Survey on Hydrogen Utilization System for Developing “Carbon Neutral Port” at the Port of Yokohama

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Summary-1

Ports in Japan serve as logistics hubs that handle over 99% of imports and exports in the country as well as industrial hubs where various companies are located. The city of Yokohama is working to transform the Port of Yokohama, one of Japan's leading ports, into a Carbon Neutral Port (CNP) that achieves net zero greenhouse gas (GHG) emissions. Efforts to accomplish this include building a waterfront industrial center and upgrading port functions to contribute to decarbonization through importing, storing, and using large volumes of next-generation energy, such as hydrogen and ammonia. The ultimate goal is to make the port carbon-neutral by 2050.

The CO2 emitted from Yokohama's waterfront district accounts for 40% of the city's total emissions, so decarbonizing the waterfront district would play a major part in attaining carbon neutrality for the city and the port. To accomplish this, Yokohama is carrying out CNP initiatives in collaboration with the national government, private-sector companies, and other nearby local governments.

This study examines the potential for hydrogen supply (i.e., manufacture and procurement) and hydrogen demand (i.e., use) in Yokohama's waterfront district. Some aspects of the study also examined the Kawasaki area to gain an understanding of the surrounding area and compare it with Yokohama's waterfront. To examine the supply potential, we independently formulated an outlook for the supply volume of primary energy in 2050 since major energy corporations are not at the stage in which they can identify initiatives in individual locations. To examine the demand potential, as stakeholders of the port, we identified and considered issues in the way that they would contribute to expanding hydrogen use among port management bodies and port operating companies in Japan, with a focus on researching demand and considering case studies of port areas, which connect land and sea.

Furthermore, we assessed the economic efficiency through analyzing local industry, taking advantage of the fact that the city of Yokohama is conducting the study.

Summary-2

With regard to hydrogen supply (i.e., manufacture and procurement), the greatest potential for supplying by-product hydrogen in the waterfront districts of Yokohama and Kawasaki is in petroleum refining, as shown in previous studies. But unlike previous studies, we examined individual companies, so the disclosed figures are limited. To determine the potential for procuring from outside Japan, we set a procurement environment in which pipeline supply will be superior to other supply methods in the future in the waterfront district assuming that one or more hydrogen receiving and supply sites will be formed in the Keihin region. We examined the potential for domestic procurement through means such as conducting a case study of procuring hydrogen via surplus electricity from offshore wind power.

With regard to hydrogen demand (i.e., use), because it is difficult to ascertain the extremely large-scale demand of power plants and large-scale demand of in-house power generation by factories at Yokohama's waterfront district, we estimated the potential for hydrogen demand in Yokohama's waterfront district to be approximately 27,000 tonnes over the mid-term (2030) and 720,000 tonnes over the long-term (2050) based on statistical figures such as energy consumption in the waterfront district, taking into account "the course of hydrogen use" explained below.

We also examined the following specifically for the port area: onshore power supply to vessels at anchor, fuel supply to hydrogen-powered vessels, conversion of cargo handling equipment to hydrogen power, conversion of land transport of shipping containers to hydrogen power, energy management that utilizes renewables and fuel cells at wharves, and the streamlining of hydrogen storage and delivery with pipelines and other means. In addition, we identified the issues with realizing hydrogen use by examining case studies. We confirmed that if these efforts were carried out, hydrogen demand would be approximately 400 tonnes over the mid-term and 30,000 tonnes over the long-term.

Summary-3

Furthermore, since the Japanese government has not presented a forecast for primary energy supply volume in 2050, we estimated the volume by totaling multiple scenarios released by research organizations to determine “the course of hydrogen use”. According to our estimate, hydrogen and ammonia will account for between 12% and 27% (avg. 20%) of the total primary energy supply volume in 2050. Because the Yokohama waterfront district is striving to become a hub for the large-scale import of hydrogen, we set the hydrogen supply volume at 1% of the government’s target for 2030 and 27% for 2050.

To estimate GHG emissions, we used an estimation method that links port measures of the port management body with environmental measures of the local government not currently considered in the manual presented by the Japanese government. To estimate GHG emissions from vessels at anchor, we used internationally adopted indicators.
This enabled us to ascertain the amount of the emissions reductions, and based on the assumption that freight volume handled at the public terminal will be higher in fiscal 2030, we ascertained that CO2 would decrease approximately 55% and that this will require considerable investment to achieve.

The economic efficiency of implementing next-generation energy in Yokohama and its waterfront district was examined from the perspectives of “local economic activities” and the “economy and environment,” using the National Institute for Environmental Studies’ 3EID (Embodied Energy and Emission Intensity Data for Japan Using Input-Output Tables). This revealed quantitatively that the energy industry is deeply embedded in Yokohama’s economy.
With regard to cost parity, we conducted a preliminary calculation of possible cases of hydrogen use in cargo handling equipment. This revealed that achieving parity is possible in the area of mobility, as stated in previous studies.

Lastly, because this study was conducted by stakeholders of the port, it is based on a perspective that differs from a major energy corporation or consulting firm. We hope that it is beneficial to port management bodies across Japan who are considering decarbonization efforts.

Future transition of Japan's energy supply structure toward carbon neutrality in 2050 and Image of initiatives at the Port of Yokohama

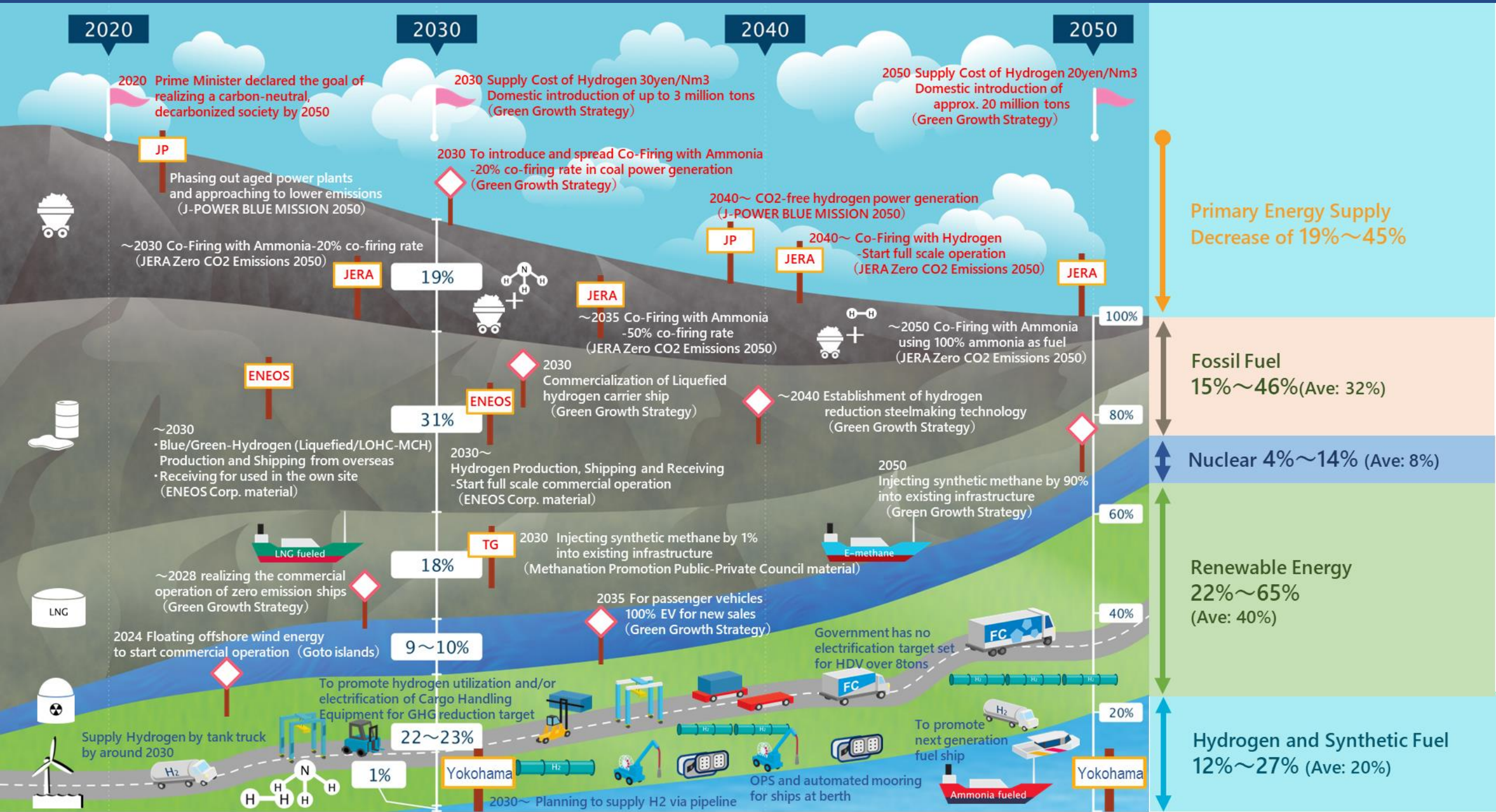
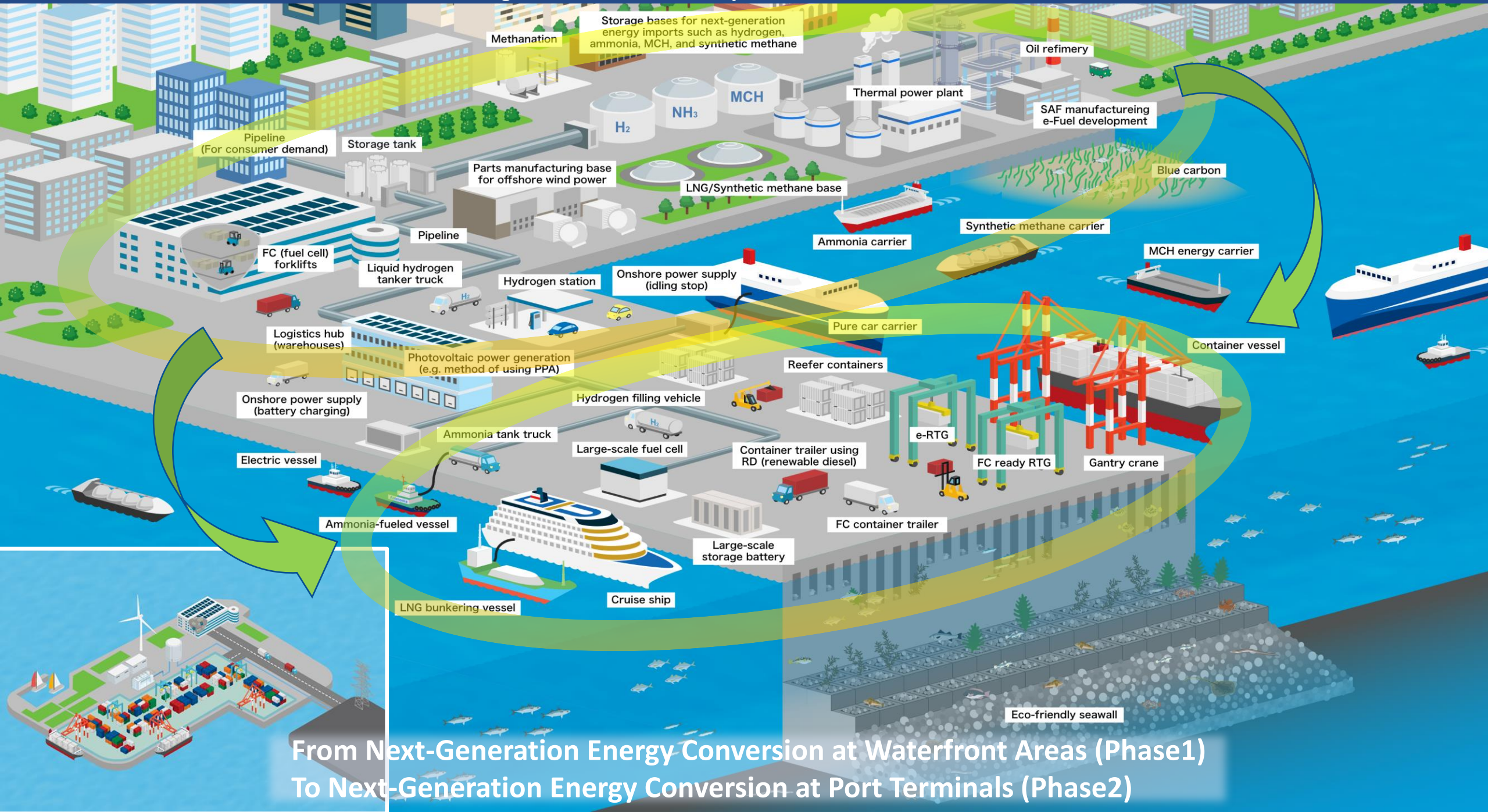


Image of a carbon neutral port at the Port of Yokohama



From Next-Generation Energy Conversion at Waterfront Areas (Phase1)
To Next-Generation Energy Conversion at Port Terminals (Phase2)