

FOCAL POINT ON HYDROGEN ENERGY IN JAPAN

PRODUCED IN PARTNERSHIP WITH JAPAN MINISTRY OF ECONOMY, TRADE AND INDUSTRY

JAPANESE HYDROGEN GAMBLE

Japan's massive investment in **HYDROGEN ENERGY** is aimed at positioning the resource-poor nation as a world leader in the energy economy

Just 20 kilometres from the Fukushima nuclear power plant that went into meltdown after the 2011 earthquake and tsunami, a phoenix is rising from the ashes. Rows of photovoltaic panels are arranged around a gleaming white complex of tanks and transformers, framed by the Japanese coastline. In March 2020, Japan started operating one of the world's largest solar-to-hydrogen plants. The Fukushima Hydrogen Energy Research Field (FH2R) uses up to 20 megawatts of solar power to run a 10-megawatt alkaline electrolyzer, zapping water to create oxygen and hydrogen gases. Tiny compared to other power sources — coal-fired power plants usually generate hundreds or thousands of megawatts — the pilot plant is currently undergoing operational tests and is supplying hydrogen to several facilities in Fukushima prefecture. It can produce up to 1,200 normal cubic metres of hydrogen per hour, which is enough to fill the tanks of more than 20 fuel-cell vehicles. While it may be small, it is an important step for a nation fixed on finding a new way to supply energy in the 21st century, and the reverberations are being felt around the world.

Japan was one of the first countries to commit to pursuing hydrogen as an alternative energy source and is investing 84.8 billion yen (US\$802 million) in fiscal 2021. "Energy security is very high on Japan's agenda since it is poor in natural resources," says Eiji Ohira, director general of Fuel Cell and Hydrogen Technology Office at New Energy and Industrial Technology Development (NEDO). Hydrogen can be



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By **2030**, Kawasaki Heavy Industries, Ltd aims to have two ships ready to bring **225,000** tonnes of hydrogen to Japan, enough to power **3 million** fuel-cell vehicles for **10,000** kilometres every year.



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In 2019, Japan had **3,757** fuel-cell passenger vehicles. The government plans for this to rise to **200,000** by 2025.



created from a wide range of sources — including biomass, fossil fuels and renewable energy sources.

"Hydrogen can contribute to diversifying our energy resources, which will enhance our energy security," explains Toshiyuki Shirai, director of the Hydrogen and Fuel Cells Strategy Office at Ministry of Economy, Trade and Industry (METI). The Japanese government has pledged to become a carbon-free society by 2050. "We believe hydrogen is a crucial element for achieving carbon neutrality in the future," says Shirai. The headline attraction of hydrogen is that its combustion produces only water as a waste product. And depending on how it is generated, hydrogen can be made without any greenhouse-gas emissions. It is thus an energy vector — a convenient way to store and transport energy. The concept being tested at Fukushima is that hydrogen could complement renewable energy sources such as solar and wind power by storing the generated electricity as hydrogen.

AHEAD OF THE PACK

"Japan is a global leader in developing and deploying hydrogen technologies," says Tim Karlsson, executive director of the International Partnership for Hydrogen and Fuel Cells in the Economy. It is working collaboratively with countries around the world, both bilaterally and in global initiatives and partnerships on developing and deploying hydrogen technologies and facilitating the global hydrogen trade, Karlsson notes. Japan has been promoting hydrogen energy on the global stage for many years, most recently by hosting annual meetings since 2018 called the Hydrogen Energy Ministerial Meeting. "These annual ministerial meetings allow energy ministers to share their vision, highlight their country's latest actions, and collectively understand what still needs to be done to support the energy transition underway," says Karlsson.

"Most notable in Japan's hydrogen strategy is the focus on international supply networks, where hydrogen would be produced overseas and shipped to Japan," says Monica

Nagashima engagement manager at Japan Energy Transition Initiative (JETI)/InfluenceMap. "The current goal is to identify the combination of technologies that will give the lowest import cost of hydrogen." She notes that various options for hydrogen storage and transport are being considered, including their suitability for long-term transportation by sea. The three main carrier technologies are liquefied hydrogen, ammonia and organic hydrides like methylcyclohexane. Nagashima comments that in addition to considering cost, it will be important for Japan to address the rising greenhouse-gas emissions from the long-distance transport of hydrogen.

The first demonstration of a seamless international supply chain for liquefied hydrogen is due to occur later in 2021. In the world-first Hydrogen Energy Supply Chain (HESC) project, hydrogen produced from brown coal in Australia will be shipped to Japan in a specially outfitted ship. A consortium of Japanese and Australian companies will generate hydrogen by reacting coal with oxygen and steam under high temperatures and pressures, which produces a gas mixture consisting mostly of carbon monoxide and hydrogen. The carbon monoxide is then reacted with steam to produce additional hydrogen and carbon dioxide. Finally, the hydrogen is extracted using a separation system and liquefied. The ship will employ cryogenic storage tanks and vacuum isolation to keep the hydrogen liquid.

The FH2R and HESC projects demonstrate that hydrogen can be created from different energy sources and can be both created domestically and imported from overseas, hinting that hydrogen's promise to diversify the energy sector may finally be on the verge of being realized. These projects are attracting the attention of the world. "By focusing efforts on hydrogen technologies and systems, Japan will continue to be a technology innovator, an example for the world of new sustainable energy and industrial systems, and a global leader in energy transition," says Karlsson. ■

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Japan currently has **161 HYDROGEN REFUELING STATIONS** in operation — more than any other country.



Tim Karlsson, executive director of the International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE).

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