

**LIST OF FIGURES**

2.1	Technology Option for IoT Applications.....	6
2.2	Key Strengths and Weaknesses of Different Types of Technologies.....	6
2.3	Wireless Communication Technologies Trade Off for IoT Solution.....	7
2.4	Long Range (LoRa) Wide Area Network (WAN) Architecture.....	8
2.5	LoRa WAN Device Classes.....	9
2.6	Narrowband IoT (NB-IoT) Architecture.....	10
2.7	NB-IoT Deployment Scenario.....	11
2.8	Electrical energy distribution system.....	12
2.9	Features of Smart Meter.....	13
2.10	Architecture of 2 (Two)-Ways Smart Meter.....	14
2.11	Key Steps in the Cost-Benefit Analysis Process.....	18
3.1	Research Framework.....	20
3.2	Population Density Map of West Java, Indonesia.....	22
3.3	Proposed Scenario.....	23
4.1	Time on Air (ToA) Illustration.....	26
4.2	LoRa Modem Packet Formatting.....	26
4.3	Duty Cycle Visualization.....	27
4.4	Single Gateway Capacity for LoRa WAN.....	28
4.5	Initial Number of Gateways for High and Low Density Area.....	30
4.6	Projected Customer Growth of LoRa WAN gateways for High and Low Density...31	
4.7	Projected Customer Growth of NB-IoT sites for High and Low Density....	31
4.8	Coverage Prediction for LoRa WAN at Urban Scenario.....	34
4.9	Histogram of Signal Level (dBm) for LoRa WAN at Urban Scenario.....	34
4.10	Elevation Profile of Poor Coverage Area for Bandung.....	35
4.11	Coverage Prediction for LoRa WAN at Suburban Scenario.....	36
4.12	Histogram of Signal Level (dBm) for LoRa WAN at Suburban Scenario.....	36
4.13	Elevation Profile of Poor Coverage Area for Tasikmalaya.....	37
4.14	Coverage Prediction for NB-IoT at Urban Scenario.....	38
4.15	Histogram of Signal Level (dBm) for NB-IoT at Urban Scenario.....	39

---

4.16	Coverage Prediction for NB-IoT at Suburban Scenario.....	40
4.17	Histogram of Signal Level (dBm) for NB-IoT at Suburban Scenario.....	40
4.18	Business Model of Smart Metering for LoRa WAN.....	42
4.19	Business Model of Smart Metering for NB-IoT.....	43
4.20	Smart Metering Cost Structure.....	44
4.21	Smart Metering Benefit Structure.....	46
4.22	Total Cashflow Kota Bandung–NB-IoT.....	51
4.23	Total Cashflow Kota Bandung–LoRa WAN.....	52
4.24	Total Cashflow Kota Tasik–NB-IoT.....	52
4.25	Total Cashflow Kota Tasik–LoRa WAN.....	52
4.26	Sensitivity Parameters Proportion.....	53
4.27	Key Decision Kriteria.....	54
4.28	Weighting Key Decision Criteria of LoRa WAN and NB-IoT.....	59