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Japan's Carbon Neutrality and Green Growth Strategy

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I. Introduction

In October 2020 the Japanese government declared its target of achieving carbon neutrality by 2050, in hand with the Green Growth Strategy led by the Ministry of Economy, Trade and Industry (METI). The Green Growth Strategy is significant in that it has identified climate change responses as an "opportunity for growth," despite strong perceptions of global warming countermeasures acting as an additional burden on companies and industries, and in particular constraining economic growth.

Japan's current Kishida Cabinet is also mobilizing all its policy capabilities for energy transition from fossil fuels to renewable energy and hydrogen energy to achieve the 2030 GHG reduction target of 46% compared to 2013, as stated in the country's Nationally Determined Contributions (NDCs). Among them, the overseas development and transportation of hydrogen energy into Japan and the domestic green hydrogen development are making great progress since the announcement of the Basic Hydrogen Strategy in December 2017.

This Brief is structured as follows. In the following section we will examine Japan's 2030 energy transition plan revised within the 6th Strategic Energy Plan in June 2021, focusing on policies to expand the introduction of renewable energy, especially solar and wind power (offshore wind power), and then the Basic Hydrogen Strategy announced in December 2017 and performance up to date. The third section reviews the national roadmap to Carbon Neutrality by 2050, presented in the Green Growth Strategy, by dividing it into power and non-power sectors, and 14 priority development areas including offshore wind power, hydrogen, nuclear power, automobiles and batteries, semiconductors, and information & technology. Furthermore, the government's major policy tools for realizing the Carbon Neutrality by 2050 initiative, such as fiscal support (e.g. the Green Innovation

Fund), preferential tax treatment, green finance, and carbon pricing, are reviewed. The concluding section summarizes the discussion so far and briefly presents policy implications for the Korean government.

II. Energy Transition in Japan

Japan presented the targets for electric power composition by energy source in 2030 as coal 19%, natural gas 20%, renewable energy 36– 38%, nuclear power 20–22% in the 6th Strategic Energy Plan in October 2021. Renewable energy is expected to change the most in 2030 compared to 2019, and the proportion of power generation in this sector is expected to double from 18% in 2019 to 36–38% in 2030. Among renewable energies, solar and wind power are the sectors that the Japanese government is putting the most emphasis on, and it is estimated that about 40 to 54 GW of additional generation capacity will be needed to meet the 2030 solar power generation target. In the case of wind power, it is estimated that additional generation capacity of 6 GW and 3.3 GW of onshore wind power and offshore wind power are needed, respectively. The Japanese government introduced the marketbased Feed-In Premium (FIP) in April 2022, judging that the existing Feed-In Tariffs (FIT) system not only increased the burden of consumers' electricity bills, but also caused excessive supply of electricity from renewable energy sources. Recently, Japan has been focusing on offshore wind power generation, and as of September 2022, offshore wind power demonstration projects have begun in four "promotion zones" including Goto City, Nagasaki Prefecture.



Figure 1. Electric Power Composition: 2030 Target

Source: Agency for Natural Resource and Energy (2021). The 6th Strategic Energy Plan.

In December 2017, Japan became one of the first countries to announce a national hydrogen strategy, pursuing both the realization of a low-carbon society and the guarantee of energy security. The Basic Hydrogen Strategy consists of securing adequate supply of hydrogen, expanding use of hydrogen, utilization of fuel cells, innovative technology development, international cooperation, and strengthening public relations and regional cooperation (see Table 1).

Table 1. Japan's Basic Hydrogen Strategy (December 2017)

Main Issues		Objectives
Securing the supply of hydrogen	 Utilization of overseas unused resources and re- newable energy 	Hydrogenation of overseas cheap unused fossil resources (e.g. lignite) and do- mestic transportation
	2. Developing an in- ternational hydro- gen supply chain	Development of liquefied hydrogen supply chain / development of organic chemical hydride supply chain / use of ammonia as an energy carrier / review of methanation / domestic transportation using existing pipelines
Expanding use of hy- drogen	3. Expansion of do- mestic renewable energy and revival of local economy	Expansion of hydrogen utilization as a domestic renewable energy source / re- vival of local economy through utilization of local resources
	4. Electric power sector	Set hydrogen government procurement to 300,000 tons per year by 2030
	5. Mobility sector	Expansion of hydrogen charging stations / development and introduction of fuel cell buses, fuel cell forklifts, fuel cell trucks, and fuel cell ships
	6. Industry sector	Reviewing the possibility of using hydrogen in the manufacturing process and heat utilization
7. Utilization of fuel cells		Exploration of overseas markets for household fuel cells / development of fuel cells for business and industrial use
8. Innovative technology develop- ment		Development of new hydrogen production technologies such as water electro- lyzer, artificial photosynthesis, and high-purity hydrogen permeation membrane / development of hydrogen liquefier and liquefied hydrogen preservation mate- rials / development of energy carrier, fuel cell technology
9. International cooperation		Building an international cooperation model / packaging the technology of hy- drogen supply chain to export overseas / leading international standardization by cooperating with international organizations related to hydrogen
10. Reinforcing public relations and inter-regional cooperation		Reinforcing public relations about the safety and the significance of hydrogen use / reinforcing information sharing and communication between the central and local governments

Source: Ministerial Meeting on Renewable Energy & Hydrogen (2017). Hydrogen Basic Strategy (in Japanese)

Japan's national hydrogen strategy is making the most progress in two areas: overseas procurement of hydrogen energy and domestic green hydrogen development. Japan has adopted a strategy of combining unused overseas energy and CCS technologies or procuring hydrogen from overseas' cheap renewable energy in large quantities, considering its domestic hydrogen development environment is unfavorable in various aspects, such as renewable energy generation, fossil fuel deposits, and areas where CCS is available. The overseas procurement of hydrogen energy by Japanese companies has been successful in two cases. Over two years from 2020 to 2021, HySTRA, a Japanese technology research association, succeeded in a demonstration project to build a hydrogen supply chain using brown coal in Australia, and to bring liquid hydrogen into Japan. In June 2020, the Japanese technology research association AHEAD succeeded in producing MCH (methylcyclohexane) by combining hydrogen and toluene at a hydrogenation plant in Brunei, and then supplying this to a thermal power plant in Japan. Regarding Japan's domestic green hydrogen development, the Fukushima Hydrogen Energy Research Field (FH2R) project started construction in August 2018 as part of a demonstration project commissioned by the New Energy and Industrial Technology Development Organization (NEDO) which entered operation in March 2020. FH2R can produce, store, and supply up to 900 tons of hydrogen per year, 1,200Nm³ per hour, after electrolyzing water using a 20MW solar power generation facility installed on a site of 180,000m².

III. Green Growth Strategy

The green growth strategy announced by the Japanese government in December 2020 (revised in May 2021) presents a roadmap for realizing carbon neutrality by 2050, as shown in Figure 2. Japan has declared its goal of achieving carbon neutrality by reducing greenhouse gas (GHG) emissions by 46% by 2030 against 2013 levels and reducing actual emissions to zero by 2050. In Japan, CO₂ emissions from the energy sector in 2019 were estimated at 1.03 billion tons, of which 57.3% (590 million tons) were emitted from the non-power sector and 42.7% (440 million tons) from the electric power sector. In the non-electric power sector, Japan's roadmap to carbon neutrality takes the promotion of energy efficiency and hydrogen strategy by 2030 and electrification by 2050 as its basic strategies, and places importance on the replacement of fossil fuels with hydrogen and ammonia, and the development of CO2 reduction and reuse technologies such as Carbon Capture, Utilization and Storage (CCUS) and carbon recycling. In the electric power sector, it can be seen that the focus is on reducing the proportion of thermal power generation and making renewable energy the main power source.



Figure 2. Japan's Roadmap to Carbon Neutralization by 2050

Note: CCUS - Carbon Capture, Utilization and Storage, DACCS - Direct Air Carbon Capture and Storage, BECCS - Bioenergy with Carbon Capture and Storage.

Source: Cabinet Secretariat (2021). Green Growth Strategy Accompanying Carbon Neutrality by 2050 (in Japanese).

Japan's green growth strategy designates 14 areas as key development industries, including offshore wind power, hydrogen, nuclear power, automobiles and batteries, semiconductors, and information & technology (see Table 2). It also presents action plans in the key 14 areas such as R&D, demonstration projects, and commercialization of new products according to the growth stage of each area.

Furthermore, the green growth strategy proposes fiscal support through the Green Innovation Fund, preferential tax treatment, green finance, carbon pricing, and international cooperation as major policy tools for realizing carbon neutrality by 2050. The Ministry of Economy, Trade and Industry (METI) established the 2 trillion yen Green Innovation Fund at the New Energy and Industrial Technology Development Organization (NEDO) in March 2021 to support the 14 key areas presented in the green growth strategy. As of October 2022, NEDO is promoting 84 R&D projects (1,662 billion yen) in three areas: renewable energy, hydrogen/ammonia and CO₂ utilization in industry, and low-carbon and energy efficiency technologies in the industrial sector.

	Areas	Objectives
1	Offshore wind, solar, geothermal	In 2040, 30 to 45 million kW project promotion [offshore wind power] In 2030, unit cost of power generation \rightarrow 14 yen/kWh [solar power]
2	Hydrogen and fuel ammonia	In 2050, production of 20M.t of green hydrogen Securing a market worth 500 billion yen in Southeast Asia [fuel ammo- nia]
3	Next-generation thermal energy	In 2050, 90% injection of synthetic methane into existing infrastruc- ture
4	Nuclear power	In 2030, introduction of decarbonized hydrogen production technology in high-temperature gas furnace
5	Automobile/Battery	In 2035, 100% of EVs in new passenger car sales
6	Semiconductor/IT	In 2040, carbon neutralization of the semiconductor and information communication industries
7	Ship	In 2028, realization of commercial operation of decarbonized ships
8	Logistics, human flow, civil infrastructure	In 2050, the realization of a carbon-neutral port
9	Food, Agriculture, Forestry and Fisheries	In 2050, realization of carbon neutrality in agriculture, forestry and fisheries industries
10	aircraft	After 2030, phased installation of key decarbonized technologies such as batteries
11	Carbon recycling and materials	In 2050, commercialization of artificial synthetic plastic [carbon recy- cling] In 2050, Realization of zero carbon steel[materials]
12	Housing/building/next-generation power management	In 2030, ZEH/ZEB introduction to new housing/buildings [Housing/ buildings]
13	Resource circulation	In 2030, introduction of about 2 M.t of biomass plastics
14	Lifestyle related	In 2050, realization of carbon-neutral, resilient and comfortable living

Table 2. Japan's Green Growth Strategy: 14 Priority Areas

Source: Ministry of Economy, Trade and Industry (2022). Latest domestic and international trends related to carbon neutrality (in Japanese)

The Japanese government promotes sustainable finance policies in the three categories of green finance, transition finance, and innovation finance. In green finance policy, green bonds were introduced in the mid-2010s, with annual issuance exceeding 1 trillion yen in 2021 (see Figure 3). Regarding transition finance, together with the METI and Ministry of the Environment (MOE), the Financial Services Agency (FSA) announced the "Basic

Guidelines on Climate Transition Finance," and METI implemented various financial support measures such as the Transition Finance Model Project in May 2021. The Japanese government uses the term "transition finance" as a financial instrument to support industries and companies that cannot decarbonize at once, such as steel, petrochemicals, and cement, to introduce technology such as energy efficiency, fuel conversion, and high-efficiency power generation at the transition stage toward decarbonization. Figure 3 shows that the amount of "transition bonds" issued was only 20 billion yen in 2021, but jumped to 265 billion yen in the first half of 2022, indicating the Japanese government's high interest in transition finance. In the area of innovation finance, the government provides investors with information on companies participating in decarbonization efforts. For example, the METI releases a list of approximately 600 "Zero Emissions Challenge" companies.



Figure 3. Sustainability Bonds Issuance Trend in Japan

Source: Ministry of the Environment (Japan), Green Finance Portal. https://greenfinanceportal.env.go.jp (Accessed on 2022. 11. 9).

The Japanese government recognizes carbon pricing as an economic method for achieving carbon neutrality through the utilization of market mechanisms, but still has a policy of operating the carbon pricing system within a range that does not impede innovation, investment promotion, and industrial competitiveness. The government holds a negative view of the Emission Trade System (ETS), recognizing its strengths in reducing CO₂ emissions

but citing high risks related to undermining industrial competitiveness. Unlike the EU, Korea, and China, Japan does not operate a nationwide ETS market, and only two local governments in Tokyo and Saitama have implemented the system since 2011. Regarding the introduction of carbon tax, the Japanese government maintains a negative stance in that it does not fit the green growth strategy and purpose of expanding corporate green investment. The Japanese government is concerned that environmental taxes such as climate change tax, other energy taxes, and Feed-In Tariff (FIT) levies impose too much of a burden on companies. In sum, the Japanese government prefers voluntary carbon credit schemes in the private sector, such as the carbon market or the J-Credit trading market.

IV. Conclusion

Since the declaration of its 2050 Carbon Neutral Strategy in October 2020, the Korean government has also been promoting green growth strategies to create new industries and jobs through decarbonization across the country. It is beyond the scope of this study to directly compare the GHG reduction policies of Korea and Japan, but in general, it can be evaluated that Korea is more active in GHG reduction than Japan. For example, Korea presents a 2030 GHG reduction target of 40% compared to 2018 emission levels, but in terms of annual average reduction rates, Korea has set 4.71% against Japan's target rate of 3.56%, making it a more ambitious target than Japan. Furthermore, while Japan has set a target of 19% for coal-fired power generation in the 2030 energy mix, Korea stipulates an "exit" from this power source. However, regarding the renewable energy target, Japan is presenting 36-38%, while Korea remains in the 20% level.

Korea's green growth strategy needs to be reexamined, particularly on how to operate the carbon pricing system, which is a burden on companies in the process of realizing their 2050 carbon neutrality goals. Above all, while re-examining the operation of the carbon tax and ETS, which are the basic elements of carbon pricing, it is also necessary to pay attention to the introduction of the carbon credit system, which encourages voluntary participation by companies in a similar manner to the Japanese government. Finally, in order to realize the goal of 2050 Carbon Neutrality, it is necessary to reference the Japanese government's plan to revitalize the financial market in three areas: green finance, transition finance, and innovation finance.

Japan's green growth strategy is being promoted in a very similar way to Korea's, with both Korea and Japan looking to hydrogen and offshore wind power as key industries to foster. Korea's green growth strategy needs to consider competition and cooperation with Japan from the perspective of midto long-term technological cooperation. In particular, both Korea and Japan struggle with geographical limitations in terms of the domestic development of renewable energy and hydrogen energy, making overseas hydrogen energy codevelopment and global supply chain establishment important tasks. Accordingly, the joint advancement of Korean and Japanese companies in a third country in the field of clean energy (e.g. hydrogen) has recently emerged as a promising field for cooperation. The Korean government needs to discover and promote cooperative agenda with the Japanese government in order to secure next-generation energy sources. KEP