Executive Summary

Although currently hydrogen is used for industrial activities such as ammonia production or refining, there will be big potential to be one of clean energies in future. Energy uses of hydrogen are; a. fuel for Fuel Cell Vehicle (FCV) in road transport sector, b. fuel for power generation (start from mixture with natural gas and shift to 100% hydrogen finally), c. heating fuel for boiler or furnace in industry sector. However, hydrogen is not competitive to gasoline and diesel vehicles so far due to high hydrogen price (about US90cent/Nm3 in Japan) and fuel cell vehicle (about US$70,000/car in Japan). Power generation to use hydrogen is also not competitive to Natural gas based Combined Cycle Gas Turbine (CCGT) due to the same reasons. In addition, since places for hydrogen production and consumption are different, hydrogen supply amount, such as byproduct hydrogen in importing countries, like Japan, is not enough to meet its demand in future. Consequently, establishment of international/regional hydrogen supply chain will be indispensable.

According to this research study, hydrogen supply cost of local supply chain will be forecasted to go down to US40-50cent/Nm3 on average at a station. It will be in the range in some cases, but it will be still higher on average than around US30-40cent/Nm3 which is competitive target price for gasoline. If epoch making technological development on FCVs and hydrogen power plants would be achieved, hydrogen supply cost will be expected to go down largely based on expansion of hydrogen market scale through significant price down of FCVs and hydrogen power plants.

Use of hydrogen is expanding in transport sector. So far FCVs represent personal cars but now included buses and railway trains. Regarding the buses, Tokyo Metropolitan Government will increase the hydrogen buses to 100by 2020 and Sarawak Local Government will start to operate hydrogen buses soon.

Results of the hydrogen demand forecasting to apply the three scenarios indicate to replace 2% of fossil fuels by hydrogen in 2040. On the other hand, CO2 emissions are expected to reduce 2.7% and higher than reduction of fossil fuels. The reason is to reduce coal consumption for power generation due to replacement of hydrogen.

There are two types of hydrogen production processes; a. applying reforming and gasification of fossil fuels such as natural gas and coal, b. applying water electrolysis using electricity generated by renewable energy such as hydro/geothermal, solar/PV and wind. Although on the view of CO2 emissions, the latter is recommended, hydro / geothermal power as well as reforming of natural gas will firstly be introduced to produce hydrogen due to their lower costs. Gasification of coal and solar/PV & wind might start to produce hydrogen after achievement of their cost reduction through significant technology development. However in case of fossil fuels, treatment of CO2 is very important applying CO2/EOR and CCUS. Basically solar/PV and wind need electric energy storage, currently cost of which is much expensive, to mitigate their intermittent power supply. Then hydrogen will be one of storage options because of its capability for large scale and mid-long term storage.

Hydrogen gets remarkably high evaluation recently. Japanese Government launched the Basic Hydrogen Strategy and hydrogen is now included in the 5th Basic Energy Plan of Japan. The hydrogen council released a publication namely “Hydrogen Scaling Up” to mention that hydrogen demand will be 20% of TFEC of the world in 2050. Australia and New Zealand also seek for possibility to export hydrogen to Japan. However only Brunei Darussalam and Sarawak State of Malaysia among ASEAN member states shows their interest on hydrogen because the hydrogen supply chain demonstration project is ongoing in Brunei Darussalam and introduction of hydrogen buses in Sarawak State of Malaysia. In this regard, it is recommended that a working group consisting of ASEAM and +6 members will be set up to produce common understanding on hydrogen under EAS region.