Novel global supply chain of renewable hydrogen to realize carbon neutrality

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To mitigate global warming caused by the accumulation of CO_2 and to pass on a sustainable society to the next generation, achieving carbon neutrality is an essential goal. However, its realization involves many difficulties, both from a technical perspective and in changing people's behavior. It is important to organize the necessary technological developments and policies along time and spatial axes and to take actions that can be connected to the future, starting with what can be done now.

In the energy system, it is necessary to electrify energy demand as much as possible and to supply the majority of electricity through solar and wind power generation. To complement the intermittency of these variable power sources and to provide energy for demands that cannot be covered by electricity, CO_2-free hydrogen is required.

To achieve carbon neutrality in Japan, more than 20 million tons of CO_2-free hydrogen will be needed annually. To produce this amount of hydrogen through water electrolysis, 1000 TWh of electricity is required, which is equivalent to Japan's current annual power generation. The capacity of solar power generation needed for this is as much as 900 GW, which is impossible to introduce on land. Therefore, in countries like Japan, where the potential for introducing solar and wind power generation is insufficient, it is necessary to import hydrogen produced from renewable energy in suitable locations overseas.

Although significant investments have been made in the development of carrier technologies for the long-distance transport and storage of hydrogen, and demonstration projects are progressing, large-scale social implementation is expected to occur after 2040. On the other hand, for hydrogen needed for decarbonizing heavy industries such as steel and chemical industries, it is more rational, from the perspective of ease of transport and storage, to manufacture primary industrial materials produced using hydrogen, such as reduced iron and methanol/ethanol produced from atmospheric CO_2, overseas and import them into Japan. Thus, to achieve carbon neutrality in countries with scarce renewable energy resources, it is essential to establish a new global supply chain that produces hydrogen and related materials in countries rich in renewable energy resources.