The 4th Government-Private Forum on the Cleaner Energy Future Initiative for ASEAN (CEFIA)

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Development of Clean Ammonia Value Chain

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IHI Corporation

IHI, Company Profile

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Year of establishment
1853

Capital
107.1 billion yen

Revenue(Consolidated)
1,172.9 billion yen
(fiscal 2021)

Number of employees (consolidated)
28,801

Works
7

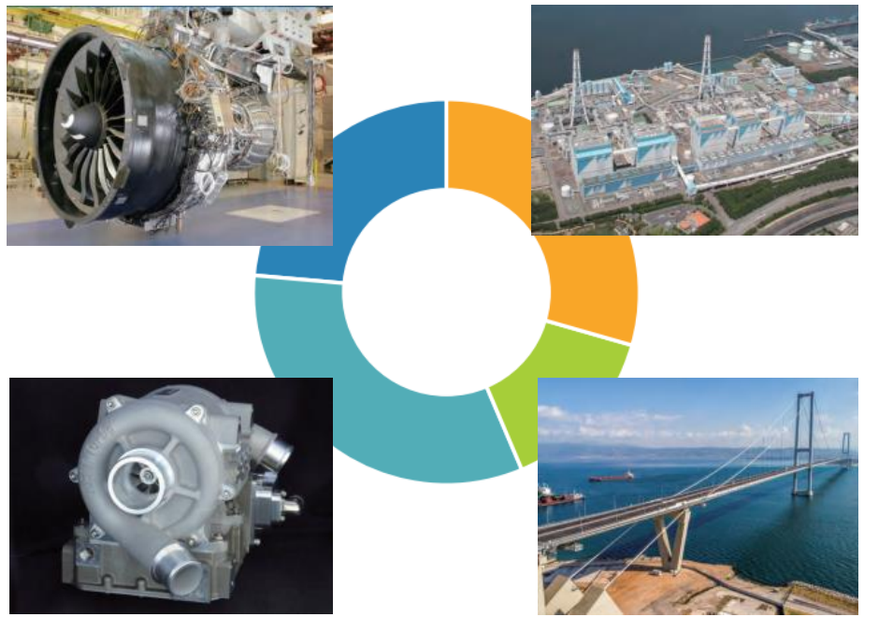
Branches in Japan
8

Overseas representative offices
14

Affiliated companies in Japan
59
[Subsidiaries: 43 Affiliates: 16]

Overseas affiliates
142
[Subsidiaries: 120 Affiliates: 22]

Revenue Compostitions by business areas (Consolidated/fiscal 2021)



Resources, Energy & Environment	29%
Social Infrastructure & Offshore Facilities	14%
Industrial Systems & General-Purpose Machinery	32%
Aero Engine, Space & Defense	23%

Note : The total may not be 100% owing to the exclusion of "Other" and "Adjustments".

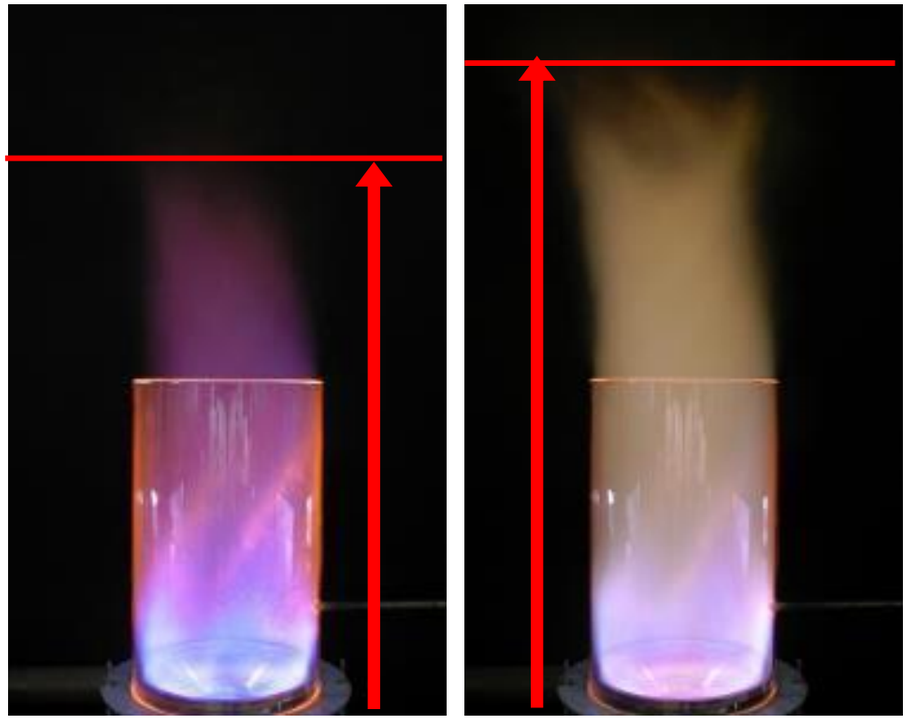
What and Why Ammonia ?

Current Use of Ammonia

- Global Annual consumption is over 200Mt

Ammonia as a fuel

- Lower Flame Speed
- NOx Generation



Natural gas **Co-firing with NH_3**

Ammonia as an energy carrier

- Largest Volumetric Energy Density
  = Suitable for Large scale Sea Transportation

	LNG	NH3	Liq. H2	MCH
Tank Capacity Ratio	Base	**1.8**	2.6	4.0
LHV: Low Heat Value [MJ/kg]	48.0	18.6	120	120
SG: Specific Gravity [t/m3]	0.45	0.68	0.07	0.77 H2;6.2%
Energy Density (LHV x SG)	22.5	12.6	8.4	5.7
Tank Material	SUS (9%Ni)	**C/S** (SLA325A)	SUS	C/S
Boiling Point @1atm [℃]	-162	-33	-253	101
Storage Period	14 Days	**Long Term**	7 Days	Long Term
Others	-	Toxic (High)	Embrittlement Risk	Toxic (Low)

Japan's challenge to achieve carbon neutrality in 2050

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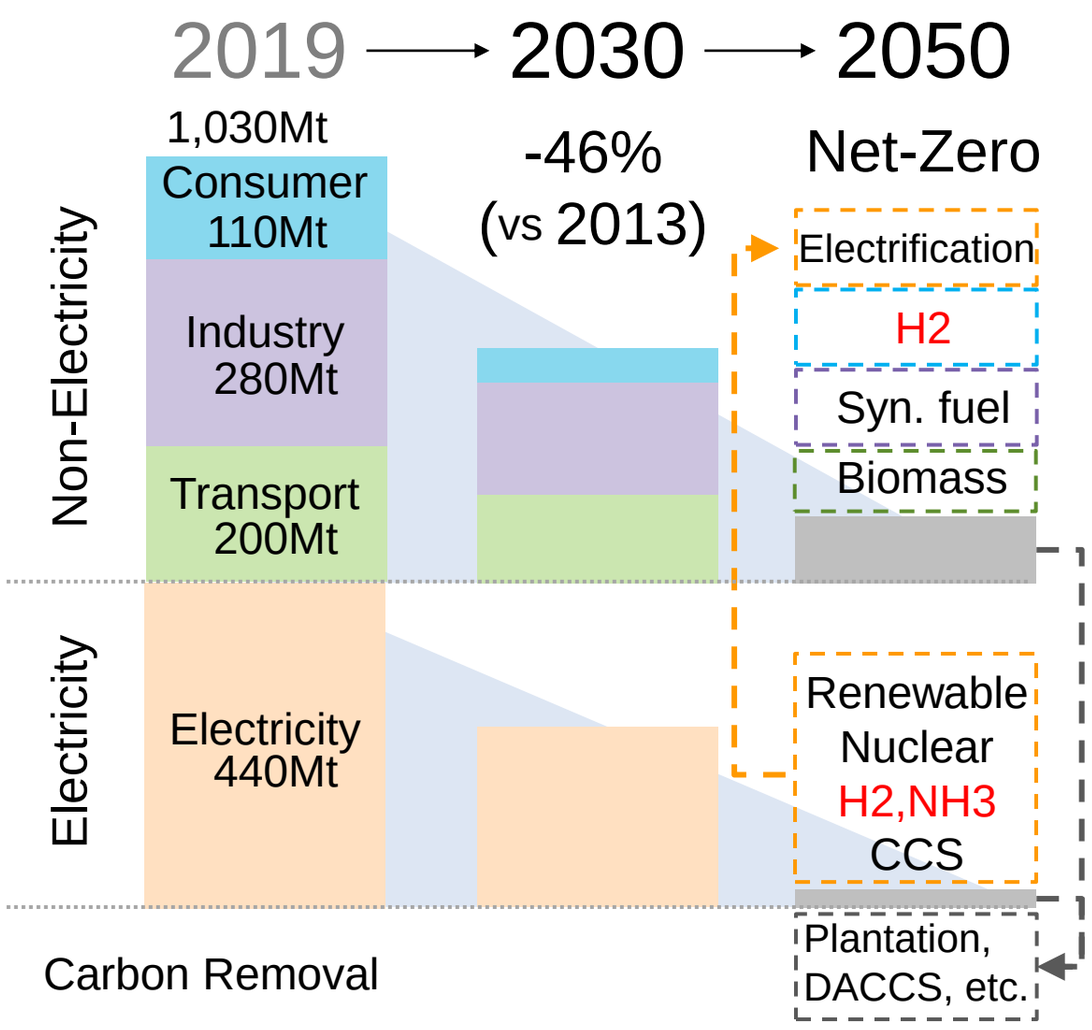
Milestone and Major Actions



Estimated Demand of Fuel Ammonia

- 3 mil ton in 2030, 30 mil ton in 2050

Support of Japanese Government

- Private-Public Investment
  \150T ($1.15T) in Next 10 years
  \20T ($154B) of green transition bond
  \300B($2.3B) for H2 & NH3 in 2030

- Support is for
  Investment in CAPEX of use
  Investment in CAPEX for Supply chain
  Differentiation of Fuel Price

Acceleration to build supply chains, expansion and commercialization

Building Fuel Ammonia Businesses Through New Value Chains

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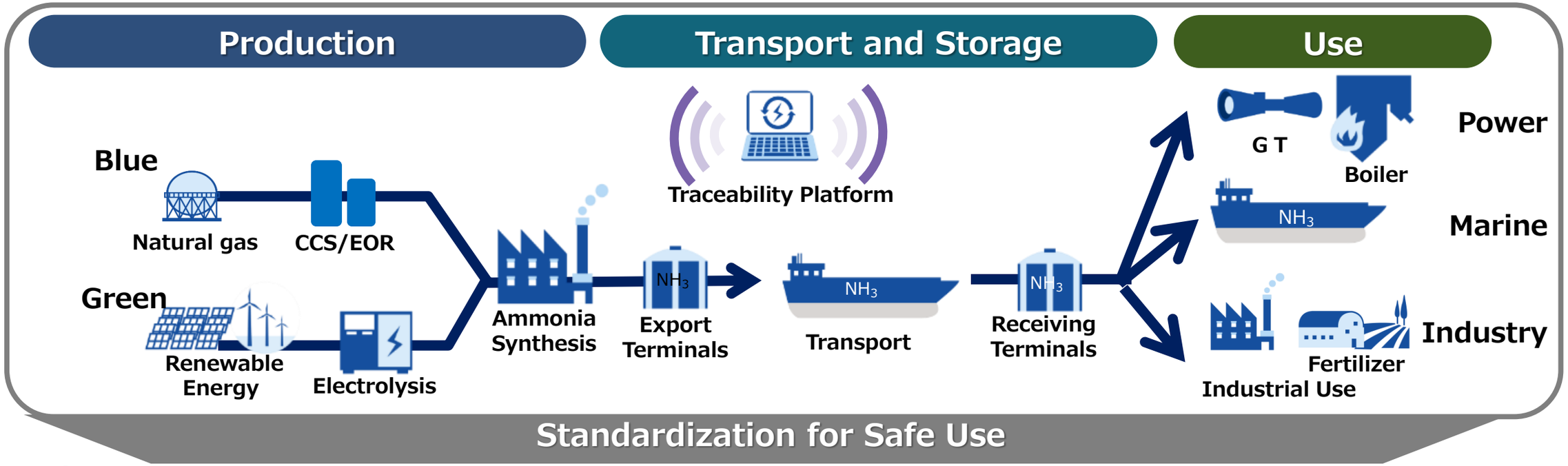
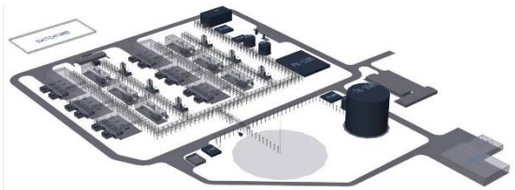


➢ IHI's ongoing activities

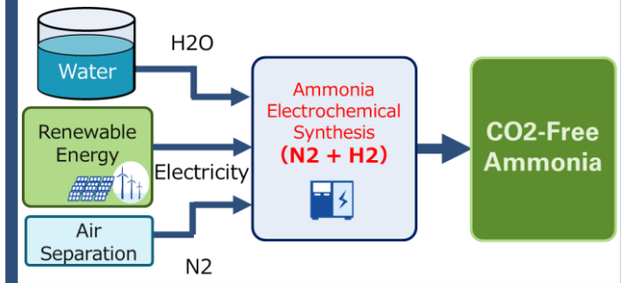
Business Investment

Green Ammonia Production



Next Gen Technology

Direct Synthesis



Receiving Terminal

Retrofit

Offshore FSRB

Use

IHI's activity to create Ammonia Value Chain in Southeast Asia

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➢ Collaborating Around the World to Deploy Fuel Ammonia

Malaysia

Feasibility Study:
JCM Scheme
Feasibility Study:
Decarbonizing the Power Sector

Singapore

Feasibility Study:
Ammonia-fueled GT and Existing Infrastructure conversion

Indonesia

Pilot Operation
Southeast Asia's First Ammonia Co-Firing in the Existing Boiler.

Feasibility Study
Co-firing and mono-firing ammonia, biomass, and other fuels in Boiler.

Production **Use**

Cost effective and faster installation of Fuel Ammonia

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Transport and Storage

- An A-FSRB offers the advantages of **shorter construction time and lower costs** and is expected to **speed up the adoption of fuel ammonia**

- Converting LNG facilities should drive ammonia uptake by **slashing costs and ensuring effective land usage**.

Cost effective and faster installation of Fuel Ammonia

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Use

➢ IHI is accelerating the conversion of thermal power plants to zero CO_2 emissions

- Retrofit of Ammonia firing

GT

2027:2MW

2030:-400MW

Image courtesy of GE

- Switching to GT

Boiler

2024:20%

2028 >50%

Goal
Zero carbon emission thermal PP

- Stepwise increase of co-firing ratio toward zero CO_2 emission

2025 → 2030 → 2040 → 2050

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