Executive Summary

Brunei Darussalam has started producing hydrogen, called SPERA Hydrogen, from processed gas to be generated during the production process of liquefied natural gas (LNG) and exporting it to Japan from the end of 2019, with the full support of Japan. Hydrogen is basically classified as clean energy because no carbon dioxide (CO_2) is emitted after its combustion. Thus, hydrogen is expected to be used globally in the future.

The country's road transport sector highly consumed gasoline and diesel oil, its share being 38% in 2015, accounting for the highest in the final energy consumption sector. In addition, the major source of power generation in Brunei was natural gas, with a share of 99% in 2015. If the country could shift from oil and gas to hydrogen for transport and electricity generation fuel, it could drastically reduce oil and gas consumption as well as CO_2 emissions. This means that hydrogen could be a sustainable energy or technology for Brunei Darussalam. However, a large issue is hydrogen's high supply cost.

This study forecasts hydrogen demand in Brunei Darussalam until 2040. It targets the road transport and power generation sectors, which are energy intensive. So far, hydrogen has not been used in road transport and power generation. This study applies the scenarios approach: (i) case 1, where 10% of vehicles and gas power plants will be replaced by hydrogen vehicles (fuel cell vehicle or FCV) and gas and hydrogen mixed power plants (hydrogen mixing rate at 10%); (ii) case 2, uses 30%; and (iii) case 3, 50%.

If Brunei will shift to hydrogen, oil consumption in the road sector will decrease by 12% in case 1, 36% in case 2, and 58% in case 3 from oil consumption of business-as-usual (BAU) (no hydrogen use) in 2040. On the other hand, gas consumption in the power generation sector will reduce 1% in case 1, 20% in case 2, and 32% in case 3 under BAU in 2040. As a result, CO_2 emissions will decrease by 3% in case 1, 11% in case 2, and 18% in case 3 compared to BAU. Shifting to hydrogen will also bring economic benefits. The use of hydrogen will lower domestic consumption of oil and gas, and this reduced amount can be exported to Asian countries. If the 2019 oil price will be the same until 2040, the amount will be between US$70 million and US$391 million in all cases, corresponding to 0.5% and 3.0% of gross domestic product in 2018.

Under the hydrogen scenarios in all cases, hydrogen demand is forecasted at 126 ktoe to 714 ktoe. Hydrogen is or will be produced from natural gas through the reforming process, but carbon capture and storage (CCS) will be necessary to shift from grey to blue hydrogen. According to this study, the potential of hydrogen production will be significant, more than 2,500 ktoe in 2040, from both gas reforming and gasification and solar/photovoltaic (PV) (use electricity of solar/PV for electrolysis). This suggests that Brunei Darussalam can shift to a hydrogen society; a remaining issue though is hydrogen's supply cost as it is much higher than current oil and gas prices.

Hydrogen supply cost fully depends on production and transportation technologies and hydrogen production scale. If hydrogen production scale will be large (as in case 3), its cost will

surely decline. Also, the production cost of the reforming technology is lower than other hydrogen production technologies. Several transportation technologies bring hydrogen from its production sites to final destinations such as hydrogen charging stations. However, if its transportation scale is large, its cost will surely decline. This study then suggests that if hydrogen demand will be more than 70,000 m^3 per hour, hydrogen supply cost at a refuelling station of 1,000 Nm3/h will decline to around US$0.80/$m^3$. It is much higher than existing gasoline and gas prices, but these prices are fully subsidised by the Brunei government. In addition, considering the two major benefits of hydrogen, which are reduction of CO_2 emissions and savings in oil and gas consumption, the US$0.80/$m^3$ could be acceptable by the Brunei people in the future.

Last but not the least, when Brunei Darussalam shifts to a hydrogen society, its Ministry of Energy should have appropriate hydrogen utilisation policies, action plans, and road map. If necessary, the ministry can obtain various international support such as the pros and cons of hydrogen demand and supply from East Asia Summit countries, like Japan.