Executive Summary

Electricity demand in Indonesia has been growing rapidly at a rate of 8.1% per year from 1990–2015 and will continue at a slightly lower rate of 6.2% per year in 2015–2040, according to the East Asia Summit (EAS) energy outlook prepared by the Economic Research Institute for ASEAN and East Asia (ERIA) (2019). As a result, the share of electricity per total final energy consumption is forecast to increase from 10.6% in 2015 to 16.3% in 2040. The increase in electricity will occur not only on large islands such as Java (Jakarta) and Sumatra (Medan) but also on the small and midsized Islands of Indonesia. The eastern part of Indonesia, which is surrounded by Kalimantan, Sulawesi, Papua, and Nusa Tenggara islands, comprises many small and midsized islands whose population share was 16% of the total Indonesian population in 2017. Due to the continuous growth of the population in this area, electricity demand is expected to increase up until 2040. The current operation of three production sites of liquefied natural gas (LNG) – Bontang, Donggi, and Tangguh – and one planned LNG site, Masela, would be an opportunity to shift from diesel oil, the main fuel source of the small and midsized islands, to natural gas for power generation. Such a shift would reduce the high fuel costs of diesel oil and carbon dioxide emissions in this area. However, the economical delivery of LNG from its production sites to demand sites needs to be studied.

To analyse the issue, this study applied two approaches: (i) linear programming (LP) – to find an optimal LNG flow between origins and destinations, and (ii) dynamic simulation (DS) – to simulate LNG delivery operation on a personal computer based on LNG demand and supply information. The DS extracts the appropriate size of LNG storages and appropriate size and number of LNG tankers. For the DS, the simulation conducted through manipulation of several parameters encompasses the size of LNG storage, its initial volume, storage level for LNG tankers, the size of LNG tankers, and distance information between origins and destinations, including the average speeds of LNG tankers.

Based on the LP approach, demand sites totalling 18 in this area are divided into four groups: Bontang, Donggi, Masela, and Tangguh. After that, three case studies of the DS were undertaken in each group. The key findings from the DS are as follows:

1) There are two LNG delivery methods: hub & spoke and milk run. Hub & spoke delivers LNG to a specific island per navigation whilst milk run delivers LNG to several islands per navigation.
2) The milk-run method entails a high operation rate of LNG tankers because of the smaller number of LNG tankers required. In other words, the idling time of LNG tankers is reduced. Hence, the milk-run method is economically recommended as an LNG delivery method in this area.
3) However, the milk-run method does not contribute to the reduction of LNG storage costs; occasionally, the method needs a bigger size of LNG storage to avoid lack of LNG shortage delivered.

4) Thus, more precise DS will be needed to seek more realistic solutions to both LNG storages and tankers using more reasonable parameters of the DS.

This study respects Indonesia' current LNG policy, which is LNG export at Bontang LNG – the limited amount of LNG is delivered to LNG domestic demand sites near Bontang. Several big LNG demand sites near Bontang are Bali, Lombok, Palu, and Makassar. One policy recommendation is a swap of the export role between Bontang and Tangguh because Tangguh is quite far from the main LNG demand islands in this area.

Case 3 applying the milk-run method shows the lowest cost amongst the cases. Its LNG delivery cost is around US$55–US$77 per tonne, a cost level that is higher still than the international LNG trade price of US$50–US$70 per tonne of Japan's LNG CIF (cost, insurance, and freight) in 2018 until the first quarter of 2020 because the LNG delivery cost does not include its production cost. The capital expenditure (CAPEX) of LNG storages accounts for half of the total costs – thus, the following policy is recommended. There are 18 sites that have diverse electricity demand in this area, and this study assumes all the sites will shift to natural gas generation. However, there are only eight of the big electricity demand sites with more than 500 million tonnes of LNG per year. Hence, shifting to gas power plants can be done only in the case of eight sites, such as Bali, Lombok, and Halmahera. The remaining sites apply other power systems such as a combination of diesel power plants and solar PV (photovoltaic) system, together with microgrid technology.

Gas has a big advantage over coal in generating power as it is easy to control the output level. Thus, a combination of gas power generation and renewable energy electricity, such as a solar and wind power system, will be a more suitable option for Indonesia, especially on small and midsized islands. Thus, seeking an optimal LNG delivery system under an affordable power generation mix with gas power generation will be crucial in for the future.