



**May 2021**

# **Japan Energy Newsletter**

**Japan Electric Power  
Information Center, U.S.A.**

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## 1 Japan is Advancing the Development of Ammonia Fuel Technologies

Japanese utilities view the ammonia mixed combustion method as a promising pathway to reduce thermal power plant CO<sub>2</sub> emissions, which is a key part of their plan to achieve the Japanese government's goal of reaching carbon neutrality by 2050. In May 2021, JERA, a joint venture between Tokyo Electric Power Company (TEPCO) and Chubu Electric Power (Chuden), confirmed its collaboration with a leading ammonia manufacturer, Yara International ASA (Yara). JERA also signed a memorandum of understanding (MOU) in February 2021 with Petroliam Nasional Berhad, a Malaysian state-owned oil and natural gas company, to collaborate on decarbonization technologies, including the development of ammonia fuel. In March 2020, JERA launched a demonstration project to use and integrate ammonia fuel with thermal power generation. Meanwhile, Chugoku Electric Power, IHI Corporation, and Mitsubishi Heavy Industries are also separately developing and investing in ammonia fuel technologies. This report analyzes the current trends in the development and deployment of ammonia fuel technologies by Japanese utilities and electrical equipment manufacturers, with a focus on JERA.

### 1.1 Background

Following the 2050 Carbon Neutral Declaration by Prime Minister (PM) Suga, Japan's Federation of Electric Power Companies (FEPC)<sup>1</sup> announced in December 2020 that it would take a wide range of measures to reduce greenhouse gas emissions to achieve carbon neutrality by 2050. The measures include making renewable energy the main power source in Japan; maximizing the use of nuclear energy; reducing and decarbonizing thermal power generation; advancing new technologies and promoting energy innovation in fields such as hydrogen ammonia, carbon capture, utilization and storage (CCUS), and next-generation nuclear reactors; and promoting the expansion of electrification.<sup>2</sup>

Zero-emission ammonia fuel is carbon-free and has an established global supply chain, which means that there is increasing potential to use ammonia as a fuel for thermal power plants, industrial reactors, and cargo ships. Thermal power plants, in particular, are well-situated to take advantage of ammonia fuels to reduce their CO<sub>2</sub> emissions. Since ammonia can be easily combusted with coal, coal-fired power plants are expected to use ammonia ahead of other industries. Therefore, the ammonia mixed fuel combustion method must be further developed for integration into the power generation field.

In October 2020, Japan's Ministry of Economy, Trade and Industry (METI) launched the Public-Private Fuel Ammonia Promotion Council in partnership with related companies such as JERA, Mitsubishi Heavy Industries, IHI Corporation, and trading companies, as well as government-affiliated organizations.<sup>3</sup> The Council's interim report, released in

<sup>1</sup> Japan's Federation of Electric Power Companies (FEPC) consist of 10 Japanese utility companies.

<sup>2</sup> [https://www.fepec.or.jp/about\\_us/pr/oshirase/\\_icsFiles/afieldfile/2020/12/18/press\\_20201218.pdf](https://www.fepec.or.jp/about_us/pr/oshirase/_icsFiles/afieldfile/2020/12/18/press_20201218.pdf)

<sup>3</sup> Member List.

[https://www.meti.go.jp/shingikai/energy\\_environment/nenryo\\_anmonia/pdf/001\\_03\\_00.pdf](https://www.meti.go.jp/shingikai/energy_environment/nenryo_anmonia/pdf/001_03_00.pdf)

February 2021, sets four top priorities to work towards the expansion of ammonia usage — securing a stable supply chain, reducing costs, minimizing environmental impacts, and expanding overseas usage. The interim report creates a roadmap for boosting the supply and demand for ammonia fuel by 2050 and sets goals for deployment: introducing and deploying 20% ammonia mixed fuel combustion into coal-fired power plants by 2030; and increasing the ammonia mixed fuel combustion ratio to approximately 50% by 2050.<sup>4</sup>

## 1.2 JERA's Collaborations on the Ammonia Value Chain

On May 11, 2021, JERA, a joint venture between Tokyo Electric Power Company (TEPCO) and Chubu Electric Power (Chuden), signed an MOU with Yara<sup>5</sup>, the world's largest nitrogen fertilizer manufacturer, to collaborate on developing an ammonia value chain, including the development of a blue ammonia<sup>6</sup> production plant.<sup>7</sup> JERA and Yara agreed to jointly work on the following activities:

- 1) Upgrading Yara's Pilbara Fertilizer plant in Australia to a blue ammonia production plant;
- 2) Developing new blue and green ammonia production projects;
- 3) Optimizing the sea transportation of ammonia fuel; and
- 4) Meeting the ammonia demand and supply in Japan, including the demand for power generation

JERA expects that the collaboration with Yara will ensure a stable supply of ammonia fuel for power generation, helping to build and expand its green fuel supply chain as part of the realization of the JERA Zero CO2 Emissions 2050.<sup>8</sup>

In addition to its MOU with Yara, JERA has been aggressively pursuing various other decarbonization initiatives. In February 2021, it signed an MOU with the Malaysian state-owned oil and natural gas company Petroliaam Nasional Berhad to collaborate on promoting Liquefied Natural Gas (LNG) usage in Asian countries and building ammonia and hydrogen fuel supply chains.<sup>9</sup> Furthermore, JERA and its partners, including IHI Corporation, Marubeni, and Woodside Energy, announced in March 2020 that they would conduct an Ammonia Mixed Fuel Combustion for Coal-Fired Power Plants Pilot Project. The pilot project was commissioned by New Energy and Industrial Technology Development Organization (NEDO).<sup>10</sup> The project, which ran from March 2020 to February 2021, examined and evaluated the feasibility, economic efficiency, and technical issues of using ammonia as a fuel for coal-fired power plants.

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<sup>4</sup> [https://www.meti.go.jp/shingikai/energy\\_environment/nenryo\\_anmonia/pdf/20200208\\_1.pdf](https://www.meti.go.jp/shingikai/energy_environment/nenryo_anmonia/pdf/20200208_1.pdf)

<sup>5</sup> <https://www.yara.com/investor-relations/>

<sup>6</sup> There are mainly two types of ammonia categorized by manufacturing methods. Blue ammonia is the conventional ammonia for which by-products such as CO2 has been captured and stored. On the other hand, green ammonia is made with hydrogen that comes from water electrolysis powered by alternative energy.

<sup>7</sup> [https://www.jera.co.jp/information/20210511\\_675](https://www.jera.co.jp/information/20210511_675)

<sup>8</sup> <https://www.jera.co.jp/corporate/zeroemission>

<sup>9</sup> [https://www.jera.co.jp/information/20210210\\_622](https://www.jera.co.jp/information/20210210_622)

<sup>10</sup> [https://www.jera.co.jp/information/20200327\\_479](https://www.jera.co.jp/information/20200327_479)

### 1.3 Ammonia Use by Japanese Utilities and Electrical Equipment Manufacturers

In addition to JERA, Chugoku Electric Power (Energia) and several Public-Private Fuel Ammonia Promotion Council members, such as IHI, Mitsubishi Heavy, and Mitsubishi Power, have also conducted ammonia fuel projects in recent years. Major past projects include the following.

Company	Month/Year	Description
Chugoku Electric Power (Energia)	July 2017 <sup>11</sup>	<ul style="list-style-type: none"> <li>Commissioned by the Japan Science and Technology Agency (JST), Energia conducted an ammonia mixed fuel combustion test (Mixed combustion ratio: 0.6% and 0.8%) at Energia Mizushima Coal-Fired Power Station (Location: Kurashiki City, Okayama Prefecture, Output: 156MW)</li> <li>The project confirmed that ammonia fuel combustion will not affect the environment. Energia will seek to increase the mixed combustion ratio in a future project.</li> </ul>
IHI Corporation	March 2020 <sup>12</sup>	<ul style="list-style-type: none"> <li>Commissioned by NEDO, IHI has been developing a 2MW class gas turbine with sprayed liquid ammonia. It is the first time in the world that the turbine has been able to stably combust liquid ammonia with a thermal ratio of 70% and reduce the amount of NOx generated. Furthermore, the project has demonstrated that the gas turbine can be partially operated with 100% liquid ammonia mixed fuel combustion.</li> </ul>
Mitsubishi Power	March 2021 <sup>13</sup>	<ul style="list-style-type: none"> <li>Mitsubishi Power announced that it had started developing the world's first 40MW class gas turbine system that directly uses ammonia as fuel for gas turbine power generation. It aims to make ammonia for common practical use by 2025.</li> <li>The company is contributing to the creation of a fuel ammonia supply chain by developing technologies that can directly combust ammonia. They hope to offer ammonia fuel combustion as an option for small and medium-sized power plants in the industrial sector and remote islands.</li> </ul>
Mitsubishi Heavy Industries	April 2021 <sup>14</sup>	<ul style="list-style-type: none"> <li>Mitsubishi Heavy Industries America (MHIA) invested in Colorado-based Starfire Energy, which develops green ammonia technology. Mitsubishi Heavy Industries aims to accelerate the development of the hydrogen and ammonia value</li> </ul>

<sup>11</sup> <https://www.energia.co.jp/press/2017/10697.html>

<sup>12</sup> [https://www.ihi.co.jp/ihi/all\\_news/2020/resources\\_energy\\_environment/1197059\\_1601.html](https://www.ihi.co.jp/ihi/all_news/2020/resources_energy_environment/1197059_1601.html)

<sup>13</sup> <https://power.mhi.com/jp/news/20210301.html>

<sup>14</sup> <https://www.mhi.com/jp/news/210409.html>

Company	Month/Year	Description
		chain businesses. AP Ventures, Chevron Technology Ventures, and Osaka Gas USA also invested in Starfire Energy.

## 2 Establishment of a New Regional Electric Power Company, Ena Electric Power, in April 2021

In April 2021, Ena City in Gifu Prefecture, in collaboration with Chubu Electric Power (Chuden) and NGK Insulators, established its first local government-funded regional new electric power company, Ena Electric Power as part of the city's goal to move forward towards becoming a zero-carbon city. Ena Electric Power plans to begin operating its retail electricity business in April 2022. Since the deregulation of the electricity retail market in Japan, local governments are increasingly taking the lead in establishing new electric power companies in the region. Regional electric power companies can balance the electricity supply and demand locally and boost the local economy. This report highlights the latest development of local government-led electric power companies in Japan.

### 2.1 The Establishment of Ena Electric Power

In April 2021, Ena City (Gifu Prefecture) announced that it would establish a new regional electric power company, Ena Electric Power, in cooperation with NGK Insulators and Chuden's subsidiary, Chuden Miraiz. Utilizing in-house solar power systems with NAS Batteries for power storage, Ena Electric Power will provide stable electricity to public facilities and NGK Insulators' buildings located in the city without relying on feed-in tariffs (FITs system). The company will contribute to the decarbonization of the city and will support local business development by promoting the consumption of locally produced energy sources. The company also plans to enhance regional disaster resilience by using the solar battery system as a backup power source in emergency situations such as power outages caused by natural disasters. The city will also create a sustainable business model to monetize its local renewable energy investment activities. The establishment of Ena Electric Power is a public-private partnership that aims to realize the Japanese government's goals for carbon neutrality.<sup>15</sup> The business information of Ena Electric Power is as follows.

**Figure 1 Ena Electric Power**

Services	<ul style="list-style-type: none"> <li>• Retail electricity business</li> <li>• Renewable energy generation and sales business</li> <li>• Services that expand the use of renewable energy, etc.</li> </ul>
Equity Capital	80 million yen (appx. \$734,716 USD)
Investment Ratio	NGK Insulators 75.0% Ena City 12.5%

<sup>15</sup> [https://miraiz.chuden.co.jp/info/press/1206096\\_1938.html](https://miraiz.chuden.co.jp/info/press/1206096_1938.html)

	Chuden Miraiz 12.5%
Established	April 14, 2021 (Scheduled)
Start of Business	April 1, 2022 (Scheduled)

## 2.2 New Regional Electric Power Companies

Since March 2000, Japan has gradually pursued the deregulation of the electricity retail market. With the full liberalization of the market in 2016, Japanese consumers, including households and businesses, are allowed to freely select their own provider, and new retail electric providers have begun to enter the market.<sup>16</sup> New regional electric power companies are being established to maximize the region's power sources and to provide power to public facilities, companies, and residential homes located in the region. A regional electric power company established with the investment of a local government is called a "local government electric power company." As of February 2020, there are at least 52 nationwide, and the number is expected to increase.<sup>17</sup> The main purposes for these companies are to revitalize local productivity; reduce greenhouse gas emissions by using renewable energy; enhance emergency preparedness and response to disasters; and reduce electricity rates for public facilities. These companies generally seek to provide renewable energy for local production and consumption.

While local government electric power companies are expected to bring many advantages to the regions that they serve, there have been some challenges associated with their market entry and operations, including financial difficulties, dissatisfaction with their results, and concerns about whether they are meeting their region's mission and vision. For example, Miyama Smart Energy, launched by Miyama City, Fukuoka Prefecture in 2015, became insolvent due to inadequate business operations.<sup>18</sup> Ikoma Citizen Power, established by Ikoma City, Nara Prefecture, was sued by residents who alleged that the electricity charges under a free contract were set at a high price.

There have also been cases where local government electric power companies only procure a small portion of local electricity, even though they claim to use 100% local power sources. Similarly, in some cases, the companies do not generate electricity from the power sources within the area, and instead sign a contract with other retail electricity providers located outside of the region. It remains to be seen whether the local government electric power companies can overcome these challenges, through actions such as securing power resources and hedging against risks.

<sup>16</sup> [https://www.enecho.meti.go.jp/category/electricity\\_and\\_gas/electric/electricity\\_liberalization/what/](https://www.enecho.meti.go.jp/category/electricity_and_gas/electric/electricity_liberalization/what/)

<sup>17</sup> <https://www.env.go.jp/press/files/jp/113284.pdf>

<sup>18</sup> <https://miyama-se.com/wp-content/uploads/2020/02/c43517446419c1e98268425fcde5739d.pdf>