Chapter 8

Conclusions and Recommendations

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This project used the linear programming (LP) and dynamic simulation (DS) approaches. The LP approach is one of the optimisation methods and, under several constraints, it seeks to minimise costs or maximise profits. In this project, the LP approach, considered as the optimal transport model, was used to find the minimum cost of LNG flows from origin (LNG production sites) to destination (LNG demand sites) based on distances between them. There are two constraints: supply and demand. On the other hand, the DS approach fully depends on the queuing theory of operations research. Usually, the queuing theory applies to seek, for example, the necessary number of elevators when a new office building is constructed based on the number of workers at and visitors to the office building. A PC-based DS software generates transactions at random. In the case of a new office building mentioned above, the transactions are the number of workers and visitors to arrive in front of the elevators every second or minute during rush hours, such as 8–9 a.m. and 5–6 p.m. The status of the queues in front of the elevators are checked. In this case, the number of elevators is a parameter and, based on trial and error, we seek for the appropriate number of elevators by assessing the length of the queues. In this project, the parameters were necessary capacity, initial amount of LNG before starting the simulation, storage level to call an LNG tanker at 18 cities and areas in Eastern Indonesia. For LNG tankers, we sought for their necessary number and size to deliver LNG from the production sites to the demand sites. We also assessed two LNG delivery methods, hub & spoke and milk-run under the DS approach. By implementing multiple simulations to tune up the parameters, the results of nine cases (three cases x three groups) plus one were eventually extracted.

MEMR Indonesia plans to shift from the current diesel power plants system to the gas-fired power plant (GPP) system in Eastern Indonesia, roughly defined as the area surrounded by Kalimantan, Sulawesi, Papua, and Nusa Tenggara islands. One reason is that four LNG production sites in this area are currently exporting LNG to Japan. Another reason is the remarkable electricity demand potential in this area. However, the electricity demand will be extremely diverse – from 16,799 GWh at Makassar to 116 GWh at Serui, Yapen Island in 2030. On the other hand, GPPs consuming LNG need an ISO (International Standard Organization) tank or storage to stock LNG. Storage is very expensive because CAPEX plus OPEX of ISO tanks account for 70% of the total cost of LNG delivery to 18 cities and areas in this area, according to the simulation results. Thus, this report suggests that the following cities and areas shift to GPP by 2030 due to their large LNG demands:

1) Bali, Lombok and Sumbawa in Nusa Tenggara Island
2) South Halmahera, Ternate, Sorong city, and Manokwari in Maluku and Papua
3) Palu, Makassar, and Manado in Sulawesi

Other cities and areas, such as Jayapura city, Labuan Bajo, Kupang, etc., need to seek for other power systems, such as a hybrid power system integrating a diesel power plant and solar/PV with microgrid system, to decrease their power generation costs.

This area has four LNG production sites: Bontang, Donggi Senoro, Masela, and Tangguh. LNG production at Bontang LNG will decrease after 2026 and will be less than 3 MTPA in 2030. Donggi Senoro LNG will increase its LNG production by about 2 MTPA and all will be exported to Japan and the Republic of Korea. Masela LNG will start LNG production in 2020 and will increase it to 9 MTPA eventually after finding its LNG buyers. Tangguh LNG will decrease its LNG production from 2029 which will be less than 10 MTPA in 2030. On the other hand, GPPs will be constructed in Sulawesi (north, central, and south), West Nusa Tenggara Islands such as Bali and Lombok, and Weda and Ternate in northern Maluku. Regarding distance to these high LNG-demand places, Bontang LNG and Donggi Senoro LNG are in better positions to deliver to these places. Thus, this report recommends that Bontang and Donggi Senoro dedicate LNG delivery to domestic users whilst Masela and Tangguh mainly engage in LNG export to minimise shipping costs of LNG to domestic users in Eastern Indonesia.

This project extracts a wealth of meaningful information regarding LNG delivery to GPPs in Eastern Indonesia. The milk-run method is much better than the hub & spoke method in this area. Since LNG demand sites are close to each other, the milk-run method can reduce total cruising distance of LNG tankers and decrease the number of LNG tankers by making an LNG tanker cover a few LNG demand sites. The LNG delivery cost consists mainly of LNG storages and tankers. The cost share of LNG storages is around 70% and CAPEX of LNG storages is about 50%. Thus, the construction cost of LNG storages is crucial due to the necessity for an ISO tank. However, the operation rate of some LNG tankers is still less than 50% and the capacity of some LNG storages seems to be oversized. These non-realistic assumptions should be improved. Thus, more precise DS studies will be needed to obtain more realistic simulation solutions based on more accurate parameters, such as capacity, initial amount of LNG at LNG storages, appropriate LNG level to call an LNG tanker, as well as CAPEX and OPEX of LNG storages and tankers.