MHI Group Sustainability Initiatives & Carbon Neutrality

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Mitsubishi Heavy Industries, Ltd.

1. MHI Group and Vision for Carbon Neutrality

2. MHI Initiatives and Solutions for Energy Transition

Mitsubishi Heavy Industries Group at a Glance

1884 Foundation
over 130 years history

78,486 Employees
(Consolidated)

256 Group Companies
(Consolidated)

¥3.9TN ($35BN*) Revenue
(FY2021, consolidated)

Diverse **products**
On land, at sea, in the sky, in space

Note: The U.S. dollar revenue figure was converted from Japanese yen using the FY2021 average exchange rate, JPY 111.6/USD.


Gas turbines


Compressors


Aero engines


CO_2 capture plants


Metals machinery


Chemical plants


Transportation


Waste-to-energy


Turbochargers


Aerospace


Rocket engines


Defense

Various solutions in response to social challenges since 1884..

1880-

Building Japan's infrastructure

1884
Founding. Leased the government-owned Nagasaki Shipyard and started a shipbuilding business.

1950-

Contributing to Japan's rapid economic growth

1968
Built Japan's first container ship, the HAKONE MARU

1970-

Providing solutions to fuel diversity and energy efficiency globally

1985
Delivered the world's largest combined cycle power plant, Tohoku Electric Power Higashi Niigata Plant Unit 3, No. 2 Series (545 MW)

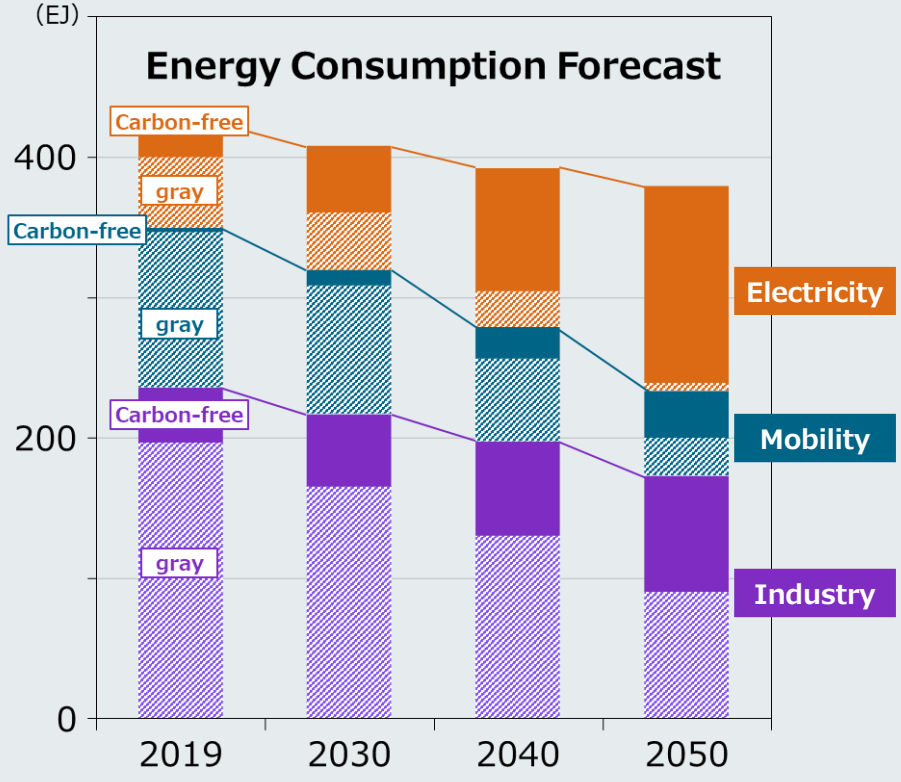
2010-

Leading a carbon-neutral world through technology

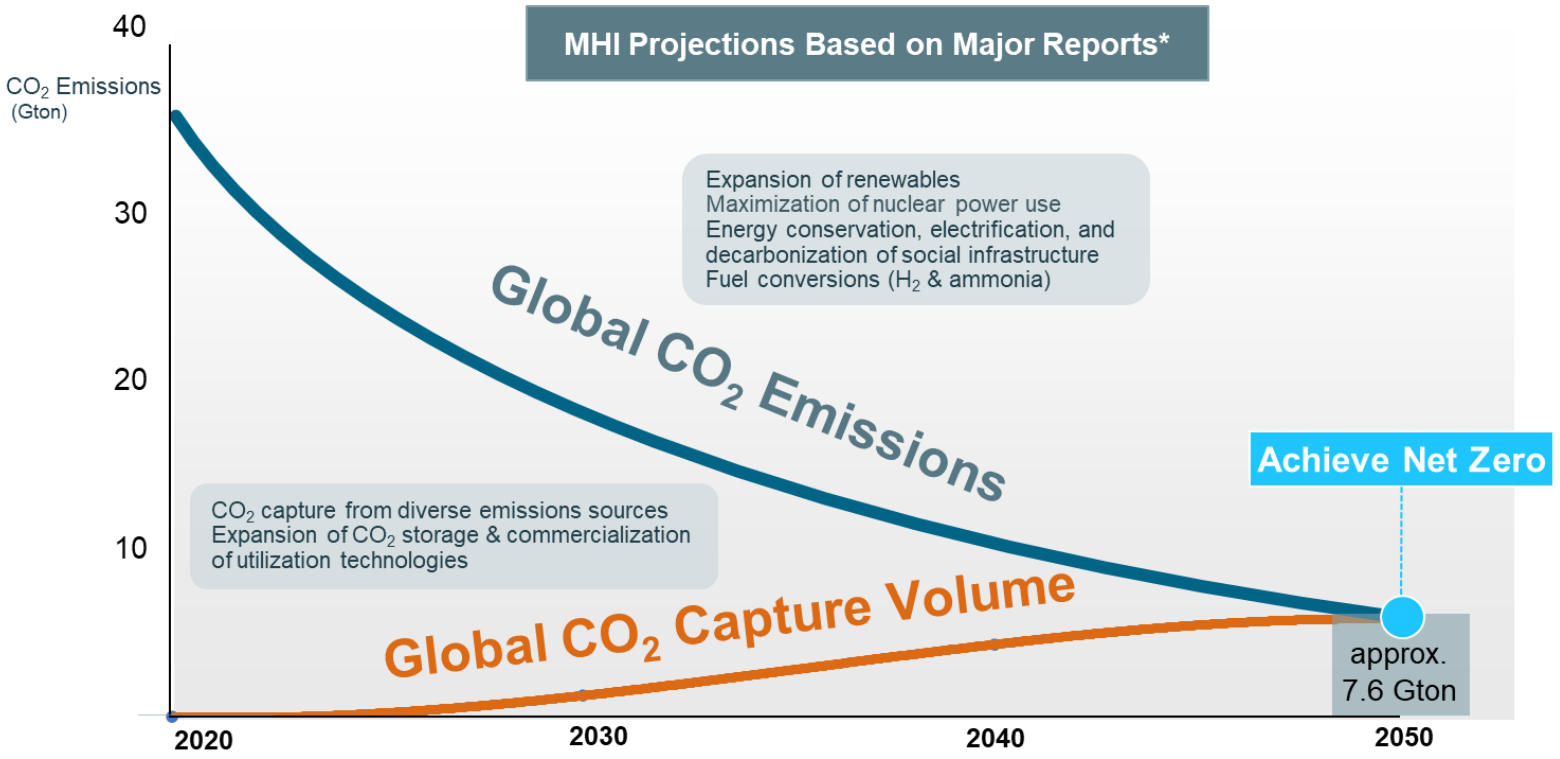
2020
World's most efficient power plant is synced to the grid and operating at full load, ahead of schedule
-- T-Point 2 validation facility features the enhanced JAC power train--

The Key in Sustainable Future – Energy Demand

Must Answer to Large Energy Demand..
Decarbonization Needs Acceleration..



IEA World Energy Outlook 2020 Sustainable Development Scenario,
IEA Energy Technology Perspective 2017/2020
EJ:exajoule : 10^{18}J



*Includes IEA Net Zero by 2050 and McKinsey 1.5C Scenario reports

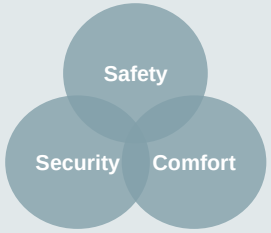
2040 Carbon Neutrality Declaration

Target Year	Reduce CO_2 emissions across MHI Group Scope 1&2	Reduce CO_2 emissions across MHI's value chain Scope 3 + reductions from CCUS
2030	-50% (compared to 2014)	-50% (compared to 2019)
2040	Net Zero	Net Zero

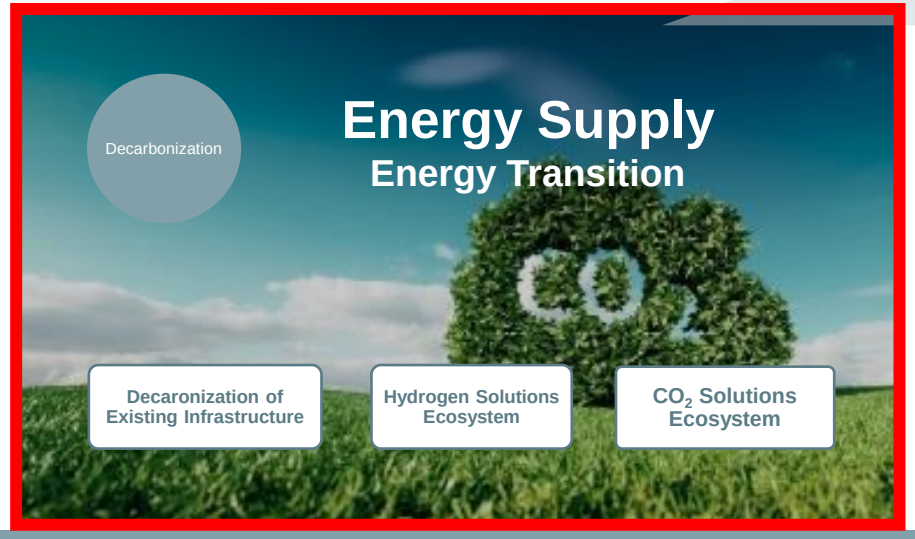
Scope 1&2: The calculation standard is based on the GHG Protocol.
Scope 3: The calculation standard is based on the GHG Protocol. However, we also account for reductions achieved by CCUS as an MHI original index.

*As CO_2 comprises 99% of MHI Group's GHG emissions, we have focused our targets solely on the reduction of CO_2 in order to simplify our message.

MHI Group will promote decarbonization of both energy supply side and energy use side.



Safe, secure, and comfortable society



Our Initiatives and solutions for Energy Transition

Build three innovative solutions ecosystems to realize “Mission Net Zero”

Decarbonize existing infrastructure

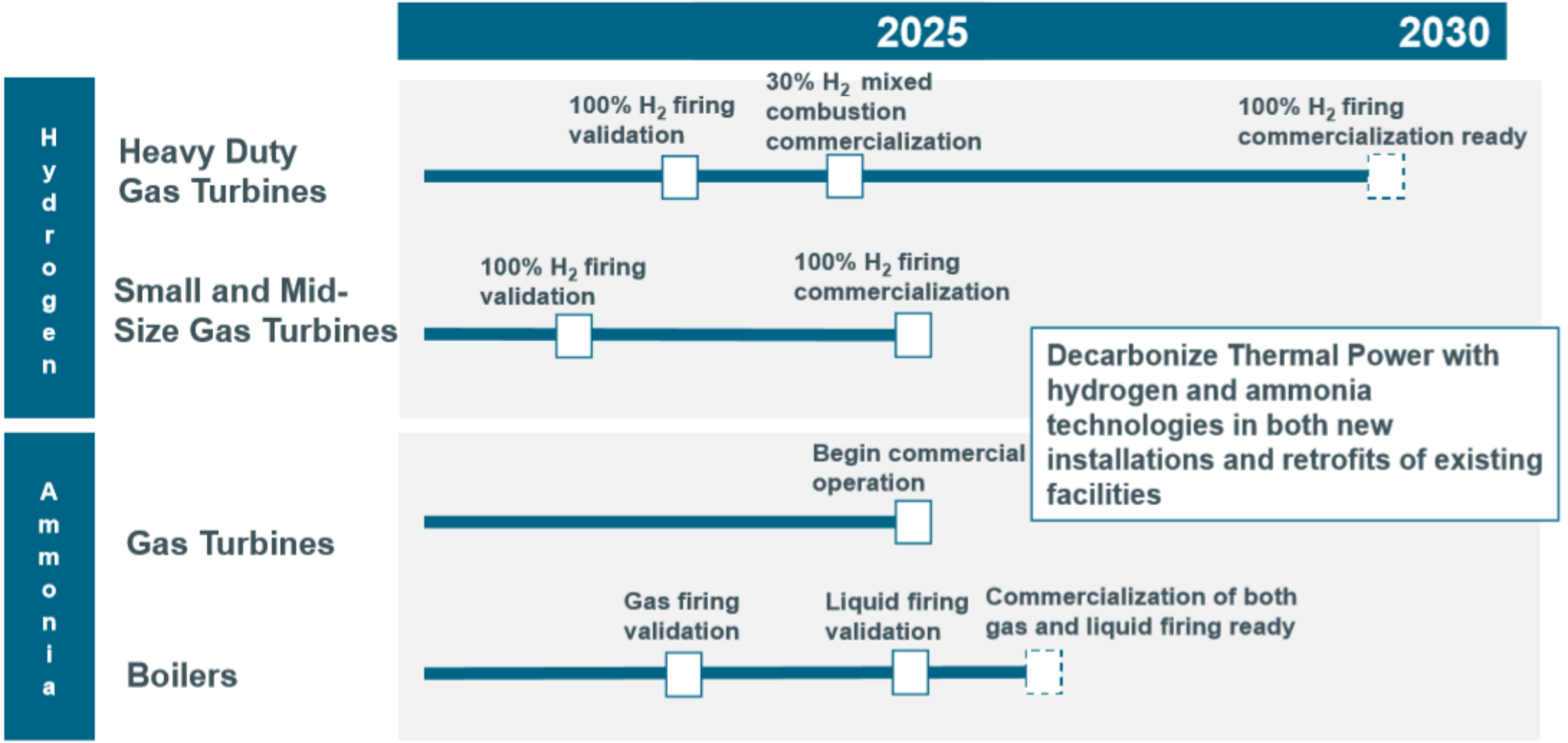
Build a hydrogen solutions ecosystem

Build a CO_2 solutions ecosystem

The Path to achieving Carbon Neutrality

Decarbonize existing Infrastructure : Thermal Power Generation

Validate and begin commercializing carbon-free power generation using hydrogen and ammonia by 2025

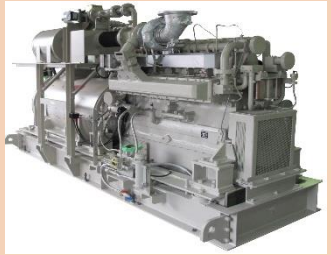


Decarbonize existing Infrastructure

Example of CO2 Reduction Solutions for Existing Facilities	Reduction Rate
Replace coal-fired thermal power plant with natural gas GTCC	-60% to -65%
30% mixed **hydrogen firing in GTCC/engine**	-10%
100% **hydrogen firing in GTCC/engine**	-100%
20% biomass/ammonia mixed firing in coal-fired thermal power plant	-20%
100% biomass/ammonia firing in coal-fired thermal power plant	-100%
Restart and extend operating life of **nuclear power plant** (replacement of fossil fuel power generation)	-100%
Replace engine forklift with electric forklift	-65%
Replace boiler with heat pump	-65%
Replace coal-fired boiler with **gas engine co-generation**	-50%

Hydrogen GTCC

Hydrogen Gas Engine



Next-Generation Light Water Reactor

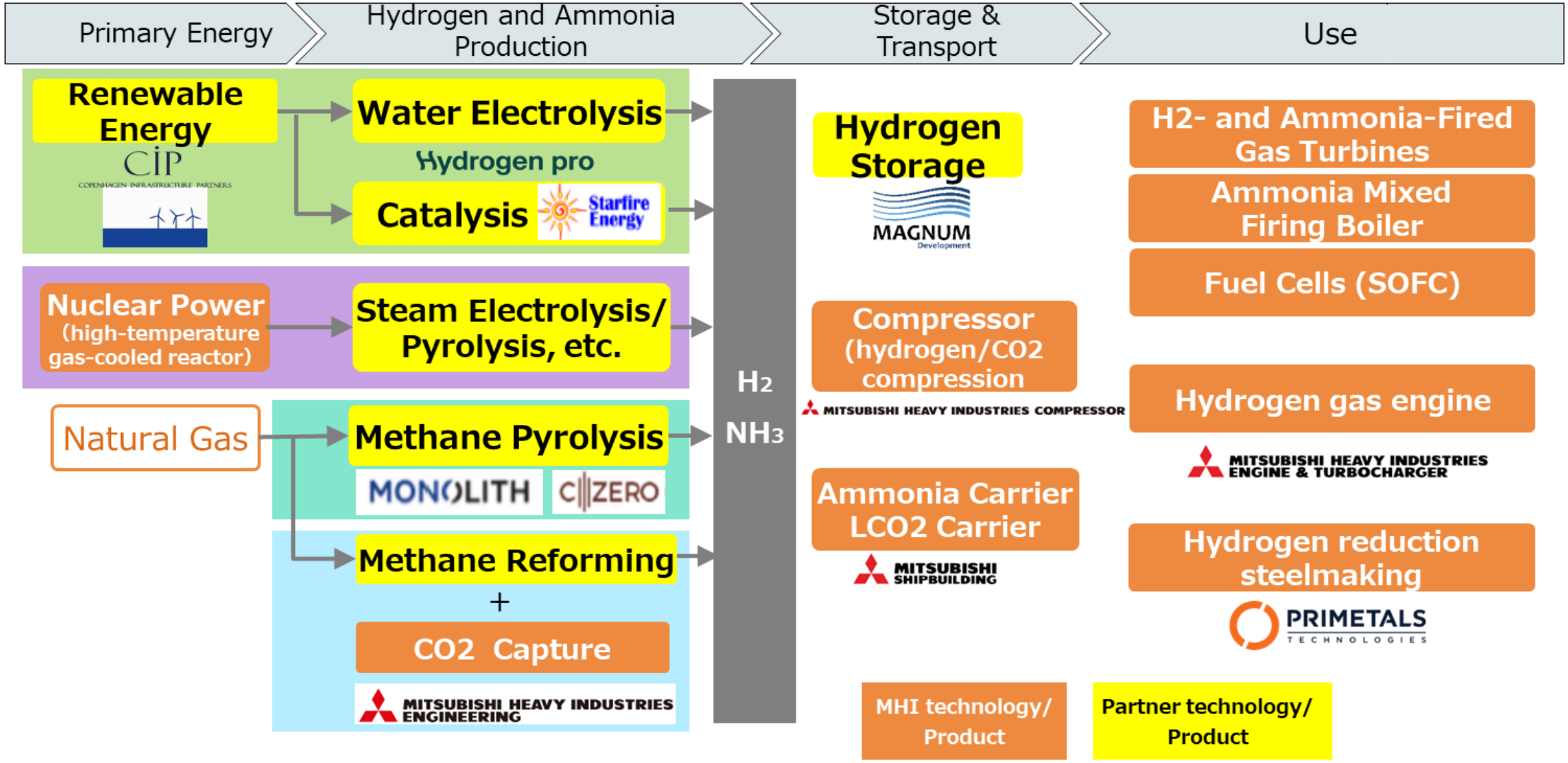
Small Modular Reactor (SMR)

Gas Engine co-generation

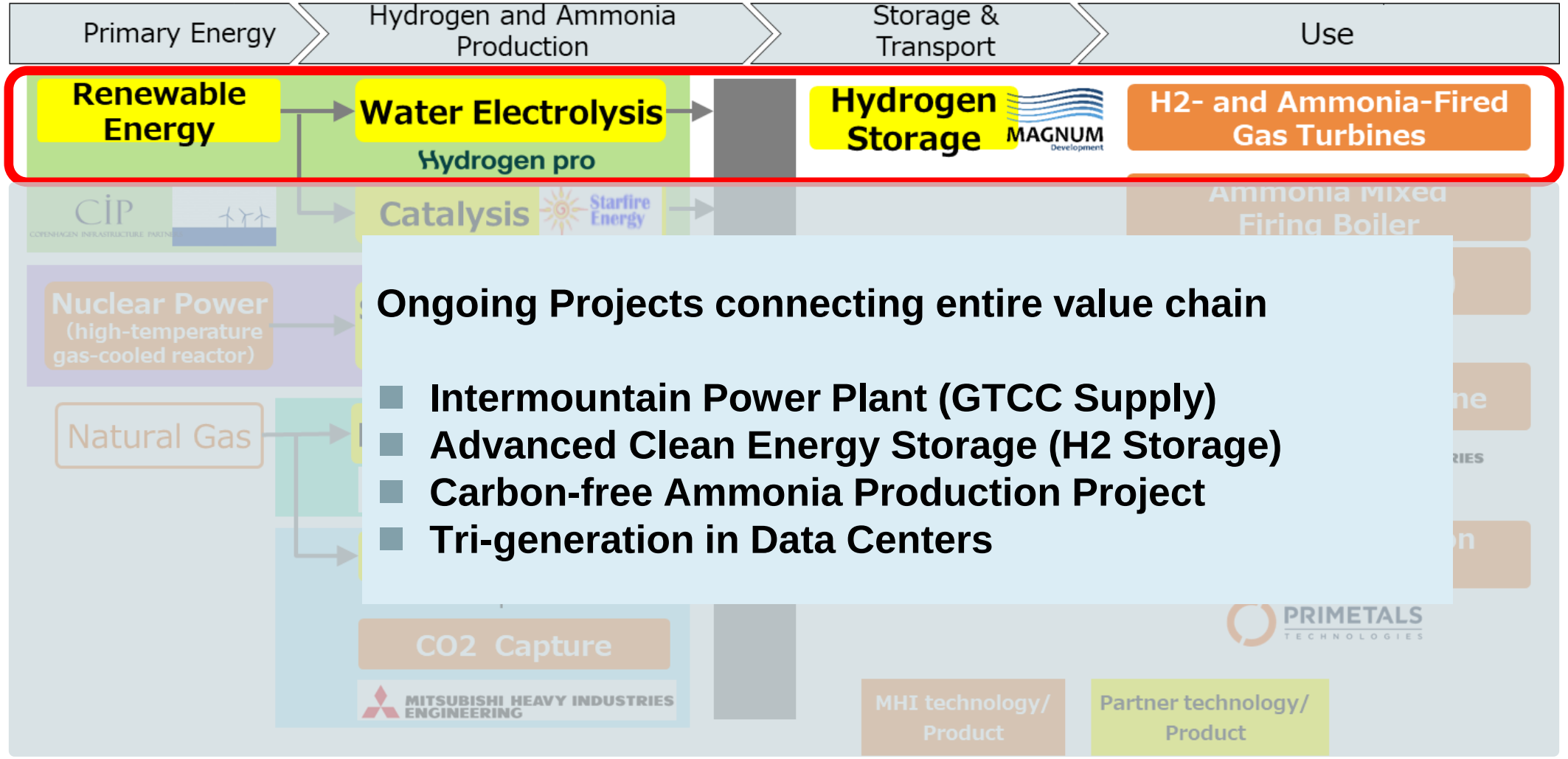
- Calculations are based on the GHG Protocol. However, emissions from our combined cycle demonstration plant (Takasago Machinery Works) and Nakoso and Hirono IGCC plants are included in Scope 3
- Main assumptions include reduction in electricity emissions in accordance with Japan's CO2 emissions reduction targets and some degree of hydrogen and CO2 solutions ecosystems development

The Path to achieving Carbon Neutrality

Expanding capability in entire value chain with strategic partnerships

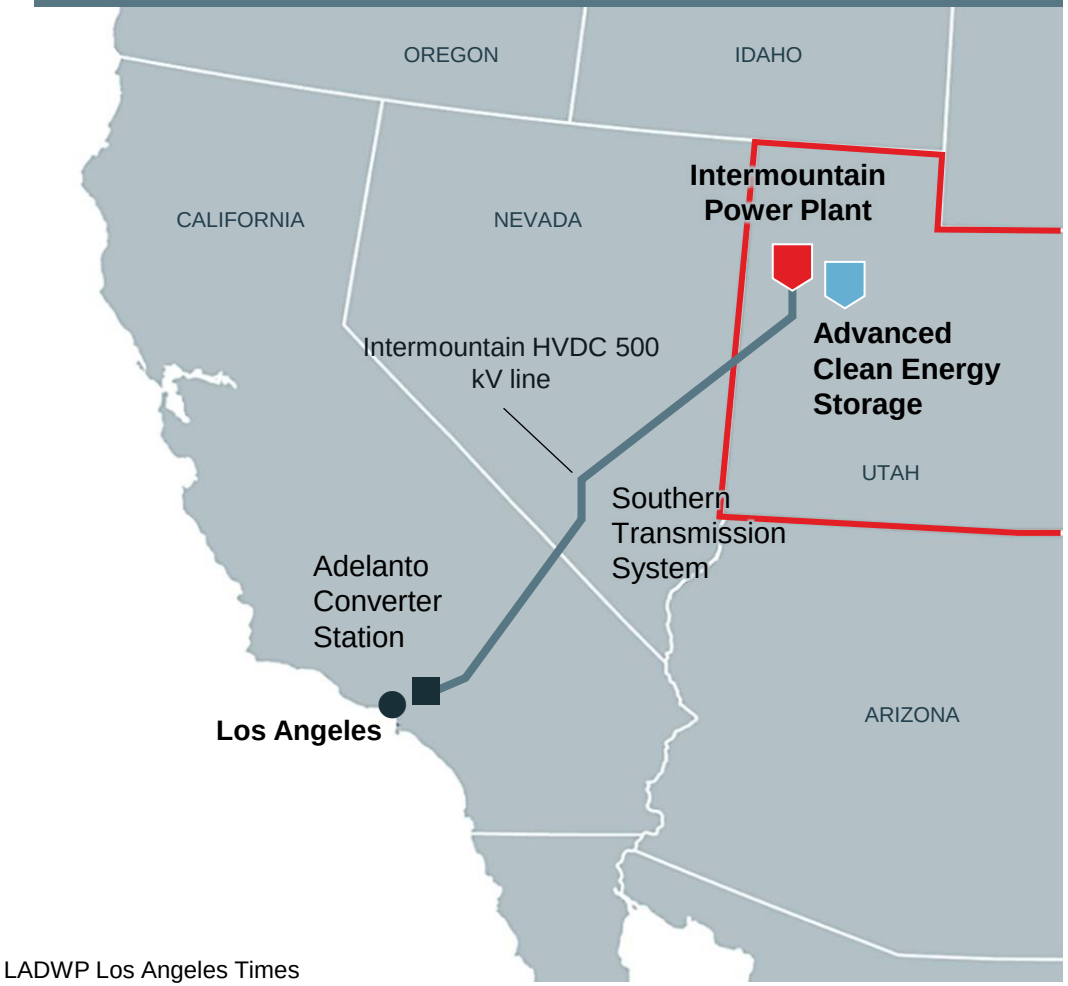


Expanding capability in entire value chain with strategic partnerships



Intermountain Power Plant

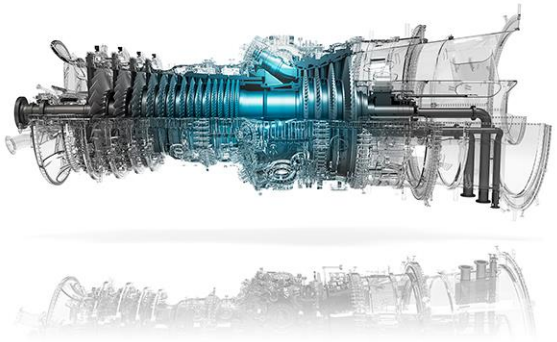
Location of Projects



Source: LADWP Los Angeles Times

Gas Turbine Model	**M501JAC**
Power Output	**840 MW (by 2 CCGT)**
Location	**Utah, USA**

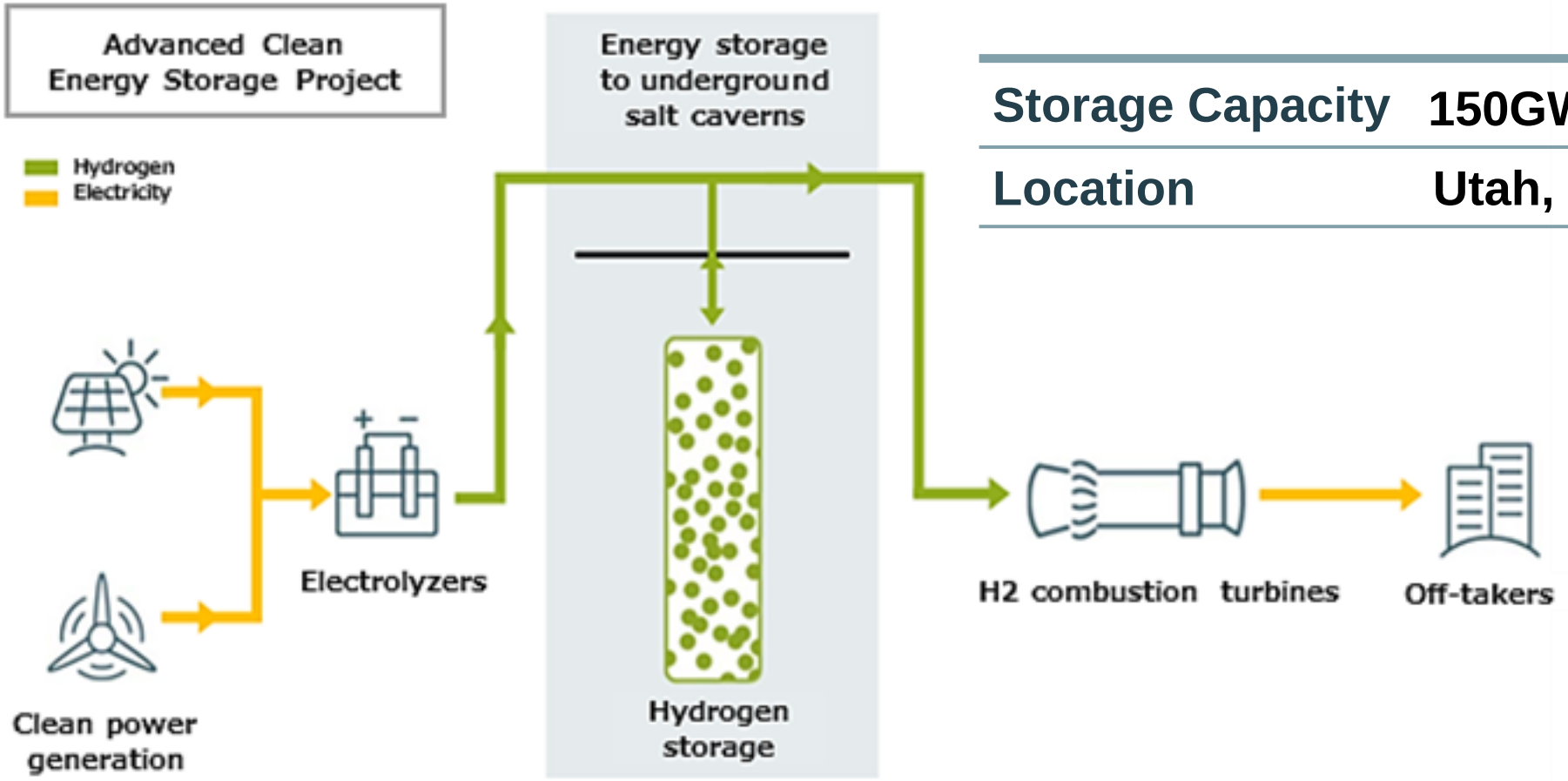
- 30% renewable hydrogen by 2025.
- 100% renewable hydrogen by 2045



Building a H2 Ecosystem – Establishment of H2 Energy Value chain

Advanced Clean Energy Storage (ACES) Project (US)

- **The Advanced Clean Energy Storage Project is the world's largest renewable energy storage project.**

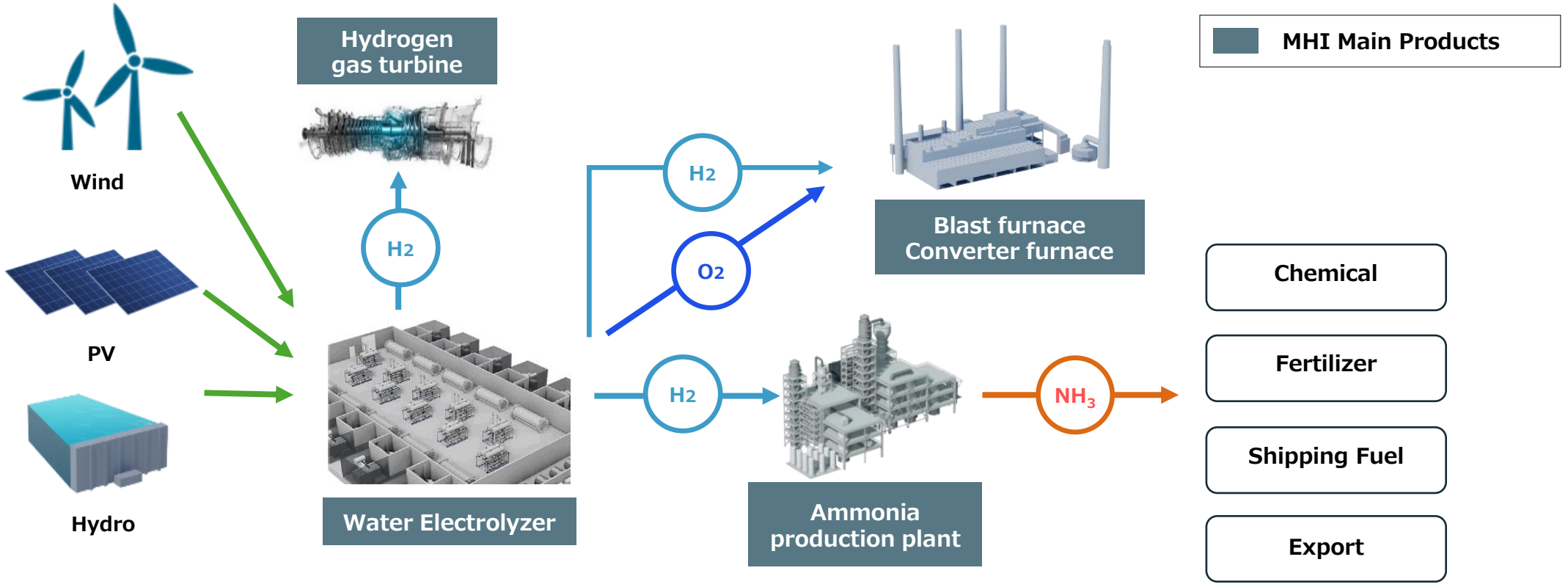


Storage Capacity	150GWh x 2
Location	Utah, USA

Building a H2 Ecosystem – Establishment of H2 Energy Value chain

Carbon-free Ammonia Production Project (Australia)

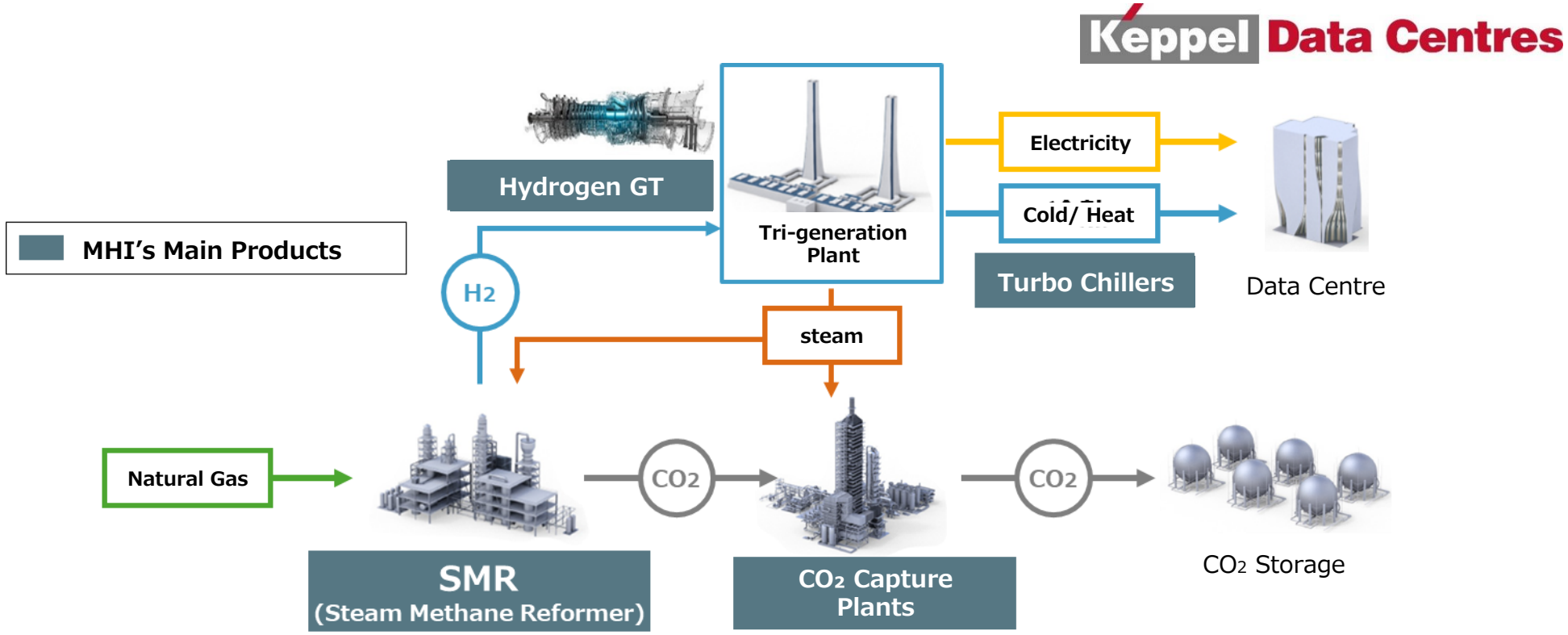
- Using abundant renewable energy to produce hydrogen and ammonia
- Contributing to regional steel industry and exporting carbon-free ammonia.



Building a H2 Ecosystem – Establishment of H2 Energy Value chain

Tri-generation in Data Centers (Singapore)

- **Supplying clean electricity, cooling/heat, and steam derived from carbon-free hydrogen for carbon neutrality of data centers**



Building a H2 Ecosystem – Takasago Hydrogen Park

One-Stop-Shop for validating Hydrogen-related technologies from Hydrogen production to power generation

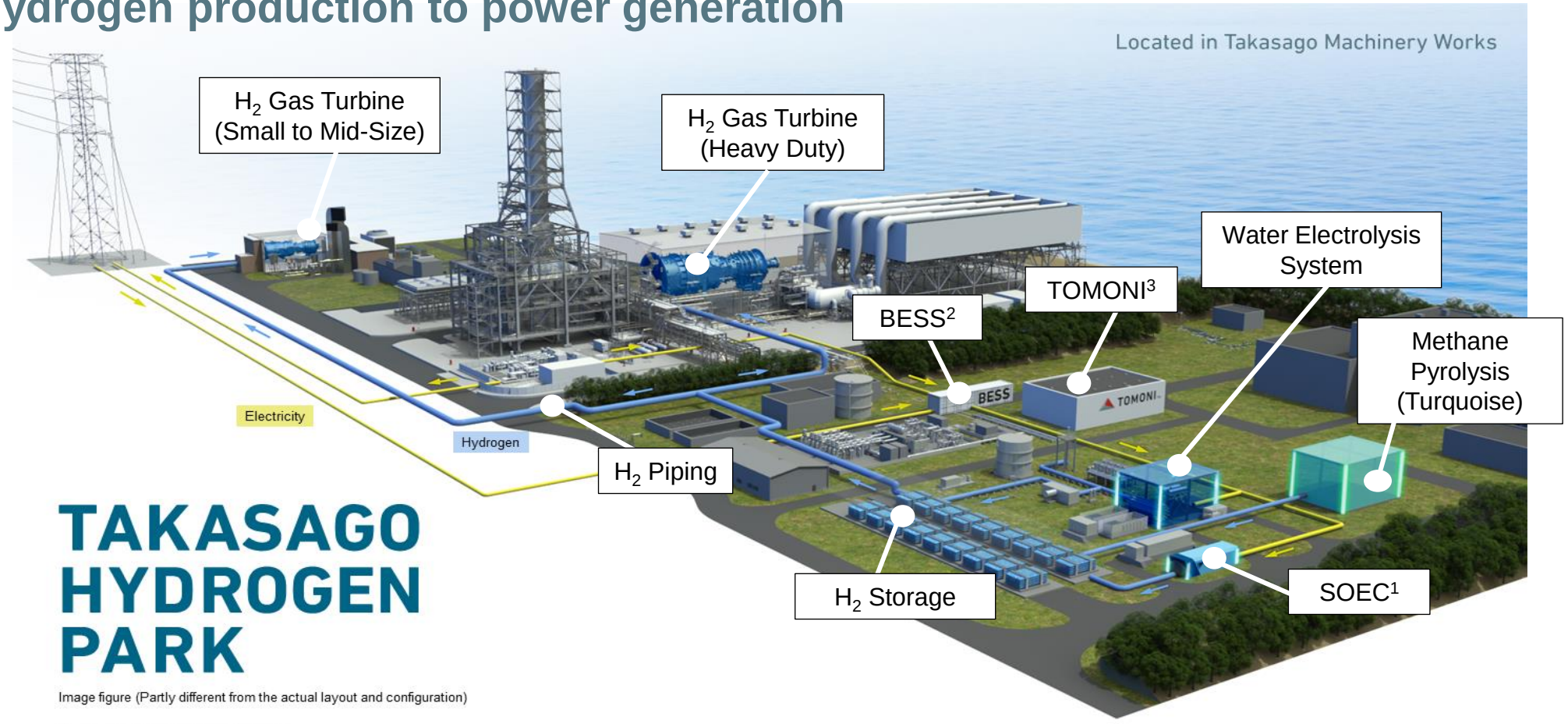


Image figure (Partly different from the actual layout and configuration)

*1 SOEC: Solid Oxide Electrolysis Cell
*2 BESS: Battery Energy Storage Systems
3 TOMONI: MHI proprietary total management system

The Path to achieving Carbon Neutrality

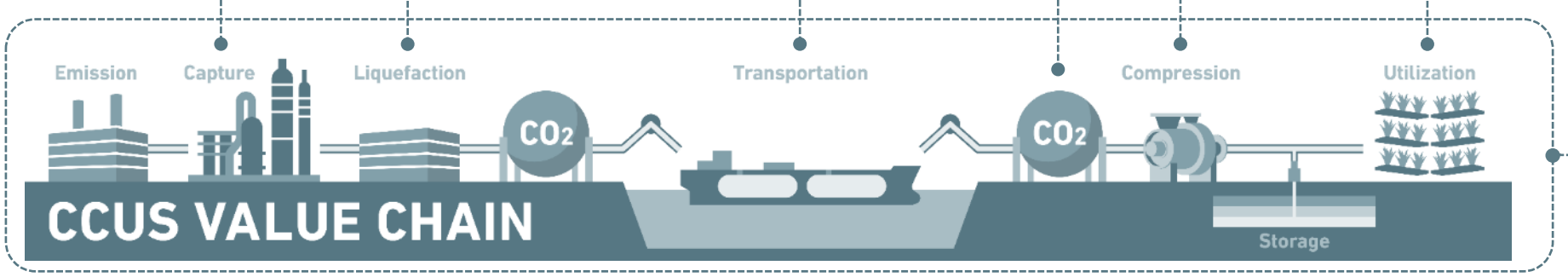
Capture, Transport, Utilization.. Entire CCUS Value Chain Solution

CCUS Digital Platform

CO_2NNEX

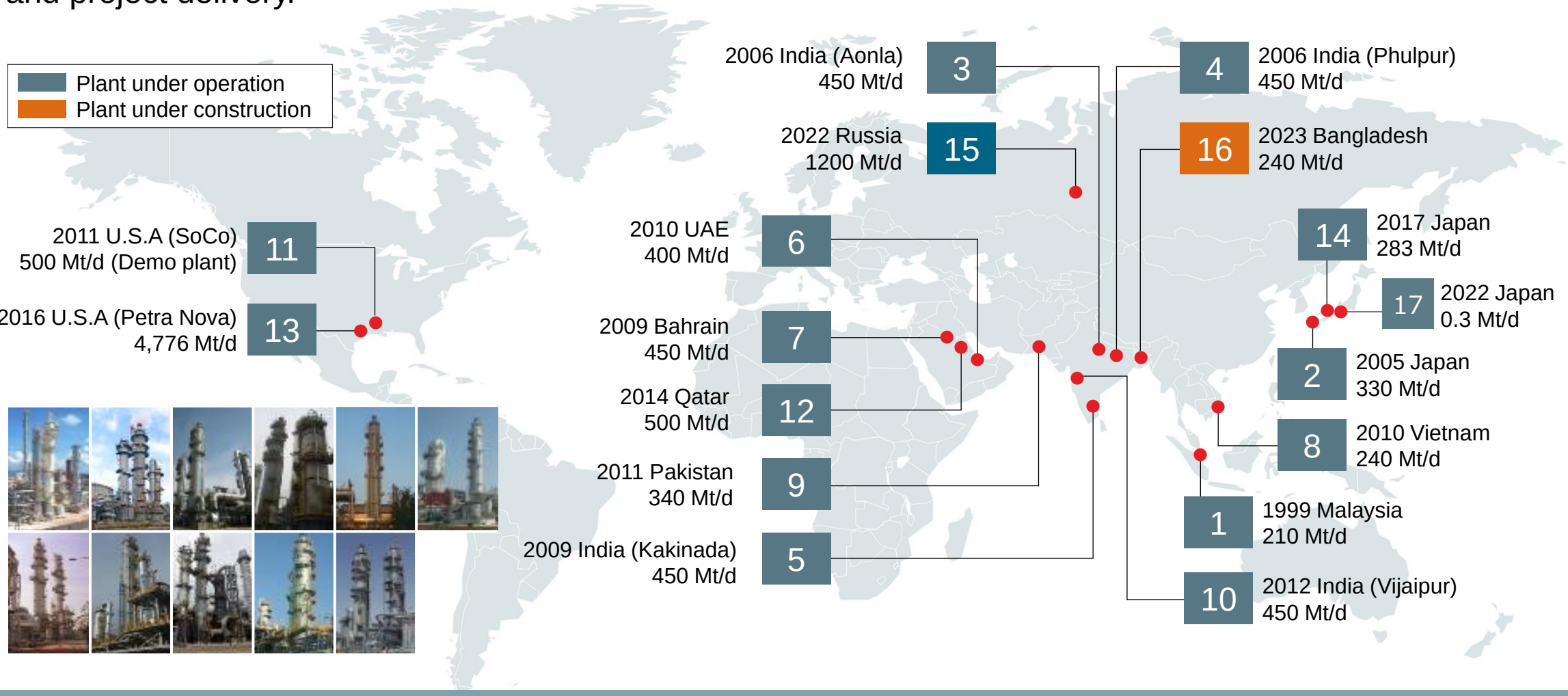
IBM x MITSUBISHI HEAVY INDUSTRIES

Example：Fertilizer plant



Building a CCUS Ecosystem – Global initiative in CO_2 Capture

MHI's experienced global KM CDR Process™ team stands ready to meet customer requirements for commercial CO_2 capture plants on various exhaust from conceptual design through detailed engineering and project delivery.



Building a CCUS Ecosystem – Global initiative in CO_2 Capture

Extra-large to mobile, Standardized & Modularized, for Mid to Small-scale, and Hardware to as-a-service.

CO_2 Emissions

PRESENT

Large-Scale
("Tailor-made")

Power Generation & Chemical

Gas-fired Power　Coal-fired Power　Chemical Plant

FUTURE

Medium and Small-Scale
(Standardized & Modularized)

Various Industrial Sectors

LNG　Cement　Vessel　Gas engine

Waste to Energy　Biomass Energy　Boiler & Furnace

Our Approach

Standardized & Modularized CO_2 capture plant line-up

	Std. Capacity	Required Area (reference only)
A	0.3 tpd	7 m × 2 m
B	3 tpd	12 m × 4 m
C	30 tpd	15 m × 15 m
D	100 tpd	25 m × 20 m
E	200 tpd	35 m × 25 m

Demonstration Partners (examples)

Vessel

Biomass Energy

LNG

- Kawasaki Kisen
- Tokuyama
- Drax, TAIHEI DENGYO
- Yokohama City / Tokyo Gas
- Next Decade
- MHI group company

Cement

Waste to Energy

Gas Engine

Building a CCUS Ecosystem – Global initiative in CO_2 Capture

1st Commercial Operation Compact CO2 Capture System (Japan)

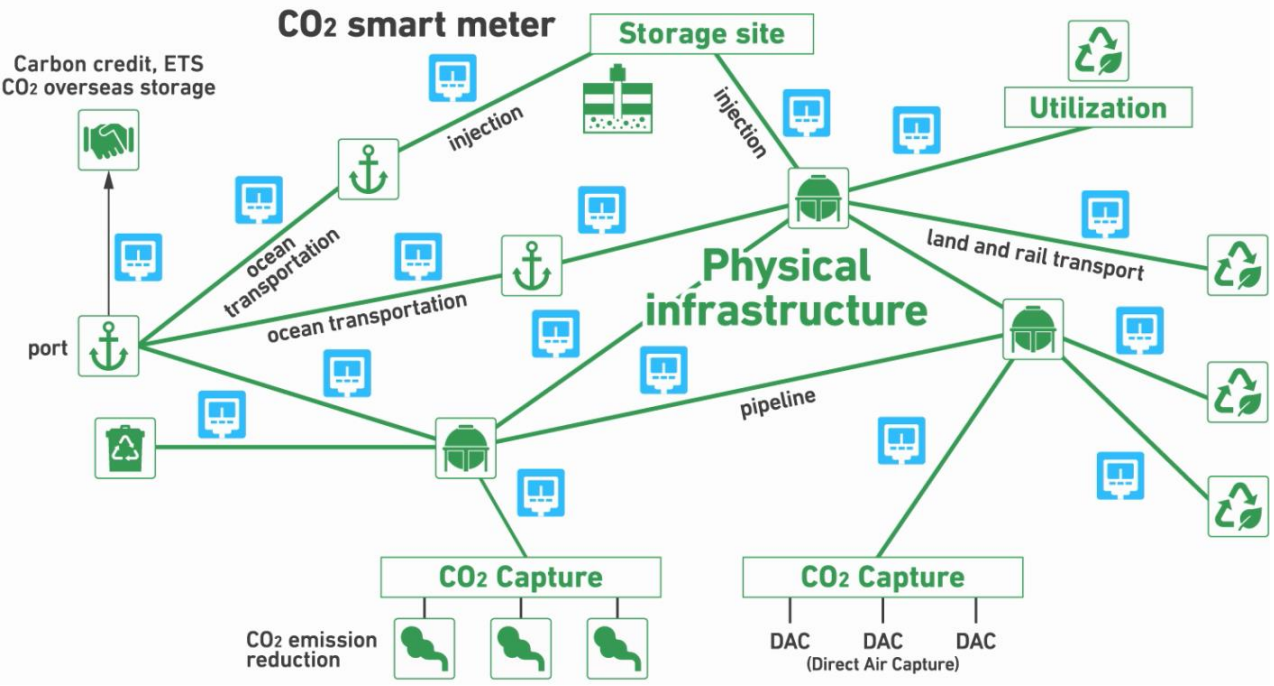
Installed at a 7MW class biomass power plant and Capturing 0.3 ton-CO_2 per day.

Goes into Commercial Operation in June 2022.

* photo courtesy of Taihei Dengyo Kaisha, Ltd.

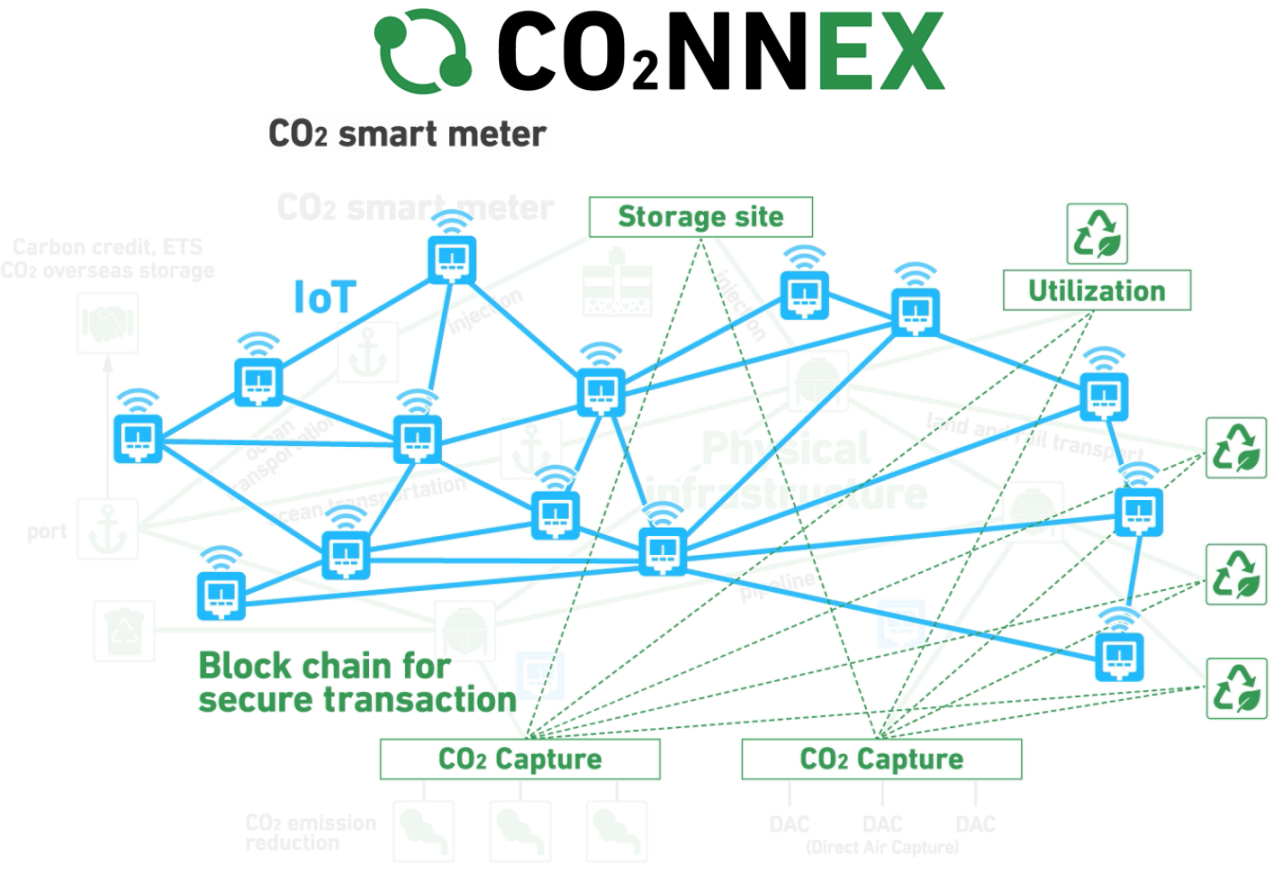
Building a CCUS Ecosystem – CCUS Digital Grid Platform

Visualizing actual CCUS activities in a virtual space using blockchain technology and IoT- enabled devices such as smart meters.



CCUS Infrastructure (real world)

CO2NNEX



CCUS digital platform (virtual world)

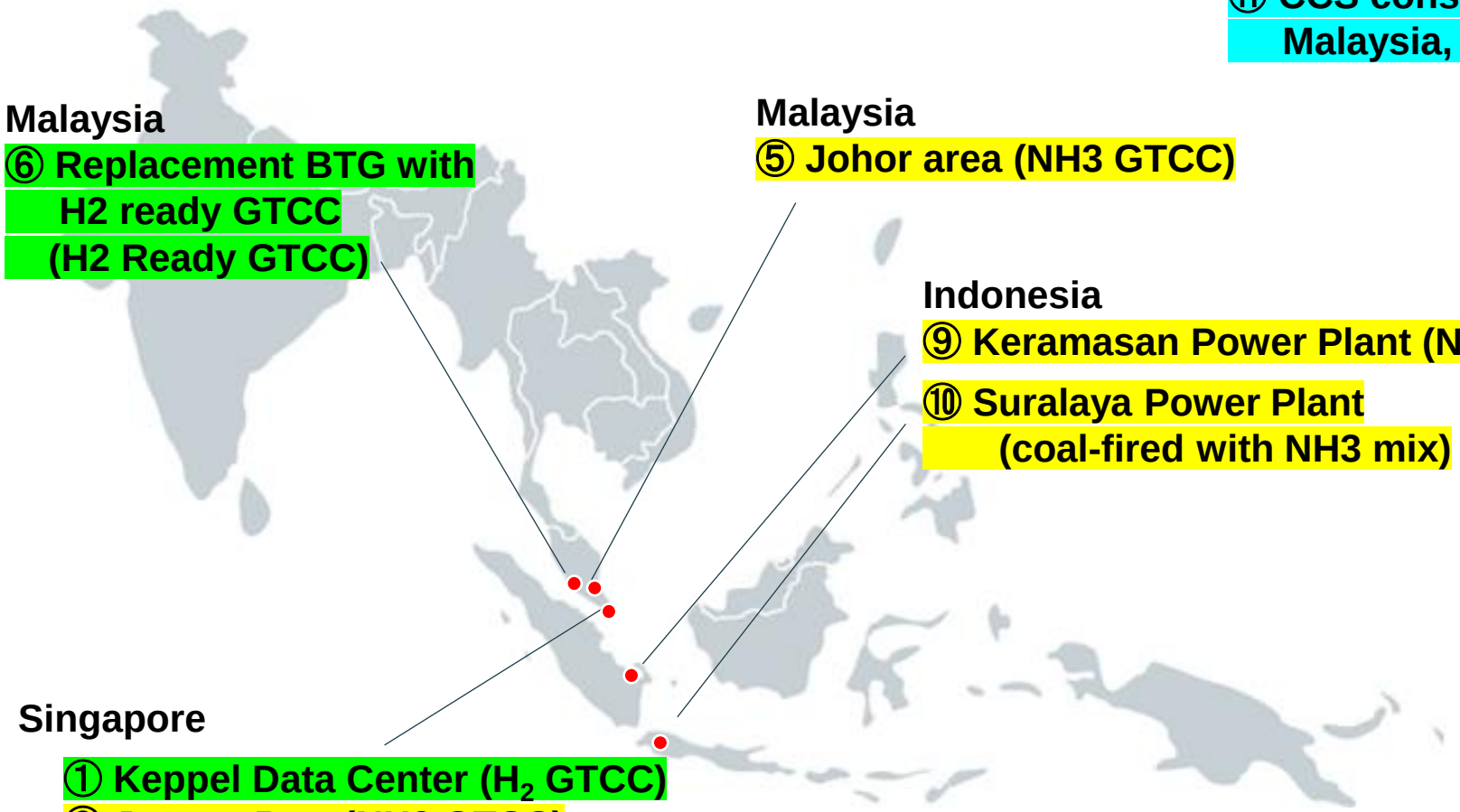
De-carbonization Projects in AP region

⑪ CCS consideration for
Malaysia, Australia, Indonesia (CO2 Utilization)

Malaysia
⑥ Replacement BTG with H2 ready GTCC (H2 Ready GTCC)

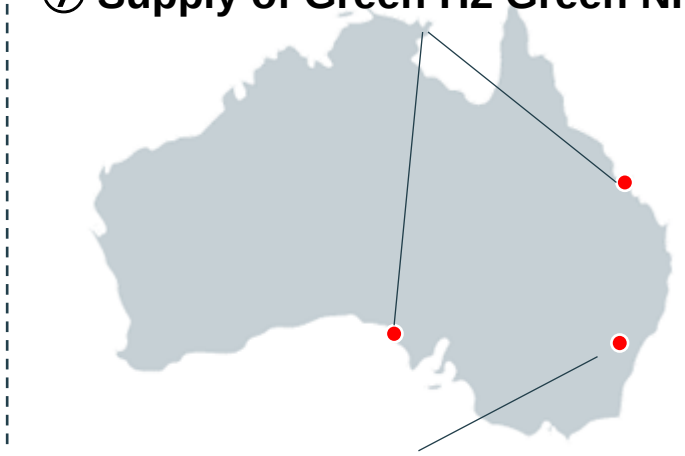
Malaysia
⑤ Johor area (NH3 GTCC)

Indonesia
⑨ Keramasan Power Plant (NH3 GTCC)
⑩ Suralaya Power Plant (coal-fired with NH3 mix)



Singapore
① Keppel Data Center (H_2 GTCC)
② Jurong Port (NH3 GTCC)
③ Keppel Sakra (H2 Ready GTCC)
④ Keppel NE (NH3 GTCC)

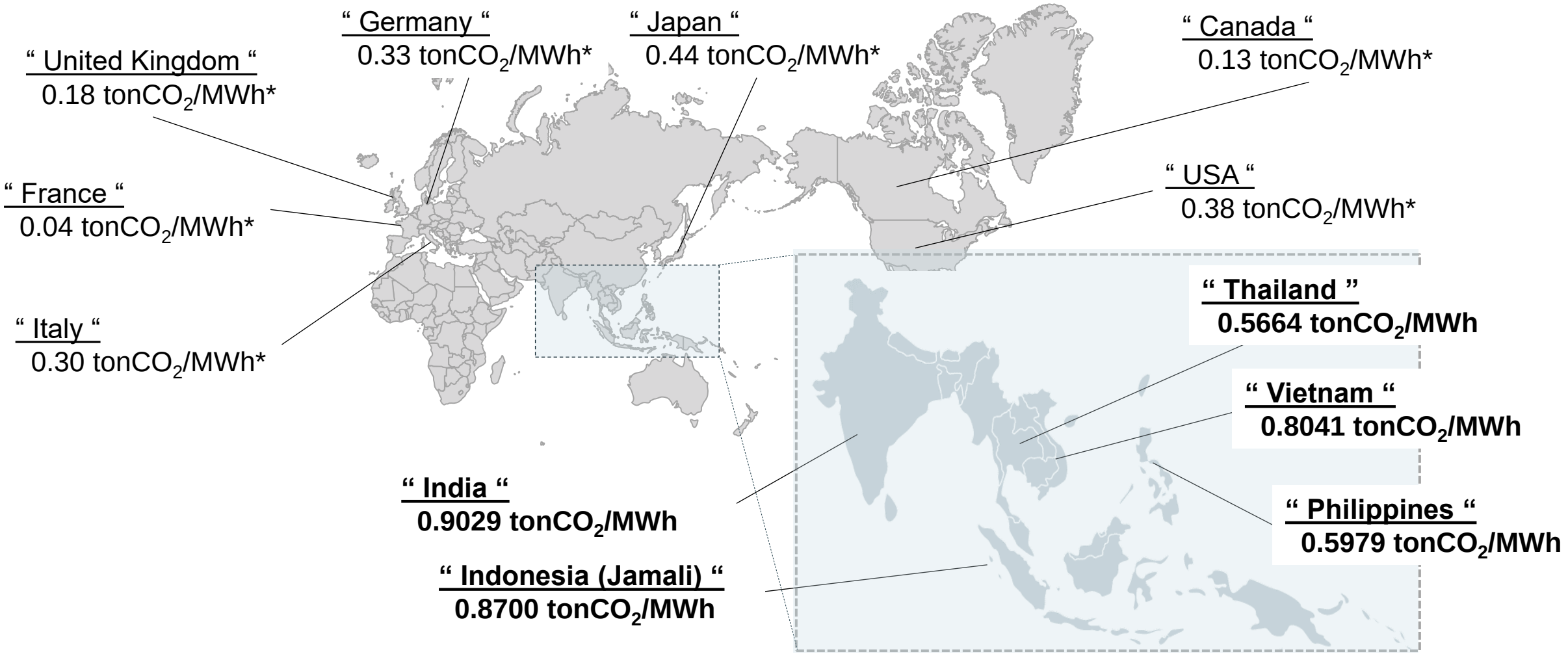
⑦ Supply of Green H2 Green NH3



⑧ Hunter Power OCGT (H2 Ready GTCC)

CO_2 reduction target in Industry Sector

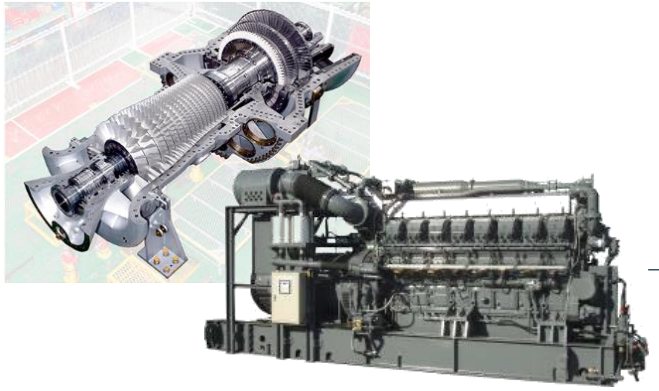
Grid electricity emissions index remain high in Southeast Asia comparing Europe, Japan & N. America
However, Company in Industry Sector set the high target for CO2 reduction.



Source： Institute for Global Environmental Strategies、* The Electric Power Council for a Low Carbon Society, ELCS

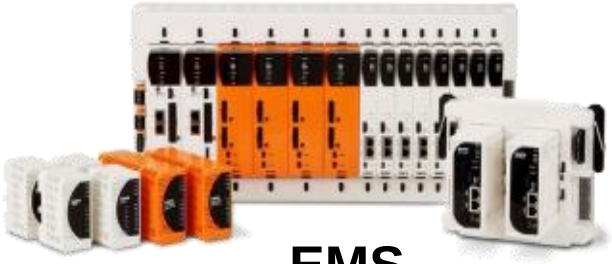
MHI solutions for Industry sector

Widely offer solutions for decarbonization & low carbon that suit the customer needs in various industry.



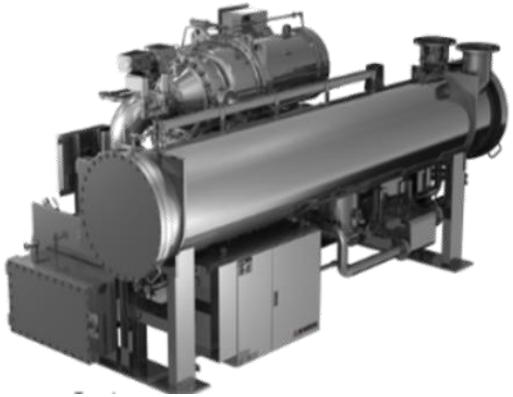
Gas/H_2 power generation (Gas engine, Gas turbine)

Waste heat power generation



EMS (Energy Management System)

Compact CO_2 capture

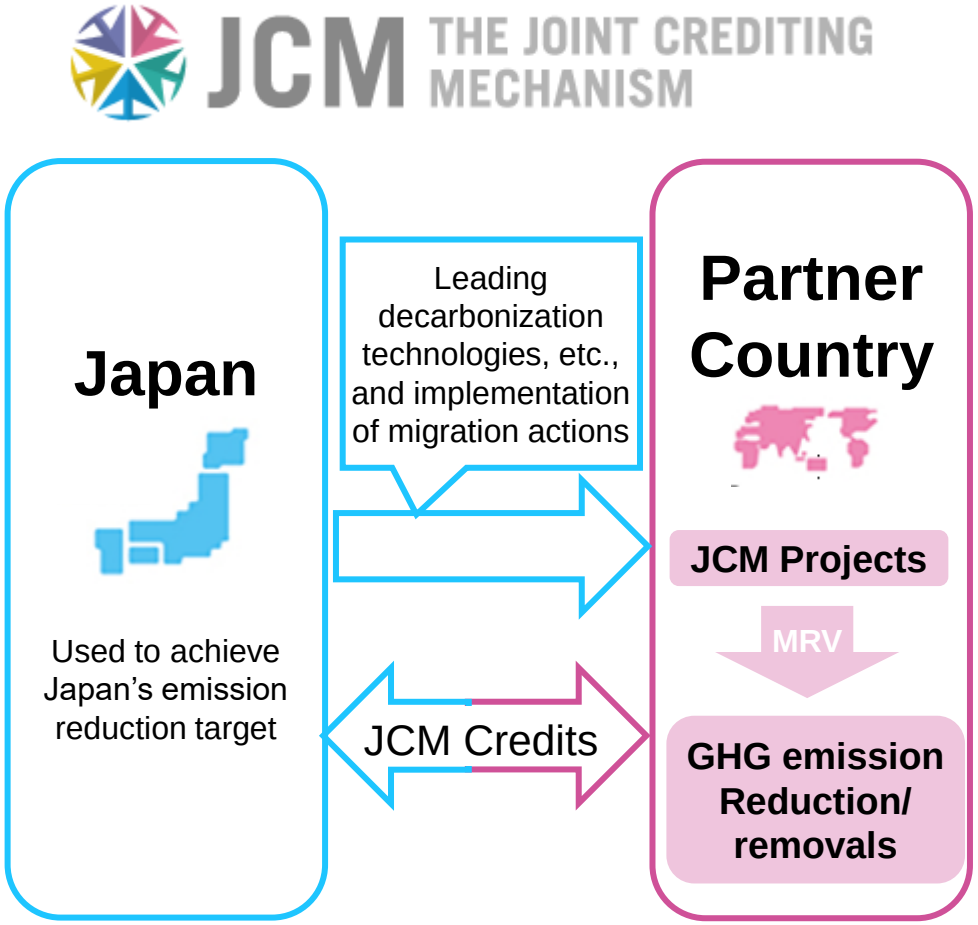


High efficiency chiller

Biomass power

JCM (the Joint Crediting Mechanism) scheme application

Thailand & Japan signed and start JCM scheme in November, 2015 for reducing GHG emission.



JCM Projects of Indonesia

- Gas Co-generation system
- Waste Heat Recovery system
- Biomass Power Plant
- Energy Saving System (High Efficiency Chiller, etc.)
- Solar Power & Battery Energy Storage System
- Hydro Power Plant

etc.

Summary

- **Targeting Net Zero Scope 1, 2, and 3+ emissions by 2040.**
  As a leader in the field of decarbonization, MHI will lead Energy Transition.

- Both short- and mid- to long-term efforts are necessary to achieve carbon neutrality.
  MHI is **taking initiatives for both these efforts by not only supply components but also establishing the value chain itself through our technologies and partnerships.**

- Leveraging the strength of our technologies to take a leading role in **accelerating the Carbon Neutrality in APAC region and Thailand.**

Thank you for listening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HEAVY INDUSTRIES

MOVE THE WORLD FORWARD

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INDUSTRIES
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