Executive Summary

Brunei Darussalam is rich in oil and gas production, but for renewable energy, only solar photovoltaic (PV) is available due to the strong sunshine. The land area of Brunei is physically and environmentally limited for setting up solar PV systems, but potential areas comprise bare ground, reservoirs, rivers, lakes, and Brunei Bay. According to this study, a total capacity of 1,030 megawatts (MW) of floating solar PV (FSPV) is available to be set up at reservoirs, rivers, and lakes in Brunei. In addition, a total of 700 MW of FSPV is available in Brunei Bay and a total of 424 MW of solar PV is available using bare ground. Thus, the total installed capacity for solar PV systems is estimated to be 2,154 MW in the country. If we assume a 17 % capacity factor for land-based solar PV systems and 19% for FSPV, the total power generation by solar PV systems is estimated at 3,510 GWh per year. If we assume a unit capital cost of solar PV and FSPV of US$800 per KW, the power generation cost is estimated at about US$0.0624 per kWh. When we use 3,510 GWh at the electrolyser facilities for producing hydrogen, the amount is estimated at 65.7 kilotonnes per year applying polymer electrolyte membrane (PEM) technology, and its hydrogen production efficiency is assumed at 4.77 kWh/Nm^3-H_2. If we assume a unit capital cost of the electrolyser facilities of US$1,050 per KWe, the total capital cost of the electrolyser is estimated at US$429 million, and the hydrogen production cost is also estimated as US$4.258 per kg-$H_2$.

Hydrogen combusts like fossil fuels but does not emit carbon dioxide, so hydrogen can be substituted for oil and gas consumption across sectors. Currently, oil and gas are largely consumed in the final energy consumption sector, which consists of the industry, transport, residential and commercial, and power generation sectors. According to this study, hydrogen demand for the power generation sector in the Association of Southeast Asian Nations (ASEAN) region is forecasted at 70 million tonnes, 1.3 million tonnes for the road transport sector, and 11.3 million tonnes for the industry sector in 2050. So far, hydrogen has not been used for energy, so a scenario approach is applied: 10% in 2030, 50% in 2040, and 100% in 2050 as the hydrogen cofiring ratio at gas power plants, and 30% in 2050 as the FCEV ratio to the total vehicle stock and the replacement of fossil fuels consumed for heat demand, such as for boilers and furnaces in the industry sector. As a result, green hydrogen production in Brunei is estimated at 73.4 kilotonnes per year. On the other hand, hydrogen demand in the ASEAN region, including Brunei, is forecasted to be more than 80 million tonnes per year by 2050. Thus, the amount of green hydrogen will not be able to meet hydrogen demand, so blue hydrogen produced from natural gas with carbon capture and storage will still be an important option for Brunei.

The investment amount for solar PV systems, mainly FSPV and water electrolysis, is estimated at about US$2,152 million and is significant compared to the annual gross fixed capital formation of about US$5,000 million. Thus, Brunei can expect a large economic impact with the operation of both facilities. However, there is still an issue of the higher green hydrogen production cost at US$3.5–US$5.2/kg-H_2 according to this study. The global target of the hydrogen supply cost will be US$1–US$2/kg-H_2, thus we need to investigate measures for hydrogen supply cost reduction, such as further cost reductions in solar PV systems and improvements in hydrogen

production efficiency by applying electrolysis technology. If Brunei exports 5 million tonnes of hydrogen, including blue hydrogen, this will amount to around US$10 billion, almost the same as the export value for Brunei in 2019. Thus, the production of blue hydrogen is indispensable for Brunei.

In addition, Brunei will be able to impot electricity from Sarawak province, Malaysia, which will be generated by hydropower plants. If Brunei imports 1GW electricity from Sarawak province, Brunei can produce green hydrogen around 65 kiloton/year, if we assume capacity factor of the hydropower at 40%. It is significant and electricity import from Sarawak province will be a very important option for Brunei to increase green hydrogen production.