Ministry of National Development Planning/Bappenas
Republic of Indonesia

ENERGY TRANSITION PARTNERSHIP
Powering Prosperity and Enabling Sustainability in South East Asia

SOLAR PV MAPPING AND DEVELOPMENT PLAN (INDONESIA)

REVIEW AND RECOMMEND SOLUTIONS OF THE IMPEDIMENTS OF SOLAR PV DEVELOPMENT

Prepared by : Consortium lead by Trama TecnoAmbiental

tta · SOLARGIS · ERM · QUADRAN SOLUSI ENGINEERING · INOVASI DINAMIKA PRATAMA

JULY 2025

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Challenges of Solar PV Development in the JAMALI Region, Indonesia

July 2025
Prepared by:

Consortium lead by Trama TecnoAmbiental S.L.

Agenda

- Introduction
- Procurement of Solar PV Development
- Financial Feasibility Analysis
- Power Purchase Agreement (PPA)
- Case Studies
- Environmental and Social

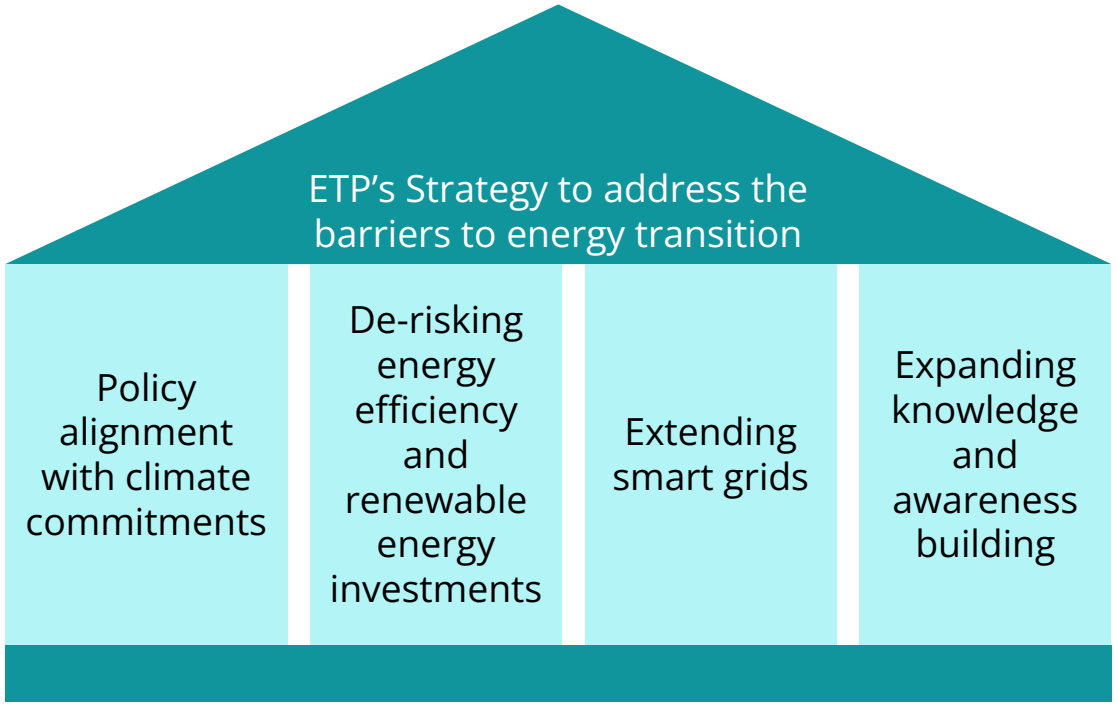
Introduction

BACKGROUND

The Southeast Asia Energy Transition Partnership brings together governments and philanthropies to work with partner countries in the region. ETP supports the transition towards modern energy systems that can simultaneously ensure economic growth, energy security, and environmental sustainability.

ETP priority countries:

- **Indonesia**
- **The Philippines**
- **Vietnam**



For this project, **ETP is working with the Ministry of National Development Planning (BAPPENAS) to support Indonesia's renewable energy transition planning**.

Project Objectives:

- Strengthen the enabling environment for renewable energy (RE) policies
- Increase the flow of public and private investments to RE projects
- Improve the development and accessibility of RE knowledge

About the Reports

Background

13.09 % Renewable Energy share in the energy mix in 2023 (MEMR, 2023)

20.9 GW Target for Renewable Energy Installed Capacity by 2030 in RUPTL 2021-2030

US $8 B Annual investment in RE required (IISD, 2022)

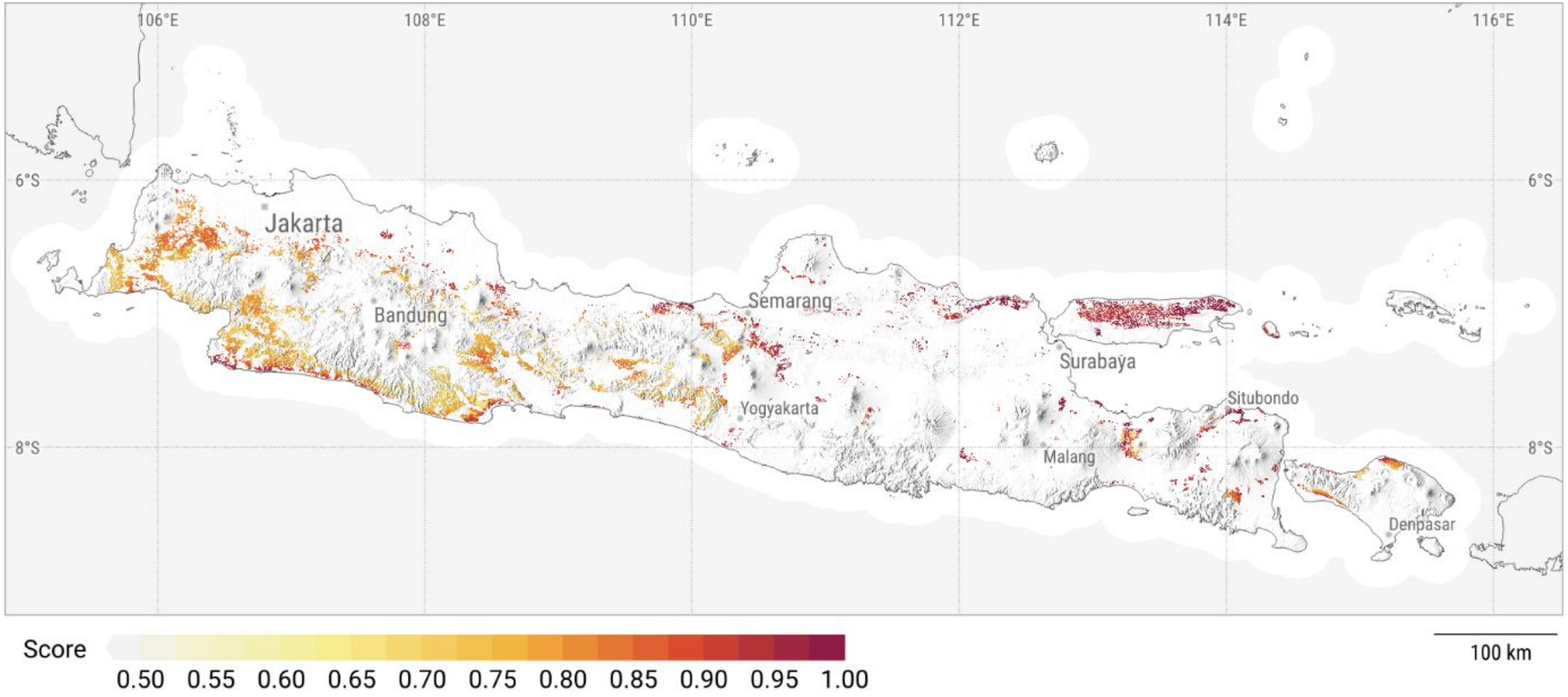
This project aims to increase the use of solar photovoltaic (PV) technology in Indonesia to reduce emissions and meet the country's goal of achieving net-zero emissions in the power sector by 2050.

Report series:

1. **Report 1**: Solar PV Procurement in Indonesia in JAMALI Region
2. **Report 2:** Financial feasibility of solar PV development in Indonesia in JAMALI Region
3. **Report 3:** Analysis of Power Purchase Agreement ("PPA") Terms for Solar PV Development in the JAMALI Region, Indonesia
4. **Report 4:** Environmental and Social ("E&S") Risks of Solar PV Development in Indonesia in JAMALI Region

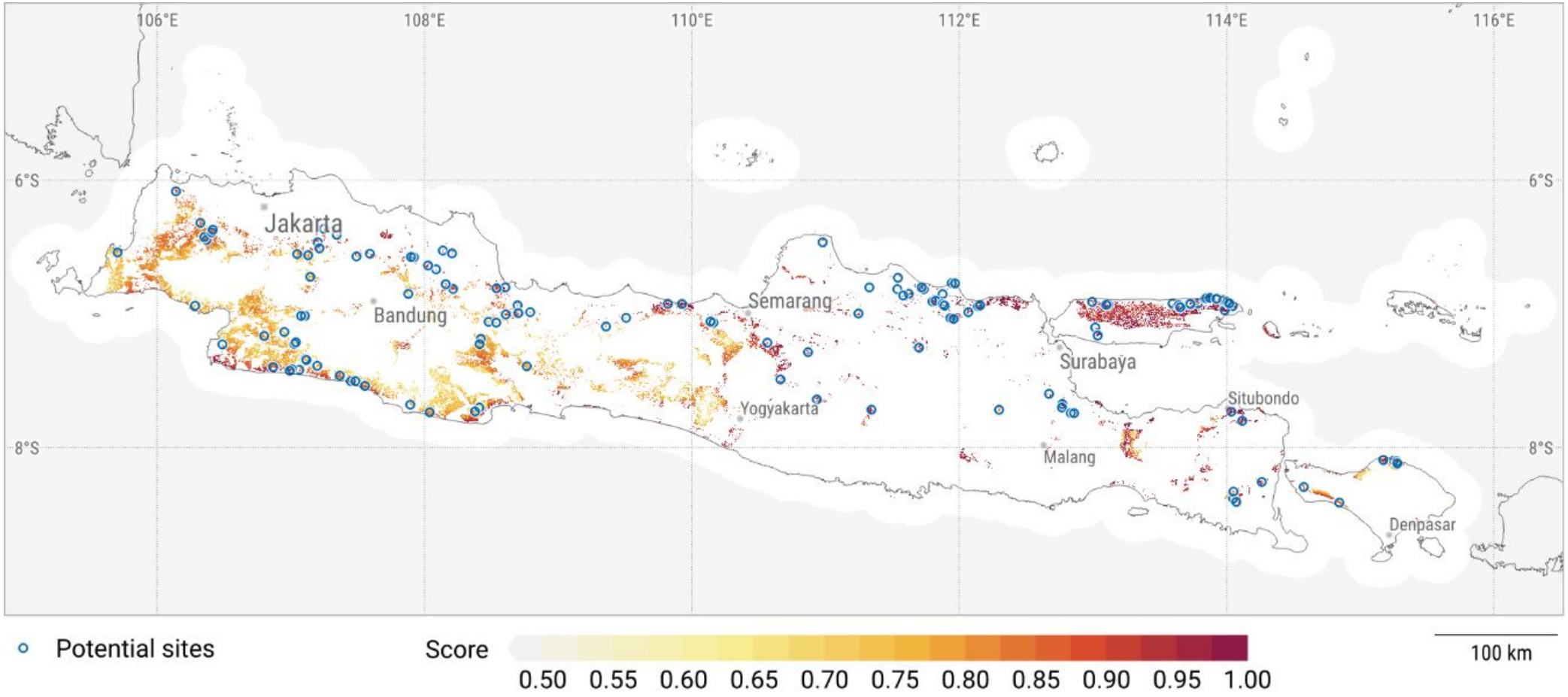
Phase 1: Solar Irradiance Mapping Result

Geospatial analysis result, the composite of binary and range layers



Phase 1: Solar Irradiance Mapping Result

140 Pre-selected Sites



Calculated score for the classified areas and 140 pre-selected potential locations for utility-scale PV development. Higher scores present more favorable areas

Phase 1: Solar Irradiance Mapping Result

GEOSPATIAL ANALYSIS

- 140 sites

E&S ANALYSIS

- 137 sites qualified
- 41 high-risk
- 96 medium risk
- 3 excluded

PRE-GRID ASSESSMENT

- Maximum Hosting Capacity for relevant substations
- Potential Solar PV Capacity

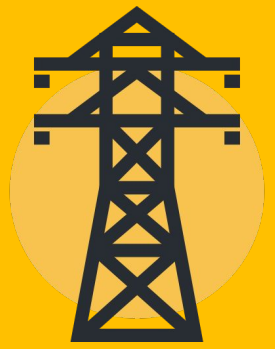
SITE PRIORITIZATION

- Final list of sites: 137 sites with 11.2 GW capacity

Potential Capacity Calculation :

Land Availability

+



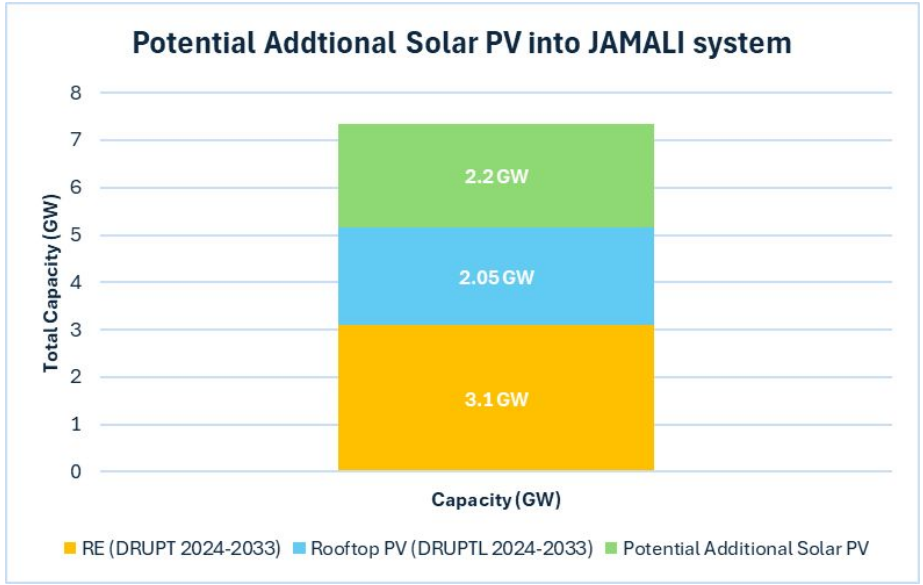
Maximum hosting capacity per substation

→ **Potential capacity**

Phase 2: Maximum Hosting Capacity

The key insights of the report are:

1. The JAMALI grid can absorb up to **2.2 GW** of Solar PV by 2030, on top of the **3.1 GW** Renewable Energy Plan in the PLN Electricity Plan (2024).
2. **25 sites** have been selected from the Phase 1 site list, with each province assigned a site. These sites are technically viable and will be re-evaluated during the financial analysis stage.
3. In the business-as-usual scenario, adding **2.2 GW of Solar PV increases the system's LCOE** due to the replacement of coal, the cheapest option when excluding social and environmental costs and carbon tax.
4. To further balance the cost increases associated with PV integration, implementing a carbon tax could be a strategic option to disincentivize fossil fuels or Carbon Credits or Renewable Energy Certificate to incentivize RE.
5. Optimal integration of **1.66 GW PV** can replace more expensive gas generation, helping **reduce overall system costs**. However, coal power production will not be replaced with Solar PV.
6. Aligning with the government's coal reduction plan, Solar PV will lower system costs by replacing gas, especially as coal is phased down.

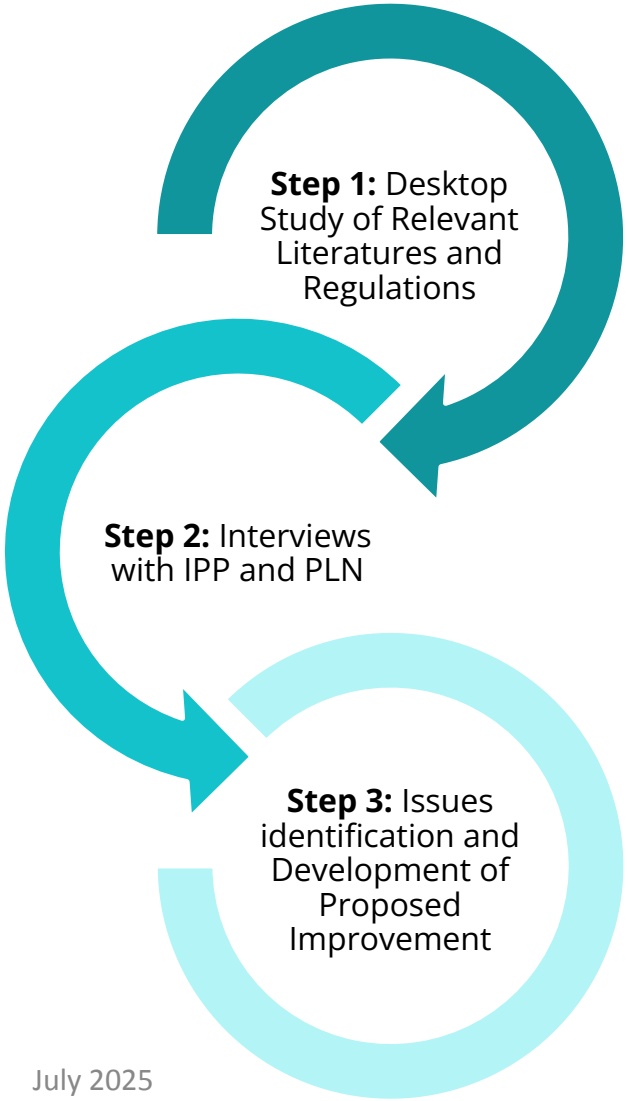


Additionally, Phase 1- Solar Irradiance Mapping report assessment identified the maximum hosting capacity for each substation to which the proposed solar PV systems (across 137 sites) can be connected. This analysis establishes the maximum solar PV capacity that can be integrated into the nearest substation, encompassing [illegible] substations assessed. It ensures the substation can accommodate the additional generation without exceeding operational limits.

Phase 3: Challenges of Solar PV Development in the JAMALI Region, Indonesia

Methodology

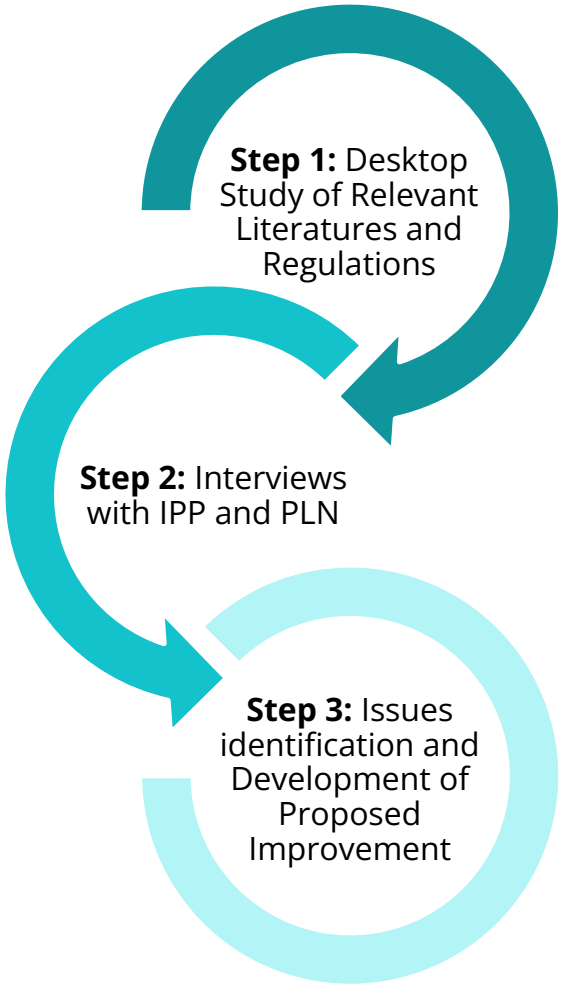
Methodology



List of Evaluated Regulations:

No	Regulation/Framework	Remarks	Issues		
			Procurement	Financial	PPA/Bankability
1	Law No. 30 of 2009 on electricity	Regulates various aspects related to electricity in Indonesia	✔		✔
2	Law No.2 of 2012 on Land Acquisition for Public Infrastructure and Presidential Regulation 04/2016	Stipulate the legal framework for land acquisition for electricity infrastructure projects.	✔		
3	Law No. 7 of 2021	This law regulates the Harmonisation of Tax Regulations		✔	
4	Government Regulation No.23 of 2021 and MoEF Regulation No.7 of 2021	The Government Regulation regulates forestry planning, changes in the allocation, function, and the use of forest areas, while the MoEF regulation provides more detailed guidance on the procedures and requirements.	✔		
5	Presidential Regulation No. 14 of 2017	This regulation stipulates that in cooperation projects between PLN and IPPs, PLN must have a minimum of 51% of shares in the project	✔		
6	Presidential Regulation No. 98 of 2021	The regulation concerning the Implementation of Carbon Economic Value for the Achievement of Nationally Determined Contribution Targets and Control of Greenhouse Gas Emissions in National Development		✔	
7	Presidential Regulation No. 112 of 2022	The latest regulation concerning the acceleration of renewable energy development for the provision of electricity	✔	✔	✔

Methodology

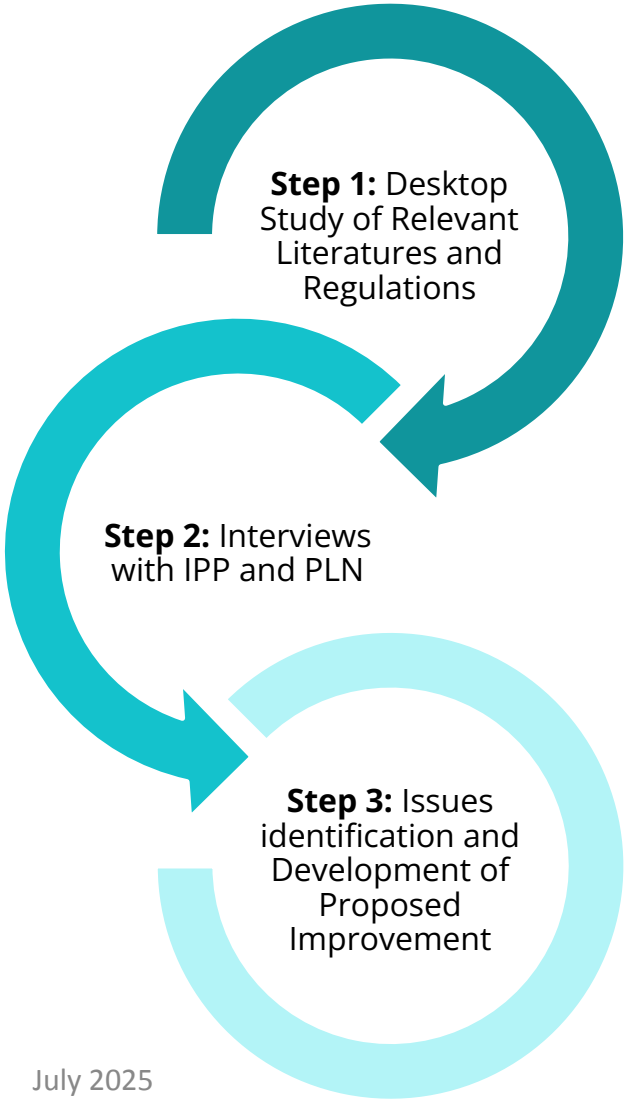


July 2025

List of Evaluated Regulations:

No	Regulation/Framework	Remarks	Issues		
			Procurement	Financial	PPA/Bankability
8	MEMR Regulation No.10 of 2017 (as amended by MEMR Regulation No.49 of 2017 and No.10 of 2018)	Outlines the terms and conditions for PPAs			✔
9	MEMR regulation No.50 of 2017 (amended by MEMR regulations No.53 of 2018 and No. 4 of 2020)	Focuses on the utilisation of renewable energy resources for electricity production, including solar PV	✔		✔
10	MEMR Regulation No. 2 of 2024 (amendment to MEMR Regulation No. 26 of 2021)	The regulation encourages solar rooftop deployment to accelerate the achievement energy mix target	✔		
11	MEMR Regulation No. 5 of 2025	Replaces the PPA provisions under MEMR Regulation No. 10 of 2017 (and its amendments) and establishes comprehensive guidelines for PPAs with renewable energy power plants.			✔
12	MoHA Regulation No. 7 of 2024	This regulation outlines the rent charged for regional government properties, which includes the base rent tariff and the rent adjustment factor.	✔		
13	MoF Regulation No. 68 of 2024	This regulation strengthens government support for the provision of infrastructure, which brings significant updates to support PPP infrastructure projects.		✔	
14	Ministry of Finance Regulation (PMK) No.5 of 2025	The regulation outlines the procedures for providing government guarantees and risk management to accelerate the development of renewable energy for electricity supply. This regulation includes guidelines for government guarantees against payment defaults by PT PLN (Persero) in renewable energy projects.	✔	✔	✔

Methodology



List of Evaluated Regulations:

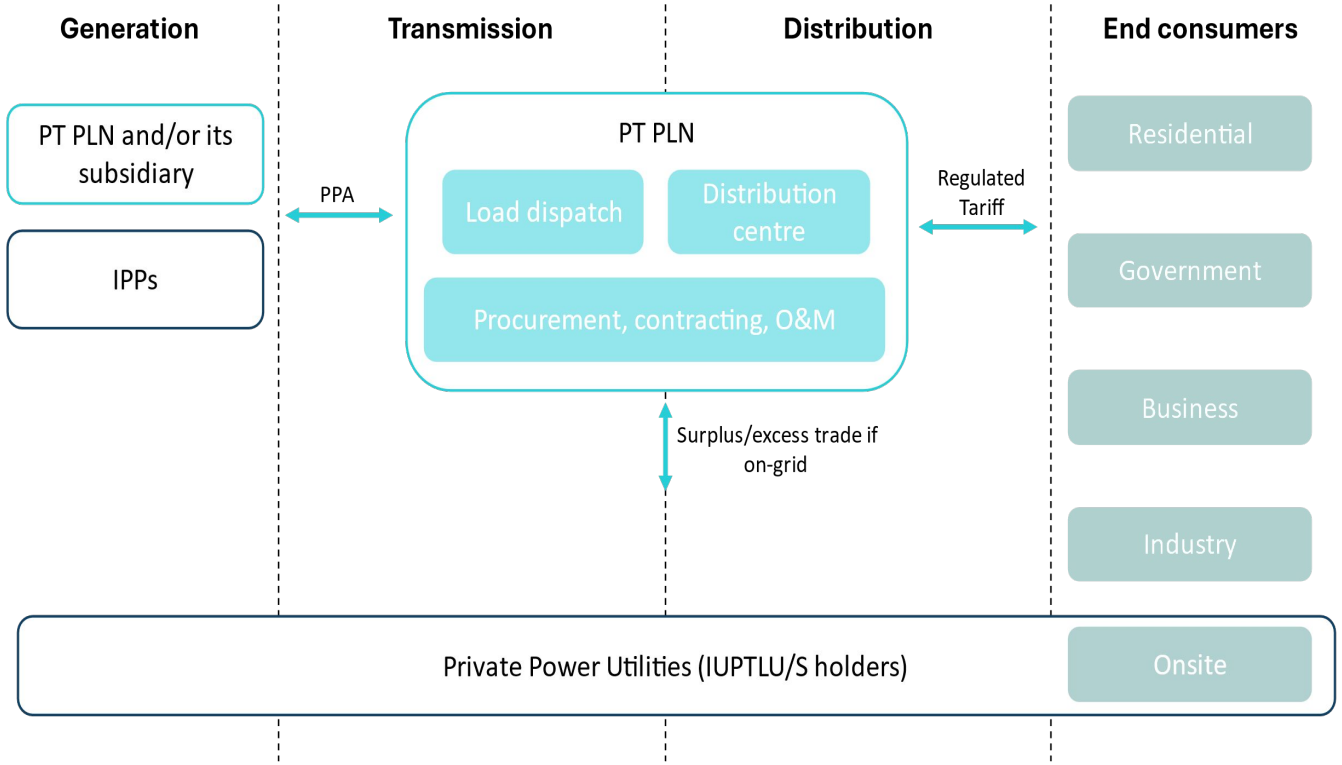
No	Regulation/Framework	Remarks	Issues		
			Procurement	Financial	PPA/Bankability
15	PLN Director's Regulation No.22 of 2020 on guidelines for procurement of goods/services	This regulation provides comprehensive guidelines for the procurement of goods and services by PT PLN (Persero) including procedures for competitive bidding, direct appointment, and direct procurement.	✔		✔
16	PLN Director's Regulation No.62 of 2020 on Purchase of Electric Power from New And Renewable Energy Power Plant	establishes the framework for purchasing electricity from new and renewable energy power plants. This regulation includes the terms and conditions for PPAs between PLN and IPPs. It specifies the pricing mechanisms, contract duration, and technical requirements for renewable energy projects. The regulation also includes the PLN's procurement process.	✔		✔
17	Energy Law 30/2007; Government Regulation (PP) 78 of 2019; Minister of Finance Regulation (PMK) 130 of 2020; 11 of 2020; PMK 21 of 2010; PMK 176 of 2009 as amended by PMK 188 of 2015 and PMK 76 of 2012	Provision of tax facilities to individuals and companies involved in RE investment: • Income tax deduction, • Investment tax deduction, • Accelerated depreciation, and amortisation, • Import duty exemption, • VAT exemption on imported goods, and • Tax holiday.	✔		

Procurement of Solar PV Development

Landscape of the Current Solar PV Development Procurement

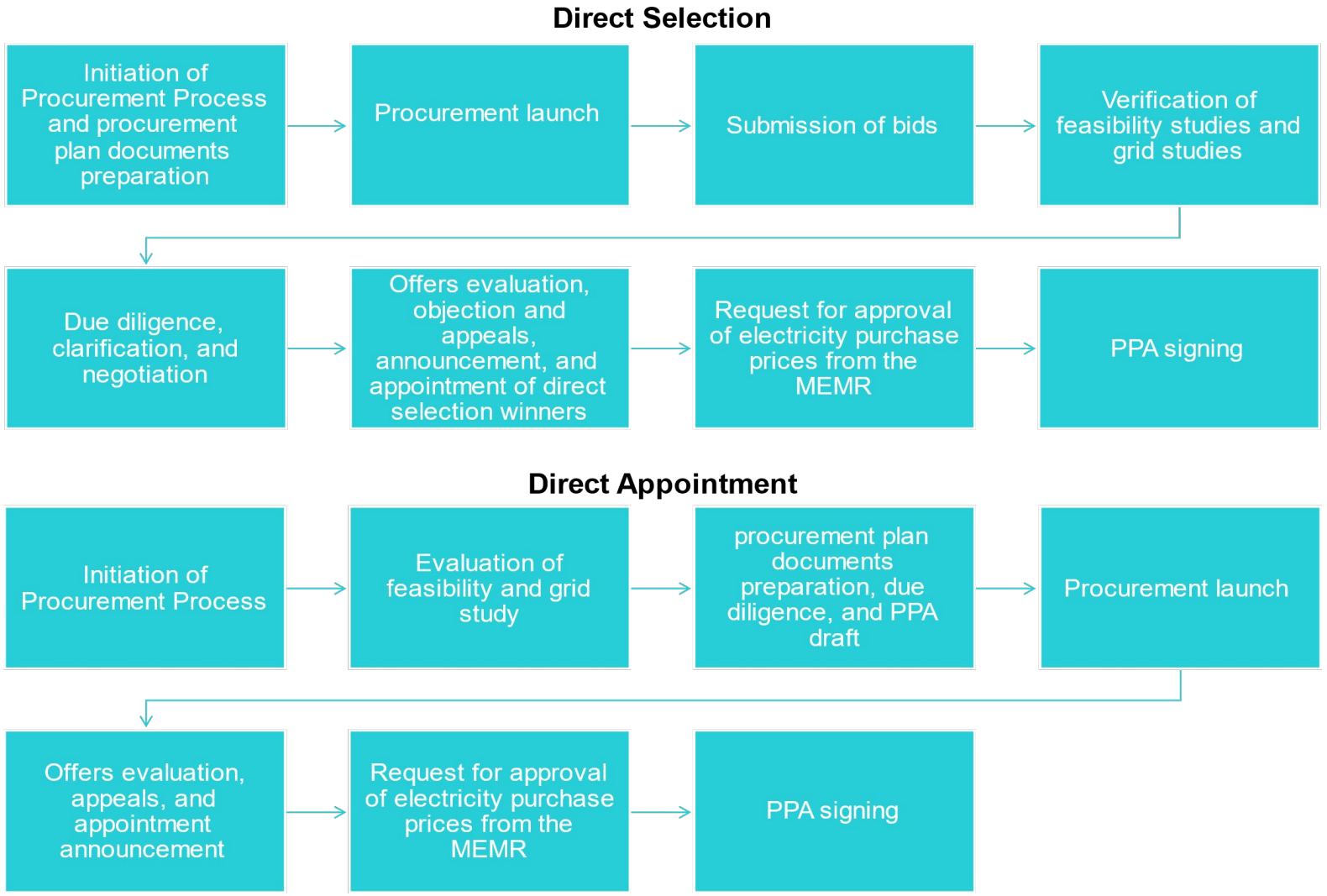
Institutional Setup of Indonesia's Electricity Market

Indonesia's electricity market is based on a single-buyer system in which PLN, as the state utility company, holds a fundamental role



- The adjacent figure shows the power generation sector in Indonesia segmented into three main activities: **transmission, distribution, and generation**. The private sector's participation is limited to Independent Power Producers (IPPs), which are involved in the generation of electricity.
- The competitive landscape for prospective developers is **largely confined to the energy procurement phase**, through tenders organised by PLN.
- The tenders usually **follow the plan outlined** in the Electricity Supply Business Plan (RUPTL), which is also developed by PLN.

Procurement process based on PLN Director Regulation No.62 of 2020



Relevant Stakeholders (1/2)

No	Stakeholder	Roles and Responsibilities
1	Ministry of Energy and Mineral Resources (MEMR)	• Develops, implements, and oversees implementation of policies and regulations for energy and mineral resources, including issued regulations that govern the procurement process, such as MEMR Regulation No. 50 of 2017. • Develops RUEN and RUKN guideline, as stipulated in Government Regulation No. 73 of 2023 and MEMR Regulation No. 8 of 2021. • Responsible for the ratification of PLN's RUPTL.
2	Ministry of Finance (MoF)	• Provides financial incentives and subsidies for renewable energy projects, including solar PV initiatives. • Develops and implements policies related to renewable energy investments, such as the PMK No. 5 of 2025.
3	Ministry of Environment and Forestry (MoEF)	• Ensures that renewable energy projects adhere to environmental regulations • Facilitates the necessary permits for renewable energy projects that require the use of protected or forest lands, as stipulated in MoEF Regulation No.7 of 2021.
4	PT PLN (Persero)	• Organises the procurement of renewable energy projects, including solar PV initiatives and appoints the tender winner. • Purchases electricity from IPPs. • Develops the RUPTL, aligning with the RUEN and RUKN.
5	National Land Agency (ATR/BPN)	• Manages land use and spatial planning • Assesses the suitability of the proposed area utilisation activities in relation to its zoning classification concerning the *Izin Usaha Penyediaan Tenaga Listrik Umum*/ Electric Power Supply Business License for Public Use (IUPTLU) permit. • Issues building approval and functional eligibility certificates. • Head of Committee of the Indonesia Land Bank Authority

Relevant Stakeholders (2/2)

No	Stakeholder	Roles and Responsibilities
6	The Indonesia Land Bank Authority (*Badan Bank Tanah)*	• Manages state land • carries out land acquisition for development in the public interest or direct land acquisition, including energy projects.
7	Developers	• Participate in power plant tenders • Form and invest in an IPP after the tender is won
8	Independent Power Producers (IPPs)	• Develop, finance, and operate solar PV projects • Enter into PPAs with PLN or other off takers
9	Financiers (e.g., conventional banks, private equity firms, venture capitalists, etc.)	• Provide the capital needed to fund energy projects. • Assess financial viability and risks by evaluating PPA terms to ensure sufficient revenue streams and negotiating conditions to mitigate risks.
10	Development finance agencies (e.g., Asian Development Bank, International Finance Corporation, etc.)	• Support development projects, including power projects, by providing concessional terms, such as equity, loans or grants on more favourable terms than those available in the market, often with lower interest rates or more extended repayment periods • In some cases, it may also help to fund project preparation (e.g., feasibility study development, transaction advisory, etc.)

Regulatory Framework Related to Solar PV Procurement (1/3)

The following table summarise the regulatory framework related to Solar PV procurement, categorised into electricity in general, procurement, local content requirement, land acquisition, and incentives.

No	Regulation/ Framework	Remarks
		Electricity in general
1	Law No. 30 of 2009 on electricity	Regulates various aspects of electricity in Indonesia, including generation, transmission, distribution, and sales.
2	Presidential Regulation No. 14 of 2017	This regulation amended Presidential Regulation No. 4 of 2016 concerning the Acceleration of Electricity Infrastructure Development. In the case where the GoI assigns PLN or its subsidiaries as a mandatory strategic partner in an IPP for specific projects, It stipulates that PLN must have a minimum of 51% of shares in cooperation projects between PLN (or its subsidiaries) and project developers.
3	Presidential Regulation No. 112 of 2022	The latest regulation concerning the acceleration of renewable energy development for the provision of electricity is one measure to entice investments and accelerate the RE mix target, as well as reduce GHG emissions. This regulation includes a ceiling price for renewable energy, including solar PV.
4	MEMR Regulation No. 50 of 2017 (adjusted with MEMR Regulation No.4 of 2020 and No. 53 of 2018)	• Focuses on utilising renewable energy resources for electricity production, including solar PV. • Stipulates renewable energy sources' maximum tariff and minimum capacity/availability factor, the IPP selection/bidding process, and the power purchase scheme.
		Procurement
5	MEMR Regulation no 5 of 2025	This regulation provides comprehensive guidelines for PPAs involving renewable energy power plants.
6	PLN Director's Regulation No.22 of 2020 on guidelines for procurement of goods/services	This regulation provides comprehensive guidelines for PLN's procurement of goods and services, including procedures for competitive bidding, direct appointment, and direct procurement.

Regulatory Framework Related to Solar PV Procurement (2/3)

No	Regulation/ Framework	Remarks
		Procurement
7	PLN Director's Regulation No.62 of 2020 on Purchase of Electric Power from New And Renewable Energy Power Plant	• Establishes the framework for purchasing electricity from new and renewable energy power plants, including the terms and conditions for PPAs between PLN and IPPs. • Specifies renewable energy projects' pricing mechanisms, contract duration, and technical requirements. • Provides a framework for PLN's power plant procurement process.
		Local Content Requirement
8	MEMR regulation No.11 of 2024	This regulation stipulates the minimum local content of equipment that should be used in solar PV power plants
9	Ministry of Industry Regulation No. 34 of 2024.	This regulation regulates the LCR weight of Solar Module Products.
10	DGNREEC Regulation (Kepdirjen EBTKE) No.150 of 2024	This regulation outlines procedures for calculating the fulfilment of the value of the combined domestic component level of goods and services within the scope of the electricity infrastructure development project for renewable energy power plants.
11	MEMR Ministerial Decree No.191.K/EK.01/MEM.E/2024	Regulates the minimum limit of combined LCR value of goods and services in the scope of electricity infrastructure development projects
		Land Acquisition
12	Law No.2 of 2012 on Land Acquisition for Public Infrastructure and Presidential Regulation 04/2016	Stipulates the legal framework for land acquisition for electricity infrastructure projects.

Regulatory Framework Related to Solar PV Procurement (3/3)

No	Regulation/ Framework	Remarks
		Land Acquisition
13	Presidential Regulation No. 62 of 2018, amended by Presidential Regulation No. 78 of 2023	This regulation regulates how to handle social impacts in providing land for national development.
14	Presidential Regulation No. 19 of 2021 as amended by Presidential Regulation No. 32 of 2023	This regulation supports the implementation of Law No.2 of 2012 and regulates in more detail the implementation of land acquisition, including location determination, compensation, and objection handling.
15	Government Regulation No.23 of 2021 and MoEF Regulation No.7 of 2021	This regulates forestry planning, changes in the allocation and function of forest areas, and the use of forest areas. At the same time, the MoEF regulation provides more detailed guidance on the procedures and requirements for the use of forest areas.
16	Government Regulation No. 64 of 2021	This regulation establishes the Indonesia Land Bank Authority, a special agency tasked with managing land to ensure its availability for various purposes. This regulation grants the Land Bank special authority to handle land for public and social interests, national development, economic equality, land consolidation, and agrarian reform
17	MoHA Regulation No. 7 of 2024	This outline covers the rent charged for regional government assets, including the base rent tariff and the rent adjustment factor, including for power plant projects.
		Incentives
18	Government Regulation (PP) 78 of 2019; Minister of Finance Regulation (PMK) 130 of 2020 as amended by PMK 69 of 2024; 81 of 2024; PMK 21 of 2010; PMK 176 of 2009 as amended by PMK 188 of 2015 and PMK 76 of 2012	Provision of tax facilities to individuals and companies involved in RE investment: • Income tax deduction, • Investment tax deduction, • Accelerated depreciation, and amortisation, • Import duty exemption, • VAT exemption on imported goods, and • Tax holiday. Details of incentives regulation are explained in the following section.

Available Incentives for RE Development

Discussions with developers indicate that these incentives from could help make projects more financially viable. It was suggested by a developer that socialisation is necessary to increase awareness among renewable energy developers about these government incentives.

No	Type of Incentives	Regulation Basis	Remarks
1	Tax allowance	Government Regulation No. 78/2019	This regulation enhances tax allowances for companies investing in renewable energy, offering reductions in net taxable income, accelerated depreciation, and extended loss carry-forward periods.
2	Tax allowance	PMK No. 11/2020	This regulation provides technical guidance on implementing PP No.78 of 2019 on tax allowance facilities, detailing procedures for applying for and utilising these incentives.
3	Tax holiday	PMK No. 130/2020	This regulation further stimulates investment by offering a 50% to 100% reduction in corporate income tax for a period of 5 to 20 years. For investments between IDR 100 billion and IDR 500 billion, companies can receive a 50% reduction in corporate income tax for 5 years. For investments exceeding IDR 500 billion, companies can benefit from a 100% reduction in corporate income tax for 5 to 20 years, depending on the investment amount.
4	Income tax deduction and import duty exemptions	PMK No. 21/2010	This regulation provides tax and customs facilities for renewable energy projects, including a 30% net income reduction over six years, accelerated depreciation, and exemptions from import duties and VAT for machinery and equipment.
6	Import duty exemptions	PMK Regulation No. 66/PMK.010/2015	This regulation provides incentives by exempting capital goods from import duties on those used to develop or expand electricity generation industries in the public interest.

Major Challenges and Measures to Address Key Issues of

Solar PV Procurement in JAMALI

Procurement Challenges for Solar PV Development in JAMALI

Procurement process	Despite the Presidential Regulation's 90-day direct appointment, the actual process may take more than the estimation. RUPTL's frequent updates provide uncertainty to the investors, while the RUPTL's unrealistic COD targets cause delays in project commencements. Delays can be caused by the lengthy IUPTLU permit process, requiring multiple approval phases.
Local Content Requirements	Most domestic products are more expensive than international alternatives, deterring investments in projects required to use local components. The limited availability of high-quality Tier-1 solar PV modules also lead to higher costs; currently, Indonesia needs to largely expand its production to reach cost competitiveness with imported panels.
Land Acquisition	Lengthy and complex land acquisition processes may stall the progress of solar projects and make international financiers invest in IPPs with already secured land permits and approvals. Besides, significant resistance from local communities persists due to cultural, and social factors, where adding community engagement strategies create more friction.
Shareholder Requirement	The shareholder loan requirement makes the strategic partner take on more debt than PLN, raising project costs and tax burdens. This shareholder requirement also impacts investment returns, making projects less attractive to investors. The requirement makes potential strategic partners face difficulties securing financing and maintaining competitive pricing.

Prioritization and estimated timeline definition

The priority level and estimated time required to implement suggested solutions are defined in the table below.

Priority level:

Priority	Indicator
High	Red
Moderate	Yellow
Low	Green

Estimated timeline:

Estimated Timeline to Implement the Suggested Measures	Definition
Short term	Challenges that take **1-2 years** to address, involving straightforward and not complex solutions. These are the “low-hanging fruits”.
Mid term	Challenges that take **3-5 years** to address, involving more intricate solutions that may require additional effort
Long term	Challenges requiring long-term solutions that may take **5 years or more** to address, involving complex changes and multiple stakeholders

Proposed Solutions for Solar PV Procurement Challenges in JAMALI (1/2)

	Challenges	Proposed Solutions	Relevant institution	Priority	Estimated timeline to implement the suggested
1	Complex and lengthy procurement procedures	• Implement a robust system to regularly monitor the tender process • Implement bundled and capacity-based procurement models • Develop a comprehensive procurement timeline and project announcement schedule • Consider conducting pre-feasibility analysis on the potential sites before the tender process, utilising the output of this study during the planning of solar PV projects • Conduct market sounding or lenders briefing to gather inputs on the project's bankability	PLN	**High Priority**	Short term
2	Local Content Requirements (LCR)	• Develop a long-term plan to balance the support for local industries and the project feasibility • Set clear milestones and timelines for LCR compliance • Provide fiscal incentives based on the LCR achieved • Provide non-fiscal support such as training and technical assistance to RE technology manufacturers, particularly for solar PV • Establish collaboration opportunities with leading solar PV manufacturers • Provide incentives for research and development of local solar PV modules at a national level	Lead institution: MEMR Supporting institution: MoI, MoF	**Moderate priority**	Mid term

Proposed Solutions for Solar PV Procurement Challenges in JAMALI (2/2)

	Challenges	Proposed Solutions	Relevant institution	Priority	Estimated timeline to implement the suggested measure
3	Lengthy and complex land acquisition processes	• Implement expedited land acquisition procedures for identified preferred zones • Implement Different Land Procurement Models (e.g., opening tenders for areas in which the land has been secured beforehand) • Collaborate with The Indonesia Land Bank Authority • Utilise government-owned land for solar PV projects	Lead institution: MEMR Supporting institution: MoEF, Bappenas, PLN, ATR/BPN, The Indonesia Land Bank Authority	**High Priority**	Long term
4	The requirement for PLN or its subsidiary to own a minimum of 51% share in the SPC	• Revisit the minimum shares requirement in PLN or its subsidiaries • Explore available government support options (e.g., State Equity Participation, loans) • Explore support options from Danantara	Lead institution: PLN Supporting institution: MEMR	**High Priority**	Mid term
		• Procure the projects without assigning PLN and/or its subsidiaries as mandatory strategic partner in the IPP	PLN	**High Priority**	Short term
		• Restructure subsidy on the consumer's electricity tariff	Lead institution: PLN Supporting institution: MEMR	**Moderate priority**	Mid term

Action Plan for the Proposed Solutions

Action Plan for The Proposed Solutions: Procurement (1/2)

Action Plan	Year					Role of Stakeholder						
	1	2	3	4	5	MEMR	PLN	MoF	MoEF	MoM	Developer/ IPP	ATR/BPN and Indonesia Land bank Authority
IPP Procurement Process												
Create a bundled or capacity-based procurement mechanism						A	R	-	-	-	C	-
Conduct feasibility analysis (pre-FS) based on the identified potential sites from this study						A	R	C	C	-	I	-
Establish a dedicated monitoring team for the tender process						A	R	C	-	-	I	-
Streamline the permitting process and continuously implement comprehensive and transparent project documentation						A	R	-	-	-	I	-
Develop a comprehensive procurement timeline and project announcement schedule						A	R	-	-	-	I	-
LCR												
Develop a long-term plan to balance support for local industries and project feasibility						A	C	C	-	-	C	-
Set clear milestones and timelines for LCR compliance						R/A	C	-	-	-	C	-
Provide fiscal incentives based on the LCR achieved						C	C	R/A	-	-	C	-
Provide non-fiscal support such as training and technical assistance to manufacturers						A	C	C	-	R	I	-
Establish collaboration opportunities with leading solar PV manufacturers						R/A	R	-	-	I		
Provide incentives for research and development of local solar PV modules at a national level						A	I	R	C	I		

Action Plan for The Proposed Solutions: Procurement (2/2)

Action Plan	Year					Role of Stakeholder						
	1	2	3	4	5	MEMR	PLN	MoF	MoEF	MoM	Developer/ IPP	ATR/BPN and Indonesia Land bank Authority
Complex land acquisition process												
Implement expedited land acquisition procedures for identified preferred zones						A	I	C	R	-	C	-
Utilise government-owned land and/or collaborate with The Indonesian Land Bank Authority for solar PV projects						R/A	C	C	C	I	C	R
Minimum share requirement for PLN or its subsidiaries in a SPC												
Revisit the minimum shares requirement in PLN or its subsidiaries						C	R/A	I	-	-	C	-
Consider procuring the projects without assigning PLN and/or its subsidiaries as mandatory strategic partner in the IPP												
Explore available government support options						C	R/A	C	-	-	-	-
Reduce subsidy for consumers' electricity tariffs that align with the nation's economic condition						A	R	C	-	-	-	-

Financial Feasibility Analysis

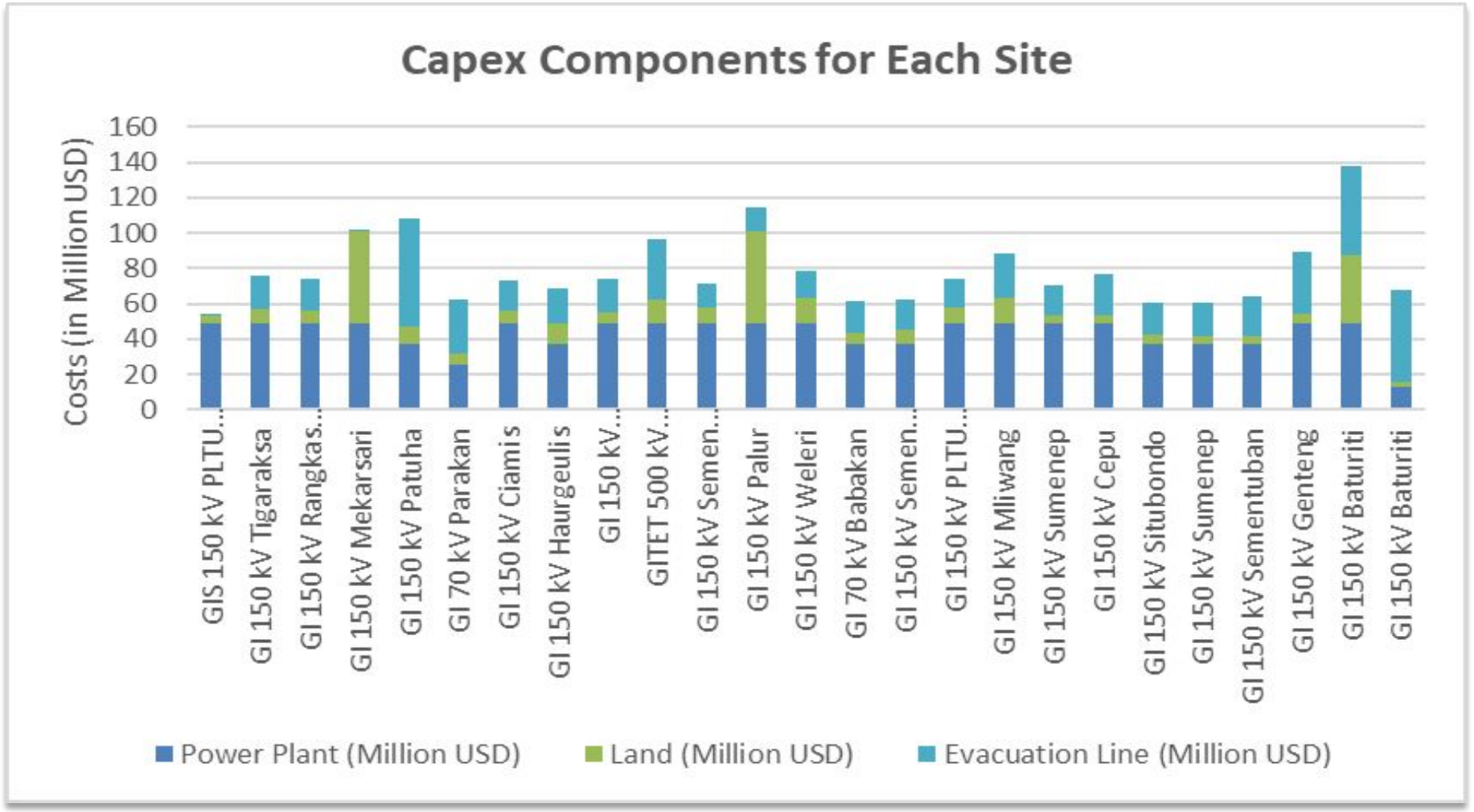
Financial Model Assumptions

General Assumption

<table>
<tr><th>No.</th><th colspan="2">Assumption</th><th>Source</th></tr>
<tr><td>1</td><td>Inflation Rate</td><td>
<table>
<tr><th></th><th>2025</th><th>2026</th><th>2027</th><th>2028+</th></tr>
<tr><td>Inflation Rate</td><td>2.80%</td><td>3.10%</td><td>3.20%</td><td>3.20%</td></tr>
</table>
</td><td>Economic Intelligence Unit Forecast (July 2024)</td></tr>
<tr><td>2</td><td>Exchange Rate</td><td>Rp 15,394.00</td><td>BI Middle Rate as of 4th October 2024</td></tr>
<tr><td>3</td><td>Ceiling Price</td><td>
<table>
<tr><th rowspan="2">Capacity</th><th colspan="2">HPT for Solar Plant (cent USD/kWh)</th><th colspan="2">HPT for Solar Plant (cent USD/kWh)</th></tr>
<tr><th>Year 1 to 10</th><th>Year 11 to 30</th><th>Year 1 to 10</th><th>Year 11 to 30</th></tr>
<tr><td>>20 MW</td><td>6.95</td><td>4.17</td><td>6.95</td><td>3.96</td></tr>
</table>
</td><td>Perpres 112/2022 with F factor of 1.0 for JAMALI</td></tr>
<tr><td>4</td><td>Power Generation</td><td>> 25 MW</td><td>MCDM Analysis</td></tr>
<tr><td>5</td><td>Capital Expenditure</td><td>Main Power Plant: 450-520 USD per KW
Land: 10sqm per KW x Land Price per Sites
Evacuation Line: 1.3 Million USD per KM</td><td>Discussion with Various Developer & PLN
Total Capex is presented in the next slide</td></tr>
<tr><td>6</td><td>Operational Expenditure</td><td>Fixed cost: 10.3 USD per kW /per year
Variable cost: 0.0005 USD per kWh.</td><td>Desktop Study & Discussion with Various Developer
Consists of Fixed Cost and Variable Cost for main power plant’s operational and maintenance expense with total of 25.80 million USD per year for 25 Sites.</td></tr>
<tr><td>7</td><td>Target Project IRR</td><td>8.00%</td><td rowspan="2">Desktop study for the renewable energy sector</td></tr>
<tr><td>8</td><td>Target Equity IRR</td><td>12.00%</td></tr>
</table>

Total Capex

The capex consists of **costs for main power plant, land, and evacuation line** as summarized below



Base Scenario Analysis

Scenario Assumption

The **financial feasibility analysis** has been performed for the following **4 (four) scenarios**:

Scenario	Land Ownership	Ceiling Price (cent USD/kWh)	
		Year 1 to 10	Year 11 to 30
1	Non-government-owned land	6.95	4.17
2	Government-owned	6.95	3.96
3	Non-government-owned land	5.50	3.30
4	Government-owned	5.50	3.14

The analysis were performed to **25 sites** selected from MCDM Analysis as has been explained in Report Phase 1, as follows:

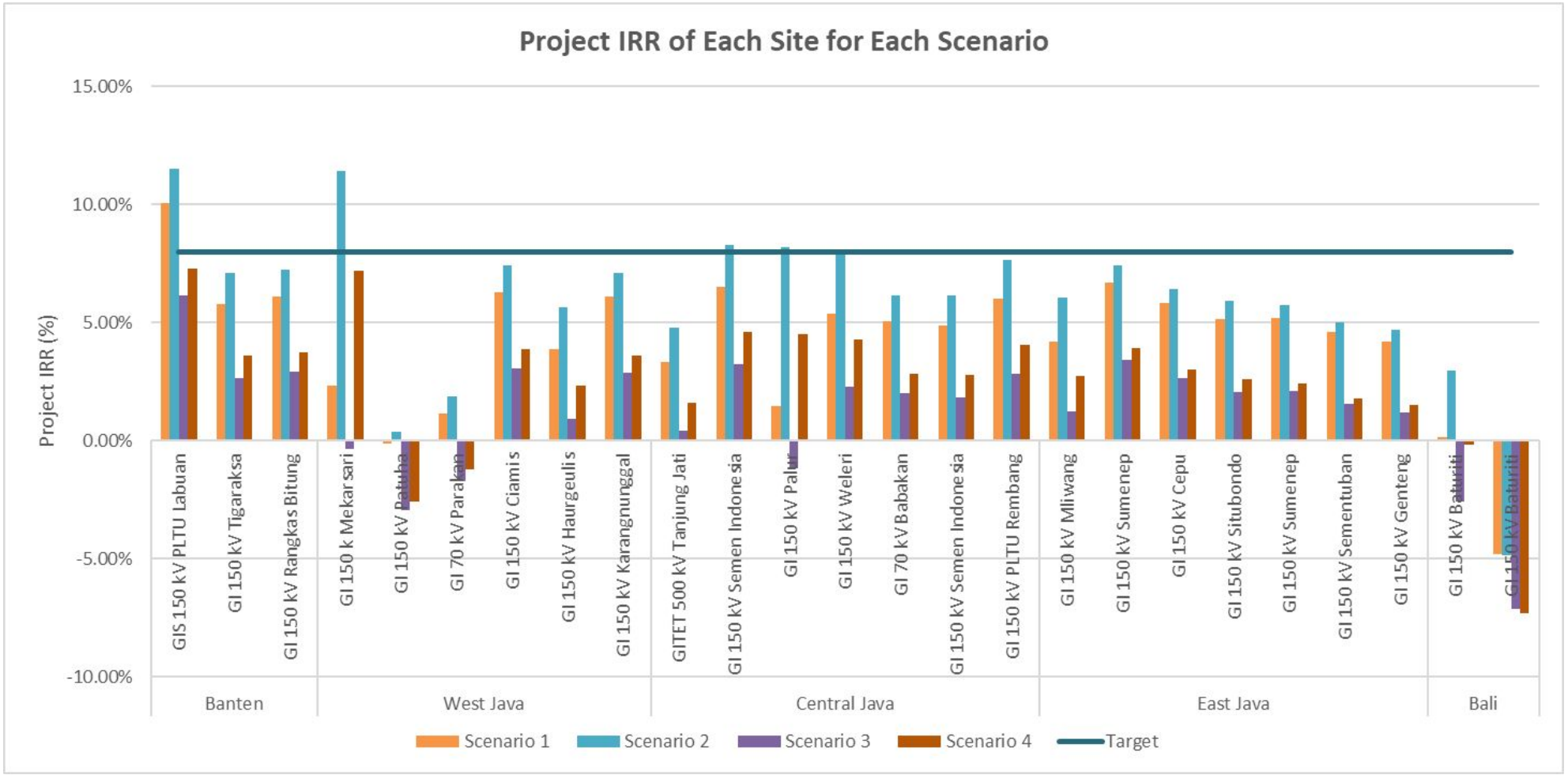
No	Hub Name	Capacity (MW)	Gross Energy Generated* (Mwh/year)
1	GIS 150 kV PLTU Labuan	100	153,300
2	GI 150 kV Tigaraksa	100	153,300
3	GI 150 kV Rangkas Bitung	100	153,300
4	GI 150 kV Mekarsari	100	153,300
5	GI 150 kV Patuha	75	114,975
6	GI 70 kV Parakan	50	76,650
7	GI 150 kV Ciamis	100	153,300
8	GI 150 kV Haurgeulis	75	114,975
9	GI 150 kV Karangnunggal	100	153,300
10	GITET 500 kV Tanjung Jati	100	153,300
11	GI 150 kV Semen Indonesia	100	153,300
12	GI 150 kV Palur	100	153,300

*Gross Energy for the First Year of Operation

No	Hub Name	Capacity (MW)	Gross Energy Generated* (Mwh/year)
13	GI 150 kV Weleri	100	153,300
14	GI 70 kV Babakan	75	114,975
15	GI 150 kV Semen Indonesia	75	114,975
16	GI 150 kV PLTU Rembang	100	153,300
17	GI 150 kV Mliwang	100	153,300
18	GI 150 kV Sumenep	100	153,300
19	GI 150 kV Cepu	100	153,300
20	GI 150 kV Situbondo	75	114,975
21	GI 150 kV Sumenep	75	114,975
22	GI 150 kV Sementuban	75	114,975
23	GI 150 kV Genteng	100	153,300
24	GI 150 kV Baturiti	100	153,300
25	GI 150 kV Baturiti	25	38,325

Base Case Scenario

The financial feasibility analysis has been performed for 25 sites in four scenarios as mentioned in previous slide. The results are as follows:



Key Points:

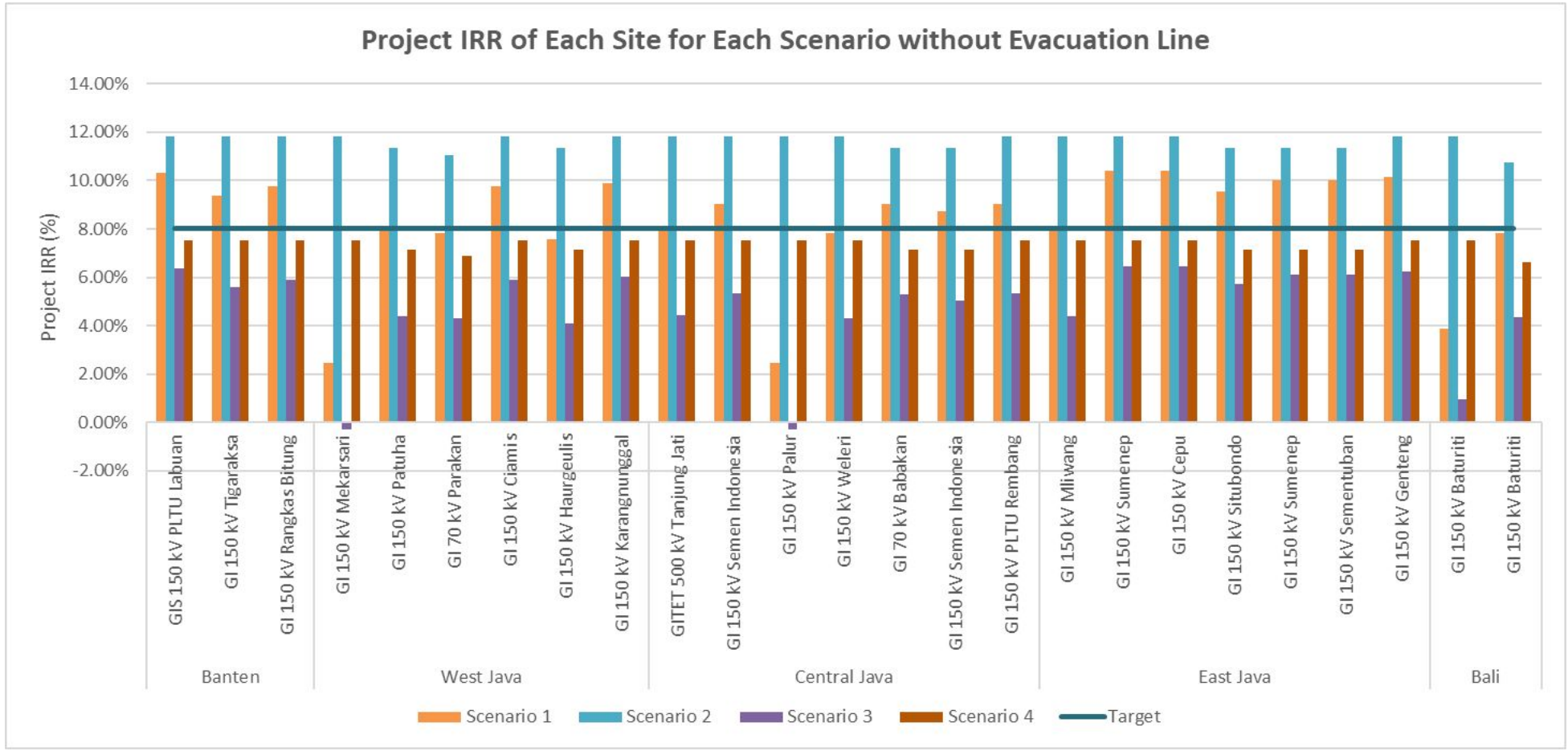
- From the analysis, only two sites (GIS 150 kV PLTU **Labuan** and GI 150 kV **Mekarsari**) are feasible in scenario 2 if we use the target Project IRR of **8.00**% and target Equity IRR of **12.00**%.
- The reason for these results is that the tariff used for each scenario is not sufficient to cover the capex for the solar project.

Note: numbers in black indicate that the project is financially feasible, while numbers in red indicate that the project is not financially feasible.

*Gross Energy for the First Year of Operation

Additional Scenario : Exclusion of Evacuation Line Capex

Another analysis was performed to see the impact of excluding certain cost component, specifically the 150 kV evacuation line. This scenario was selected because the cost for corresponding evacuation line depends on the length of the line and could account for an average of 29.3% of the total capex across 25 sites. The highest cost evacuation line is for the GI 150 kV Baturiti site, where It accounts for 76.6% of the site's total capex.



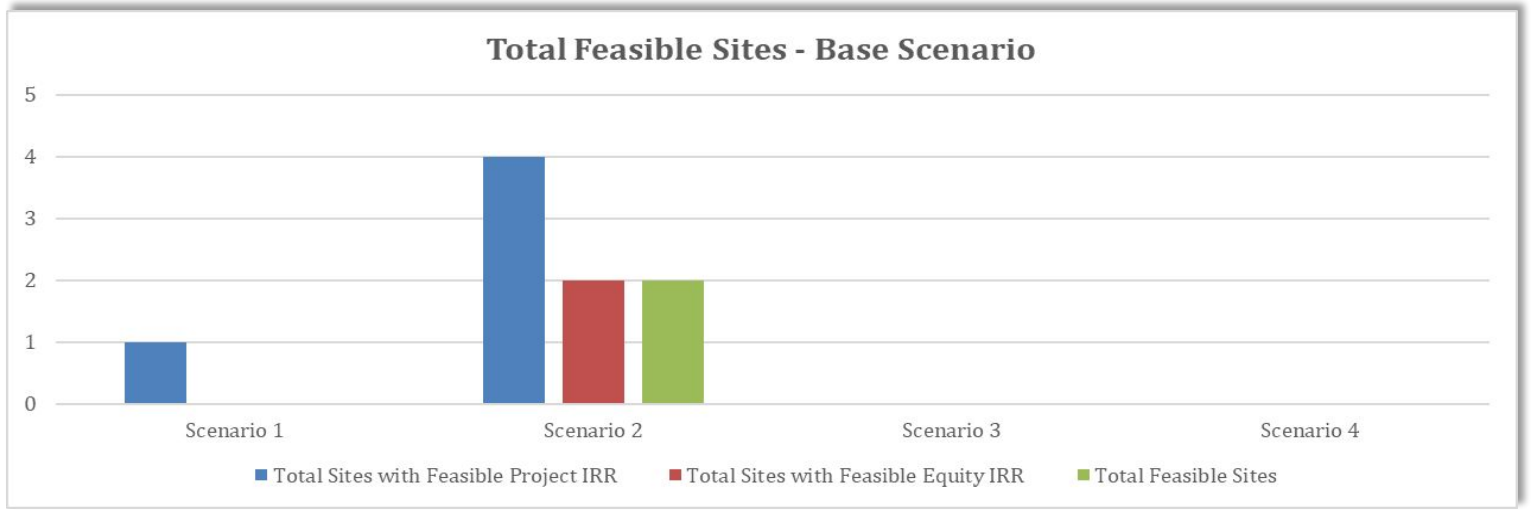
Key Points:

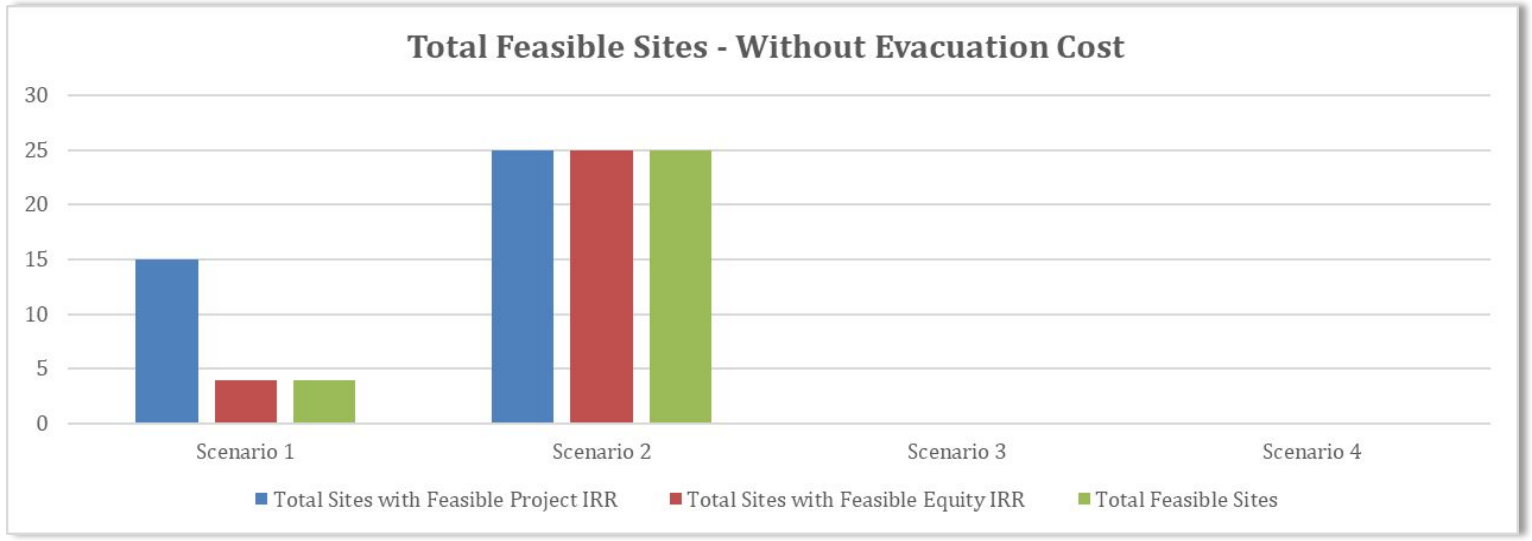
- From the analysis, without the evacuation line capex, there are **4** feasible sites (**0.4 GW)** for scenario 1 and **25** sites (**2.2 GW**), will be feasible for scenario 2 while no scenario is feasible for scenario 3 and 4.
- This shows that the capex for the evacuation line has a significant impact on the feasibility analysis of each site but is **not enough to compensate the decrease** in tariff for scenario 3 and 4.

Note: numbers in black indicate that the project is financially feasible, while numbers in red indicate that the project is not financially feasible.

*Gross Energy for the First Year of Operation

Summary: Total Feasible Sites for Each Scenario





In the financial analysis for the base scenarios, only

2 sites

are financially feasible under Scenario 2, while no sites are financially feasible under Scenario 1, 3, and 4.

Meanwhile, financial analysis for the scenarios **excluding cost component for evacuation line gives better results** by having 4 sItes financially feasible sites under Scenario 1, and 25 financially feasible sites under Scenario 2.

Sensitivity Analysis

Sensitivity Analysis Assumption

Sensitivity analysis were performed to see the impact of changing several parameters to the financial feasibility. The analysis were performed to the base scenario and scenario with exclusion of evacuation line capex. The parameters that will be analyzed are as follows :

Assumption	Base Scenario	Sensitivity Analysis 1	Sensitivity Analysis 2	Sensitivity Analysis 3	Sensitivity Analysis 1
Energy Generation	Calculate using Average Capacity Factor from Solar PV Projects in Indonesia	Global Solar Atlas	Calculate using Average Capacity Factor from Solar PV Projects in Indonesia	Calculate using Average Capacity Factor from Solar PV Projects in Indonesia	Global Solar Atlas
Land Area Required per MW	1 ha/MW	1 ha/MW	0.75 ha/MW	1 ha/MW	0.75 ha/MW
Fixed Opex	10.3 USD per kW per year	10.3 USD per kW per year	10.3 USD per kW per year	4 USD per kW per year*	4 USD per kW per year*

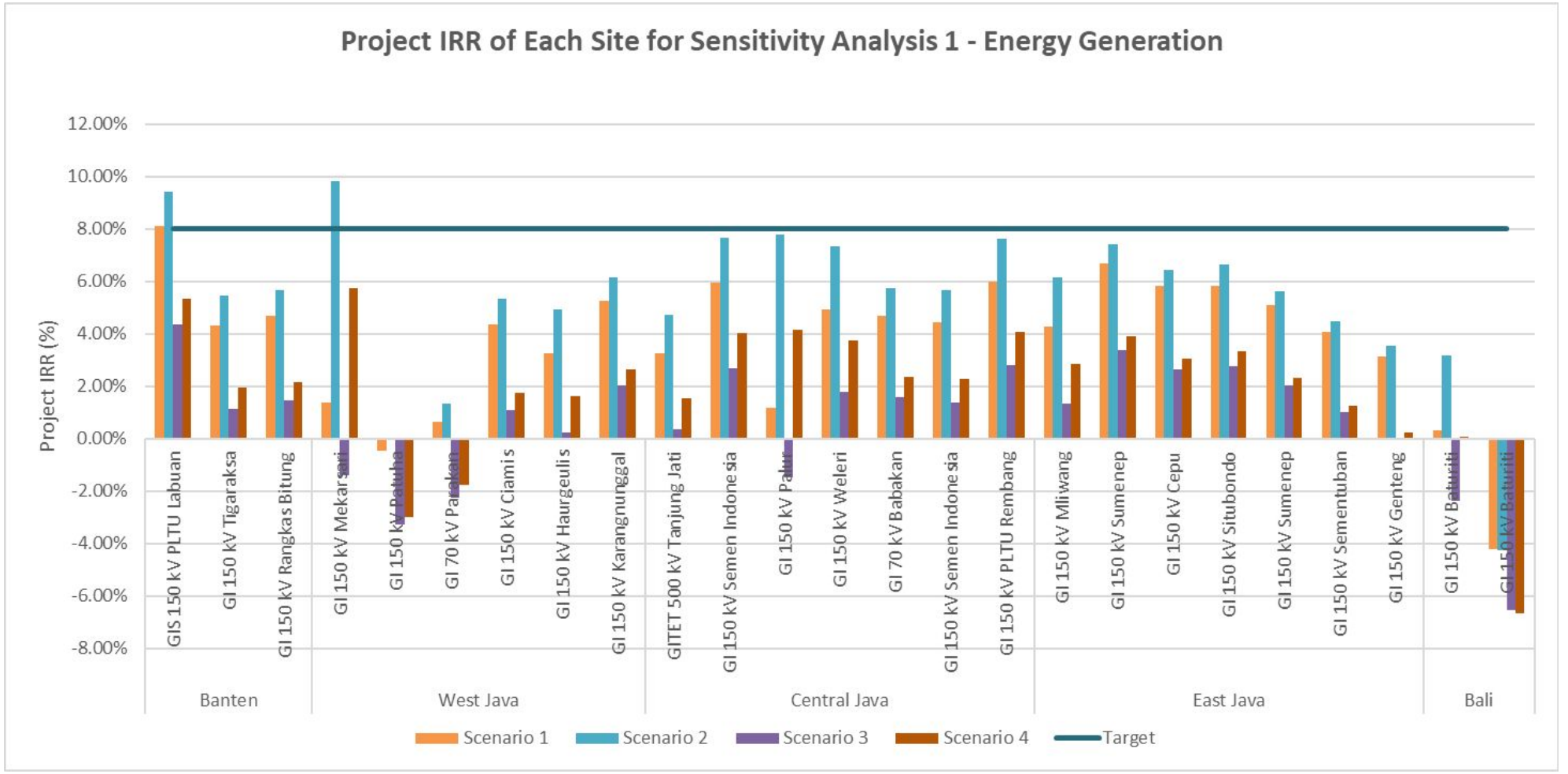
Notes: *Assumption is based on lowest O&M Cost from IRENA Study

The energy generation for 25 sites from Global Solar Atlas are as follows :

No	Hub Name	Capacity (MW)	Gross Energy Generated* (Mwh/year)
1	GIS 150 kV PLTU Labuan	100	136,710
2	GI 150 kV Tigaraksa	100	137,330
3	GI 150 kV Rangkas Bitung	100	138,060
4	GI 150 kV Mekarsari	100	140,750
5	GI 150 kV Patuha	75	111,698
6	GI 70 kV Parakan	50	73,570
7	GI 150 kV Ciamis	100	133,400
8	GI 150 kV Haurgeulis	75	109,208
9	GI 150 kV Karangnunggal	100	143,910
10	GITET 500 kV Tanjung Jati	100	152,720
11	GI 150 kV Semen Indonesia	100	147,450
12	GI 150 kV Palur	100	149,620
13	GI 150 kV Weleri	100	147,980
14	GI 70 kV Babakan	75	111,548
15	GI 150 kV Semen Indonesia	75	111,075
16	GI 150 kV PLTU Rembang	100	153,140
17	GI 150 kV Mliwang	100	154,410
18	GI 150 kV Sumenep	100	153,070
19	GI 150 kV Cepu	100	153,510
20	GI 150 kV Situbondo	75	121,110
21	GI 150 kV Sumenep	75	114,015
22	GI 150 kV Sementuban	75	110,655
23	GI 150 kV Genteng	100	140,460
24	GI 150 kV Baturiti	100	155,850
25	GI 150 kV Baturiti	25	40,713

Sensitivity Analysis 1 – Energy Generation (Base Scenario)

The sensitivity analysis has been performed for 25 sites in base scenario with the change of energy generation assumption . The results are as follows:



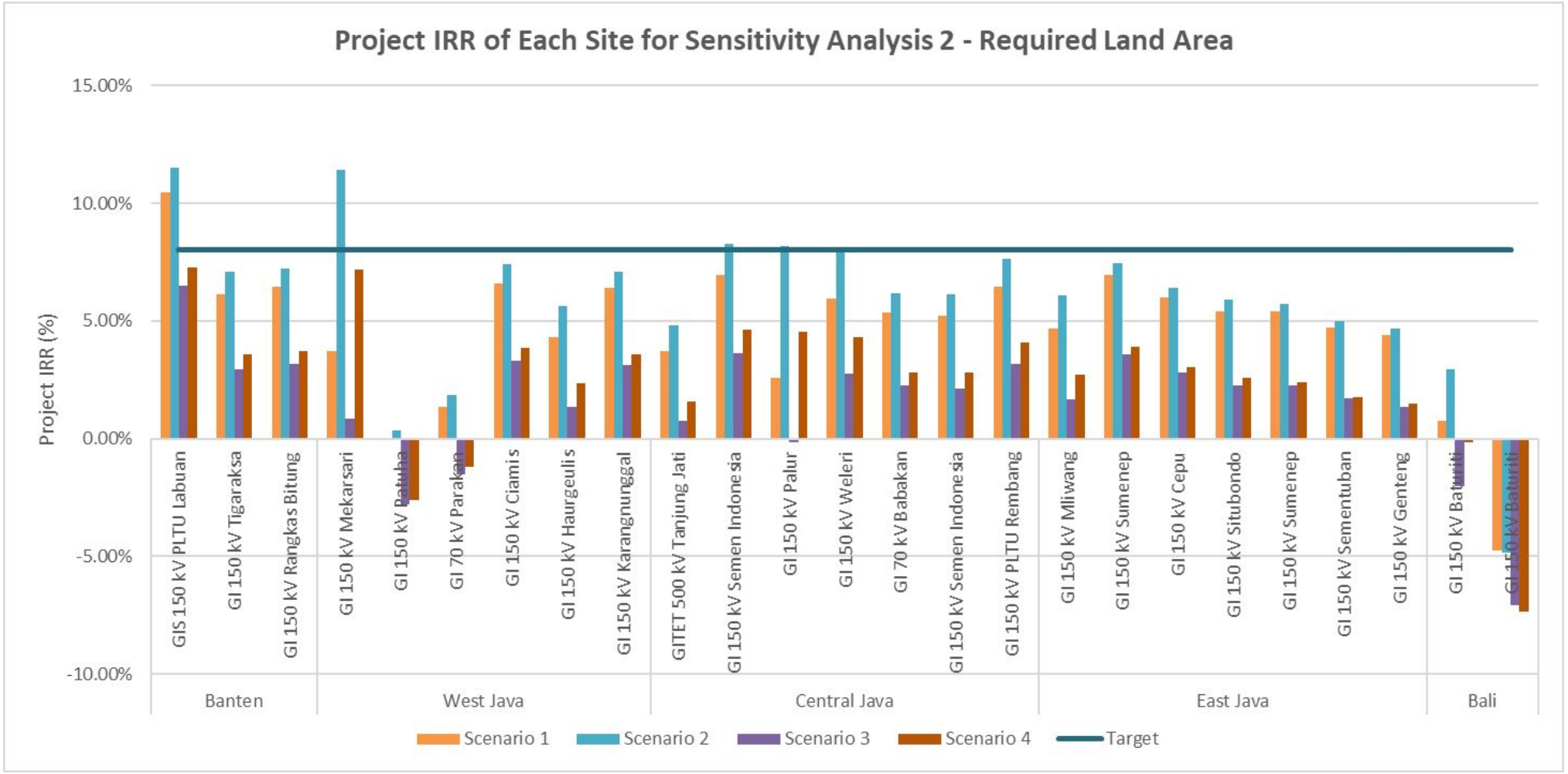
Key Points:

- Using the assumptions from Global Solar Atlas, **no sites are feasible** using the target Project IRR of 8.00% and target Equity IRR of 12.00%..
- The reason for these results is that average Global Solar Atlas estimated a **lower energy generation** than the average capacity factor in Indonesia.

Note: numbers in black indicate that the project is financially feasible, while numbers in red indicate that the project is not financially feasible.
*Gross Energy for the First Year of Operation

Sensitivity Analysis 2 – Land Area Required (Base Scenario)

The sensitivity analysis has been performed for 25 sites in base scenario with the change of land area required assumption . The results are as follows:



Key Points:

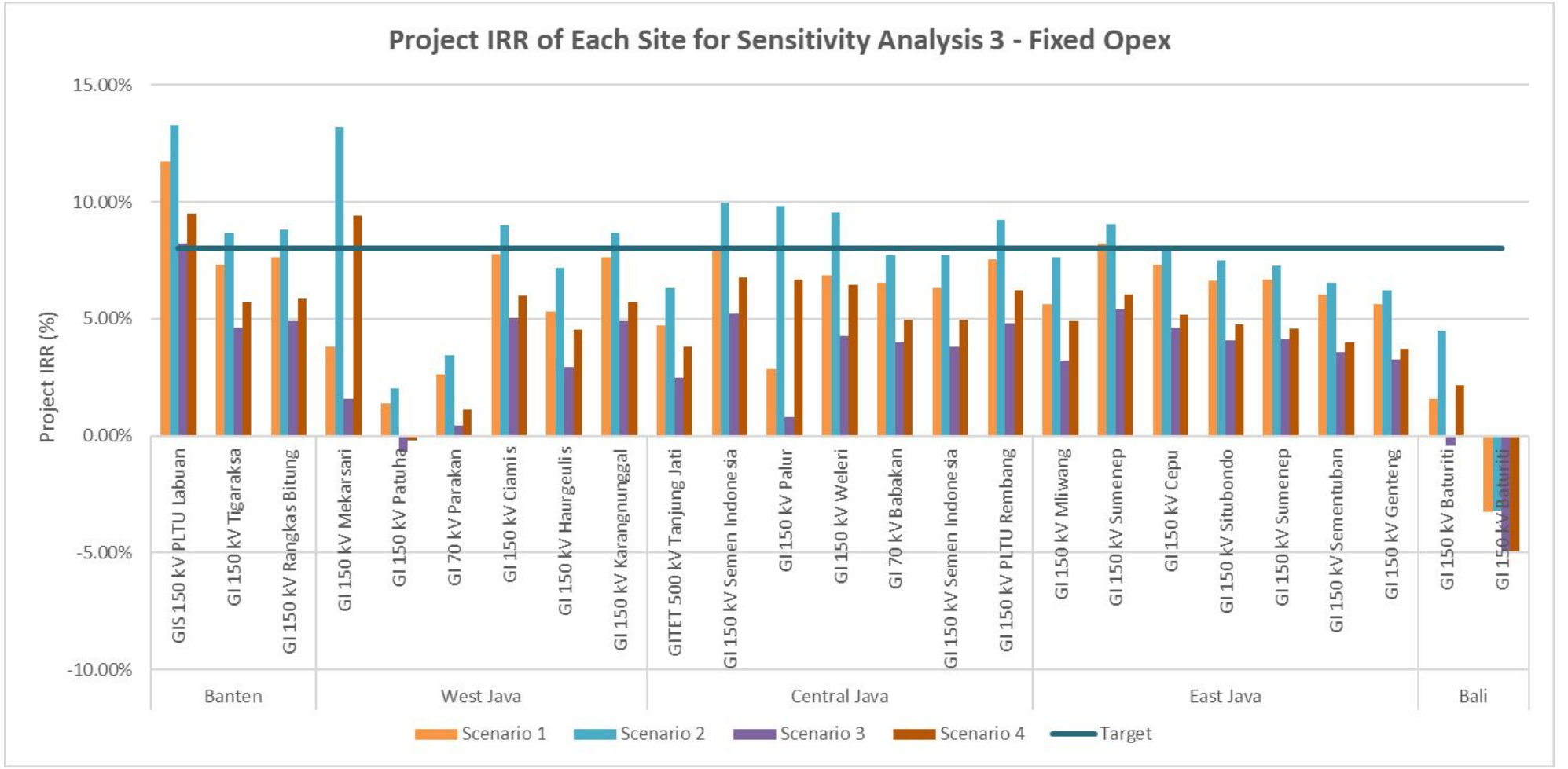
- With the change in assumptions for required land per MW, two sites (GIS 150 kV PLTU **Labuan** (S_id 8) and GI 150 kV **Mekarsari** (S_id 24)) **are feasible**. GIS 150 kV PLTU Labuan (S_id 8) is feasible for scenario 1 and 2 while GI 150 kV Mekarsari (S_id 24) is only feasible for scenario 2.
- These analysis shows that by changing the required land per MW parameter has positive impact on the overall feasibility of the project and improves the overall IRR of all 25 sites.

Note: numbers in black indicate that the project is financially feasible, while numbers in red indicate that the project is not financially feasible.

*Gross Energy for the First Year of Operation

Sensitivity Analysis 3 – Fixed Opex (Base Scenario)

The sensitivity analysis has been performed for 25 sites in base scenario with the fixed opex assumption . The results are as follows:



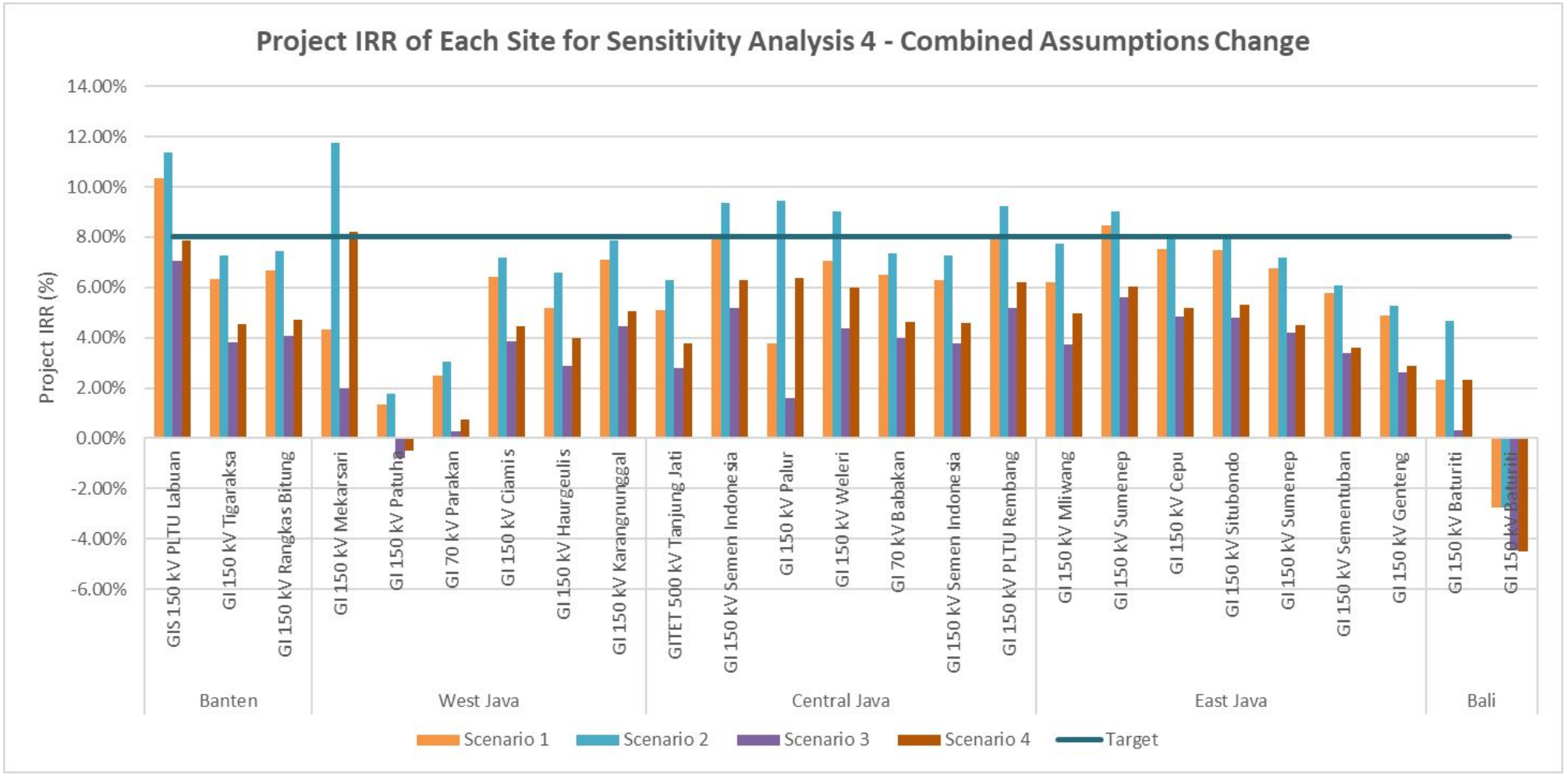
Key Points:

- With the change in assumptions for fixed opex assumption, two sites (GIS 150 kV PLTU Labuan (S_id 8) and GI 150 kV Mekarsari (S_id 24)) are feasible. GIS 150 kV PLTU Labuan (S_id 8) is feasible for scenario 1 and 2 while GI 150 kV Mekarsari (S_id 24) is only feasible for scenario 2.
- These analysis shows that by changing the fixed opex assumptions has positive impact on the overall feasibility of the project and improves the overall IRR of all 25 sites.

Note: numbers in black indicate that the project is financially feasible, while numbers in red indicate that the project is not financially feasible.
*Gross Energy for the First Year of Operation

Sensitivity Analysis 4 – Combined Assumptions (Base Scenario)

The sensitivity analysis has been performed for 25 sites in base scenario with all three combined assumptions . The results are as follows:



Key Points:

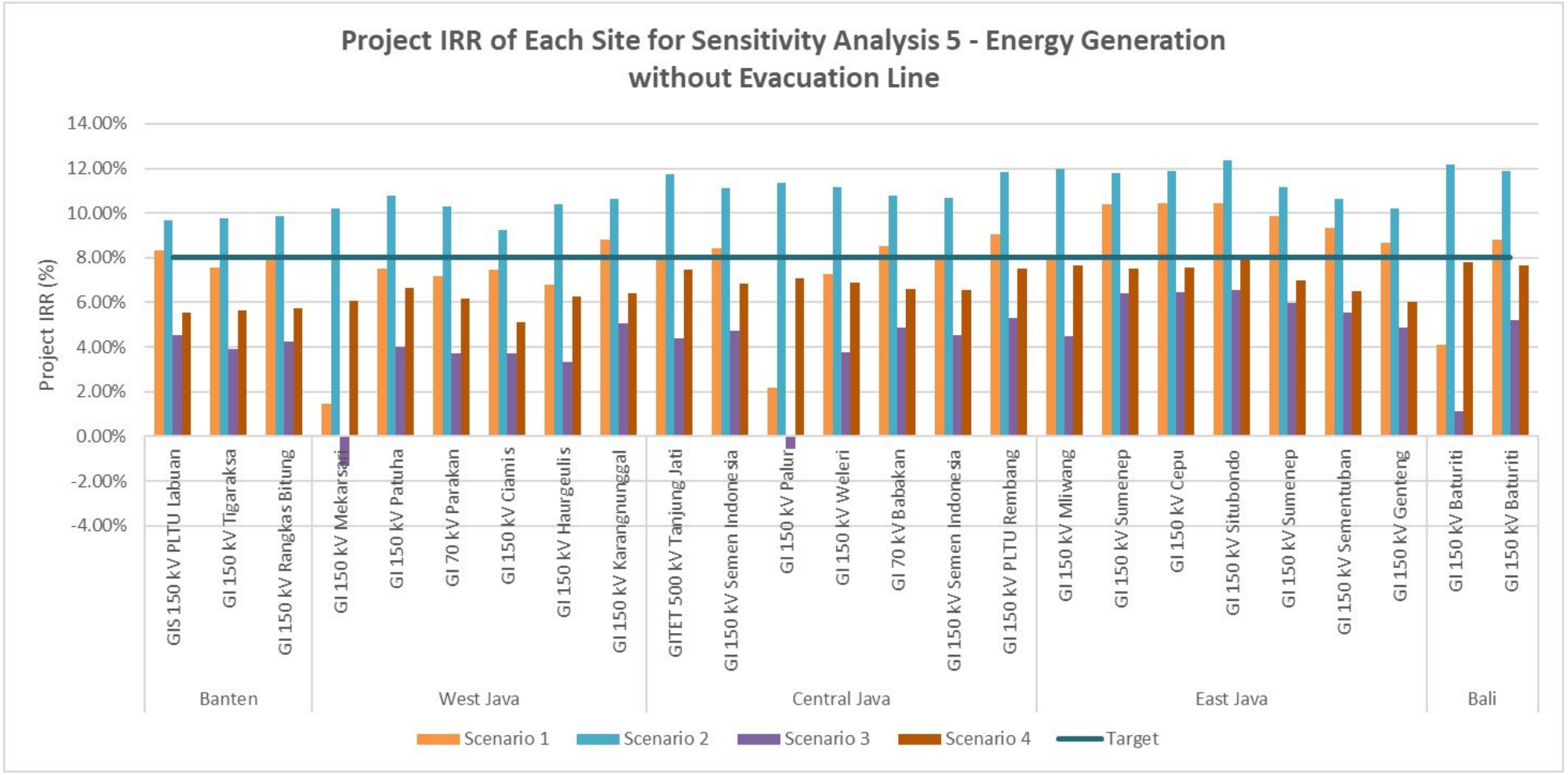
- With the change in all assumptions, two sites (GIS 150 kV PLTU Labuan (S_id 8) and GI 150 kV Mekarsari (S_id 24)) are feasible. GIS 150 kV PLTU Labuan (S_id 8) is feasible for scenario 1 and 2 while GI 150 kV Mekarsari (S_id 24) is only feasible for scenario 2.
- These analysis shows that by changing all assumptions has positive impact on the overall feasibility of the project and improves the overall IRR of all 25 sites.

Note: numbers in black indicate that the project is financially feasible, while numbers in red indicate that the project is not financially feasible.

*Gross Energy for the First Year of Operation

Sensitivity Analysis 5 – Energy Generation (Exc. Evac. Line Capex Scenario)

The sensitivity analysis has been performed for 25 sites in base scenario with the change of energy generation assumption . The results are as follows:



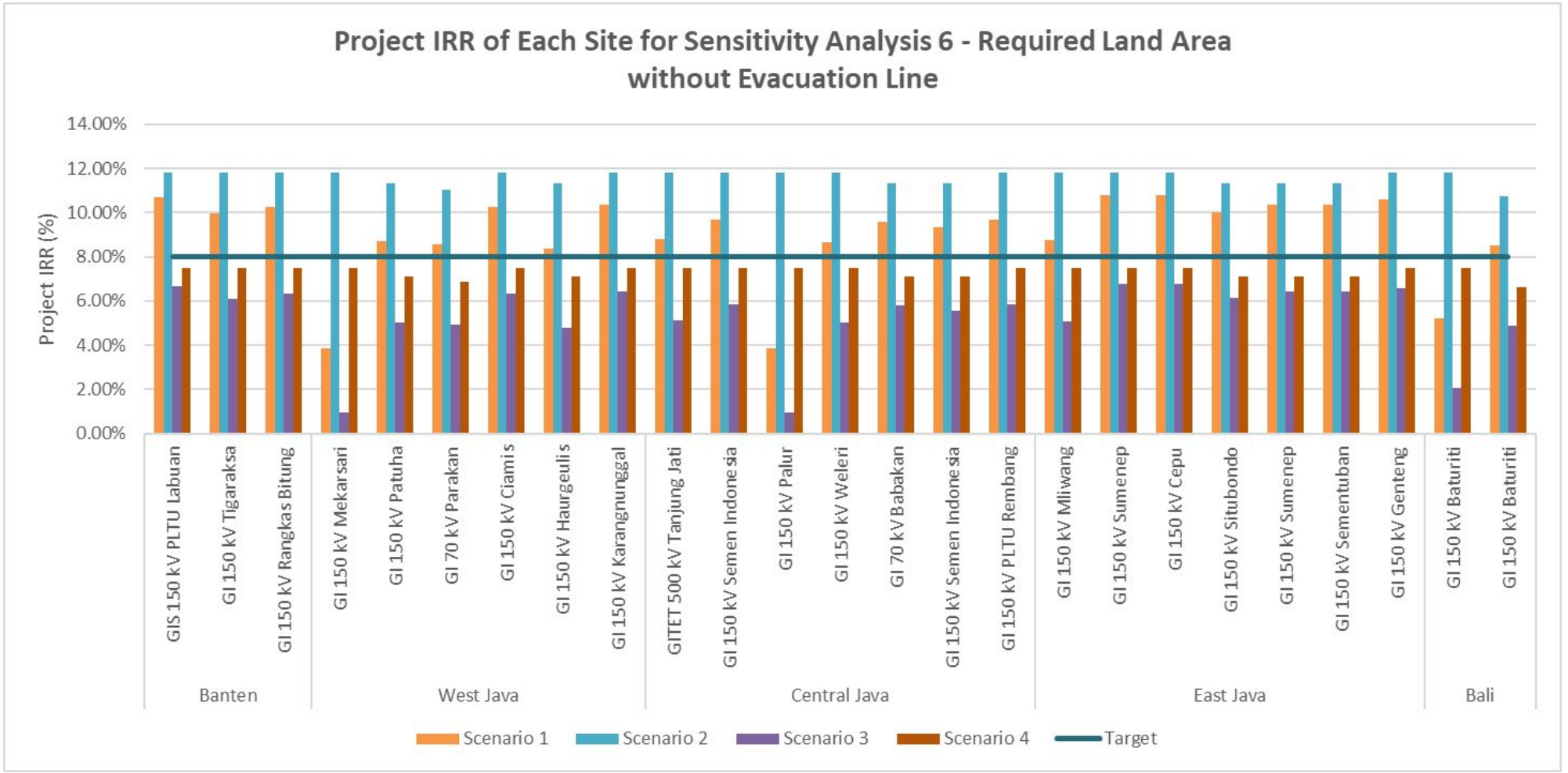
Key Points:

- Without the CAPEX for the evacuation line and the change in assumptions for energy generation, three sites with total capacity of 275 MW are feasible if we use the base price of 6.95 cents USD/kWh. 21 sites that use the base price with government lands, with a total capacity of 1.8 GW are feasible.
- With the exclusion of the evacuation line CAPEX and change in assumptions for energy generation, the project is still not feasible if the lower tariff of 5.50 cents USD/kWh is used, as shown in the results from Scenarios 3 and 4.

Note: numbers in black indicate that the project is financially feasible, while numbers in red indicate that the project is not financially feasible.
*Gross Energy for the First Year of Operation

Sensitivity Analysis 6 – Land Area Required (Exc. Evac. Line Capex Scenario)

The sensitivity analysis has been performed for 25 sites in base scenario with the change of land area required assumption . The results are as follows:



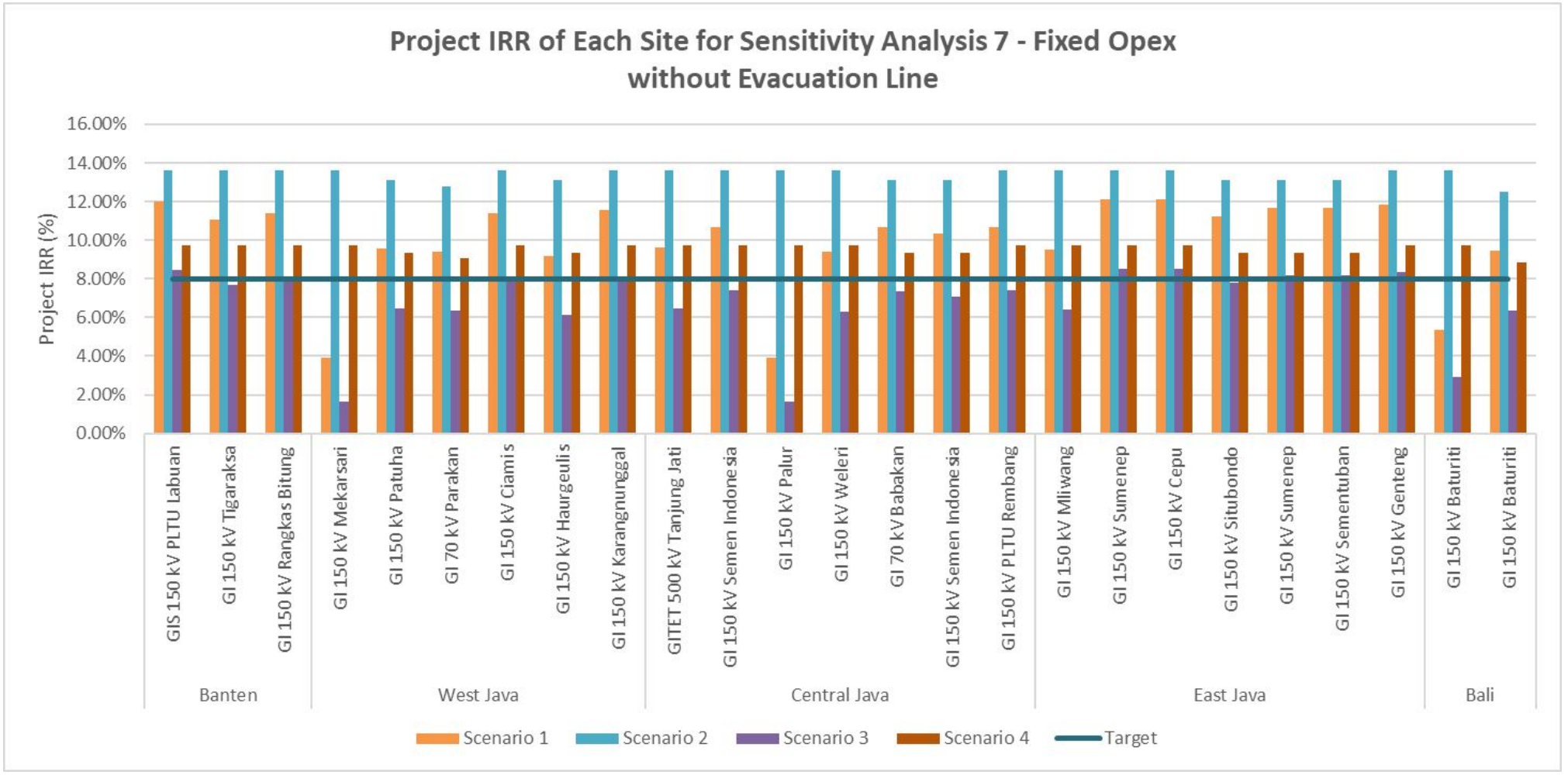
Key Points:

- Without the CAPEX for the evacuation line and the change in assumptions for required land per MW, 9 sites with total capacity of 0.85 GW are feasible if we use the base price of 6.95 cents USD/kWh. All 25 sites that use the base price with government lands, with a total capacity of 2.2 GW are feasible.
- With the exclusion of the evacuation line CAPEX and change in assumptions for required land per MW, the project is still not feasible if the lower tariff of 5.50 cents USD/kWh is used, as shown in the results from Scenarios 3 and 4.

Note: numbers in black indicate that the project is financially feasible, while numbers in red indicate that the project is not financially feasible.
*Gross Energy for the First Year of Operation

Sensitivity Analysis 7 – Fixed Opex (Exc. Evac. Line Capex Scenario)

The sensitivity analysis has been performed for 25 sites in base scenario with the fixed opex assumption . The results are as follows:



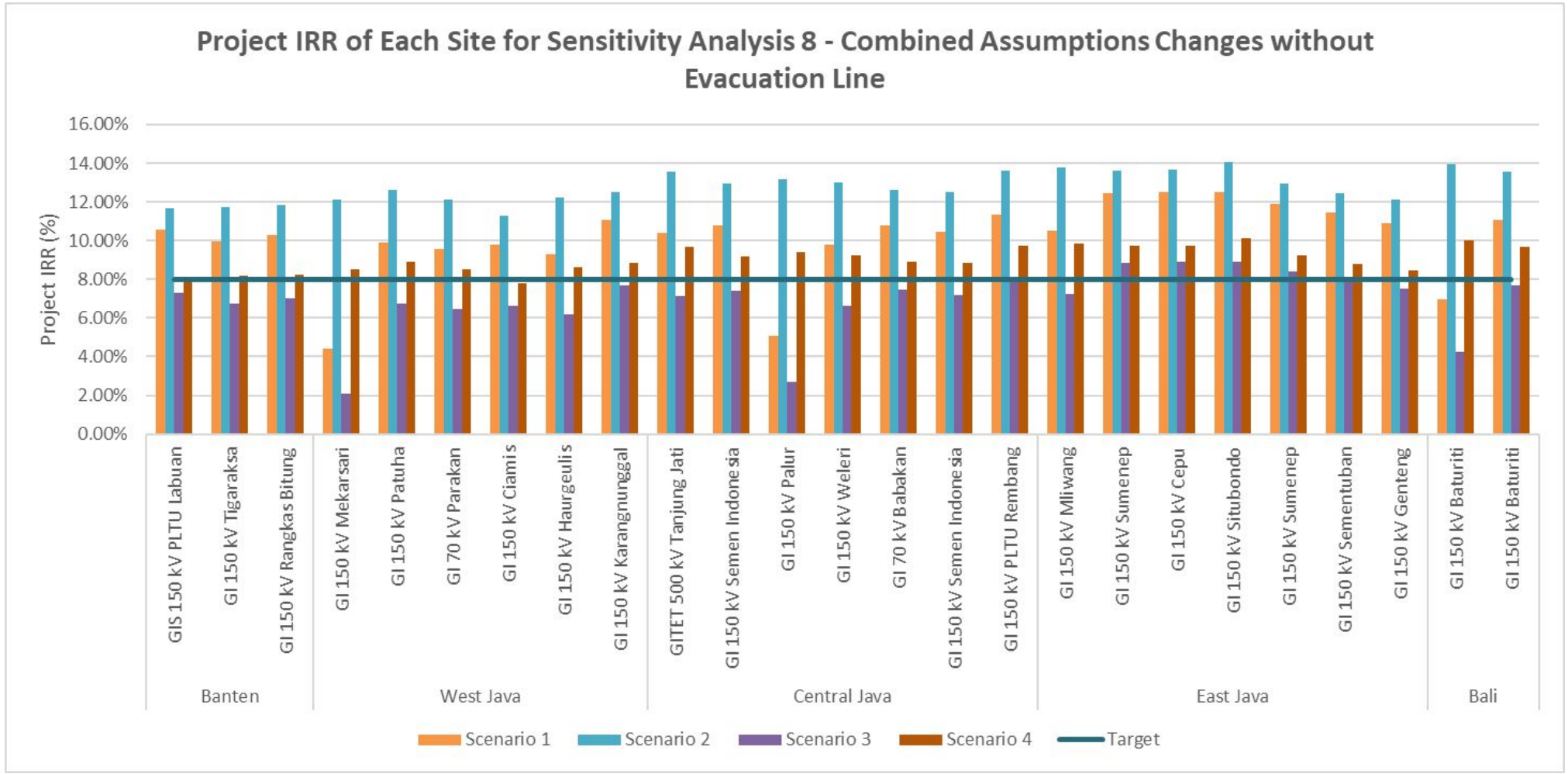
Key Points:

- Without the CAPEX for the evacuation line and the change in assumptions for fixed opex, 15 sites with total capacity of 1.4 GW are feasible if we use the base price of 6.95 cents USD/kWh. All 25 sites that use the base price with government lands, with a total capacity of 2.2 GW are feasible.
- With the exclusion of the evacuation line CAPEX and change in assumptions for fixed opex, the project is still not feasible if the lower tariff of 5.50 cents USD/kWh is used, as shown in the results from Scenarios 3 and 4.

Note: numbers in black indicate that the project is financially feasible, while numbers in red indicate that the project is not financially feasible.
*Gross Energy for the First Year of Operation

Sensitivity Analysis 8 – Combined Assumptions (Exc. Evac. Line Capex Scenario)

The sensitivity analysis has been performed for 25 sites in base scenario with all three combined assumptions . The results are as follows:

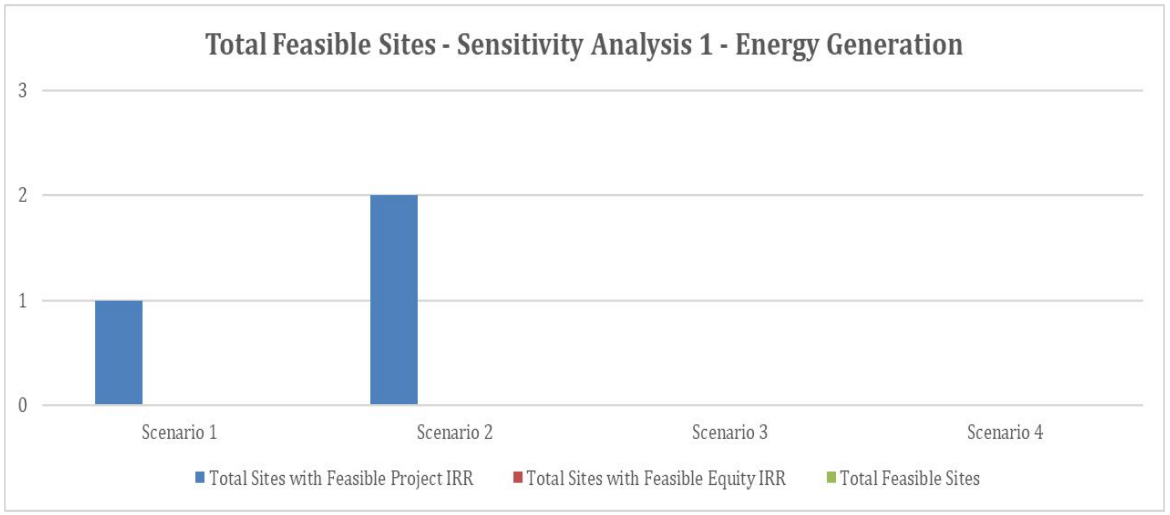


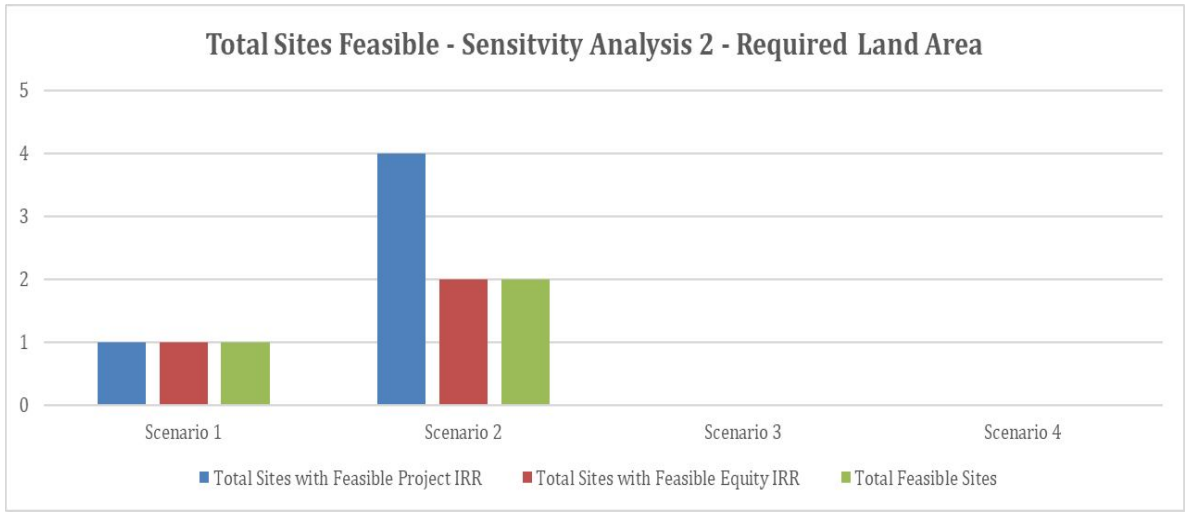
Key Points:

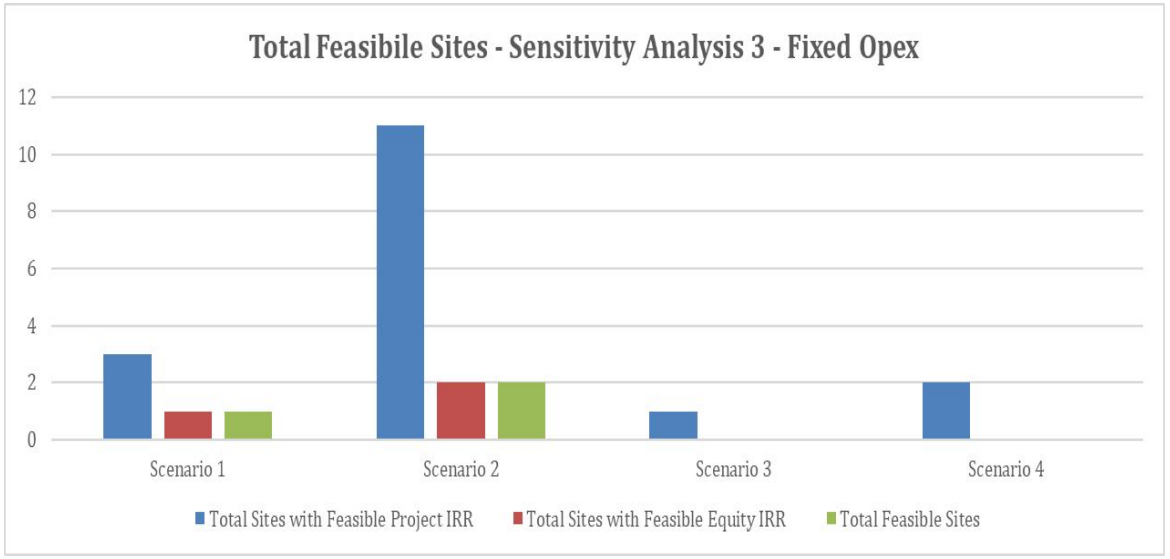
- Without the CAPEX for the evacuation line and the change in all assumptions, 16 sites with total capacity of 1.4 GW are feasible if we use the base price of 6.95 cents USD/kWh. All 25 sites that use the base price with government lands, with a total capacity of 2.2 GW are feasible.
- With the exclusion of the evacuation line CAPEX and change in all assumptions, the project is still not feasible if the lower tariff of 5.50 cents USD/kWh is used, as shown in the results from Scenarios 3 and 4.

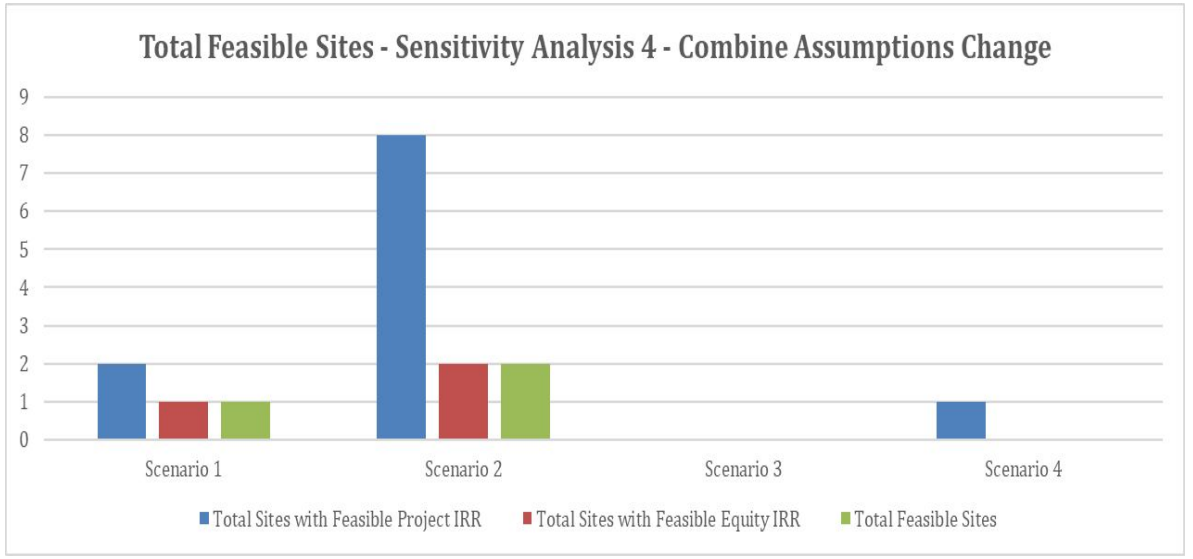
Note: numbers in black indicate that the project is financially feasible, while numbers in red indicate that the project is not financially feasible.
*Gross Energy for the First Year of Operation

Summary: Total Feasible Sites for Each Sensitivity Scenario (1/2)

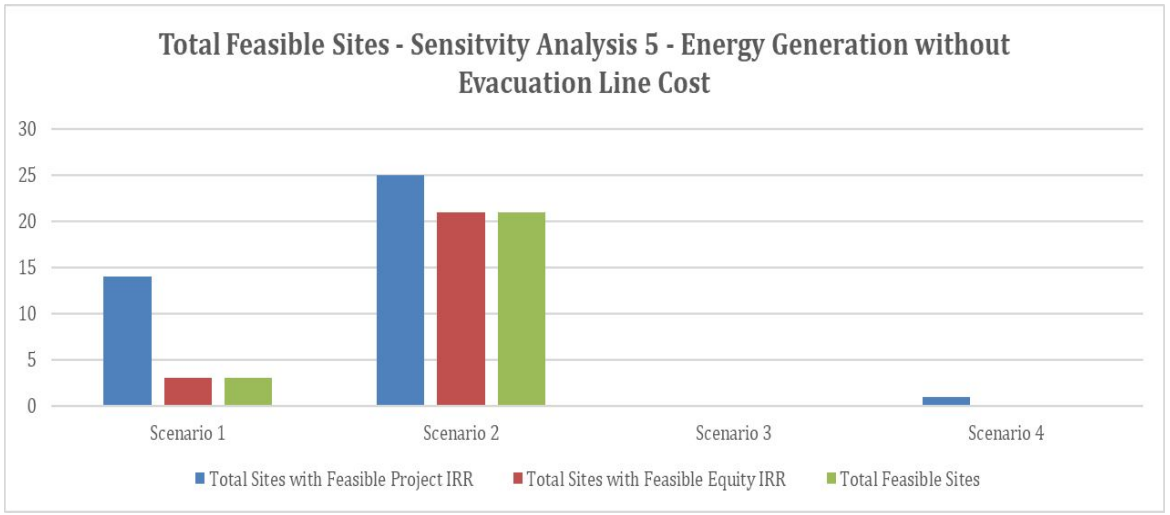


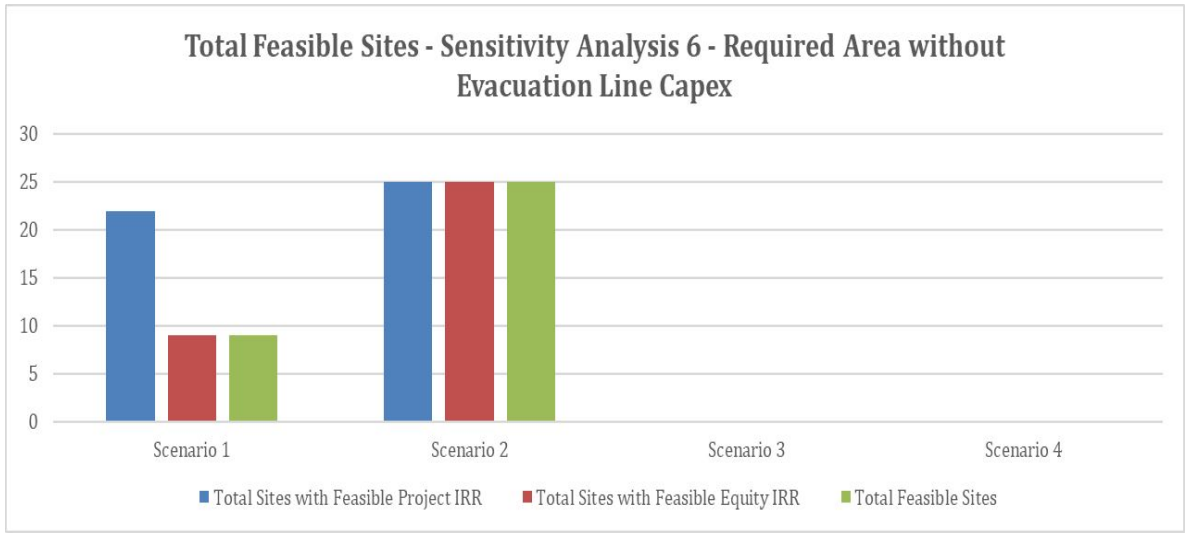


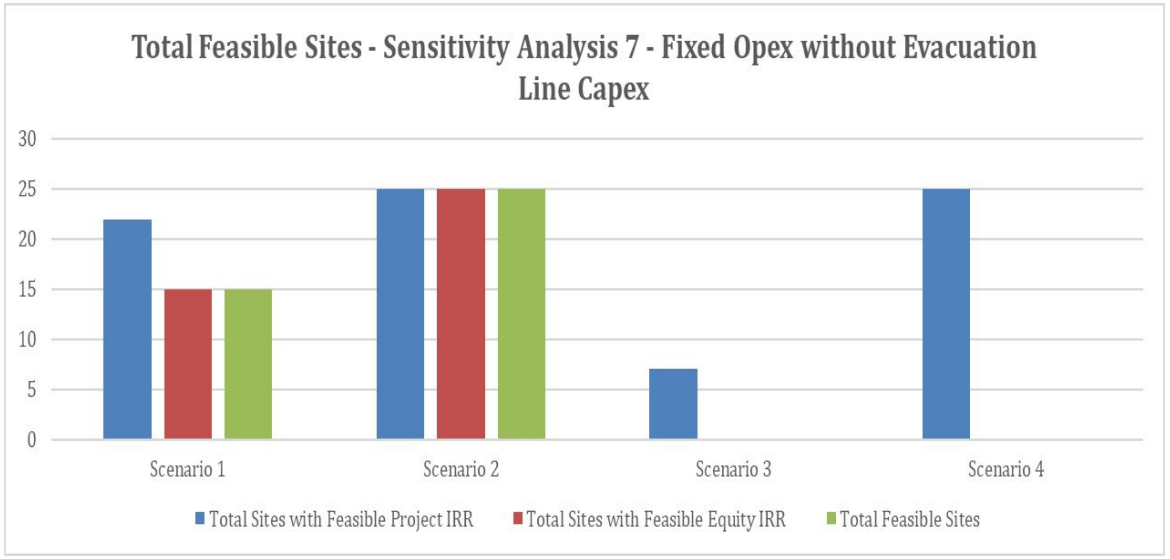


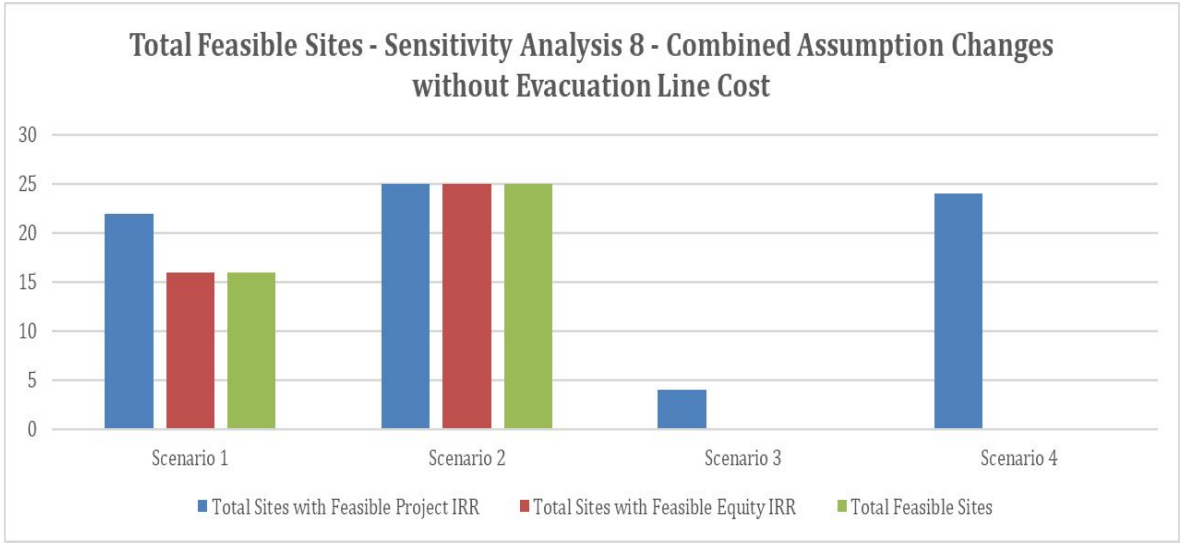


Summary: Total Feasible Sites for Each Sensitivity Scenario (2/2)









Financial Feasibility Challenges & Proposed Solution

to Improve Financial Result

Financial Feasibility Challenges for Solar PV Development in JAMALI

Tariff	Ceiling price as regulated in Perpres 112/2022 does not align with the market conditions. Furthermore, the tariff is set to be flat for the first 10 years then decreases and remains flat from Year 11 onwards. This structure does not align with operational realities, where O&M costs are likely to increase over time due to factors such as inflation.
High Loan Interest Rate	Indonesia's loan interest rate is the highest among other countries in ASEAN and significantly higher than China, due to limited competitions, with one of the reasons because of the limited number of foreign banks in Indonesia and a shallow foreign exchange market which means Indonesian banks cannot effectively hedge any foreign currency-based loans
Land Price & Evacuation Line Cost	High land capex is the result of high land price in Jamali Area especially in Industrial and Tourism Area while High evacuation line cost is the result of far distance to the existing substation. High Land and Evacuation Line Capex will increase the overall Capex thus reducing the overall feasibility of the project.
Investment schemes and financing mechanisms	Lack of attractive investment schemes and financing mechanisms poses a barrier to scaling solar PV development. Different investment schemes and financing schemes will be needed especially if the results of feasibility study yields small number of feasible sites for the project.

Prioritization and estimated timeline definition

The priority level and estimated time required to implement suggested solutions are defined in the table below.

Priority level:

Priority	Indicator
High	Red
Moderate	Yellow
Low	Green

Estimated timeline:

Estimated Timeline to Implement the Suggested Measures	Definition
Short term	Challenges that take 1-2 years to address, involving straightforward and not complex solutions. These are the “low-hanging fruits”.
Mid term	Challenges that take 3-5 years to address, involving more intricate solutions that may require additional effort
Long term	Challenges requiring long-term solutions that may take 5 years or more to address, involving complex changes and multiple stakeholders

Proposed Solution to Improve Financial Results (1/4)

	Challenges	Proposed Improvement	Relevant institution	Priority	Estimated timeline to implement the suggested measure
1	Ceiling price as regulated in Perpres 112/2022 does not align with the market conditions	• Adjust the ceiling price to reflect the true cost of generation or by having a flat tariff for the whole concession period • Conduct discussions with developers on developing a pricing structure suitable for the market conditions	MEMR, PLN	High Priority	Mid Term
2	High Loan Interest Rate	• Liberalisation and deepening of the foreign exchange market to reduce the differential between USD and IDR interest rates • Macro-economic policy to have a controlled inflation forecast for 2025 and 2026 within the target range of 2.5±1% and the stable Rupiah exchange rate	MoF	Moderate Priority	Long Term

Proposed Solution to Improve Financial Results (2/4)

	Challenges	Proposed Solutions	Relevant institution	Priority	Estimated timeline to implement the suggested measure
2	High Loan Interest Rate	• Strengthening the interest rate structure of the Rupiah money market to maintain attractive yields and increase portfolio inflows to domestic financial assets • Strengthening the payment system infrastructure and expanding digital payment acceptance	MoF	Moderate Priority	Long Term
3	Land Price and Evacuation Line Cost	• PLN to install substations close to some planned solar PV clusters prior to the solar PV development • Exclude costs of evacuation line from the ceiling price calculation • Consider utilising government-owned land or mandate ministries with unused land to make it available for solar PV development projects	MEMR, MoEF, other government institutions who have available and suitable land	High Priority	Mid Term

Proposed Solution to Improve Financial Results (3/4)

	Challenges	Proposed Improvement	Relevant institution	Priority	Estimated timeline to implement the suggested measure
3	Land Price and Evacuation Line Cost	• Provide the developer with an in-principal agreement on the tariff that would be agreed in the PPA, so the developer could calculate the maximum land price that could be paid • Earmark revenue from carbon tax for projects to achieve the NZE, including for solar PV development • Consider having a Viability Gap Fund (VGF) to finance some parts of the CAPEX (i.e., the land or the evacuation line costs) if the tariff reform is not possible. • Consider development of floating solar PV to minimise land use	MEMR, MoEF, other government institutions who have available and suitable land	High Priority	Mid Term

Proposed Solution to Improve Financial Results (4/4)

	Challenges	Proposed Improvement	Relevant institution	Priority	Estimated timeline to implement the suggested measure
4	Lack of attractive investment schemes and financing mechanisms	• To consider alternative investment schemes and financing mechanisms for the project such as for some of the capex to be provided by the government, use of VGF to help finance some of the capex, land renting scheme from local government at a low or zero lease fee, use of blended finance, and use of guarantees.	Ministry of Finance, MoEF, PLN, Danantara	Moderate Priority	Mid Term

Proposed Investment and Financing Scheme

Proposed Investment and Financing Scheme

To address the identified challenges, the following five investment and financing schemes have been proposed:

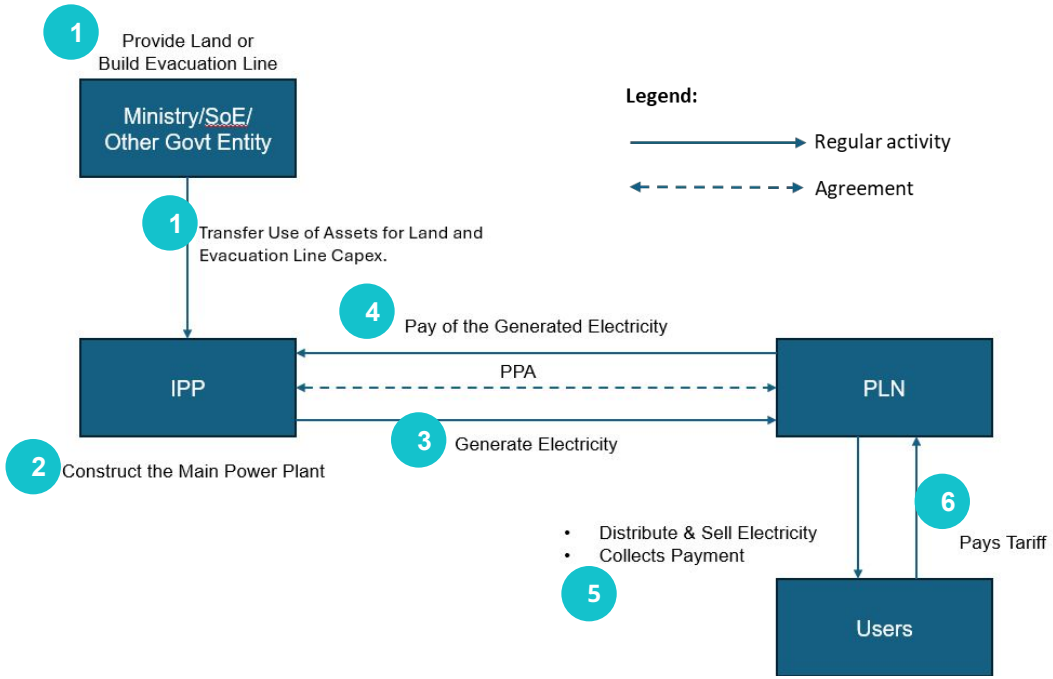
1. Investment and Financing Scheme 1: Land or evacuation line to be provided by certain ministry/government institution/SoE prior to the development of the main power plant;
2. Investment and Financing Scheme 2: Portion of the capex to be financed through a VGF by the MoF; and
3. Investment and Financing Scheme 3: IPP and/or PLN to rent the land owned by the local government.
4. Investment and Financing Scheme 4: Use of blended finance; and
5. Investment and Financing Scheme 5: Use of guarantees.

Summary of each investment and financing scheme is as below:

Investment & Financing Scheme	Support Provider	Form of Support
1	Ministry/SoE/other government institution	Provision of land or construction of evacuation line
2	Ministry of Finance	Viability Gap Fund (VGF) for certain portion of the capex, preferably for the land provision or evacuation line construction
3	Local government	Land provision
4	Multilateral Development Institutions	Provide Concessional Financing
5	Ministry of Finance	Provide Political Risk Guarantee

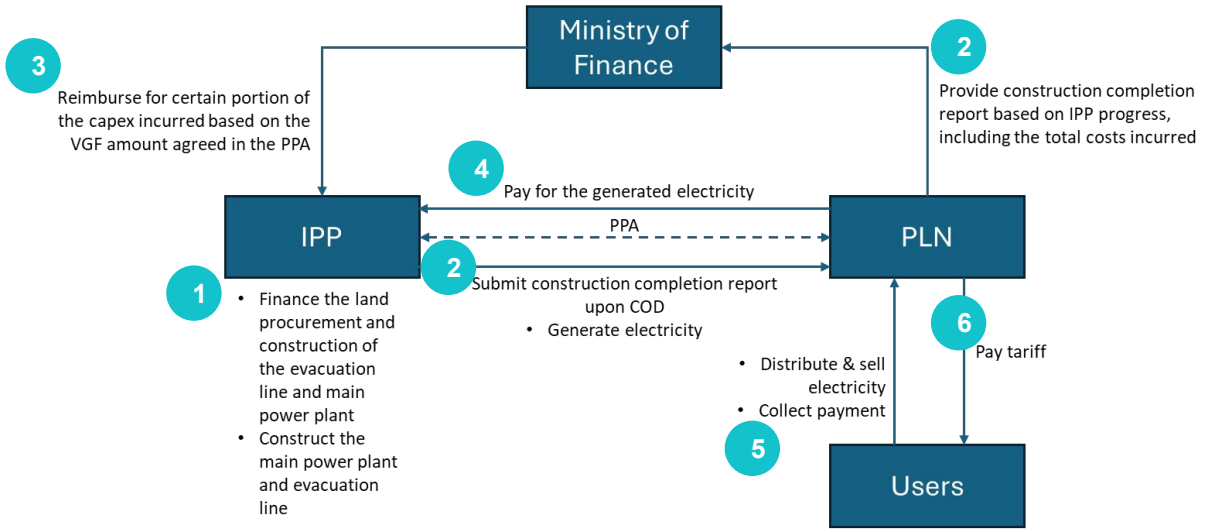
Proposed Investment and Financing Scheme 1 and 2

Proposed Investment and Financing Scheme 1



1. Certain ministry/government institution/SoE provides land or build the evacuation line prior to the construction, then transfer it to the IPP
2. IPP finances and builds the main power plant
3. IPP generates electricity upon the start of the commercial operation date (COD) during the concession period as agreed in the PPA
4. PLN pays IPP for the electricity generated by the IPP
5. PLN distributes and sells the electricity to the users then collect the payment based on the regulated tariff.
6. Users pay tariff to PLN based on their consumption

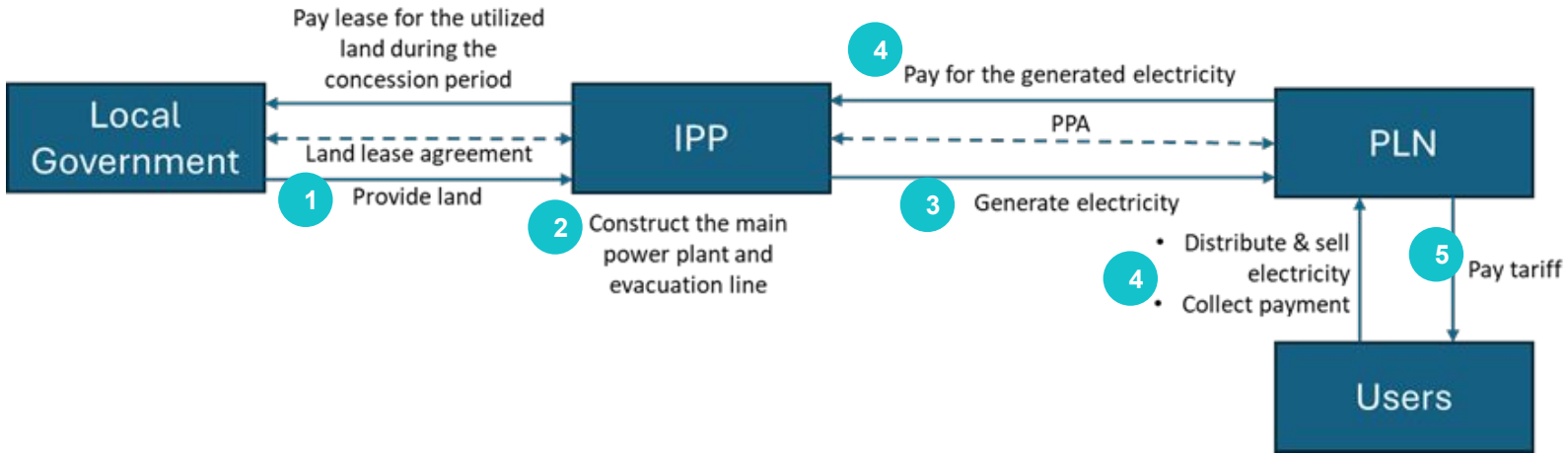
Proposed Investment and Financing Scheme 2



1. IPP procures the land and constructs the main power plant as well as the evacuation line using its own capital.
2. Upon COD, IPP will then need to submit construction completion report to PLN, who will submit it to the MoF as proof for the VGF payment to the IPP.
3. MoF pays VGF to the IPP
4. PLN pays IPP for the electricity generated by the IPP
5. PLN distributes and sells the electricity to the users then collect the payment based on the regulated tariff.
6. Users pay tariff to PLN based on their consumption

Proposed Investment and Financing Scheme 3

Proposed Investment and Financing Scheme 3

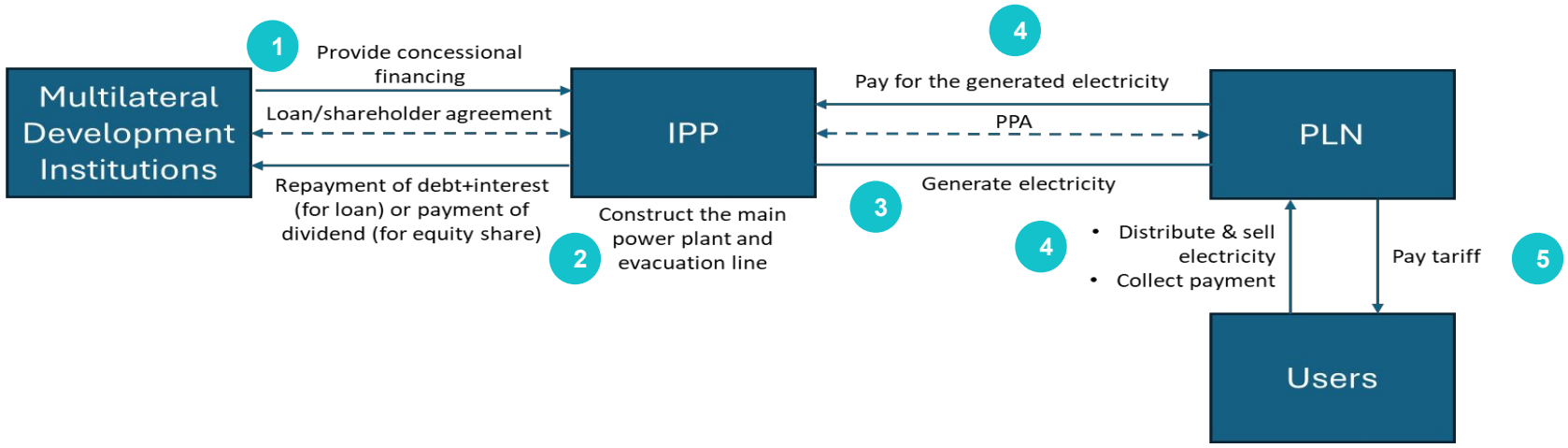


1. Local government provides the land
2. IPP constructs the main power plant and the evacuation line
3. IPP generates the electricity
4. PLN pays for the electricity generated by the IPP, then distribute and sell it to the users
5. The users pay tariff for the consumed electricity.

However, after the concession period ends and upon the asset transfer from the IPP to the PLN (on a Build-Transfer-Operate/BOT scheme), should the power plant continue to be operated by PLN, PLN will need to continue paying for the land lease to the local government.

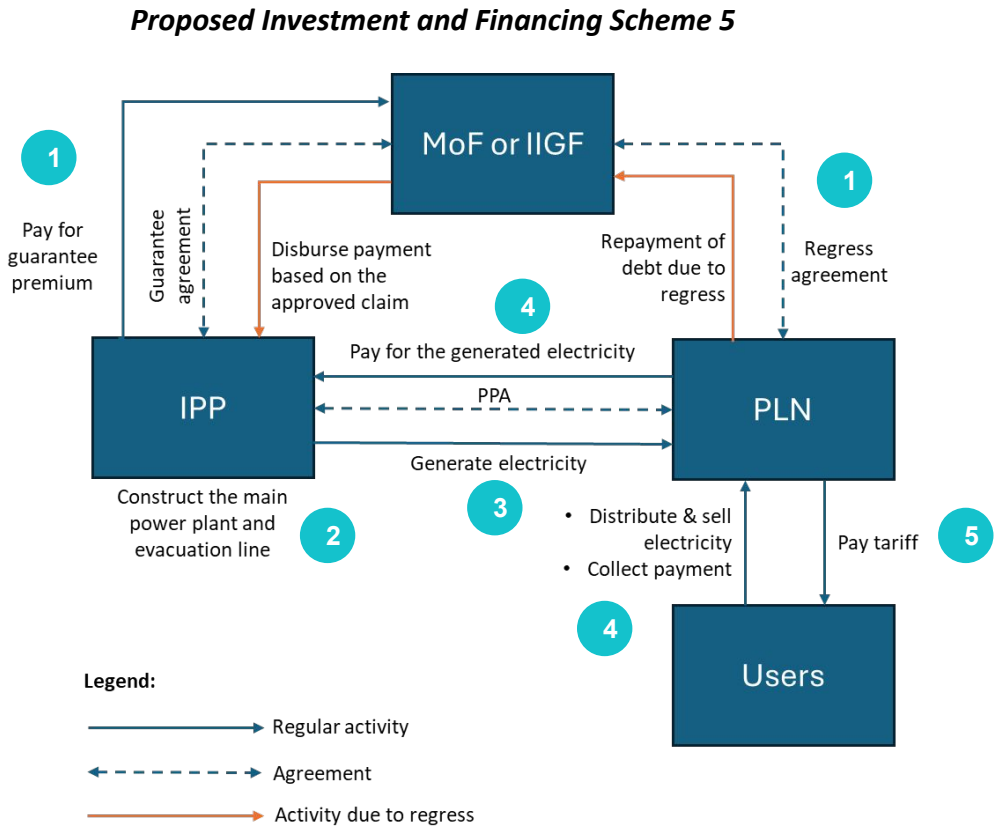
Proposed Investment and Financing Scheme 4

Proposed Investment and Financing Scheme 4



1. Multilateral Development Institutions provides the concessional financing
2. IPP constructs the main power plant and the evacuation line
3. IPP generates the electricity
4. PLN pays for the electricity generated by the IPP, then distribute and sell it to the users
5. The users pay tariff for the consumed electricity.

Proposed Investment and Financing Scheme 5



1. IPP enter an agreement with MoF or IIGF for guarantee agreement and PLN enter an agreement with MoF or IIGF for regress agreement. PLN will pay MoF or IIGF for the regress agreement and will disburse payment based on the approved claim.
2. IPP constructs the main power plant and the evacuation line
3. IPP generates the electricity
4. PLN pays for the electricity generated by the IPP, then distribute and sell it to the users
5. The users pay tariff for the consumed electricity.

Pros and Cons of The Proposed Investment and Financing Schemes

Investment & Financing Scheme	Support Provider	Form of Support	Pro	Cons
1	Ministry/SoE/other government institution	Provision of land or construction of evacuation line	Reduction in the development cost, leading to potentially better return to IPP at the same tariff level	PLN would need to find additional source of funds to purchase the land and/or to construct the evacuation line
2	MoF	VGF for a certain portion of the CAPEX, preferably for the land provision or evacuation line construction	Potentially gives better return to IPP at the same tariff level	• Project preparation and feasibility study might take longer than usual to account for the VGF in-principal approval from the MoF prior to the procurement • IPP would need to cover for the capex first, as VGF could only be claimed after the COD
3	Local government	Land provision	• Reduction in the development cost, leading to potentially better return to IPP at the same tariff level • Potentially lower E&S risks than utilising non-government land	PLN might need to consider other type of incentives to be given to the local government in exchange for the land provision, e.g., shares in the IPP for the Regional-owned Enterprise (Badan Usaha Milik Daerah/BUMD)
4	Multilateral development institutions (e.g., ADB, IFC) or bilateral institutions (e.g., KfW Development Bank, PT SMI) and Investment Wealth Fund (Danantara)	Provision of concessional finance that could be combined with purely commercial finance (blended finance)	Lower loan interest or requested equity return than conventional financing, providing the IPP with better return at the same tariff level	IPP needs to enter into several financial agreements with multiple parties
5	MoF, IIGF or other such institutions	Provision of guarantee	Provides the investors with more certainty on the return, hence improving the project's bankability	Potential additional cost for the guarantee premium

Relevant Institutions for the Proposed Solutions

No	Stakeholder	Roles and Responsibilities
1	Ministry of Energy and Mineral Resources (MEMR)	• Develops and enacted regulation in relation with electricity tariff • Evaluates the tariff proposed by the IPPs should it be higher than the ones regulated under the Perpres 112/2022 • Approves or disapproves tariff proposed by the IPPs in accordance with the evaluation results
2	Ministry of Finance (MoF)	• Provides financial incentives and subsidies for renewable energy including solar PV projects • manages the budget allocation for renewable energy projects • Facilitates access to international funding and investment for solar PV development. • Provides government guarantee for PLN default risk
3	PT PLN (Persero)	• Purchases electricity from IPPs through PPAs.
4	Independent Power Producers (IPPs)	• Develops, finances, and operates solar PV projects and enter into power purchase agreements (PPAs) with PT PLN or other off-takers.
5	Local Government	Determines the land utilization price and mechanism (either sale or rent) for sites that will be used for solar PV development under their respective authority
6	Association and Industry Players	Advocates for favourable policies and regulations for the solar PV industry, including on the ceiling price.
7	Multilateral development institutions (e.g., Asian Development Bank, International Finance Corporation) or bilateral institutions (e.g., KfW Development Bank, PT SMI) and Investment Wealth Fund (Danantara)	• Offer loans with a longer tenor and lower interest rate than commercial banks or accept a lower return on equity • May provide support at the project preparation stage
8	BUPI (e.g., IIGF)	Provides political and/or PLN default risk guarantees

Action Plan for the Proposed Solutions

Action Plan for The Proposed Solutions: Financial (1/2)

Action Plan	Year					Role of Stakeholder									
	1	2	3	4	5	MEMR	PLN	MoF	MoEF	Local government	IPP	Association & Industry	Multilateral development institutions or bilateral institutions	IIGF	Danantara
Tariff															
Conduct a feasibility study and discussion with IPPs to ensure that the tariff can match the market condition						C	R/A	I	-	-	C	C	-	-	-
Determine a tariff that is aligned with the market condition						R/A	C	R	-	-	C	I	-	-	-
Piloting project using the new tariff structure						C	R/A	C, I	-	I	C	I	-	-	-
Land and Evacuation Line Capex															
Map potential government-owned land to be used for solar PV projects						A	R	-	C	C	C	C	-	-	-
Discuss with government institutions who own the potential land						C	R/A	C	C	C	I	I	-	-	-
Develop draft regulation to mandate ministries with unused land to make it available for solar PV development projects						R/A	C	C	C	C	C	C	-	-	-
Pilot project to implement the new regulation on government-own land for solar PV projects						A	R	-	C	C	C	C	-	-	-
Discuss with relevant stakeholders the potential to have a Viability Gap Fund (VGF) to finance some parts of the capex (i.e., the land or the evacuation line costs)						R	C	R/A	-	-	C	I	-	-	-
Develop draft regulation for a VGF for solar PV development projects						R	C	R/A	-	-	C	I	-	-	-
Pilot project to implement the new regulation on VGF for solar PV projects						C	R	R/A	-	-	C	I	-	-	-

Action Plan for The Proposed Solutions: Financial (2/2)

Action Plan	Year					Role of Stakeholder									
	1	2	3	4	5	MEMR	PLN	MoF	MoEF	Local government	IPP	Association & Industry	Multilateral development institutions or bilateral institutions	IIGF	Danantara
Investment Scheme and Financing Mechanism															
Discuss with relevant stakeholders regarding the improvement of investment schemes and financing mechanisms.						C	R/A	C	-	C	C	C, I	-	-	-
Develop draft regulations for the new investment scheme and financing mechanism						R/A	C	C	-	C	C	I	-	-	-
Pilot project to implement the new regulation on investment scheme and financing mechanism						C	R/A	C	-	C	C	I	-	-	-
Use blended finance combining concessional sources with purely commercial finance						I	R/A	-	-	-	I	-	C	C	C
Use of guarantees						I	R/A	-	-	-	I	-	C	C	-
Explore other support options from Danantara						-	R/A	-	-	-	-	-	-	-	C

Power Purchase Agreement (PPA)

Landscape of the Current Solar PV Development PPA

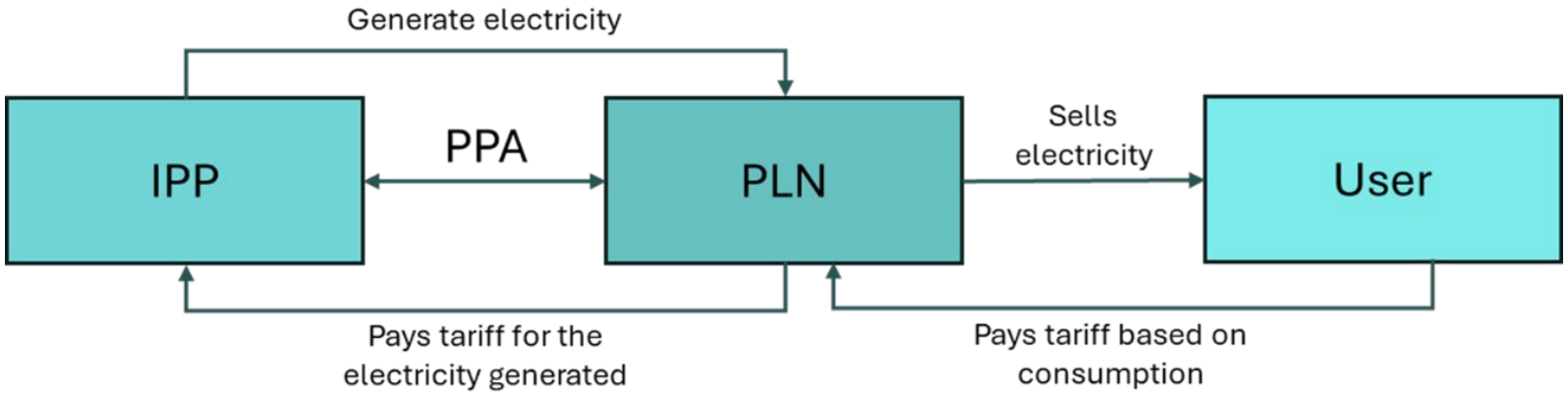
Current Setting

A Power Purchase Agreement (PPA) involves 2 actors:

PLN
- has rights to transport, distribute, and retail electricity in Indonesia.
- Uses power from its own generation assets or buys the electricity generated by IPPs.

IPPs
- Special-purpose companies (SPCs) formed by developers who are awarded the project by PLN during the procurement stage.
- Must enter a long-term PPA with PLN to sell electricity and obtain budget security for project financing.

Common project structure:



Relevant Stakeholders

No	Stakeholder	Roles and Responsibilities
1	Ministry of Energy and Mineral Resources (MEMR)	• Develops, implements, and oversees implementation of policies and regulations for energy and mineral resources, including issues regulations that govern the PPA structure, namely MEMR Regulation No. 5 of 2025. • Develops RUEN and RUKN, as stipulated in Government Regulation No. 73 of 2023 and MEMR Regulation No. 8 of 2021. • Responsible for the ratification of PLN's RUPTL.
2	PT PLN (Persero)	• Signs PPAs with IPPs • Purchases electricity from IPPs based on the agreed tariff in the PPAs
3	Independent Power Producers (IPPs)	• Develop, finance, and operate solar PV projects • Enter into PPAs with PLN or other off takers
4	Financiers and International Development Agencies (IDAs) (e.g., conventional banks, private equity firms, venture capitalists, etc.)	• Evaluates draft PPA terms to assess financial viability and risks, as well as negotiating conditions to mitigate risks

Regulatory Framework

No	Regulation/Framework	Remarks
Electricity and renewable energy in general		
1	Law No. 30 of 2009 on electricity	• Regulates various aspects of electricity in Indonesia, including generation, transmission, distribution, and sales.
2	Presidential Regulation No. 112 of 202	• Regulates the ceiling price for renewable energy, including solar PV.
3	MEMR regulation No.50 of 2017 (amended by MEMR regulations No.53 of 2018 and No. 4 of 2020)	• Focuses on utilising renewable energy resources for electricity production, including solar PV. It stipulates the maximum tariff and minimum capacity/availability factor of renewable energy sources, the IPP selection/bidding process, and the power purchase scheme.
PPA		
4	MEMR Regulation No. 5 of 2025	• Replaces the PPA provisions under MEMR Regulation No. 10 of 2017 (and its amendments) and establishes comprehensive guidelines for PPAs with renewable energy power plants. Details of the regulation are explained in Section 2.2.2.
5	PLN Director's Regulation No.22 of 2020 on Guidelines for Procurement of Goods/Services	• Provides comprehensive guidelines for the procurement of goods and services by PLN, including the required contents of the PPAs between them and the IPPs.
6	PLN Director's Regulation No. 62 of 2020 on the Purchase of Electricity from New and Renewable Energy Power Plants	• Incorporates required provisions in the PPAs for purchasing electricity from new energy sources. • Establishes guidelines for acquiring electricity from new and renewable energy generators.
Government guarantee		
7	Ministry of Finance Regulation No. 5 of 2025	• Stipulates a government guarantee and risk mitigation mechanism to accelerate the development of renewable energy projects for electricity supply in Indonesia, including solar PV power plants.

Risk Allocation in The PPA (1/5)

Risk allocation in the PPA is governed by the recently issued MEMR Regulation no 5/2025, as amendment to the MEMR Regulation No. 10 of 2017.

- Key changes of the risk allocation is as below.

Clause	MEMR Regulation No. 10 of 2017	MEMR Regulation No. 5 of 2025	Remarks
Article 5 - PPA Terms	PPA is executed for a maximum period of 30 years, starting from the COD, taking into account the type of power plant used.	PPA is executed for a maximum period of 30 years, calculated from the COD, as determined by PLN, considering the project's economic feasibility and the type of power plant utilised. In the event of an extension of the PPA, the electricity sales price for the extended period will be based on the highest price after the 10th year (stage 2).	MEMR Regulation 5/2025 emphasizes that if the PPA term is extended, the electricity price during the extension period will be based on the price from Stage 2 (after 10 years).
Article 6 - Cooperation Scheme	PPA shall utilise the Build, Own, Operate, Transfer (BOOT) model.	PPA shall utilize the Build, Own, Operate (BOO) model; or other development and operation models, based on the agreement of the parties, taking into account the type of power generation facility.	Under MEMR Regulation 5/2025, PPA cooperation scheme is governed flexibly, by the agreement between PLN and the IPP, in contrast to MEMR Regulation 10/2017, which is governed in a more rigid manner.
Article 7 – Incentive of COD Acceleration (Rights and Obligations of IPP)	IPP as seller has the rights: a. ... b. To receive an incentive for the accelerated execution of COD, as requested.	[Removed]	The incentive for the accelerated execution of COD as the right of the IPP has been deleted in the MEMR Regulation 5/2025.

Risk Allocation in The PPA (2/5)

Clause	MEMR Regulation No. 10 of 2017	MEMR Regulation No. 5 of 2025	Remarks
Article 9 –Risk Allocation	The risks borne by PLN are as follows: Electrical power/load requirements a. Limited transmission capability b. Force Majeure The risks borne by the IPP are as follows: a. Land acquisition; b. Licensing and permits, including environmental permits; c. Fuel availability; d. Development schedule accuracy; e. Power plant performance; and f. Force majeure	The risks borne by PLN are as follows: a. Electrical power or load requirement; b. Readiness of the transmission and distribution system; and **c. currency exchange rate volatility.** Risks borne by the IPP are: a. Land acquisition; b. Permits, including environmental permits and land utilisation compliance with the spatial planning; c. Develop schedule accuracy; **d. Currency exchange;** e. Power plant performance; and f. Fuel availability and cost for biomass, biogas, biofuel, or geothermal	The currency exchange rate volatility is included as PLN's risk under the MEMR Regulation 5/2025. Risk related to the land utilisation compliance with the spatial planning should also be borne by the IPP in addition to the land acquisition risk.
Article 10 – Performance Securities	Project performance guarantee is done in 3 stages. No submission deadline is mentioned.	**Performance bond is required** to be given to PLN, with maximum value of 10% from the total project cost. All performance securities documents shall be submitted by IPP to PLN **on the effective date of the PPA**.	MEMR Regulation 5/2025 includes the requirement of performance bonds and emphasises the submission of performance securities by the IPP as conditions precedent for the PPA effective date.
Article 14 and Article 25 – Liquidated Damages	The calculation basis for Liquidated Damages is not specified.	Liquidated Damages shall be calculated on a daily basis for each day of delay, with a maximum imposition of **180 calendar days**. PLN reserves the right to terminate the PJBL if the Liquidated **Damages calculation reaches the maximum value**.	MEMR Regulation 5/2025 stipulates that the maximum duration for the imposition of liquidated damages is 180 calendar days, and if this period is exceeded, PLN has the right to terminate the PPA.

Risk Allocation in The PPA (3/5)

Clause	MEMR Regulation No. 10 of 2017	MEMR Regulation No. 5 of 2025	Remarks
Article 14 – Deemed COD	Not regulated	In the event of a delay in the required COD and the power plant being in a Deemed Commissioning status **due to certain conditions of PLN beyond force majeure, IPP shall be entitled to receive payment for the electricity deemed to have been supplied**, starting from the date it is considered to have commenced operations (**Deemed COD**).	Acknowledgement of the Deemed COD concept, which refers to a situation where the delay in COD is caused by PLN, such that the COD is still deemed to have occurred, and the IPP is entitled to receive payment.
Article 14 –Excess Energy	PT PLN (Persero) can purchase electricity exceeding the AF or CF stated in the PJBL **at a price based on an agreement between both parties.**	PLN purchases electricity exceeding CE or AF, with a maximum limit of the unit's rated capacity, subject to the following conditions: a. The purchase price of the electricity **shall not exceed 80% of the PPA tariff**; and b. It must **align with the electricity demand of the local power system**.	Excess energy that may be accepted by PLN and the corresponding payment to the IPP. The purchase price for excess energy will now be up to 80% of the agreed tariff in the PPA, as opposed to being based on negotiation in the previous regulation.
Article 17 and Article 18 – Grace Period and Curtailment for Deemed Dispatch	Not regulated	In the event that IPP is unable to deliver electricity due to Deemed Dispatch, PLN is obligated to pay for the electricity that could not be delivered due to Deemed Dispatch **based on the grace period applicable under the PPA**. IPP is entitled to Deemed Dispatch if a **curtailment is imposed by PLN**.	Emphasize that the deemed dispatch to be imposed is subject to the grace period and curtailment requirements beforehand.

Risk Allocation in The PPA (4/5)

Clause	MEMR Regulation No. 10 of 2017	MEMR Regulation No. 5 of 2025	Remarks
Article 26 – Transfer of Shares	The transfer of ownership rights over the IPP may not be made until the power plant reaches COD, except in the case of a transfer to an affiliate whose shares are owned by more than 90% by the sponsor (funding party), intending to transfer the shares.	The transfer of ownership rights over the IPP may not be made until the power plant reaches COD, except in the case of a transfer to an affiliate whose shares are owned by more than 90% by the sponsor (funding party) intending to transfer the shares; **and/or transfer to the lender (step-in rights for the lender) may occur in the event of a breach of contract (default) by IPP.**	In addition to the exception for transfer restrictions to affiliates whose shares are owned at least 90% by the sponsor, the transfer restriction exception also applies to the transfer of shares to the lender in the event of default by the IPP.
Article 30 – Dispute Settlement	Any dispute between PLN and the IPP shall be resolved through deliberation for consensus. If a resolution is not reached, the dispute shall be referred to an expert mutually agreed upon by both parties.	Any dispute between PLN and the IPP shall be resolved through deliberation for consensus **within 30 calendar days**. If a resolution is not reached, the dispute shall be referred to an expert **within 150 calendar days** mutually agreed upon by both parties.	Establishment of a timeframe for resolving disputes through deliberation for consensus , and through an expert
Article 34 – Environment Attributes or Carbon Economic Value	Not regulated	The rights to environmental attributes or the carbon economic value of a power plant utilizing renewable energy sources shall be exercised **in accordance with the provisions of applicable laws and regulations or as agreed upon by the parties**.	Emphasise the utilisation of the environmental attributes or the carbon economic value of a renewable power plant.

Risk Allocation in The PPA (5/5)

Clause	MEMR Regulation No. 10 of 2017	MEMR Regulation No. 5 of 2025	Remarks
Article 35 –Refinancing	Not regulated	To optimise the implementation of renewable energy electricity supply activities, IPP may carry out refinancing in the form of a **financing arrangement** between the IPP and the lender, and shall inform PLN accordingly.	Recognition of the refinancing option by the IPP.
Article 36 – Language	Not regulated	PPA shall be drafted in **Indonesian and, if necessary, in a foreign language**. In the event of any discrepancy, the language specified in the PPA shall prevail.	Option to have a bilingual PPA

Major Challenges and Measures to Address Key Issues of

Solar PV PPA

PPA Challenge for Solar PV Development in JAMALI

Complex and long lead time for the PPA signing process	• Variability and lack of accessible templates lead to extensive back-and-forth communication between the parties involved in the PPA signing process, resulting in longer lead times and increased costs for project developers. • The required BoD approval process for PLN and/or its subsidiaries for PPA signing • Lender's due diligence process could prolong the PPA signing process
Risk allocation on land acquisition	When dealing with non-government land, IPPs must engage directly with landowners for buying and selling procedures. This requires them to navigate various legal requirements, address environmental concerns, negotiate with landowners, and manage community concerns, all of which can significantly delay project timelines if not properly managed.
Omission of Commercial Operation Date (COD) Acceleration Incentive	Omission of the COD acceleration incentive from the recently issued MEMR Regulation No. 5 of 2025 might be deemed unfavourable by the investors. A case study example is a scheme implemented in Vietnam, where a specific COD deadline was established for solar PV power plants. Developers who successfully met this deadline became eligible for certain incentives (e.g., Feed-in-tariff). This approach led to a surge in solar PV development throughout the country.

Proposed Solutions for the Solar PV PPA Challenges (1/2)

	Challenges	Proposed Solutions	Relevant institution	Priority	Estimated timeline to implement the suggested measure
1	Complex and long lead time for the PPA signing process	• Conduct discussions or lenders' briefing prior to the procurement • Develop a standardised template PPA • Develop a SOP for BoD approval process • Consider having a KPI on PPA signing targeted timeline	PLN	High Priority	Mid term
2	Risk allocation on land acquisition	• PLN or government to assess land rights status and/or estimated land price prior to the procurement • PLN to secure a Memorandum of Understanding (MoU) or in-principal agreement with potential landowner prior to procurement process	PLN	High Priority	Mid term
		• Potential land acquisition risk sharing or differentiation of the risk allocation between PLN and Independent Power Producers (IPPs) in the PPAs (e.g., based on land ownership status)	Lead institution: PLN Supporting institution: MEMR		

Solar PV PPA Challenges and Proposed Solutions (2/2)

	Challenges	Proposed Improvement	Relevant institution	Priority	Estimated timeline to implement the suggested measure
3	Omission of Commercial Operation Date (COD) Acceleration Incentive	• Engage with developers and investors on the impact of omission of the COD acceleration incentive to the market's attractiveness	PLN	High Priority	Mid term
		• Consider reenacting the provision of incentive on COD acceleration	Lead institution: MEMR Supporting institution: PLN		

Action Plan for the Proposed Solutions

Action Plan for The Proposed Solutions: PPA

Action Plan	Year					Role of Stakeholders			
	1	2	3	4	5	MEMR	PLN	Financiers and IDA	IPP
Complex and long lead time for the PPA signing									
Develop draft template PPA						C	R, A	C	C
Conduct public consultations with IPPs, financial institutions, and legal advisors for the draft template PPA						I	R	C	C
Finalise the standardised PPA template and distribute it as the official framework for solar PV projects						R/A	R	C	C
Organise training and workshops for stakeholders to implement the standardised PPA template						R/A	R	C	C
Monitor application of the standardised PPA template across projects and its impact on project timelines and costs						R/A	R	C	C
Develop a SOP on BOD approval process						I	R, A	-	C
Consider having a KPI on PPA signing target timeline						I	R, A	-	C, I
Land Acquisition									
PLN or government to assess land rights status and/or estimated land price prior to the procurement						-	R/A	I	C
PLN to secure a Memorandum of Understanding (MoU) or in-principal agreement with potential landowner prior to procurement process						-	R/A	-	C
Potential land acquisition risk sharing or differentiation of the risk allocation between PLN and IPPs in the PPAs (e.g., based on land ownership status)						C	R/A	C, I	C
Omission of COD Acceleration Incentive									
Engage with developers and investors on the impact of omission of the COD acceleration incentive to the market's attractiveness						C, I	R, A	C	C
Consider reenacting the provision of incentive on COD acceleration						R, A	R	C	C, I

Case studies

Local Content Requirement (LCR)

Case Study	LCR approach	Result	Lessons learnt
India 	• Phased LCR implementation began in 2010 with a domestic content requirement of 30%. • Under the "Make in India" initiative, the LCR mandate increased to 50% for government-supported projects.	• The "Make in India" initiative resulted in India being ranked among the top 100 nations in the Ease of Doing Business index in 2024 (Ministry of Commerce & Industry, 2024). • Foreign Direct Investment (FDI) inflows into India increased steadily, totalling $70.95 billion, in the fiscal year 2023-2024	• Phased LCR implementation could attract investments and impact growth of the country's industry.
United States of America 	• Applies LCR in phases depending on the year of construction. • Promotes LCR through the Inflation Reduction Act. • Offers a 10% bonus tax credit for new power plants that generate renewable or carbon-neutral electricity and meet domestic content requirements.	• Enhanced American manufacturing of iron, steel, and other products used in clean energy projects. • Spurred companies to announce over US$196 billion in clean power investments and US$92 billion in clean energy manufacturing	• Offering incentives could encourage LCR compliance and industry growth.
South Africa 	• Also adopted a phased LCR approach, current LCR value is 45% with a target of reaching 60%.	• LCR contributed towards attracting investment, generating jobs and strengthening the available skills-based and know-how in the country. • The policy have generated positive externalities for foreign investors through reducing production costs, enabling them to develop local supply chains, and setting up a competitive base for regional export markets.	• The definition of local content must be clear and simple. • The policy should be carefully calibrated and realistic. • There should be systems in place for monitoring • The procurement processes must be designed with local content and industrialisation of the country's economy as the priority.

Feed-in-Tariff (FiT)

Case Study	FiT Scheme	Result	Lessons learnt
Thailand 	• Solar and wind projects exclusively use the fixed-price FiT. This rate is designed to cover both the construction costs of power plants and their ongoing operation and maintenance (O&M) expenses. • The latest renewable energy procurement phase emphasizes projects with 20-25 year fixed pricing contracts.	• The FiT Scheme spurred the growth of solar projects.	• Thailand and Vietnam's experiences highlight the importance of integrating FiT schemes with broader power sector planning to enhance project viability. • While Thailand continues to use FiT schemes, Vietnam's shift to a post-FiT tariff framework with Circular 19 underscores the potential for more transparent, reflective pricing. • For regions like Indonesia, adopting site-specific tariff determination, based on irradiation data, could improve revenue-cost matching. However, such shifts could inadvertently reduce incentives for thorough site analysis, as developers might rely on the tariff model to mitigate site risks.
Vietnam 	• Vietnam launched its FiT program in 2011 offering attractive rates to solar and wind developers. • Introduced in early 2024, Circular 19 regulation aims to establish a structured tariff framework, setting out annual tariff ranges based on irradiation data. • In 2025 the FiT rates were updated, distinguishing between project types (e.g., ground-mounted vs. floating solar) and BESS. This update highlights ongoing concerns about whether tariffs sufficiently cover the complex costs associated with BESS-integrated projects.	• The FiT scheme in Vietnam faced significant challenges, particularly aligning with broader power sector plans, leading to integration issues that impacted renewable project bankability. • Misapplications of FiT rates added to these challenges, with some ineligible projects receiving preferential tariffs.	

Electricity Market

Case Study	Market Arrangement	Key difference with Indonesia's electricity market	Lessons learnt
Thailand 	• Thailand operates under an "enhanced single-buyer" system characterized by distinct entities (EGAT, MEA, PEA) handling different regions. • In 2024, the Thai government confirmed plans to introduce third-party grid access and direct Power Purchase Agreements (PPAs), creating new investment opportunities in renewable energy.	• Thailand's "enhanced single-buyer" system differs with Indonesia's single buyer system, where PLN is the sole off-taker and operator. • Direct PPAs is not available in Indonesia	• Indonesia can draw lessons from Thailand and Vietnam by implementing third-party access and direct Power Purchase Agreements (PPAs) to invigorate renewable energy investments. • The EU's liberalized electricity market and cross-border interconnections offer a blueprint for Indonesia to increase competition and reliability. • Indonesia could promote bilateral contracting and private sector participation by allowing developers to propose projects, especially in areas difficult for PLN to. • Establishing Renewable Purchase Obligations (RPOs) could further drive demand for clean energy, while careful planning and study are necessary to address potential challenges related to market opening and higher customer tariffs or subsidies.
Vietnam 	• Vietnam's electricity market is characterized by an unbundled single-buyer system. • Vietnam has operated a cost-based pool market where the Electric Power Trading Company serves as the sole electricity off-taker. With mandatory participation for power plants over 30 MW. • In 2024, the government introduced corporate or direct Power Purchase Agreements (PPAs).	• Vietnam operates a wholesale electricity market where power plants with a capacity greater than 30 MW must participate. • Direct PPAs is not available in Indonesia	
European Union 	• The European Union operates a fully liberalized and competitive electricity market, characterized by the involvement of diverse participants including producers, consumers, and traders. • This market functions on a cross-border basis, enabling electricity trade across member states to enhance competition and reliability of supply.	• EU's electricity market is fully liberalised and competitive, where as Indonesia's electricity market is a single-buyer system. • The market facilitates more competition with cross-border power sale	

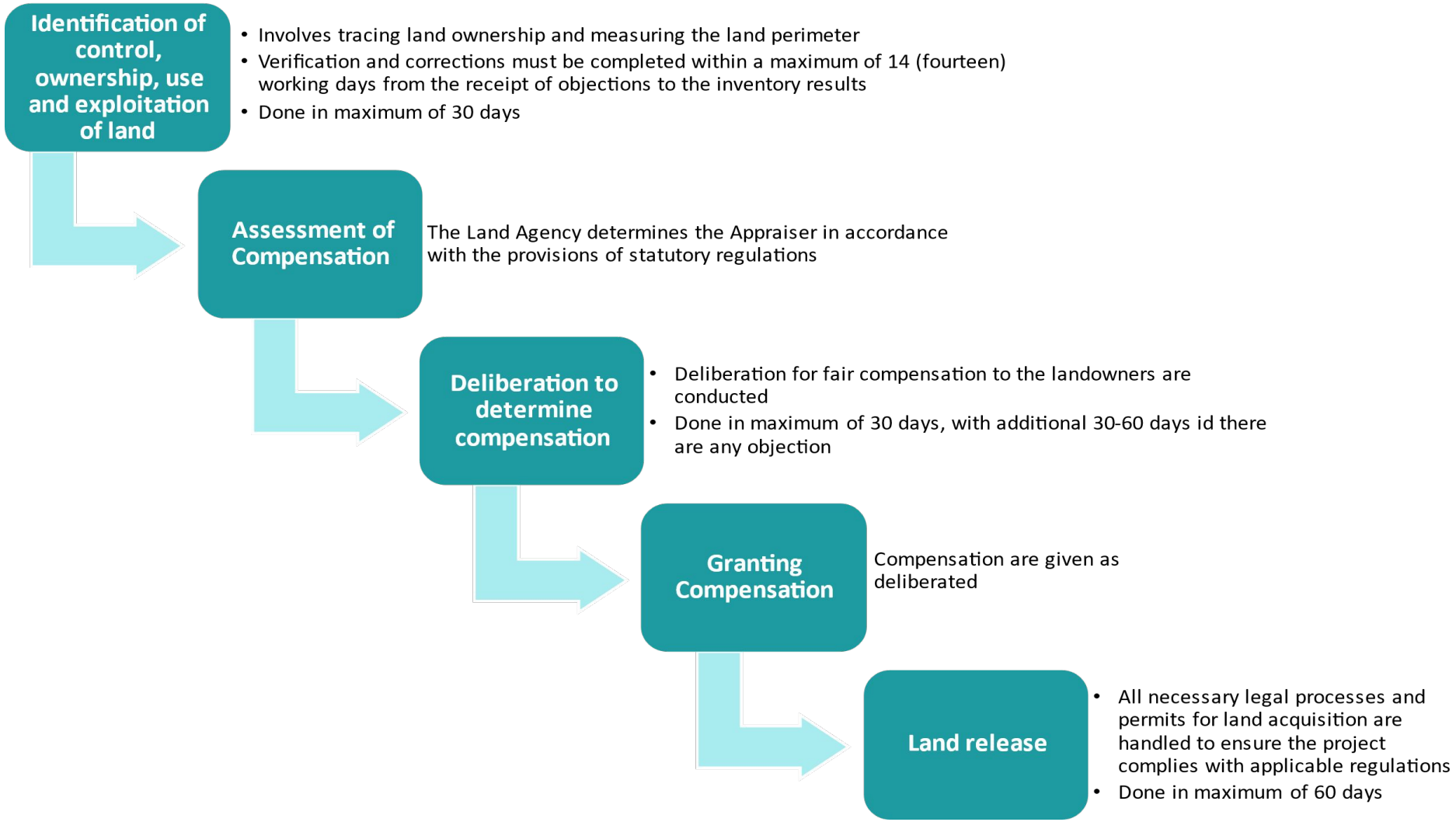
Environmental and Social Aspects for Solar PV Development

Coordination Gaps and Challenges

The development of solar PV projects in JAMALI encounters various multi-level governance challenges, particularly regarding E&S compliance. These challenges arise from overlapping authorities, conflicting regulations, and bureaucratic inefficiencies. As a result, there are significant delays, legal uncertainties, and social conflicts, particularly in the following areas:

Aspect	Coordination Gaps	Problems	Consequences
Land ownership clarification	ATR/BPN and Local Governments	• BPN manages land certification, but local governments control the RTRW (Spatial Planning) • Disputes arise when land is certified but classified as "protected" in the local RTRW • Desa Adat authorities often clash with BPN on ownership recognition	• The Project is delayed because developers face lawsuits or must renegotiate land acquisition • Social conflict arises if the local communities reject projects and land rights are unclear
Permits and Licensing	MoEF, MEMR, and local governments	• MoEF requires AMDAL/UKL-UPL, while MEMR issues IUPTL (Electricity License), Local Government issues IMB (Building Permit), but often lacks the technical capacity to assess solar PV project building permits • Some permits (e.g., AMDAL) still require manual submissions, which can lead to delays	• MoEF may reject permit mismatches, a project approved by MEMR due to incomplete AMDAL • Corruption risks arise when local officials may demand "fees" to speed up permits
Land Use Classification	MoEF, ATR/BPN, and PUPR	• MoEF may classify land as a protected forest, while BPN issues HGU (Cultivation Rights), PUPR may designate the same land for watershed protection • Provincial and district-level spatial planning often does not align	• Legal uncertainty is possible as the developers risk being fined if land is reclassified post-investment • Project cancellation
Compensation and community engagement	Village Ministry, Local Government, and Developer	• Local Government sets compensation rates (based on NJOP), but communities demand higher rates. • Village Ministry may push for CSR programs, but developers lack clear guidelines	• Protests and blockades, the project may stall after landowners refused compensation • Reputation damage and poor community engagement lead to negative media coverage.

Land Acquisition Process



Key Physical Factors: Slope, Soil, Flooding, Disaster Risks

Exposure to natural disasters

- Prioritize sites with low risk of flooding, earthquakes, and volcanic activity (especially in JAMALI).
- Floodplains may be ideal but are vulnerable to flash floods during the plant's 20+ year lifespan.

Slope and accessibility of the site

- Ideal slope: <3% (highly suitable); 3–7% (suitable); 7–10% (moderately suitable).
- Slopes >10% increase costs; up to 15% possible with grading or specialized mounts.

Soil composition

- Assess soil stability, drainage, and erosion risks.
- Avoid poorly drained or erodible soils to prevent equipment damage and habitat disruption.
- Retain or plant native vegetation to support biodiversity and water regulation.

Glint/glare Risks near Airports and Urban Areas

- Conduct glint/glare studies for sites within 3–5 km of airports (further for international hubs).
- Ensure compliance with aviation safety standards.

Impact of PV Construction on Soil, Water, Air, and Ecosystems

Potential ecological and environmental resource and site damages during construction

- Dust, emissions, and noise can affect local communities and ecosystems.
- Soil compaction reduces fertility and water infiltration—limit heavy equipment in sensitive areas.
- Protect soil microorganisms through low-impact construction practices.

Hazardous materials disposal

- Develop plans for safe handling and disposal of damaged PV modules and components.
- Include proper procedures in construction and operational phases to prevent toxic release.

Risk to future development, traffic, and transportation

- Construction may stress local roadways—schedule transport during off-peak hours.
- Improved access roads benefit communities but may affect future land use.
- Buffer zones needed to avoid shading; avoid high-density urban areas where possible.

Major Challenges and Measures to Address Key Issues of

Environmental and Social Aspects

Solar PV E&S Challenges and Proposed Solutions (1/5)

	Challenges	Proposed Solution	Relevant institution	Priority	Estimated timeline to implement the suggested measure
1	**Land ownership and Acquisition:** • Land prices can surge dramatically as landowners become aware that a solar PV project is planned for their area • Land ownership remains unclear, preventing stramlining of the land acquisition process by verifying the land documentation with landowners • Local disputes can happen between government-designated use and traditional use of the land • Illegal occupants require resettlement	Involve stakeholders and promote transparency in how the land value is determined	ATR BPN, MoF	Medium Priority	Short term
		Align land pricing methodology with government bodies' regulations	ATR BPN	Medium Priority	
		Streamlining land ownership validation processes, including against traditional use claims		High Priority	
		Transparent and clear regulations on illegal occupation and illegal use of the land		Medium Priority	
		Introduce the idea of using unproductive government-owned land for renewable energy projects	MEMR, ATR BPN, MoEF	Medium Priority	Mid term

Solar PV E&S Challenges and Proposed Solutions (2/5)

Challenges	Proposed Solution	Relevant institution	Priority	Estimated timeline to implement the suggested measure
2 **Permit and Licensing:** A complicated process and a lack of a streamlined procedure to obtain the various licenses and permits required to develop a solar PV project.	Creating an integrated solar PV development permit	MEMR	Medium Priority	Short term
	Publish permitting and licensing guidelines for solar PV projects		High Priority	Short term
	Expand the existing OSS system to include a dedicated portal for RE projects			Long term
	Provide consultancy services from government bodies to the public and solar developers		Medium Priority	Short term

Solar PV E&S Challenges and Proposed Solutions (3/5)

Challenges	Proposed Solutions	Relevant institution	Priority	Estimated timeline to implement the suggested measure
3 Land classification and use, including environmental impact measurements • Current land use planning regulations do not include solar PV plants as a designated zoning option. • Alignment between land use plans and renewable energy priorities, and no areas are designated to be compatible for renewable energy uses. • Impacts of land conversion on food security, biodiversity, and community livelihoods. • Degraded vs. productive land selection. • Absence of carbon sequestration policies.	Include solar PV power plant as a designated zoning option	ATR BPN	High Priority	Mid term
	Alignment between central government, provincial government, and local government land use plans, zoning, and designations (such as forestry, peatland, etc)	MEMR, MoEF, ATR BPN, Provincial govt, District govt	High Priority	Mid term
	Clarification on the definition of productive land (such as agricultural, conservation forests, etc) and whether they should be converted to renewable energy uses	MoEF, ATR BPN	Medium Priority	Long term
	Promote agrivoltaics	MEMR	Medium Priority	Long term

Solar PV E&S Challenges and Proposed Solutions (4/5)

Challenges	Proposed Solutions	Relevant institution	Priority	Estimated timeline to implement the suggested measure
3 Land classification and use, including environmental impact measurements • Current land use planning regulations do not include solar PV plants as a designated zoning option. • Alignment between land use plans and renewable energy priorities, and no areas are designated to be compatible for renewable energy uses. • Impacts of land conversion on food security, biodiversity, and community livelihoods. • Degraded vs. productive land selection. • Absence of carbon sequestration policies.	Standardise methodology for land use impact measurement	ATR BPN	High Priority	Mid term
	Transparent and uniform assessment methodology on the impact of the land use conversion on food security, community livelihoods, and biodiversity	MEMR, MoEF, ATR BPN, Provincial govt, District govt	High Priority	Mid term
	Transparent and uniform assessment methodology on the impact of the land use conversion on carbon sequestration capacity	MoEF, ATR BPN	High Priority	Short term
	Foster carbon sequestration policies referring to the international framework	MEMR	Medium Priority	Mid term

Solar PV E&S Challenges and Proposed Solutions (5/5)

Challenges	Proposed Solutions	Relevant institution	Priority	Estimated timeline to implement the suggested measure
4 **Social inclusion, land rights, and project acceptance** • Unresolved issue of traditional land claims • The absence of FPIC and inadequate community consultation processes often trigger social conflict and resistance. • Regulatory and Institutional Gaps. There is no dedicated or consistent mechanism for registering customary land claims or compensating for traditional uses • Substantial risk of uncovering unknown archaeological sites during construction. • Visual disruption caused by solar PV installations can diminish the scenic value of the landscape, affecting tourism and local cultural identity • Limited participation in economic development is linked to the solar PV installations. • Most local SMEs lack the financial resilience, procedural compliance, and technical capability to qualify as project suppliers.	Implement a fair mechanism of community resettlement	MEMR, ATR BPN, MHA, MoLHR	Medium Priority	Mid term
	Implement a Free, Prior and Informed Consent (FPIC) approach to stakeholder engagement	MEMR, IPP, PLN		
	Raise awareness about legal rights in local communities and provide legal assistance and advocacy	MHA, MoLHR		
	Consider collaboration with local vocational schools and/or training centres that can offer the training and capacity development needed for the interested local community		Medium Priority	Short term
	Involve local communities as part of the labour of the project	IPP, PLN	Low Priority	Short term
	Engage SMEs in the project supply chain			
	Foster best practices for the hiring process and health and safety within the IPPs and SMEs			
	Provide a consistent and transparent mechanism for registering customary land claims or compensating for traditional uses	ATR BPN	Medium Priority	Mid term

Action Plan for the Proposed Solutions

Action Plan for The Proposed Improvement: E&S

Action plan	Year					Role of stakeholder												
	1	2	3	4	5	MEMR	PLN	Bappenas	Spatial Planning/ ATR BPN	Ministry of Industry	Ministry of Investment (BKPM)	Ministry of Home Affairs	Ministry of Environmental and Forestry	Ministry of Manpower	Local government	IPP	Association & Industry	Local Community
Land ownership and acquisition dynamics																		
Design land pricing methodology						C	C	R	R/A	-	I	-	I	-	C	I	C	C
Implement expedited land acquisition procedures for identified preferred zones						R/A	C	C	R	I	I	I	C	I	R	I	C	C
Land acquisition: permit and licensing																		
Create an integrated solar PV development permit						R	R	C	R	C	A	C	C	I	C	C	C	I
Land classification and use																		
Improve the land use planning regulations: solar PV development						R	C	C	R/A	C	I	-	R	I	C	I	I	C
Implement standardised methodology for the land impact measurement, including land use trade-off evaluation						R	C	C	C	I	I	-	A	-	C	I	I	I
Promote agrivoltaics						C	C	R	A	C	C	-	A	-	C	R	I	I
Utilize government-owned land and/or collaborate with The Indonesian Land Bank Authority for solar PV projects						R	C	C	R/A	C	C	C	C	C	R	R	I	I
Social inclusion, land rights and project acceptance																		
Free prior and informed consent (FPIC) approach to stakeholder engagement						C	I (*)	-	I	-	I	I	I	-	R	A	-	R
Community involvement in the project supply chain						I	I (*)	C	-	-	I	-	-	-	R	R/A	-	C
Implementation of mechanisms for the resettlement of communities						R	I (*)	C	R	-	I	R	C	-	R	R/A	-	A
Increase SMEs engagement						I	I (*)	C	-	-	I	-	-	-	R	R/A	-	C
Foster best practices for the protection of local communities' rights						C	R	C	C	C	-	-	-	R	A	R	I	C

Socio-Environmental Impact of Solar PV Development

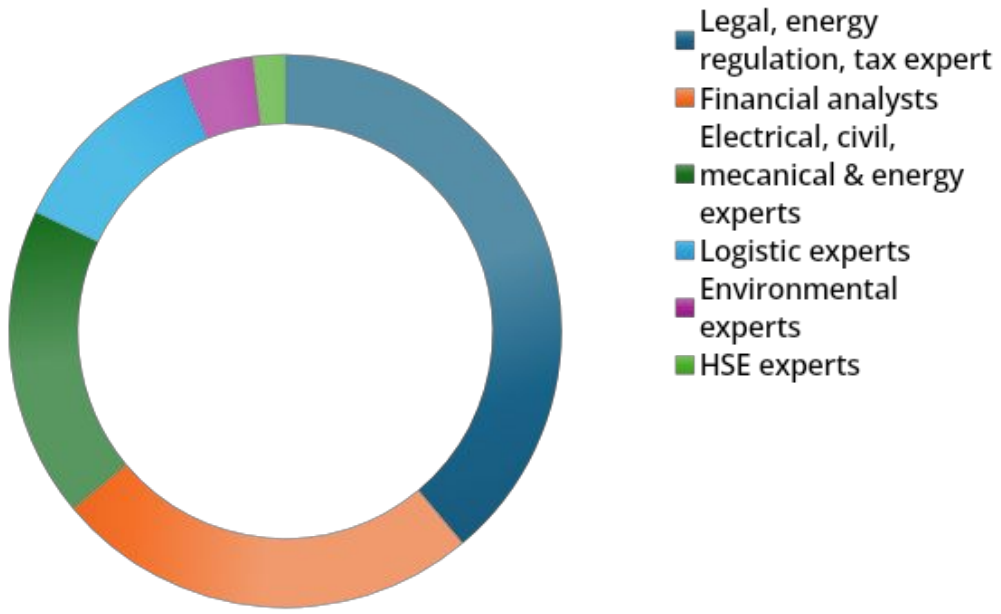
Job Creation Potential

To estimate the direct job creation for a 2.2 GW solar PV development, job multipliers published by the National Renewable Energy Laboratory (NREL) for the U.S. context are utilized. Based on the NREL 2025 PV job multiplier of 2.1 jobs per MW, the total estimated direct job creation for a 2.2 GW solar PV development is 4,620 jobs. The distribution of these jobs across different industry segments, based on NREL's 2020 composition (assuming similar proportions for 2025), is presented in the table below:

Segment	Estimation Jobs	Percentage of Total
Construction and Installation	2,449	53%
Professional Services	693	15%
Manufacturing	601	13%
Wholesale Trade and Distribution	462	10%
Operation and Maintenance (O&M)	92	2%
Other	323	7%
Total	4,620	100%

Job Creation Potential

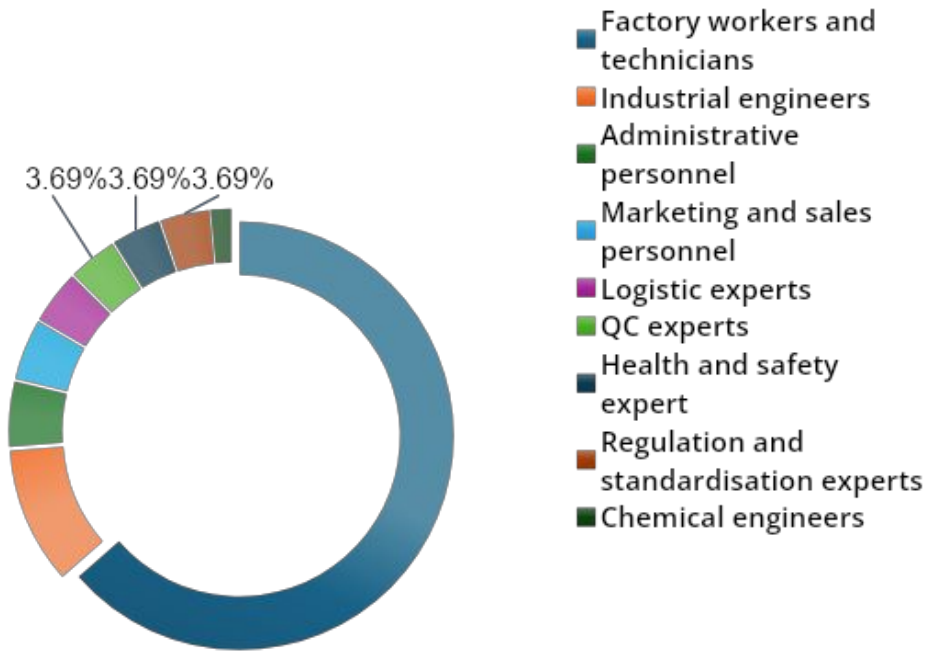
In addition, we also tried to calculate the number of person-days from each phase in the entire supply chain process that can be created from the development of 2.2 GW Solar PV



Human Resources	Site Selection	Feasibility Analysis	Engineering Design	Project Development	Total by Occupation
Legal, energy regulation, tax expert	7,920	2,640	3,740	22,000	36,300
Financial analysts	0	1,320	0	22,000	23,320
Electrical, civil, mecanical & energy experts	5,280	5,720	5,940	0	16,940
Logistic experts	0	0	0	11,000	11,000
Environmental experts	2,640	1,320	0	0	3,960
HSE experts	0	0	1,760	0	1,760
Total	15,840	11,000	11,440	55,000	93,280
Percentage	17%	12%	12%	59%	100%

Job Creation Potential

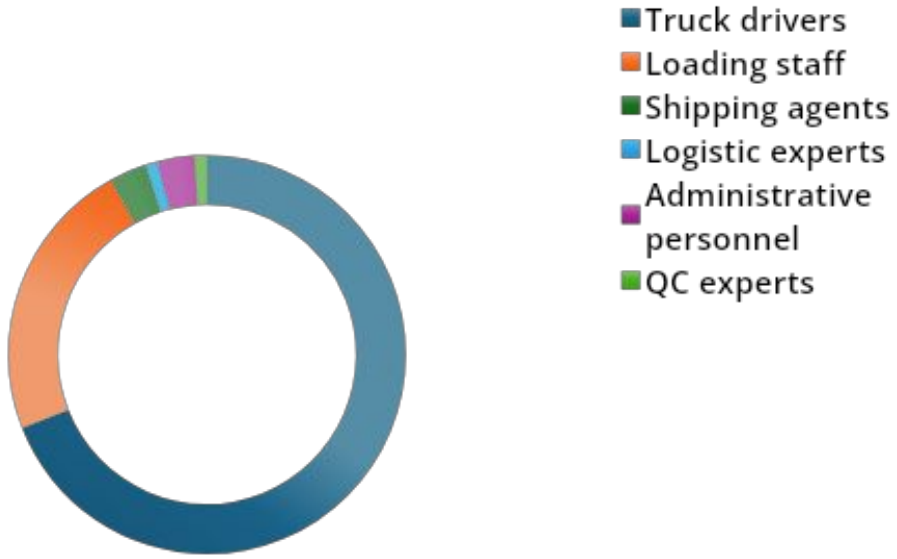
Manufacture & Procurement



Human Resources	Solar cells	Solar modules	Inverters	Solar structures	Total by occupation
Factory workers and technicians	739,200	277,200	218,680	169,400	1,404,480
Industrial engineers	101,640	46,200	43,120	36,960	227,920
Administrative personnel	33,880	33,880	21,560	18,480	107,800
Marketing and sales personnel	33,880	67,760	0	0	101,640
Logistic experts	33,880	15,400	21,560	18,480	89,320
QC experts	33,880	7,700	21,560	18,480	81,620
Health and safety expert	33,880	7,700	21,560	18,480	81,620
Regulation and standardisation experts	33,880	7,700	21,560	18,480	81,620
Chemical engineers	33,880	0	0	0	33,880
Total	1,078,000	463,540	369,600	298,760	2,209,900
Percentage	49%	21%	17%	14%	100%

Job Creation Potential

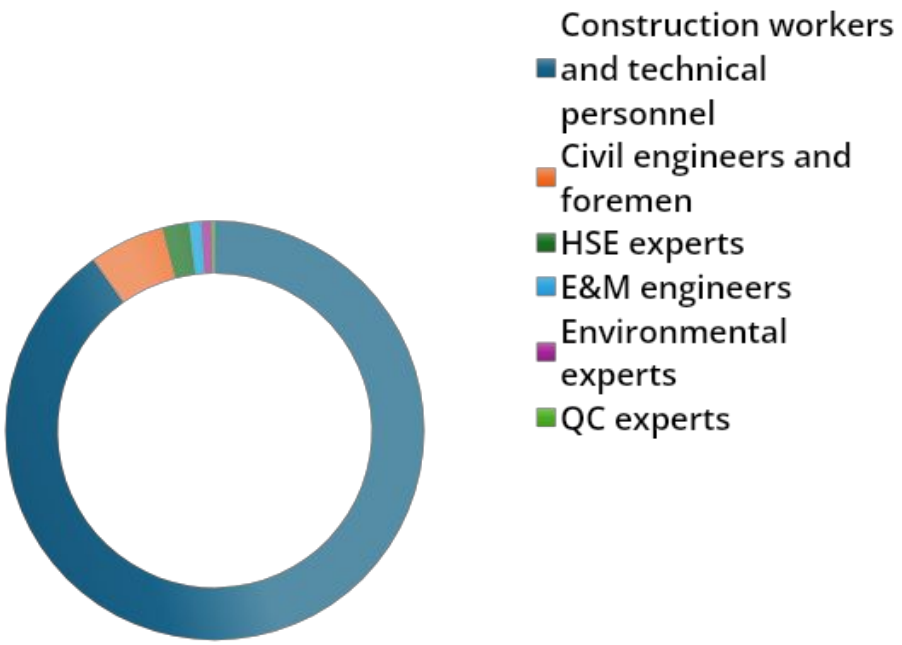
Transport



Human Resources	Total
Truck drivers	105,501
Loading staff	35,167
Shipping agents	4,587
Logistic experts	1,529
Administrative personnel	4,587
QC experts	1,529
Total	152,900
Percentage	100%

Job Creation Potential

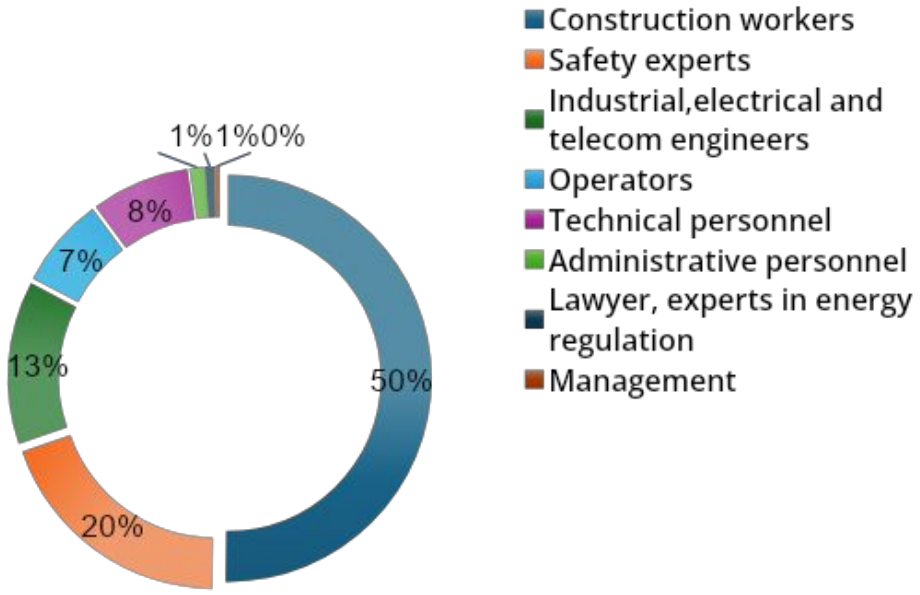
Installation and Grid Connection



Human Resources	Site preparation and civil works	Assembling works	Cabling and grid connection works	Commissioning	Total
Construction workers and technical personnel	880,000	374,000	264,000	44,000	1,562,000
Civil engineers and foremen	61,600	39,600	0	0	101,200
HSE experts	19,800	6,600	4,400	4,400	35,200
E&M engineers	0	0	7,920	8,800	16,720
Environmental experts	840	0	0	0	13,200
QC experts	0	0	280	0	4,400
Total	962,240	420,200	276,600	57,200	1,732,720
Percentage	56%	24%	16%	3%	99%

Job Creation Potential

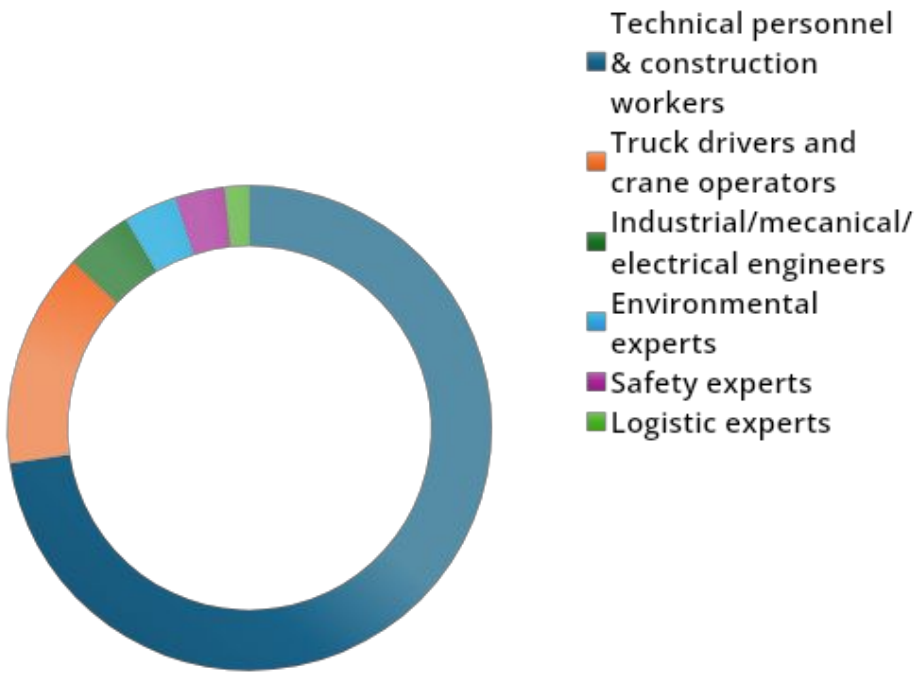
Operations and Maintenance



Human Resources	Operation	Maintenance	Total
Construction workers	0	299,514	299,514
Safety experts	0	116,478	116,478
Industrial, electrical, and telecom engineers	19,028	58,258	77,286
Operators	43,067	0	43,067
Technical personnel	0	46,591	46,591
Administrative personnel	7,008	0	7,008
Lawyer, experts in energy regulation	4,463	0	4,463
Management	2,232	0	2,232
Total	75,799	520,841	596,640
Percentage	13%	87%	100%

Job Creation Potential

Decommissioning



Human Resources	Planning	Dismantling	Disposing	Site clearing	Total
Technical personnel & construction workers	0	88,000	33,000	44,000	165,000
Truck drivers and crane operators	0	32,560	0	0	32,560
Industrial/mecanical/electrical engineers	1,320	7,040	0	1,760	10,120
Environmental experts	1,100	3,520	1,760	1,760	8,140
Safety experts	0	3,520	1,760	1,760	7,480
Logistic experts	1,100	0	2,640	0	3,740
Total	3,520	134,640	39,160	49,280	227,040
Percentage	2%	59,3%	17%	21,7%	100%

GHG Emission Reduction Potential

Estimated Annual Electricity Generation from 2.2 GW Solar PV

The annual electricity generation is calculated as follows:

- Annual Generation (MWh/year) = Installed Capacity x 8,760 hours/year x Capacity Factor
- Annual Generation = 2.2 GW x 1,000 MW/GW x 8,760 hours/year x 0.18 = 3,468,960 MWh/year (3,469 TWh/year)

GHG Emissions from the 2.2 GW Solar PV Project (Lifecycle)

These are the emissions directly attributable to the solar PV project itself over its lifetime, normalized to its annual electricity generation.

- Total PV Emissions = Annual Generation (MWh/year) x 1,000kWh/MWh x Solar PV GHG Intensity (g CO_2e/kWh)
- Total PV Emissions = 3,468,960 MWh/year x 1,000kWh/MWh x 46 gram CO_2e/kWh
- Total PV Emissions = 159,572.16 tonnes CO_2e/year

Displaced GHG Emissions from Conventional Grid Electricity

- Displaced Emissions = Annual Generation (MWh/year) x Emission factor
- Displaced Emissions = 3,468,960 MWh/year x 0.88 tons CO_2/MWh
- Displaced Emissions = 3,052,684.8 tonnes CO_2e/year

GHG Emission Reduction Potential

GHG Emissions Land Clearing Process

No.	ADM1	ADM2	Land Category at Regency Level	Visual Observation from Satellite Imaging	Land area needed to be cleared (ha)	Emission factor from land clearance (t CO2/ha/year)	Emissions from land clearing (t CO2/year)
S73	Jawa Tengah	Pati	Farm/Moor	Sengon and Cassava plantation	100	58,7	5870
S67	Jawa Tengah	Rembang	River Border Area	Teak Plantation	100	258,74	25874
S87	Jawa Timur	Tuban	Dryland Agricultural Designation Area	Paddy field	100	-8	-800
S94	Jawa Timur	Sumenep	Holticulture	Jatropha plantation, sparse occupancy	100	0,4	40
S62	Jawa Tengah	Sukoharjo	Plantation Designation Area	Sugarcane plantation	100	3	300
S79	Jawa Timur	Bojonegoro	Plantation Area	Paddy field	100	-8	-800
S119	Jawa Timur	Situbondo	Water Catchment Areas	Empty grasslands	75	0	0
S27	Jawa Barat	Cianjur	Plantations/Annual Crops	Paddy field	75	-8	-600
S69	Jawa Tengah	Kendal	Food Crops Area	Corn field	100	-1,7	-170
S99	Jawa Timur	Sumenep	Water Catchment Areas	Empty field	75	0	0
S72	Jawa Tengah	Brebes	Agricultural Area	Teak Plantation	75	258,74	19405,5
S68	Jawa Tengah	Rembang	Dryland Agricultural Area	Paddy field	75	-8	-600
S117	Jawa Timur	Tuban	Water Catchment Areas	Corn field	75	-1,7	-127,5

GHG Emission Reduction Potential

GHG Emissions Land Clearing Process

No.	ADM1	ADM2	Land Category at Regency Level	Visual Observation from Satellite Imaging	Land area needed to be cleared (ha)	Emission factor from land clearance (t CO2/ha/year)	Emissions from land clearing (t CO2/year)
S65	Jawa Tengah	Rembang	Coal and Mining Area	Teak Plantation	100	258,74	25874
S8	Banten	Pandeglang	Holticulture	Chilli plantation	100	1,8	180
S80	Jawa Timur	Banyuwangi	Plantation Area	Sengon plantation	100	51,8	5180
S53	Jawa Barat	Indramayu	Farm Forestry/Hutan Rakyat	Teak Plantation	50	258,74	12937
S24	Jawa Barat	Karawang	Industrial Estate	Shrublands	100	121	12100
S9	Jawa Barat	Ciamis	Food Crops Area	Sengon and Gliricidia plantation	100	275	27500
S14	Jawa Barat	Indramayu	Farm Forestry/Hutan Rakyat	Paddy field	75	-8	-600
S20	Jawa Barat	Tasikmalaya	Wetland Agricultural Area	Rubber plantation	100	250	25000
S6	Banten	Lebak	Settlement Area	Cassava plantation	100	45	4500
S2	Banten	Lebak	Community Plantation	Banana and coconut plantation	100	215	21500
S132	Bali	Buleleng	Plantation and Holticulture Agricultural Designation Area	Banana and coconut plantation	100	215	21500
S134	Bali	Buleleng	Tourism Designation Area	Paddy field	25	-8	-200
S65	Jawa Tengah	Rembang	Coal and Mining Area	Teak Plantation	100	258,74	25874

GHG Emission Reduction Potential

Net Annual GHG Emission Reduction

The net annual GHG emission reduction is determined by subtracting the solar PV project's own lifecycle emissions from the emissions it displaces on the grid and emissions from land clearing activities:

- Net Reduction = Displaced Emissions – Total PV Emissions – Land Clearing Emissions
- Net Reduction = (3,052,684.8 - 159,572.16 - 203,863) tonnes CO_2e/year
- Net Reduction = 2,689,249.8 tonnes CO_2e/year

Based on the estimated annual generation from 2.2 GW of solar PV, and after accounting for carbon sequestration loss due to land clearance, the net avoided emissions are estimated at

2.68 million tonnes of CO_2 per year.

ENERGY TRANSITION PARTNERSHIP

Powering Prosperity and Enabling Sustainability in South East Asia

THANK YOU

UNOPS

AFD AGENCE FRANÇAISE DE DÉVELOPPEMENT

Federal Ministry for Economic Affairs and Climate Action

Department for Energy Security & Net Zero

Environment and Climate Change Canada
Environnement et Changement climatique Canada

Australian Government
Department of Climate Change, Energy, the Environment and Water

CIFF CHILDREN'S INVESTMENT FUND FOUNDATION

SEQUOIA CLIMATE FOUNDATION

Annex

Capex – Main Plant

There is an economy of scale rule for the main power plant, meaning that the smaller the capacity of the plant at each site, the more expensive the price per kW will be. The rule of thumb is as follows

No	Capacity (MW)	Price (USD/KW)
1	25	520
2	50	510
3	75	500
4	100	485
5	250	460
6	500	450

The total cost of the main power plant for each site is as follows

No	HubName	Capacity (MW)	Unit Price (USD/MW)	Total Main Power Plant Cost (Million USD)
1	GIS 150 kV PLTU Labuan	100	485.000	48.5
2	GI 150 kV Tigaraksa	100	485.000	48.5
3	GI 150 kV Rangkas Bitung	100	485.000	48.5
4	GI 150 kV Mekarsari	100	485.000	48.5
5	GI 150 kV Patuha	75	500.000	37.5
6	GI 70 kV Parakan	50	510.000	25.5
7	GI 150 kV Ciamis	100	485.000	48.5
8	GI 150 kV Haurgeulis	75	500.000	37.5
9	GI 150 kV Karangnunggal	100	485.000	48.5
10	GITET 500 kV Tanjung Jati	100	485.000	48.5
11	GI 150 kV Semen Indonesia	100	485.000	48.5
12	GI 150 kV Palur	100	485.000	48.5

No	HubName	Capacity (MW)	Unit Price (USD/MW)	Total Main Power Plant Cost (Million USD)
13	GI 150 kV Weleri	100	485.000	48.5
14	GI 70 kV Babakan	75	500.000	37.5
15	GI 150 kV Semen Indonesia	75	500.000	37.5
16	GI 150 kV PLTU Rembang	100	485.000	48.5
17	GI 150 kV Mliwang	100	485.000	48.5
18	GI 150 kV Sumenep	100	485.000	48.5
19	GI 150 kV Cepu	100	485.000	48.5
20	GI 150 kV Situbondo	75	500.000	37.5
21	GI 150 kV Sumenep	75	500.000	37.5
22	GI 150 kV Sementuban	75	500.000	37.5
23	GI 150 kV Genteng	100	485.000	48.5
24	GI 150 kV Baturiti	100	485.000	48.5
25	GI 150 kV Baturiti	25	520.000	13.0

Capex – Land Price

The total land price for each site is as follows

No	Province	City	HubName	Area (m^2)	Unit Price (USD/m^2)	Total Land Price (Million USD)
1	Banten	Citeureup	GIS 150 kV PLTU Labuan	1.000.000	5.2	5.2
2	Banten	Pasir Kecapi	GI 150 kV Tigaraksa	1.000.000	8.4	8.4
3	Banten	Sekarwangi	GI 150 kV Rangkas Bitung	1.000.000	7.1	7.1
4	West Java	Wanasari	GI 150 kV Mekarsari	1.000.000	52.0	52.0
5	West Java	Kertasari	GI 150 kV Patuha	750.000	13.0	9.7
6	West Java	Cikawung	GI 70 kV Parakan	500.000	12.7	6.3
7	West Java	Cintanagara	GI 150 kV Ciamis	1.000.000	7.1	7.1
8	West Java	Bantarwaru	GI 150 kV Haurgeulis	750.000	14.8	11.1
9	West Java	Cipatujah	GI 150 kV Karangnunggal	1.000.000	6.6	6.6
10	Central Java	Wedusan	GITET 500 kV Tanjung Jati	1.000.000	14.1	14.1
11	Central Java	Tengger	GI 150 kV Semen Indonesia	1.000.000	9.7	9.7
12	Central Java	Genengsari	GI 150 kV Palur	1.000.000	52.0	52.0
13	Central Java	Sidodadi	GI 150 kV Weleri	1.000.000	14.9	14.9
14	Central Java	Cikakak	GI 70 kV Babakan	750.000	8.4	6.3
15	Central Java	Joho	GI 150 kV Semen Indonesia	750.000	9.7	7.3
16	Central Java	Sambong	GI 150 kV PLTU Rembang	1.000.000	9.7	9.7
17	East Java	Siding	GI 150 kV Mliwang	1.000.000	14.5	14.5
18	East Java	East Dasuk	GI 150 kV Sumenep	1.000.000	4.9	4.9
19	East Java	Dolokgede	GI 150 kV Cepu	1.000.000	4.9	4.9
20	East Java	Bayeman	GI 150 kV Situbondo	750.000	6.5	4.9
21	East Java	West Tambaagung	GI 150 kV Sumenep	750.000	4.9	3.7
22	East Java	Trantang	GI 150 kV Sementuban	750.000	4.9	3.7
23	East Java	Karangharjo	GI 150 kV Genteng	1.000.000	5.7	5.7
24	Bali	Sembiran	GI 150 kV Baturiti	1.000.000	39.0	39.0
25	Bali	Bukti	GI 150 kV Baturiti	250.000	11.7	2.9

Capex – Evacuation Line

The total evacuation line cost for each site is as follows

No	Province	City	HubName	Length (km)	Unit Price (Million USD/km)	Total Evacuation Line Cost (Million USD)
1	Banten	Citeureup	GIS 150 kV PLTU Labuan	0.7	1.3	0.9
2	Banten	Pasir Kecapi	GI 150 kV Tigaraksa	14.2	1.3	19.0
3	Banten	Sekarwangi	GI 150 kV Rangkas Bitung	14.0	1.3	18.2
4	West Java	Wanasari	GI 150 kV Mekarsari	0.9	1.3	1.2
5	West Java	Kertasari	GI 150 kV Patuha	47.0	1.3	61.1
6	West Java	Cikawung	GI 70 kV Parakan	23.4	1.3	30.4
7	West Java	Cintanagara	GI 150 kV Ciamis	13.3	1.3	17.3
8	West Java	Bantarwaru	GI 150 kV Haurgeulis	15.2	1.3	19.8
9	West Java	Cipatujah	GI 150 kV Karangnunggal	14.6	1.3	19.0
10	Central Java	Wedusan	GITET 500 kV Tanjung Jati	26.2	1.3	34.0
11	Central Java	Tengger	GI 150 kV Semen Indonesia	10.0	1.3	12.9
12	Central Java	Genengsari	GI 150 kV Palur	10.4	1.3	13.5
13	Central Java	Sidodadi	GI 150 kV Weleri	11.4	1.3	14.8
14	Central Java	Cikakak	GI 70 kV Babakan	13.2	1.3	17.2
15	Central Java	Joho	GI 150 kV Semen Indonesia	13.3	1.3	17.3
16	Central Java	Sambong	GI 150 kV PLTU Rembang	12.4	1.3	16.1
17	East Java	Siding	GI 150 kV Mliwang	19.2	1.3	25.0
18	East Java	East Dasuk	GI 150 kV Sumenep	13.1	1.3	17.1
19	East Java	Dolokgede	GI 150 kV Cepu	17.6	1.3	22.9
20	East Java	Bayeman	GI 150 kV Situbondo	14.1	1.3	18.3
21	East Java	West Tambaagung	GI 150 kV Sumenep	14.9	1.3	19.3
22	East Java	Trantang	GI 150 kV Sementuban	17.9	1.3	23.2
23	East Java	Karangharjo	GI 150 kV Genteng	26.8	1.3	34.8
24	Bali	Sembiran	GI 150 kV Baturiti	39.0	1.3	50.7
25	Bali	Bukti	GI 150 kV Baturiti	40.0	1.3	51.9

Total Capex

The capex consists of costs for main power plant, land, and evacuation line. Summary of the capex for each site is as follows. Details of each component can be found in the Annex

No	Province	City	HubName	Main Power Plant (Million USD)	Land (Million USD)	Evacuation Line (Million USD)	Total (Million USD)
1	Banten	Citeureup	GIS 150 kV PLTU Labuan	48.5	5.2	0.9	54.6
2	Banten	Pasir Kecapi	GI 150 kV Tigaraksa	48.5	8.4	19.0	75.9
3	Banten	Sekarwangi	GI 150 kV Rangkas Bitung	48.5	7.1	18.2	73.9
4	West Java	Wanasari	GI 150 kV Mekarsari	48.5	52.0	1.2	101.7
5	West Java	Kertasari	GI 150 kV Patuha	37.5	9.7	61.1	108.3
6	West Java	Cikawung	GI 70 kV Parakan	25.5	6.3	30.4	62.2
7	West Java	Cintanagara	GI 150 kV Ciamis	48.5	7.1	17.3	72.9
8	West Java	Bantarwaru	GI 150 kV Haurgeulis	37.5	11.1	19.8	68.3
9	West Java	Cipatujah	GI 150 kV Karangnunggal	48.5	6.6	19.0	74.1
10	Central Java	Wedusan	GITET 500 kV Tanjung Jati	48.5	14.1	34.0	96.6
11	Central Java	Tengger	GI 150 kV Semen Indonesia	48.5	9.7	12.9	71.2
12	Central Java	Genengsari	GI 150 kV Palur	48.5	52.0	13.5	114.0
13	Central Java	Sidodadi	GI 150 kV Weleri	48.5	14.9	14.8	78.2
14	Central Java	Cikakak	GI 70 kV Babakan	37.5	6.3	17.2	61.0
15	Central Java	Joho	GI 150 kV Semen Indonesia	37.5	7.3	17.3	62.1
16	Central Java	Sambong	GI 150 kV PLTU Rembang	48.5	9.7	16.1	74.3
17	East Java	Siding	GI 150 kV Mliwang	48.5	14.5	25.0	87.9
18	East Java	East Dasuk	GI 150 kV Sumenep	48.5	4.9	17.1	70.4
19	East Java	Dolokgede	GI 150 kV Cepu	48.5	4.9	22.9	76.2
20	East Java	Bayeman	GI 150 kV Situbondo	37.5	4.9	18.3	60.7
21	East Java	West Tambaagung	GI 150 kV Sumenep	37.5	3.7	19.3	60.5
22	East Java	Trantang	GI 150 kV Sementuban	37.5	3.7	23.2	64.3
23	East Java	Karangharjo	GI 150 kV Genteng	48.5	5.7	34.8	89.0
24	Bali	Sembiran	GI 150 kV Baturiti	48.5	39.0	50.7	138.1
25	Bali	Bukti	GI 150 kV Baturiti	13.0	2.9	51.9	67.8