CHAPTER I
INTRODUCTION

I.1 Background

Electricity is an essential energy for the daily life of any human being. In Indonesia, the electrification rate reached 99.63%. Although the number of electrification rate is high, most of the electricity is obtained through fossil fuels which make up 80% of shares from the total electricity. Meanwhile, hydropower only makes up 14%, and geothermal power makes up 4% of the total energy share of electricity generators. In a way to boost the usage of renewable energy for electricity production, Presidential Regulation No. 5 Year 2006 was released, the figure below shows the target for renewable energy utilization for electricity generation.

Source	Installed capacity (2015) *[MW]*	Share of energy generation (2025) *[%]*
Solar	773	5%
Wind	737	
Hydro	8,688	
Ocean	1	
Biomass	1,287	5%
Geothermal	3,516	5%
Total	15,002	17%

Source: Presidential Regulation No.5/2006

Note: Indonesia also considers the liquefied coal as a renewable energy source. This will account for 2% of the total primary energy demand making total share become 17%.

Figure I- 1 Presidential Regulation No. 5 Year 2006

(Source: energypedia.info)

As an archipelago with more than 4,400 rivers, Indonesia is blessed with abundant water resources which makes hydro-based electrical power plants a potential renewable energy source. A study conducted by PT PLN in 1982 found that the total potential hydropower resources in Indonesia is 75 GW, yet the

development and implementation of hydropower in Indonesia remains minor compared to the utilization of nonrenewable sources.

Table 2: Energy consumption for generation of electricity (by source)

Sources	Consumption for electricity generation *[BOE]*
Coal	144,522
Oil	63,611
Natural gas	62,857
Hydropower	44,559
Geothermal	14,682
Biomass	58
Total	330,289

Source: Handbook of energy & economic statistics of Indonesia (2011)

Figure 2: Share of energy source for electricity generation

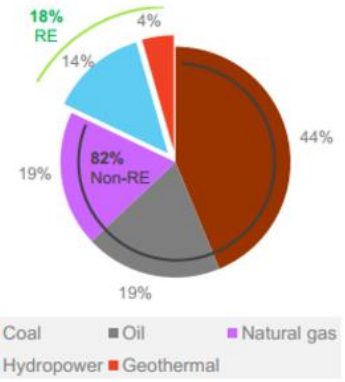


Figure I- 2 Energy Consumption for Electricity and Its Share

(Source: energypedia.info)

In the recent Presidential Regulation Number 112 Year 2022 About Acceleration of Renewable Energy Development for Electricity Supply, it is stated that PT PLN has to consider: the development of renewable energy in accordance with the target of the best energy mix based on the national electricity master plan; balance between supply and demand; and the economics of renewable energy generation. It also stated that the implementation of RUPTL (Rencana Usaha Penyediaan Tenaga Listrik) by PT PLN must: prioritize the purchase of electricity from power plants that utilize renewable energy sources; operate power plants that utilize renewable energy sources continuously (must-run) in accordance with local characteristics in the event of low load conditions; use domestic products in accordance with the provisions of laws and regulations; and develop power plants that utilize renewable energy sources.

In order to comply with the central government, the Governor of Banten Province also created the Regional Regulation of Banten Province Number 7 Year 2022 Concerning the General Plan of Banten Region Energy 2022-2050, in which

the implementation of the RUED (Rencana Umum Energi Daerah) contains several targets and aims as follows:

a. The creation of new renewable energy sources will be at a minimum of 11,2% in 2025 and 16,8% in 2050.
b. The fulfillment of final energy needs for 13.584 thousand TOE (Tonne Oil Equivalent) in 2025 and 33.451 thousand TOE in 2050;
c. The achievement of electricity consumption of 2.231 kWh per capita in the year 2050 and 6.742 kWh per capita in the year 2050;
d. The achievement of household electrification rate nearing 100 percent in the year 2026;
e. The fulfillment of electricity powerplant needs for 10.404 MW in the year 2025 and 19.251 MW in the year 2050;
f. The achievement of final energy intensity of 24,19 TOE/Billion Rupiah in the year 2025 and 16,89 TOE/Billion Rupiah in the year 2050;
g. The fulfillment of final energy usage of 0,99 TOE/capita in the year 2025 and increasing to 1,97 TOE/capita in the year 2050;
h. The controlled greenhouse gas emissions of no more than 39,6 million tons of CO2 in 2025 and 116,72 million tons of CO2 in 2050.

As of 2021, Banten Province's electrification rate reached 97,67%, which is fairly lower compared to the national electrification rate in the same year which reached 99,6%. The electrification situation in Banten is not yet evenly distributed as Pandeglang and Lebak Regency has electrification rates below 90%, with the highest number of households without electrification as the Pandeglang Regency has 15.830 households without electrification and Lebak Regency has 23.266 households without electrification. The electrification rate is 94,03% and 93,82% respectively for Padeglang and Lebak Regency.

Table I- 1 Electrification Rate for Banten Province in 2021

	Electrification Rate(%)	Number of Unelectrified Household	Number of Unelectrified Village
Pandeglang Regency	94.03	15830	0
Lebak Regency	93.82	23266	1
Tangerang Regency	97.23	27132	0
Serang Regency	99.99	15425	0
Tangerang City	99.18	40	0
Cilegon City	98.92	1167	0
Serang City	99.97	2449	0
South Tangerang City	97.67	147	0
Banten Province	97.67	85456	1

(Source: Regional Regulation of Banten Province Number 7 Year 2022 Concerning the General Plan of Banten Region Energy 2022-2050)

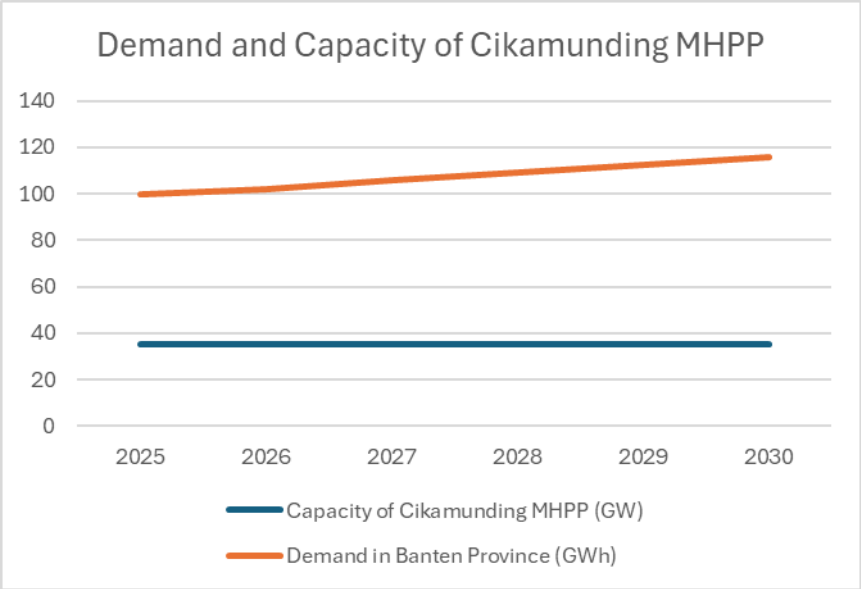
After accounting for the unelectrified 85,465 households in Lebak Regency and the average household consumption in 2024 according to the PT PLN statistics, the calculated average demand created by the unelectrified household in 2025 is equal to 99.93 GWh. This unserved customer can be supplied by the Cikamunding MHPP to fulfill at least 30% of the total annual demand of unelectrified household in Banten Province.

Table I-2 Unsupplied Demand of the Unelectrified Household

Number of Unelectrified Household in Banten Province	**Average Energy Used per Household in 2024 (kWh)**	**2025 Demand for the Unelectrified Household (GWh)**
85456	1794.02	99.93

According to the PT PLN RUPTL (Rencana Usaha Penyediaan Tenaga Listrik) in 2024-2035, there is possible growth in electricity consumption, in which will increase the demand for electricity. The projection between the increasing demand for Banten Province and capacity of Cikamunding MHPP is illustrated in Figure I-4, the demand is constantly increasing for about 3% annually.

Figure I-3 Demand and Capacity Projection



As of now, based on the PT PLN RUPTL (Rencana Usaha Penyediaan Tenaga Listrik) in 2025-2034, the electrical burden in Banten Province is around 4,143 MW and it is being supplied from several power plants which are Steam and Gas Power Plant (PLTGU) Cilegon, Steam Power Plant (PLTU) Labuan, and PLTU Lontar which generate an electric supply of 2,060 MW and connected into 150 kV power grid. In addition, the electrical need is also supplied by the PLTU Suralaya which generates 3,802 MW, PLTU LBE which generates 625 MW, and PLTU Jawa-7 Unit 1 which generates 991 MW, which is then interconnected to 500 kV power grid.

The problem with the PLTU and PLTGU is the massive amount of coal used that increases the emission of greenhouse gas. The PLTU and PLTGU are the highest contributors to greenhouse gas emissions with 52,8% of the total greenhouse gas emissions in Banten, while there is still 5000 MW of renewable energy that has not been utilized. Based on the LEAP projection done by the Banten Province RUED, as the 2015 energy consumption is equal to 1,550 kWh per capita, the electricity consumption projection for 2025 is equal to 2,231 kWh per capita and will increase to 6,742 kWh per capita as of 2050. With the increasing amount of electricity demand, the coal usage to provide electricity will also increase yearly.

Below here is the projection of the greenhouse gas emission for Banten Province as of 2015 to 2050:

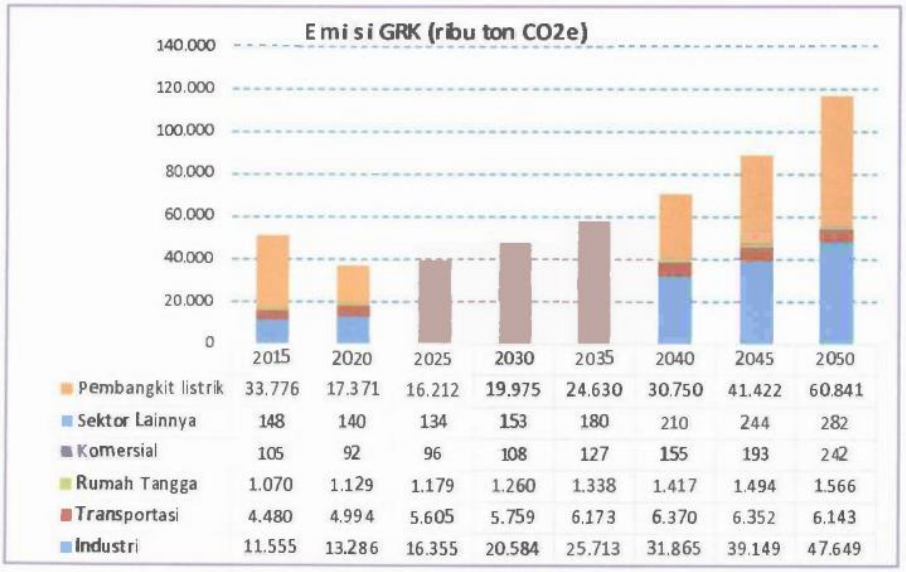


Figure I- 3 Greenhouse Gas Emission Projection

(Source: Regional Regulation of Banten Province Number 7 Year 2022 Concerning the General Plan of Banten Region Energy 2022-2050)

Table I-3 Electricity Projection for Banten Province 2025-2050

	2025	**2030**	**2040**	**2050**
Electricity Consumption (GWh)	30725	40130	69519	114737
Manufacture Industry	19312	25175	42260	69774
Transportation	187	510	1369	2448
Household	7799	9927	18140	29446
Commercial	3427	4518	7750	13069
Electricity Consumption per Capita (kWh/Capita)	2231	2750	4344	6742

(Source: Regional Regulation of Banten Province Number 7 Year 2022 Concerning the General Plan of Banten Region Energy 2022-2050)

As a means to fulfill the increasing demand for electricity, increasing the electrification rate specifically in Lebak Regency, while also ensuring that there will be no increase in greenhouse gas emissions, generating electricity using renewable energy must be prioritized. There are several powerplant choices that utilize renewable energy such as PLTA (Pembangkit Listrik Tenaga Air/Hydroelectric Power Plant), PLTM (Pembangkit Listrik Tenaga Minihidro/Mini Hydroelectric Power Plant), PLTMH (Pembangkit Listrik Tenaga Mikrohidro/Micro Hydroelectric Power Plant), PLTS (Pembangkit Listrik Tenaga Surya/Solar Power

Plant), PLTB (Pembangkit Listrik Tenaga Bayu/Wind Power Plant), and PLTP (Pembangkit Listrik Tenaga Panas Bumi/Geothermal Power Plant). By considering the location of Lebak Regency which is near the Mount Halimun Salak National Park and has an abundant number of waterfalls, mini hydroelectric power plants (MHPPs) can potentially help address the issues to boost the implementation of hydropower resources and provide electricity in Lebak Regency.

MHPP is a renewable electricity powerplant that is characterized by its capacity of up to 10 MW, which is considered a sustainable and localized energy solution for remote and rural communities. Mini-hydro systems utilize turbines, pumps, or waterwheels to convert the energy of flowing water into rotational energy, which then drives a generator to produce electricity. Most MHPP projects are "run-of-river" systems, which utilize natural water flow without significant dam construction, making them environmentally and socially less invasive. Such systems are particularly suited for Indonesia's mountainous and water-abundant regions.

Cikamunding is a small village located in South Banten, near the Pelabuhan Ratu district. Electricity at Cikamunding Village and the surrounding area is provided by the 20 kV distribution system of Pelabuhan Ratu & New PRATU Substation. This distribution system is operated by PT. PLN Rayon Pelabuhan Ratu, under the supervision of PT. PLN Area Sukabumi and under the working area of PT. PLN Distribusi Jawa Barat dan Banten. In period of April 2015, PLN Rayon Pelabuhan Ratu served 161,745 customers with a total power demand of 128.04 MVA at peak load conditions and mainly consisted of households.

Figure I- 4 Cikamunding MHPP Project Site

In the construction of the MHPP Cikamunding, it is proposed to be a run-of-river type hydropower scheme with a low weir across the Cibareno River, which originates from the Halimun Mountain about 20 km away from the site. The catchment area of the intake is mainly covered with rainforest with less than 4% of the catchment is used for cultivation of paddy fields and only 1% if the catchment area is inhabited. The surrounding terrain is fairly steep with rapid river flow and sharp rising peak floods. The estimated catchment area at the proposed Cikamunding Intake site is about 185 sq.km, while the length of Cibareno River up to the intake is around 25.5 km. The average river slope is about 2.2%.

Figure I- 5 Catchment Area of Cikamunding MHPP

Cikamunding MHPP itself is planned to be connected to the 20 kV power grid owned by PT PLN through a cooperation agreement to purchase the electricity generated. Cikamunding MHPP will be equipped with 6,000 kW capacity with engine model 2 x 3,000 kW, and the electricity generated will be distributed to the PLN UP3 South Banten Distribution System using the 20 kV power grid. This plan is to equip the PT PLN goals of maintaining the 100% electrification rate at Banten Province which has been forecasted to increase by 5.6% in the next ten years, and to also minimize the electricity creation from non-renewable sources which is the PLTU.

As the need for sustainable and equitable energy is exceptionally growing and regulated through Presidential Regulation No. 5 Year 2006 and No. 112 Year 2022, also to fulfill the General Plan of Energy for Banten Province Year 2022-2050 through the Regional Regulation of Banten Province Number 7 Year 2022, mini hydroelectric power plants are deemed as one of the solutions for providing electricity from a renewable source. Furthermore, as of 2021, Lebak Regency's electrification rate is only equal to 93,82% with 23.266 households with no electrification, it is important to ensure that there are means to increase the electrification rate so that the near 100% electrification can be achieved in 2026.

Therefore, the development of Cikamunding MHPP is planned to produce 6,17 MW to generate adequate electricity for villages in Lebak Regency and also to support the 100% electrification rate plan from the Banten Province RUED and PT PLN RUPTL for Banten Province while also being a sustainable renewable energy source generator. Hence, it is deemed as important to develop this project as it is aligned with the government policy of utilizing renewable energy and enhancing the 100% electrification rate in Banten Province due to the increasing demand. In consequence, this research is conducted to evaluate and do a feasibility study of the development of the Cikamunding MHPP from the market, technical, and financial aspects of the project.

Nevertheless, a proposal alone does not justify an investment of this size. The viability of such a project must examined before moving from an advancement stage, to a successful operational asset. Therefore, a comprehensive feasibility study

is needed to evidence the success of the Cikamunding MHPP proposal using three aspects which are market, technical, and financial. This research is conducted to systematically assess the Cikamunding MHPP proposal from three critical perspectives: market, technical, and financial. The study aims to validate the market opportunity, confirm the technical soundness of the engineering design, and determine the financial viability and profitability of the investment. Only through such a detailed analysis can stakeholders make an informed decision about proceeding with a project that carries significant economic, social, and environmental implications.

I.2 Problem Formulation

1. How is the feasibility analysis of the Cikamunding MHPP based on the market aspect?
2. How is the feasibility analysis of the Cikamunding MHPP based on the technical aspect?
3. How is the feasibility analysis of the Cikamunding MHPP based on the financial aspect?
4. How is the result of the sensitivity analysis of the Cikamunding MHPP?

I.3 Research Objectives

1. Measure the feasibility based on the market aspect of the Cikamunding MHPP.
2. Measure the feasibility based on the technical aspect of the Cikamunding MHPP.
3. Measure the feasibility based on the financial aspect of the Cikamunding MHPP.
4. Measure the sensitivity analysis of the Cikamunding MHPP.

I.4 Research Scope

1. This research is only limited to the market, technical, and financial aspects.
2. The data gathered are within the timeline of 2015 until 2021.
3. Interest rates, inflation, taxes, and other economic conditions are considered stable during the analysis period.

I.5 Research Benefit

1. The benefit for the company as a suggestion related to the project that is being carried out.
2. The benefit for the writer is for the writer to gain more knowledge and understanding, especially in financial feasibility study.

I.6 Systematic of Writing

CHAPTER I INTRODUCTION

This chapter defines the background for the problem, the problem formulation, research objectives, research benefits, research scope and limitation, and the writing systematics for the final project/research.

CHAPTER II LITERATURE REVIEW

This chapter describes and explains the basic theories associated with the research that is carried out. This chapter will provide the systematic framework of thinking and basic theories that will support the research conducted to design the final project.

CHAPTER III RESEARCH METHODOLOGY

This chapter provides the problem-solving systematics that is being used during the research which aligns with the objectives that are trying to be achieved and also the step where the research model is being developed and analyzed.

CHAPTER IV DATA GATHERING AND PROCESSING

This chapter contains the details of the data being used, the data gathering process, and the data processing. In which, these data will be analyzed in the next chapter.

CHAPTER V DATA ANALYSIS

This chapter discusses the analysis of the obtained and processed data from the previous chapter using the method that has been chosen to support the problem-solving of this project.

CHAPTER VI CONCLUSION AND SUGGESTION

This chapter describes the conclusion from the research that has been done and the suggestions for the company and any upcoming research to improve the condition at a later date.