Message from the Executive Officer (Development-focus Businesses)

Building a decarbonized society through the establishment of an ammonia value chain, and creating a chain of value creation together with our customers

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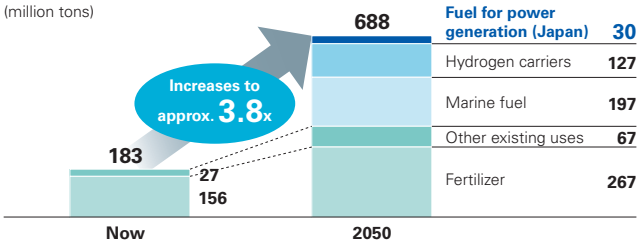
Focus on ammonia as a decarbonized fuel

The IHI Group is developing power generation technology that uses ammonia as a decarbonized fuel, and is working to build a value chain that covers production through to utilization. Currently, about 1.1 million tons of ammonia are used annually in Japan, mainly for fertilizer, of which about 20% is imported from overseas. Globally, about 200 million tons of ammonia are used each year, and demand as a fuel is expected to rise, particularly for electric power, industry, and ships. In recent years, Europe and the United States have also embraced ammonia as a pathway to achieve completely zero-emission power generation. As global interest in decarbonization through ammonia grows, the Japanese government has introduced support policies to encourage the adoption and expansion of fuel ammonia, setting a target to increase domestic demand to 3 million tons per year by 2030.

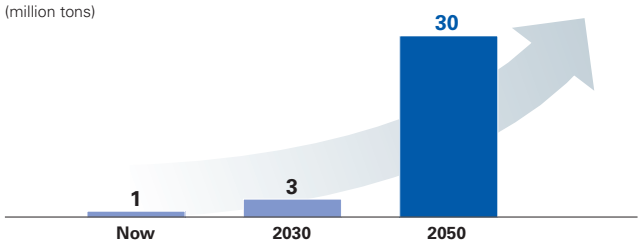
The IHI Group has been pioneering the development of ammonia combustion technology for more than a decade, drawing on expertise in combustion cultivated through thermal power generation. This provides us with a technological advantage in achieving efficient and stable

Required ammonia volume as assumed by IRENA (worldwide)



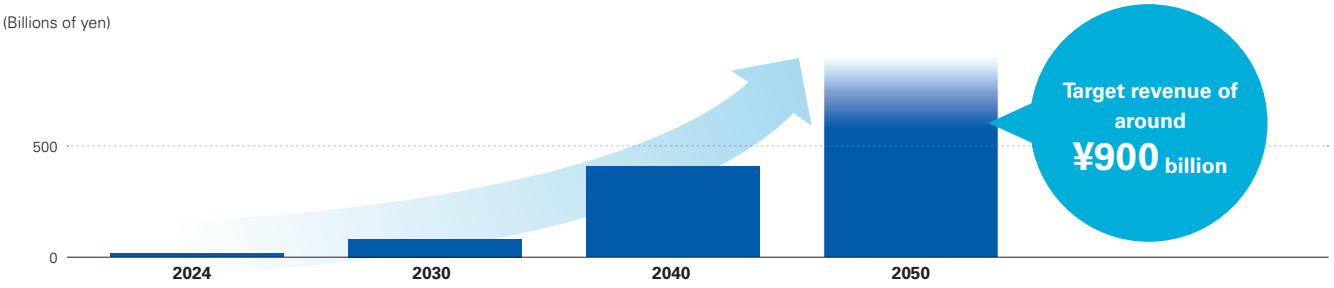
Source: International Renewable Energy Agency (IRENA)

Required ammonia volume as assumed by the Japanese government



Source: Ministry of Economy, Trade and Industry

Net sales of fuel ammonia value chain businesses



combustion of clean ammonia that emits no CO_2. With the establishment of this combustion technology, we expect the scope of ammonia utilization to continue expanding. Looking ahead, we will leverage government support to build an ammonia value chain, aiming to ultimately develop a self-sustaining ammonia business that links all stages of the chain.

Status of IHI Group's efforts to build an ammonia value chain

To promote the ammonia value chain business, we aim to provide value by connecting upstream (production), midstream (storage and transportation), and downstream (utilization) processes for ammonia.

In the upstream field of ammonia production, the most notable progress is a project in India to produce and sell green ammonia. In collaboration with ACME, a leading renewable energy company, the IHI Group has signed an agreement to consider investing in ACME with the aim of producing green ammonia in India and exporting it to Japan. Furthermore, in Australia, we are considering participating in a joint project with Energy Estate, CS Energy, and Idemitsu Australia to produce and sell 500,000 tons of green ammonia annually and export it to Japan by around 2030.

The greatest challenge in green ammonia production is reducing production costs. The IHI Group is working to develop various technologies to produce ammonia at lower cost.

In the midstream area of storage and transportation, we have conducted feasibility studies for ammonia supply bases in Kansai, Soma, and Tomakomai. We plan to examine tank specifications and related equipment at these bases, carry out studies on the allocation of ammonia carriers, and develop a business model for commercialization. In addition, IHI Plant Services Corporation, a Group company, is developing a new large-capacity tank of over 100,000 tons, more than double the conventional capacity, to improve the economic efficiency of storage terminals. In Japan, ammonia tanks of 10,000 to 20,000 tons for the chemical industry currently dominate the market, so we aim to achieve storage terminals with high capital expenditure efficiency by introducing a new type of large-capacity tank.

Furthermore, in order to establish a secure and stable ammonia supply system, we have signed a basic agreement with Vopak of the Netherlands, one of the world's leading tank service providers, for the development and operation of ammonia terminals in Japan. Furthermore, to optimize ammonia marine transportation and create a complementary system that can respond flexibly to supply fluctuations, we intend to pursue both safety and economic efficiency while working with and leveraging insights of specialized partner companies, including Norway's Yara, the world's largest fertilizer manufacturer.

In the downstream field of utilization, from April to

IHI technologies for ammonia utilization

Field	Utilization technology/equipment		Details
Electricity	Boilers		• Completed development of ammonia burner (May 2022) • JERA and IHI completed 20% ammonia fuel substitution demonstration test at Hekinan Thermal Power Station Unit 4 (1,000 MW) in June 2024. Obtained strong results
	Large gas turbines	 7F.05 : Source : GE Vernova	• GE Vernova and IHI signed a joint development contract for a large-scale ammonia-fired gas turbine (December 2023) • Targeting commercialization of GE Vernova-made 6F.03, 7F, and 9F gas turbines in 2030
Industry	Small gas turbines	 JPNP21020	• Successfully completed the world's first 100% liquid ammonia combustion in an IHI-made 2 MW-class gas turbine (IM270) (June 2022) • Long-term durability tests have been conducted at the Aioi Works since July 2024
	Industrial furnaces	 source: Idemitsu Kosan Co.,Ltd.	• Successfully demonstrated over 20% ammonia fuel substitution at a naphtha cracking furnace at Idemitsu's Tokuyama Complex (February 2024)
Ships	Engines		• Successfully substituted 80% ammonia fuel in an actual four-stroke engine for the first time globally (May 2023) • Completed the demonstration voyage of Sakigake, the ammonia-fueled tugboat, in March 2025

June 2024, we conducted the world's first large-scale demonstration test for substituting fuel ammonia at a 20% heating value ratio, at the Hekinan Thermal Power Station in collaboration with JERA, and obtained favorable results. At the Aioi Works, long-term durability tests of a small ammonia-fired gas turbine (IM270) began in June of the same year, and development of a 2 MW-class liquid ammonia-fired gas turbine is progressing steadily. The IM270 is being operated in cooperation with Gentari, a Malaysian state-owned clean energy company within the Petronas group, with the goal of starting commercial operation at its own plant.

Furthermore, in 2024, the world's first tugboat equipped with a marine-use ammonia reciprocating engine successfully completed its demonstration voyage. This marks a major step forward in the utilization of ammonia, and we are entering a new stage in adopting ammonia as a fuel in the ship sector as well.

Social implementation of ammonia technology and innovation of value creation models

The IHI Group possesses three major strengths in the ammonia value chain.

The first is advanced ammonia combustion technology. Ammonia is composed of hydrogen and nitrogen; incomplete combustion or byproducts pose the risk of worsening environmental impact. The IHI Group has established a technology for reliably burning off ammonia by applying combustion technology cultivated over many years in thermal power generation. This has also been proven to reduce emissions of nitrogen oxides (NOx) and nitrous oxide (N_2O), a greenhouse gas, generated during combustion.

Second, our products under development enhance economic rationale for our customers. In principle, the system does not require major renovations and can operate with both coal and ammonia using existing coal-fired facilities, enabling a smooth transition to cleaner fuels. In addition, in the event of an emergency, the fuel can be flexibly switched back to coal. This high level of operational flexibility is another distinguishing feature for the IHI Group.

Our third major strength is the capability to develop and provide ammonia receiving and storage facilities, drawing on experience in the LNG sector. The IHI Group currently holds about 70 percent of the ammonia storage tank market in Japan and is well-positioned to contribute to the construction of large receiving bases and supply systems to meet the upcoming growth in demand for ammonia.

Leveraging these technological advantages and the strength of its supply system, the IHI Group is shifting from a traditional business model of selling products to a value chain business model of providing value backed by technology. A typical example of this is the ammonia value chain business, which is positioned as a Development-focus Business.

As efforts to realize a decarbonized society accelerate, the IHI Group will establish a system to handle the entire process from ammonia production to storage, transportation, and utilization. This will enable us to offer flexible schemes that meet the needs of our customers and to make proposals that meet their needs throughout the value chain. By creating value in the upstream, midstream, and downstream stages and linking these stages in an integrated manner, we aim to build a new chain of value. This is the core concept of the ammonia value chain we are pursuing and a key strategy for the next generation of our Development-focus Businesses.

Roadmap for expanding the ammonia value chain business

The IHI Group aims to realize revenue of approximately 900.0 billion yen across the entire ammonia value chain by 2050. In addition to the production and supply of fuel ammonia, we plan to develop new businesses centered on ammonia, including storage facilities, utilization equipment, and operation, maintenance, and parts services, to establish ammonia as a business pillar alongside the aero engines and space fields.

To achieve this goal, we are making all preparations for around 2030, when full-scale social implementation of ammonia is expected, by making use of government support under the Hydrogen Society Promotion Act enacted by the Japanese government in 2023. Although there has been a change of administration in the United States and signs of a global slowdown in decarbonization initiatives, many companies continue to pursue decarbonization, and we do not expect this to have a significant impact on the IHI Group. Taking a long-term view, we will steadily promote the development of an ammonia value chain to achieve both a decarbonized society and sustained growth and profitability.

Development-focus Businesses: Special Feature: Social implementation of ammonia

Initiatives for social implementation of ammonia

In June 2024, IHI, together with JERA and NEDO, completed the world's first large-scale demonstration test to substitute ammonia for coal at a large coal-fired power plant. In this special feature, we present the IHI Group's initiatives and achievements in ammonia combustion technology.

A pioneer in ammonia combustion develops ammonia utilization technology

For more than a decade, the IHI Group has focused on the properties of ammonia, which can efficiently transport hydrogen and emits no CO_2 during combustion. Alongside the boiler combustion technology described here, we are also actively engaged in developing world-leading ammonia combustion technology for gas turbines and gas engines.

For boiler combustion technology, IHI has made steady development progress in this area. In 2017, we successfully carried out a combustion trial of ammonia with coal at our Aioi Works, and since 2021, in partnership with JERA, we participated in the Development of Technologies for Carbon Recycling and Next-Generation Thermal Power Generation/R&D and Demonstrations on Technologies for Ammonia Co-firing Thermal Power Generation, a project funded by the New Energy and Industrial Technology Development Organization (NEDO). In 2024, at Unit 4 of the Hekinan Thermal Power Station, we conducted the world's first large-scale fuel ammonia substitution demonstration test at a large coal-fired power plant from April to June.

2017 Began development of ammonia combustion technology in boilers for thermal power generation at Aioi Works

2021 Began development of a burner boiler to increase ammonia utilization to over 50%

Note: Construction completed in 2022

2022 Conducted a demonstration test of 20% ammonia fuel substitution at JERA's Hekinan Thermal Power Station Unit 4 (output: 1 million kW)

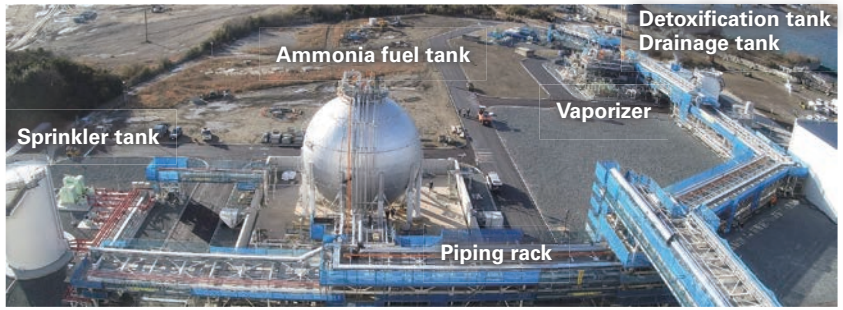


Photo courtesy of JERA Co., Inc.

Utilizing demonstration test results for social implementation

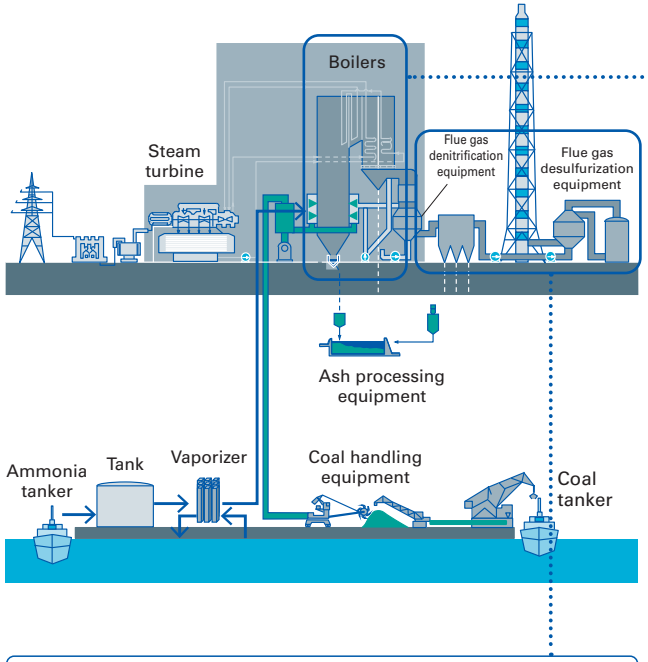
The large-scale substitution demonstration test was conducted to evaluate the performance of the entire boiler plant when burning 20% ammonia. In addition to confirming operability and controllability under dynamic operating conditions such as startup, shutdown, and load changes, and verifying leakage prevention measures, we also evaluated and studied security measures in the event of an ammonia leak.

Specifically, in fiscal 2021, we began planning for each kind of equipment and examining safety measures, and we remodeled boilers and installed necessary equipment accordingly. In April 2024, we launched a demonstration test of 20% ammonia fuel substitution at a rated output of 1 million kW, which was successfully completed in June of the same year. The demonstration achieved air pollutant reductions to levels comparable to those of conventional coal combustion, overcoming one of the key challenges of ammonia combustion. Furthermore, the test deepened our understanding of the balance between ammonia transport, combustion, and control, while confirming the safety of the system. This proves that ammonia can be used as a fuel as a way to reduce CO_2 emitted by thermal power generation facilities.

Based on the results of the 20% ammonia fuel substitution demonstration test, we will continue to refine boiler plant specifications, aiming to develop technology that is both safe and economically viable. We have already begun development of technologies for more than 50% ammonia combustion in thermal power plants, and even 100% combustion, and to implement these technologies in society.

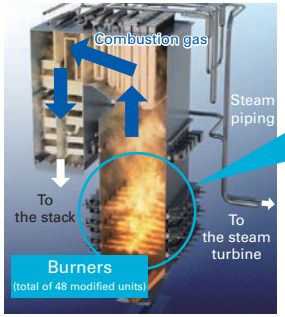
2024 Completed a 20% ammonia fuel substitution demonstration test operating at a rated output of 1 million kW

Items checked in the ammonia demonstration test

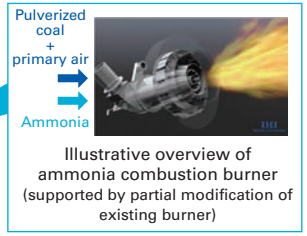


Verification point 1: Performance evaluation of the entire boiler plant

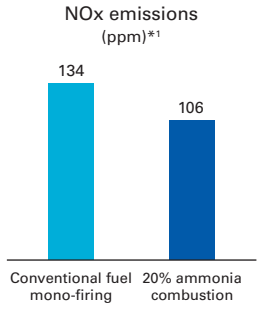
Fuel conversion to 20% ammonia use results in the same or lower amount of nitrogen oxides (NOx) and about 20% less CO_2 and sulfur oxides (SOx), respectively, compared to coal fuel. Nitrous oxide (N_2O), which has a strong greenhouse effect, was also found to be well less than the lower limit of quantification.

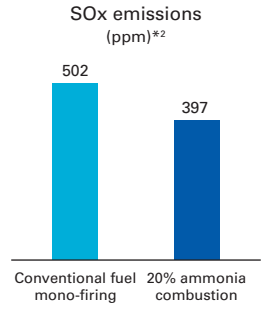


Power generation boiler



Illustrative overview of ammonia combustion burner (supported by partial modification of existing burner)





*1 dry, corrected to 6% O_2

*2 wet

Verification point 2: Prevention of ammonia leakage and security measures in case of leakage

In addition to verifying safety design that prevents ammonia leakage and preventative measures in case of equipment failure or mishandling, we also verified safe and secure facility operation alongside JERA, including testing a system for early detection of equipment malfunctions and participating in training and education to prevent damage from spreading.