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The Japanese Basic Hydrogen Strategy

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The Japanese Basic Hydrogen Strategy

I. Introduction

On June 6, 2023, the Renewable Energy and Hydrogen Ministerial Meeting revised the Basic Hydrogen Strategy for the first time in about six years. The Japanese government's plan, which envisions a significant investment exceeding 15 trillion Japanese yen over a period of 15 years by public and private sectors into the hydrogen and ammonia supply chain, has garnered significant attention.

Hydrogen energy, which can be produced from a variety of energy sources, including the use of renewable energy and methods such as electrolysis of water, possesses the characteristic of not emitting carbon dioxide during combustion. It is gaining great expectations as a new technology for achieving carbon neutrality.

Japan formulated the world's first national fundamental strategy on hydrogen in December 2017, positioning itself as a leader in advancing towards a hydrogen society. However, since then, 25 countries and regions other than Japan have developed hydrogen strategies by 2022[1]. Additionally, in the wake of the Russian invasion of Ukraine, there has been an increasing momentum in Europe and other regions to break away from energy dependency on Russia. As a result, the race for establishing hydrogen and ammonia supply networks has become significantly competitive over the past few years. Japan's position as a driving force in realizing a hydrogen society, which it has built in the past, is being challenged now.

This newsletter provides an overview of the current situation, including the government's efforts towards realizing a hydrogen society and the contents of the newly revised Hydrogen Basic Strategy ("Basic Hydrogen Strategy").

II. What is the Basic Hydrogen Strategy?

(i) History of the Basic Hydrogen Strategy

In April 2017, during the tenure of former Prime Minister Shinzo Abe, the first "Renewable Energy and Hydrogen Ministerial Meeting" was held, where the government instructed the ministers to work together to formulate a basic strategy to achieve a hydrogen society. Subsequently, in the second

[1] International Energy Agency "Global Hydrogen Review 2022" (Page 8)

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"Renewable Energy and Hydrogen Ministerial Meeting" held in December 2017, the Basic Hydrogen Strategy (the "Initial Basic Hydrogen Strategy") was formulated.

The Initial Basic Hydrogen Strategy, which aimed to realize a hydrogen society where hydrogen is utilized in daily life and industrial activities, compiled a shared vision and an action plan towards its realization, considering the year 2050 as the target. Recognizing the need to reduce the procurement and supply costs of hydrogen, the strategy set a target for the introduction of 300,000 tons of hydrogen by 2030. It aimed to achieve a hydrogen cost of around 30 yen/Nm^3 by 2030, and ultimately, around 20 yen/Nm3 in the future.

(ii) Background to the Revision of the Basic Hydrogen Strategy

The government is conscious that Japan not only formulated the world's first national-level hydrogen strategy but also led international discussions towards the realization of a hydrogen society. For instance, in October 2018, the Ministry of Economy, Trade, and Industry and the New Energy and Industrial Technology Development Organization (NEDO) hosted the Hydrogen Energy Ministerial Meeting, gathering over 300 participants, including representatives from 21 countries, regions, and organizations. During this meeting, the "Tokyo Statement" was declared to contribute to realizing the benefits of hydrogen. Additionally, Japanese companies have showcased high technological capabilities, holding a significant number of hydrogen-related patents at the global level.

However, over the past few years, the world has made a significant shift towards achieving carbon neutrality, with major countries swiftly implementing policies and investment plans to decarbonize their economies. Furthermore, the Russian invasion of Ukraine has caused significant changes in the energy supply and demand structure. For example, the United Kingdom has implemented a contracts for difference (CfD) scheme aiming to support for price differentials between low-carbon hydrogen and fossil fuels through the "Low Carbon Hydrogen Business Model"[2], and Germany has established the "H2Global Foundation" for hydrogen purchasing and sales through bidding processes[3], along with announcing a government support of 900 million euros. These countries have taken the lead in considering and implementing specific support systems ahead of Japan. Furthermore, the United States is also planning to make substantial investments in the hydrogen industry, including preferential measures for the production of clean hydrogen based on new tax systems under the Inflation Reduction Act of 2022.

Meanwhile, it is true that during this period, Japan has also expanded its support for the hydrogen and ammonia sectors to some extent. The revised "Green Growth Strategy Through Achieving Carbon Neutrality in 2050" (the "Green Growth Strategy") on June 18, 2021, aimed to concentrate support on the scaling up of electrolyzers and the implementation of excellent component technologies in devices, utilizing the Green Innovation Fund. The Green Growth Strategy aimed to further reduce device costs and improve durability to maintain and enhance international competitiveness. It also set a goal to achieve a ratio of clean hydrogen (blue hydrogen and green hydrogen) out of the maximum hydrogen supply of 3 million tons per year by 2030, surpassing the amount of renewable hydrogen supply (approximately 420,000 tons per year) set out in Germany's national hydrogen strategy announced in June 2020. The Green Innovation Fund was established with a scale of 2 trillion yen, and one-third of the projects are related to the hydrogen and ammonia industry.

The recent revision of the Basic Hydrogen Strategy can be seen as a new step for Japan to play a pioneering role in realizing a hydrogen society amidst the intensified international competition.

[2] https://www.gov.uk/government/publications/hydrogen-production-business-model
[3] https://www.bmwk.de/Redaktion/EN/Pressemitteilungen/2021/06/20210614-new-funding-instrument-h2global-launched.html

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III. Key Points of the Revision of the Basic Hydrogen Strategy

(i) Setting the Hydrogen Introduction Target for 2040

In the 6th Strategic Energy Plan, which was approved by the Cabinet in October 2021, the government had already set targets for domestic hydrogen supply and supply cost for 2030 and 2050.

Year	2022	2030	2050
Volume of Supply	2 million ton/year (Estimated amount)	Up to 3 million ton/year	Around 20 million ton/year
Supply Cost	100 yen/Nm^3 (Price at hydrogen station)	30 yen/Nm^3 (CIF price)	Less than 20 yen/Nm^3

Source：The 6th Strategic Energy Plan, Page 79

The revised Basic Hydrogen Strategy, while maintaining the targets for 2030 and 2050, newly set a target for the introduction of hydrogen (including ammonia) in 2040 at approximately 12 million tons. Regarding supply cost, the Basic Hydrogen Strategy stated the aim to further reduce costs through methods such as leveraging the Green Innovation Fund, advancing technological development, and mobilizing various measures based on the Basic Hydrogen Strategy to stimulate demand and promote private sector investment. However, no specific numerical targets were set in this regard.

(ii) Efforts in Supply of Hydrogen

(a) Support for Domestic Hydrogen Production Businesses

Hydrogen can be produced from various energy sources, but among them, hydrogen generated through electrolysis of water using renewable energy (green hydrogen) can be considered the most environmentally friendly production method. However, in Japan, where the adoption of renewable energy has been slower compared to Europe, the cost of electricity generated from renewable sources remains considerably high. Therefore, it is currently challenging to significantly reduce the production costs of domestically produced green hydrogen. Despite this, there is an increasing need for Japan, which heavily relies on imported oil and gas and is now facing a pressing need for enhanced energy security, especially in the wake of the recent Russian invasion of Ukraine, to expand domestic hydrogen production capacity. Additionally, in the current market condition where suppression orders of renewable energy output (primarily from solar power generation) have frequently been issued, converting and storing surplus electricity as hydrogen can also serve as an adjustment mechanism for electricity supply.

In this context, the Basic Hydrogen Strategy explicitly states that the government will, when it introduces supporting initiatives focusing on price differences with existing power sources, provide maximum support to domestic projects that are expected to have sufficient price reductions and future competitiveness, with a view to enhancing energy security.

(b) Promotion and Advancement of Electrolyzers

An essential component in the production of green hydrogen is the electrolyzers for hydrogen production. While small and medium-scale industrial electrolyzers have already been somewhat widely adopted, large-scale devices and the development of systems capable of handling the load fluctuations from renewable energy sources are necessary for mass production of green hydrogen. In the Green Growth Strategy, Japan recognizes that it has already constructed some of the world's largest water electrolysis devices and possesses technology at the highest international level. However, it acknowledges that some foreign companies, particularly in

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Europe, have taken the lead in technology development aimed at further scaling up of electrolyzers. To maintain and enhance international competitiveness, the Basic Hydrogen Strategy focuses on concentrated support for the scaling up of electrolyzers by Japanese companies, as well as the implementation of excellent component technologies to further reduce device costs and improve durability.

In the Basic Hydrogen Strategy, a target for the adoption of electrolyzers by Japanese-related companies by 2030 (including adoption overseas) is set at around 15 GW, which corresponds to approximately 10% of the projected global adoption of electrolyzers by 2030. The Basic Hydrogen Strategy explicitly states the goal of establishing a hydrogen production infrastructure.

(c) Regulatory Incentives for Expanding Low-Carbon Hydrogen Adoption

The Basic Hydrogen Strategy highlights the need to promote the adoption of hydrogen and ammonia while aiming for decarbonization from the early stages. To achieve this, it emphasizes the importance of developing transition measures to facilitate the shift towards low-carbon hydrogen through measures such as: (i) considering market designs that provide incentives for the purchase of low-carbon hydrogen, and (ii) implementing regulatory measures to promote the supply of low-carbon hydrogen.

When considering the role that hydrogen should play in decarbonization, it becomes important to define what constitutes low-carbon hydrogen. Taking into account the current technological level and setting ambitious yet achievable targets, the Basic Hydrogen Strategy tentatively defines low-carbon hydrogen as having a carbon dioxide (CO_2) emission of 3.4 kg-CO2e or less per kilogram of hydrogen production "from well to production gate" (i.e., from raw material production to the outlet of the hydrogen production device).

(d) Addressing Risks in Supply Chain Development

The development of hydrogen supply chains carries significant risks due to the immaturity of hydrogen-related technologies, uncertainties regarding future hydrogen prices and demand, and the potential disruption of supply chains if infrastructure delays occur at either upstream or downstream stages, given the nascent stage of the technology. To address these risks, the government aims to establish a system for private sector insurance against such risks and create a business environment where investment by businesses and financing from financial institutions can be facilitated by public agencies partially assuming the risks in cases where risks are substantial.

(iii) Efforts in Demand of Hydrogen

Hydrogen is expected to contribute to decarbonization in various sectors, such as power generation (e.g., fuel cells and turbines), transportation (e.g., vehicles, ships, aircrafts and trains), and industries (e.g., steel production, chemicals and oil refining). In the Green Growth Strategy, the government mentioned that it aims to strengthen international competitiveness in areas such as hydrogen power generation turbines, commercial vehicles like fuel cell trucks, and hydrogen-reduced iron production, where Japanese companies possess excellent technologies and growth potential.

In the Basic Hydrogen Strategy, it is stated that strategic planning and implementation will be conducted in various sectors such as power generation, fuel cells, and heat/material utilization, taking into account domestic and international trends. These efforts aim to enhance industrial competitiveness and expand hydrogen demand.

(iv) Establishment of Support Systems for Development of Large-scale Supply Chains

The Basic Hydrogen Strategy aims to promptly establish a regulatory and supportive framework for

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the development of large-scale supply chains and the establishment of supply infrastructure, focusing on the following two aspects.

(a) Institutional Development for the Establishment of Large-scale and Resilient Supply Chains

For first movers (meaning, according to the Basic Hydrogen Strategy, companies that plan to start supplying low-carbon hydrogen and ammonia in Japan by around 2030, having taken investment risks ahead of competitors), the Basic Hydrogen Strategy considers the implementation of a scheme to support the price difference between the "reference price" and the "benchmark price" for the hydrogen and ammonia which they supply over the long term. The "benchmark price" refers to a price that reasonably recovers the costs required for business continuity while generating appropriate returns, and the "reference price" refers to the "parity price of existing fuels." Essentially, this scheme aims to mitigate the risks borne by first movers by compensating for the price difference between hydrogen and ammonia and fossil fuels. In the meantime, it is currently forecasted that the combined public and private investment in supply chains will exceed 15 trillion yen over 15 years.

(b) Institutional Development to Facilitate the Development of Efficient Supply Infrastructure for Demand Creation

To achieve the large-scale adoption of hydrogen and ammonia, the development of extensive supply infrastructure, such as storage tanks and pipelines, is crucial. The government plans to establish approximately three large-scale hubs in major metropolitan areas with significant industrial demand over the next 10 years. Additionally, about five medium-scale hubs will be developed in regions where significant demand aggregation can be expected based on specific industrial characteristics.

(v) Direction toward strengthening competitiveness of the hydrogen industry and safe use of hydrogen

(a) Overview of the hydrogen industry strategy

The outline of the hydrogen industry strategy ("Hydrogen Industry Strategy"), which aims to enhance the industry's competitiveness, has been revealed in the Basic Hydrogen Strategy. With the increasing global and domestic interest in hydrogen utilization, the Basic Hydrogen Strategy aims to achieve "triple benefits" of decarbonization, stable energy supply, and economic growth by comprehensively addressing the domestic and international hydrogen markets and rapidly commercializing hydrogen technologies to gain a competitive edge in the market.

In the Hydrogen Industry Strategy, five categories (highlighted in gray in the below table) and nine areas (underlined in the below table) are identified as key areas to focus on, representing the core of the hydrogen industry that requires concentrated efforts.

5 categories and 9 areas		summary	
Hydrogen Supply	Hydrogen Production	Reduce electrolyzer equipment cost/prices of hydrogen produced from renewable energy	・ Support for expansion of manufacturing capacity for electrolyzer (water electrolysis equipment) and related materials ・ Promotion of system development for effective use of renewable energy and improvement of equipment operation rate

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		Promote new water electrolysis technologies	・ Implementation into society by studying the development and demonstration of high-temperature steam electrolysis and AEM-type water electrolysis
	Construct Hydrogen Supply Chain	Trends in hydrogen transportation technologies	[Liquefied hydrogen] ・ Development of larger and more efficient hydrogen transportation technologies, establishment of international standards for commercial vessels, and implementation into society with respect to a supply chain for Japan ・ Supply chain development in overseas markets
			[MCH] ・ Development of dehydrogenation technology using existing refinery facilities and demonstration of the establishment of an international supply chain ・ Development and demonstration of innovative technologies, etc., capable of converting water and toluene to MCH
			[Ammonia] ・ Establishment of large-scale decomposition technology to extract hydrogen, etc.
		Development Technologies and Enabling Conditions for Cost Reduction in Domestic Transportation	・ Further technological development and efficient transportation of hydrogen to lower costs for compressors, storage tanks, etc. ・ Technological development (including development of regulations) for the installation of inexpensive, durable pipelines ・ Implementation of technological development of hydrogen storage alloys
		Marine Transportation by Ship	・ Promote implementation into society with respect to carriers that contribute to large-scale transport of hydrogen, ammonia, etc.
Decarbonized Power Generation		・ Accelerate technological development of high-mixed-combustion hydrogen power generation ・ Support for building a robust large-scale supply chain ・ Establishment of a commercial supply chain through support scheme for hydrogen and ammonia supply infrastructure base development, and realization of a stable supply of hydrogen fuel through linkage with the Long-Term Decarbonized Power Auctions, etc.	
Fuel Cells	Industrialize Fuel Cell Business	Support the Fuel Cell Support Industry	・ Cost reduction as an integrated system including fuel cell stack
		Create Co-benefits and Enhance the Business Value of the Hydrogen	・ Pursue co-benefits such as value of cleanness, benefit for worker health and solution to labor shortage issues, etc.

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		Industry	
		Creation of Demand Clusters	・ Focused support for projects that contribute to demand creation, such as ports, industrial parks, model cities, and horizontal development by industry
	Develop Strategies from a Global Perspective	・ Market acquisition through public-private partnerships ・ Accurate implementation of "Open & Close strategy"	
	Increase Demand in Japan, the mother market	Mobility & Power Segments	[Automobile] ・ Focused support for FCV commercial vehicles ・ Establishment of targets for FCV conversion and guidelines for the introduction of filling infrastructure in the transportation sector ・ Robust support for first movers, etc.
			[Railway vehicles, etc.] ・ Technical problem solving and implementation into society of longer range, higher power, and smaller size fuel cell railcars ・ Decarbonizing the rail sector as well as the hydrogen supply chain
			[Vessels] ・ Dissemination of vessels that contribute to the decarbonization of coastal shipping (e.g., electric propulsion vessels with hydrogen fuel cells and batteries)
			[Harbors] ・ Promotion of the formation of carbon neutral ports (strategic placement and development of hydrogen and ammonia receiving bases, establishment of fuel supply systems for next-generation ships, etc.)
			[Hydrogen station] ・ Optimal arrangement of integrated supply and demand through multi-use stations ・ Streamlining and optimization of regulations, including review of inspection and testing methods ・ Widespread use of hydrogen stations for commercial vehicles
		Consumer Sector	[Household fuel cells] ・ Maximize the potential of household fuel cells ・ Support for development of fundamental and evaluation technologies that enable performance, durability, cost reduction, etc.
			[Commercial/industrial fuel cells] ・ Increased power generation efficiency (from 40-55% to 60%), improved catalyst activity, and lower costs
			[Development of fuel cell technology] ・ Support for higher power output for railroads and ships ・ High performance and space saving for construction and

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			agriculture/forestry machinery, drones, etc.
Direct Use of Hydrogen	Decarbonized Steel	• Establishment of hydrogen-reduced ironmaking technology and expansion of international competitiveness for deployment in overseas markets	
	Decarbonized Chemical Products	• Strengthening of international competitiveness in addition to support for the establishment of technology for the market of plastics and other products made from CO_2	
	Hydrogen-Fueled Vessels	• Promotion of international rule-making from both economic and regulatory perspectives, including introduction of zero-emission ships, establishment of domestic production infrastructure, and improvement of education and training environment for seafarers	
Hydrogen Compounds	Fuel Ammonia	• Promote technological development and demonstration to achieve a mixed fuel ratio of over 50% and to shift to exclusive use of combustion • International standardization of fuel ammonia supply chain • Promote introduction of ammonia-fueled vessels, etc., build domestic production infrastructure, and improve education and training environment for seafarers, etc.	
	Recycled Carbon products	Consumer Sector	• Promote the use of LP gas that does not depend on synthetic fuels (e-fuel), synthetic methane, or fossil fuels
		Decarbonization of Aviation	• Promote utilization of SAF and create domestic and international demand for aircraft equipped with new technologies

(b) Hydrogen Safety Strategy

In addition to the Hydrogen Industry Strategy, the Basic Hydrogen Strategy also provides an outline of the hydrogen safety strategy ("Hydrogen Safety Strategy"). Regarding the Hydrogen Safety Strategy, a study group for formulating the Hydrogen Safety Strategy was established by the METI on August 5, 2022, and the interim report of the study group, titled "Hydrogen Safety Strategy (Interim Summary)," was published on March 13 of this year[4]. The outline of the Hydrogen Safety Strategy in the Basic Hydrogen Strategy is based on this Interim Summary and aims to establish a foundation for a secure and safe hydrogen society and create an environment that promotes hydrogen utilization. The overview of the Hydrogen Safety Strategy is as follows.

Three courses of action		Nine concrete means
1	Efforts based on collection of scientific data and evidence through technology development	Strategic acquisition of scientific data and sharing of data related to common areas
		Realization of a smooth experimental and demonstration environment
2	Streamline and adapt rules towards gradual implementation into hydrogen society	Approach to priority areas in the Supply Chain • Consumption of hydrogen and ammonia • Timing to start design works

[4] a study group for formulating the Hydrogen Safety Strategy: Hydrogen Safety Strategy (Interim Summary), March 13, 2023 (https://www.meti.go.jp/shingikai/safety_security/suiso_hoan/pdf/20230313_2.pdf)

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		・ Policy positioning such as demonstration projects being carried out by project promotion government agencies
		Clarifying the future pathway on the technology development and demonstration stage
		Building and developing third-party certification and inspection bodies
		Collaboration with local governments
3	Develop enabling conditions for use of hydrogen	Risk communication
		Human resource development
		Efforts to grasp trends in global market, harmonize regulations, and establish international standards

IV. Conclusion

In the near future, the formulation of the Hydrogen Safety Strategy and the Hydrogen Industry Strategy, as well as the enactment of new laws related to hydrogen, are planned in accordance with the revised Basic Hydrogen Strategy. The Japanese government's efforts towards realizing a hydrogen society are expected to progress in a multidimensional and accelerated manner, so it is important to continue monitoring these developments.

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