Energy Transition and Japan's Strategy for Hydrogen Society

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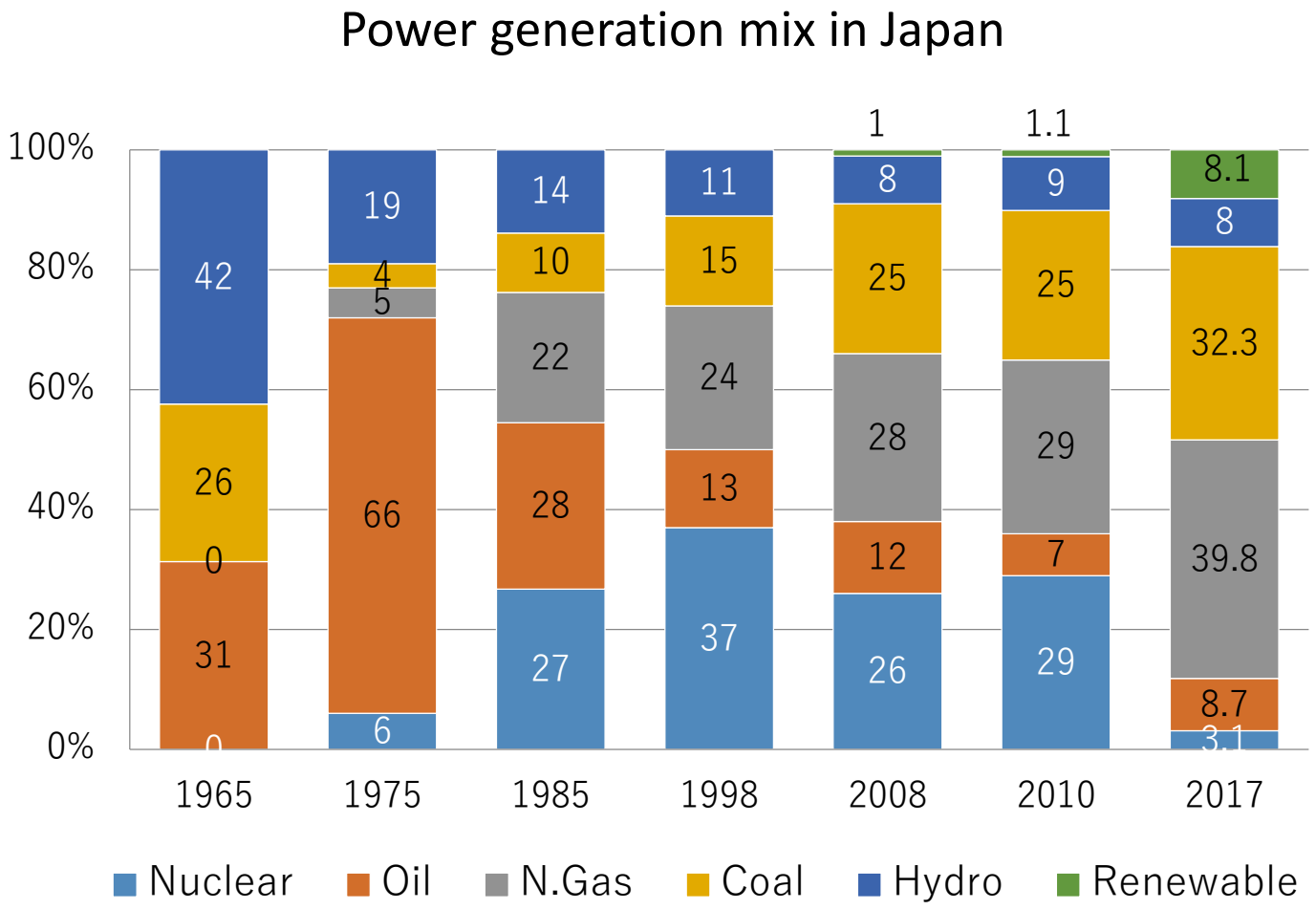
19 February, 2020 @International Symposium on CCUS and H2

Ongoing Energy Transition in Japan



Expansion of RE introduction in Japan

(GW)

	2012 (June)	2019 (March)	Introduced + Approved (2019 March)	2030 Target
	Before FIT	7yrs from FIT		
PV	5.6	48.7	82.3	64
Wind	2.6	3.7	10.8	10
Small Hydro	9.6	9.7	9.9	11.0 – 11.7
Biomass	2.3	3.8	11.3	6.0 -7.8
Geothermal	0.5	0.5	0.6	1.4 – 1.6
Total	20.6	66.4	114.9	92.4 – 94.5

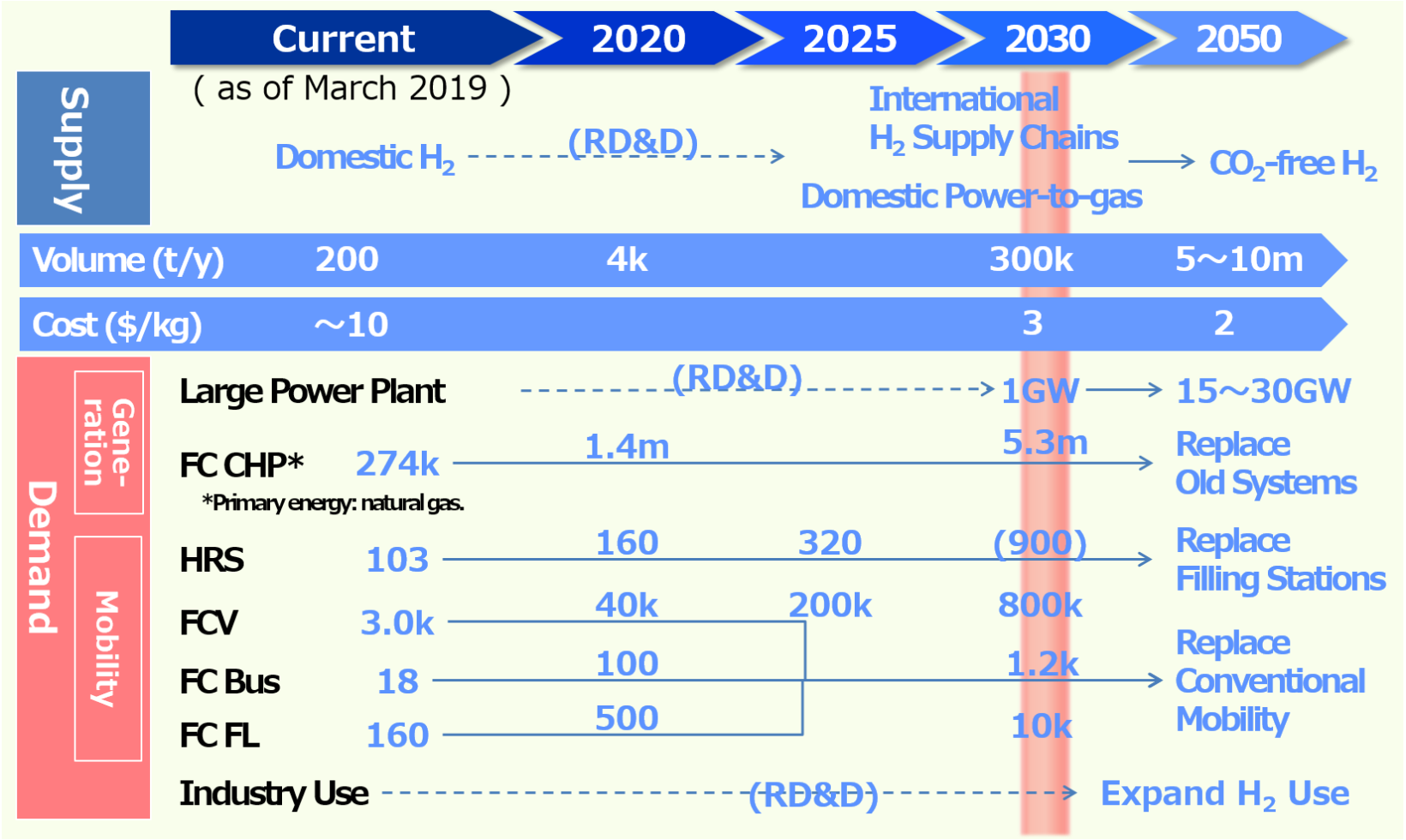
(Source：Calculated from METI announcement)

National Hydrogen Strategy

"Basic Hydrogen Strategy" (Prime Minister's Initiative)

- ✓ **World's first national strategy**
- ✓ **2050 Vision: position H_2 as a new energy option** (following Renewables)
- ✓ **Target: make H_2 affordable** ($3/kg by 2030 ⇒ $2/kg by 2050)

Scenarios on Hydrogen Basic Strategy



NEDO R&D Program (1)

1. Fuel Cells:

(1) PEFC: for mobility

- Target: 0.03-0.1 g-PGM/kW (depend on durability), 50,000 hrs. life time (commercial vehicle), Power Density:> 4kW/L (in 2030)

(2) SOFC: for stationary use

- Complete co-generation model (> 50%) by 2017
- New target: >60% efficiency (mono-generation)

2. Hydrogen Refueling Station:

Reducing CAPEX / OPEX

- To address regulatory reform on FCV/HRS in Japan
  ex. Unmanned operation with remote monitoring, Risk assessment on HRS, etc.
- Developing low cost equipment (incl. polymer materials, Electro-chemical compressor, etc.)

NEDO R&D Program (2)

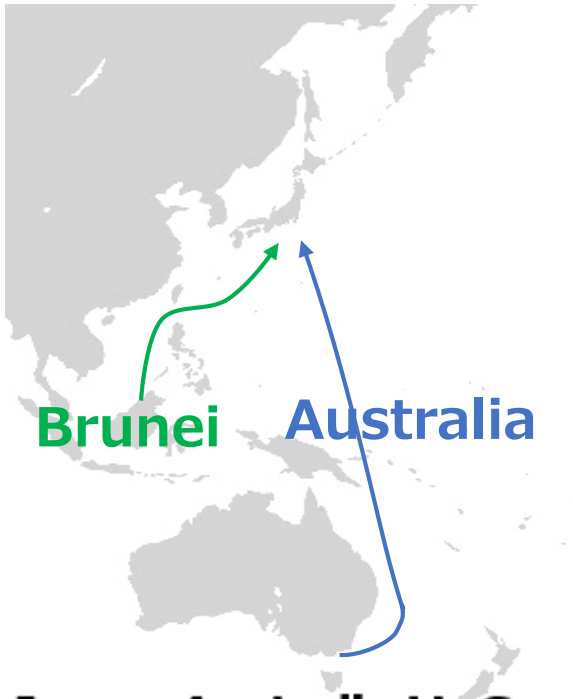
3. Hydrogen Supply Chain / Gas Turbine:

- Developing combustor for Hydrogen Gas Turbine
  Control of combustion for low NOx, back fire, etc.
- Realizing large scale hydrogen supply chain
  Hydrogen carriers for long distance transportation

4. Power to Gas:

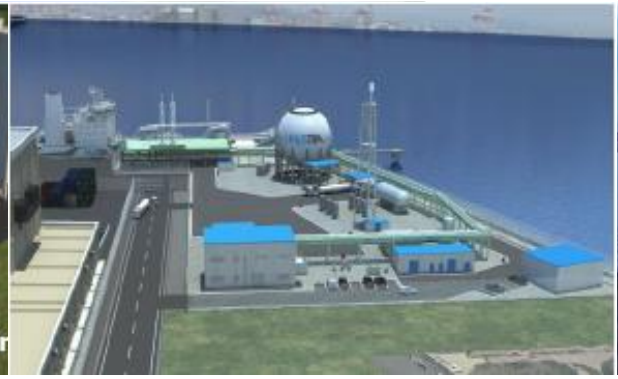
- Developing System Technology
  Operation, Energy management, for demand response
- Improving electrolysis technology
  Analyzing reaction mechanism, develop lifetime evaluation, etc.
  (Alkaline, PEM, SOEC)

Overseas H2 Supply Chain Demonstration Projects



Japan-Brunei H_2 Supply Chain Project

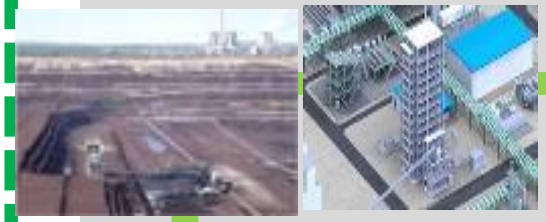
Japan-Australia H_2 Supply Chain Project



Liquefied H2 Supply Chain Demonstration Project

Latrobe Valley

Gasification Facilities



Australia

Gas treatment

CCS (Carbon Net)

Transport

Hastings

H2 Liquefaction, Handling terminal

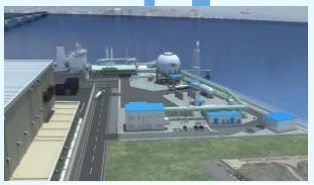
LH2 Cargo Ship Carrying : 75t-H2

9000km 16days

Pre-Test site @Kita-Kyushu

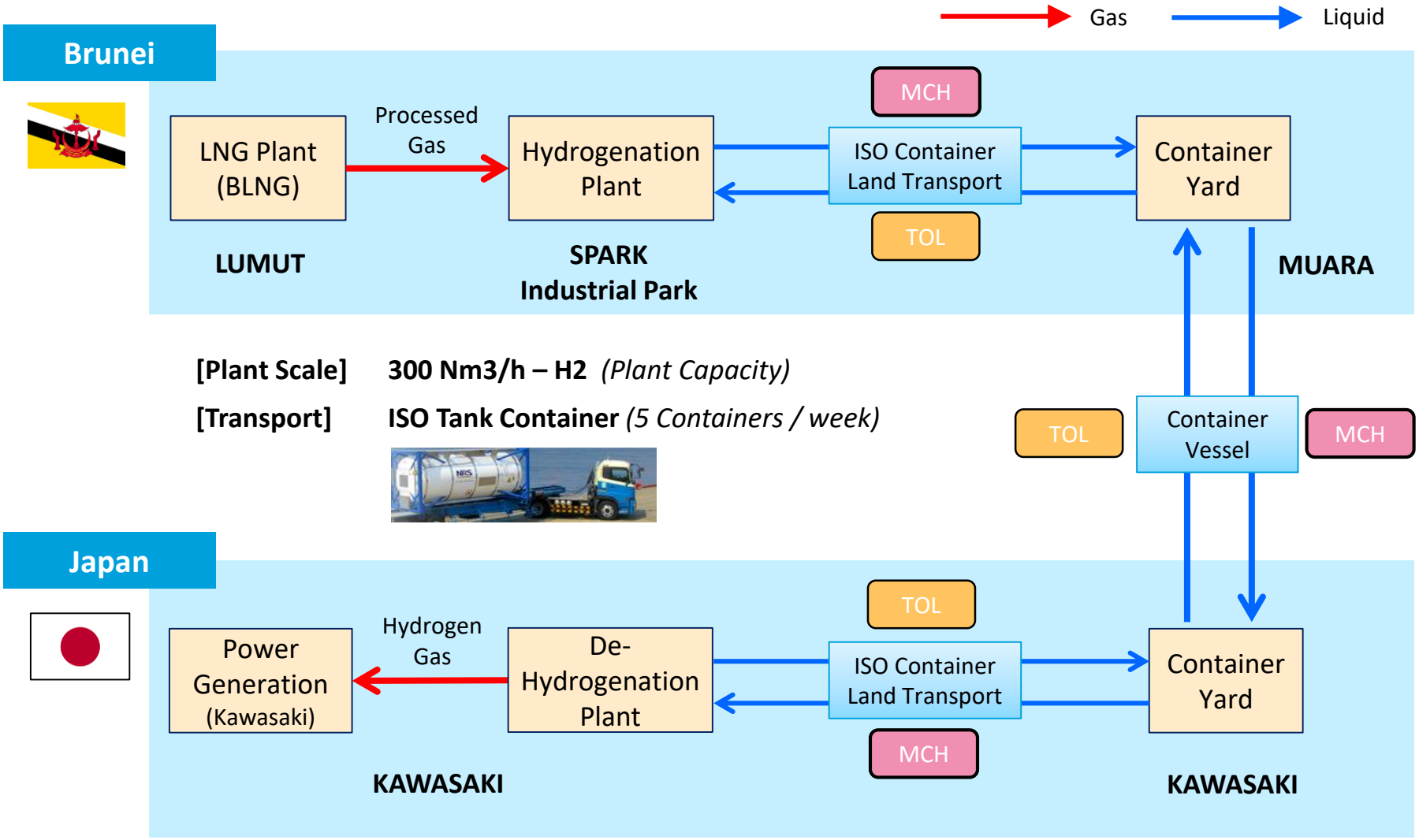
NEDO

LH2 Terminal Storage : 150t-H2 (2,500m3)



Kobe Air Port Ialand

The Organic Chemical Hydride Supply Chain Demonstration Project



MCH : Methyl cyclohexane, TOL : Toluene

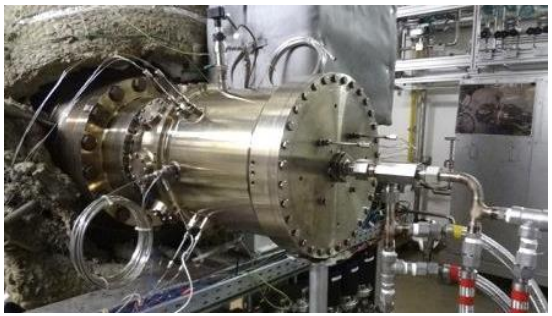
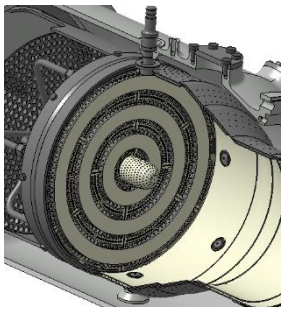
Integration with Renewable Energy Sources

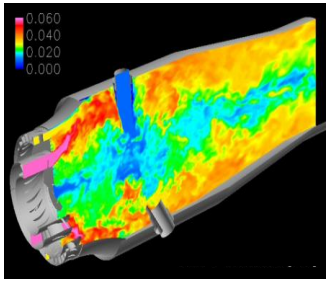
Fukushima (w/ 10MW Alkaline Electrolysis)

Item	Specification
Function	(1) Manufacturing・Storage・Supply of hydrogen (2) Balancing the supply and demand of the electricity grid
Annual manufacturing capability of hydrogen (Rated output)	900t-H2／year
Input power of electrolyzer	(Max.) 10MW (Rated) 6MW (Range) 1.5MW ～ 10MW

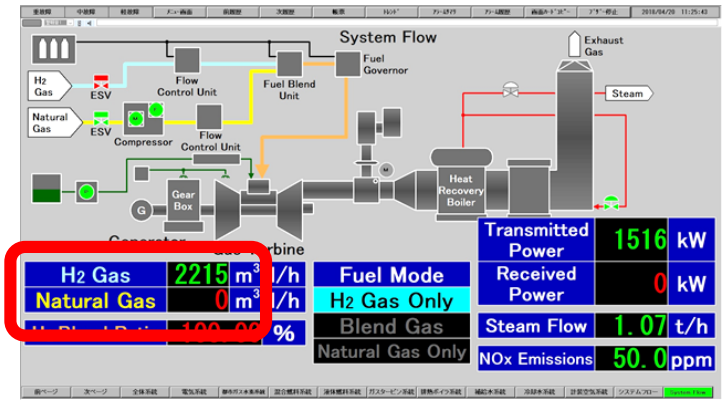
H2 fueled Gas Turbine

Developing combustor for H_2 Gas Turbine



Demonstration Project / H_2 Gas Turbine providing heat & power

Conclusion

- Energy transition is ongoing in Japan. Renewable is expanding beyond the target while nuclear still remains low.

- Expansion of VRE requires higher level of flexibility in grid management. Short of nuclear may require cleaner fuel in thermal power generation. H2 could be a solution for both challenges.

- R&D efforts are ongoing in order to realize ”Hydrogen Society“ including H2 gas turbine. Two major challenges are reducing H2 cost and expanding applications that generate hydrogen demand.