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Study on Introduction of CO₂ Free Energy to Japan with Liquid Hydrogen

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In Japan, both attainments of CO₂ emission reduction and energy security are the very important social issues after Fukushima Daiichi accident. On the other hand, fuel cell vehicles utilizing pure hydrogen will be on the market in 2015. It is anticipated that hydrogen consumption in Japan will exceed domestic production capability in the next decade. From these backgrounds, Japanese government has been making a road map on the introduction of hydrogen energy supply chain.

Under these circumstances, imported CO₂ free hydrogen will be one of the solutions for energy security and CO₂ reduction, if the hydrogen price is affordable. Accordingly, realization of low cost hydrogen production is of importance. To achieve this, Kawasaki Heavy Industries, Ltd. (KHI) performed a feasibility study on CO₂-free hydrogen energy supply chain utilizing Australian brown coal linked with CCS (Carbon dioxide Capture and Storage).

In the study, brown coal gasification hydrogen production systems, transportation methods etc. are examined. The supply chain with liquid hydrogen transportation shows the lowest CIF (Cost Insurance and Freight) of hydrogen for the first commercial chain. The CIF of hydrogen is 1.5 times higher than that of natural gas imported to Japan today. The imported hydrogen linked with CCS is virtually CO₂ free and thus will become competitive to price rising conventional fossil fuels when CO₂ penalties, e.g. taxes, is imposed.

This paper presents structure of the CO₂ free hydrogen supply chain, and cost breakdown of the CIF. Based on the evaluated hydrogen cost, fuel economy is compared between fuel cell and gasoline engine hybrid electric vehicles. Also, cost of power (electricity: yen/kWh) is compared amongst hydrogen gas turbine combined cycle and existing power generations.

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