Hydrogen/Ammonia Policy Challenges for 2024
– Continuous discussions required from diverse viewpoints while developing systems to support introduction –

The Institute of Energy Economics, Japan

Yoshiaki Shibata

Senior Research Director, Manager, New Energy System Group

Assistant Director, Clean Energy Unit

Key points

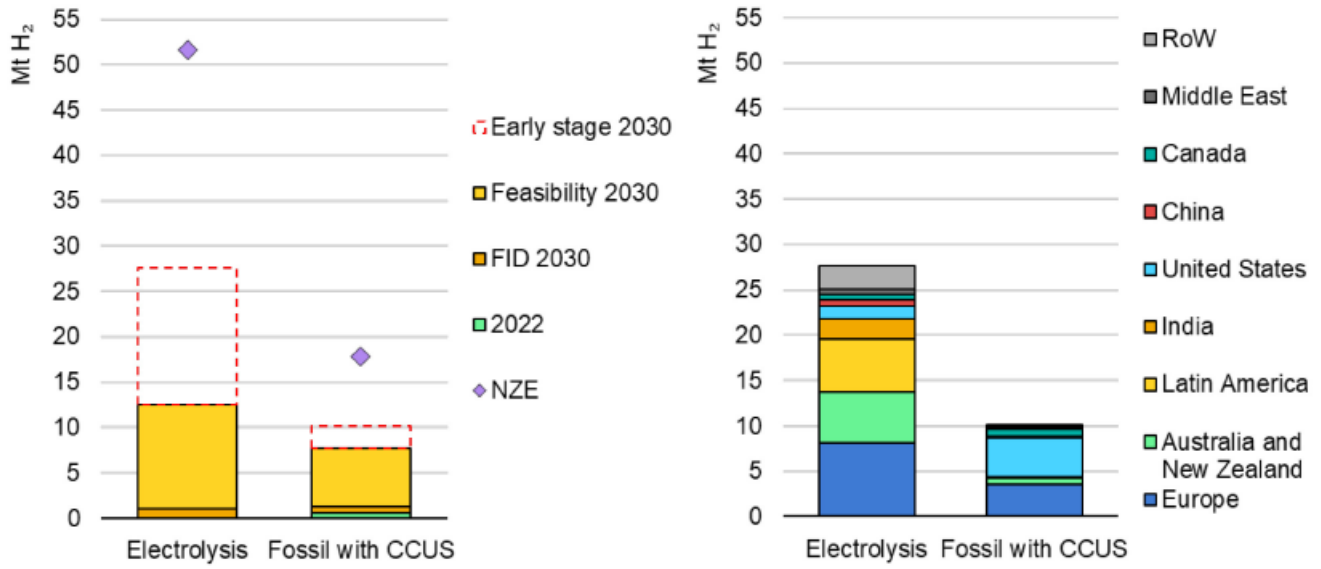
- ✓ Expected global hydrogen supply in 2030 falls far short of the level required for carbon neutrality in 2050.
- ✓ Japan plans to develop a contract for difference and production base development systems to support hydrogen projects in 2024. How to allocate a limited budget for supporting hydrogen projects and how to judge the rationality of hydrogen production and use will draw attention.
- ✓ Challenges towards securing hydrogen demand include the development of technology to convert hydrogen carriers into hydrogen and relevant cost reduction to respond to hydrogen use, as well as the creation of systems for financial support, carbon pricing, and mandatory hydrogen usage obligations.
- ✓ A future hydrogen network that covers imports and domestic distribution should be discussed.
- ✓ To enhance the international competitiveness of Japan's water electrolysis technology, Japanese companies should globally market not only relevant equipment and components, but also hydrogen energy management systems.

Global Hydrogen Adoption Outlook

- Hydrogen supply under all existing projects including those in the initial phase is expected to reach up to 38 million tons (27 million tons from water electrolysis and 10 million tons from fossil fuels with CCUS), falling far short of the level required for 2030 under the International Energy Agency's Net Zero Emissions by 2050 scenario. Supply under projects subject to final investment decisions is limited to the minimal level.
- Europe has a tendency to use renewable energy sources for water electrolysis hydrogen, while the United States has a trend of using fossil fuels with CCUS for hydrogen production.

Global clean hydrogen supply outlook (2030)

Figure 3.2 Low-emission hydrogen production by technology route, maturity and region based on announced projects and in the Net Zero Emissions by 2050 Scenario, 2030



Source: IEA, "Global Hydrogen Review 2023"

Focus for 2024: Japan's Hydrogen Project Support

- Japan plans to introduce price difference compensation (contract for Difference: CfD) and production base development systems to support hydrogen projects. Details were compiled on December 6 (at a METI panel on hydrogen and ammonia). The public invitation is planned to start around the summer of 2024.
  - Price difference compensation (domestic production, overseas production plus marine transportation)
    - ✓ Projects will be selected through a comprehensive assessment covering energy policy (S+3E's), GX (Green Transformation) policy (decarbonization and industrial competitiveness enhancement), and project completion feasibility.
  - Production base development support (domestic transportation and storage)
    - ✓ Projects will be selected through a comprehensive assessment covering feasibility, economic efficiency, CO2 emission reduction effect, contributions to regional economies, and industrial competitiveness enhancement.
- Focus
- ➢ The framework for selecting hydrogen projects not only from the viewpoint of efficiency but also from various other perspectives is important.
- ➢ How should a limited budget be distributed among projects. The selection of various projects is important for energy security.
- ➢ How should the rationality of hydrogen production and use be judged, for example, renewable energy additionality and comparison with other applications (water electrolysis and batteries, hydrogen production from biomass/biogas and direct use), etc. ?
- ➢ Regarding CfD, hydrogen's carbon intensity must be minimized, given that environmental value is taken into account in the reference price.

Importance of Securing Hydrogen Demand

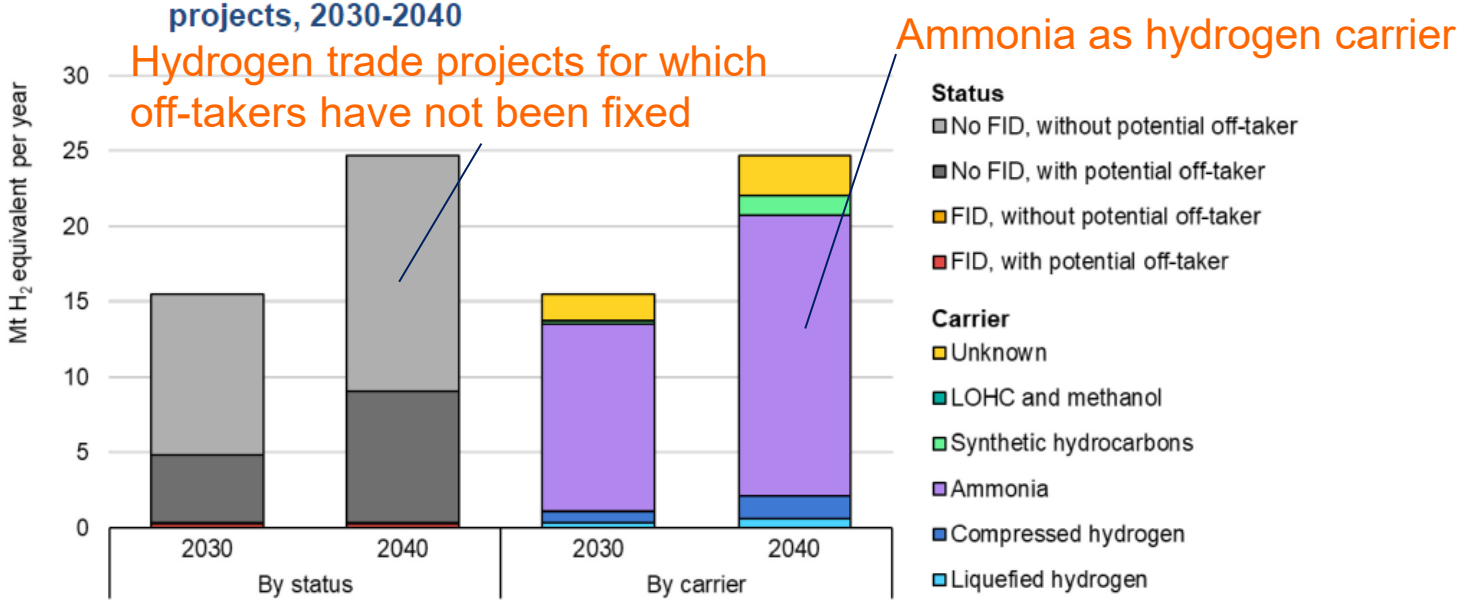
- No off-taker is fixed for most hydrogen trade projects.

  ➡ Need to secure hydrogen demand

- Ammonia accounts for most hydrogen carriers in the hydrogen trade. To secure hydrogen demand, ammonia must be cracked into hydrogen. Costs for other hydrogen carriers must be reduced.

Clean hydrogen trade outlook

Figure 4.1 Low-emission hydrogen trade by status and by carrier based on announced projects, 2030-2040



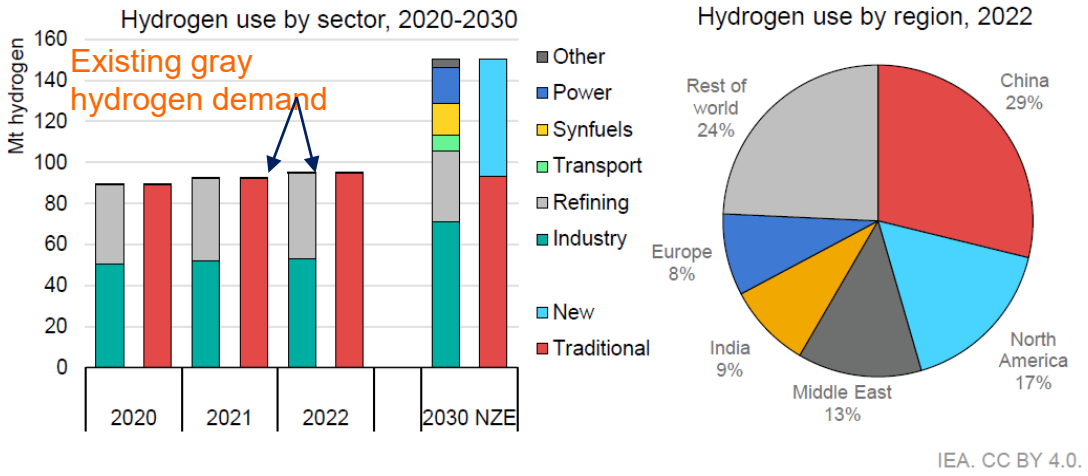
Source: IEA, "Global Hydrogen Review 2023"

Converting Gray Hydrogen into Clean Hydrogen

- The creation of new hydrogen demand should be explored along with the conversion of gray hydrogen into clean hydrogen. However, attention should be paid to the following issues:
  - Currently, hydrogen by-produced in plants is used in many cases, indicating that attention should be paid to the conversion impact on plant production processes.
  - Distribution networks for merchandised hydrogen are well-established, but the capacity is limited (to some 30,000 tons in Japan)

Global hydrogen demand (Including conventional gray hydrogen)

Figure 2.1 Hydrogen use by sector and by region, historical and in the Net Zero Emissions by 2050 Scenario, 2020-2030

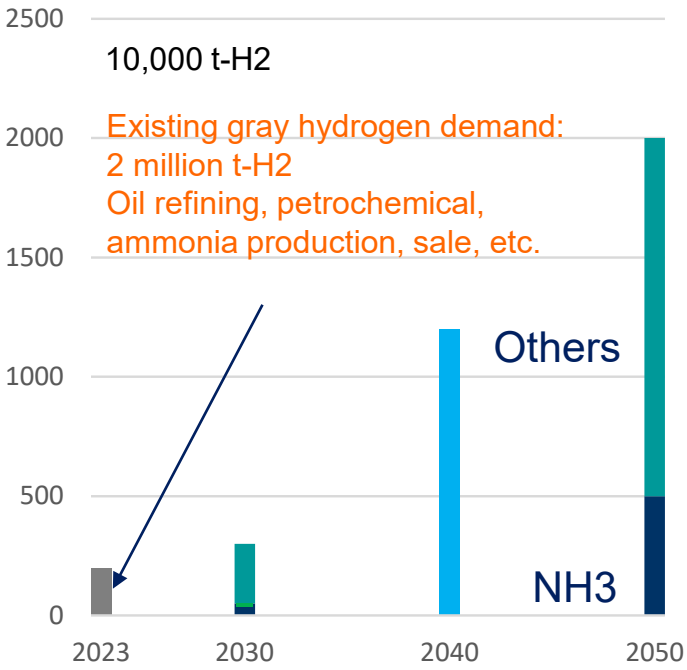


Notes: NZE = Net Zero Emissions by 2050 Scenario. "Other" includes buildings and biofuels upgrading.

Hydrogen use continues to grow, but remains concentrated in traditional applications, such as industry and refining.

Source: IEA, "Global Hydrogen Review 2023"

Japan's hydrogen adoption target (hydrogen tons)

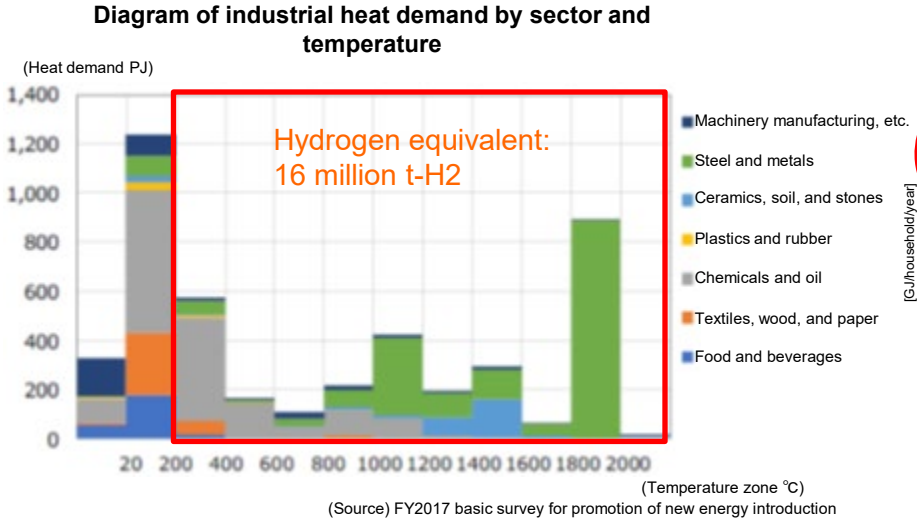


Source: "New Hydrogen Strategy," 57th IEEJ Webinar in June 2023

Hydrogen Applications Should Be Developed: Specific Candidates

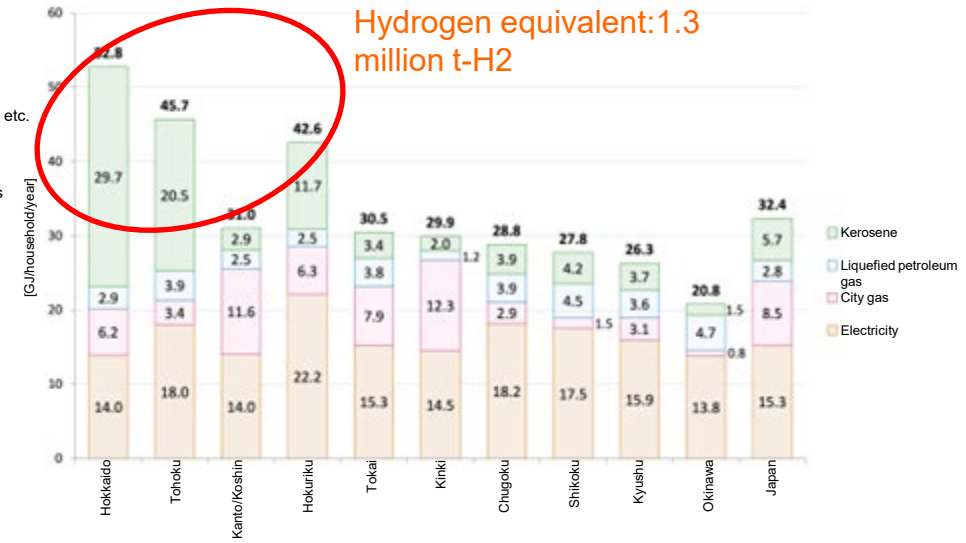
- It is important to identify and secure applications that are difficult to realize decarbonization without hydrogen. Candidates include long-distance and large-scale transportation (trucks, buses, aircraft, and ships), industrial high-temperature heat demand, and cold-region heat demand.

Industrial heat demand by temperature zone



Source: Document for the 36th meeting of the Strategic Policy Committee

Residential energy consumption intensity by region



Source: Ministry of the Environment
https://www.env.go.jp/earth/ondanka/kateico2tokei/html/energy/detail/01/#main

- ✓ Hydrogen applications for temperatures above 200°C have strong potential.
- ✓ Hydrogen distribution is relatively easy for coastal industrial areas.
- ✓ Performance limits of cold-region heat pumps and significance of hydrogen based on resilience
- ✓ Optimal hydrogen distribution methods should be considered.

Systems for Securing Hydrogen Demand

- In order to secure hydrogen demand, it is necessary to consider not only financial support and carbon pricing for inducing hydrogen use, but also mandatory hydrogen usage obligations promoted.
- Also necessary are efficient hydrogen distribution networks to link supply to demand. Relevant initiatives are being promoted in Japan, Europe, and North America.

Financial support cases

- U.K.: CfD (Low Carbon Hydrogen Business Model)
- Germany: Joint procurement and CfD (H2 Global)
- U.S.: Tax credit (Inflation Reduction Act)
- Japan: CfD

Case for mandatory hydrogen usage obligations

- EU renewable energy directive:
  - ✓ Industrial hydrogen use: 42% by 2030 and 60% for RFNBO (Renewable Fuels of Non-Biological Origin) by 2035
  - ✓ Transportation sector fuels: Increase the share to 5.5% for advanced biofuels (inedible) + RFNBO and 1% or more for RFNBO by 2030

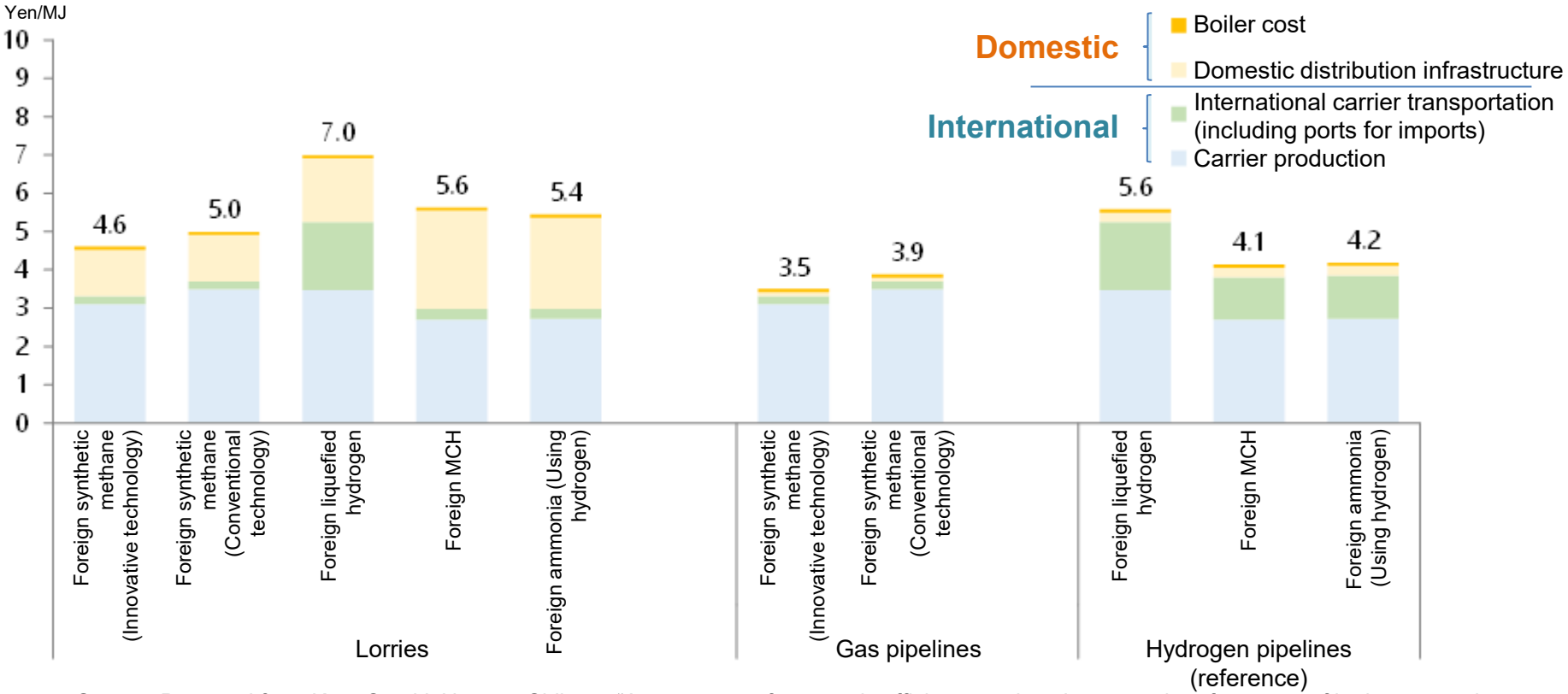
Hydrogen network development projects

- Europe: European Hydrogen Backbone, etc.
- U.S.: Regional Clean Hydrogen Hubs (Infrastructure Investment and Jobs Act)
- Japan: Support for production base development

International and Domestic Hydrogen Networks

- Domestic options include not only various hydrogen carriers, but also compressed hydrogen, and pipelines.
- The utilization of existing infrastructure and desirable future networks should be discussed.

Hydrogen carrier cost comparison (assuming industrial heat demand of overseas and domestic users)



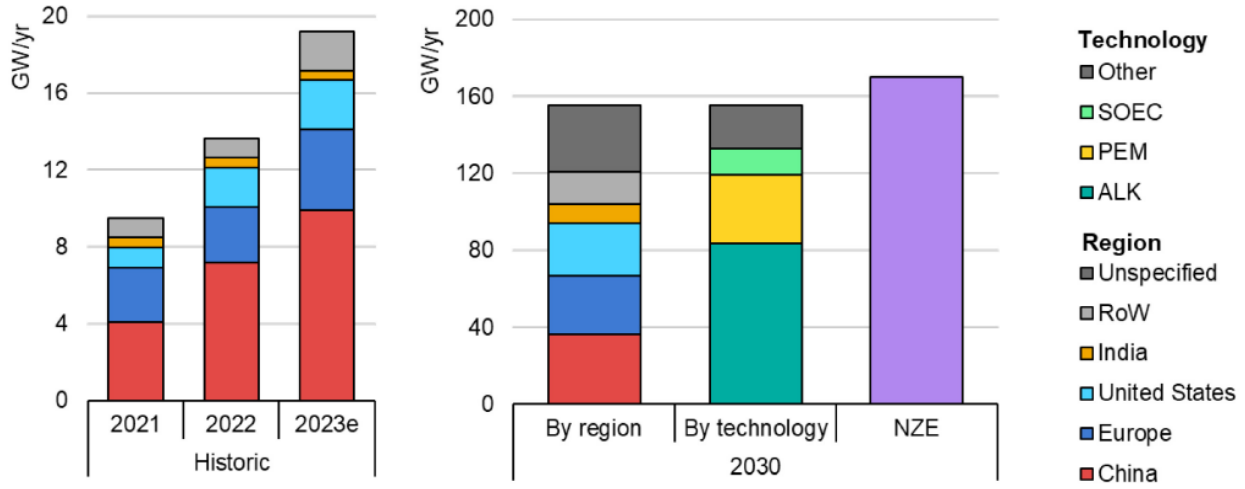
Source: Prepared from Kan, Otsuki, Nagata, Shibata, “Assessment of economic efficiency and environmental performance of hydrogen carriers from overseas production to domestic final consumption,” IEEJ, November 2023

Water Electrolysis: International Competitiveness Should Be Enhanced

- Europe, the United States, China, and India are predicted to almost occupy the global water electrolysis market in 2030.
- To increase the market share for Japanese products, Japanese companies should not only expand sales of parts and equipment, but also market hydrogen energy management systems that aim for optimal operations from hydrogen production with water electrolysis to hydrogen supply to consumers. To this end, it is necessary to strengthen domestic power-to-gas initiatives.

Electrolyser manufacturing capacity outlook

Figure 3.7 Electrolyser manufacturing capacity by region and technology according to announced projects and in the Net Zero Emissions by 2050 Scenario, 2021-2030



Source: IEA, "Global Hydrogen Review 2023"

Contact: report@tky.ieej.or.jp