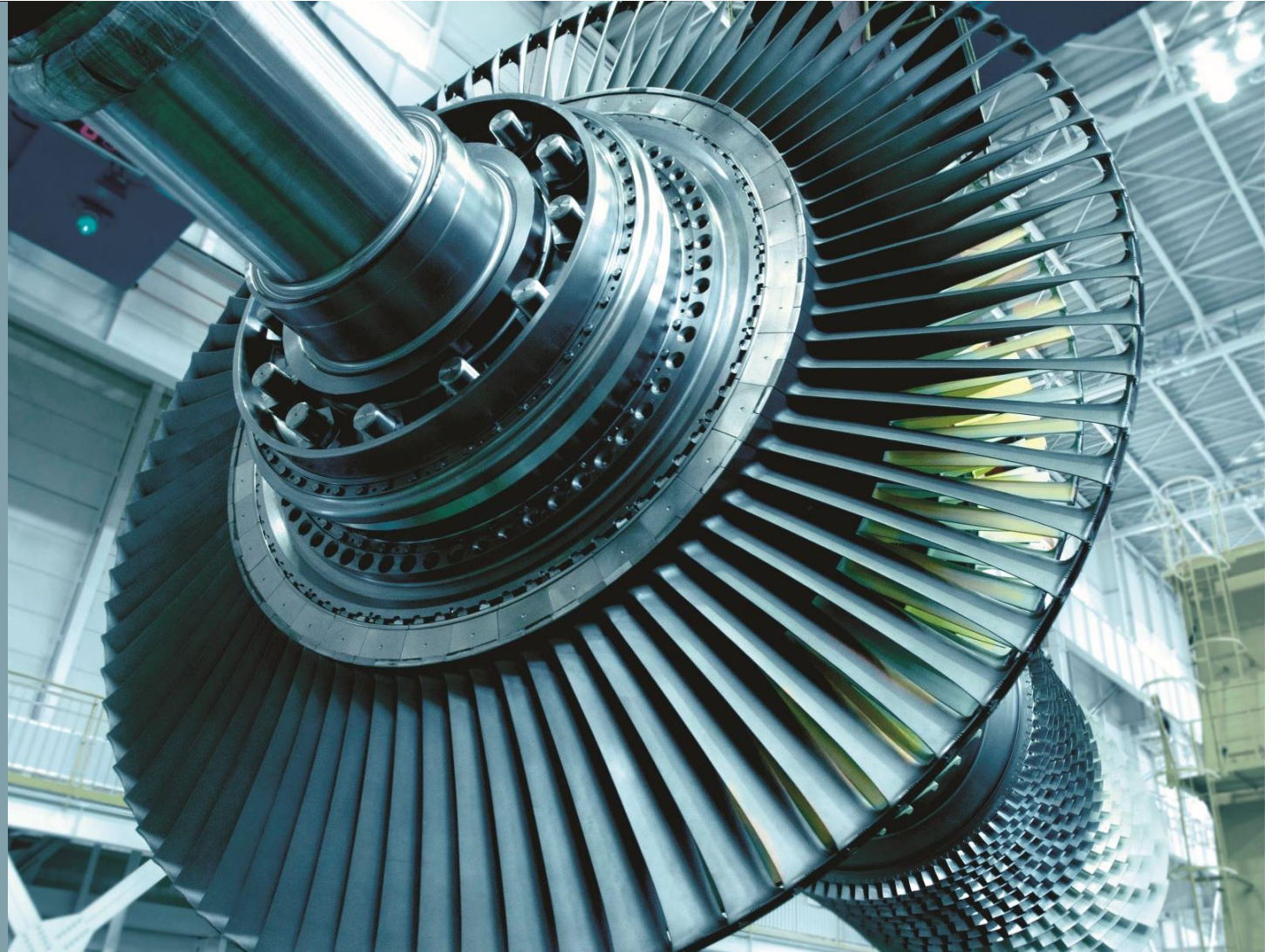


Mitsubishi Heavy Industries, Ltd. GTCC Business Briefing

2025/10/7

Mitsubishi Heavy Industries, Ltd.



1. MHI Gas Turbine Business
2. MHI Gas Turbine Technology
3. MHI Energy Transition Initiatives



1. MHI Gas Turbine Business

Overview of Mitsubishi Heavy Industries (MHI) Group

 **1884** Foundation over 140 years history |  **77,274** Employees (Consolidated, As of March 31, 2025) |  **256** Group Companies (Consolidated, As of March 31, 2025) |  **5,027.1** Billion Yen Revenue (FY2024, consolidated)

 **Business Area**
Energy Systems, Plants & Infrastructure Systems, Logistics, Thermal & Drive Systems, Aircraft, Defense & Space

Main Products



Gas Turbines



Steam Turbine



Compressors



Aero Engines



Marine Machinery



Nuclear Energy Systems



CO₂ Capture Plants



Transportation



Waste-to-Energy



Aerospace

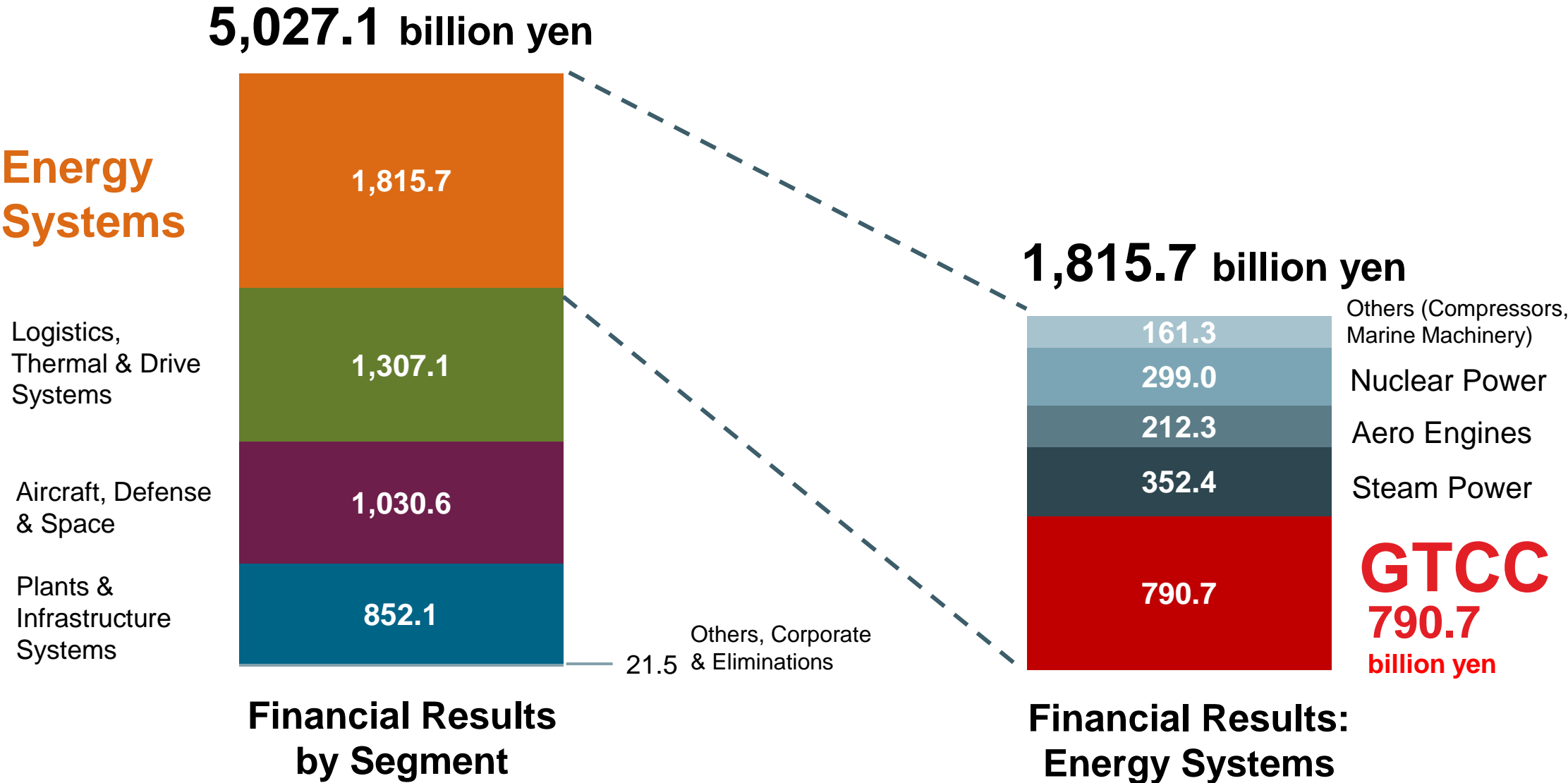


Frigate



Fighter

Positioning of MHI GTCC Business (FY24 Revenue/Consolidated)

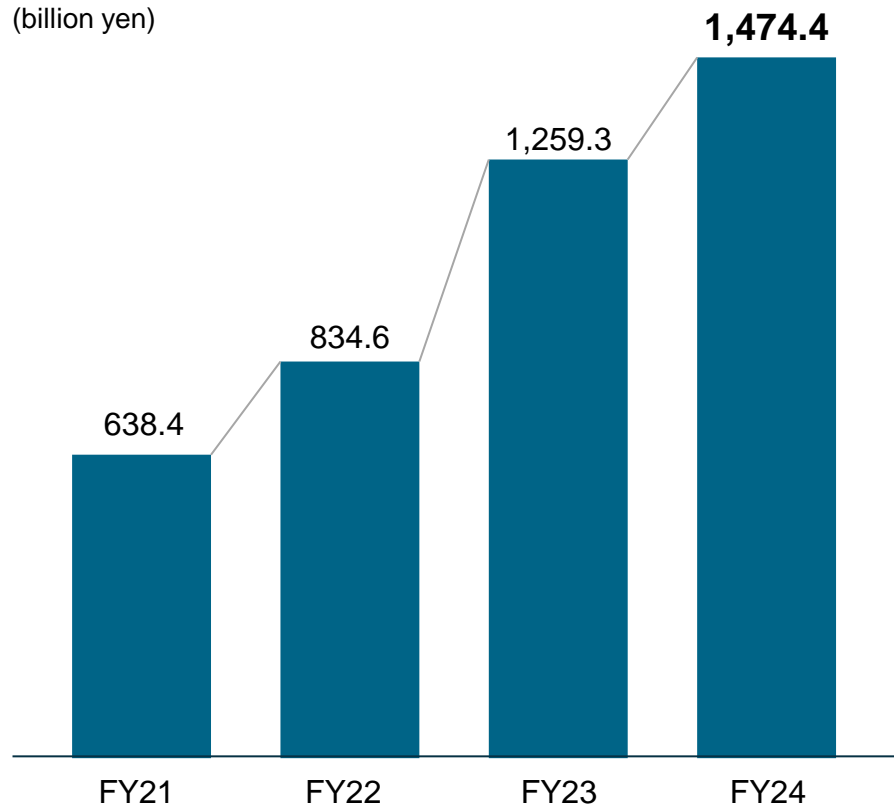


Financial Results Highlights: GTCC Order Intake and Revenue

- In many cases, long-term after-sales contracts are signed at time of new installation order intake, thereby securing future revenue
- Working to increase production capacity for main gas turbine components

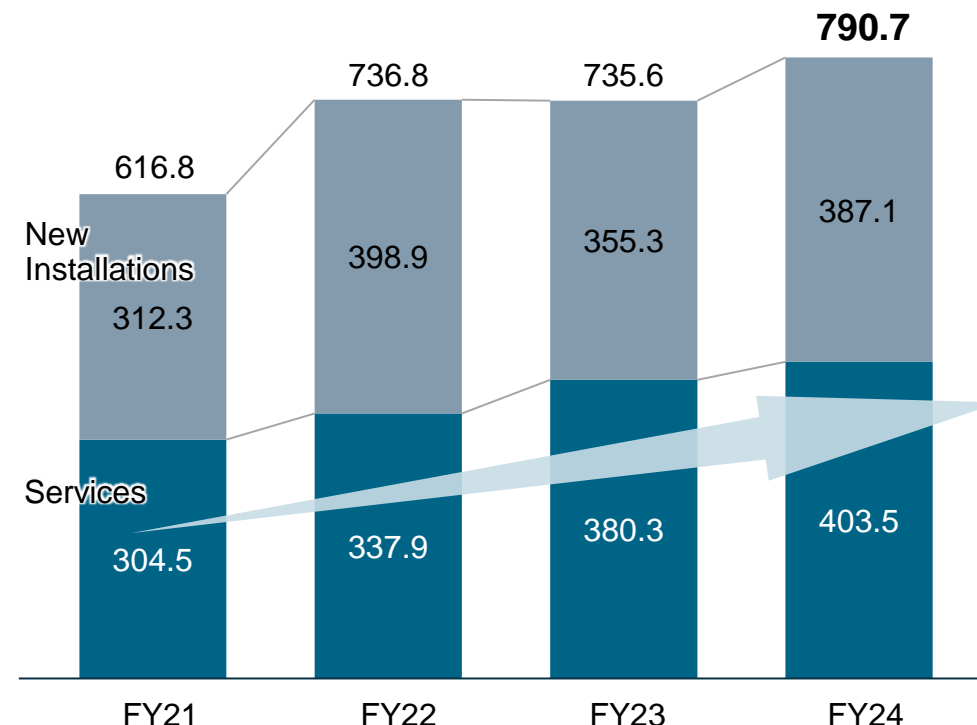
Order Intake

(billion yen)



Revenue

(billion yen)



Large Frame Gas Turbine Order Intake and Contract Backlog (units)

	FY2023	FY2024	Q1 FY24	Q1 FY25
Americas	7	11	4	6
Asia	9	5	2	2
EMEA	-	9	-	-
Other Regions	1	-	-	-
Order Intake Total	17	25	6	8
Contract Backlog	36	48	38	53

(Reference) China Licensee Order Intake

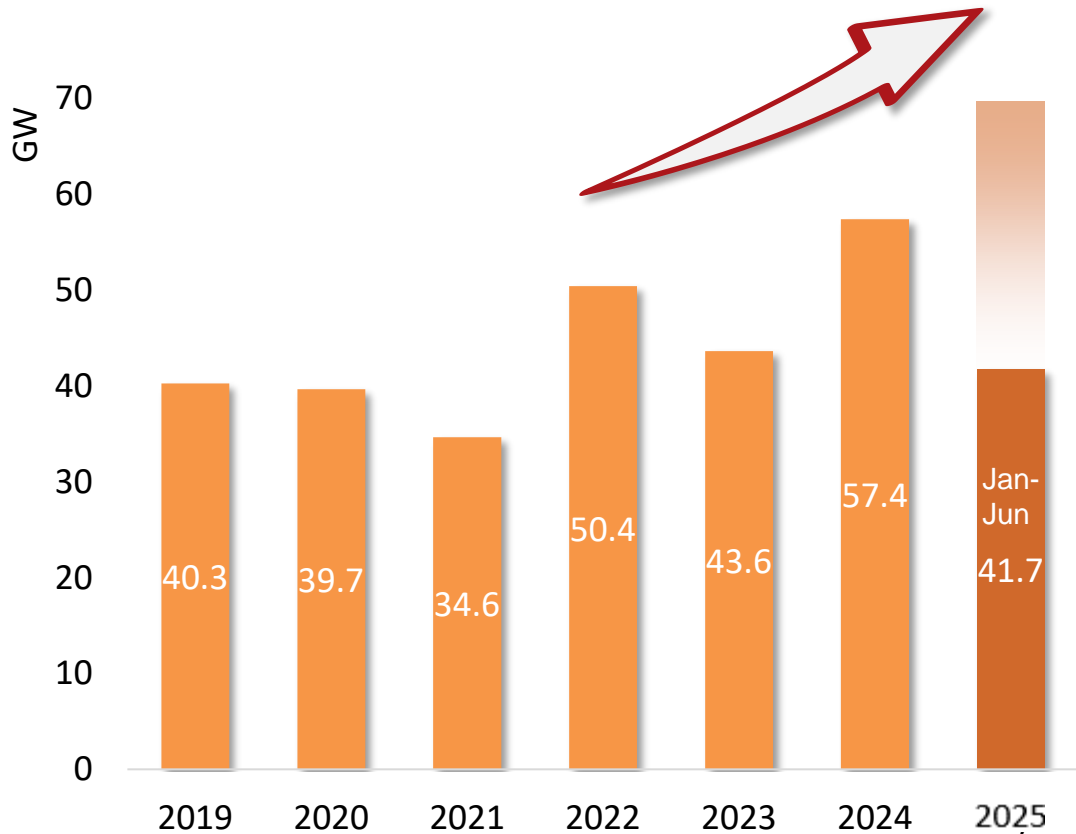
	FY2023	FY2024	Q1 FY24	Q1 FY25
Order Intake	21	7	-	3

CY2024 Gas Turbine Market Volume

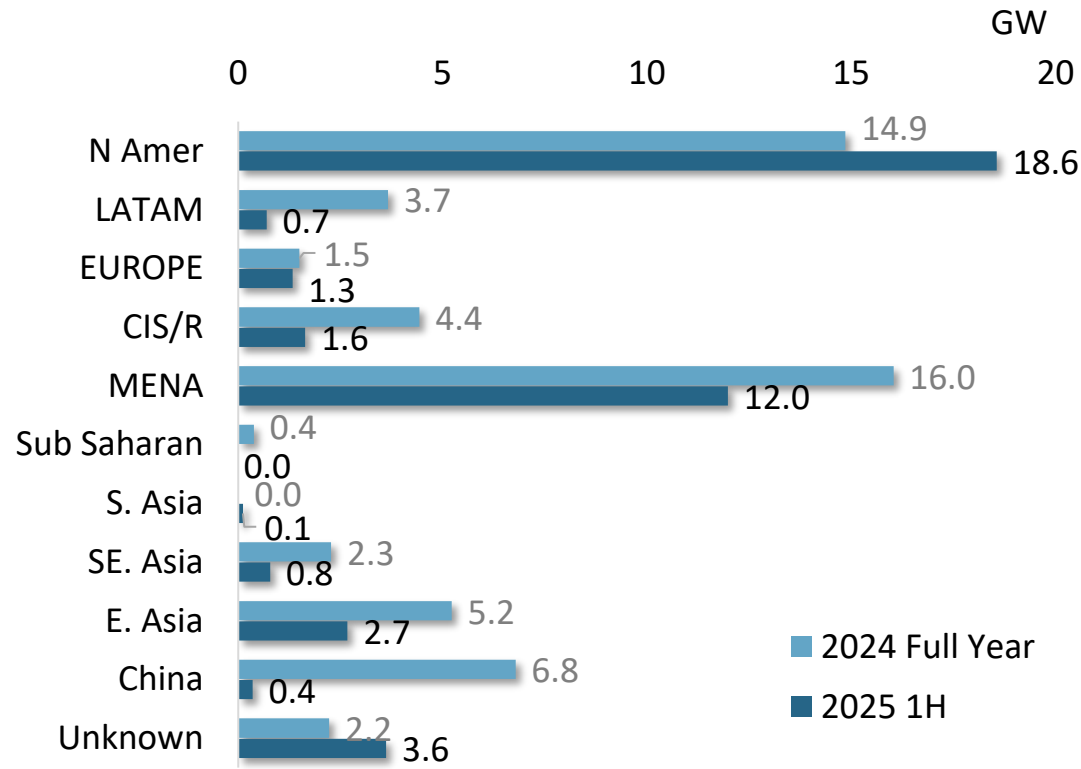


- GT market volume reached 57.4 GW in 2024, the highest since 2018
- In 1H 2025, GT market volume had already reached 41.7 GW, with the speed growth exceeding 2024
- Demand in North America and MENA has increased dramatically

Historical GT Market Volume

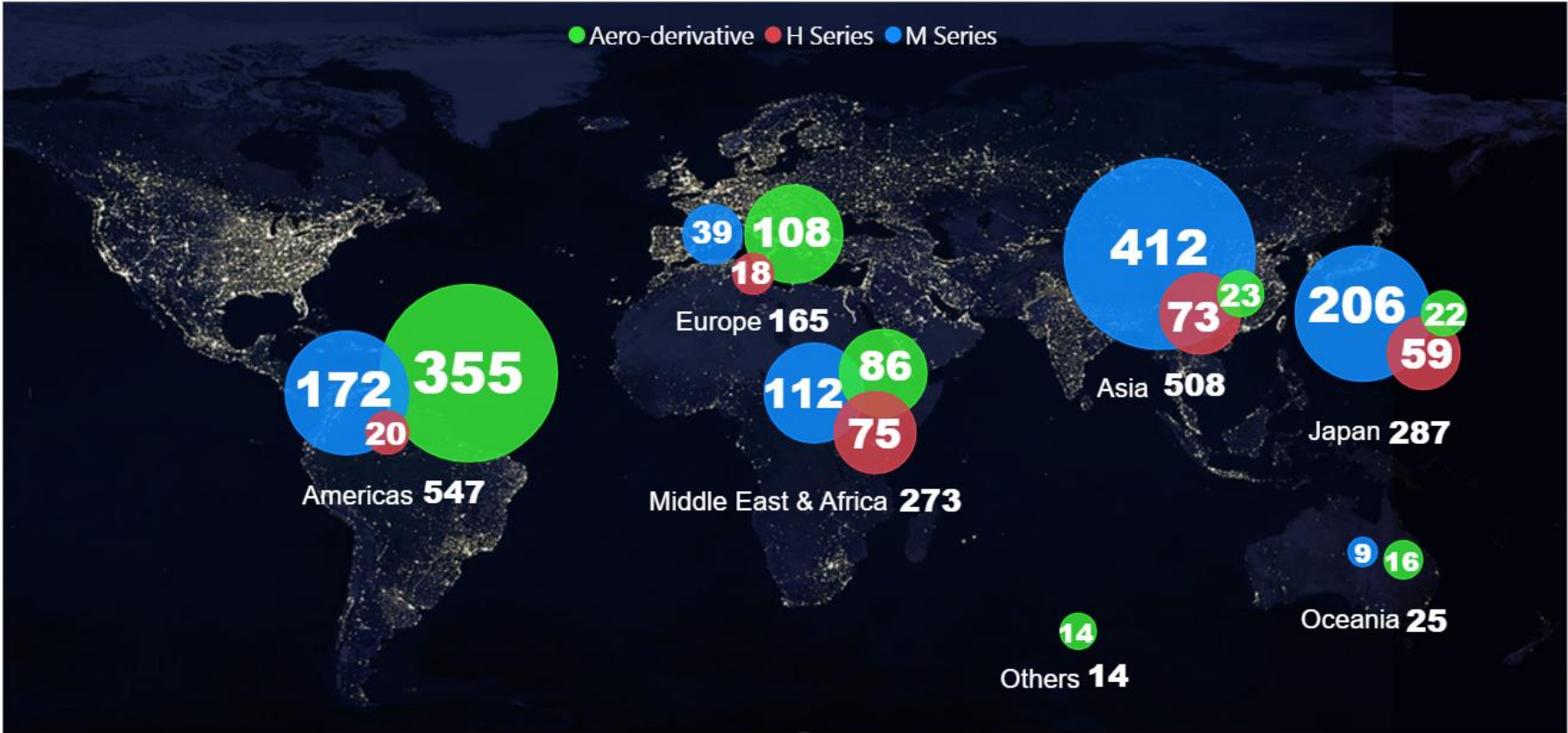


Market Volume by Region (CY2024 and 1H CY2025)



(Courtesy McCoy Power Reports)

MHI's Gas Turbine Orders and Market Share



Model	Units
H-100	33
H-15	6
H-25	206
Total	245

Model	Units
M501D	26
M701D	109
Total	135

Model	Units
M501F	80
M701F	257
Total	337

Model	Units
M501G	91
M701G	11
Total	102

Model	Units
M501J	114
M701J	58
Total	172

Model	Units
FT4000	14
FT8	610
Total	624

Grand Total
1,819 Units
Including GT manufactured by
licensee and awarded PJ

In addition, 204 units of M series Mid&Small Class GTs.

As of August 31, 2025



**Worldwide
Delivery**



**Sales
Offices**



- MHI has 10 major gas turbine parts manufacturing and repair bases worldwide



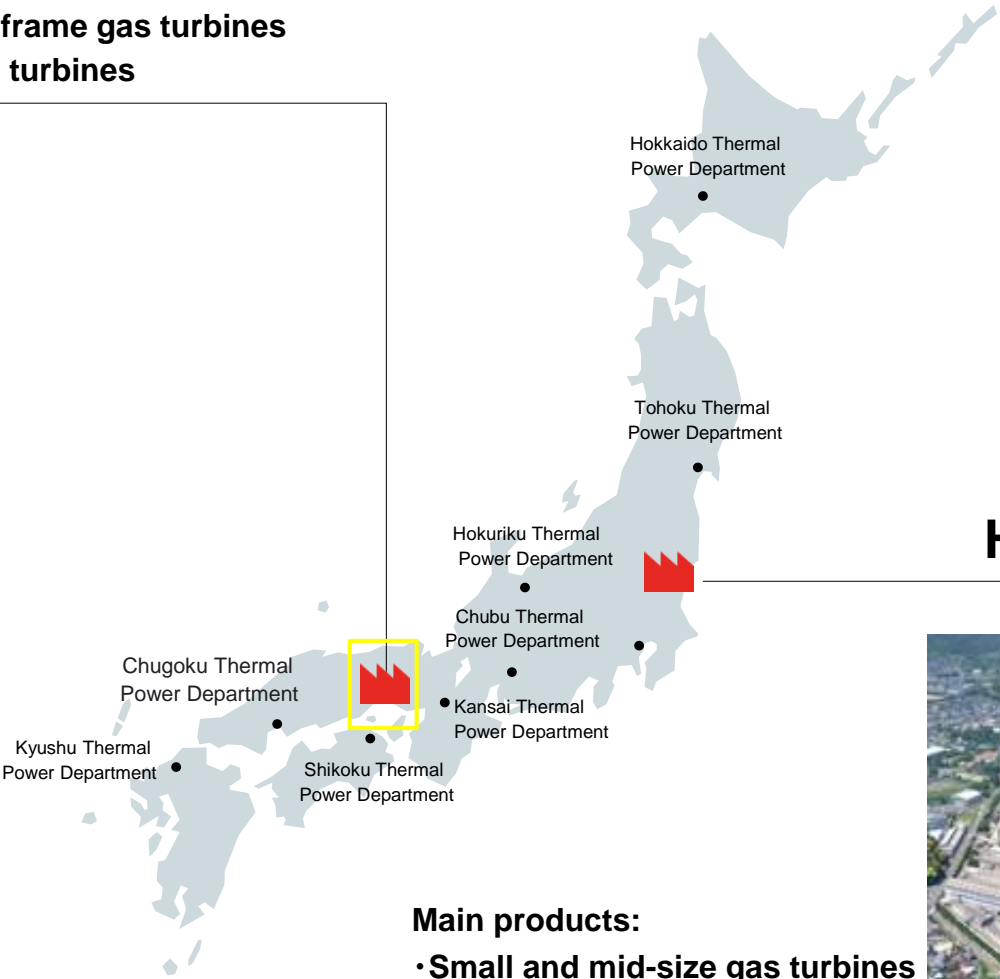
Takasago Machinery Works



- Main products:
- Large frame gas turbines
 - Steam turbines



● Domestic Bases



Hitachi Works



- Main products:
- Small and mid-size gas turbines
 - Steam turbines

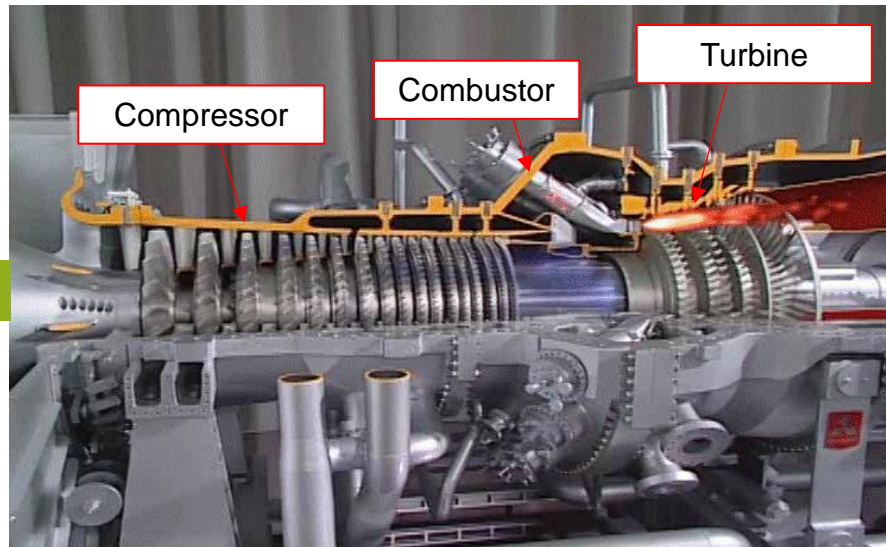


2. MHI Gas Turbine Technology

- Combined cycle efficiency can be improved by increasing gas turbine inlet temperature

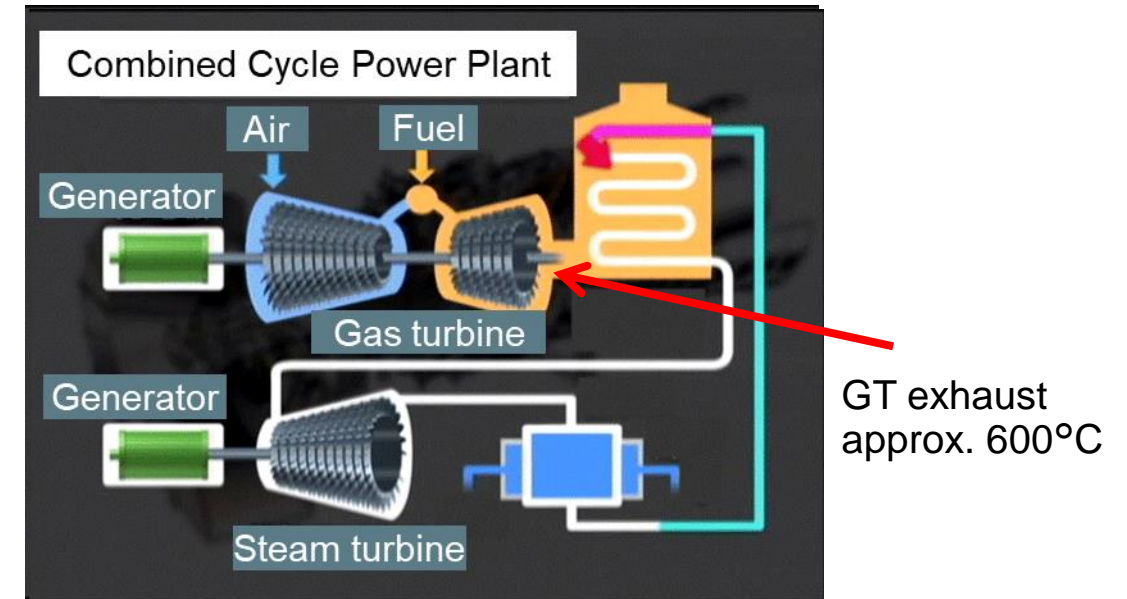
Gas Turbine Layout

Generator



- Main components are compressor, combustor, and turbine.
- High pressure, high temperature gas from combustion of fuel gas expands and produces power by rotating the turbine

Combined Cycle Power Plant Layout



- After generating electricity with the gas turbine, gas turbine exhaust heat is utilized to generate additional electricity with a steam turbine
- Combined cycle (gas turbine + steam turbine) achieves the highest thermal efficiency

1880-

Building Japan's infrastructure

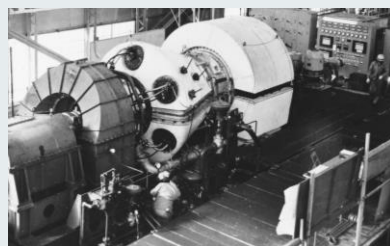


1884 Established Mitsubishi Heavy Industries

1908 Developed Japan's first Steam Turbine

1950-

Contributing to Japan's rapid economic growth



1960 Started gas turbine business in technical partnership

1970-

Providing solutions to fuel diversity and energy efficiency globally



1986 Became original developer of high efficiency gas turbines

2010-

Leading a carbon-neutral world through technology



2011 J-series gas turbine inlet temperature 1,600°C demonstration completed

2018 Successfully tested a large-scale turbine using 30% hydrogen fuel mix

2020 Next generation 1,650°C class gas turbine M501JAC demonstration start

2021 Started development of ammonium fueled gas turbine

2025 J-series gas turbine operating hours exceed 3 million hours, Cumulative orders of 172 units

1868-

Japan's Industrial Revolution

1973 / 1979
Oil Crisis

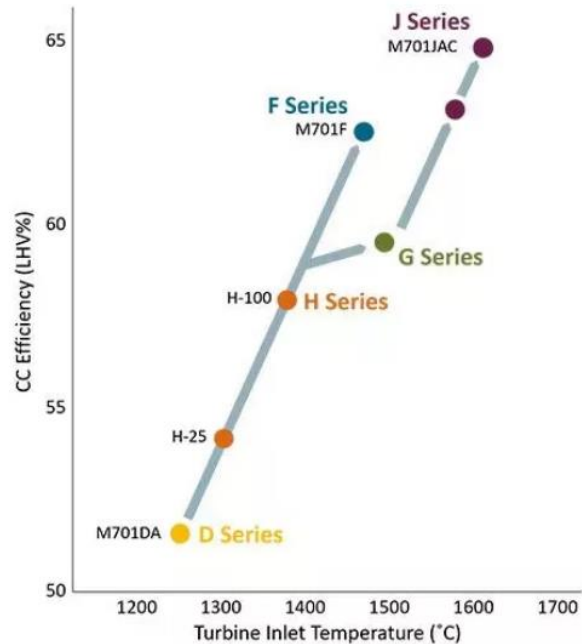
2015

The Paris Agreement on climate change

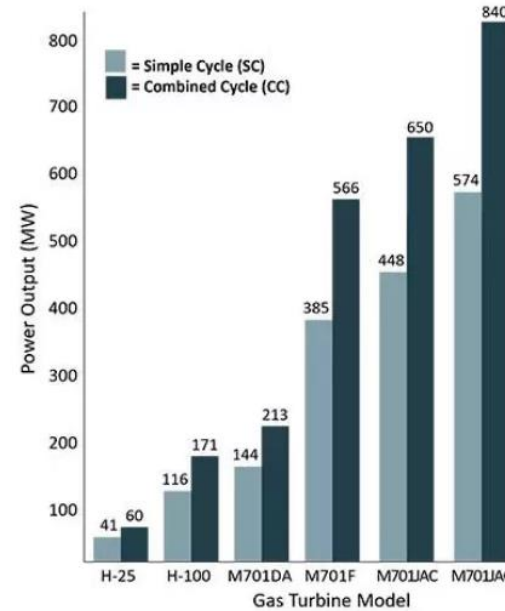
■ MHI offers a wide range of Gas Turbines – from small frame to large frame.

50 Hz

C/C Thermal Efficiency

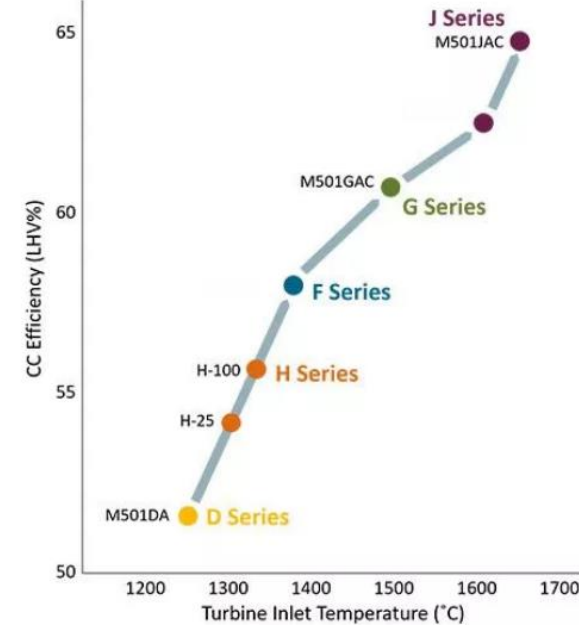


SC & CC Output

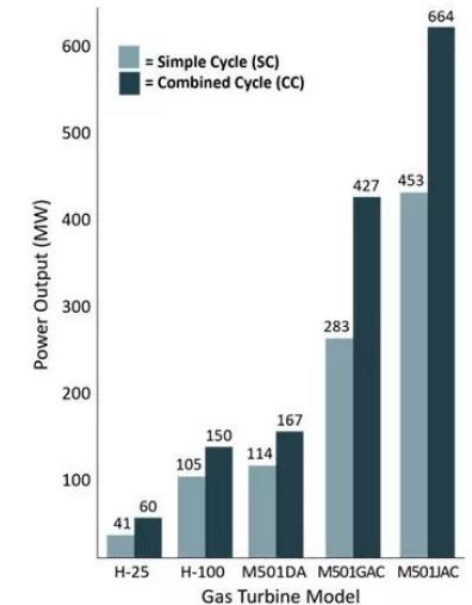


60 Hz

C/C Thermal Efficiency



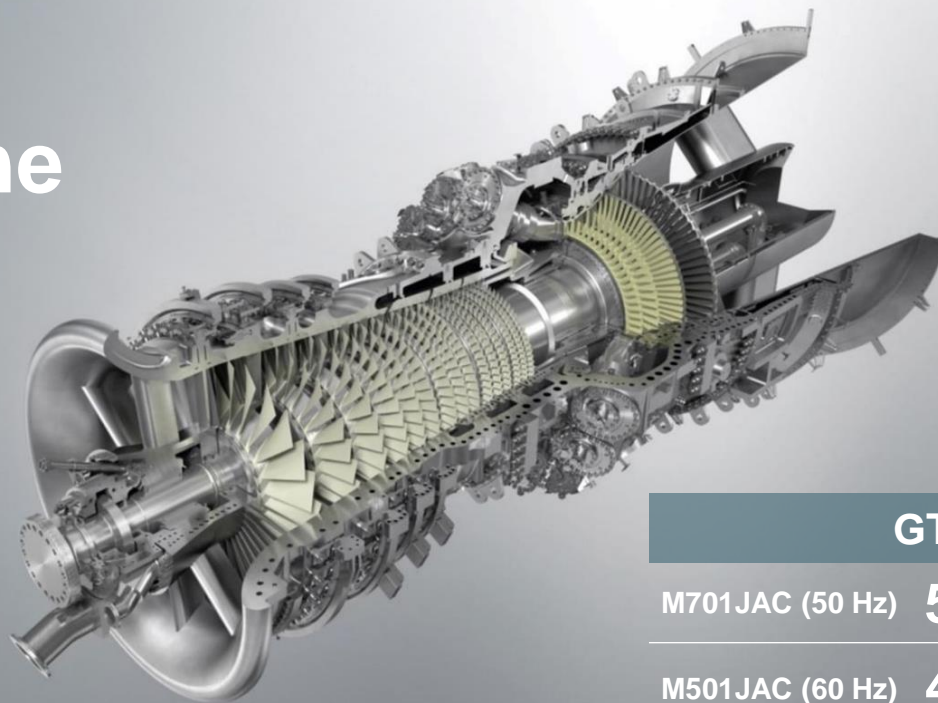
SC & CC Output



M701JAC GTCC Output: 840MW (50 Hz), equivalent to 2 million households' worth of electricity, which covers Yokohama City (1.8 million households).

- Contributing to the achievement of Carbon Neutrality with our world-leading power generation technology

JAC Gas Turbine



GT/CC

M701JAC (50 Hz) **574 MW / 840 MW**

M501JAC (60 Hz) **453 MW / 664 MW**



Type 2 Combustor

Completed design of combustor for 30% H₂ co-firing in 2018.

30% H₂ co-firing operation was successfully achieved at T-Point 2 in 2023.

High efficiency

Achieved 64% CC efficiency with

- High pressure ratio compressor (25:1)
- Enhanced air-cooled combustors
- Advanced thermal barrier coating (TBC)

High reliability

Cumulative total operating hours exceeds 3 million hours

- Booked units: 172
(J/JAC series as of August 2025)

Fuel flexibility

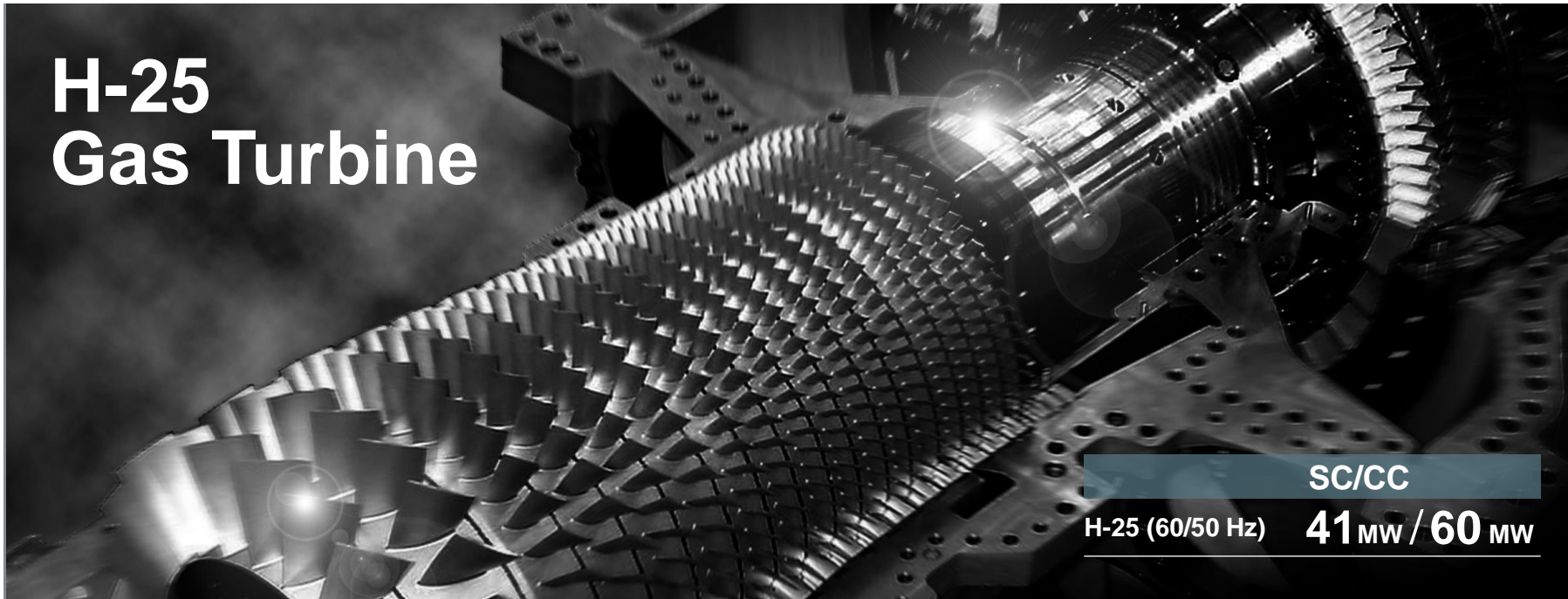
Compatible with a variety of fuels:

- Fossil fuels (natural gas, oil)
- Clean fuels (**hydrogen**)

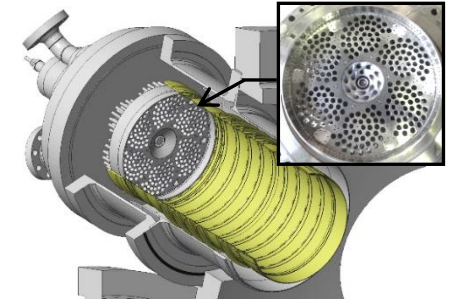
Small Frame Gas Turbine (H-25-Series)

- 30-40 MW gas turbine optimized for cogeneration* systems. Extensive track record of over 30 years.
- Developing combustors for use with hydrogen and ammonia

H-25 Gas Turbine



SC/CC
H-25 (60/50 Hz) **41 MW / 60 MW**



Type 3 Combustor

**Demonstration of 100%
H₂ firing began at
Takasago Machinery
Works in 2024**

High Efficiency

**More than 80% Total
Cogeneration Efficiency**

- Simple cycle 36.2%
- Combined cycle 54.0%
- Cogeneration Over 80.0%
79 ton/h (heat output)

High Reliability

**Cumulative total operating hours
exceeds 12.5 million hours**

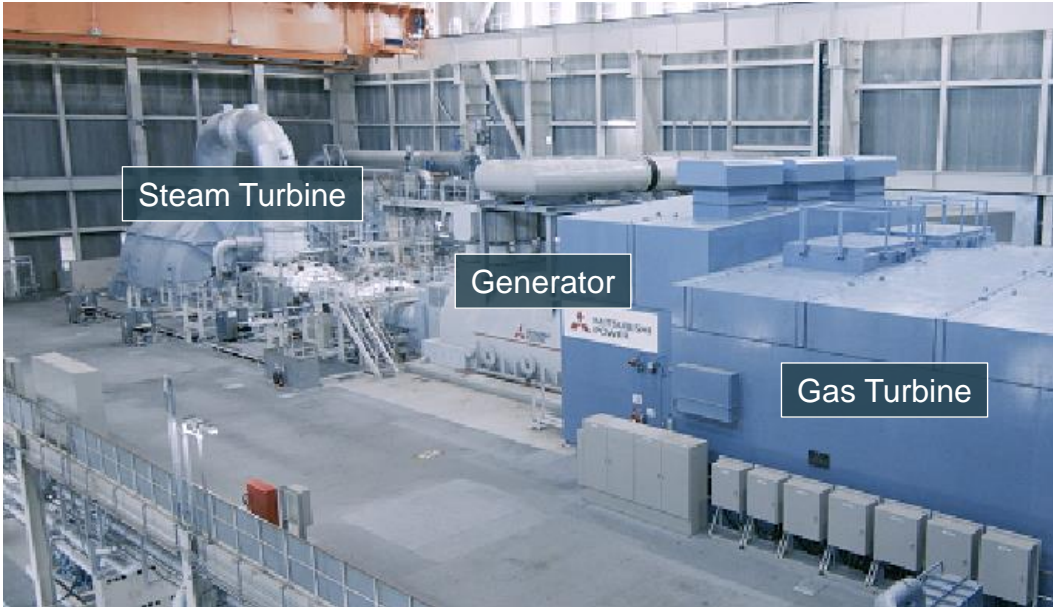
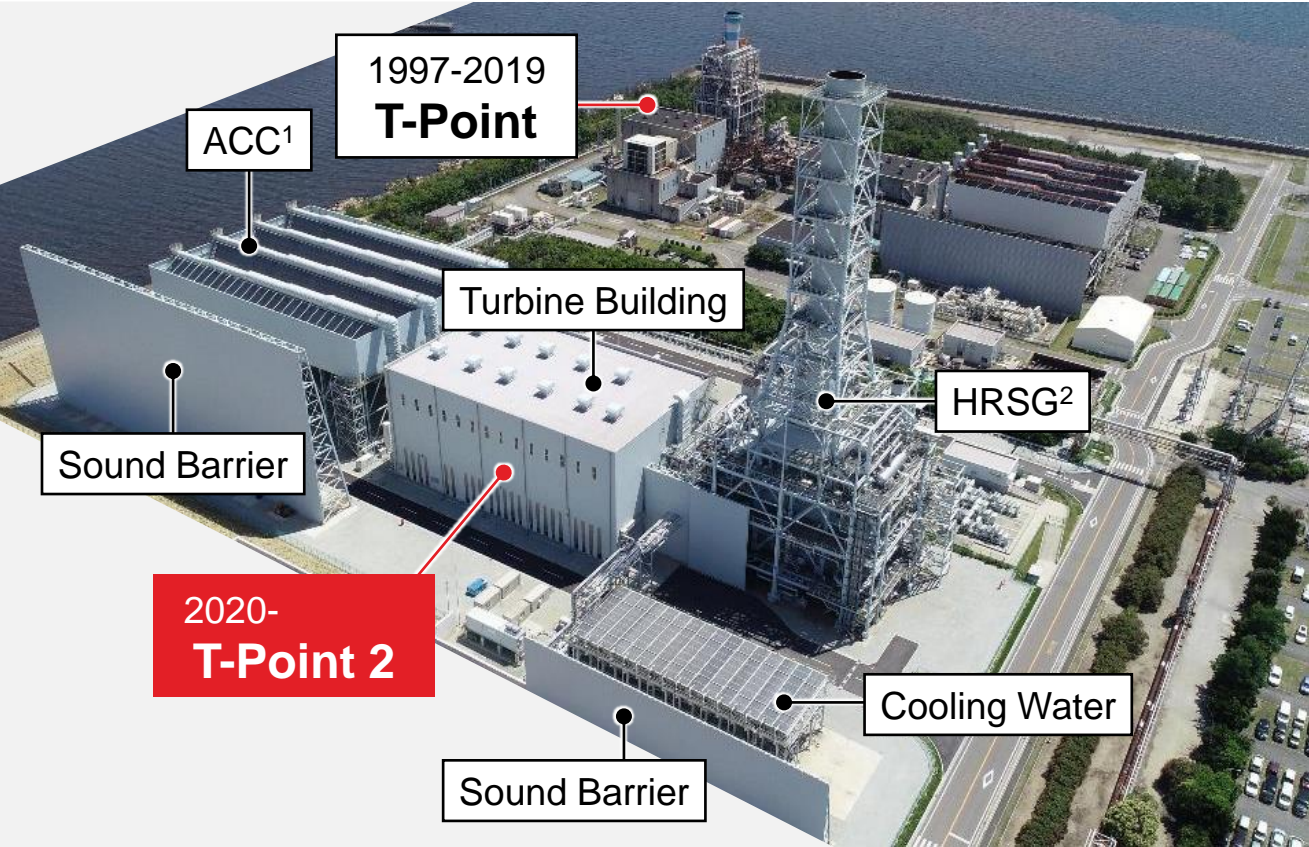
- Booked units: 206
(H-25 as of August 2025)

Fuel Flexibility

Compatible with a variety of fuels:

- Fossil fuels (natural gas, oil)
- Clean fuels (**hydrogen**)

Commercial-Scale Power Plant for Long Term Validation: T-Point 2



- Since 1997, all new gas turbine models have been validated in our on-site, commercial-scale power plant
- In 2020, renovations were completed, allowing for the validation of more advanced gas turbine technologies with larger capacities

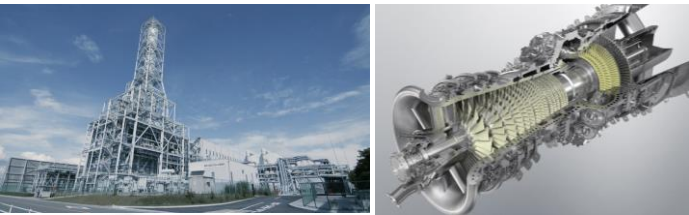
	T-Point	T-Point 2
Output (@5°C)	389MW	566MW
GT Type	M501J	M501JAC
Began Operation	June 1997	July 2020
Turbine Inlet Temp.	1,600°C	1,650°C
Combustor Cooling Method	Steam Cooled	Air Cooled
CC Efficiency ³	62% LHV ⁴	>64% LHV

Power Generation

Small & Mid-size Gas Turbine (40MW)



Large Frame Gas Turbine (566MW)



Production

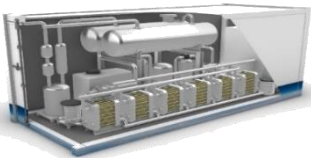
Green Hydrogen production technologies for geographies with many renewable energy resources



Alkaline water electrolyzer (in operation)



SOEC* (in demonstration operation)



Anion Exchange Membrane (AEM) water electrolyzer

Turquoise hydrogen production technologies for geographies with few renewable energy resources



Methane Pyrolysis

Storage

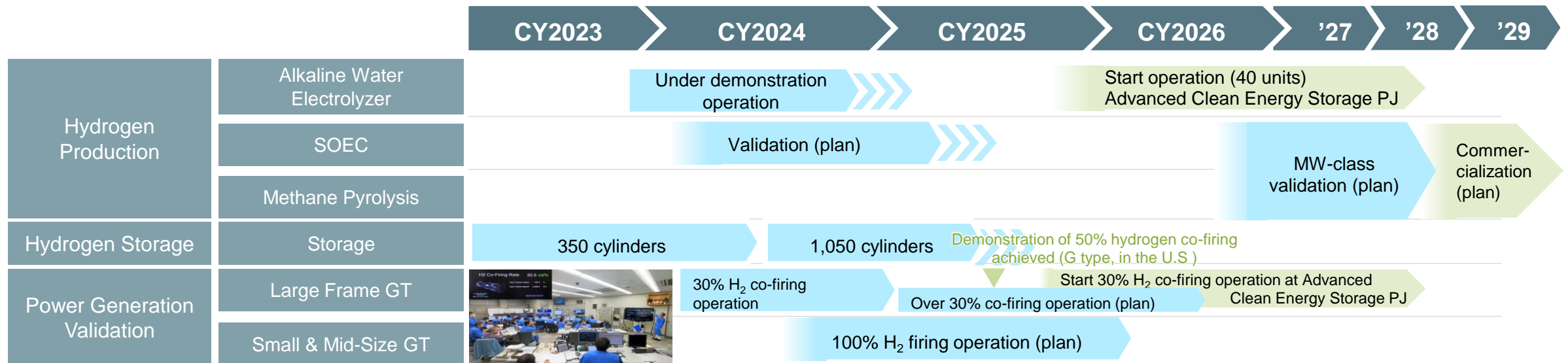


Hydrogen Storage
350 → 1050 Units

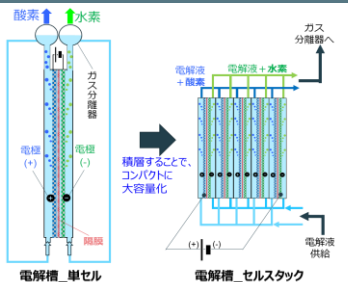


Takasago Hydrogen Park schedule

- September 2023: Started operation of alkaline water electrolyzer
- November 2023: 30% hydrogen co-firing operation with M501JAC Gas Turbine using hydrogen produced by alkaline water electrolyzer
- 2024: 100% hydrogen firing operation with H-25 gas turbine
- 2024-2025: Hydrogen storage to be increased to 117,000 Nm³ (1,050 units)



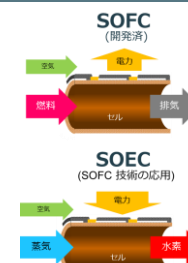
Alkaline Water Electrolyzer



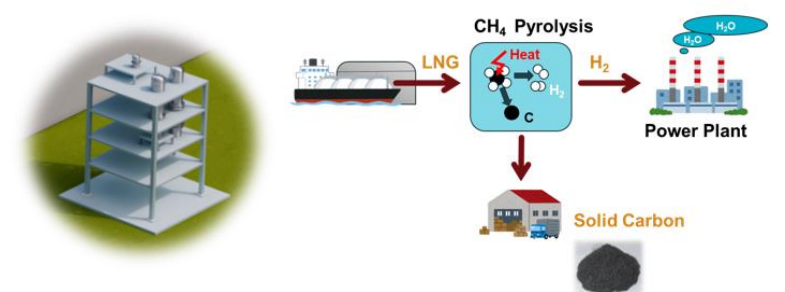
SOEC



SOEC: Solid Oxide Electrolysis Cell



Methane Pyrolysis

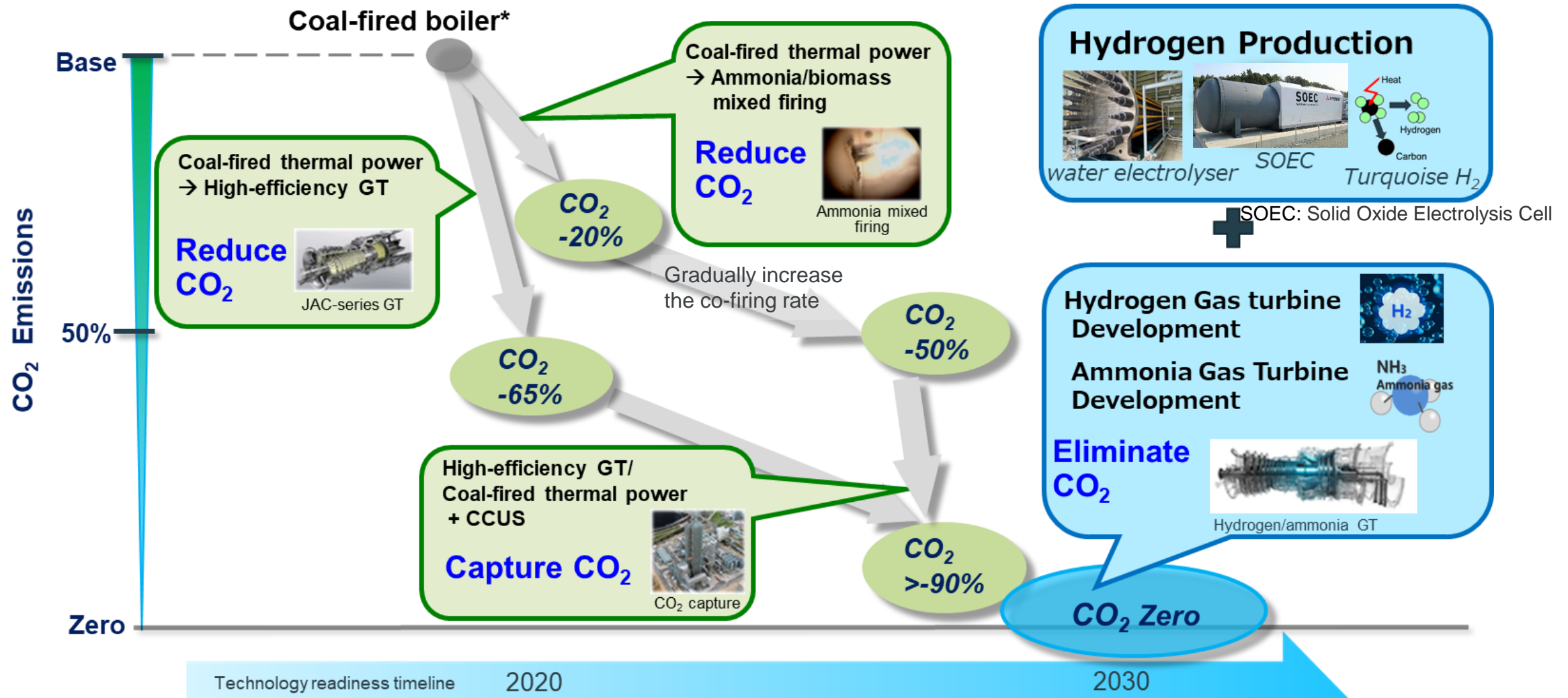




3. MHI Energy Transition Initiatives

Roadmap for Decarbonizing Existing Infrastructure

■ Reducing, capturing, and eliminating CO₂ is one path to decarbonizing thermal power

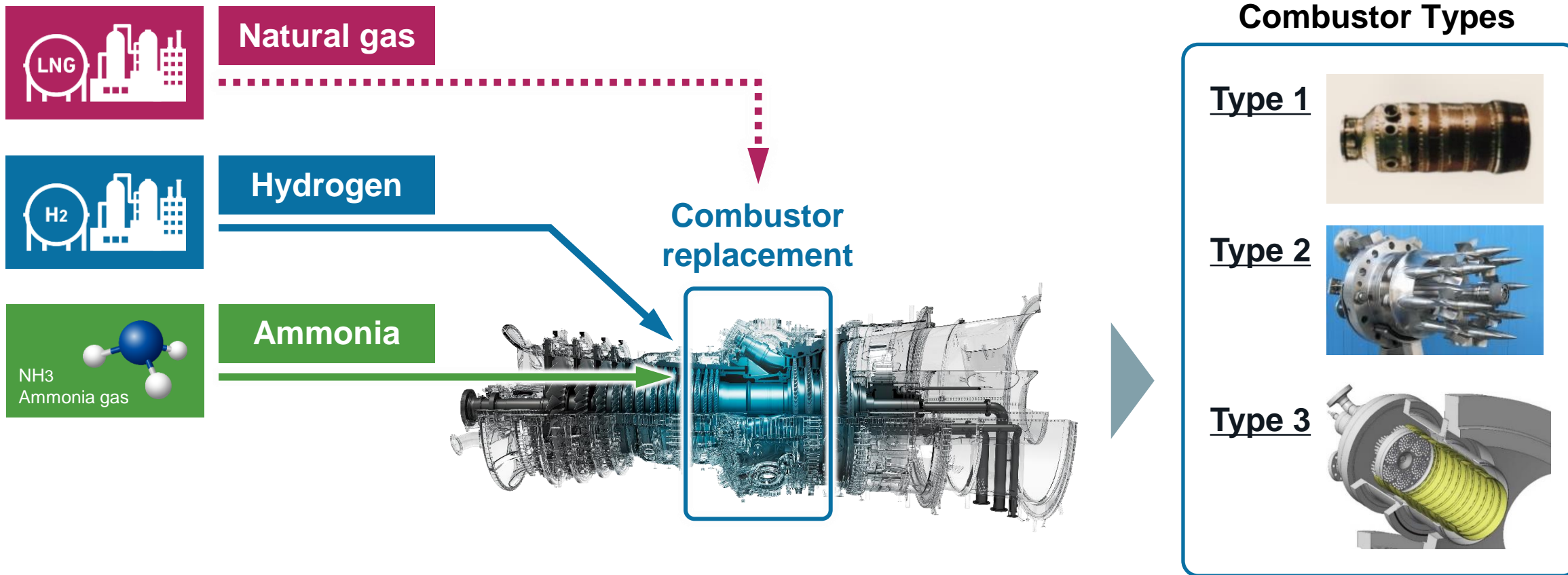


*Based on CO₂ emissions from subcritical pressure coal-fired boilers

CCUS: Carbon dioxide Capture, Utilization and Storage

Conversion to Hydrogen/Ammonia Gas Turbine

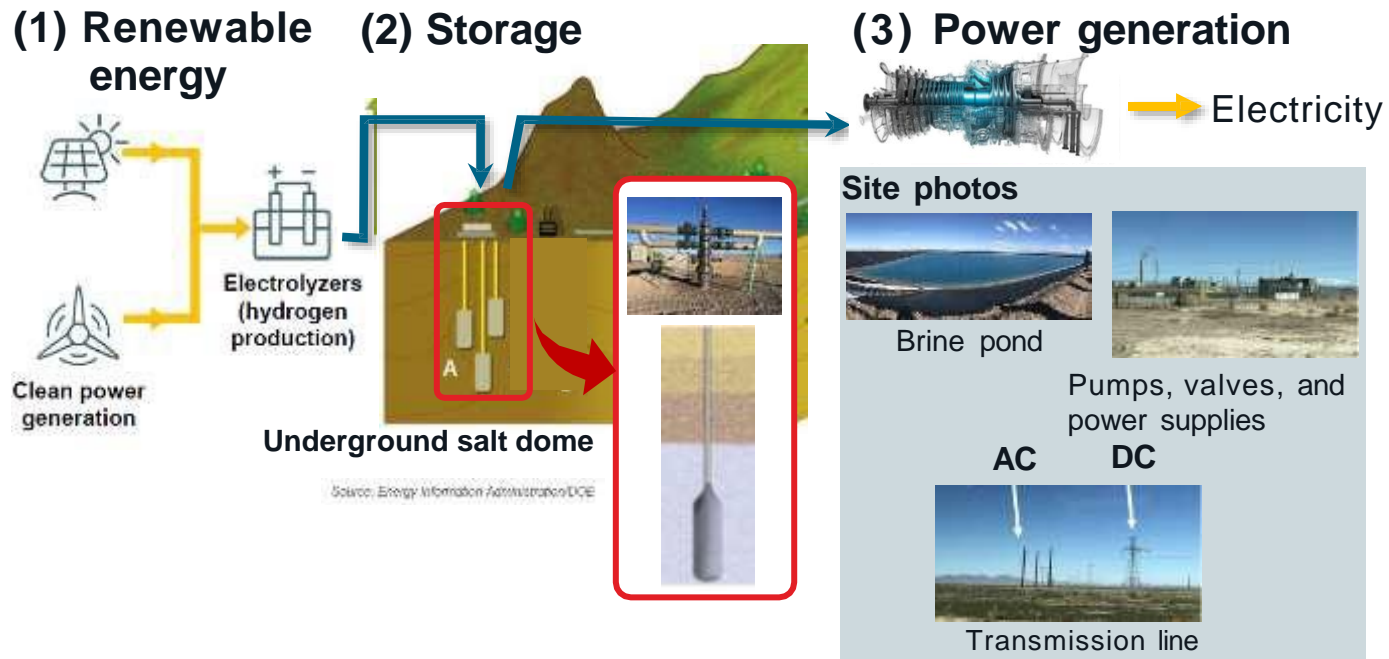
- Fuel conversion from natural gas to hydrogen/ammonia is easily achieved by replacing combustors and adding fuel systems



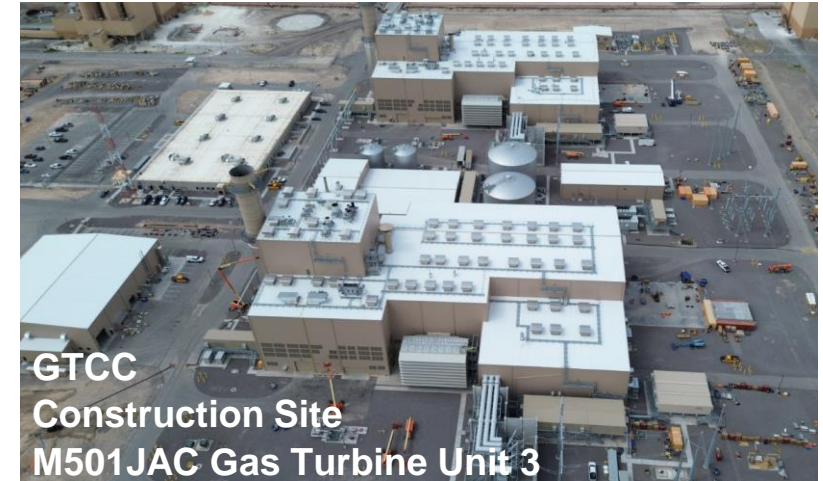
Hydrogen Firing Gas Turbine project in United States (1)

■ Advanced Clean Energy Storage Project (USA)

1. Green hydrogen production by electrolyzers using renewable energy from the West Coast.
2. Storage in salt caverns in North America.
3. Power generation by gas turbine on demand.
4. DOE Loan application submitted for up to \$595 million



Mitsubishi Heavy Industries to supply two hydrogen-capable M501JAC gas turbine power trains (1x1) to Intermountain Power Agency. Plans to co-fire 30% hydrogen in 2026 and operate with 100% hydrogen no later than 2045.

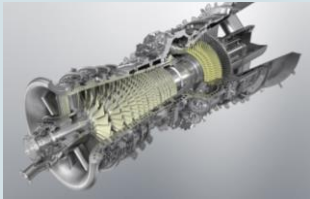


Hydrogen Gas Turbine Projects in the United States ②

■ 50% hydrogen blend testing successfully completed at Georgia Power's Plant McDonough-Atkinson

2025-6-16 press release <https://power.mhi.com/regions/amer/success-stories/mcdonough>

Utilize



M501GAC (283MW)
large-capacity gas turbine

Type 2 Pre-Mixed Combustor



Successful
operation at
20% (2022)
50% (2025)

hydrogen co-firing

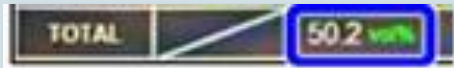


Fig. Monitoring display, Hydrogen > 50 vol.%

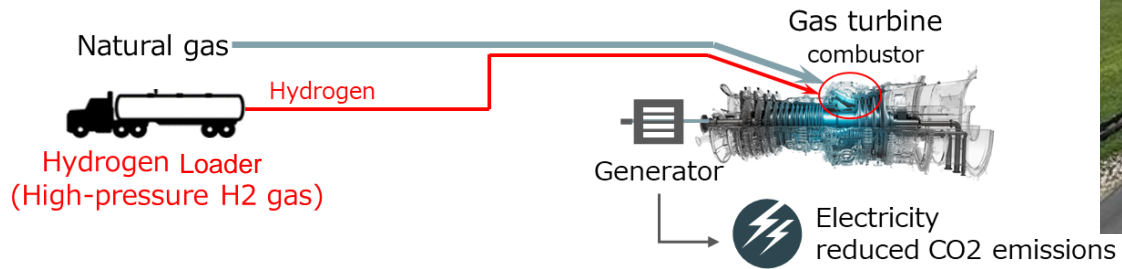







Fig. Diagram of Hydrogen Installation



Photo: Hydrogen co-firing project (2012 COD existing GTCC power plant)

- Successfully completed 50% hydrogen fuel blending at both partial and full load on an M501GAC natural gas turbine
- Carried out hydrogen system logic and combustor safely, and achieved less than 15 ppm in NO_x emissions

Reference Materials

Materials	URL (QR code)	URL	Materials	URL (QR code)	URL
TAKASAGO MACHINERY WORKS		https://www.mhi.com/company/location/takasago/catalogue.pdf	Carbon Neutrality Handbook		https://www.mhi.com/company/overview/carbon-neutral/pdf/cn_handbook_2022.pdf
T-POINT 2 (Proving Ground for Gas Turbine Advancements)		https://power.mhi.com/catalogue/pdf/t-point2.pdf	HYDROGEN POWER GENERATION HANDBOOK		https://power.mhi.com/catalogue/pdf/hydrogen_en.pdf
GTCC (Gas Turbine Combined Cycle Power Plants)		https://power.mhi.com/catalogue/pdf/gtcc.pdf			

