CFAA member activities in ASEAN

13/02/2025

Clean Fuel Ammonia Association

Clean Fuel Ammonia Association

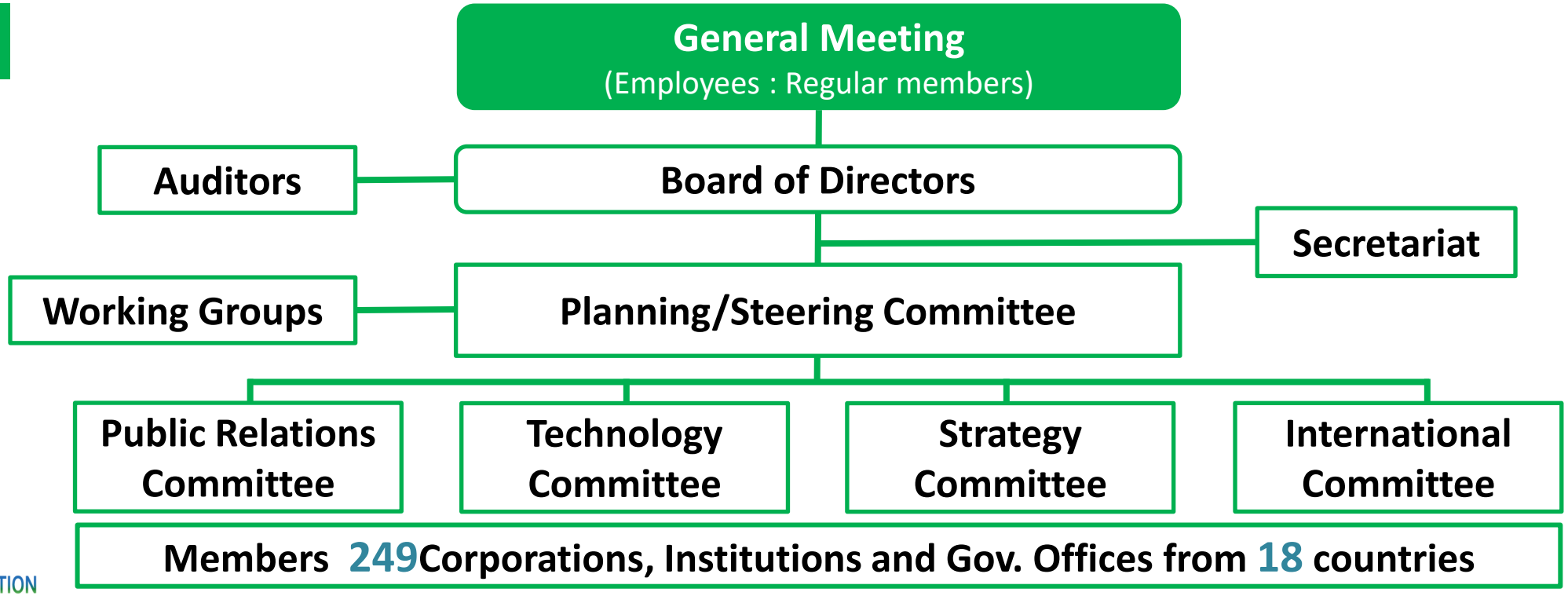
Establish

Apr. 1, 2019 Green Ammonia Consortium
Jan. 14, 2021 Clean Fuel Ammonia Association

Key Objectives

- Implementation of clean fuel ammonia value chain
- Promotion of policy and regulations
- Coordination of RD&D activities
- International relationship and collaboration

Organization



Member List of Clean Fuel Ammonia Association

As of July 16 , 2024

[Board Member] 15 companies

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

[General Member] 140 companies

- ABE NIKKO KOGYO
- AGC
- Air Water Inc.
- AISAN INDUSTRY
- Aramco Asia Japan
- Asahi Kasei
- Asahi Tanker
- BP Japan
- Cataler
- Central Tank Terminal
- Chiyoda
- Chubu Electric Power Company
- CHUGAI RO
- CLEARIZE
- ConocoPhillips Japan
- Cosmo Engineering
- Cosmo Oil
- Daihatsu Diesel
- DAIICHI JITSUGYO
- Diamond & Zebra Electric Mfg
- EBARA
- Electric Power Development
- ENEOS
- Emerson Japan
- Fuji Car Manufacturing
- Fuji Electric
- Fuji Oil
- FUKUI SEISAKUSHO
- GYXIS
- HANWA
- HAZAMA ANDO
- HIROSHIMA GAS
- Hitachi Industrial Products
- Hitachi Zosen
- Hokkaido Electric Power
- Hoku energy
- Hokuriku Electric Power Company
- HORIBA
- IINO KAIUN
- INFLUX
- INPEX
- ISHII IRON WORKS
- Iwatani Corporation
- Iwatani Gas
- Japan Oil Engineering
- Japan Oil Transportation
- Japan Petroleum Exploration
- JFE Engineering
- JFE Steel Corporation
- JGC Catalysts and Chemicals
- Kajima
- Kawasaki Kisen Kaisha
- Kawasaki Heavy Industries
- KOBELCO WIRE COMPANY
- KOBE STEEL
- Kowa Company
- Kyushu Electric Power
- LRQA Limited
- MAEDA CORPORATION
- Maruzen Petrochemical
- Mitsubishi Electric
- MITSUBISHI GAS CHEMICAL
- Mitsubishi Materials
- Mitsui E&S
- Mitsui O.S.K. Lines
- Mitsui Sumitomo Insurance
- Mizuho Research & Technologies
- N.E. CHEMCAT CORPORATION
- NGK INSULATORS
- NICHIAS
- NIKKISO
- Nikki-Universal
- Nippon Kaiji Kentei Kyokai
- Nippon Kaiji Kyokai (ClassNK)
- Nippon Kayaku
- Nippon Oil Pump
- Nippon Paper Industries
- NIPPON SHARYO, LTD.
- NIPPON SHOKUBAI
- NIPPON STEEL
- NIPPON STEEL PIPELINE&ENGINEERING
- NIPPON STEEL Stainless Steel
- NIPPON STEEL TRADING
- Niterra
- Nitto Denko
- Non-Destructive Inspection
- NRS CORPORATION
- NS UNITED KAIUN KAISHA
- OBAYASHI
- Okinawa Electric Power
- Osaka Gas
- OVAL Corporation
- Penta-Ocean Construction
- Planning and Design Center for Greener Ships
- Resonac Holdings
- Safar International
- Senko Line
- Shell Japan
- Shikoku Electric Power Company
- Shimadzu
- SHIMIZU
- SHIN NIHON KENTEI KYOKAI
- Shin Nippon Machinery
- Shinsho Corporation
- Sojitz
- SUMITOMO CORPORATION
- Sumitomo Mitsui Banking
- Sumitomo Mitsui Construction
- Suzuyo Shoji
- Taisei Corporation
- TAIYO NIPPON SANSO
- Takenaka
- 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
- Wärtsilä Japan
- Weathernews Inc.
- YANMAR HOLDINGS
- Yokogawa Electric

Member List of Clean Fuel Ammonia Association

As of July 16 , 2024

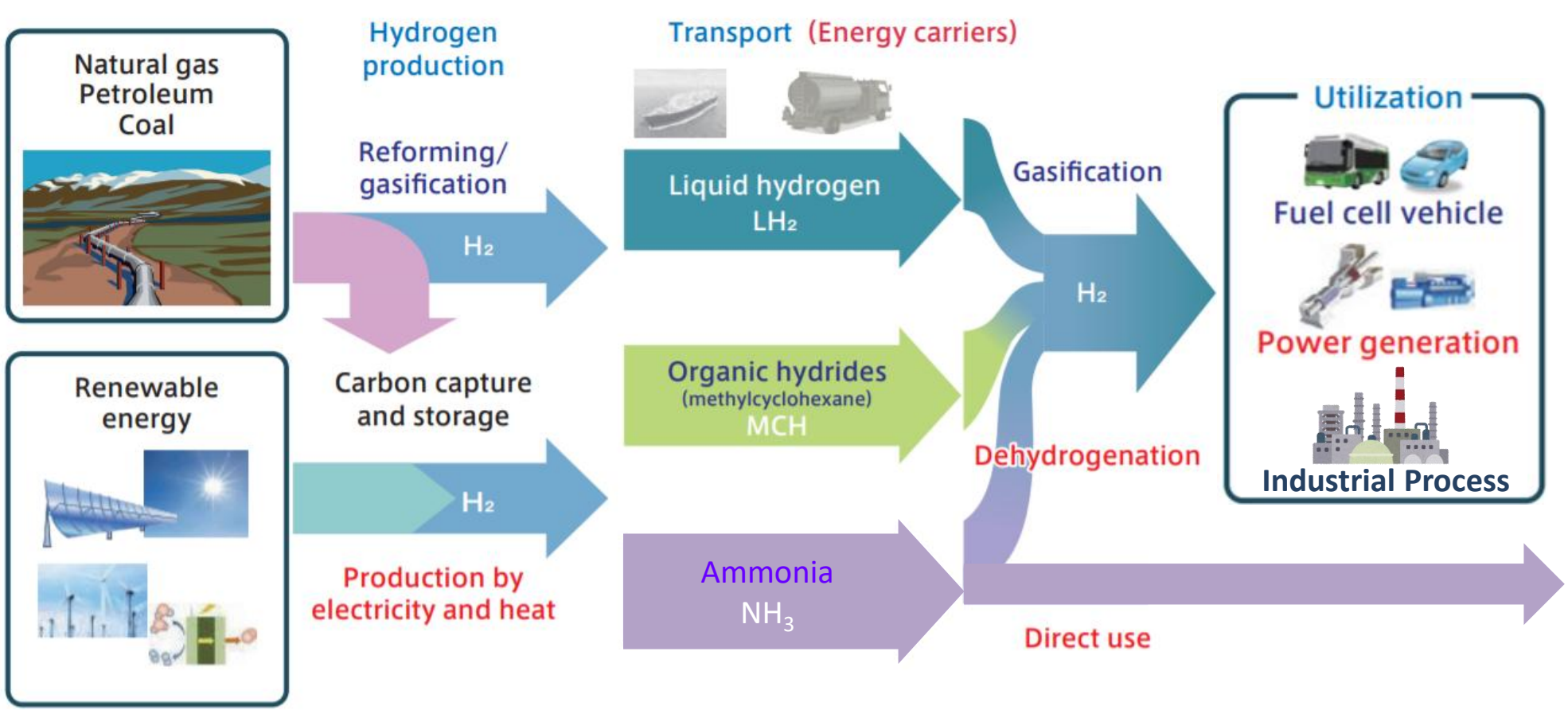
[Associate Member (foreign company)] 42 companies
ACME Cleantech Solutions Private Limited (IN)
Adani New Industries Limited (IN)
A-Enviro Chile GmbH – Austria Energy - (AUT)
AES Andes (CHL)
AMEA Power LLC (UAE)
Amogy Inc（US)
Argus Media Japan KK（JAP）
Avaada Green H2 Private Limited. (IN)
Baker Hughes (UK, US)
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 Metals Group (AUS)
Green Hydrogen International Corp. (US)
Hexagon Energy Materials Limited (AUS)
Hygenco Green Energies Private Limited,（IN）
KBR,Inc.(US)
LSB INDUSTRIES (US)
Meridian Energy ltd（NZ）
Novatek Gas and Power Asia Pte. Ltd. (SIN)
NTPC Limited (IN)
NW interconnected Power Pty Ltd
(Asian Renewable Energy Hub) (AUS)
OCI N.V.（NLD）
Orica Limited（AUS）
Origin Energy Limited (AUS)
Pilot Energy Limited (AUS)
Purus Marine (UK)
Sasol South Africa Limited (S.A.)
SQM Industrial S.A. (CHL)
Stanwell Corporation (AUS)
The Hydrogen Utility (AUS)
THERMON IN (US)
TotalEnergies Japan S.A.(CHE)
Vopak Asia Pte Ltd（SIN）
UGL Pty Limited (AUS)
Welspun New Energy Limited (IN)
Woodside Energy (AUS)
Yara International ASA (NOR)

[Advisory Member] 4 persons, 41 institutions
Bunro Shiozawa (ex-SIP Deputy PD)
Kenichi Aika (ex-SIP Deputy PD)
Takeo Kikkawa (International University of Japan)
Tetsuro Hitoshi
Aichi Prefectural Government
Akita Industrial Technology Center
Alberta Japan Office (CA)
Ammonia Energy Association (USA)
Austrade Tokyo Office (Embassy)
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 Norway in Tokyo, 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)
Hokkaido Government
Ibaraki Prefectural Government
InvestChile (CHL)
Japan Bank for International Cooperation
Japan Coal Frontier Organization
Japan Fertilizer & Ammonia Producers Association
Japan Organization for Metals and Energy Security
Japan Ship Technology Research Association
National Institute of Advanced Industrial Science and Technology (AIST)
New Zealand Embassy, Tokyo, Japan
Niihama City
National Institute of Maritime, Port and Aviation Technology
Research Institute for Applied Sciences
Shin-Mutsu-Ogawara Inc.
SHUNAN CITY
The Australian Hydrogen Council(AHC) (AUS)
The High Pressure Gas Safety Institute of Japan
The Institute of Applied Energy (IAE)
The Institute of Energy Economics, Japan
The New Zealand Hydrogen Council (NZHC)(NZ)
THERMAL AND NUCLEAR POWER ENGINEERING SOCIETY
TOMAKOMAI CITY
YOKKAICHI CITY

[Honorary Member] 1 person
Osamu Ishitobi (Former Chairman)

[Associate Member (individual)] 7 persons
Fumiteru Akamatsu
Hideaki Kobayashi
Hirohumi Taba
Jyun Kubota
Norihiko Nakamura
Suguru Kimura
Yoshitsugu Kojima

Hydrogen Energy Carrier



Power Generation

Mix combustion in coal fired boiler

Gas turbine

Industrial

Furnace

Maritime

Deep-sea shipping

Transportation across the Ocean by H_2 Energy Carriers (Ammonia, LH_2, and Organic Hydride) from Australia to Japan, **Ammonia is likely the cheapest mechanism.**

("The Future of Hydrogen"; prepared by the IEA for the G20, Japan in 2019)

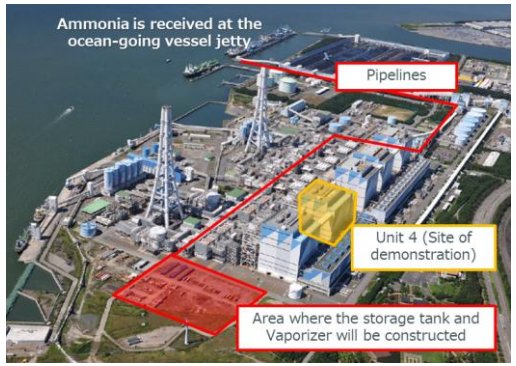
Why Ammonia

- Directly combusted without CO_2 emissions.
- Largest H_2 content among 3 carriers and most efficient in marine transportation.
  (NH_3 **121** kg-H_2/m^3 liquid , LH_2 71 kg-H_2/m^3 , MCH 47 kg-H_2/m^3)
- Large commercial supply chain is established, and cost structure is clear.
  (Global production: 200 million tons, International trade: 20 million tons)
- NOx emissions can be controlled by technologies.
  (Air-fuel ratio , Two staged combustion etc.)
- Technologies are becoming ready for commercial use.
- Safety standards are practically used in chemical and power industries.
- Primary markets are controlled facilities with trained operators such as power plant, industrial factories and data centers.

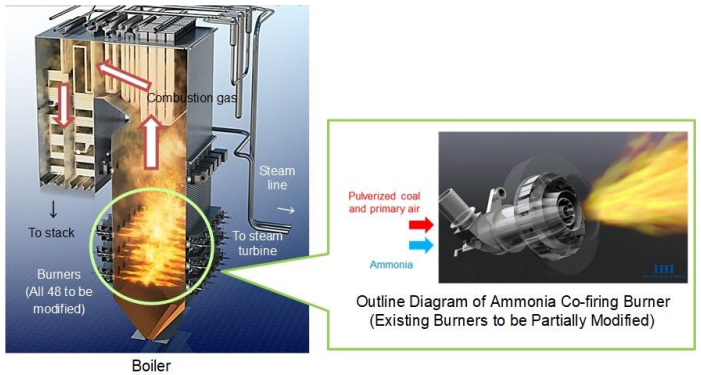
Key Technologies of Ammonia Utilization in the Energy Market

Combustion in Coal fired Boilers (IHI,MHI)

- 20 % firing is achieved.
- Over 50% - up to 100 %NH_3 firing is under development.
- Large Scale Demonstration(March-June 2024)
  (20 %NH_3 in 1 GW Coal Power of JERA)
- Feasibility Study with Malaysia, Indonesia, India, Thailand, Taiwan



Provided by JERA



Provided by IHI

Gas Turbines (IHI, MHI)

- 2 MW-60 MW
  Development of NH_3 Single Fuel GTs by 2025
- 400 MW Class
  Developments of NH_3 Sigle Fuel System and H_2 Turbine with NH_3 Cracking System by 2030

Provided by IHI

Provided by ©Mitsubishi Heavy Industries, Ltd.

Key Technologies of Ammonia Utilization in the Energy Market

Industrial Furnaces (AGC, Taiyo Nippon Sanso)

- Development of NH_3 Single Fuel Glass Melting Furnace by 2025

Provided by AGC

Marine Diesel Engine (NYK, Japan Engine, IHI power system, Japan Shipyard)

- Small 4 Stroke Engine by 2024
- Large 2 Stroke Engine by 2026
- NH_3 Engine Tugboat in 2024
- First NH_3 fueled NH_3 carrier is planned to be launched in Nov. 2026.

Provided by NYK

Activities of CFAA Members in ASEAN

Feasibility Study for Ammonia Substitution – Philippines

◆ **Project Outline**

- MOU has been signed between Aboitiz Power (AP) and JERA in the presence of President Ferdinand “Bongbong” R. Marcos Jr. together with key officials from the Philippine Government in Feb-2023.
- Under the MOU, AP and JERA outlined collaborative efforts in assessing the feasibility of ammonia power generation and further development of the ammonia and hydrogen value chains in the Philippines.
- The considered Power Plant: Sub Critical Coal Fired Power Plant
- Study contents

✓ Technological study for 25% ammonia substitution
✓ Ammonia Procurement cost during the project period
✓ Economic assessment and the CO2 emission reduction throughout the value chain

◆ **Feasibility Study Result**

- Technically, there are no major isuues.
- Additional environmental impact assessment would be required, but no major issues found.
- In the point of commercial, even with the use of price-competitive blue ammonia, cost increases are inevitable compared to coal.

Signing of MOU
(President Marcos is front row, fourth from left)

Activities of CFAA Members in ASEAN

Feasibility Study for Ammonia Substitution – BLCP Project in Thailand

◆ **Project Outline**

- JERA invested EGCO (Electricity Generating Public Company Limited, Thailand) and had a MOU about future corroboration for decarbonization technologies.
- JERA was appointed by METI (Japanese Ministry of Economy) as a consultant for feasibility study on ammonia co-firing in coal fired power plant in Thailand.
- The considered Power Plant: BLCP Power Plant, Sub Critical Coal Fired Power Plant 1,434MW(717MW×2Unit)

◆ **Feasibility Study Result**

- Technically, there are no major isuues.
- Most of the environmental & social impacts expected from ammonia substitution would be technically mitigated enough to be negligible.
- In the point of commercial, the LCOE calculated in this FS is competitive with other power sources after 2030. In order to recover the necessary costs for modification, continued efforts will be necessary to obtain support from the government and other financial sources.
- As for regulations, currently, there is no concrete system in place to introduce ammonia as fuel into thermal power generation facility.

Activities of CFAA Members in ASEAN

Project for Green ammonia firing (Indonesia)

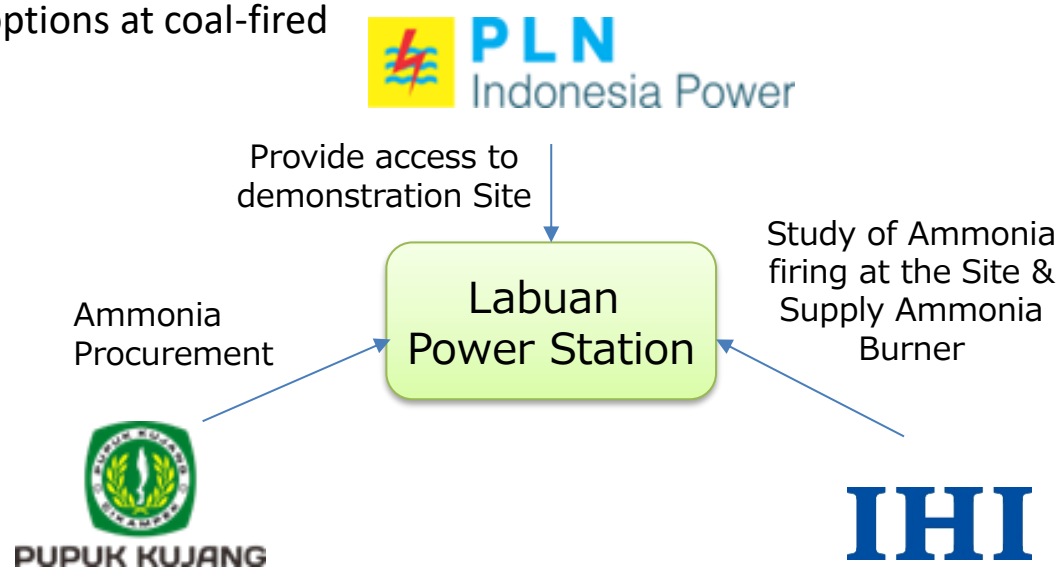
MOU to study for green ammonia value chain and firing at Labuan Coal-fired Power Plant

◆ **Project Outline**

- To conduct a study involving the entire ammonia value chain from the supply to combustion of green ammonia, including demonstration at the Labuan coal-fired power plant
  with PT PLN Indonesia Power, PT Pupuk Kujang
- To contribute to achievement of carbon neutrality in Indonesia by 2060, studying on the entire ammonia value chain and on the application of ammonia combustion which is one of the decarbonization options at coal-fired power plants.

◆ **Demonstration Plant**

Labuan Power Plant



Activities of CFAA Members in ASEAN

Project for Natural gas-fired boiler (Indonesia)

IHI Initiates Southeast Asia's First Ammonia Mix-Firing Pilot Facility at Operational Power Plant

◆ **Project Outline**

- IHI and PT PLN Nusantara Power (PLN NP) achieved ammonia co-firing at the No.1 Boiler of the gas-fired Gresik Steam Power Plant.
- This ammonia co-firing with fossil fuels at an operating unit was a first in South-East Asia. This effort proved the potential of ammonia co-firing technologies at an existing facility and the feasibility of deploying a range of facilities for ammonia co-firing.
- Apply the carbon-neutral fuels at thermal power plants to attain net-zero greenhouse gas emissions by 2060 as Indonesian government target.

◆ **Schedule**

- FY2022 Small amount co-firing achieved
- Discuss for future FS of ammonia co-firing/mono-firing

◆ **Plant where the demonstration carried out**

Gresik Power Plant

https://www.ihi.co.jp/en/all_news/2022/resources_energy_environment/1197857_3488.html

Activities of CFAA Members in ASEAN

Project for Decarbonization Roadmap of TNB (Malaysia)

Create Decarbonization Roadmap in Coal-Fired Power Stations in Malaysia with Ammonia and Biomass mix-firing technology

- **Project Outline**

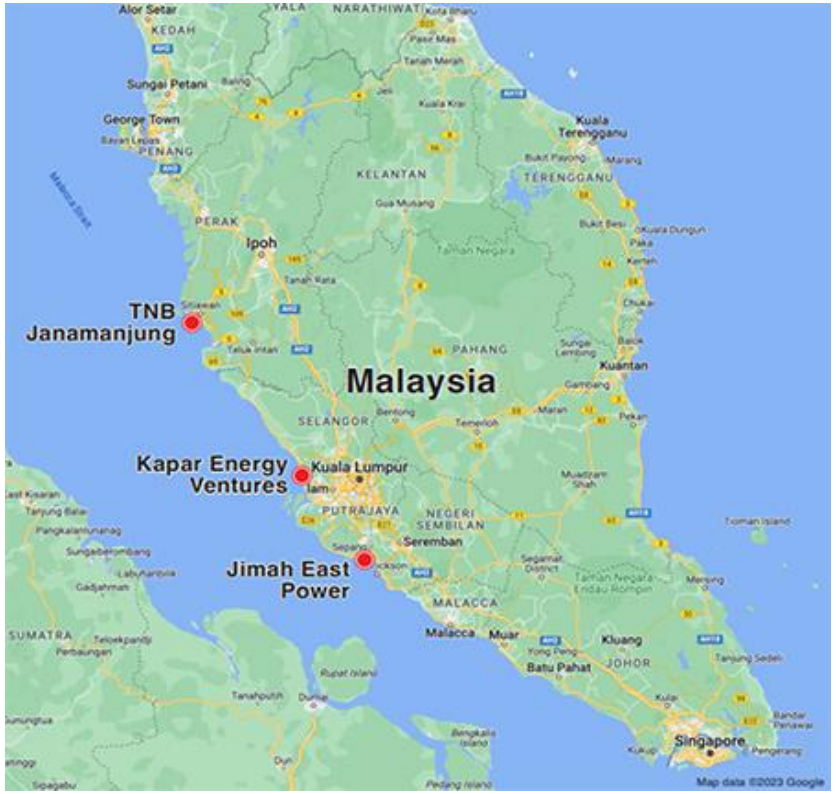
  IHI and TNB Power Generation Sdn. Bhd., Malaysia's largest power producer, have finished its joint feasibility study and agreed to move to the next step in relation to TNB Genco's coal-fired power stations.

- **Goal**

  To develop the decarbonization roadmap for TNB Genco's coal-fired power stations by applying IHI's ammonia and biomass combustion technology

Target :
0.35 t-CO_2/MWh by 2035

Ammonia + Biomass + Coal Biomass co-firing, Natural gas conversion



From the top, TNB Janamanjung Sdn. Bhd., Kapar Energy Ventures Sdn. Bhd., Jimah East Power Sdn. Bhd.

https://www.ihi.co.jp/en/all_news/2023/resources_energy_environment/1199835_3523.html

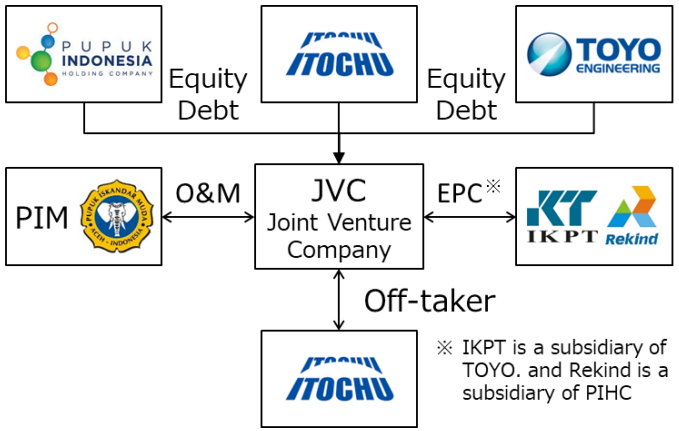
Activities of CFAA Members in ASEAN

Green Ammonia Initiative from Aceh (GAIA)

- Country: The Republic of Indonesia
- CFAA Member: Toyo Engineering Corporation (TOYO)
- Partner: Pupuk Indonesia Holding (PIHC), Itochu Corporation (ITOCHU)
- Start Year: 2022 (Commencement of Feasibility Study)
- Overview:
  - ✓ Collaboration Outline: Agreed to jointly develop a project to produce green ammonia by leveraging existing ammonia plant of Pupuk Iskandar Muda(PIM) which is PIHC's subsidiary
  - ✓ Strategy: Utilize surplus capacity of PIM's existing ammonia plant (designed by TOYO to produce green ammonia and integrate with ITOCHU's bunkering business. Aim to replicate this green ammonia initiative at other PIHC's existing plants in the future
- Schedule：
  - ✓ Aug.2024: Selected for the Global South Future-Oriented Co-Creation Project
  - ✓ Aug.2024: Signed Joint Development Agreement
  - ✓ Nov.2024: Signed Shareholder's Agreement
  - ✓ 1Q 2025: Establish Joint Venture Company
  - ✓ 2Q 2025: Final Investment Decision
  - ✓ 4Q 2027: Start Commercial Operation

【Location of PIM's Existing Ammonia Plant】

【SHA Announcement in COP29 Japanese Pavilion】

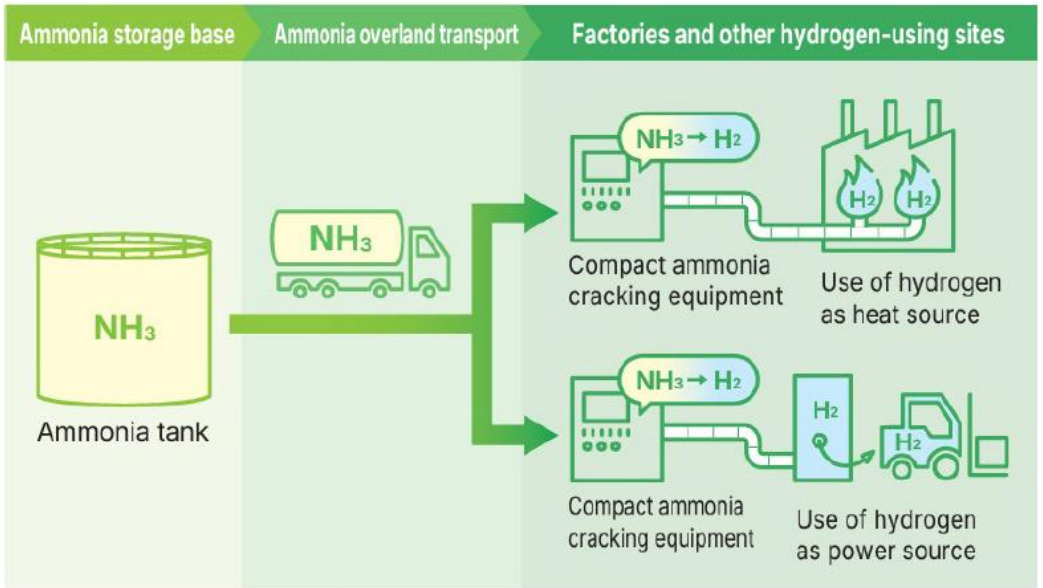


【Structure Outline】

Activities of CFAA Members in ASEAN

Demonstration Study for the Utilization of Hydrogen and Ammonia for fuel

- Country: Kingdom of Thailand
- CFAA Member: Toyo Engineering Corporation (TOYO)
- Partner: JERA Co., Inc., JERA Asia Pte. Ltd.
- Start Year: 2024
- Overview:
  - ✓ To quickly achieve a hydrogen society, it will be important to ensure that the ammonia cracking to extract hydrogen is able to respond to the demand for hydrogen.
  - ✓ TOYO, JERA and JERA Asia jointly investigate methods of providing a stable supply of hydrogen in Thailand and the potential for its widespread use across a range of industries.
  - ✓ The three companies verify the technology for extracting hydrogen from ammonia through cracking and developing ways to optimize the design of hydrogen storage facilities
  - ✓ The Demonstration Study is supported by New Energy and Industrial Technology Development Organization (“NEDO”) International Demonstration Project on Japan’s Technologies for Decarbonization and Energy Transition.
  - ✓ This basic study has run for one year beginning from the middle of FY 2024.



【Concept of Ammonia Cracking for Industrial Hydrogen Demand】

Thank you for your kind attention