JOURNAL LA MULTIAPP
VOL. 07, ISSUE 02 (511-524), 2026
DOI: 10.37899/journallamultiapp.v7i2.3017

Feasibility Analysis of the 40 MWp Tembesi Floating Solar Power Plant Development Project

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Article Info

Article history:
Received 3 January 2026
Received in revised form 17 January 2026
Accepted 7 February 2026

Keywords:
Floating Solar Power Plant
Operation Feasibility
Financial Feasibility

Abstract

This study aims to analyze the feasibility of the Tembesi Floating Solar Power Center (PLTS) construction project with a capacity of 40 MWp in the Batam - Bintan electricity system. The financial feasibility includes calculation of investment costs, operation and maintenance costs, and cost benefit analysis using indicators such as Net Present Value (NPV), Internal Rate of Return (IRR), and Payback Period. The operational feasibility analysis includes alternatives to achieving goals, assessment of how to achieve goals, scope of work, and conclusions of the operational feasibility study. The results showed that the construction of a floating solar power plant in Tembesi Reservoir is technically feasible. The proposed design and technology are capable optimal performance of the floating solar PV system, ensuring effective and efficient operations. Financial analysis, including consideration of sensitivities and assumptions, shows that the project is financially viable. The project has an internal rate of return (IRR) that meets the investment feasibility requirements. The rates are 8.82 cUSD/kWh if the power is evacuated through 150 kV lines, and 7.96 cUSD/kWh if evacuated through 20 kV lines. Based on the analysis, the construction of 40 MWp Tembesi Floating Solar Power Plant electricity system is declared feasible to be implemented.

Introduction

Energy plays a crucial role in national development. Rapid economic and population growth increases energy demand and dependence on natural resources, leading to an imbalance between fossil fuels and energy supply. According to Indonesian Government Regulation No. 79 of 2014, the renewable energy mix target is 23% by 2025 and 31% by 2050, provided economic viability is met. This policy is reflected in Presidential Regulation No. 22 of 2017, which established the National Energy General Plan (RUEN).

RUEN 2021 data shows that Indonesia's renewable energy potential includes 29.5 GW of geothermal energy, 75 GW of hydropower, 19 GW of mini/microhydro, 32.7 GW of bioenergy, 207.9 GW of solar energy, and 60.6 GW of wind energy. Indonesia's solar energy potential is 4.8 kWh/m2/day, equivalent to 112,000 GWp. The development of solar power plants (PLTS) as part of renewable energy must be prioritized (Harianto & Karjadi, 2022; Saroji et al., 2022; Zaheb et al., 2024; Aryanfar et al., 2022).

The use of renewable energy in large-scale power plants is a solution to reduce greenhouse gas emissions (Afif & Martin, 2022). Renewable energy has great potential to meet energy needs, with much research ongoing (Al Nehru et al., 2021; Østergaard et al., 2022; Deshmukh et al., 2023; Guchhait & Sarkar, 2023; Li et al., 2023).

ISSN: 2716-3865 (Print), 2721-1290 (Online)

To conduct an economic analysis of solar power plant implementation, it is crucial to consider various factors such as technical feasibility, economic feasibility, and financial calculations (Liu et al., 2022; Iakovleva et al., 2022; Paradongan et al., 2024; Hamad et al., 2024). Several studies provide valuable insights into the design, analysis, and feasibility of solar power plants, which aid in the decision-making process.

Contreras conducted a feasibility analysis of a solar power plant with a direct steam generation system, demonstrating the importance of techno-economic analysis in estimating levelized energy costs and improving plant performance (Alqahtani & Patiño-Echeverri, 2016; Al-Breiki & Bicer, 2023; Sultan et al., 2023; Elfeky & Wang, 2023). This type of analysis helps in comparing different solar power technologies and optimizing cost-effectiveness. Goswami conducted a techno-economic analysis of a floating solar power plant, emphasizing the importance of such studies for sustainable development and cost-effective energy solutions (Arifin et al., 2023; Manolache et al., 2025; Singh et al., 2023; Vardhini & Devi, 2024). This highlights the need to consider both technical and economic aspects when evaluating solar power projects.

According to data from the Central Statistics Agency (BPS), Indonesia's economic growth reached 3.51% in 2021. The government issued the 2021-2030 RUPTL (Regional Energy Plan) as a guideline for national energy management, with a target of 23% renewable energy mix by 2025. PLN Batam is collaborating with PT TBS Energi Utama (Toba) to build a floating solar power plant (PLTS) in the Tembesi Reservoir, Batam, with a capacity of 35 MW.

The government is following up on the Minister of Energy and Mineral Resources Regulation No. 2 of 2018 and No. 49 of 2018 concerning the use of rooftop solar power plants. Bali supports the use of rooftop solar power plants at a minimum of 20% in government buildings, in accordance with Governor Regulation No. 45 of 2019 and Bali Governor Circular Letter No. 5 of 2022. The RUEN target for Bali is to develop solar power plants by 8.62% or 108.2 MW of the total potential of 1,254 MW.

Solar power plants (PLTS) convert solar energy into electricity using photovoltaic (PV) modules. Indonesia has abundant solar energy resources with an average solar radiation intensity of 4.5 kWh/m2 per day (Artiyasa et al., 2023; Putra, 2025; Samhuddin et al., 2025). Data from the PV Watts Calculator shows that the average solar radiation intensity in Indonesia in 2022 was 5.03 kWh/m2 per day. Solar energy has the largest potential among other types of renewable energy in Indonesia, amounting to 207.8 GWp (Asrori et al., 2022). Therefore, solar power plants are very suitable for use as a backup or primary source of electrical energy.

Several studies have been conducted to design solar power plants as a primary or backup power source. Sanjaya designed a rice field irrigation pump system with solar power plants for the 55-hectare Subak Semaagung farm, with an initial investment cost of Rp 1,168,137,010 (Bachtiar, 2006). Another study used solar power plants to power water pumps in a hydroponic greenhouse in Malang Regency, producing 4,527 liters of water per day (Bamisile & Dagbasi, 2015).

The PLTS system consists of several main components, namely solar panels, Solar Charger Controller (SCC), batteries, and inverters. PLTS installation systems are divided into On-Grid, Off-Grid, and Hybrid Systems (Budiyanto et al., 2021; Puspitasari et al., 2024). Off-Grid PLTS is a generation system that is not connected to other electricity networks, so it requires batteries as energy storage (Damanik & Silaban, 2023). On-Grid PLTS is connected to the PLN electricity network, does not use batteries, and is known as net-metering, where electric current is exported to PLN if it is in excess and imported from PLN if it is in short supply (Enciso Contreras et al., 2023; Afianti, 2023; Cantiqa & Dirkareshza, 2025).

ISSN: 2716-3865 (Print), 2721-1290 (Online)

Planning a rooftop solar power plant using PVSyst produces technical design recommendations and a level of generation reliability in the form of a performance ratio (PR) (Goswami et al., 2019). Project feasibility analysis is calculated based on the Net Present Value (NPV), Benefit Cost Ratio (BCR), and Payback Period (PP). Based on this background, this study is entitled "Feasibility Analysis of the Tembesi 40 MWp Floating Solar Power Plant (PLTS) Development Project in the Batam – Bintan Electricity System".

Methods

Research Flow

Starting Research: The first step to starting a research project.

Literature Study: Conducting a study of journals, books, and information related to PLTS to increase understanding.

Primary Data Collection: Collecting data related to the Batam-Bintan Electricity System, such as reservoir area, installed load, and energy consumption.

Secondary Data Collection: Collecting meteorological data such as geographic location, peak sun hour, and solar irradiation.

PLTS Model Design: Develop a PLTS model based on the data that has been collected.

Model Simulation: Perform simulations to check the performance of the PLTS model.

Investment Analysis: Assess the investment payback period, savings, and efficiency of the designed solar power plant model.

Conclusion and Suggestions: Summarize the research results and provide suggestions.

Research Completed: The final stage of research.

Data Collection Methods

Primary Data Collection: Collecting direct data through measurements, such as reservoir area and daily load usage.

Secondary Data Collection: Collecting data from books, journals, and related institutions, including solar radiation data, irradiation, and PLTS component specifications.

Observation Method: Observing field conditions directly to understand the implementation of the research.

Steps for Planning a Solar Power Plant:

Solar radiation assessment.

Area assessment for generation.

Assessment of the configuration of the PLTS system.

Selection and specification information for solar power plant equipment.

Solar Power Plant Design: Designing a solar power plant with a Flat Plate Arrays system on the roof of the building for cost efficiency and space usage.

Simulation: Mimicking real processes to model the performance of a solar power plant.

Solar Power Plant System Design

Off-Grid Solar Power Plant: A standalone solar power system that only uses solar energy, involving a PV Array, regulator or SCC, and batteries.

On-Grid PLTS: The PLTS system is connected to the PLN grid to reduce electricity bills, involving a PV Array, on-grid inverter, and PLN as a backup.

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Results and Discussion

Analysis of the Feasibility Study for the Operation of the 40 MWp Tembesi Floating Solar Power Plant (PLTS)

The operational feasibility analysis of the 40 MWp Tembesi Floating Solar Power Plant (PLTS) covers various important aspects, including alternative ways to achieve the targets, assessment of the ways to achieve the targets, scope of work, conclusions of the operational feasibility study (OFS), and environmental assessment. Alternatives to achieve the targets involve reviewing solar panel technology options, electricity distribution systems, and energy management strategies, while the assessment of these alternatives is based on reliability, efficiency, and financial feasibility. The scope of work includes construction, installation, testing, and long-term operation. The OFS presents an evaluation of the project's operational feasibility, potential benefits, risks, and project recommendations. The environmental assessment evaluates the project's impacts on land, biodiversity, and greenhouse gas emissions, and designs environmental impact mitigation strategies to ensure the project's long-term sustainability. The integration of all these aspects provides a holistic view of the project's potential to support renewable energy and meet the community's energy needs efficiently and sustainably.

Power System Analysis

Table 1. Active Power Before and After the Floating Solar Power Plant is Connected (Peak Load)

Unit	Rating / Limit (MW)	2024 Without PV Plant (MW Generation)	2024 With PV Plant (MW Generation)
CC GTPP ELB	36.50	33.00	33.00
IPP Excess Power	47.50	47.50	47.50
BTA Atas Diesel Plant	23.04	–	–
BTA Baru Diesel Plant	21.00	–	–
Baloi Diesel Plant	24.68	–	–
Sekupang Diesel Plant	18.00	–	–
GTPP Batam	30.00	27.00	28.00
GTPP DEB I	31.50	26.00	28.00
GTPP DEB II	31.50	26.00	28.00
GTPP MEB I	27.50	23.00	25.00
GTPP MEB II	27.50	23.00	25.00
GTPP TM 2500	18.00	–	–
GTPP Tj Uncang I	42.50	38.71	24.88
GTPP Tj Uncang ELB I	35.00	32.00	–
GTPP Tj Uncang ELB II	35.00	32.00	33.00
GTPP Tj Uncang II	42.50	39.00	39.00
GTPP Baloi Peaker	30.00	25.00	27.00

ISSN: 2716-3865 (Print), 2721-1290 (Online)

GTPP Kabil I	24.60	–	–
GTPP Kabil II	12.00	–	–
GTPP Panaran	24.60	23.00	23.00
CFSPP Tj Kasam I	55.00	50.00	50.00
CFSPP Tj Kasam II	55.00	50.00	50.00
CFSPP DEB	22.00	18.00	20.00
CFSPP MEB	22.00	18.00	20.00
CFSPP Tj Uncang	40.00	37.00	37.00
Tembesi PV	41.50 (Peak)	–	30.00

A power system analysis was conducted to understand the impact of the integration of the 40 MWp Tembesi Floating Solar Power Plant (PLTS) on the Batam-Bintan electricity system. This simulation compares network performance before and after the PLTS is operational, including load flow analysis on the 150 kV Batam network in 2024. The scenarios analyzed include peak load conditions and low load conditions, both before and after the PLTS is connected, as well as alternative evacuation simulations via buses 1 and 2-20 kV Panaran. The results of this simulation show the active power generated before and after the PLTS is connected under peak load conditions.

Table 1 shows the active power generated by various power plants in the Batam-Bintan electricity system for 2024, both without PV Plant (2024 Without PV Plant) and with PV Plant (2024 With PV Plant). CC GTPP ELB produced 33.00 MW, IPP Excess Power 47.50 MW, BTA Atas Diesel Plant 21.00 MW, Baloi Diesel Plant 24.68 MW, and Sekupang Diesel Plant 18.00 MW in both conditions. GTPP Batam increased from 27.00 MW to 28.00 MW after the PV Plant was connected. GTPP Tj Uncang I and II showed a significant decrease after the PV Plant was connected, from 38.71 MW to 24.88 MW and from 39.00 MW to 30.00 MW, respectively. CFSPP TJ Kasam I and II remain at 50.00 MW in both conditions. Tembesi PV generates an additional 30.00 MW in the condition with PV. The load flow analysis aims to ensure that the integration of PV does not cause the system voltage to exceed the Grid Code limit (-10% to +5% of the nominal voltage of 150 kV). Simulations show that with PV integration, the system can still meet the N-1 criterion (system resilience to single component failure). This analysis also calculates the active and reactive power and transmission line loading for each 150 kV bus point before and after the PV is connected, ensuring grid stability and reliability. Thus, the integration of the 40 MWp Tembesi Floating PV is expected to provide significant additional power, help meet energy needs, and maintain the stability and reliability of the Batam-Bintan electricity system in accordance with PLN standards and the Grid Code.

Table 2. Reactive Power Before and After the Floating Solar Power Plant is Connected (Peak Load)

Unit	2024 Without PV Plant (MVAR)	2024 With PV Plant (MVAR)
CC GTPP ELB	24.75	24.75
IPP Excess Power	29.44	29.44
BTA Atas Diesel Plant	–	–
BTA Baru Diesel Plant	–	–
Baloi Diesel Plant	–	–
Sekupang Diesel Plant	–	–
GTPP Batam	20.25	21.00

ISSN: 2716-3865 (Print), 2721-1290 (Online)

GTPP DEB I	19.50	21.00
GTPP DEB II	19.50	21.00
GTPP MEB I	17.25	18.75
GTPP MEB II	17.25	18.75
GTPP TM 2500	–	–
GTPP Tj Uncang I	30.21	38.67
GTPP Tj Uncang ELB I	24.00	–
GTPP Tj Uncang ELB II	24.00	24.75
GTPP Tj Uncang II	29.25	29.25
GTPP Baloi Peaker	18.75	20.25
GTPP Kabil I	–	–
GTPP Kabil II	–	–
GTPP Panaran	12.15	12.68
CFSPP Tj Kasam I	37.50	37.50
CFSPP Tj Kasam II	37.50	37.50
CFSPP DEB	13.50	15.00
CFSPP MEB	13.50	15.00
CFSPP Tj Uncang	27.75	27.75
Tembesi PV	–	4.27

Table 3. Explanation of the 150 kV Transmission Line before the Floating PLTS

Transmission Line	**Base (kV)**	**Type**	**Loading (%) Per Circuit**	
			Peak Load (%)	**Low Load (%)**
Baloi – Harapan	150	2 Cct, 1×241.5 mm² ACCC Lisbon	18.85	11.65
Batu Besar – Tj. Kasam	150	2 Cct, 2×282 mm² ACSR Dove	30.34	23.97
Kabil – Batu Besar	150	1 Cct, 1×ACFR 315/40 mm²	28.07	22.56
Muka Kuning – Panaran	150	2 Cct, 2×402 mm² ACSR Drake	12.50	4.85
Nongsa – Batu Besar	150	2 Cct, 2×402 mm² ACSR Drake	0.94	0.48
PV – Muka Kuning	150	1 Cct, 2×402 mm² ACSR Drake	–	–
PV – Panaran	150	1 Cct, 2×402 mm² ACSR Drake	–	–
Panaran – Sagulung	150	2 Cct, 2×428.8 mm² ACSR Zebra	9.84	6.60
Sagulung – Sei Harapan	150	2 Cct, 2×428.8 mm² ACSR Zebra	16.01	10.35
Sagulung – Tj. Uncang	150	2 Cct, 2×428.8 mm² ACSR Zebra	12.55	8.09
Sei Baloi – Batu Besar	150	2 Cct, 1×241.5 mm² ACCC Lisbon	12.49	12.34
Sei Harapan – Nagoya	150	2 Cct, 2×428.8 mm² ACSR	14.81	9.84

ISSN: 2716-3865 (Print), 2721-1290 (Online)

Sei Harapan – Tj. Uncang	150	2 Cct, 2×428.8 mm² ACSR	20.79	13.41
Tj. Kasam – Kabil	150	1 Cct, 1×ACFR 315/40 mm²	35.20	27.38
Tj. Kasam – Muka Kuning	150	2 Cct, 2×402 mm² ACSR Drake	9.56	2.94
Tj. Sengkuang – Sei Baloi	150	2 Cct, 2×428.8 mm² ACSR Zebra	6.29	4.23

Table 4. Explanation of the 150 kV Transmission Line After Floating PLTS

Transmission Line	**Base (kV)**	**Conductor Type**	**Loading (%) Per Circuit**	
			Peak Load (%)	**Low Load (%)**
Baloi – Harapan	150	2 Cct, 1×241.5 mm² ACCC Lisbon	17.11	8.82
Batu Besar – Tj. Kasam	150	2 Cct, 2×282 mm² ACSR Dove	31.94	22.67
Kabil – Batu Besar	150	1 Cct, 1×ACFR 315/40 mm²	29.76	21.22
Muka Kuning – Panaran	150	1 Cct, 2×402 mm² ACSR Drake	14.57	2.31
Nongsa – Batu Besar	150	2 Cct, 2×402 mm² ACSR Drake	0.94	0.64
PV – Muka Kuning	150	1 Cct, 2×402 mm² ACSR Drake	13.18	3.40
PV – Panaran	150	1 Cct, 2×402 mm² ACSR Drake	6.39	4.59
Panaran – Sagulung	150	2 Cct, 2×428.8 mm² ACSR Zebra	13.84	4.86
Sagulung – Sei Harapan	150	2 Cct, 2×428.8 mm² ACSR Zebra	16.08	9.12
Sagulung – Tj. Uncang	150	2 Cct, 2×428.8 mm² ACSR Zebra	8.74	8.56
Sei Baloi – Batu Besar	150	2 Cct, 1×241.5 mm² ACCC Lisbon	14.13	10.93
Sei Harapan – Nagoya	150	2 Cct, 2×428.8 mm² ACSR	14.87	9.89
Sei Harapan – Tj. Uncang	150	2 Cct, 2×428.8 mm² ACSR	19.37	12.39
Tj. Kasam – Kabil	150	1 Cct, 1×ACFR 315/40 mm²	36.87	26.02
Tj. Kasam – Muka Kuning	150	2 Cct, 2×402 mm² ACSR Drake	10.92	1.26
Tj. Sengkuang – Sei Baloi	150	2 Cct, 2×428.8 mm² ACSR Zebra	6.31	4.24

Table 5. Voltage Profile of 150 Kv Substation Before and After Floating Solar Power Plant is Connected (Peak Load)

Bus ID	**Nominal (kV)**	**2024 Without PV**		**2024 With PV**	
		Voltage (kV)	**Voltage (p.u.)**	**Voltage (kV)**	**Voltage (p.u.)**

ISSN: 2716-3865 (Print), 2721-1290 (Online)

Tanjung Sengkuang	150	148.884	0.993	148.337	0.989
Sagulung	150	151.345	1.009	150.749	1.005
Panaran	150	152.413	1.016	152.107	1.014
Tanjung Kasam	150	151.218	1.008	150.789	1.005
Muka Kuning	150	151.944	1.013	151.570	1.010
Sei Harapan	150	150.131	1.001	149.525	0.997
Sei Baloi	150	149.145	0.994	148.599	0.991
Tanjung Uncang	150	151.703	1.011	151.034	1.007
GIS Kabil	150	150.501	1.003	150.047	1.000
Batu Besar	150	149.949	1.000	149.470	0.996
Nongsa	150	149.901	0.999	149.422	0.996
Nagoya	150	149.726	0.998	149.117	0.994

Table 6. Voltage Profile of 150 Kv Substation Before and After Floating Solar Power Plant is Connected (Low Load)

Bus ID	**Nominal (kV)**	**2024 Without PV**		**2024 With PV**	
		Voltage (kV)	**Voltage (p.u.)**	**Voltage (kV)**	**Voltage (p.u.)**
Tanjung Sengkuang	150	150.416	1.003	149.833	0.999
Sagulung	150	151.956	1.013	151.172	1.008
Panaran	150	152.703	1.018	151.611	1.011
Tanjung Kasam	150	152.380	1.016	151.608	1.011
Muka Kuning	150	152.551	1.017	151.569	1.010
Sei Harapan	150	151.188	1.008	150.490	1.003
Sei Baloi	150	150.589	1.004	150.007	1.000
Tanjung Uncang	150	152.163	1.014	151.431	1.010
GIS Kabil	150	151.827	1.012	151.088	1.007
Batu Besar	150	151.388	1.009	150.683	1.005
Nongsa	150	151.360	1.009	150.655	1.004
Nagoya	150	150.924	1.006	150.224	1.001

Load simulations of all 150 kV transmission lines at peak and low loads before and after the floating solar power plant was connected showed that all transmission lines were loaded below 50%, meeting the N-1 reliability criteria. Load flow analysis showed that the voltage profiles at peak and low load conditions were within the acceptable range according to Grid Code requirements (-10% to +5%). Under low load conditions, the voltages of all substations remained in good condition and almost the same as before the floating solar power plant was connected. All substation buses were in acceptable condition according to Grid Code regulations. In conclusion, based on the operational feasibility study, the construction of the floating solar power plant in the Tembesi reservoir is feasible.

Financial Feasibility Study Analysis of the 40 MWp Tembesi Floating Solar Power Plant (PLTS)

Sensitivity Analysis

Table 7. Sensitivity Analysis

DESCRIPTION	**WACC**	**IRR Equity**	**IRR Project**	**NPV (US$)**	**BCR**	**Payback Period**		**Leveled Tariff(cent$/kWh)**	**TariffABDE [Rp/kWh]**
BaseScenario	8.16%	12.09%	8.60%	1,474,888	1.03	9 Years	3 months		1,323.00

ISSN: 2716-3865 (Print), 2721-1290 (Online)

EPC COST								$ 8. 82	
- USD 624/kWh (-10%)	8.16%	12.00%	8.56%	1,226,006	1.03	9 Years	4 months	$ 8. 08	1,212.03
- USD 693/kWh (Base)	8.16%	12.09%	8.60%	1,474,446	1.03	9 Years	3 months	$ 8. 82	1,323.00
- USD 832/kWh (+20%)	8.16%	8.41%	6.71%	-5,520,994	0.89	11 years old	1 month	$ 8. 82	1,323.01
ELECTRICITY DEMAND									
- 48,800 MWh (-20%)	8.16%	12.09%	8.60%	1,476,535	1.03	9 Years	3 months	$ 8. 82	1,323.05
- 61,000 MWh (Base)	8.16%	12.09%	8.60%	1,474,446	1.03	9 Years	3 months	$ 8. 82	1,323.00
- 70,150 MWh (+15%)	8.16%	12.09%	8.60%	1,474,330	1.03	9 Years	3 months	$ 8. 82	1,322.98
BASE EXCHANGERATE									
- 1 USD = Rp. 13,500 (-10%)	8.16%	12.08%	8.60%	1,474,941	1.03	9 Years	3 months	$ 8. 86	1,328.67
- 1 USD = Rp. 15,000 (Base)	8.16%	12.09%	8.60%	1,474,446	1.03	9 Years	3 months	$ 8. 82	1,323.00
- 1 USD = Rp. 18,000 (+20%)	8.16%	12.26%	8.69%	1,759,677	1.04	9 Years	2 months	$ 8. 82	1,587.60

The table above shows that a 20% increase in capital expenditure (EPC) from the base scenario capital expenditure results in a negative NPV. However, the other two variables, electricity demand and exchange rate, do not significantly affect the NPV, with swings of -10%, -20%, 15%, and 20%, respectively, with a fixed tariff component (LEGC) of 8.82 cUSD/kWh and without the E component of 7.96 cUSD/kWh.

Calculation of the EPC Value of a 40MWp Floating Solar Power Plant

Table 8. Capex Plan for 40 MWp Floating Solar Power Plant

No	Description	Rab (Rp)
1	Development Cost	14,445,000,000
2	EPC Cost of Solar Power Plantfloating	478,345,161,220
3	Power evacuation transmission to GI	88,248,062,736
4	VAT, Import Tax & Duty Fee	57,270,000,000
Total Investment Budget		638,308,223,956

Based on the total capital expenditure (Capex) and an assumed exchange rate of Rp15,000 per USD, the investment cost of the power plant is estimated at USD 841.7 per kW, which is equivalent to a total investment value of Rp581,038,223,956. This figure represents the overall financial requirements for the project, including the procurement of major equipment, installation of electrical systems, construction of supporting infrastructure, as well as technical and managerial costs incurred during the development phase. Therefore, this amount reflects the substantial financial commitment needed to implement the power plant under the standard power evacuation scheme.

However, when the power evacuation option is implemented through a 20 kV distribution network, the total investment requirement decreases to Rp492,790,161,220, which is equivalent to a unit cost of USD 713.9 per kW. This cost reduction is mainly attributed to the lower infrastructure requirements, simpler technical specifications, and reduced installation and operational complexity associated with medium voltage distribution systems. In general,

ISSN: 2716-3865 (Print), 2721-1290 (Online)

a 20 kV network requires less capital investment because it involves shorter transmission distances and lighter equipment compared to higher voltage transmission systems.

The difference in investment values between the two scenarios indicates that the selection of the power evacuation system has a significant impact on the overall project cost structure. Consequently, decisions regarding the choice of evacuation method should consider not only technical performance and system reliability but also economic efficiency and long term financial feasibility. By adopting a more cost effective distribution option, the project can achieve lower initial capital expenditure, which may enhance its return on investment and support sustainable operational performance in the future.

Project Resume

COMPONENT TARIFF		(Year 1)	(Year 11)
Component - A	c US$/kWh	7.95	5.73
Component - B	c US$/kWh	0.59	0.86
Component - C	c US$/kWh	-	-
Component - D	c US$/kWh	0.01	0.01
Component - E	c US$/kWh	0.98	0.43
Total Tariff ($ /kWh)	**c US$/kWh**	**9.52**	**7.03**
LEVELIZED TARIFF	**c US$/kWh**	**Rp/kWh**	
Component - A	7.12	1,067.93	
Component - B	0.83	124.50	
Component - C	-	-	
Component - D	0.01	1.50	
Component - E	0.86	129.06	
Total ABCDE	**8.82**	**1,323.00**	
Total ABD	**7.96**	**1,193.94**	
Total ABDE	**8.82**	**1,323.00**	

Figure 1. LEGC Simulation Results of ABDE Component Tariffs

COMPONENT TARIFF		(Year 1)	(Year 11)
Component - A	c US$/kWh	7.95	5.72
Component - B	c US$/kWh	0.59	0.86
Component - C	c US$/kWh	-	-
Component - D	c US$/kWh	0.01	0.01
Component - E	c US$/kWh	-	-
Total Tariff ($ /kWh)	**c US$/kWh**	**8.55**	**6.59**
LEVELIZED TARIFF	**c US$/kWh**	**Rp/kWh**	
Component - A	7.12	1,067.78	
Component - B	0.83	124.50	
Component - C	-	-	
Component - D	0.01	1.50	
Component - E	-	-	
Total ABCDE	**7.96**	**1,193.78**	
Total ABD	**7.96**	**1,193.78**	
Total ABDE	**7.96**	**1,193.78**	

Figure 2. LEGC Simulation Results of ABD Component Tariffs (Without Component E – Evacuation Through 20 kV)

To analyze investments in solar power projects, a capital budgeting analysis is conducted, focusing on the calculation of Free Cash Flow to the Firm (FCFF). This calculation includes Cash Outlay and Cash Inflow. Cash Outlay consists of Capital Expenditure (Capex) costs, including EPC (Engineering, Procurement, and Construction) and Non-EPC costs, Interest During Construction (IDC) costs, Operation & Maintenance (O&M) costs, and fuel costs. Furthermore, financing costs such as commitment fees, upfront fees, and agency fees are also taken into account.

Cash inflow is derived from electricity sales revenue, calculated based on production capacity factor (CF), average selling price to consumers, and transmission and distribution losses. FCFF is calculated using the following formula:

$$\text{Free Cash Flow to Firm} = \text{EBIT} \times (1-t) + \text{Depreciation} - \text{Net Reinvestment}$$

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where Net Reinvestment is:

Net Reinvestment = ΔNWC + ΔCapex

In this calculation, Net Working Capital (NWC) is ignored, assuming that working capital remains constant throughout the study period.

Table 9. Simulation Results - Financial Feasibility Indicators

Indicator	Unit	Evacuation via 150 kV	Evacuation via 20 kV
IRR Equity	%	12.09	12.95
IRR Project	%	8.60	9.03
WACC	%	8.16	8.16
NPV	US$	1,474,888.36	2,486,979
BCR	time	1.03	1.07
Payback Period		9 years 3 months	8 years 11 months
DSCR	time	1.56	1.62

In the financial calculation of the EPC project, a sensitivity analysis was conducted on the generating capacity factor (CF), investment cost (Capex), and electricity demand, with the result that changes in investment cost (Capex) are the most sensitive to changes in NPV and IRR. The project's useful life is set for 25 years, and by considering the sensitivity analysis and existing assumptions, the project with the financial lease/IPP scheme is financially feasible to continue with a sales and purchase tariff of 8.82 cUSD/kWh (LEGC) if the power evacuation is via 150 kV and 7.96 cUSD/kWh if the power evacuation is via 20 kV, with the financial feasibility indicators of each scheme.

Conclusion

The operational feasibility analysis shows that the construction of a 40 MWp floating solar power plant (PLTS) in the Tembesi reservoir is feasible. This means that the project can be operated well within the existing technical and operational context. The financial feasibility study of the 40 MWp Tembesi floating solar power plant project, after considering sensitivity analysis and applicable assumptions, shows that the project is financially viable with an appropriate Internal Rate of Return (IRR). This indicates that the project has good profit prospects and is financially feasible to continue. The financial feasibility analysis considering the financial lease/IPP scheme shows that the 40 MWp Tembesi floating solar power plant project is feasible to continue if the electricity purchase tariff is 8.82 cUSD/kWh with power evacuation via 150 kV or 7.96 cUSD/kWh with power evacuation via 20 kV. This means that the project can be profitable and feasible based on the tariffs set for the two power evacuation scenarios.

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