

Is Hydrogen Really the Future of Japan's energy security

Japan hopes to decarbonise its economy through hydrogen. But reliance on imported hydrogen risks creating a new version of an old problem.

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Japan's energy system has long been characterized by its dependence on fossil fuels, as the country remains the world's fifth-largest oil consumer. In 2022, Japan imported roughly 97% of oil and was the largest importer of liquefied natural gas globally, a structural vulnerability that has shaped its political institutions, economic choices and foreign policy for decades (EIA, 2023).

As a solution, Japan has shifted its energy system towards hydrogen. A more renewable approach with a question beneath the optimism arguing if hydrogen can truly resolve Japan's energy security or does it simply shift its dependence of fossil fuels in a new form?

Why Japan Turned to Hydrogen

The fragility of Japan's energy systems was exposed with unprecedented clarity after the 2011 Fukushima disaster, leading to a significant shift in energy policy and practices. The disaster resulted in a sudden loss of nuclear capacity as all nuclear reactors immediately stopped, which has been a key part of Japan's energy strategy (Britannica, 2011). In the years since, Japan has searched urgently for a pathway to satisfy the energy trilemma: security, affordability and sustainability, leading to reliance and demand for fossil fuels and particularly natural gas. However, Japan's energy policy has evolved over the years, focusing on renewable energy sources (Britannica, 2011).

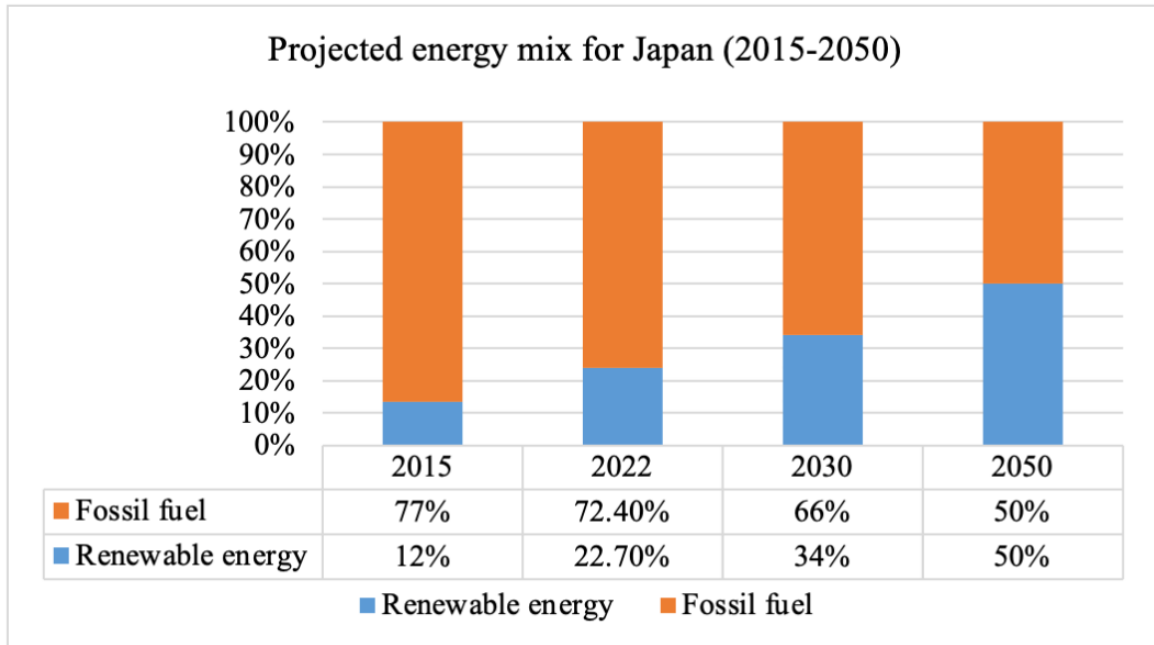


Figure 1 - Projected energy mix for Japan (2015-2050) (Richards, 2024)

Japan is in an era of energy revolution, committing to a greener future. Although the nation was powered by fossil fuels in 2015, leaving renewable energy to 12%; projections show a shift with renewables accelerating to provide a third of energy mix in 2030 and a 50% of energy mix by 2050 (Richards, 2024)

Hydrogen has become a milestone in Japan’s energy development, aiming to create a “hydrogen society” through investment and policies achieving net zero emissions by 2050 (JETRO, 2025). The nation stands as the first nation to publish a hydrogen strategy and position itself as a global leader in building an international hydrogen supply chain (Matsuno, 2025).

Japan's Hydrogen Strategy

Japan was the first country in 2017 which formulated a national hydrogen strategy, known as the Basic Hydrogen strategy. The strategy then evolved with the 2050 Carbon Neutrality Declaration in 2020, emphasizing how essential hydrogen's role is in achieving net zero emissions, particularly in sectors like transportation, steel production and energy generation (The Ministerial Council on Renewable Energy, 2023).

Japan's hydrogen strategy aims to achieve carbon neutrality by 2030, with set targets including 3 million tons of hydrogen use by 2030 and 20 million tons used by 2050 (Konovalov et al, 2025). To achieve this the country aims to invest about 15 trillion yen from both the public and the private sector over the next 15 years; investing will allow the building of a hydrogen supply chain, one of the most significant financial commitments of technological advancement globally; proving that is not just a domestic investment but a global initiative (JETRO, 2025). A major partnership has been Chiyoda Corporation collaboration with NEDO, establishing pioneering hydrogen supply chain, transforming over 100 tons of hydrogen from Brunei Darussalam to Japan in 2020 (JETRO, 2025).

Through these initiatives, the green hydrogen market is expected to generate a revenue of USD 1,205.6 million by 2030, equivalent to a growth rate of 37.4% from 2022 to 2030, as shown in Figure 2 (Grand View Horizon, 2025).

Japan green hydrogen market, 2019-2030

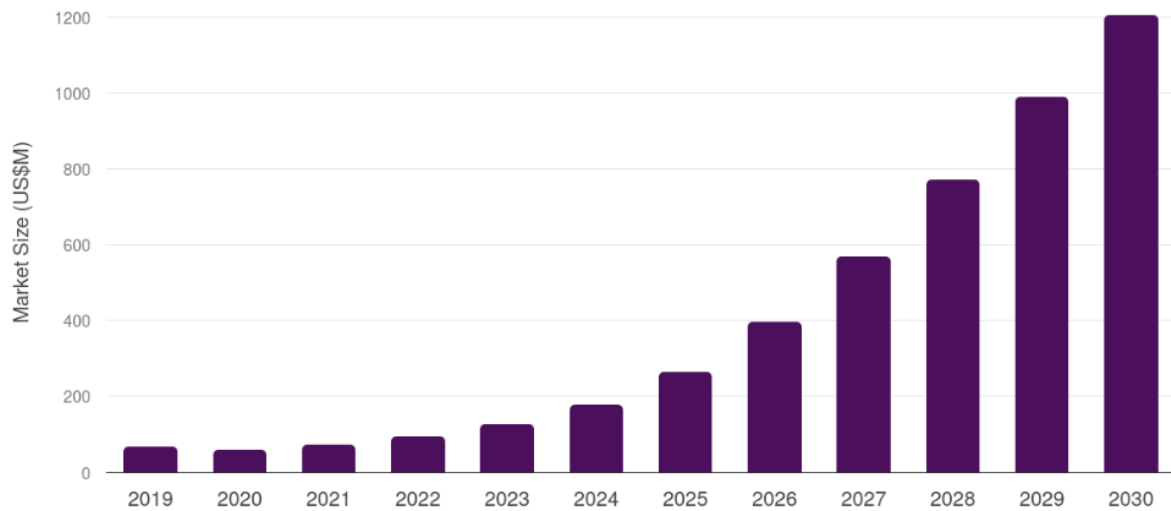


Figure 2 - Japan's green hydrogen market, 2019 - 2030 (Grand View Horizon, 2025)

Affordability

Affordability remains a crucial obstacle to Japan's hydrogen plans, as cost of production, transportation and storage of hydrogen is incredibly higher than that of fossil fuels. Studies have concluded that even if hydrogen production is reduced to \$2/kg, carbon abatement costs are expected to be \$500 to 1,250/tCO₂ in many of the sectors (Matsuno, 2025).

In 2024, Japan imported about 194 billion yans of hydrogen, mostly from United States and China, ranking hydrogen as the 110th most imported product in the country (OEC, 2023). Imported hydrogen adds costs to the country due to the need of specialized shipping, liquefaction or ammonia synthesis and appropriate port infrastructure.

Although the Japanese government implemented a range of subsidies like Hydrogen Society Promotion Act to support hydrogen economy, hydrogen remains costly for consumers like industrial firms and transport operators (METI 2024; Lister, 2025).

Security

Hydrogen has been presented as a key pathway forward for Japan to strengthen its energy security while transition to cleaner energy, yet it simultaneously creates a clear paradox. Japan's limited natural resources and small mineral reserves do not allow production of hydrogen at a large scale domestically and is therefore forced to rely heavily on imported hydrogen (Britannica, 2019). This dependency highlights economic challenges the country faces and the need for innovation and resources allocation to achieve energy demand.

The paradox lies in Japan's effort to withdraw from foreign oil and gas, while reducing fossil fuels in its energy mix, simultaneously accelerating its reliance on imported hydrogen. Although the strategy is framed to improve energy security through diversification of energy mix, it could ultimately replace fossil fuel dependence with overseas hydrogen suppliers. In the case where exporting countries experience trade barriers, regulatory uncertainty, geopolitical tensions or currency fluctuations, Japan could potentially be exposed to external risks (Laceup, 2025).

Sustainability

Japan's hydrogen strategy is highly interconnected with sustainability and align with United Nations Sustainable Development Goals (SDGs), particularly SDG7 (Affordable and Clean Energy) and SDG13 (Climate Action), by focusing on decarbonization (United Nations, 2015). The strategy aims to achieve carbon neutrality by 2050, a significant step towards reducing greenhouse gas emissions and tackling climate change, through the promotion of hydrogen as a low-carbon energy source (Konovalov et al, 2025). Additionally, ensuring hydrogen remain affordable and accessible aims to meet SDG9 (Industry, Innovation and Infrastructure) (United Nations, 2015).

However, the extent of sustainability of this approach varies on hydrogen's production and supply. Japan's hydrogen is produced through both domestic generation and overseas supply due to the country's limited natural resources and capacity. The country can potentially supply about 4 to 5 million tons per year of domestic hydrogen

by 2050, meaning 20 million additional tons are needed from overseas sources (Bank, 2023). Domestically, hydrogen is produced from fossil fuels like natural gas, referred as grey hydrogen (Konovalov et al, 2025). At the same time, Japan invests heavily on importing hydrogen and hydrogen carriers like ammonia from countries with reliance on renewable energy like Australia and Middle East (Matsuno, 2025). While these countries aid in securing large hydrogen volumes, their sustainability varies, as some countries produce green hydrogen made from renewables and other from fossil hydrogen generating emissions.

Additionally, transportation of hydrogen requires energy intensive process, reducing overall environmental gains (AVEVA, 2025). Japan's hydrogen supply is in fact more diverse, but in the long-term sustainability will depend how efficiently emissions are managed.

Policy Adjustment and the Path Forward

Hydrogen is an essential tool in Japan's decarbonization strategy; however, relying solely on hydrogen as a central solution, risks the reinforcement of existing energy vulnerabilities instead of resolving them. Adjusting existing policy towards diversifying energy transitions is crucial. This could be done by investing and expanding domestic renewable energy, particularly offshore wind and solar; as of 2024 the country had 5.1GW of offshore wind projects under development with a national goal of 10GW by 2030 and 30 to 45 GW by 2040, expecting to contribute for 4 to 8% of energy supply in 2040 (METI, 2025). Expanding on these goals would reduce import dependence and lower emission costs.

Simultaneously, Japan has composed the "6th Strategic Energy Plan" in 2021, aiming to reduce energy consumption by 62 million kilounces by 2030 (USDA, 2021) and formulated the "Zero Energy Buildings" (ZEB) regulations, which are building with reduced annual energy consumption through improved heat insulation and solar shading (InfluenceMap, 2014). Japan could enhance its ZEB regulations to focus on reducing dependence of imported energy sources through mandating greater integration of domestic renewable energy generation, while minimizing energy storage requirements and ensuring reliability during supply disruptions. ZEB regulations could also prioritize domestically available materials and technologies reducing electricity consumption.

Moving forward, hydrogen should be targeted in heavy industry or transport, which are challenging to decarbonise sectors, rather than being promoted as a universal energy solution. Strengthening its energy policy and shifting away from technology focused approaches to an approach involving clean energy, including setting clear carbon intensity standards and providing price support for industries. Japan should also invest in domestic infrastructure for storage and transport while deepening international partnerships for secure affordability.

By combining regulatory advancements, financial incentives, domestic infrastructure for energy production and renewable energy advancements, Japan can increase energy security while providing a cleaner energy mix.

Conclusion

Hydrogen is an essential and futuristic component of Japan's energy strategy and energy mix, offering benefits of decarbonization and technological advancement. Despite that, it does not completely resolve the country's energy security and affordability challenges. Although hydrogen reduces reliance on fossil fuels, it could potentially risk replacement of that dependence with new vulnerabilities such as import reliance, high costs and uncertain sustainability outcomes.

Hydrogen should not be viewed as a solution but as one element within a diversified and resilient energy system. Japan should focus on offshore wind and solar for renewable energy production, reducing emissions, increasing domestic energy production and ensuring energy security, affordability and sustainability.

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