Optimization of On-Grid Solar Power System Planning at Plaza Asia Tasikmalaya Using HOMER

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Intisari* – *Penelitian ini menyajikan perencanaan teknis dan ekonomis secara komprehensif untuk sistem Pembangkit Listrik Tenaga Surya (PLTS) On-Grid di Plaza Asia Tasikmalaya dengan memanfaatkan perangkat lunak HOMER (Hybrid Optimization Model for Multiple Energy Resources). Tujuan utama dari studi ini adalah mengembangkan konfigurasi sistem PLTS yang optimal berdasarkan profil beban aktual dan data radiasi matahari lokal, tanpa membahas tahap implementasi fisik maupun dampak pasca-instalasi. Proses perencanaan mencakup analisis kebutuhan energi berdasarkan lokasi, pemetaan potensi energi surya menggunakan data satelit, serta pemilihan komponen sistem seperti panel surya, sistem penyimpanan energi (baterai), dan inverter. Observasi lapangan dan studi dokumentasi dilakukan untuk memperoleh data konsumsi listrik, intensitas radiasi matahari, serta spesifikasi dan harga komponen sistem.Hasil simulasi menggunakan HOMER menunjukkan bahwa konfigurasi sistem optimal terdiri dari 1.894-unit panel surya monokristalin berkapasitas 340 Wp, 102 unit baterai EnerSys PowerSafe SBS 1800 (kapasitas 248 kWh), dan 50 unit inverter SolaX X3-Hybrid10 berkapasitas 10 kW. Sistem ini diproyeksikan mampu menghasilkan energi sebesar 902.334 kWh per tahun, yang dapat mencukupi sekitar 62,1% kebutuhan listrik bangunan. Sisa kebutuhan energi akan dipasok dari jaringan PLN, terutama saat intensitas matahari rendah atau pada beban puncak. Simulasi juga menghasilkan indikator kinerja utama seperti Net Present Cost (NPC), biaya investasi awal, dan Cost of Energy (COE) yang dihitung HOMER menggunakan prinsip arus kas diskonto. Indikator tersebut penting dalam menilai kelayakan teknis dan finansial dari konfigurasi sistem yang dirancang.Dengan menitikberatkan pada simulasi yang akurat, input data aktual, dan desain sistem yang layak secara ekonomi, penelitian ini menawarkan pendekatan perencanaan yang dapat direplikasi untuk integrasi energi terbarukan di bangunan komersial. Studi ini juga menunjukkan pentingnya pemanfaatan perangkat simulasi seperti HOMER dalam mendukung perencanaan investasi, pemilihan teknologi, dan formulasi kebijakan terkait sistem energi surya On-Grid. Temuan ini dapat menjadi acuan teknis bagi perencanaan energi masa depan di fasilitas komersial lain dengan potensi surya serupa.

Kata kunci* – *Pembangkit Listrik Tenaga Surya, HOMER, Perencanaan Tekno-Ekonomi, Energi Terbarukan, Simulasi.

Abstract – This study presents a comprehensive techno-economic planning of an On-Grid Photovoltaic Power Plant (PV PP) system for Plaza Asia Tasikmalaya by utilizing the HOMER (Hybrid Optimization Model for Multiple Energy Resources) software. The main objective is to develop an optimized PV system configuration based on actual load profiles and solar radiation data, without focusing on physical implementation or post-installation impacts. The planning process includes site-specific energy demand analysis, assessment of solar potential using satellite-derived datasets, and the selection of system components such as photovoltaic panels, battery storage, and inverters. Field observations and documentation were conducted to collect primary and secondary data regarding electricity consumption trends, solar irradiance levels, and component specifications and prices. The simulation using HOMER indicates that the optimal system configuration comprises 1,894 units of 340 Wp monocrystalline solar panels, 102 EnerSys PowerSafe SBS 1800 battery units (248 kWh), and 50 SolaX X3-Hybrid10 inverters rated at 10 kW. The system is projected to generate 902,334 kWh annually, supplying approximately 62.1% of the total electricity consumption of the building. The remaining demand is met by the PLN grid, especially during periods of low irradiance or peak loads. The simulation yields key performance indicators including Net Present Cost (NPC), Initial Capital Cost, and Levelized Cost of Energy (COE), which are calculated by HOMER using discounted cash flow principles. These indicators are crucial in evaluating the technical and financial feasibility of the planned configuration. By focusing on accurate simulation, real-world data inputs, and economically viable system design, this study contributes a replicable planning approach for renewable energy integration in commercial buildings. It also highlights the importance of using simulation tools like HOMER in supporting investment planning, technology selection, and policy formulation related to on-grid solar energy systems. The findings may serve as a technical reference for future energy planning in similar commercial settings across regions with comparable solar resources.

Keywords – PV Power Plant, HOMER, Techno-Economic Planning, Renewable Energy, Simulation.

I. INTRODUCTION

The rapid growth in global energy demand has led to reliability and security issues for power systems [1]. One of the evolving solutions to address this issue is the utilization of renewable energy, particularly solar energy. Solar energy is increasingly important for reducing dependence on fossil fuels and mitigating the impacts of climate change [2]. Solar cells, devices capable of converting sunlight into electrical energy through the photovoltaic principle [3], have become a key component in harnessing this energy source. Solar energy is also an abundant, inexhaustible, pollution-free, and environmentally safe energy source [4-5].

One practical application of solar energy utilization is the construction of Solar Power Systems (Photovoltaic Power Plant), which offer a clean and sustainable electricity solution [6-7]. Indonesia, located on the equator, has significant potential for solar energy development. The high solar radiation intensity in most regions of Indonesia presents a substantial opportunity for Photovoltaic Power Plant system development [8]. One system that has been widely implemented is the on-grid Photovoltaic Power Plant, which is connected to the main power grid. This system allows for the optimal use of solar energy and can help reduce electricity costs [9]. Investing in renewable energy, especially solar energy, offers numerous benefits. Besides reducing greenhouse gas emissions to limit climate change impacts, this investment also ensures reliable and cost-effective energy delivery [10]. In Indonesia, the transition to renewable energy is a strategic step driven by the National Energy Policy (KEN). KEN sets a target of achieving a renewable energy mix of 23% by 2025 and 31% by 2050. Therefore, harnessing solar energy as one of the abundant renewable energy sources in Indonesia is becoming increasingly relevant.

Plaza Asia Tasikmalaya, one of the largest shopping centers in East Priangan, has significant potential for implementing an on-grid Photovoltaic Power Plant system on its rooftop. With an area of approximately 14.5 hectares and high electricity demand for the operation of facilities such as lighting, air conditioning, escalators, and other electronic equipment, implementing a Photovoltaic Power Plant system can provide substantial benefits. Currently, Plaza Asia relies on electricity from PLN and generators as backup power sources. This dependence presents various challenges, including high operational costs due to fluctuating electricity tariffs and environmental impacts from fossil fuel use [11].

However, Plaza Asia has a rooftop area of about 5,442 m² that can be utilized for installing solar panels. Its location at 7° 20' 32.3" South Latitude and 108° 12' 59.1" East Longitude indicates high solar exposure potential. According to data from NASA, the solar radiation intensity in this area reaches an average of 4.60 kWh/m²/day, which is sufficient for Photovoltaic Power Plant system development. By utilizing this rooftop area, Plaza Asia can generate its own electricity, reduce electricity consumption from PLN, and ultimately lower operational costs.

The development of a Photovoltaic Power Plant system cannot be carried out without thorough planning. In-depth analysis is required to determine the system type, number of solar panels, storage battery capacity, and inverters to be used. The on-grid Photovoltaic Power Plant system is an ideal choice for commercial areas like Plaza Asia because it can connect to the PLN power grid. With this system, excess electricity generated by solar panels can be sold back to PLN, providing additional economic benefits.

To efficiently design and optimize the Photovoltaic Power Plant system, analytical tools such as HOMER (Hybrid Optimization Model for Multiple Energy Resources) are needed. This software allows for the simulation of various hybrid power plant system configurations, including Photovoltaic Power Plant. By considering various variables such as electricity load demand, solar radiation potential, component prices, and equipment economic lifespan, HOMER can help determine the best Photovoltaic Power Plant system configuration for Plaza Asia's needs [12].

Electricity demand in Indonesia continues to rise in line with population growth, urbanization, industrialization, and commercial sector development. This increase in energy consumption still largely depends on fossil fuels, such as coal, petroleum, and natural gas [13-14]. Dependence on fossil energy not only pressures the dwindling natural resource reserves but also leads to increased greenhouse gas emissions, contributing to climate change [15-16]. Additionally, fluctuations in fossil fuel prices in the global market cause instability in national electricity prices, ultimately affecting various economic sectors.

Therefore, the transition to renewable energy, such as solar energy, is essential. Utilizing unlimited renewable energy like solar energy is the needed solution to meet the growing energy demand [17]. However, this transition depends not only on technology but also on social, economic, and political factors [18].

The key problem addressed in this study is the lack of optimal energy planning using simulation-based methods for commercial-scale Photovoltaic Power Plant systems. While several studies have discussed solar system design, many have not focused on comprehensive techno-economic planning using tools such as HOMER in the context of commercial buildings with high and fluctuating demand. This study contributes novelty by applying a simulation-based approach using HOMER to design an optimized On-Grid Photovoltaic Power Plant configuration tailored to Plaza Asia's specific conditions. Unlike prior works that mainly focus on technical sizing or residential systems, this research provides an integrated framework combining real energy demand data, component configuration, and cost analysis to support investment decisions for commercial-scale solar power planning. The findings of this research are expected to serve as a reference for future energy planning in similar commercial facilities and contribute to achieving Indonesia's renewable energy mix target by 2025.

II. METHODOLOGY

This study adopts a quantitative approach through a series of steps, including literature review, data collection, Photovoltaic Power Plant system planning, simulation using HOMER software, and analysis of the simulation results. The following are the stages of the research conducted by Figure 1.

A. *Literature Review*

The literature review aims to understand the concepts, theories, and practices related to solar power plants, solar energy potential in Indonesia, especially in the Tasikmalaya area, and the use of HOMER software in Photovoltaic Power Plant system planning. The literature sources include books, scientific journals, research reports, technical standards related to Photovoltaic Power Plant, and weather data. This literature review is essential to establish theoretical foundation and guide in determining the proper methods and steps in the planning and analysis of the Photovoltaic Power Plant system.

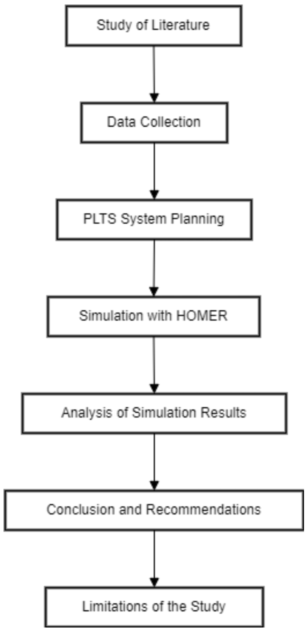

Figure 1. Flowchart Research

B. Data Collection

Data collection is conducted through field observations at Plaza Asia Tasikmalaya and documentation studies. The data collected includes:

1) *Energy Consumption Data*: Collecting electricity consumption data at Plaza Asia Tasikmalaya over the past year. This data is obtained through coordination with building management to gather complete information on monthly and daily electricity loads. This energy consumption data will be used to determine the electricity demand that the *Photovoltaic Power Plant* system must meet.

2) *Solar Energy Potential Data:* Solar radiation intensity data at the Plaza Asia Tasikmalaya location is downloaded from NASA data through HOMER software. This data includes daily solar radiation values over one year and the clearness index, indicating the amount of solar energy that can be harnessed at the location.

3) *Technical and Economic Data of Photovoltaic Power Plant Components:* Identifying and selecting the components of the Photovoltaic Power Plant system to be used, such as solar panels, batteries, and charger controllers. The collected data includes technical specifications, efficiency, economic life, and the price of each component. The selected components must match the requirements and characteristics of the planned Photovoltaic Power Plant system for Plaza Asia. To support the techno-economic analysis conducted in this study, a set of assumptions was established based on market references, manufacturer specifications, and related literature. These assumptions form the input for HOMER's financial modeling features, including the calculation of Net Present Cost (NPC), Levelized Cost of Energy (LCOE), and Initial Capital. Table 1 summarizes the key assumptions used:

Table 1. Techno-Economic Assumptions for PV Power Plant System Simulation

Parameter	Unit	Value	Source/Note
PV Panel Price	IDR/Wp	5,000	Market average (2023–2024)
PV Panel Lifetime	Years	25	Manufacturer spec.
Inverter Price	IDR/kW	3,500,000	Market estimation
Inverter Lifetime	Years	15	Typical range
Battery Price	IDR/kWh	6,500,000	Based on SBS 1800 market price
Battery Lifetime	Years	10	Manufacturer spec.
Battery Replacement Cost	IDR/kWh	85% of initial price	HOMER assumption default
Operation & Maintenance (O&M)	% of capital/year	1.5%	Literature-based [10]
Project Lifetime	Years	25	Assumed constant
Discount Rate	%	8%	Common in energy planning in IDN
Inflation Rate	%	3%	Assumed national average
Grid Electricity Tariff (PLN)	IDR/kWh	1,450	PLN Business User Class C

C. Photovoltaic Power Plant System Planning:

Based on the data collected, the Photovoltaic Power Plant system planning is carried out by considering the configuration and capacity of the components to be used. First, the solar panels are selected, determining both their number and type. In this study, the chosen panel is the Monocrystalline Canadian Solar CS6U-340M, with a capacity of 340 Wp per panel. The number of solar panels required is calculated based on Plaza Asia Tasikmalaya's daily electricity demand and the local solar radiation intensity. Next, the battery capacity and quantity are determined to store the generated electrical energy. The selected battery is the EnerSys PowerSafe SBS 1800, with a storage capacity of 248 kWh, ensuring that the Photovoltaic Power Plant system can provide continuous electricity, particularly during the night or periods of low solar radiation. The inverter is then chosen based on the appropriate type and capacity for the system, converting direct current (DC) from the solar panels into alternating current (AC) suitable for use by the electrical loads at Plaza Asia. The inverter capacity is determined by the peak power generated by the Photovoltaic Power Plant system. Lastly, the system is configured as an On-Grid system, allowing it to connect with the PLN power grid. This configuration enables the electricity generated by the solar panels to be used directly by the building, while any excess energy can be sold back to PLN.

D. Simulation Using Homer Pro

The simulation is conducted using HOMER (Hybrid Optimization Model for Energy Renewable) software to model and analyze the Photovoltaic Power Plant system at Plaza Asia Tasikmalaya. The steps in the simulation are as follows:

1. *Input Data:* Entering the electricity consumption data, solar radiation intensity, and technical data of the Photovoltaic Power Plant components into the HOMER software. This data includes daily electricity loads, average daily solar radiation intensity, and component specifications such as solar panel capacity, battery, and inverter.

2. *System Modeling:* Creating the Photovoltaic Power Plant system configuration in HOMER by entering the components to be used, such as solar panels, batteries, inverters, and the PLN power grid. This configuration includes setting up the operational scenarios and synchronization with the PLN power grid.

3. *Simulation and Optimization:* HOMER software simulates various configurations and optimizes to determine the most efficient and economical Photovoltaic Power Plant system. This simulation includes calculating energy production by solar panels, energy storage in batteries, energy consumption by the load, as well as cost analysis (Cost of Energy - COE) and the overall system cost (Net Present Cost - NPC).

4. *Sensitivity Analysis:* Sensitive analysis is conducted to evaluate how changes in specific variable, such as solar radiation intensity, battery capacity, and component prices, affect the performance and cost of the Photovoltaic Power Plant system.

E. Analysis of Simulation

The simulation results from HOMER software are analyzed to determine the performance and feasibility of the designed Photovoltaic Power Plant system. This analysis includes after analyzing the simulation results, conclusions will be drawn regarding the potential and feasibility of implementing the Photovoltaic Power Plant system at Plaza Asia Tasikmalaya. These conclusions cover the technical and economic feasibility of the proposed system, the contribution of renewable energy to reducing electricity consumption from PLN, and recommendations for the development and implementation of Photovoltaic Power Plant in other commercial buildings.

III. RESULTS AND DISCUSSION

The results of this study include the planning and simulation of a Solar Power System Photovoltaic Power Plant at Plaza Asia Tasikmalaya using HOMER software. This research covers several key aspects, including energy demand modeling, selection of Photovoltaic Power Plant components, energy production analysis, and economic evaluation. The following is a more detailed explanation of the results obtained:

A. Energy Demand Modeling

The study began with collecting electricity consumption data at Plaza Asia Tasikmalaya over a full year. This data was used to determine the electricity demand that the Photovoltaic Power Plant system must meet. Based on the analysis, the average daily electricity demand at Plaza Asia is approximately 2,545 kWh, with varying load consumption between day and night shown on figure 2. The peak energy demand occurs at night (19:00 - 22:00), when electricity usage reaches its highest value.

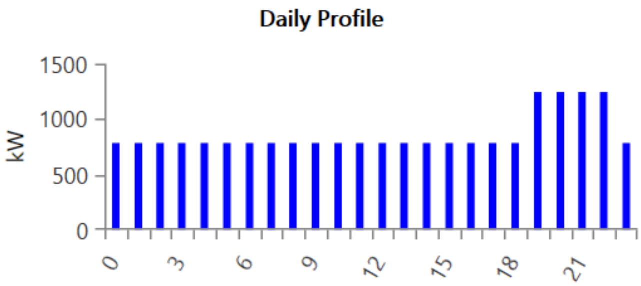

Figure 2. Load Profile

B. Energy Demand Modeling

Based on the energy demand data and the solar energy potential at the research location the planned Photovoltaic Power Plant system uses Monocrystalline Canadian Solar CS6U-340M solar panels, EnerSys PowerSafe SBS 1800 storage batteries, and SolaX X3-Hybrid10 inverters. The selected solar panels have a capacity of 340 Wp per panel with a module efficiency of approximately 17.49%. Based on the calculations, the number of panels required to meet the daily energy demand of 2,545 kWh is 1,894 panels. The total surface area of the solar panels required is approximately 3,681 m², which can be installed on the rooftop of Plaza Asia. To store the electrical energy generated by the solar panels, EnerSys PowerSafe SBS 1800 batteries with a capacity of 248 kWh were selected. According to the calculations, the number of batteries required to meet the energy storage needs is 102 units. The chosen inverter has a capacity of 10 kW. To convert direct current (DC) electricity from the solar panels into alternating current (AC) for the electrical loads at Plaza Asia, 50 inverter units are needed.

C. Photovoltaic Power Plant Planning

The HOMER software uses the input parameters listed in Table 1 to simulate the performance of the PV Power Plant system. These include technical specifications such as panel capacity, inverter size, and battery storage, as well as economic parameters such as component costs, lifetime, operation and maintenance (O&M) costs, discount rate, and project duration. HOMER's financial module applies to a discounted cash flow model to compute long-term investment metrics such as the Net Present Cost (NPC), Initial Capital

Cost, and Levelized Cost of Energy (COE). These indicators are generated automatically during optimization by evaluating thousands of component configurations while considering system constraints and variability in load and solar resource. The use of real market price inputs and standard economic assumptions ensures the validity of the cost estimations. Based on the energy demand data and the solar energy potential at the research location, the planned Photovoltaic Power Plant system uses Monocrystalline Canadian Solar CS6U-340M solar panels, EnerSys PowerSafe SBS 1800 storage batteries, and SolaX X3-Hybrid10 inverters. The selected solar panels have a capacity of 340 Wp per panel with a module efficiency of approximately 17.49%. Based on the calculations, the number of panels required to meet the daily energy demand of 2,545 kWh is 1,894 panels. The total surface area of the solar panels required is approximately 3,681 m², which can be installed on the rooftop of Plaza Asia. To store the electrical energy generated by the solar panels, EnerSys PowerSafe SBS 1800 batteries with a capacity of 248 kWh were selected. According to the calculations, the number of batteries required to meet the energy storage needs is 102 units. The chosen inverter has a capacity of 10 kW. To convert direct current (DC) electricity from the solar panels into alternating current (AC) for the electrical loads at Plaza Asia, 50 inverter units are needed.

D. Simulation and Optimization Using HOMER Software

Figure 3 show schematic at Homer. The simulation was conducted using HOMER software to analyze the performance and optimization of the designed Photovoltaic Power Plant system. The input data for the simulation included solar radiation intensity (average 4.60 kWh/m²/day), daily electricity load, and the specifications of the Photovoltaic Power Plant components to be used shown on Table 2.

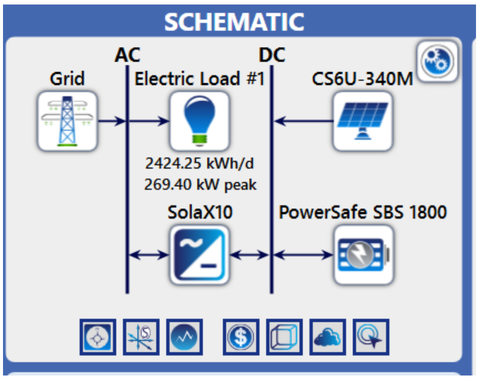

Figure 3. Schematic

The Solar Power System (Photovoltaic Power Plant) designed for Plaza Asia has an annual electricity production capacity of 902,334 kWh. This amount is significant, as the PHOTOVOLTAIC POWER PLANT can meet approximately 62.1% of Plaza Asia's total electricity needs. The remaining electricity demand will be fulfilled by the PLN power supply, especially during cloudy weather or at night. The simulation results show that the Photovoltaic Power Plant contributes 61.3% as a renewable energy source for Plaza Asia. Moreover, the excess energy generated can be fed back into the PLN grid.

Table 2. PLN Grid Electricity Production

Month	Energy Purchased (kWh)	Energy Sold (kWh)	Peak Load (kWh)	Energy Charge (Rp)
January	48.064	42.847	248	12.592.716,91
February	44.232	37.070	244	13.637.935,32
March	47.500	46.238	242	9.065.313,59
April	48.278	44.160	269	11.674.297,26
May	42.437	49.122	217	1.317.106,59
June	47.288	43.471	245	11.247.142,16
July	46.215	47.314	249	6.800.086,36
August	46.072	49.907	218	4.401.420,33
September	46.996	49.468	228	5.739.433,84
October	43.950	48.081	204	3.787.845,39
November	44.486	40.739	222	10.716.375,79
December	46.145	43.059	236	10.421.249,32
Annual	551.663	541.475	269	101.400.922,86

With adequate battery storage capacity, this Photovoltaic Power Plant system can operate optimally for approximately 1.75 days without sunlight. The excellent performance of the solar panels is also demonstrated by the solar energy penetration level reaching 102%, indicating that the solar energy potential has been maximized.

The HOMER software calculates economic indicators such as Net Present Cost (NPC), Initial Capital Cost, and Cost of Energy (COE) using a discounted cash flow approach based on system financial parameters, including project lifetime, discount rate, initial investment, annual operation and maintenance costs, and component replacement over the system's lifespan. The NPC represents the total discounted cost of the system over the project duration, while the Initial Capital Cost reflects the upfront cost of purchasing and installing all components. The COE is determined by dividing the total system cost (NPC) by the total electricity generated during the project lifetime, resulting in a cost value per kilowatt-hour (Rp/kWh). Additionally, HOMER automatically performs system configuration optimization by searching for the most technically and economically efficient combination of components, considering technical constraints and variability in input parameters such as solar radiation and load profiles.

The economic indicators shown above were calculated based on the techno-economic assumptions presented in Table 1. HOMER computes NPC using a present value approach over a 25-year project lifespan with an 8% discount rate. Initial capital represents the upfront cost for purchasing and installing all components at market prices. Meanwhile, the COE (Rp 1,083.14/kWh) was obtained by dividing the total net present cost by the total energy generated throughout the system's lifetime. The assumptions for O&M (1.5% of capital per year), component replacement cost (85% of original), and inflation (3%) were integrated into HOMER's cash flow model to reflect realistic long-term financial performance.

E. Economic Analysis

The simulation results also include an economic analysis to evaluate the feasibility of investing in the Photovoltaic Power Plant system at Plaza Asia Tasikmalaya. Several indicators calculated include:

1) *Net Present Cost (NPC):* The total system cost over its operational lifespan (25 years) is Rp 42,918,760,000. This cost includes initial investment, operation, and maintenance.

2) *Initial Capital:* The initial investment cost required for procuring the PHOTOVOLTAIC POWER PLANT system components is Rp 5,047,067,500.

3) *Cost Of Energy:* The cost of electricity production per KWH (Cost of Energy) is Rp 1,083.14/kWh. This Value is relatively compared to PLN's electricity tariffs,

4) *Operating Cost:* The annual operation and maintenance cost is Rp 1,363,238,000 per year.

Based on the input parameters and economic variables in Table 1, the simulation projects that the PV system configuration not only meets a significant portion of Plaza Asia's energy demand (62.1%) but also maintains economic viability under realistic market conditions. The cost structure derived through HOMER's simulation ensures that the estimated LCOE and NPC reflect actual investment feasibility rather than theoretical efficiency alone. These results underscore the importance of integrating techno-economic parameters into the system design process to achieve both operational reliability and financial sustainability in commercial PV projects.

F. Energy Production and Consumption

The Solar Power System (Photovoltaic Power Plant) installed at Plaza Asia can generate 902,334 kilowatt-hours (kWh) of electricity annually. This amount is significant enough to meet most of Plaza Asia's electricity needs. However, to ensure a stable power supply, especially during low sunlight intensity, the Photovoltaic Power Plant is supported by the PLN grid, which provides an additional 551,663 kWh per year. Interestingly, the excess energy generated by the Photovoltaic Power Plant during clear weather can be sold back to PLN, thereby not only saving electricity costs but also providing additional revenue. The simulation and analysis results indicate that the Photovoltaic Power Plant system at Plaza Asia Tasikmalaya has good potential to reduce dependence on PLN electricity and utilize renewable energy. With an annual total energy production of 902,334 kWh, the Photovoltaic Power Plant system can contribute 62.1% to Plaza Asia's electricity needs. In addition, using HOMER software allows for more efficient and economical planning by generating an optimal system configuration, including selecting appropriate components, estimating costs, and analyzing system performance.

IV. CONCLUSION

This study demonstrates that the implementation of an On-Grid Solar Power System (Photovoltaic Power Plant) at Plaza Asia Tasikmalaya is effective in meeting electricity needs and supporting the utilization of renewable energy. With an average solar radiation intensity of 4.60 kWh/m²/day and a rooftop area of approximately 5,442 m², the designed Photovoltaic Power Plant system can generate 902,334 kWh of electricity per year, fulfilling around 62.1% of Plaza Asia's electricity demand. The system configuration includes 1,894 solar panels, 102 battery units, and 50 inverter units, integrated with the PLN grid to ensure a stable power supply. The economic analysis shows that the total system cost over 25 years is IDR 42,918,760,000, with a cost of electricity production (Cost of Energy) of IDR 1,083.14/kWh, which is relatively competitive and provides long-term savings. Although the initial investment is substantial, the low annual operational costs and potential revenue from energy export to PLN make this system economically viable. Furthermore, the implementation of this Photovoltaic Power Plant contributes to reducing carbon emissions and supports the national renewable energy mix target. This study recommends regular monitoring of the system's performance and integration with smart grid and IoT technology for system optimization, positioning Photovoltaic Power Plant as a strategic step towards sustainable energy and a greener environment.

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