Eduvest – Journal of Universal Studies
Volume 5 Number 9, September, 2025
p- ISSN 2775-3735- e-ISSN 2775-3727

Blended Finance for Renewable Energy Project In PT. Sarana Multi Infrastruktur (PERSERO) Study Case: Hydroelectric and Mini Hydro Powerplant

Mahfud Gesang Nurdiyono, Sylviana Maya Damayanti
Institut Teknologi Bandung, Indonesia
Email: mahfud_nurdiyono@sbm-itb.ac.id

ABSTRACT

Indonesia's government commitment to achieving Net Zero Emissions by 2060 places strategic focus on accelerating renewable energy development, including hydroelectric and mini-hydro power plants. Despite their potential, mini-hydro projects face numerous challenges. PT Sarana Multi Infrastruktur (Persero) (PT SMI), as a government-backed financial institution, is expected to take a catalytic role in overcoming these barriers. This research aims to explore how blended finance can enhance the feasibility and bankability of hydroelectric and mini-hydro power plant projects in Indonesia, focusing on PT SMI's role and initiatives. This research applies a mixed-methods approach, combining qualitative insights from stakeholder interviews with quantitative comparative analysis of financial ratios (IRR, NPV, DSCR, PLCR, WACC) between projects with and without blended finance. The case study focuses on eight hydro projects to simulate financing scenarios with varying degrees of blended finance application. The findings reveal that blended finance significantly improves bankability and financial feasibility, particularly for mini-hydro projects under 10 MW, by reducing the cost of capital and improving financial ratios. Projects supported by investment grants demonstrate higher DSCR and IRR, making them more attractive to private lenders. However, current limitations in grant disbursement processes, internal structuring, and pricing policy reduce the effectiveness of PT SMI's role. The study proposes a structured bundling strategy of financial instruments and a strategic plan for enhancing partnerships with strategic partners to scale up impact and strengthen PT SMI's transformation into a development finance institution.

KEYWORDS *Blended Finance, Feasibility, Bankability, Renewable Energy, Project Finance, Mini-hydro.*

INTRODUCTION

Indonesia has planned to reach Net Zero Emission by 2060 or sooner (ESDM, 2024). According to the roadmap from the Ministry of Energy and Mineral Resources, the roadmap to energy transition will be based on these strategies: (1) Energy Efficiency Implementation, (2) Electrification (EV, induction stove, etc.), (3) NRE Development (on-grid, off-grid, biofuel), (4) New Energy Source (nuclear, hydrogen, ammonia), (5) Carbon Capture and Storage (CCS)/Carbon Capture, Utilization, and Storage (CCUS), and (6) Moratorium on Coal Fired Power Plants and early retirement of existing Coal Fired Power Plants.

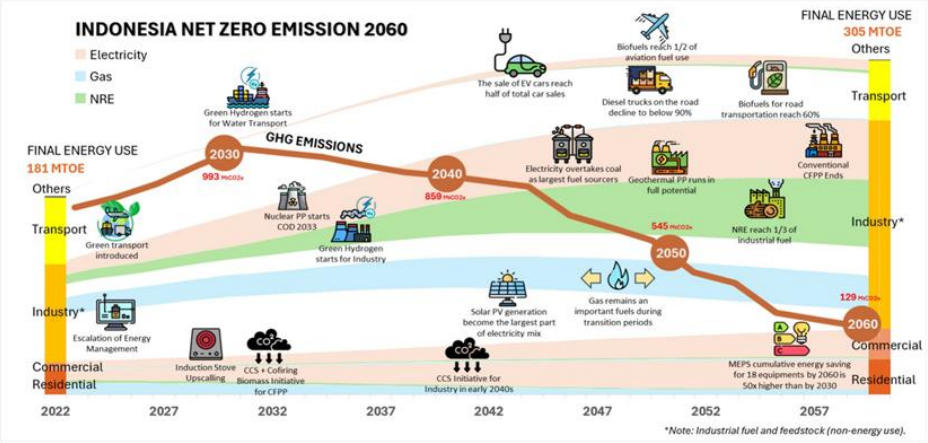


Figure 1. Indonesia Net Zero Emission 2060 infographics

The development of renewable energy is one way to mitigate climate change and reduce our dependency on fossil fuels. Hydroelectric power plants and mini-hydroelectric power plants, which are small-scale hydroelectric projects that generate electricity using flowing river water, have potential as renewable energy solutions. Different from other types of power plants, hydroelectric and mini-hydroelectric power plants are often more flexible, scalable, and suitable for rural or off-grid areas, enabling electricity access while maintaining a low carbon footprint. Hydroelectric power plant classification based on size is as follows (Kaonang, 2024):

Table 1. Hydroelectric powerplant classification

Classification	Capacity
Hydroelectric	> 10 MW
Mini hydro	1 MW – 10 MW
Micro hydro	5kW ≤ 1 MW

In Indonesia, transitioning from coal-powered plants to renewable energy alternatives is a national priority (RUPTL, 2021), as outlined in the *Rencana Usaha Penyediaan Tenaga Listrik* ("RUPTL"). However, while hydroelectric power plant projects offer significant potential, they face challenges in development due to limited financing structures and risk appetite from potential lenders.

Blended finance is a mechanism combining development finance and commercial finance to support sustainable development goals in developing countries (OECD, 2018). Blended finance can be implemented using several financial instruments from multiple sources like public, private equity, and philanthropic funds (OECD, 2019). Blended finance is an innovative approach to solve financing barriers for renewable energy projects by mitigating risk and enhancing returns for private investors. Blended finance can deliver philanthropic funds into their purpose, which is high-impact carbon reduction projects such as mini-hydro power plants.

Structured or bundled financing schemes specific to hydroelectric and mini-hydro power plant projects can provide positive impacts such as lowering the cost of capital by leveraging grants, improving bankability through de-risking facilities like guarantees or insurance, and attracting investment by standardizing financial structures, making the projects more attractive to investors (Harto Jawadz et al., 2019; Reza et al., 2023; Rinaldi & Mulyono, 2021; Rosytha & Suryana, 2023; Sarwono et al., 2018).

PT Sarana Multi Infrastruktur (*Persero*) (PT SMI), as a catalyst infrastructure financing institution in Indonesia, has an important role in exploring and implementing such financing mechanisms to accelerate the development of renewable energy, including mini-hydro power plants.

PT Sarana Multi Infrastruktur (*Persero*) or PT SMI is a state-owned enterprise under the Ministry of Finance, established in 2009 to serve as a catalyst in accelerating Indonesia's infrastructure development. Operating as a Special Mission Vehicle (SMV), PT SMI focuses on sustainable financing and supports national priorities through its three main business pillars: Financing and Investment, Public Finance, and Advisory Services & Project Development. With a strong commitment to ESG principles and the SDGs, PT SMI leads in sustainable infrastructure financing, including the SDG Indonesia One platform and its role as the Energy Transition Mechanism (ETM) Country Platform Manager. Despite challenges in developing mini-hydro projects, PT SMI continues to expand its renewable energy portfolio, aiming to increase its sustainable financing portion and support Indonesia's energy transition goals.

Several studies have investigated the role of blended finance in renewable energy projects. For example, Hodge et al. (2021) analyzed blended finance mechanisms in renewable energy investments in Southeast Asia, finding that such schemes can effectively leverage public funds to attract private investment. However, their study primarily focused on large-scale projects (>50 MW) and did not explore the specific dynamics of smaller-scale mini-hydro projects, which often face distinct challenges such as higher per-unit capital costs, site-specific risks, and limited investor interest. Another study by Pueyo et al. (2020) examined risk mitigation tools for renewable energy financing in developing countries, highlighting that guarantees, concessional loans, and insurance can enhance bankability. Yet, the study provided only theoretical insights and did not empirically test the impact of structured blended finance packages on actual project financial performance, leaving a gap in practical, context-specific evidence for Indonesian mini-hydro projects.

This research aims to explore how blended finance can enhance the feasibility and bankability of hydroelectric and mini-hydro power plant projects in Indonesia, focusing on PT SMI's role and initiatives. It investigates key challenges in financing, identifies effective structured finance models, and provides recommendations to improve PT SMI's blended finance schemes. The study is limited to Indonesia and selected PT SMI-financed projects, with constraints in data access due to confidentiality and limited stakeholder participation. Despite these limitations, the research seeks to offer practical insights for accelerating renewable energy financing and supporting Indonesia's energy transition.

RESEARCH METHOD

This research adopts a mixed-methods approach with a comparative analysis design to evaluate the impact of blended finance on the financial feasibility of hydroelectric and mini-hydro power plant projects. Quantitative analysis compares financial ratios under two scenarios—with and without blended finance—while qualitative insights are gathered through interviews with key personnel from the Sustainable Financing and Partnership Divisions at PT SMI. This combination allows for a comprehensive understanding of financing structures, stakeholder needs, and expectations, ultimately leading to recommendations for an ideal blended finance model to accelerate project development.

This research design begins by identifying key business issues related to financing hydroelectric and mini-hydro power plant projects, including research questions, objectives, and limitations. It then establishes a conceptual framework grounded in Development Finance, Blended Finance, and Project Finance theories to emphasize the role of blended finance. The business issue analysis includes both internal and external assessments of PT SMI's capabilities, challenges, and market conditions. Data analysis involves a comparative evaluation of financial data under different financing structures, alongside qualitative insights from stakeholders to understand competitive advantages and funding characteristics. Based on these findings, the study proposes an ideal blended finance structure and improvements in partnership terms, followed by an implementation plan outlining actionable steps to apply the proposed solutions in real business settings.

This research utilizes both quantitative and qualitative data, obtained through primary and secondary sources. Primary data will be gathered through semi-structured interviews with key personnel at PT SMI to understand their perspectives on designing an effective blended finance structure. This method, based on predetermined questions with a flexible conversational approach, enables the exploration of relevant issues and the collection of in-depth, meaningful insights (Longhurst, 2009).

To ensure a comprehensive understanding of the research topic, this study adopts a purposive sampling approach by intentionally choosing participants with relevant expertise and professional experience in blended finance and renewable energy projects (Creswell, 2014). As a non-probability sampling method, purposive sampling enables the researcher to focus on individuals who can provide rich, detailed, and insightful information directly related to the research questions. By targeting participants with specialized knowledge, the study aims to capture in-depth perspectives that may not emerge through random sampling methods.

Table 2. Interviewee Participants

Interviewee	Role	Role and Expertise	Experience in Related sector
1	SVP Sustainable Financing Division	Credit Analysis, Strategic Marketing, Corporate Strategic Management, Risk Management, Sector Expertise.	25 Years
2	VP Sustainable Division	Credit Analysis, Sales and Marketing, Risk Management, Sector Expertise.	20 Years
3	VP Partnership Division	Maintain Relationship with Strategic Partners, negotiation and documentation role for Blended Finance instruments	15 Years

The secondary data in this study are sourced from both internal and external documents related to PT SMI to provide a comprehensive overview of potential business opportunities in financing mini-hydro power plant projects and to analyze the financial performance of these projects. This includes financial ratio data from project feasibility studies to assess bankability, as well as the terms and conditions of grant and credit enhancement facilities available through partnerships with multilateral institutions and philanthropic organizations. Key documents reviewed include the PT SMI company profile, annual reports, long-term corporate plan (*RJPP*), the 2021–2030 *RUPTL*, cooperation agreements with strategic partners, PT SMI's

renewable energy portfolio list, project feasibility study summaries, and national publications on Indonesia's Net Zero Emission goals.

The quantitative analysis in this study is based on data obtained from the feasibility studies or loan proposals of hydroelectric and mini-hydro power plant projects. It focuses on analyzing key financial ratios to evaluate the impact of blended finance on project feasibility and bankability. The primary ratio assessed is the Debt Service Coverage Ratio (DSCR), which measures a project's ability to meet its debt obligations using operating income. A scenario analysis will also be conducted to compare financial performance with and without the application of blended finance structures.

Formula:

$$\text{DSCR} = \frac{\text{Net Operating Income (NOI)}}{\text{Total Debt Service}}$$

The Debt Service Coverage Ratio (DSCR) is a key metric used to assess a project's financial health by measuring its ability to meet debt obligations. A DSCR greater than 1 indicates that the project generates sufficient income to cover debt payments, while a DSCR equal to 1 suggests income is just enough to meet those obligations. A DSCR below 1 signals that the project may face difficulties in repaying debt, potentially indicating financial distress.

The Internal Rate of Return (IRR) represents the discount rate that makes the Net Present Value (NPV) of all future cash flows from a project equal to zero. It reflects the expected annual return from the investment. A higher IRR indicates a more profitable project, and it is often used to evaluate the attractiveness of investment opportunities by comparing it with a required rate of return or cost of capital.

$$\$0 = \sum_{t=1}^{n} \frac{CF_t}{(1 + IRR)^t} - CF_0$$

$$\sum_{t=1}^{n} \frac{CF_t}{(1 + IRR)^t} = CF_0$$

When using the Internal Rate of Return (IRR) for decision-making, a project is considered acceptable if its IRR exceeds the cost of capital, indicating that it is expected to generate a return higher than the required rate. Conversely, if the IRR is below the cost of capital, the project should be rejected, as it would not provide sufficient returns to justify the investment.

Net Present Value (NPV) is calculated by subtracting the initial investment (CF_0) from the present value of expected future cash inflows (CF_t), discounted at the firm's cost of capital (r). A positive NPV indicates that the project is expected to add value to the firm and should be accepted, while a negative NPV suggests the project would result in a net loss and should be rejected.

$$\text{NPV} = \text{Present value of cash inflows} - \text{Initial investment}$$

$$\text{NPV} = \sum_{t=1}^{n} \frac{CF_t}{(1 + r)^t} - CF_0$$

Project Life Coverage Ratio (PLCR) measures the project's ability to cover its debt using the NPV of cash flows over its entire life. It is calculated by dividing the NPV of cash available

for debt service by the outstanding debt balance. A higher PLCR indicates stronger long-term debt repayment capacity.

$$PLCR = \frac{NPV(CFADS\ Over\ Project\ Life)}{Debt\ Service}$$

Weighted Average Cost of Capital (WACC) represents a firm's average cost of capital from all sources, weighted by their proportion in the capital structure. It reflects the minimum return a project must earn to satisfy investors and is calculated by combining the costs of debt and equity based on their respective weights (Frank & Shen, 2016; Gitman & Zutter, 2019; Ortiz, 2022; Vartiainen et al., 2020).

$$r_a = (w_i \times r_i) + (w_p \times r_p) + (w_s \times r_{r\ or\ n})$$

where

w_i = proportion of long-term debt in capital structure
w_p = proportion of preferred stock in capital structure
w_s = proportion of common stock equity in capital structure
$w_i + w_p + w_s = 1.0$

This study compares eight hydro power plant projects—three with blended finance and installed capacity under 10 MW, three without blended finance under 10 MW, and two without blended finance above 10 MW—to assess the impact of blended finance and project scale on financial feasibility. Scenario analysis is applied to simulate different financing conditions, including a base case (existing loan terms), Scenario A (replacing blended finance with debt), and Scenario B (introducing blended finance into conventional projects). Each scenario evaluates impacts on key financial metrics such as DSCR, PLCR, IRR, NPV, and WACC, incorporating terms from existing agreements (e.g., a 30% *capex* investment grant up to GBP 750,000).

Qualitative analysis is conducted to assess PT SMI's internal and external conditions in financing hydroelectric and mini-hydro power plant projects through PESTEL, SWOT, and TOWS analyses. By examining agreements with multilateral institutions and philanthropies, the study evaluates their willingness to provide grants and credit enhancement facilities. PESTEL analysis, in particular, helps understand the influence of six macro-environmental factors—political, economic, social, technological, environmental, and legal—on PT SMI's operations and strategic financing roles.

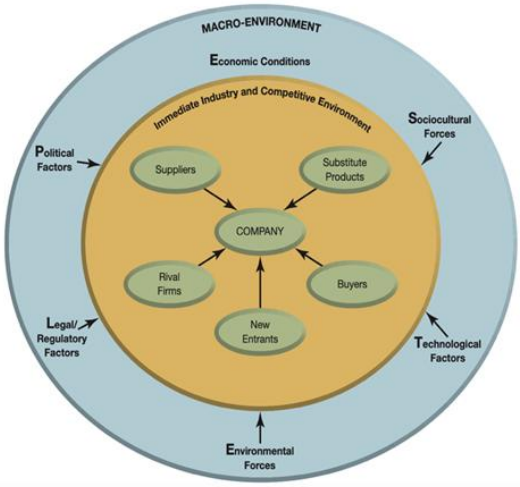


Figure 2. Macro-environmental factors

To ensure long-term sustainability and strategic positioning, a company must systematically analyze external macroeconomic factors, as their impact varies across industries. Identifying the most strategically relevant external factors—those that significantly influence a company's direction, objectives, strategy, and business model—is essential. In this study, PESTEL analysis is used to examine the external environment influencing PT SMI's role in renewable energy financing, with a focus on blended finance schemes for hydroelectric and mini-hydro power plant development.

In this study, SWOT analysis is applied to evaluate PT SMI's internal strengths and weaknesses as well as external opportunities and threats related to its role in financing renewable energy infrastructure, particularly through blended finance for hydroelectric and mini-hydro power plant projects. This analysis provides a foundation for aligning PT SMI's internal capabilities with external conditions to support effective strategic planning.

To build upon the SWOT findings, TOWS analysis is used to develop strategic recommendations by cross-referencing internal and external factors. The TOWS matrix generates four types of strategies: SO (leveraging strengths to seize opportunities), ST (using strengths to mitigate threats), WO (addressing weaknesses by capitalizing on opportunities), and WT (minimizing both weaknesses and threats). This approach enables PT SMI to formulate actionable strategies that enhance its capacity to structure and implement blended finance schemes for renewable energy development.

RESULT AND DISCUSSION

This chapter purpose is to uncover whether and how blended finance contributes to improved financial outcomes of the projects. In this chapter will presents the results of the qualitative analysis and case study scenario analysis. The analysis conducted to evaluate the financial feasibility of mini-hydro power plant projects in Indonesia, with a focus on the role of blended finance. By examining key financial metrics including DER, DSCR, IRR, NPV, PLCR and RoE.

Analysis

The PESTEL analysis highlights key external factors influencing PT SMI’s role in financing renewable energy projects. Politically, the government’s Net Zero Emission agenda

supports clean energy growth, though political shifts may disrupt continuity. Economically, high project risk, currency volatility, and limited local financing raise the need for concessional and blended finance. Socially, public support for clean energy is strong, yet local acceptance requires careful stakeholder engagement. Technologically, dependence on imported equipment poses supply chain risks, while national policies encourage local innovation. Environmentally, projects face ecological sensitivity and climate variability, demanding strict compliance with environmental regulations. Legally, rigid PPA terms, inconsistent regulations, and complex contract structures pose challenges, making legal certainty vital for investor confidence.

The SWOT analysis of PT SMI highlights its strong institutional position as a Special Mission Vehicle with close government ties, a clear mandate in sustainable infrastructure financing, and access to multilateral and philanthropic funding. Its strengths include a skilled technical team, flexible financing structures, and a strong market reputation. However, PT SMI faces internal weaknesses such as high funding costs, low product utilization, overlapping internal roles, lack of differentiated pricing for renewable projects, and limited borrower monitoring due to its non-bank status. Opportunities arise from Indonesia's National Strategic Projects, renewable energy growth driven by climate commitments, and limited commercial bank appetite for high-risk greenfield projects, positioning PT SMI as a key catalyst in infrastructure finance. Threats include stiff competition from commercial banks, reputational constraints from close government affiliation, pressure to fund higher-risk projects, strict donor compliance requirements, and inherent risks of long-term project finance, especially in greenfield and renewable sectors, which could affect portfolio quality if not managed well.

Table 3. Key points of PT SMI's SWOT analysis

Indicators	Remarks
Strength	• Close relationship with the Ministry of Finance, Bappenas, and other government institutions. (due to the role and purpose of the Company's establishment as a Special Mission Vehicle of the Ministry of Finance). • Holds mandate to advance sustainable projects (example: country platform manager for ETM, SIO, GREM). • Having good cooperation with many philanthropies and multilateral institution to tap grants and loan for renewable sector • Dedicated sectoral experts (DELST) dan sustainable financing team (DPB) to support sustainable development goals. • Have Environmental and Social Safeguard (ESS) and Corrective Action Plan (CAP) in every financed project to ensure the project does not cause negative impacts. • Project financing approach generate tailored financing structure such as flexibility in long-term loan tenor and grace period and availability period. • Has a variety of services and capabilities that can be bundled or cross-sell in the transaction. • Having a reputation as a "catalyst" in the market
Weakness	• PT SMI's cost of fund are not cheap. • Utilization of the Company's existing products is still low • Unclear roles in several division including duplication of roles. • Overlapping client coverage across several divisions. • There is no differentiation of value proposition for renewable energy vs conventional financing (e.g. cost of fund for renewable energy financing is mixed with conventional so there is no difference in pricing). • PT SMI are non-bank financial institution so PT SMI cannot monitor borrower bank account activity. • PT SMI are State-owned Enterprise and must be aware with state loss probability even from business activity loss.
Opportunity	• Potential growth from National Strategic Projects (PSN) and Public Private Partnerships (KPBU) can still be improved.

Indicators	Remarks
	• The potential for the development of renewable energy sector including from ETM program is large, driven by the commitment of the Government. • Implementation of impact monitoring for all projects in increasing the PT SMI credibility in facilitating multilateral and donor fundraising. • Competitor have limited appetite in financing of greenfield project.
Threat	• There are challenges to asset growth, including low share in key sectors. Because of competitor (mostly commercial banks) offered lower interest rate and faster processing time. • PT SMI close relationship to the Government can also be a weakness, because: - Customer perception of the PT SMI is limited to Government projects financing, State Owned Enterprise clients only, and support from the Regional Government (Pemda). - The Company is encouraged to take on projects that are less attractive and risky • Strict safeguard requirements hamper the distribution of multilateral and donor funds. • There still possibility that the project caused negative impacts because there were no consequences for ESS non-compliance. • Since PT SMI approaches in Project Finance, it cause higher inherent risks mostly embedded in construction risks.

The TOWS analysis builds on the SWOT findings by cross-referencing PT SMI's internal strengths and weaknesses with external opportunities and threats to develop four strategic response types: SO (maxi-maxi), ST (maxi-mini), WO (mini-maxi), and WT (mini-mini). This approach helps PT SMI leverage its institutional advantages while addressing organizational weaknesses and external challenges, guiding the company to improve its competitive position and effectiveness in renewable energy financing in Indonesia.

Table 4. SWOT Analysis

	Strength	**Weakness**
	SO Strategies	**WO Strategies**
Opportunity	• Leverage government relationships and sustainability mandates to actively facilitate financing in National Strategic Projects (PSN) and Public-Private Partnerships (KPBU). • Utilize PT SMI's sectoral experts and global cooperation (DELST, DPB, multilateral donors) to become the preferred channel for ETM, SIO, GREM. • Offer Cross-selling services and bundling product with technical assistance/grant from multilateral and donor (Blended Finance). • Strengthen reputation as a "catalyst" by offering a full-solution package: long-tenor loans, ESS advisory, and impact monitoring to secure new greenfield projects.	• Leverage good relationship with shareholder to get additional equity (PMN). By increasing equity, compounded cost of fund will decrease and increase competitiveness. • Enhance product utilization by aligning Product Bundling services with KPBU and ETM opportunities. • Create dedicated business development unit to match offerings to pipeline projects. • Redesign value proposition by separating cost-of-fund pricing logic between sustainable and conventional projects. • Implementing new mindset in internal stakeholders that sustainable project is market "green premium" and deserve value-added pricing. • Refocus internal structure or job descriptions to eliminate role duplication, enabling faster internal approval for donor-funded projects. • Collaborate with commercial banks and international Financial

	Strength	Weakness
		Institution in syndication financing, it can give enhancement in the transaction such as: - Risk sharing across syndication banks. - access for borrower transaction monitoring, using digital platforms to offset PT SMI's non-bank limitations.
Threat	**ST Strategies** • Proactively communicate the flexible, tailored project finance approach and PT SMI's unique long-term funding capabilities to counter competitors' lower interest rates. • Differentiate PT SMI's role in sustainable finance by highlighting ESS compliance and credible safeguards as competitive advantages in risk-prone sectors. • Rebrand public image by showcasing private-sector projects and successful collaborations with non-SOE entities to shift perception away from "government-only" focus. • Improve ESS enforcement and integrate corrective action triggers to avoid reputational risk and ensure compliance.	**WT Strategies** • Clarify division roles and coverage to ensure smoother execution, reducing project processing delays that worsen client dissatisfaction. • Limit exposure to unattractive projects by designing an internal project pipelines selection process that balances impact mandates and commercial viability. • Improve cost of funds through access to green bonds, concessional loans, and donor-backed capital pools to compete on pricing. • Strengthen project selection and implementation monitoring to mitigate construction risk exposure inherent in project finance. • Risk sharing by Collaborate with commercial banks and international Financial Institution in syndication financing scheme.

The TOWS matrix offers PT SMI a strategic framework to leverage its institutional strengths while addressing internal weaknesses and external threats. SO strategies focus on using its government mandate and partnerships to expand blended finance in renewable energy, while WO strategies aim to improve efficiency and competitiveness by refining internal processes. ST strategies help mitigate external risks by strengthening PT SMI's market identity and enforcing safeguards, and WT strategies promote internal reforms and innovative financing to manage risks. Together, these strategies align PT SMI's capabilities with external challenges, enhancing its role in Indonesia's sustainable infrastructure financing and boosting its impact in renewable energy through blended finance.

Eight existing PT SMI customer projects were selected for this case study, with available project information and financial data. Project names are withheld due to non-disclosure agreements.

Table 5. PT SMI customer projects

Project	Capacity (MW)	Capex	Equity	Debt	Blended Finance	Category
Project A	1.27	Rp24.8 bn	Rp4.9 bn	Rp16.2 bn	Yes	Mini-hydro
Project B	8	Rp18.2 bn	Rp5.2 bn	Rp10.0 bn	Yes	Mini-hydro
Project C	0.58	Rp169.7 bn	Rp33.5 bn	Rp125.7 bn	Yes	Mini-hydro
Project D	350	$839.7 mn	$157.0 mn	$682.7 mn	No	Hydro powerplant
Project E	10	Rp525.3 bn	Rp180.8 bn	Rp344.5 bn	No	Hydro powerplant
Project F	6	Rp163.8 bn	Rp32.8 bn	Rp131.0 bn	No	Mini-hydro

Project	Capacity (MW)	Capex	Equity	Debt	Blended Finance	Category
Project G	2	Rp95.3 bn	Rp23.8 bn	Rp71.4 bn	No	Mini-hydro
Project H	6	Rp235.9 bn	Rp80.7 bn	Rp155.2 bn	No	Mini-hydro

In its loan due diligence, PT SMI relies on customer-provided Feasibility Studies, typically prepared by independent consultants, covering technical, financial, legal, environmental, and management aspects. PT SMI adjusts financial assumptions from these studies based on its experience, emphasizing commonality, fairness, conservatism, and risk appetite. Key financial model assumptions include revenue cash flow, capacity factor, costs, equity and debt size, loan terms, interest rates, and repayment schedules. The analysis evaluates project feasibility using NPV, IRR, and WACC, and assesses bankability via PLCR and minimum DSCR, with the projects' financial performance under these assumptions forming the Base Scenario.

Table 6. Project Feasibility Analysis

Project	NPV	IRR	WACC	PLCR (x)	Min. DSCR (x)
Project A	Rp6.2 bn	13.6%	6.9%	1.90	1.40
Project B	Rp1.4 bn	9.1%	7.2%	1.88	1.29
Project C	Rp21.3 bn	10.2%	7.6%	1.44	1.05
Project D	$319.1 mn	10.0%	6.0%	1.99	1.10
Project E	Rp3.5 bn	7.9%	7.8%	1.51	1.24
Project F	Rp123.6 bn	13.4%	5.9%	2.47	1.27
Project G	Rp0.6 bn	9.6%	9.5%	1.25	1.12
Project H	Rp7.4 bn	9.1%	8.7%	1.60	1.13

This subchapter conducts scenario analysis by comparing two scenarios against the Base Scenario to assess the impact of investment grants on project financial projections. Scenario A applies to Projects A, B, and C, which currently use blended finance including investment grants; in this scenario, the grants are replaced with debt, assuming sponsors can provide self-financing, while all other assumptions remain the same. This simulates the projects' feasibility and bankability without blended finance support.

Table 7. Projects' Feasibility And Bankability

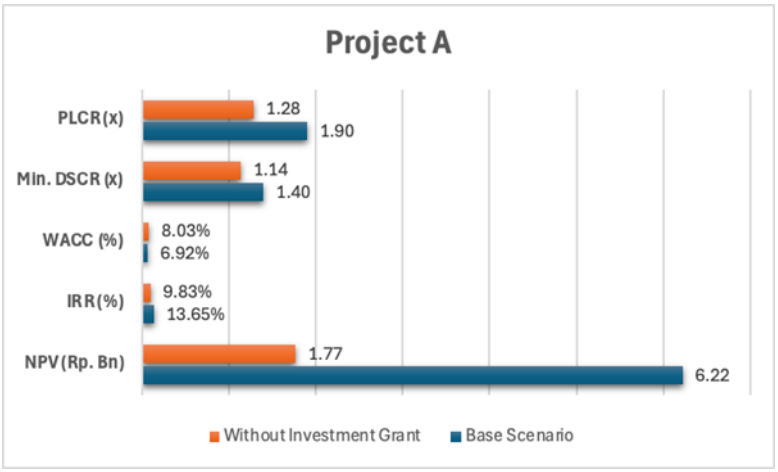
Assumptions	Equity (Rp. Bn)		Debt (Rp. Bn)		Grant (Rp. Bn)	
	Base Scenario	Scenario A	Base Scenario	Scenario A	Base Scenario	Scenario A
Project A	4.94	4.94	16.15	19.88	3.73	0.00
Project B	5.20	5.20	10.01	12.96	2.95	0.00
Project C	33.53	33.53	125.72	136.19	10.47	0.00

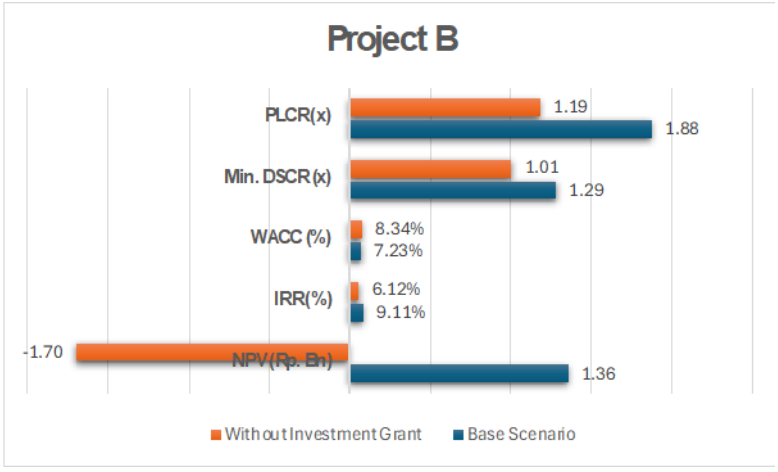
Scenario B applies blended finance with investment grants to all projects, reducing the debt portion while keeping other assumptions the same as the Base Scenario. This reflects best practices in loan negotiations, where lenders require significant equity from sponsors to demonstrate commitment, and lowering debt reduces repayment burdens. This scenario is applied to Projects D, E, F, G, and H to simulate the positive impact of enhanced blended finance on project bankability.

Table 8. Projects' Feasibility And Bankability

Assumptions	Equity (Rp. Bn)		Debt (Rp. Bn)		Grant (Rp. Bn)	
	Base Scenario	Scenario B	Base Scenario	Scenario B	Base Scenario	Scenario B
Project D	156.99	156.99	682.71	681.70	0.00	1.00
Project E	180.80	180.80	344.50	332.21	0.00	12.29
Project F	32.75	32.75	131.03	111.46	0.00	19.57
Project G	23.81	23.81	71.44	54.12	0.00	17.32
Project H	80.73	80.73	155.21	136.23	0.00	18.98

This section analyzes the impact of blended finance on the bankability of renewable energy projects by comparing three scenarios: the Base Scenario, Scenario A (excluding the investment grant and replacing it with debt), and Scenario B (including the investment grant). Scenario A highlights how removing the investment grant and increasing debt worsens project feasibility and risk, showing a consistent decline in financial performance for hydroelectric and mini-hydro projects, demonstrating the critical role of grants in improving project attractiveness to lenders.





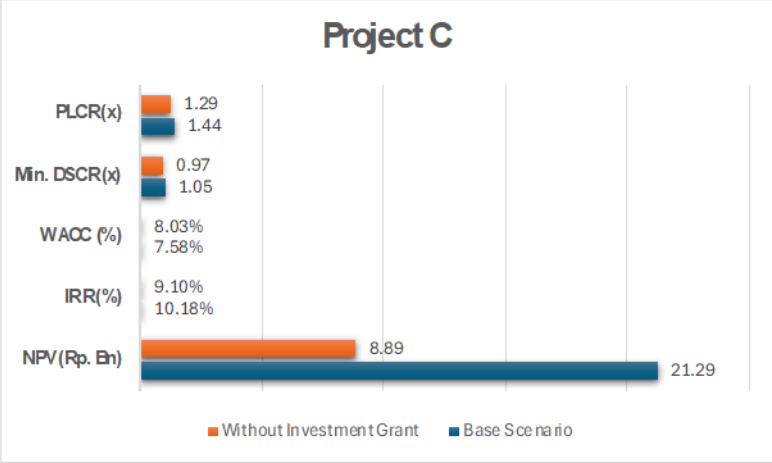
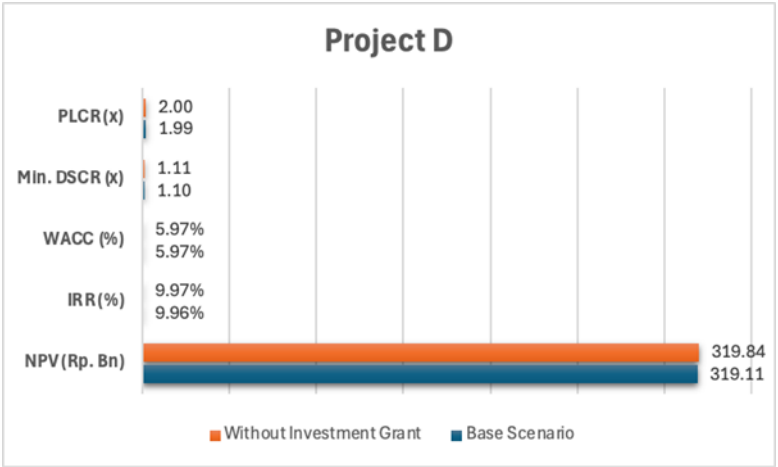
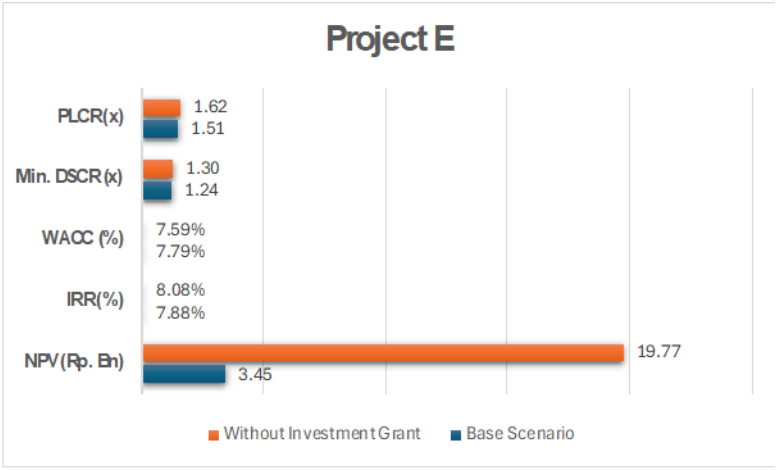


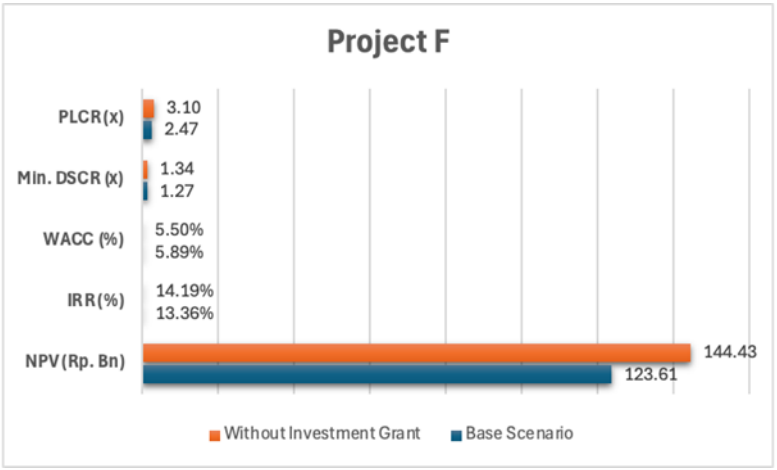
Figure 3. Projects' Analysis

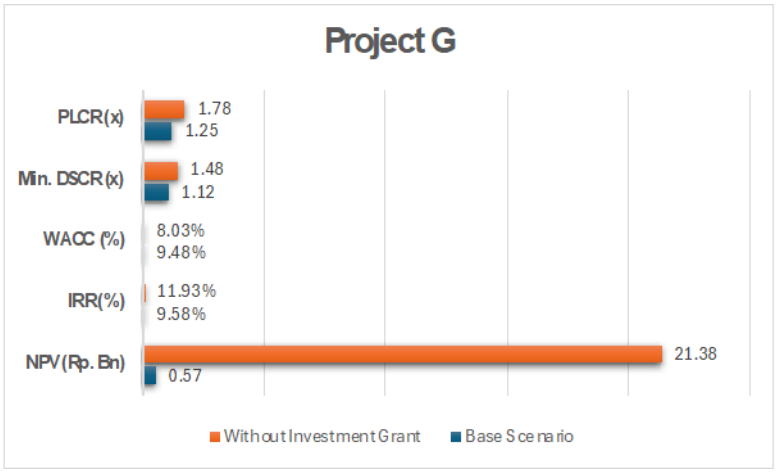
In Project A, removing the investment grant causes a 72% drop in NPV and a 16% rise in WACC, making the project less feasible despite maintaining a DSCR above 1.00x. Project B's IRR falls below WACC, resulting in a negative NPV and significantly lower DSCR and PLCR, indicating financial infeasibility and increased credit risk. In Project C, the DSCR falls below 1.00x, with declines in NPV, IRR, and WACC, signaling reduced feasibility and investor interest. Overall, removing the investment grant decreases financial feasibility and bankability, weakens debt service capacity, raises credit risk, and lowers investor appetite, underscoring the grant's critical role in blended finance for renewable energy projects.

Scenario B models the positive effects of implementing an investment grant covering up to 30% of capital expenditure (capped at GBP 750,000) across all projects. This scenario aims to demonstrate how the grant improves financial feasibility and bankability, enhancing project attractiveness and supporting private capital investment in high-risk renewable energy developments. The results indicate varying levels of impact across the portfolio:




Project E
PLCR(x)
1.62
1.51
Min. DSCR(x)
1.30
1.24
WACC (%)
7.59%
7.79%
IRR(%)
8.08%
7.88%
NPV(Rp. Bn)
19.77
3.45
Without Investment Grant
Base Scenario


Project F
PLCR(x)
3.10
2.47
Min. DSCR(x)
1.34
1.27
WACC (%)
5.50%
5.89%
IRR(%)
14.19%
13.36%
NPV(Rp. Bn)
144.43
123.61
Without Investment Grant
Base Scenario


Project G
PLCR(x)
1.78
1.25
Min. DSCR(x)
1.48
1.12
WACC (%)
8.03%
9.48%
IRR(%)
11.93%
9.58%
NPV(Rp. Bn)
21.38
0.57
Without Investment Grant
Base Scenario

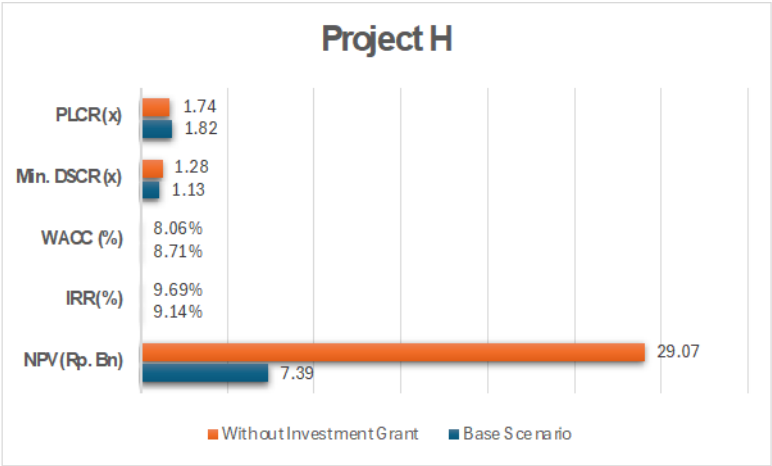


Figure 4. Projects' Analysis

In Project D, the investment grant had minimal impact on financial metrics due to the relatively large project size compared to the capped grant amount, limiting its effectiveness in improving profitability or debt service capacity. In contrast, Projects E, F, G, and H experienced substantial improvements in financial performance following the grant implementation, with NPV increasing by 293% to 473% and DSCR improving by 5% to 32%, demonstrating enhanced feasibility and bankability, especially in mini-hydro power plant developments. Scenario B thus confirms that investment grants are effective in improving financial viability, particularly when the grant represents a significant share of total capital expenditure. The improvements are evident in higher NPV and IRR, lower WACC, better DSCR and PLCR, and reduced debt exposure, collectively making projects more attractive to investors and lenders. However, the differing results in Project D emphasize that the effectiveness of blended finance is contingent upon project-specific factors such as scale, capital needs, and financial structure, underlining the need to tailor grant allocations to optimize their catalytic role in project development.

The scenario analysis confirms the catalytic role of blended finance, particularly investment grants, in enhancing the financial feasibility and bankability of renewable energy projects like mini-hydro developments. First, blended finance significantly boosts financial viability by increasing profitability indicators (NPV and IRR) and reducing financing costs (WACC), thus improving project returns relative to capital costs. Second, projects in Scenario A, which excluded investment grants, generally exhibited weakened financial performance and often fell below bankability thresholds, especially in cases with marginal returns or limited equity capacity—highlighting the essential role of blended finance in bridging financing gaps and improving risk-return profiles. Third, investment grants function as equity-like capital by reducing debt portions, lowering the cost of capital, and improving DSCR and PLCR, thereby enhancing cash flow resilience and appeal to commercial lenders and institutional investors. Finally, the analysis reveals that the effectiveness of blended finance is project-specific; its impact varies based on factors such as project size, capital intensity, and baseline financial structure, underscoring the importance of tailored financing structures to fully leverage the catalytic potential of blended finance.

The implementation of blended finance instruments at PT SMI is initiated by the Business Unit, which engages with project owners and structures the financing scheme, while

the approval process is handled by the Partnership Division, which submits proposals to donors or multilateral institutions along with required documentation. Interviews with key personnel from the Partnership Division reveal that donors evaluate proposals based on project size, environmental and social impact, sponsor credibility, and alignment with thematic sectors. However, key challenges include the lengthy approval process—typically 4 to 6 months, which often exceeds PT SMI's internal loan offer timelines of 2 to 3 months, potentially reducing competitiveness—and limitations in donor appetite, as grant amounts are often capped, making them more impactful for small-scale projects but insufficient for large-scale developments.

This subchapter presents qualitative insights from semi-structured interviews with key personnel from PT SMI's Sustainable Financing and Partnership Divisions, aimed at complementing the quantitative analysis and addressing the research questions from institutional and operational perspectives (Braun & Clarke, 2021). Using thematic analysis and coding via Atlas.ti, recurring patterns were identified and grouped into potential themes. The top five dominant themes emerging from the interviews reflect key insights related to the implementation and impact of blended finance in mini-hydro power plant financing.

Table 9. Themes Analysis

No	Themes	Description	Counter
1	Cost Reduction & Financial Instruments	Blended finance instruments like grants and concessional loans are essential for lowering capital costs and making mini-hydro projects financially feasible	27
2	Technical Assistance & Capacity	Technical assistance helps developers prepare bankable projects by improving feasibility studies, safeguards, and project readiness.	22
3	Donor Engagement & Structural Alignment	Misalignment between donor requirements and local project realities limits the effectiveness of blended finance implementation.	16
4	Financing Barriers & Bank Perception	Mini-hydro projects are often viewed by banks as high-risk due to regulatory uncertainty and weak financial profiles.	9
5	Sponsor Capability & Equity Gaps	Many developers lack the equity and credibility needed to secure financing, posing a challenge for project bankability.	6

The results highlight that improving the bankability of mini-hydro projects relies on reducing financial barriers and enhancing project readiness. Key themes such as cost reduction through financial instruments (e.g., investment grants, guarantees, interest subsidies) and technical assistance underscore the importance of both financial and non-financial support. However, misalignment between donor requirements and local project conditions, coupled with bank hesitancy and limited sponsor capacity, often hinders funding. These findings suggest that effective blended finance requires a combination of financial support, institutional coordination, capacity-building, and greater donor flexibility.

Business Solution

Based on the analysis, to enhance PT SMI's role in implementing blended finance schemes and accelerating renewable energy projects, the proposed solution is to develop a standardized blended finance structure through bundled financial products. This structure

would ideally integrate investment grants, concessional loans, and technical assistance into a single financing package, enabling more efficient project execution, reducing transaction time, and aligning better with both donor expectations and project needs.

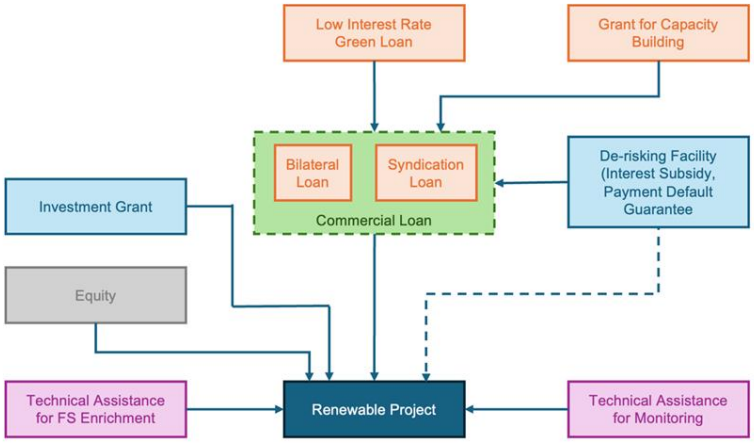


Figure 5. Business Solution Structure

In the proposed structure, blended finance instruments are categorized into three layers: the first layer includes grant facilities that directly impact technical aspects at the project level, such as technical assistance for feasibility study (FS) enrichment and operational monitoring; the second layer consists of instruments that enhance project financial performance, including investment grants to reduce capital costs and guarantees to mitigate payment default risks, thereby improving bankability and lender appetite; and the third layer includes facilities provided to PT SMI itself, such as low-interest green loans and capacity-building grants, which indirectly support project feasibility by enabling PT SMI to offer more competitive financing. To maximize impact and ensure loan uptake, the first and second layers should be bundled into a structured finance product, aligning donor funding with commercial financing to improve competitiveness and customer loyalty. However, successful implementation requires resolving challenges related to grant amount limitations and lengthy approval processes, which can be addressed through renegotiating grant ceilings with donors, proposing collaborative project approvals with aligned criteria, focusing on impactful instruments through strategic partnerships, and deepening relationships with commercial banks to expand PT SMI's role beyond a lender to a blended finance enabler, particularly in large-scale hydroelectric project syndications.

Implementation Plan & Justification

This study presents an implementation plan to translate strategic recommendations into actionable steps, focusing on renegotiating donor terms and developing a structured bundling product. The plan aligns internal readiness, stakeholder engagement, and market execution, with activities sequenced based on practical dependencies—particularly the importance of donor negotiations. Each step is justified by strategic, operational, and financial considerations to ensure feasibility and impact in expanding PT SMI’s market presence in hydro and mini-hydro projects. Key Performance Indicators (KPIs) are included to ensure accountability and track progress effectively.

Table 10. Implementation Plan

Activities	Month I	Month II	Month III	Month IV	Month V	Month VI	Deliverable
Internal Preparation	✓	✓					Negotiation Proposal
Negotiation with Donor/Multilateral		✓	✓	✓			Amended Agreement
Manual Product Updating			✓	✓			Manual Product
Product Socialization					✓	✓	Standardize Bundling Product
Deploy Marketing Programs						✓	New Customer

The implementation plan begins with Internal Preparation, aligning key units (Business Unit, Integrated Risk Management, and Partnership Division) to draft a strong negotiation proposal based on market needs and product gaps. Next, Negotiation with Strategic Partners focuses on engaging donors or multilateral institutions offering impactful financial instruments, using ZOPA and BATNA strategies to secure agreement—a critical milestone for success. Once agreed, Manual Product Updating revises internal procedures to reflect the new terms. Then, Product Socialization ensures institutional readiness through workshops and training. Finally, Deploy Marketing Programs promotes the bundling product to clients, aiming to expand PT SMI's renewable energy portfolio.

To ensure effective and accountable execution, a performance measurement framework using Key Performance Indicators (KPIs) is established to track progress across all stages of the implementation plan. These KPIs help monitor operational efficiency, evaluate strategic milestones, and identify potential risks early, enabling evidence-based decision-making. They also promote transparency, responsiveness, and continuous improvement as PT SMI strengthens its role in renewable energy financing.

Table 11. Key Performance Indicators (KPIs) Analysis

Activity	KPI	KPI Type
Internal Preparation	- Completion of internal readiness checklist (%) - Management approval - Negotiation Proposal	Milestone / Output
Negotiation with Donor/Multilateral	- Number of donor meetings held - Time to reach agreement (days) - Amended agreement signed (Yes/No)	Milestone / Output
Manual Product Updating	- % Completion of updated product documentation - SLA (days)	Process / Quality
Product Socialization	- Number of internal socialization sessions conducted - % of targeted divisions trained	Awareness / Adoption
Deploy Marketing Programs	- Number of campaigns launched - Number of prospects reached - Number of new customers acquired	Output / Impact

CONCLUSION

This study evaluates the role of blended finance in improving the financial feasibility and bankability of hydroelectric and mini-hydro power plant projects in Indonesia, with PT

Sarana Multi Infrastruktur (*Persero*) (PT SMI) as a case study. Using a mixed-methods approach—combining quantitative scenario analysis and qualitative interviews—the research finds that instruments such as investment grants, interest subsidies, and guarantees enhance key financial metrics (NPV, IRR, DSCR, PLCR) and reduce WACC, particularly for small-scale projects under 10 MW. Challenges identified include limited sponsor equity, tariff uncertainty, and underutilization of donor instruments, with the catalytic impact of blended finance most evident in smaller projects where grants represent a significant share of capital. To improve effectiveness, the study recommends that PT SMI renegotiate grant limits with donors, streamline approval mechanisms, prioritize impactful instruments, and deepen partnerships with commercial banks to expand blended finance applications, including for large-scale hydro projects. These strategies support PT SMI's transformation into a development finance institution (DFI), aligned with its long-term corporate plan (*RJPP-P*), and contribute to Indonesia's energy transition and climate goals.

REFERENCES

Braun, V., & Clarke, V. (2021). *Thematic analysis: A practical guide*. SAGE Publications Ltd.

Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches* (4th ed.). SAGE Publications, Inc.

ESDM. (2024). *Capaian kinerja semester I tahun 2024 Kementerian ESDM*. Kementerian Energi dan Sumber Daya Mineral.

Frank, M. Z., & Shen, T. (2016). Investment and the weighted average cost of capital. *Journal of Financial Economics, 119*(2), 300–315. https://doi.org/10.1016/j.jfineco.2015.09.001

Gitman, L. J., & Zutter, C. J. (2019). *Principles of managerial finance* (14th ed.). Pearson Education Limited.

Harto Jawadz, U. R., Prasetijo, H., & Purnomo, W. H. (2019). Studi potensi pembangkit listrik tenaga mikro hidro (PLTMH) di aliran sungai Desa Kejawar Banyumas. *Dinamika Rekayasa, 15*(1), 36–44. https://doi.org/10.20884/1.dr.2019.15.1.245

Kaonang, G. (2024, February). Mengenal perbedaan pembangkit listrik tenaga air PLTA, PLTM, dan PLTMH. *Solum.id*. https://solum.id/glosarium/mengenal-perbedaan-pembangkit-listrik-tenaga-air-plta-pltm-dan-pltmh/

Longhurst, R. (2009). Interviews: In-depth, semi-structured. In R. Kitchin & N. Thrift (Eds.), *International encyclopedia of human geography* (pp. 580–584). Elsevier Inc. https://doi.org/10.1016/B978-008044910-4.00366-8

OECD. (2018). *Making blended finance work for the Sustainable Development Goals*. OECD Publishing. https://doi.org/10.1787/9789264288768-en

OECD. (2019). *Blended finance evaluation: Governance and methodological challenges*. OECD Publishing. https://doi.org/10.1787/6c521604-en

Ortiz, H. (2022). Political imaginaries of the weighted average cost of capital: A conceptual analysis. *Valuation Studies, 8*(2), 5–36. https://doi.org/10.3384/vs.2001-5992.2021.8.2.5-36

Reza, M., Irham, I., Wahab, B. A., Jaya, Z., & Simamora, M. M. (2023). Manajemen risiko K3 konstruksi pada proyek PLTA Peusangan Kabupaten Aceh Tengah. *Portal: Jurnal Teknik Sipil, 15*(1), 12–20. https://doi.org/10.30811/portal.v15i1.3965

Rinaldi, A., & Mulyono, J. (2021). Peluang pembangkit listrik tenaga surya (PLTS) pada genangan waduk. *Jurnal Infrastruktur Kementerian PUPR, 7*(1), 45–53.

Rosytha, A., & Suryana, W. M. (2023). Peran unit pengelola bendungan dalam pengelolaan bendungan berkelanjutan di Satker OP BBWS Brantas (Studi kasus UPB Bendungan Babjulmati dan Bendungan Nipah). *Publikasi Riset Orientasi Teknik Sipil (Proteksi), 5*(1), 44–50. https://doi.org/10.26740/proteksi.v5n1.p44-50

RUPTL. (2021). *Rencana usaha penyediaan tenaga listrik 2021–2030*. PT Perusahaan Listrik Negara (Persero).

Sarwono, E., Karsa, H. E., Julianto, E., & Gunarto, G. (2018). Perencanaan daya mampu pembangkit listrik tenaga air di PLTMH Desa Karang Dangin Kabupaten Ketapang. *Suara Teknik: Jurnal Ilmiah, 9*(2), 123–130. https://doi.org/10.29406/stek.v9i2.1536

Vartiainen, E., Masson, G., Breyer, C., Moser, D., & Román Medina, E. (2020). Impact of weighted average cost of capital, capital expenditure, and other parameters on future utility-scale PV levelised cost of electricity. *Progress in Photovoltaics: Research and Applications, 28*(6), 439–453. https://doi.org/10.1002/pip.3189