

Activities for Fuel Ammonia Implementation

October 17, 2025

Clean Fuel Ammonia Association



Clean Fuel Ammonia Association

Establishment

- 2014~2018 : In pursuit of a hydrogen society, the Cross-ministerial **Strategic Innovation Promotion (SIP)** Program was implemented.
- April 1, 2019 : Green Ammonia Consortium (as an independent **General Incorporated Association**)
- January 14, 2021 : **Clean Fuel Ammonia Association (CFAA)**(name was changed)
- Members **260** Corporations, Institutions and Gov. Offices from **18** countries(End of Sept. 2025)

Objectives

- Contribution to the realization of a **hydrogen/ammonia society** by aiming to mitigate global warming and enhance energy security, under the recognition that ammonia is a **promising hydrogen energy carrier**
- Establishment of **value chains** that focus on **using clean ammonia fuels and raw materials** to contribute to the achievement of a low-carbon society

Main activities

- (a) Promoting collaboration by providing a **common platform** for members and stakeholders
- (b) Promoting **information sharing and exchange** among members
- (c) Deliberation toward the development of **technical standards and guidelines** for the ammonia supply chain
- (d) **Formulation of strategies** and **policy advocacy** for the early social implementation of clean ammonia
- (e) **International collaborations**
- (f) Public awareness and outreach activities to promote **proper understanding and adoption** of clean fuel ammonia



Current Key Activities For Fuel Ammonia Implementation

❑ Safety and Risk Communication

Promoting the widespread use of fuel ammonia in safe, CFAA is committed to:

- ✓ Continuous efforts to ensure safety
- ✓ Advancing risk communication
- ✓ Supporting members in the practical application of fuel ammonia

❑ International Standardization

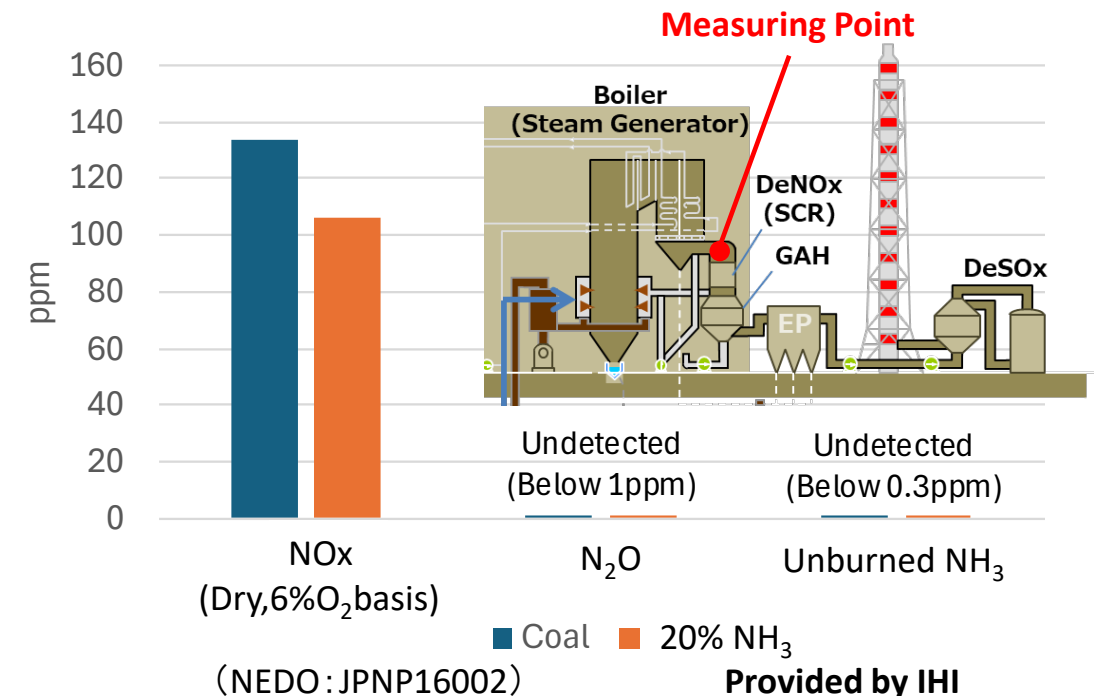
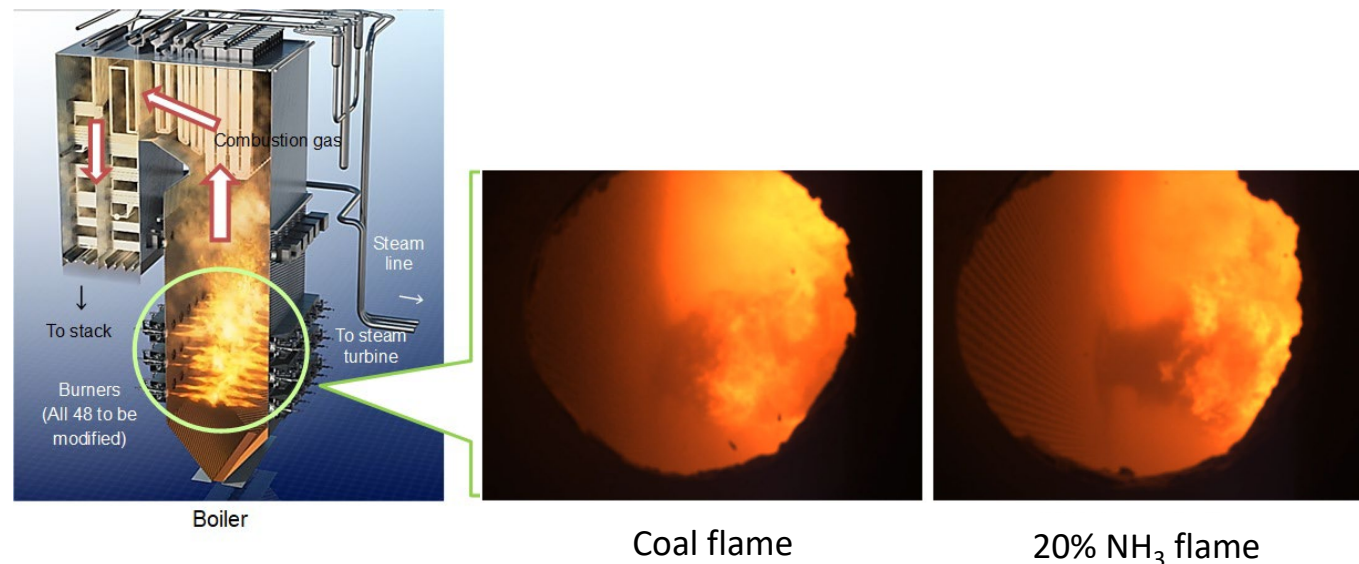
Contributing to the international standardization regarding fuel ammonia usage and so on, enabling its appropriate use across industries and regions worldwide.



Development of Fuel Ammonia Utilization Technologies Toward Social Implementation

Coal Fired Boiler

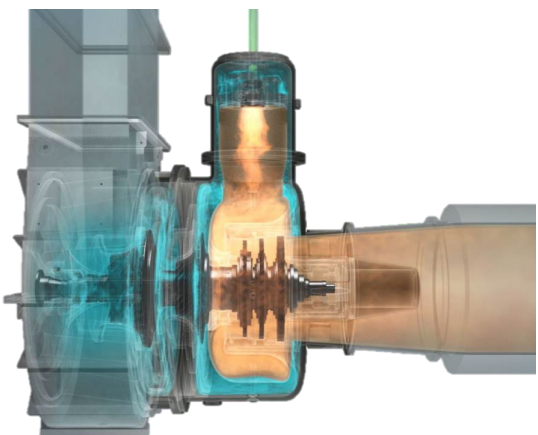
- Demonstration at 1,000MW Coal Power Plant with 20%NH₃
- This effort has yielded favorable environmental outcomes.
 - ✓ NO_x emissions are equal to or less than before ammonia substitution.
 - ✓ Emissions of powerful greenhouse gas N₂O and unburnt NH₃ have been undetectable.
 - ✓ CO₂ and SO_x emissions are reduced by 20%.
 - ✓ Flue gas properties were good condition in terms of emission.
- The international Technical Specification TS21343, which covers ammonia-fired boiler, was officially published in January 2025.



Development of Fuel Ammonia Utilization Technologies Toward Social Implementation

Gas Turbine

- 2MW Power output
- ✓ Liq. NH_3 Pure Firing
- ✓ Rich and lean two stage combustion system
- ✓ NOx emissions meet Japan's urban regulations with SCR
- Under development to deploy same technologies to large-scale gas turbines up to 400MW



2MW gas turbine

Provided by IHI



2MW gas turbine system (NEDO:JPN21020)

Provided by IHI

Marine Engine

- Ammonia-fueled engine for coastal vessels (1,600kW)
- ✓ Completed 95% NH_3 co-firing
- ✓ NOx emissions meet Tier III regulation with SCR
- ✓ Demonstration voyage of tug boat equipped above engine successfully completed
- Marine engine will be installed on 40,000m³ ammonia carrier this October, with delivery scheduled for November 2026 (8,000kW)



Ammonia-fueled engine (NEDO:JPN21031)

Provided by IHI



A-tug boat (NEDO:JPN21031)

Provided by NYK

FY2025 Activity Plan of “Hydrogen & Ammonia”

Objective:

Promote the adoption of fuel ammonia across ASEAN countries.

Key Initiatives:

- Dissemination of technical information on fuel ammonia utilization through webinars and other outreach activities.

Schedule:

- **1st Webinar:** May 25
- **2nd Webinar:** Planned within FY2025

Safety Measures for Ammonia Use

- Implementation of all possible safety measures, while maintaining communication to ensure the understanding and reassurance of local community.

Safety Measures and Communication with the Local Community

Early detection and action: 24-hour monitoring, patrol inspections, etc.



Prevention of accidents: Safety design (shock resistance, countermeasures against tsunami and high tides, etc.)
Prevention of damage spread: Liquid-proof dike, emergency shutdown function, etc.



Provided by JERA

Gain Understanding from the local Community

- ✓ Sharing knowledge about ammonia and its safety measures through communication with local communities such as fire departments
- ✓ Safety drills are planned and implemented in cooperation with the fire department. Safety measures are promoted alongside the local community.

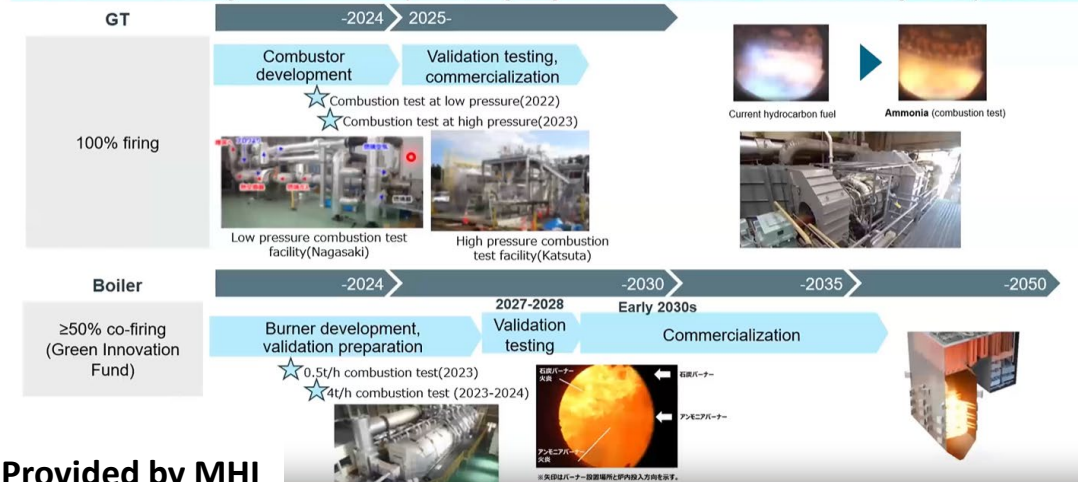


JERA

Ammonia : Power Generation Technology



- Gas turbine: Working on combustor development, aiming for commercialization after 2025
- Boiler: Working on burner development, targeting commercialization of ≥50% co-firing in early 2030s



Provided by MHI



Overview of 1st Webinar

Date & Time: May 26, 2025 | 17:00 JST

Participants: Approximately 200 attendees

Theme:

Technologies for Power Generation Using Fuel Ammonia and Introduction of Other Carbon-Neutral Technologies

Presentations:

- **JERA:** JERA's Decarbonization Activities
- **IHI Corporation:** IHI Carbon Neutral Activities – Ammonia Fuel and Others
- **Mitsubishi Heavy Industries:** Development and Verification of MHI Carbon Neutral Solutions (NH₃, H₂ and CO₂)

Webinar video is still available in CEFIA HP! Link: <https://www.cefia-dp.go.jp/event/hydrogenammonia-seminar-2025-05-26>

SESSION IV: Ammonia

JERA's Decarbonization Activities

IHI Carbon Neutral Activities – Ammonia Fuel and Others –

Development and Verification of MHI Carbon Neutral Solutions (NH₃, H₂ and CO₂)

Mr. Soichiro Niwa
General Manager,
JERA Co., Inc.

Dr. Takuya Okada
Assistant Manager,
IHI Corporation

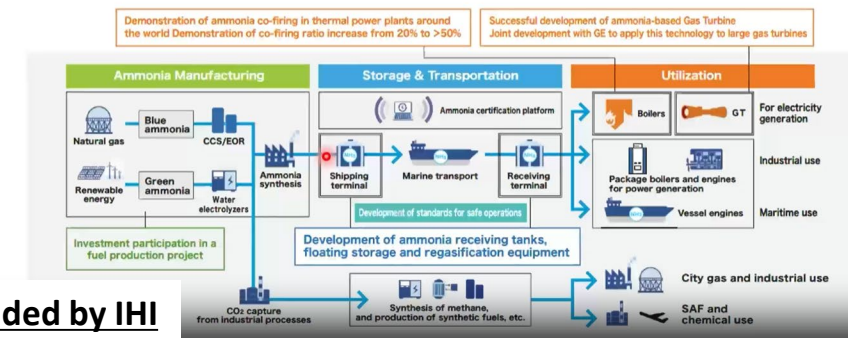
Mr. Toshishige Ai
Senior Manager,
Mitsubishi Heavy Industries, Ltd.

CEFIA
Clean Energy
Forum Initiative
for ASEAN
+3

CLEAN FUEL AMMONIA ASSOCIATION

Summary

- IHI will continue to develop and commercialize ammonia combustion technology globally, contributing to the realization of carbon neutral in thermal power plants and various industries.
- IHI will establish a global ammonia value chain through international collaboration.
- IHI will develop a variety of carbon recycling technologies, contributing to the global reduction of CO₂ emissions.



Provided by IHI

Thank you for your kind attention



Member List of Clean Fuel Ammonia Association

As of October 1, 2025

[Board Members] 15 companies

Idemitsu Kosan
IHI
ITOCHU
JERA
JGC HOLDINGS
Marubeni Corporation
Mitsubishi Corporation
Mitsubishi Heavy Industries
MITSUI & CO., LTD.
Mitsui Chemicals
MUFG Bank
NYK Line
SUMITOMO CHEMICAL
Tokyo Gas
Toyo Engineering

[General Members] 147 companies

ABE NIKKO KOGYO
AGC
Air Water Inc.
AISAN INDUSTRY
Aramco Asia Japan
Asahi Kasei
ASAHI KOHSAN
Asahi Tanker
BENFIELD ELECTRIC JAPAN
BP Japan
Cataler
Central Tank Terminal
Chiyoda
Chubu Electric Power Company
CHUGAI RO
Clariant Catalysts
CLEARIZE
ConocoPhillips Japan
Cosmo Engineering
Cosmo Oil
Daihatsu Diesel
DAIICHI JITSUGYO
Development Bank of Japan
Diamond & Zebra Electric Mfg
EBARA
EDF JAPAN
Electric Power Development
Emerson Japan
ENEOS
Fuji Car Manufacturing
Fuji Electric
Fuji Oil
FUKUI SEISAKUSHO
GYXIS
HANWA
HAZAMA ANDO
HIROSHIMA GAS
Hitachi Industrial Products
Hokkaido Electric Power
Hoku energy
Hokuriku Electric Power Company
HORIBA
IINO KAIUN
INFLUX
INPEX
ISHII IRON WORKS
Iwatani Corporation
Iwatani Gas
Japan Bank for International Cooperation
Japan Oil Engineering
Japan Oil Transportation
Japan Petroleum Exploration
JFE Engineering
JFE Steel
JGC Catalysts and Chemicals
Kajima
Kanadevia
Kawasaki Heavy Industries
Kawasaki Kisen Kaisha
KOBE STEEL
KOBELCO WIRE COMPANY
Kowa Company
Kowa Emori
Kyushu Electric Power
MAEDA CORPORATION
Maruzen Petrochemical
MAYEKAWA MFG.
Mitsubishi Electric
MITSUBISHI GAS CHEMICAL
MITSUI E&S
Mitsui O.S.K. Lines
Mitsui Sumitomo Insurance
MIURA

Mizuho Research & Technologies
MODEC, Inc.
N.E. CHEMCAT CORPORATION
NGK INSULATORS
NICHIAS
NIKKISO
Nikki-Universal
NIPPON COKE & ENGINEERING
Nippon Kaiji Kentei Kyokai
Nippon Kaiji Kyokai (ClassNK)
Nippon Oil Pump
Nippon Paper Industries
NIPPON SHARYO, LTD.
NIPPON SHOKUBAI
NIPPON STEEL
NIPPON STEEL PIPELINE&ENGINEERING
NIPPON STEEL TRADING
Nitterra
Non-Destructive Inspection
NRS CORPORATION
NS UNITED KAIUN KAISHA
OBAYASHI
Okinawa Electric Power
Osaka Gas
OVAL
Penta-Ocean Construction
Planning and Design Center for Greener Ships
Resonac Holdings
RIKEN KEIKI
Safar International
Senko Line
Shell Japan
Shikoku Electric Power Company
Shimadzu
SHIMIZU
SHIN NIHON KENTEI KYOKAI
Shin Nippon Machinery

Shinsho Corporation
Sojitz
Stäubli
SUMITOMO CORPORATION
Sumitomo Mitsui Banking
Sumitomo Mitsui Construction
Sumitomo Mitsui Trust Bank
Suzuyo Shoji
Taisei Corporation
TAIYO NIPPON SANSEI
TB Global Technologies
TEIKOKU ELECTRIC MFG.
The Chugoku Electric Power Company
The Kansai Electric Power Company
thyssenkrupp nucera Japan
TOHO GAS
Tohoku-Electric Power
TOKYO ELECTRIC POWER SERVICES
Toray Industries
Torishima Pump Mfg
TOYO KANETSU
TOYOTA CENTRAL R&D LABS
TOYOTA ENERGY SOLUTIONS
TOYOTA INDUSTRIES
Toyota Tsusho Corporation
TSUKISHIMA KANKYO ENGINEERING
TSUNEISHI SHIPBUILDING
UBE Corporation
Uyeno Transtech
Vena Energy Japan
VOLCANO
Vopak Japan
WAQUO INDUSTRY
Wärtsilä Japan
Weathernews Inc.
YANMAR HOLDINGS
Yokogawa Electric

Member List of Clean Fuel Ammonia Association

As of October 1, 2025

[Associate Members (foreign company)] 40 companies Abu Dhabi National Oil Company (UAE) ACME Cleantech Solutions Private Limited (IN) Adani New Industries Limited (IN) AES Andes (CHL) AMEA Power LLC (UAE) AM Green Ammonia (IN) Amogy Inc (US) Argus Media Japan KK (JAP) AustriaEnergy International GmbH (AUT) Australian Renewable Energy Hub Pty Ltd (AUS) Avaada Green H2 Private Limited. (IN) CF Industries (US) Chevron New Energy International Pte.Ltd.(SIN) Clean Hydrogen Works (US) DNV (NOR) Energy North Pty Ltd. (AUS) Equinor ASA (NOR) ExxonMobil LNG Market Development Inc.(US) Fortescue Future Industries (AUS) Green Hydrogen International Corp. (US) Hygenco Green Energies Private Limited, (IN) KBR,Inc.(US) Keppel Ltd. (SIN) LSB INDUSTRIES (US) MAE Holding Chile SpA (CHL) Meridian Energy Ltd (NZ) NH3 Clean Energy Limited (AUS) Novatek Gas and Power Asia Pte. Ltd. (SIN) OCI N.V. (NLD) Orica Limited (AUS) Pilot Energy Limited (AUS) Purus Marine (UK) SK E&S (KOR)	THERMON INC (US) TotalEnergies Japan S.A.(CHE) UGL Pty Limited (AUS) Uniper Global Commodities SE (DEU) Welspun New Energy Private Limited (IN) Woodside Energy (AUS) Yara International ASA (NOR) [Honorary Member] 2 persons Osamu Ishitobi (Former President of CFAA) Shigeru Muraki (Previous President of CFAA) [Associate Members (individual)] 8 persons Fumiteru Akamatsu (The University of Osaka) Hideaki Kobayashi (Tohoku University) Hirohumi Taba Jyun Kubota (Fukuoka University) Norihiko Nakamura (Former Executive technical adviser, Toyota Motor Corp) Noritoshi Yagawa (Gifu University) Suguru Kimura Yoshitsugu Kojima (Hiroshima University)	[Advisory Members] 5 persons, 43 institutions Bunro Shiozawa (Former SIP Deputy PD) Kenichi Aika (Former SIP Deputy PD) Susumu Miyazaki (Previous Executive Director of CFAA) Takeo Kikkawa (International University of Japan) Tetsuro Hitoshi (Former Auditor of CFAA) Aichi Prefectural Government Akita Industrial Technology Center Alberta Japan Office (CA) Ammonia Energy Association (USA) Austrade Tokyo Office (Embassy) Australian Hydrogen Council(AHC) (AUS) Central Research Institute of Electric Power Industry CSIRO (AUS) Department of Science and Innovation (S.A.) Electric Power Research Institute (USA) Embassy of Canada to Japan Embassy of the Kingdom of the Netherlands Embassy of the Republic of Korea in Japan German Chamber of Commerce and Industry in Japan (AHK Japan) Government of Queensland (AUS) Government of South Australia (AUS) Government of Victoria(AUS) Government of Western Australia (AUS) GX Acceleration Agency Hokkaido Government Ibaraki Prefectural Government InvestChile (CHL) Japan Carbon Frontier Organization Japan Fertilizer & Ammonia Producers Association Japan Hydrogen Association (JH2A) Japan Organization for Metals and Energy Security Japan Ship Technology Research Association	National Institute of Advanced Industrial Science and Technology (AIST) National Institute of Maritime, Port and Aviation Technology New Zealand Embassy, Tokyo, Japan New Zealand Hydrogen Council (NZHC)(NZ) Niihama City Norwegian Embassy (Trade and Technology Office) Research Institute for Applied Sciences Royal Danish Embassy Japan Shin-Mutsu-Ogawara Inc. SHUNAN CITY The High Pressure Gas Safety Institute of Japan The Institute of Applied Energy (IAE) The Institute of Energy Economics, Japan THERMAL AND NUCLEAR POWER ENGINEERING SOCIETY TOMAKOMAI CITY YOKKAICHI CITY
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