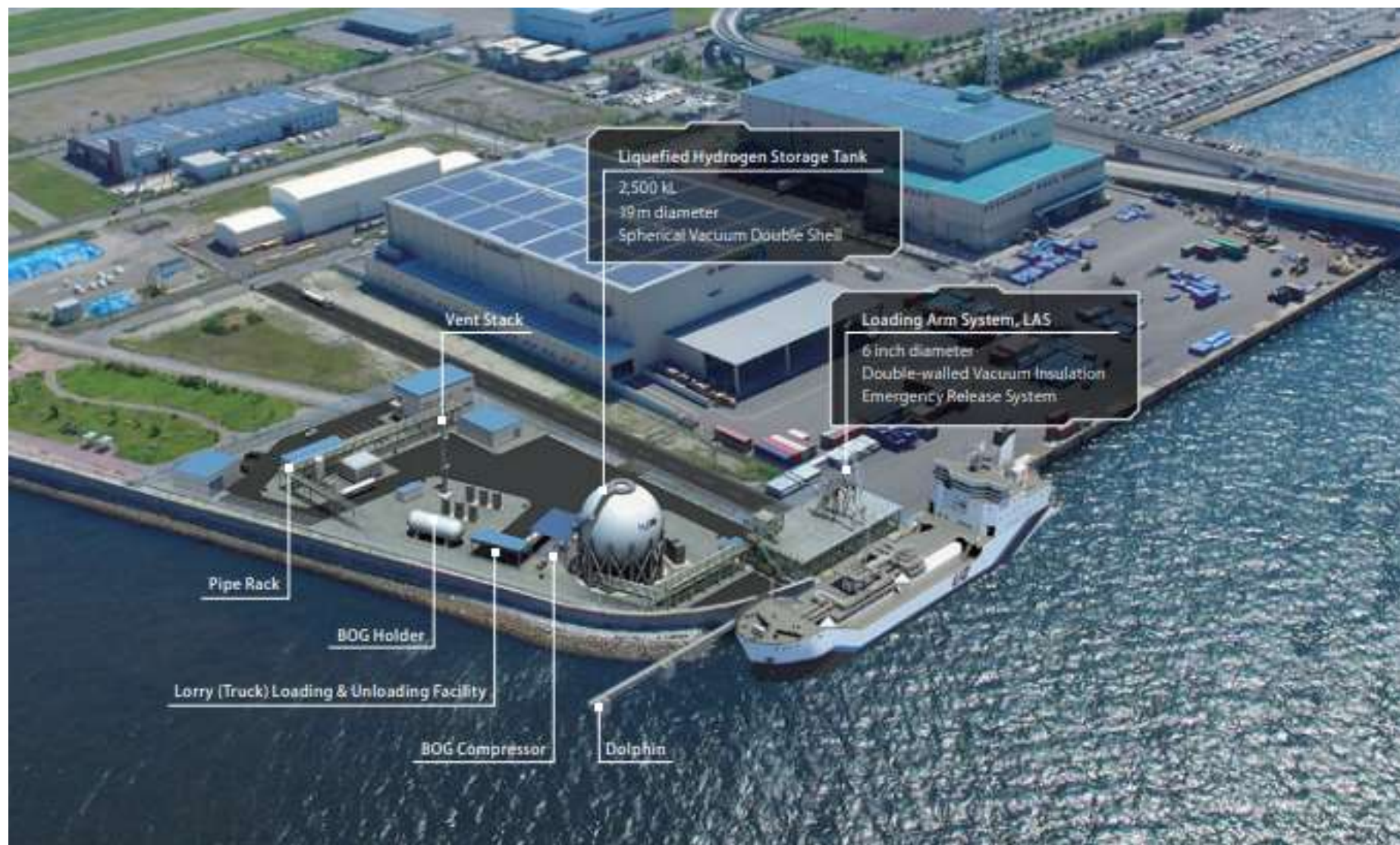


Hydrogen Storage:

- 1,250m³ x 1 / 75t-H₂
- vacuum insulated double-walled structure
- Boil off rate: 0.1 vol %

Source: CO₂-free Hydrogen Energy Supply-chain Technology Research Association (HySTRA)

Related Activities : Transportation



Source: CO₂-free Hydrogen Energy Supply-chain Technology Research Association (HySTRA)

Related Activities: @port



Total operation hours: 699 hours

- with hydrogen: 444 hours
 - Hydrogen only: 49 hours
 - H2/NG: 395 hours
- NG only: 255 hours

H2 Consumption: 179,000 Nm³ (16t)

Total Power Generation: 822 MWh

Total Steam Distribution: 547 t

Estimated CO₂ reduction: 109t

Source: KHI, Obayashi



Related Activities: @port



Concept of FC towing tractor



reddot award 2017
winner



Item		Spec
Output	Rated	8kW
	Peak	32kW
H ₂ Refueling		35MPa, 1kg (3min)
Working time		8hours
Price: JPY 13,400,000- (US\$ 127K)		

Source: Toyota Industries Corporation



Thank you!