

## List of Figures

Figure 2.1	Gas Allocation and Pricing Policy	8
Figure 2.2	Proposed Natural Gas Plant in Papua and Maluku	9
Figure 2.3	Proposed Gas Power Plant in Sulawesi, Bali, and Nusa Tenggara	10
Figure 3.1	Plant Capacities in Eastern Indonesia, 2018	12
Figure 3.2	Electricity Demand Projection in Eastern Indonesia (TWh)	13
Figure 4.1	Share of Small-Scale LNG Carrier Vessels According to Tanker Size	25
Figure 4.2	Selected Model Vessels	27
Figure 4.3	Under Keel Clearance Concept	28
Figure 5.1	Outlook LNG Badak Production and Allocation	32
Figure 5.2	Outlook Tangguh LNG Production and Allocation	33
Figure 6.1	Boundary of LNG Delivery Model	36
Figure 6.2	LNG Delivery Flow	37
Figure 6.3	LNG Delivery in the Linear Programming Model	45
Figure 7.1	Image of the Simulation on PC Screen (Bontang–Donggi Group)	53
Figure 7.2	LNG Delivery from Terminal, BON–DSL, Hub & Spoke Method (Case 1)	54
Figure 7.3	Storage Level of Each Port, BON–DSL (Case 1)	56
Figure 7.4	Diagram of Tanker Operations, BON–DSL (Case 1)	56
Figure 7.5	Operation Rate of Each LNG Tanker, BON–DSL (Case 1)	59
Figure 7.6	LNG Delivery from LNG Terminals, BON–DSL, Hub & Spoke Method (Case 2)	60
Figure 7.7	Storage Level of Each Port, BON–DSL (Case 2)	62
Figure 7.8	Diagram of Tanker Operation, BON–DSL (Case 2)	62
Figure 7.9	Rate of Operation of LNG Tankers, BON–DSL (Case 2)	63
Figure 7.10	LNG Delivery, BON–DSL, Milk-Run Method (Case 3)	64
Figure 7.11	Storage Level of Onshore Storage, BON–DSL (Case 3)	67
Figure 7.12	Diagram of Tanker Operations, BON–DSL (Case 3)	67

Figure 7.13	Rate of Tanker Operations, BON–DSL (Case 3)	68
Figure 7.14	Image of the Simulation on PC Screen (Masela Group)	69
Figure 7.15	LNG Delivery, MSL, Hub & Spoke Method (Case 1)	71
Figure 7.16	Storage Level of Onshore Storage, MSL (Case 1)	74
Figure 7.17	Diagram of Tanker Operations, MSL (Case 1)	74
Figure 7.18	Rate of Tanker Operations, MSL (Case 1)	76
Figure 7.19	Delivery from LNG Terminal, MSL, Hub & Spoke Method (Case 2)	77
Figure 7.20	LNG Storage Level of Onshore Storage, MSL (Case 2)	80
Figure 7.21	Diagram of LNG Tanker Operations, MSL (Case 2)	80
Figure 7.22	Rate of Tanker Operations, MSL (Case 2)	81
Figure 7.23	LNG Delivery, MSL, Milk-Run Method (Case 3)	82
Figure 7.24	Rate of LNG Tanker Operations, MSL (Case 3)	85
Figure 7.25	LNG Storage Level of Each Site, MSL (Case 3)	87
Figure 7.26	Diagram of LNG Tanker Operations, MSL (Case 3)	87
Figure 7.27	Simulation of LNG Delivery on PC Screen, TGH, Milk-Run Method (Case 3)	89
Figure 7.28	Image of LNG Delivery from TGH, Hub & Spoke Method (Case 1)	91
Figure 7.29	LNG Storage Level of Each Site, TGH (Case 1)	94
Figure 7.30	LNG Tanker Operations, TGH (Case 1)	94
Figure 7.31	Rate of Tanker Operation, TGH (Case 1)	96
Figure 7.32	Delivery from LNG Terminal, TGH, Hub & Spoke (Case 2)	97
Figure 7.33	Rate of LNG Tanker Operation, TGH (Case 2)	100
Figure 7.34	LNG Storage Level of Each Site, TGH (Case 2)	101
Figure 7.35	LNG Tanker Operation, TGH (Case 2)	101
Figure 7.36	Image of LNG Delivery, TGH, Milk-Run Method (Case 3)	103
Figure 7.37	Rate of Tanker Operation, TGH (Case 3)	107
Figure 7.38	LNG Storage Level of Each Site, TGH (Case 3)	108
Figure 7.39	LNG Tanker Operation, TGH (Case 3)	108
Figure 7.40	Simulation of LNG Delivery on PC Screen (Secondary Terminal)	110

Figure 7.41	LNG Delivery (Secondary Port, Milk-Run Method Partially Applied)	111
Figure 7.42	LNG Storage Level of Each Site (Secondary Port)	114
Figure 7.43	LNG Tanker Operation (Secondary Port)	114
Figure 7.44	Cruise Distance, by Case and Group (Round-trip miles)	116
Figure 7.45	Cruising Distance per Tanker	116
Figure 7.46	Comparison of Tonne Miles of Cases 1 and 2 of Dynamic Simulation and Linear Programming (tonne miles)	117
Figure 7.47	CAPEX and OPEX in LNG Onshore Storages and Tankers, BON–DSL	120
Figure 7.48	Comparison of CAPEX and OPEX, MSL (Cases 1–3)	122
Figure 7.49	Comparison of CAPEX and OPEX, TGH (Cases 1–3)	124
Figure 7.50	Total CAPEX and OPEX for Application of Secondary LNG Terminal	127
Figure 7.51	CAPEX of Each Group (Case 3)	129
Figure 7.52	Total CAPEX, by Group (Cases 1–3)	130
Figure 7.53	CAPEX and OPEX, by Group (Case 3)	131
Figure 7.54	CAPEX and OPEX (Cases 1–3)	132

## List of Tables

Table 2.1	Indonesia Gas Demand Outlook (Mtoe)	3
Table 2.2	Projected Gas Demand of Indonesia	4
Table 3.1	Provinces Covered in the Study	11
Table 3.2	Total Diesel Plants Converted to GPPs in the Eastern Indonesia	13
Table 3.3	Electricity Consumption, 2030	15
Table 3.4	Potential Location for CCGT	16
Table 3.5	Electricity Production of Selected Regions in 2030	17
Table 3.6	Capacity Factor of Power Generator (%)	17
Table 3.7	Electricity Production from Coal and Renewables (GWh)	18
Table 3.8	LNG Demand Forecast for the GPPs in the Selected Locations	20
Table 3.9	LNG Refilling Capacity for Large Ships	21
Table 4.1	Regions, Forecasted LNG Demand, Potential Seaports, and Natural Gas-Fired Power Plants	23
Table 4.2	Selected LNG Carrier Model Vessels and their Characteristics	26
Table 4.3	Selected LNG Receiver Seaports and their Accessibility for LNG Carrier Model Vessels	29
Table 6.1	LNG Production and Demand Sites	37
Table 6.2	Forecasted LNG Demand at 18 Receiving Sites in 2030	39
Table 6.3	Distance between LNG Production and Demand Sites	41
Table 6.4	Distance between LNG Demand Sites	42
Table 6.5	Annual LNG Delivery Amounts for Domestic Use at Each LNG Production Site, 2030	44
Table 6.6	Input Data of the Linear Programming Model	46
Table 6.7	Linear Programming Solution of Case 1	48
Table 6.8	Constraints to LNG Delivery (Upper Limit: Uij), kiloton	50
Table 6.9	Linear Programming Solution	50
Table 7.1	Characteristics of LNG Onshore Storage	52

Table 7.2	Characteristics of LNG Tanker	52
Table 7.3	Water Depth at Each LNG Receiving Port	52
Table 7.4	Input Conditions for Simulation	54
Table 7.5	Number and Size of Tankers (Cases 1–3)	54
Table 7.6	Operational Status of LNG Onshore Storages (Case 1)	55
Table 7.7	Operational Status of LNG Tankers, BON–DSL, Hub & Spoke (Case 1)	58
Table 7.8	Operation Cost of LNG Tankers, BON–DSL, Hub & Spoke (Case 1)	59
Table 7.9	Operational Status of Onshore Storage, BON–DSL (Case 2)	61
Table 7.10	Results of Tanker Operations, BON–DSL (Case 2)	63
Table 7.11	Cruising Distance and OPEX of Tankers, BON–DSL (Case 2)	64
Table 7.12	Comparison of Hub & Spoke and Milk-Run Distance	65
Table 7.13	Operational Status of LNG Onshore Storage, BON–DSL (Case 3)	66
Table 7.14	Results of Tanker Operations, BON–DSL, Milk-Run Method (Case 3)	68
Table 7.15	Tanker Cruising Distance and OPEX, BON–DSL, Milk-Run Method (Case 3)	69
Table 7.16	Input Conditions for Simulation	70
Table 7.17	Number and Size of Tankers in Each Case	71
Table 7.18	Operational Status of Onshore Storage, MSL (Case 1)	73
Table 7.19	Results of Tanker Operations, MSL, Hub & Spoke Method (Case 1)	75
Table 7.20	Cruising Distance and OPEX of Tanker, MSL, Hub & Spoke (Case 1)	76
Table 7.21	Operational Status of Onshore Storage, MSL (Case 2)	78
Table 7.22	Results of Tanker Operations, MSL (Case 2)	79
Table 7.23	Cruising Distance and OPEX of LNG Tankers, MSL (Case 2)	81
Table 7.24	Comparison of Cruising Distance between Hub & Spoke (Case 1) and Milk-Run Methods (Case 3)	83
Table 7.25	Operational Status of Onshore Storage, MSL (Case 3)	84

Table 7.26	Results of Tanker Operations, MSL, Milk-Run Method (Case 3)	86
Table 7.27	Cruising Distance and OPEX of LNG Tankers, MSL, Milk-Run Method (Case 3)	88
Table 7.28	Input Conditions for Simulation	90
Table 7.29	Number and Size of Tanker (Cases 1–3)	91
Table 7.30	Operational Status of Onshore Storage, TGH (Case 1)	92
Table 7.31	Results of Tanker Operations, TGH, Hub & Spoke Method (Case 1)	95
Table 7.32	Cruising Distance and OPEX of LNG Tanker, TGH, Hub & Spoke Method (Case 1)	96
Table 7.33	Operational Status of Onshore Storage, TGH (Case 2)	98
Table 7.34	Results of LNG Tanker Operations, Hub & Spoke (Case 2)	99
Table 7.35	Cruising Distance and OPEX of LNG Tanker, TGH (Case2)	102
Table 7.36	Comparison of Distance of Hub & Spoke and Milk-Run Methods	103
Table 7.37	Operational Status of Onshore Storage, TGH (Case 3)	104
Table 7.38	Results of LNG Tanker Operations, TGH, Milk-Run Method (Case 3)	106
Table 7.39	Cruising Distance and OPEX of Tanker, Milk-Run Method (Case3)	109
Table 7.40	Distance from Masera to Makassar and Makassar to the Five Ports	110
Table 7.41	Comparison of Distance of Hub & Spoke and Milk-Run Methods	111
Table 7.42	Operational Status of LNG Onshore Storage (Secondary Terminal)	112
Table 7.43	Results of Tanker Operations (Secondary Terminal)	113
Table 7.44	Cruising Distance and OPEX of Tanker (Secondary Terminal)	115
Table 7.45	Comparison of Distance of Cases 1 and 2 and Linear Programming (tonne miles)	117
Table 7.46	CAPEX and OPEX of Cases 1–3, BON–DSL	118
Table 7.47	CAPEX and OPEX of LNG Storages and Tankers (Cases 1–3)	119

Table 7.48	Table 7.48: CAPEX and OPEX, MSL (Cases 1–3)	121
Table 7.49	Comparison of CAPEX and OPEX, MSL (Cases 1–3)	122
Table 7.50	CAPEX and OPEX, TGH, by Case	123
Table 7.51	Comparison of CAPEX and OPEX, TGH (Cases 1–3)	124
Table 7.52	CAPEX and OPEX for Application of Secondary LNG Terminal	125
Table 7.53	CAPEX and OPEX for Direct Delivery from MSL to the Five LNG Receiving Sites	126
Table 7.54	Total CAPEX and OPEX for Application of Secondary LNG Terminal	127
Table 7.55	Cost Comparison between Direct Delivery of LNG and Via a Secondary Terminal	128
Table 7.56	CAPEX of Each Group (Case 3)	129
Table 7.57	Total CAPEX of Each Case	130
Table 7.58	CAPEX and OPEX of Each Group (Case 3)	131
Table 7.59	CAPEX and OPEX (Cases 1–3)	131