

MHI Group Sustainability Initiatives & Carbon Neutrality

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29th September 2022

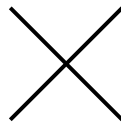
Mitsubishi Heavy Industries, Ltd.



**1. MHI Group and Vision for
Carbon Neutrality**

**2. MHI Initiatives and Solutions
for Energy Transition**

As a member of Energy, Sustainability & Climate (ESC) Task Force, MHI will contribute to accelerating just and orderly Energy Transition in realistic approach using our knowledge and experience related to various social infrastructures.



ENERGY, SUSTAINABILITY & CLIMATE

Mitsubishi Heavy Industries Group at a Glance



1884 Foundation
over 130 years history



78,486 Employees
(Consolidated)



256 Group Companies
(Consolidated)



¥3.9^{TN} (\$35^{BN*}) 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



CO₂ 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-

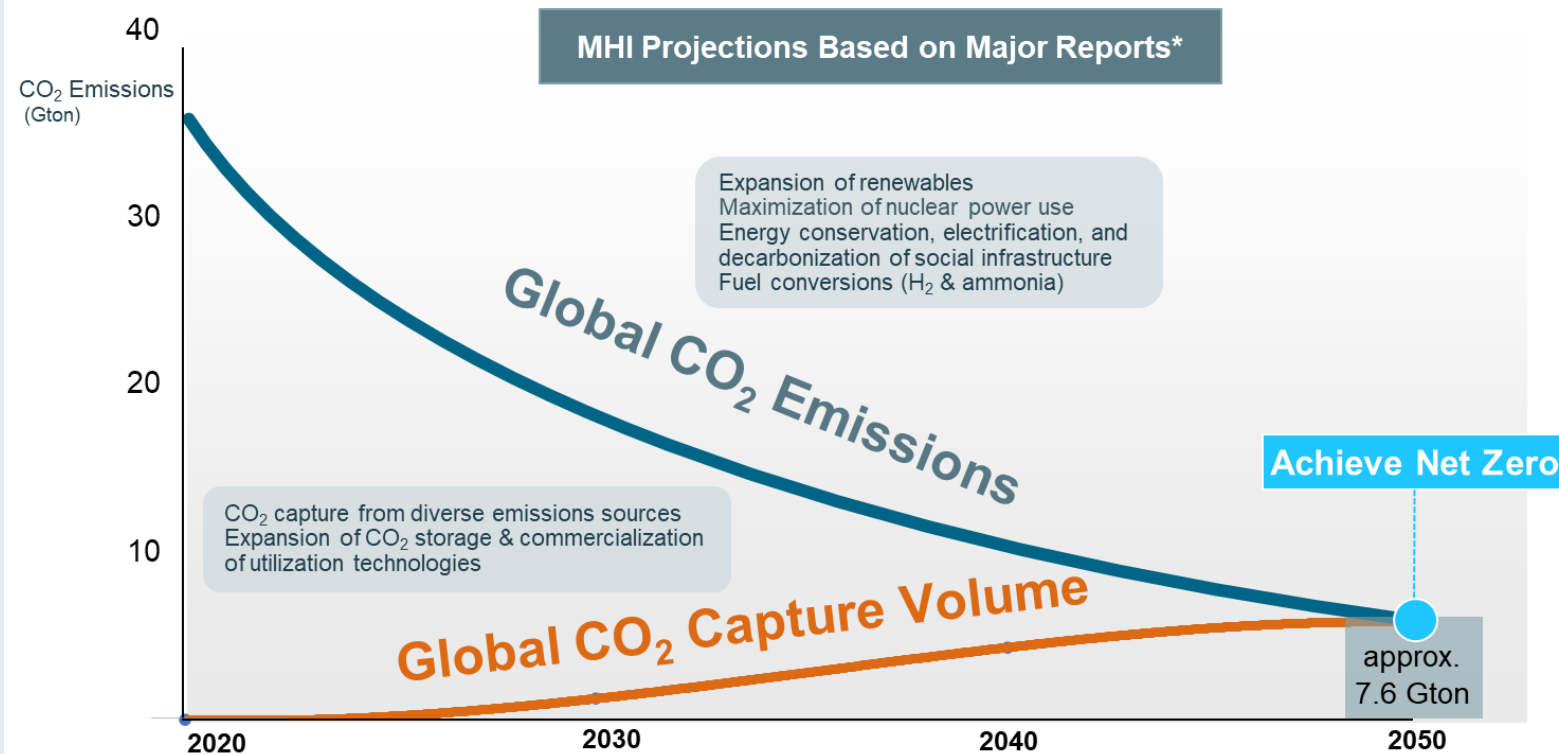
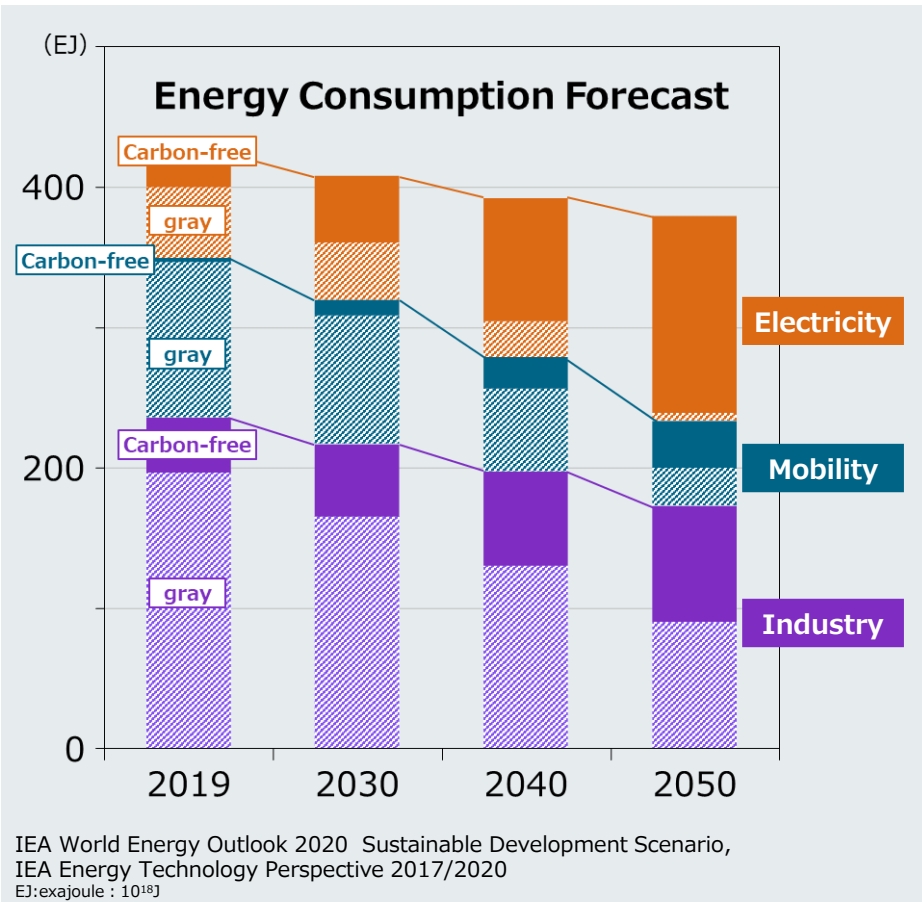
Leading a carbon-neutral world through technology



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--

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



*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 CO₂ comprises 99% of MHI Group’s GHG emissions, we have focused our targets solely on the reduction of CO₂ in order to simplify our message.

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



Our Initiatives and solutions for Energy Transition



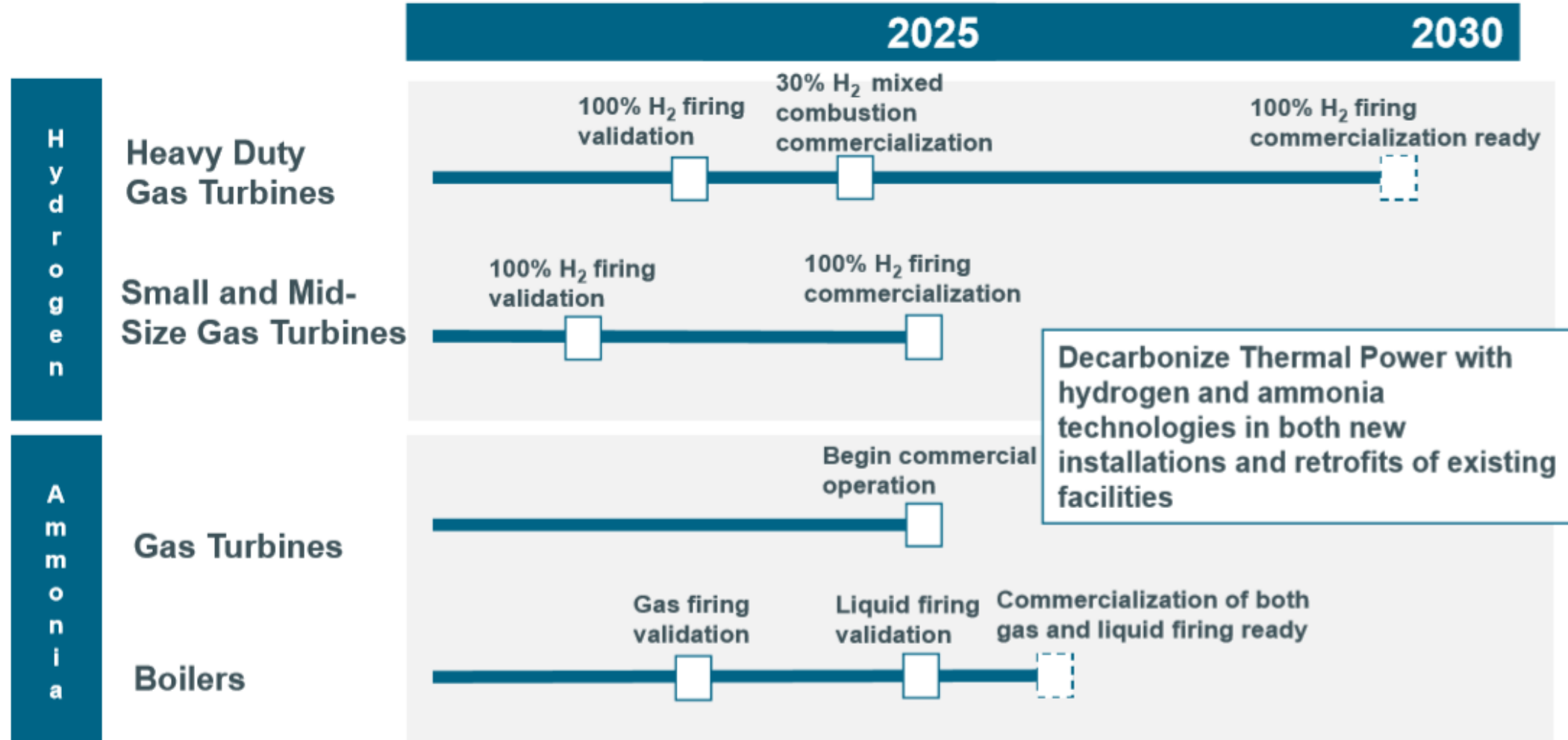
Build three innovative solutions ecosystems to realize “Mission Net Zero”



The Path to achieving Carbon Neutrality



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%

- 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

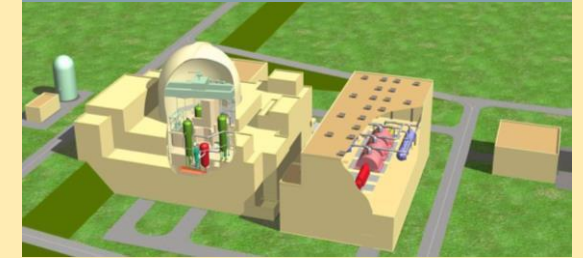
Hydrogen GTCC



Hydrogen Gas Engine



Next-Generation
Light Water Reactor



Small Modular Reactor
(SMR)



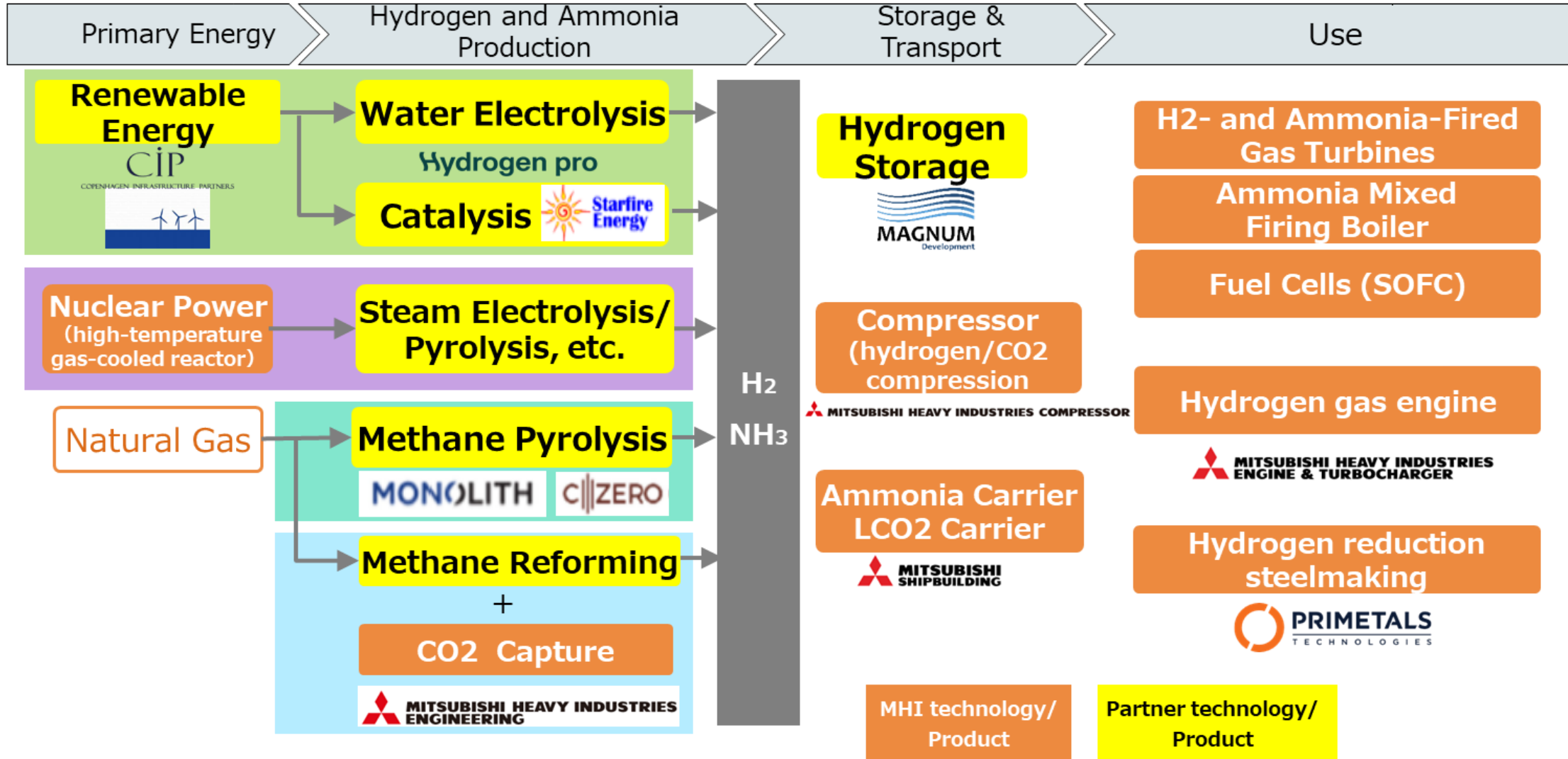
Gas Engine co-generation



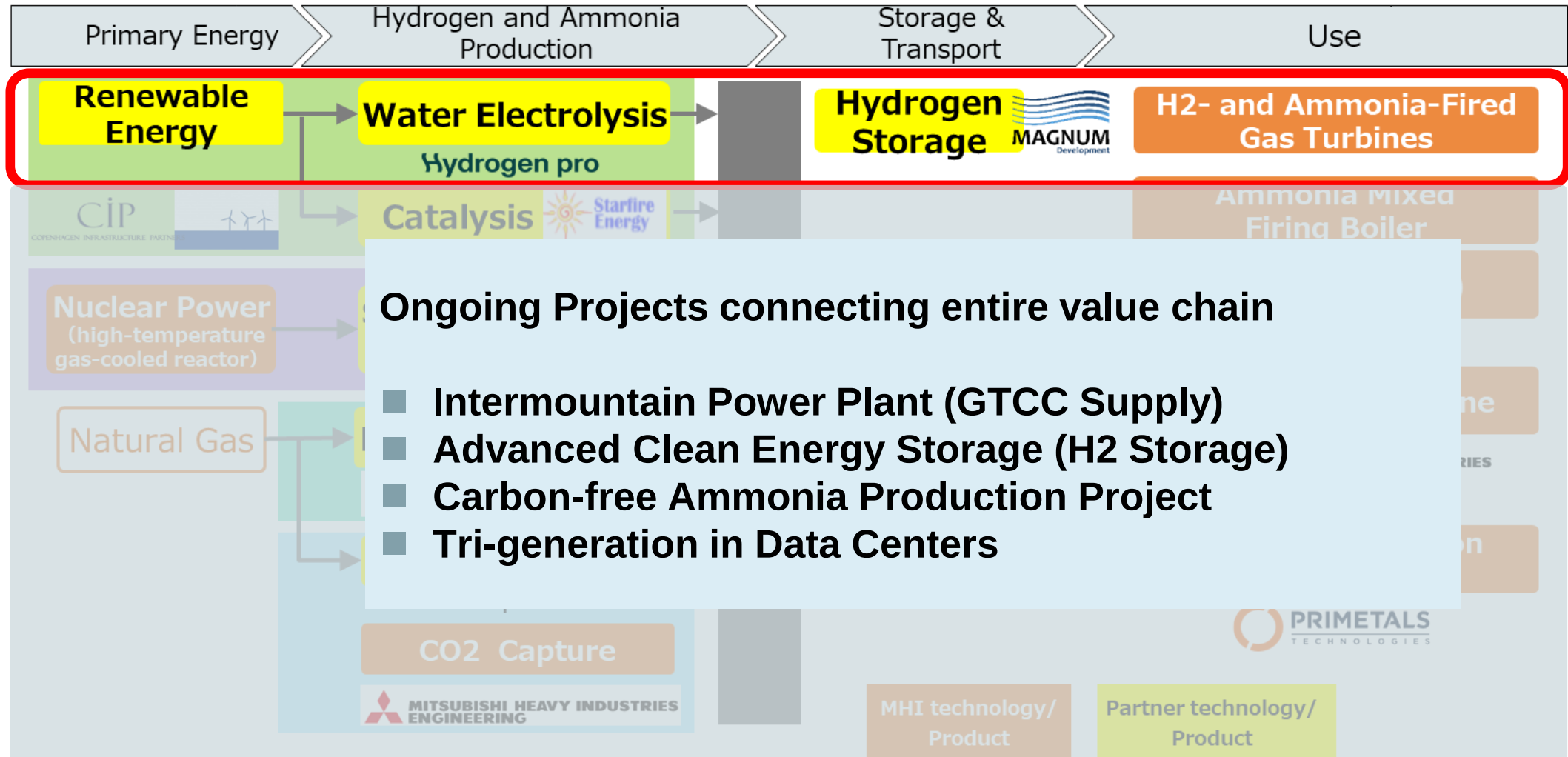
The Path to achieving Carbon Neutrality



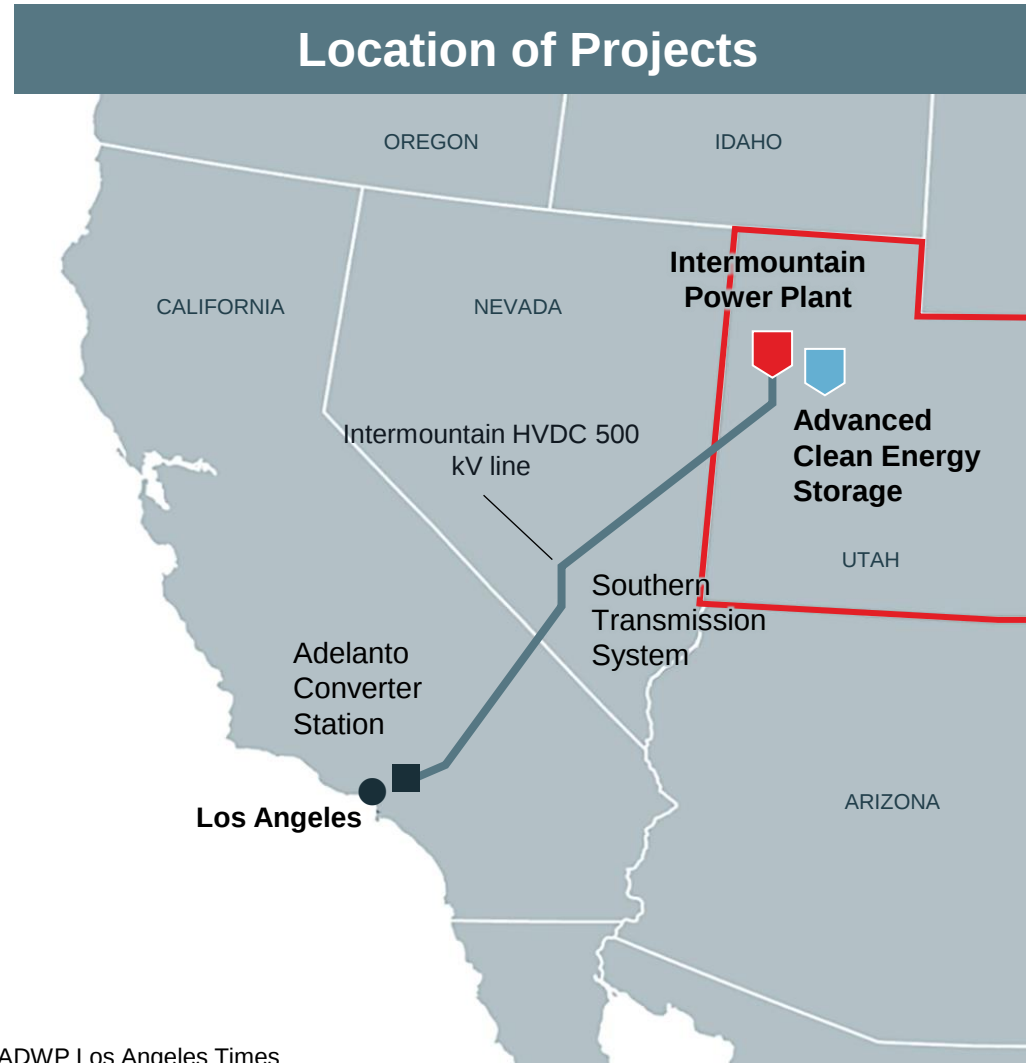
Expanding capability in entire value chain with strategic partnerships



Expanding capability in entire value chain with strategic partnerships



Intermountain Power Plant

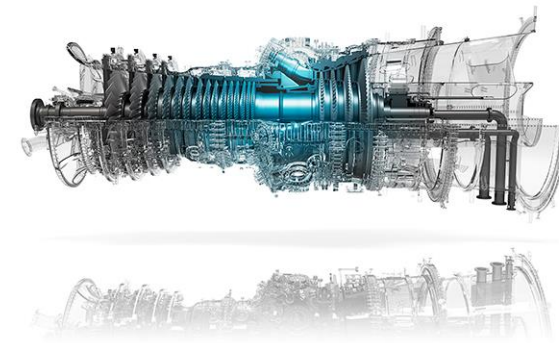


Gas Turbine Model M501JAC

Power Output 840 MW (by 2 CCGT)

Location Utah, USA

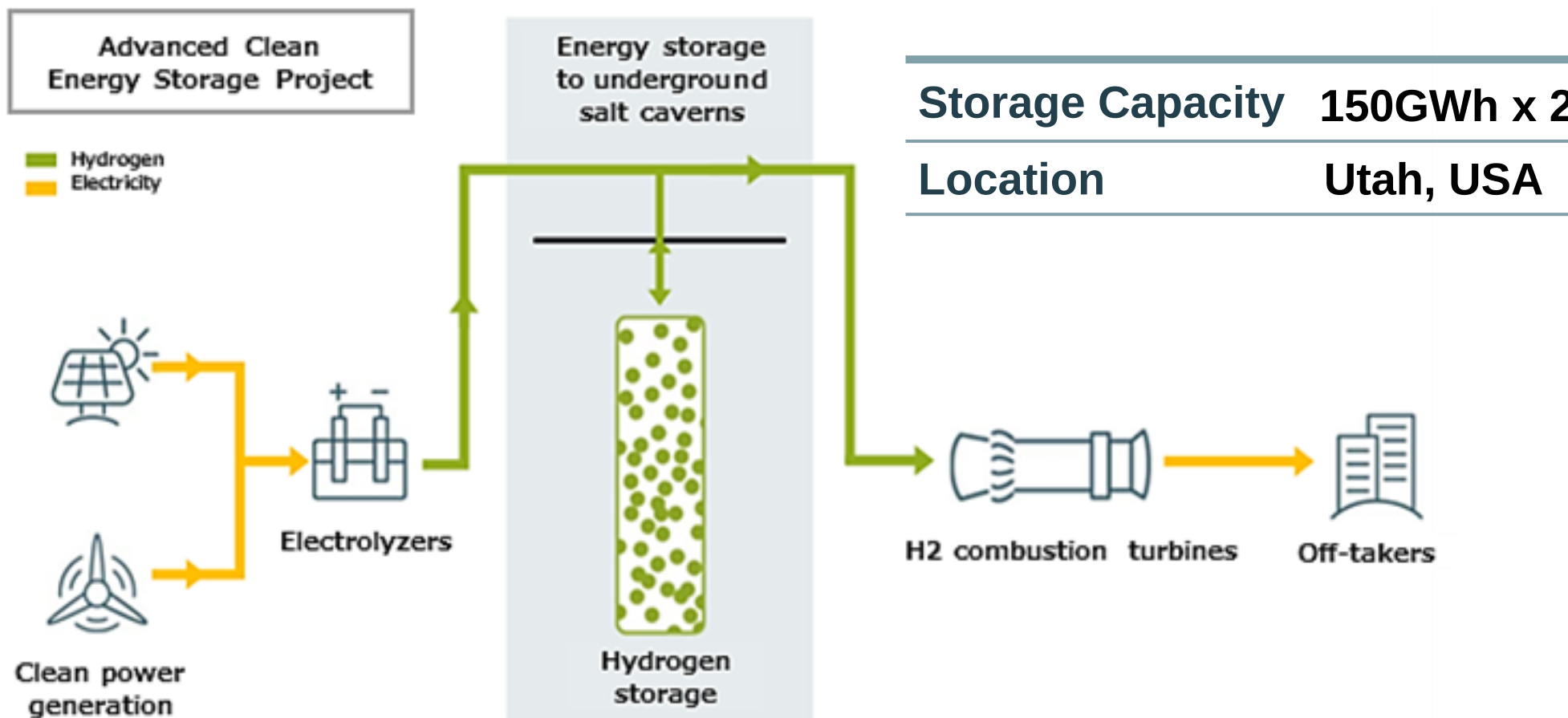
- 30% renewable hydrogen by 2025.
- 100% renewable hydrogen by 2045



Source: LADWP Los Angeles Times

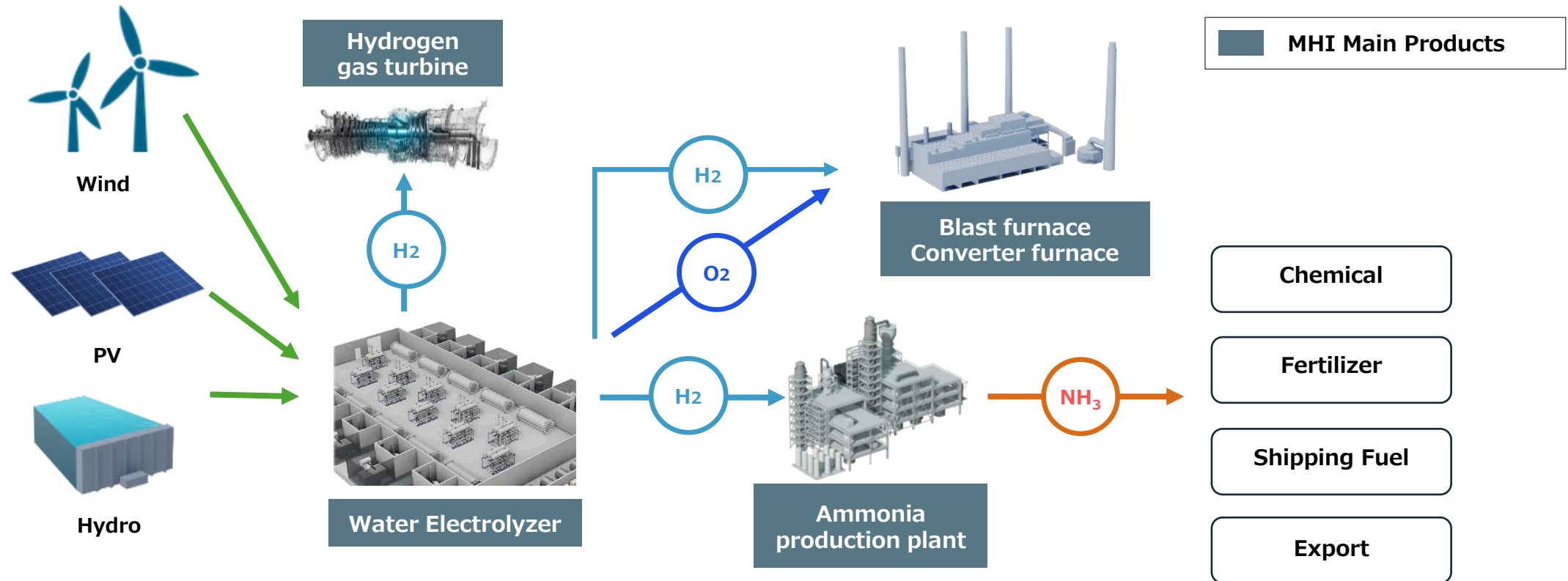
Advanced Clean Energy Storage (ACES) Project (US)

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



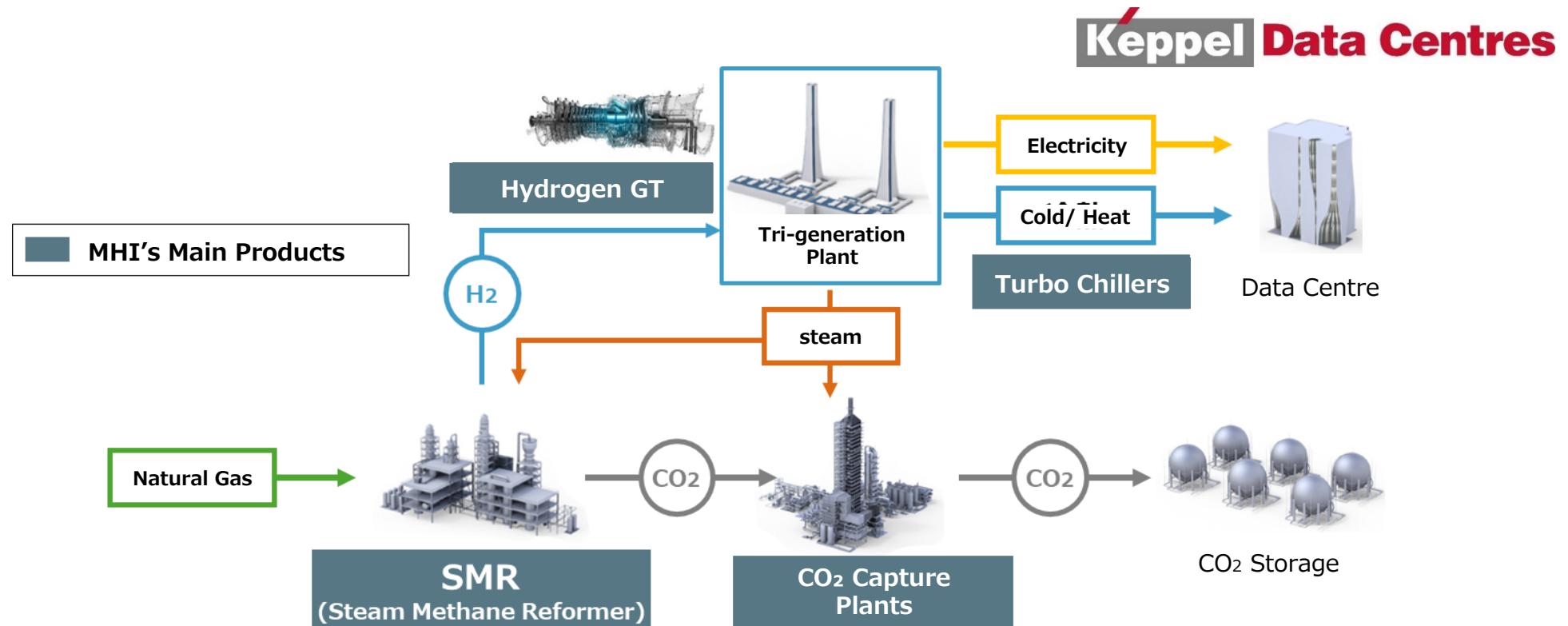
Carbon-free Ammonia Production Project (Australia)

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



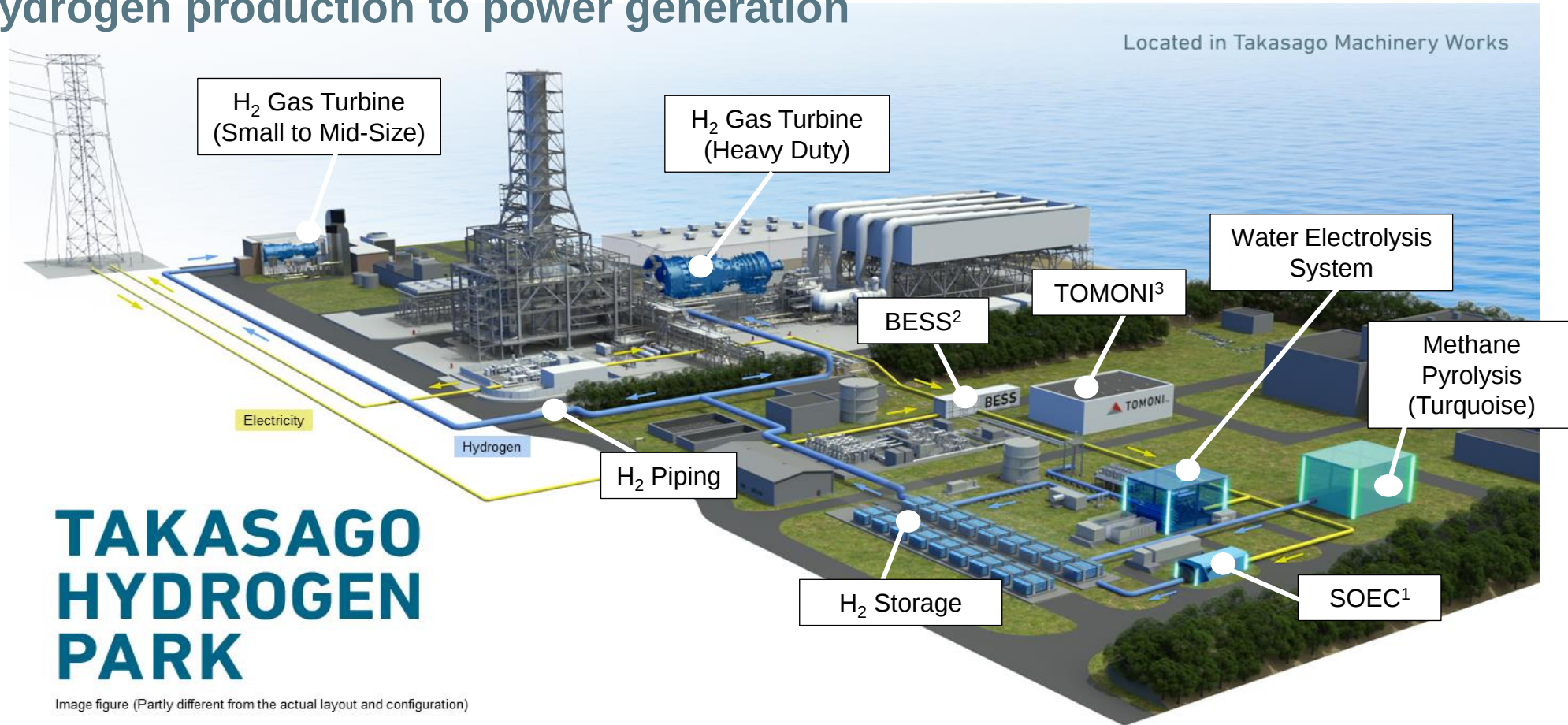
Tri-generation in Data Centers (Singapore)

- 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



*1 SOEC: Solid Oxide Electrolysis Cell

*2 BEES: 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

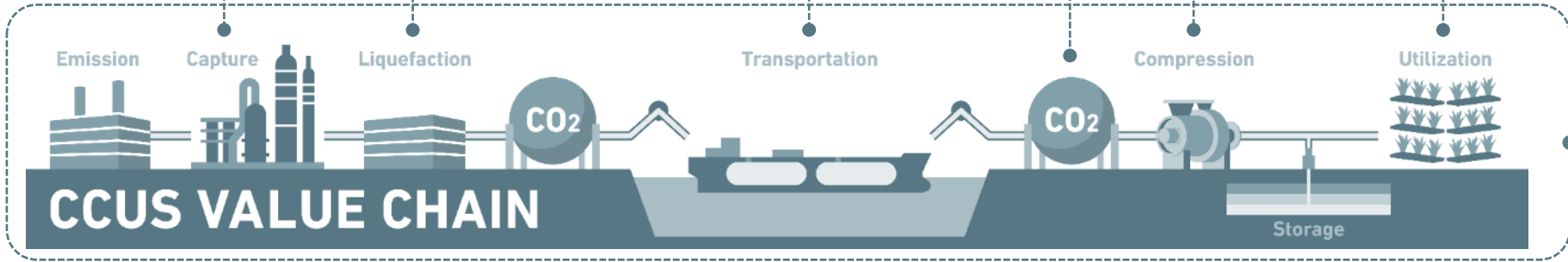
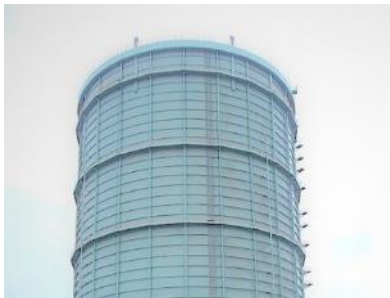


CCUS Digital Platform

CO₂NNEX

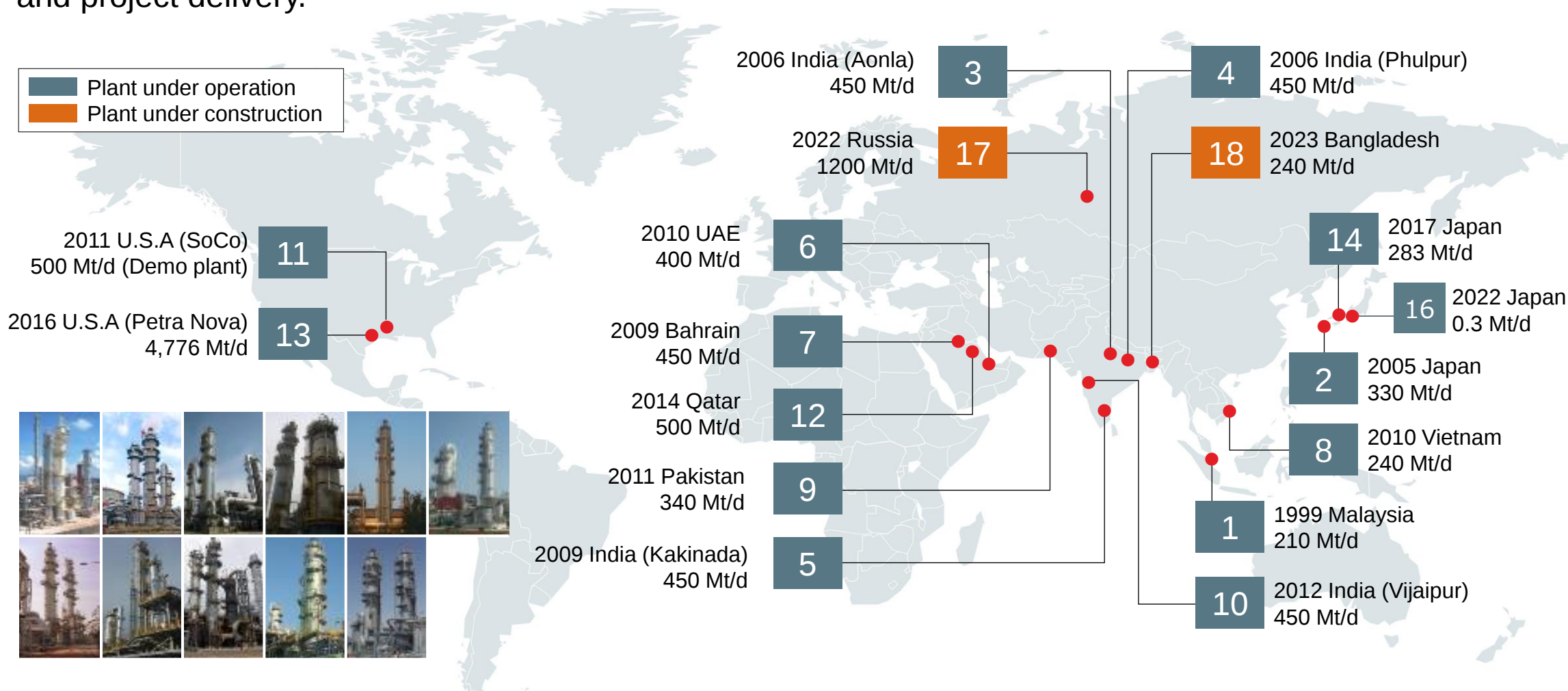


Example : Fertilizer plant

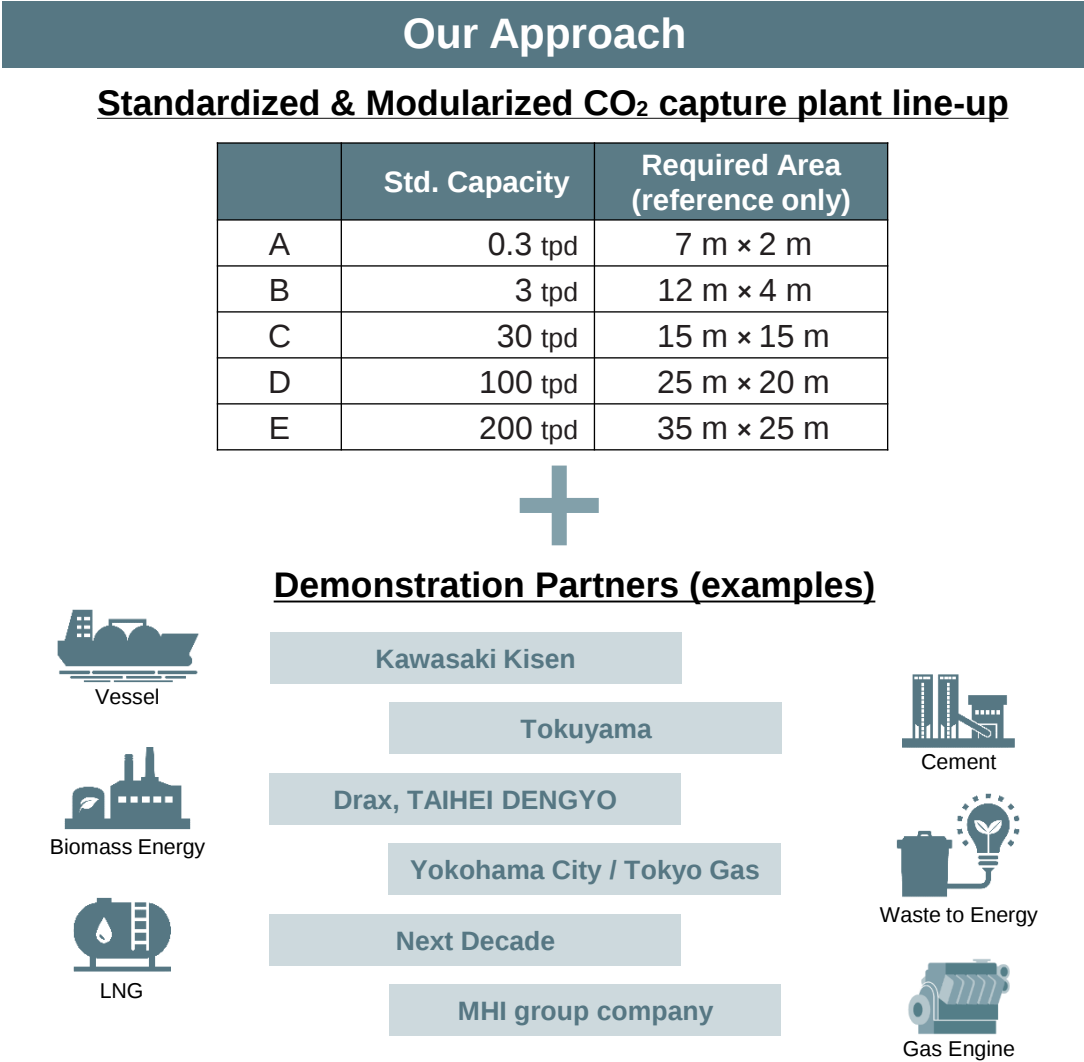
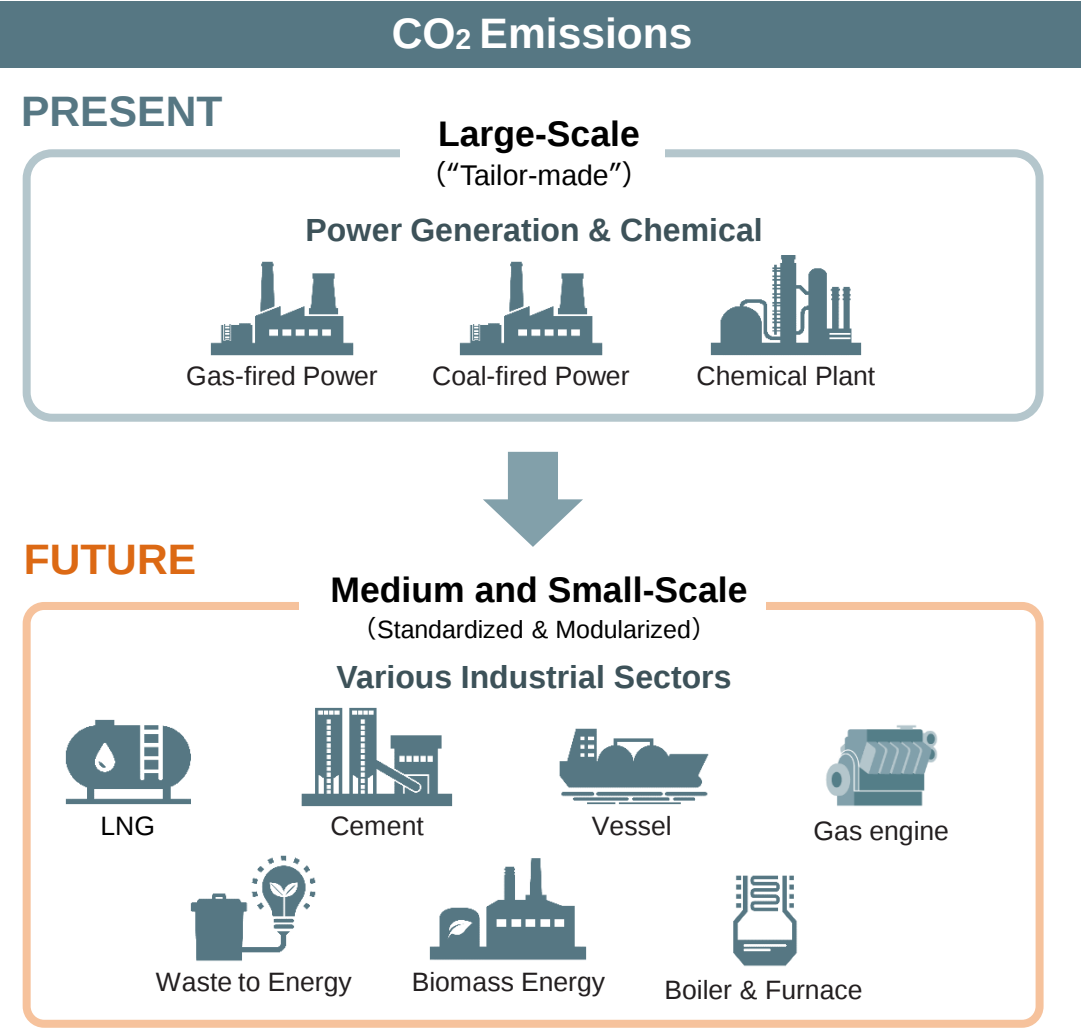


Building a CCUS Ecosystem – Global initiative in CO₂ Capture

MHI's experienced global KM CDR Process™ team stands ready to meet customer requirements for commercial CO₂ capture plants on various exhaust from conceptual design through detailed engineering and project delivery.



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



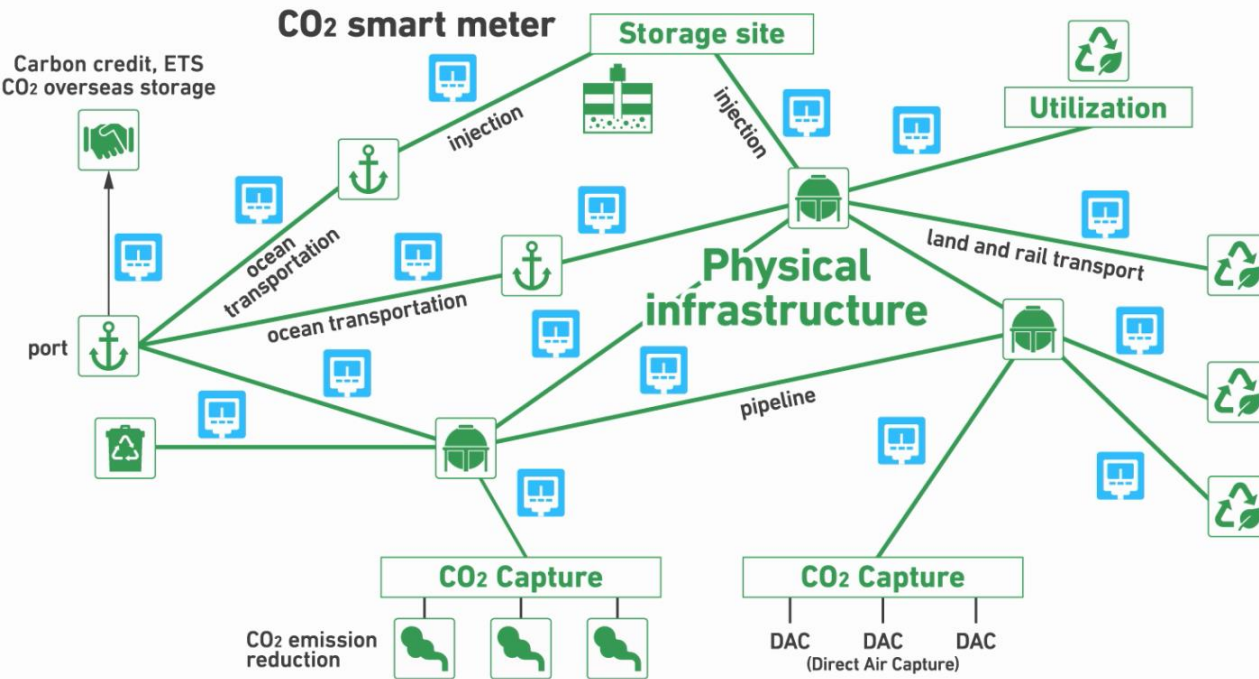
1st Commercial Operation Compact CO₂ Capture System (Japan)

Installed at a 7MW class biomass power plant and Capturing 0.3 ton-CO₂ per day.
Goes into Commercial Operation in June 2022.

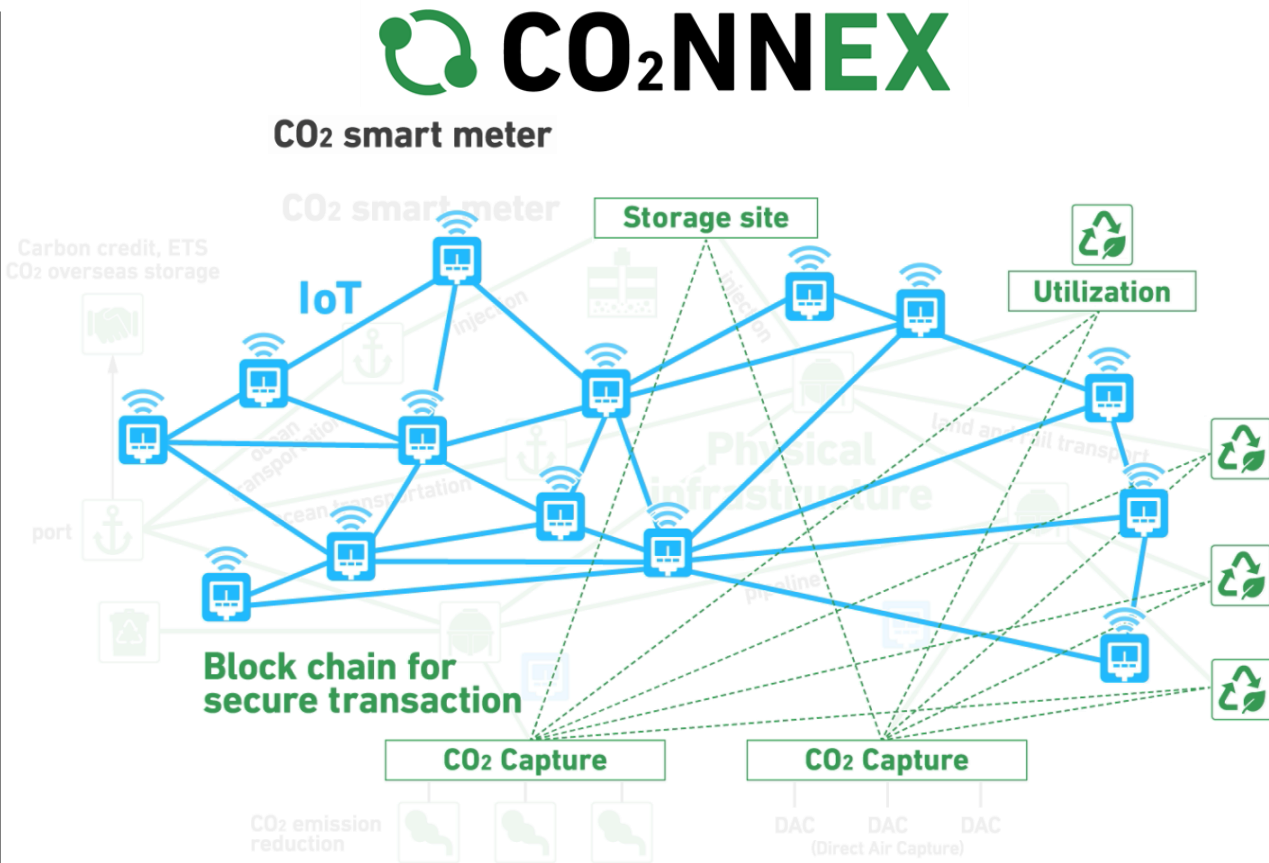


Building a CCUS Ecosystem – CCUS Digital Grid Platform

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



CCUS Infrastructure (real world)



CCUS digital platform (virtual world)

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 (H₂ GTCC)

② Jurong Port (NH₃ GTCC)

③ Keppel Sakra (H₂ Ready GTCC)

④ Keppel NE (NH₃ GTCC)

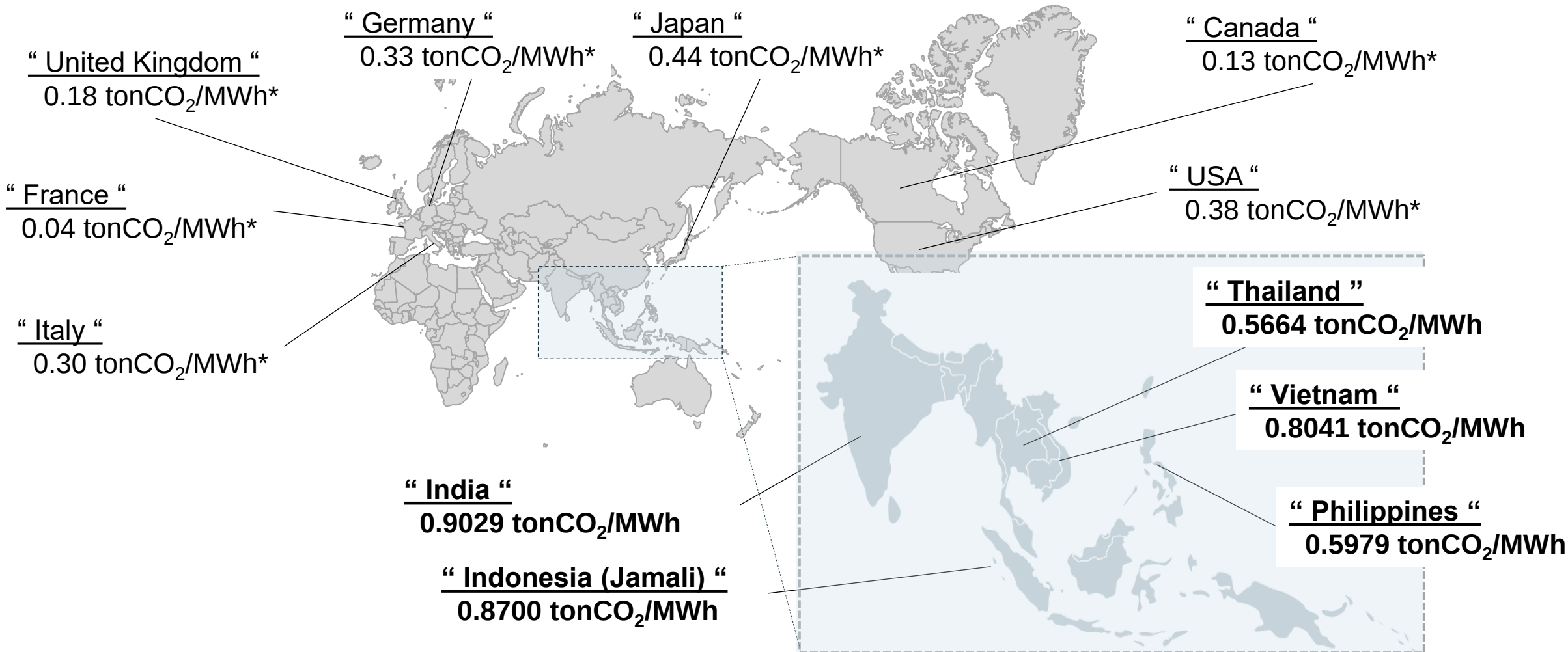
⑦ Supply of Green H₂ Green NH₃

⑧ Hunter Power OCGT (H₂ Ready GTCC)

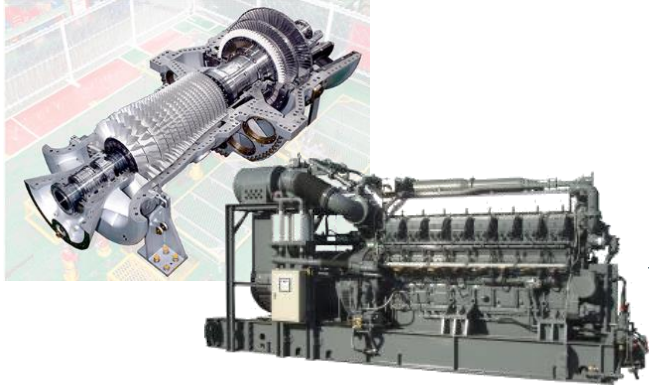


CO₂ reduction target in Industry Sector

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.



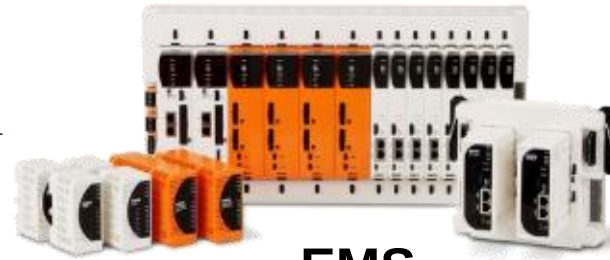
Widely offer solutions for decarbonization & low carbon that suit the customer needs in various industry.



**Gas/H₂ power generation
(Gas engine, Gas turbine)**



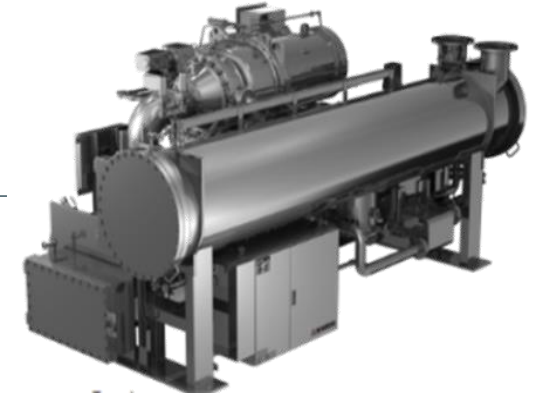
**Waste heat power
generation**



**EMS
(Energy Management System)**



Compact CO₂ capture



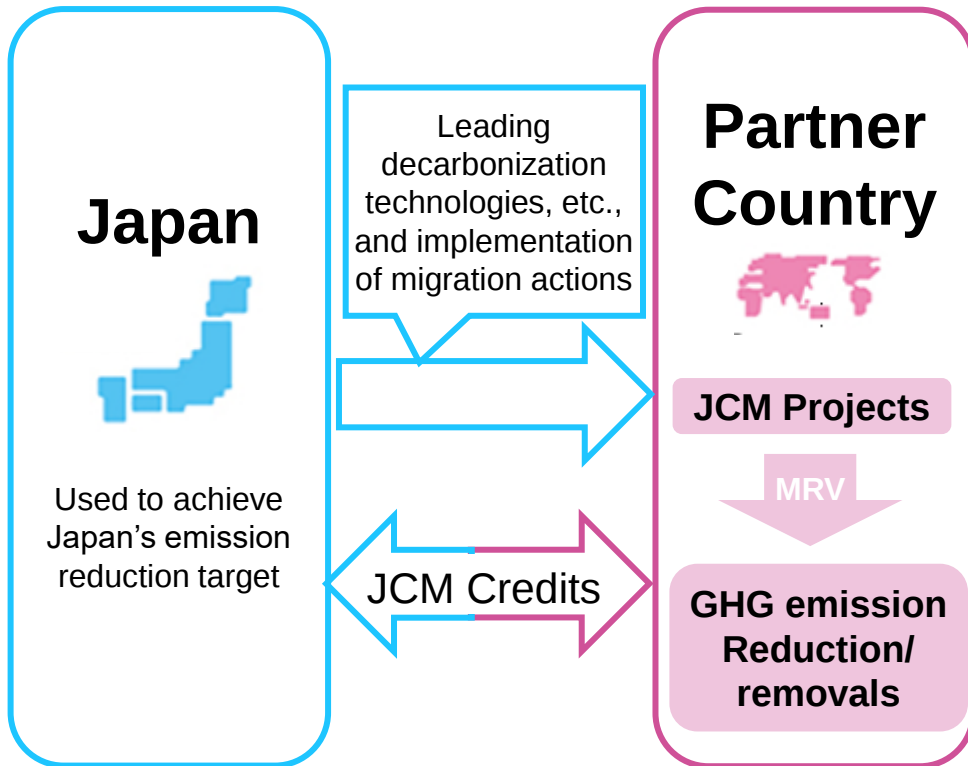
High efficiency chiller



Biomass power

JCM (the Joint Crediting Mechanism) scheme application

Indonesia & Japan signed and start JCM scheme in August, 2013 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 Indonesia.**

Thank you for listening



MOVE THE WORLD FORWARD

**MITSUBISHI
HEAVY
INDUSTRIES
GROUP**