1 GW SOLAR MAPPING AND DEVELOPMENT PLAN (INDONESIA)

Deliverable 1. Inception report

Prepared for:

Date: December, 13th, 2023

TTA Project Ref: CI-23-0028

ETP Project Ref: 22393-001-10

Doc Version: 1.0

Project:	1 GW SOLAR MAPPING AND DEVELOPMENT PLAN (INDONESIA)
Client:	United Nations Office for Project Services, **UNOPS**
Consultant:	**Trama Tecnoambiental, S.L. (TTA)**, in collaboration with **Inovasi, SolarGIS, ERM, Quadran and PwC**

D1. INCEPTION REPORT

Deliverable #1

Related Documents	**Type of document**	**Draft/final**	**Date of submission**

Financed by:	UNOPS

PRESENTATION This report contains the deliverable #1 of the project. The authors of this report are Roger Sallent (TTA), Solene Gondrexon (TTA), Indira DP (Quadran Solusi Enjinering), Lavalette Erica (PwC), Andre Susanto (Inovasi), Arryati Ramadhani (ERM) and SOLARGIS.

Table of Contents

List of Figures 2
List of Tables 2
1. Introduction 3
1.1. Background 3
1.2. Project objectives, outcomes and outputs 3
1.3. About this Report 4
2. Human resource management 6
3. Scope Management 8
3.1. Deliverable 1: Inception report 9
3.2. Deliverable 2. Phase 1 Report: Solar Irradiance Mapping and Accessible Database 9
3.3. Deliverable 3. Phase 2 Report: Grid Integration Assessment 18
3.4. Deliverable 4. Phase 3 Report: Review and Recommended Solutions of the Impediments 21
3.5. Deliverable 5. Final Report: Pre-Feasibility Study with Regulatory and non-Regulatory Analysis 29
3.6. Deliverable 6. Solar PV Technical Working Group (TWG) 31
4. Time management 33
5. Quality Management 34
6. Stakeholders Managament 35
6.1. Stakeholders engagement plan 35
6.2. Alignment with other donors' activities 35
7. Risk Management 37
8. Others 41
8.1. Sustainability, gender and social inclusion considerations 41
8.2. Monitoring and evaluation 42

List of Figures

Figure 1. Consortium's organizational chart 6
Figure 2. Consortium's organizational chart with key personnel 7
Figure 3. Flow-chart of main project activities. 9
Figure 4. PLN solar PV development plan in RUPTL 2021-2030 (PLN) 10
Figure 5. MEMR Geoportal 11
Figure 6. Solar irradiance measurement from indonesiasolarmap.com (AESI) 11
Figure 7. Indonesia's solar resources map 17
Figure 8. New and Renewable Energy Potential Map (MEMR Geoportal) 18
Figure 9. DIgSILENT PowerFactory Model example 20
Figure 10. Power sector swimlace 24
Figure 11. Evaluation Criteria 26
Figure 12. Summary of National Energy Policy – Government Regulation No 79 of 2014 28

List of Tables

Table 1. Work breakdown structure 8
Table 3. IFC Performance Standards and Key Requirements 14
Table 4. Key Stakeholders in Solar PV Development 22
Table 5. Illustrative RACI Matrix for Stakeholders Identification 23
Table 6 Several Relevant Regulations/Frameworks related to Solar PV Development in Indonesia 24
Table 7. Illustrative regulation policy matrix 25
Table 8. Example of Gaps Analysis between Existing Condition and Expected Outcome 27
Table 9. Example of Risk Assessment Table 29
Table 2. Workplan activities 33
Table 11. Risks and mitigations table 40
Table 12. Monitoring framework 43

1. Introduction

1.1. Background

The Southeast Asia Energy Transition Partnership (ETP) 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. To contribute to the achievement of the UN's Sustainable Development Goals (SDGs) and the Paris Climate Agreement objectives, ETP works in Southeast Asia, with a focus on three priority countries, namely Indonesia, the Philippines, and Vietnam.

ETP's strategy is built around four interrelated pillars of strategic engagement that are squarely aligned to address the barriers to energy transition. These are (i) policy alignment with climate commitments, (ii) de-risking energy efficiency and renewable energy investments, (iii) extending smart grids, and (iv) expanding knowledge and awareness building.

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. Indonesia has set a target of generating 23% of its energy from renewable sources by 2025 or 52% of new additional installed capacity by 2030, up from the current 14.11%. This will require an additional 8.8 GW of renewable energy capacity, representing an investment of approximately $8 billion annual investment in RE, four times the current annual investment target.

Of this new capacity, 3.6 GW and 6.4 GW are expected to come from rooftop solar PV and large-scale solar PV, respectively. However, as of 2022, only 271.6 MW peak (MWp) of solar PV has been installed, far short of the 893.3 MWp target for that year. The National Energy Plan (RUEN) drafted by the Ministry of Energy and Mineral Resources (MEMR) and enacted by the National Energy Council (DEN) in 2017 indicates that Indonesia has the potential to generate 208 GW of solar power.

Despite this potential and the ambitious goals set by the government, the development of solar PV power plants in Indonesia faces many challenges. To overcome these obstacles and enable renewable energy development, it is crucial to implement risk-reducing and mitigation measures.

1.2. Project objectives, outcomes and outputs

This project will provide technical knowledge to key stakeholders, including MEMR, the state-owned electricity company (PLN), and the Ministry of National Development Planning (BAPPENAS), to support decision-making on investments in large-scale solar PV development in the JAMALI grid and lesson learned for other grids in Indonesia. It provides the linkage to and acts as a follow-up of ETP's previous project, Upgrading PLN Jamali Load Dispatch Centre, by utilizing the newly designed system capability to integrate more Variable Renewable Energy (VRE) into the grid.

The project will produce a comprehensive study and assessment, including technical and non-technical aspects, that will inform investment decisions for the development of 1 GW of solar energy infrastructure in the JAMALI grid. The project also advises on the mechanisms for engaging with financiers and investors, with an emphasis on private-sector investors and developers. This work will serve as a key reference for PLN and the Government of Indonesia (MEMR and BAPPENAS) as they strive to increase the share of renewable energy in the country's energy mix and accelerate the transition to clean energy.

1.2.1. Objectives

The project aims to achieve the following objectives:

a. Strengthen the enabling environment for renewable energy (RE) policies through a comprehensive gap analysis of regulatory and non-regulatory factors. These factors include solar PV pricing, local content requirements (LCR), land use, licensing, permitting, infrastructure, and environmental and social impact assessments (ESIA). The analysis will identify barriers to solar PV development within the Java-Bali-Madura (JAMALI) power grid and assess challenges, impediments, and opportunities resulting from solar PV development gaps.
b. Increase the flow of public and private investments to RE projects in the power and end-user sectors by conducting pre-feasibility studies and proposing suitable financing mechanisms. The project will provide a 1 GW solar PV development plan to de-risk the projects and attract more investment.
c. Improve the development and accessibility of RE knowledge by disseminating study results to relevant stakeholders in the industry and making the findings easily accessible to the public.

1.2.2. Outcomes

The project aims to achieve the following outcomes:

a. Improved the regulatory and non-regulatory aspects of solar power development
b. Increased flow of investments for solar PV power plant projects
c. Increased investment feasibility, informed decision-making, and attracting investment in the development of sustainable solar energy infrastructure

1.2.3. Outputs

The project outputs are:

a. Solar Irradiance Data Mapping, which will be the basis of the project and strengthen the MEMR database and can be accessed by the public. The data mapping will use existing publicly or commercially available data from MEMR, NASA, and other entities.
b. Grid assessment of the local or regional electricity system, based on the collected solar irradiance data, to determine the feasibility of combined 1 GW installation through multiple projects
c. A solar PV development and investment plan for 1 GW of the JAMALI power grid, detailing steps and strategies, including specific plans to address existing challenges and impediments for solar PV development in the JAMALI power grid.
d. Lessons learned from solar PV development in Indonesia, including technical and non-technical -especially regulatory and financial- challenges, opportunities, and recommendations, for future efforts in expanding its development nationally, especially considering Indonesia's more ambitious JETP target.

1.3. About this Report

The ***Deliverable 1. Inception Report*** aims to provide the project management framework for the assignment, including but not limited to the typical sections of a Project Management Plan. This will make sure that both ETP and the consortium are on the same page. In accordance with the Terms of Reference, the inception report will contain, as a minimum:

- *Introduction and project background;*
- *Scope of Services;*
- *Methodology and work plan, including approach, methodology, timeline, outputs, and a project Gantt chart;*
- *A detailed approach to how the consultant will complete each deliverable will be met and what each submission will contain; mapping key stakeholders, outreach and communications, and a donor coordination strategy;*
- *Project management, including a chart showing the key people, their roles and responsibilities, and where they are (in-country project management is expected);*
- *Risks, mitigations, and assumptions; and*

- *Sustainability, gender, and social inclusion considerations*
- *The monitoring and evaluation framework as presented in the ETP Results Based Monitoring Framework (RBMF).*

The structure of the report is based on the Knowledge Areas from the Project Management Body Of Knowledge from the worldwide recognized Project Management Institute (PMI).

2. Human resource management

TTA is committed to building strong partnerships, both locally and globally, to harness our extensive worldwide knowledge and gain deep insights into local nuances. With the majority of our team based in Indonesia, we possess an inherent understanding of the local context, a critical advantage for this initiative. As a collaborative force, the consortium of this project composed of TTA, Inovasi, PwC, SolarGIS, Quadran Solusi Engineering and ERM, brings together a diverse group of partners, each contributing unique expertise, resources, and perspectives to address the challenges and opportunities of the project.

In line with this vision, TTA seeks to leverage our successful past collaboration with Inovasi and PwC which yielded excellent results. Inovasi will co-manage project activities, with a primary focus on engagement and local operations. Our partnership with PwC, a trusted name renowned for its work in Indonesia's energy transition, brings invaluable expertise in regulatory and financial assessments. To further enhance our capabilities, we will work with the support of SOLARGIS, a global leader in solar resource research, and Quadran Solusi Engineering, a partner with extensive experience in grid assessments within Indonesia. Leveraging Quadran's strong relationship with PLN, the national utility company will be instrumental in conducting the grid assessment. Lastly, ERM will provide diligent oversight for the critical environmental and social assessment aspects of this project.

With a significant presence of TTA team members and partners in Indonesia, we are well-positioned for close collaboration with UNOPS and the rest of the project stakeholders.

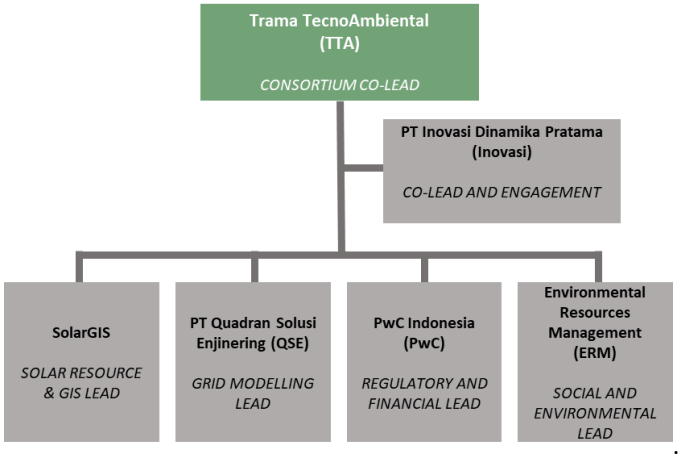


Figure 1. Consortium's organizational chart

The following chart depicts the team's organizational chart. At the top, the consortium is establishing a dedicated senior project management structure led by TTA and INOVASI. The complexity of the project justifies a dedicated and multidisciplinary management team. As a TTA in-house team member in Indonesia, Maryam will spearhead project coordination with the support of Andre, a senior expert in the Indonesian energy sector with extensive experience working alongside donors and governments. It shall be noted that Maryam is expecting a child by the end of 2023, and as such will temporarily be excused from the project during January – February 2024 in observance of her maternity leave. During this period Solene Gondrexon (TTA) will take part of her duties. Maryam will return to the project team starting March 2024.

Andre and Nino will support stakeholder engagement, field support in Indonesia, and coordination with partners. TTA's Asia Pacific Lead, Roger, will contribute with regional best practices and a global project management approach. TTA's Managing Director, Xavier, a trailblazer in the global renewable energy sector, will bring forth global best practices and insights garnered from his 35+ years of experience in the renewable energy and solar PV sector.

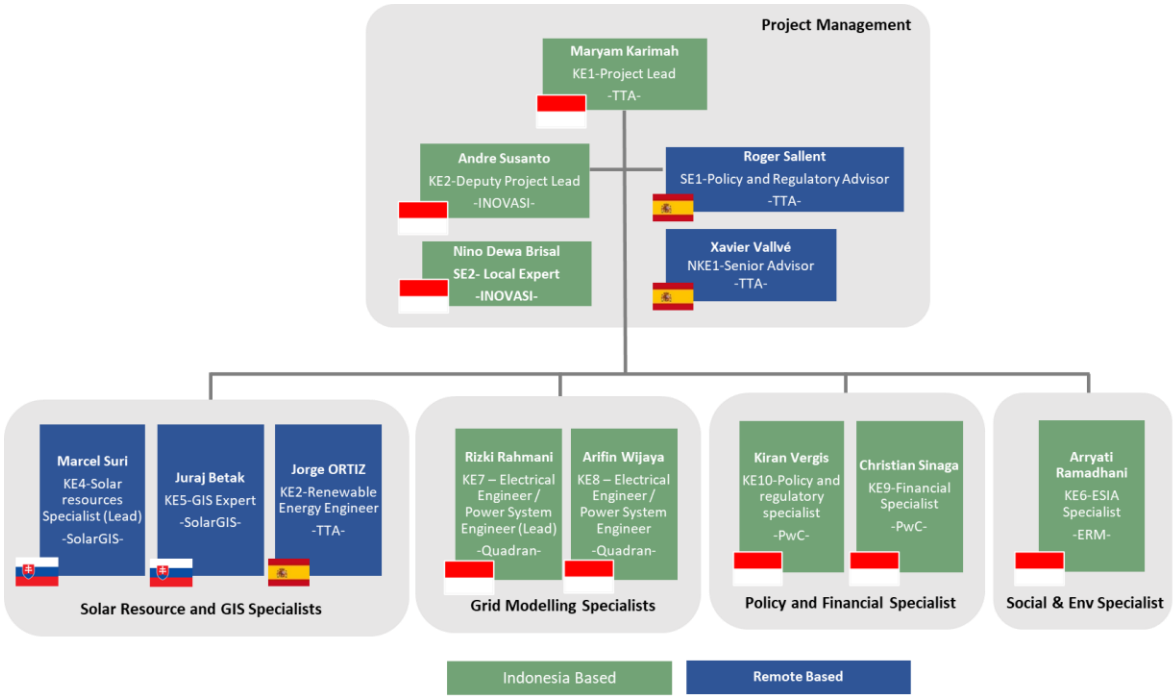


Figure 2. Consortium's organizational chart with key personnel

3. Scope Management

The following table summarizes the project's Work Breakdown Structure:

ACTIVITY	SUB-ACTIVITIES	DELIVERABLES
1. Project Scoping	1.1 Kick-off Meeting	*D1. Inception report*
	1.2 Donors' program mapping	
	1.3 Inception Report	
2. Phase 1 Report: Solar Irradiance Mapping	2.1 Preliminary Desk Study and Data Collection	*D2. Solar Irradiance Mapping and Accessible Database*
	2.2 Data Integration	
	2.3 Site Selection	
	2.4 Site Prioritization	
	2.5 Determine data's spatial and temporal resolution	
	2.6 Energy production mapping publication	
3 Phase 2 Report: Grid Integration Assessment	3.3 Data Collection	*D3. Grid Integration Assessment*
	3.4 Power Systems Modeling	
	3.5 Grid Analysis	
4 Phase 3 Report Series: Review and Recommended Solutions of the Impediments of Solar PV Development	4.1 Stakeholder Engagement	*D4.1. Challenges, impediments, and opportunities from the current gaps in solar PV development* *D4.2. Roadmap to overcome solar PV development impediments* *D4. Review and Recommended Solutions of the Impediments of Solar PV Development*
	4.2 Regulatory Analysis	
	4.3 Non-Regulatory Analysis	
	4.4 Solar PV Development Challenges and Opportunities Analysis	
	4.5 Preparation of feasible recommendations to address the impediments	
	4.6 Roadmap development	
5 Final Report: Pre-Feasibility Study with Regulatory and non-Regulatory Analysis	5.1 Regulatory and Non-regulatory Analysis of Solar PV Development	*D5. Final Report: Pre-Feasibility Study with Regulatory and non-Regulatory Analysis*
	5.2 FGDs with stakeholders	
	5.3 Investment Opportunities Analysis	
	5.4 Financing and Investment Mechanism Mapping	
6 Technical Working Group and Capacity Buildings	6.1 Planning	*D6. Event reports*
	6.2 Technical Working Group	
	6.3 Capacity Building and Workshops	

Table 1. Work breakdown structure

For the site recommendation of 1 GW Solar PV Development, the consultants propose the following process:

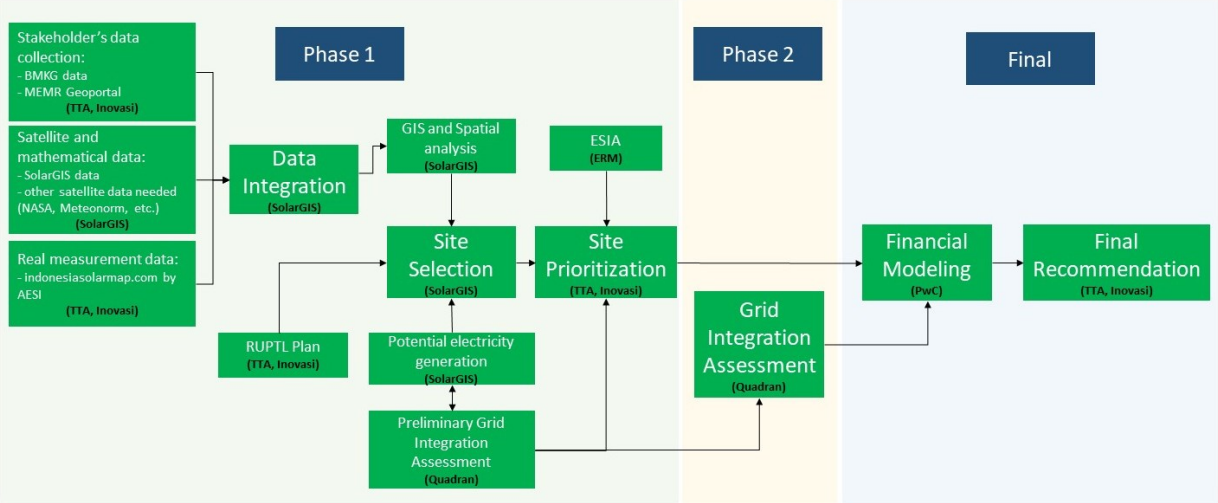


Figure 3. Flowchart of main project activities.

3.1. Deliverable 1: Inception report

Activity Lead: TTA

Deliverable 1 relates to this report. TTA organized an internal kick-off meeting on November 30th, 2023 to establish a unified understanding of project objectives, roles, and responsibilities.

TTA will convene a formal kick-off meeting in early 2024 with UNOPS and an extended number of stakeholders to foster collaboration, mutual understanding, and synergy among project participants. This kick-off meeting is important for both the consultants and the client to avoid discrepancies and clarify the scope. Thus, in this kick-off meeting, the scope between the consultants, client, and relevant stakeholders should be clarified and agreed upon.

3.2. Deliverable 2. Phase 1 Report: Solar Irradiance Mapping and Accessible Database

Activity Lead: SolarGIS

In this pivotal phase, SolarGIS takes the lead, leveraging its extensive experience and impeccable credentials in solar irradiance mapping. Our dedicated team comprises solar irradiance specialists and GIS experts meticulously selected from SolarGIS, ensuring the highest level of competence. To augment this exceptional team, TTA deploys a PV Specialist expert who not only provides valuable support but also undertakes the critical role of reviewing and ensuring the quality assurance of the deliverable.

To ensure that this deliverable yields the most significant output, we recognize the necessity of integration with two critical aspects of our project: Environmental and Social Impact Assessment (ESIA) and the forthcoming Phase 2, which encompasses grid impact assessment. In line with this vision, our team will integrate ESIA specialists who are well-versed in assessing the environmental and social dimensions of our solar PV development project.

Additionally, the Phase 2 grid impact assessment, will be conducted alongside Phase 1, which will be conducted in high-level assessment first as a support for the Phase 1 report. Quadran support as a power system expert will be an integral part of this phase, ensuring that the proposed sites are technically viable from a grid standpoint. This collaborative approach, with experts from multiple domains working in harmony, underscores our commitment to delivering a comprehensive and cohesive Phase 1 Report.

3.2.1. Preliminary Desk Study and Data Collection

The consultants will initiate the project with a desk study and literature review. The literature review will encompass several key topics, drawing from both domestic and international best practices. These topics include an examination of risks and strategies for risk mitigation, an exploration of enabling factors, an analysis of various sources of finance, and a consideration of bankability factors. The activities will also involve an in-depth examination of crucial data sources, including PLN's RUPTL, BMKG's solar irradiance data, and the MEMR Geoportal. This initial phase will serve as the foundation for subsequent activities.

Additionally, discussions with project developers regarding their project locations, PLN's project locations, etc., will identify sites where potential projects are already under consideration. These sites will undergo evaluation using the aforementioned methodology, including GIS criteria and irradiation analysis. This deliverable will provide an assessment of these locations, focusing on their suitability in terms of location, various GIS criteria, and irradiation. The assessment aims to validate each project's location and may offer additional recommendations for addressing specific criteria that might render the project less attractive, along with potential solutions if needed.

RUPTL DATA

The consultants will gain insights from RUPTL, extracting critical solar PV development planning in the JAMALI region. This data forms the cornerstone of our solar irradiance mapping and grid assessment. Our objective is to optimize the implementation of solar PV development in alignment with RUPTL's framework.

Figure 4. PLN solar PV development plan in RUPTL 2021-2030 (PLN)

STAKEHOLDER'S DATA

Additionally, we harness BMKG's solar irradiance data and the MEMR Geoportal to enrich our dataset, contributing to our understanding of solar irradiance and solar PV energy potential within JAMALI. Moreover, the consultants will collect the layer of data for the source of Geographic Information System (GIS) and spatial analysis.

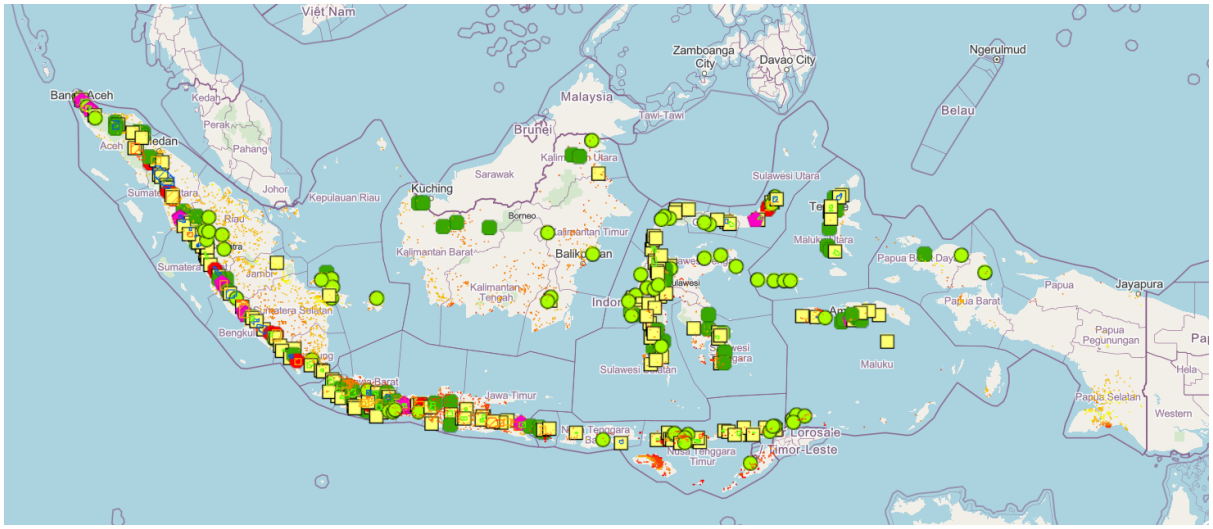


Figure 5. MEMR Geoportal

AESI PYRANOMETER DATA

To bolster our information arsenal, we acquire direct measurements from 50 strategic locations in JAMALI through https://indonesiasolarmap.com/ by AESI (paid). These on-ground measurements complement our existing high-resolution satellite data sourced from SolarGIS.

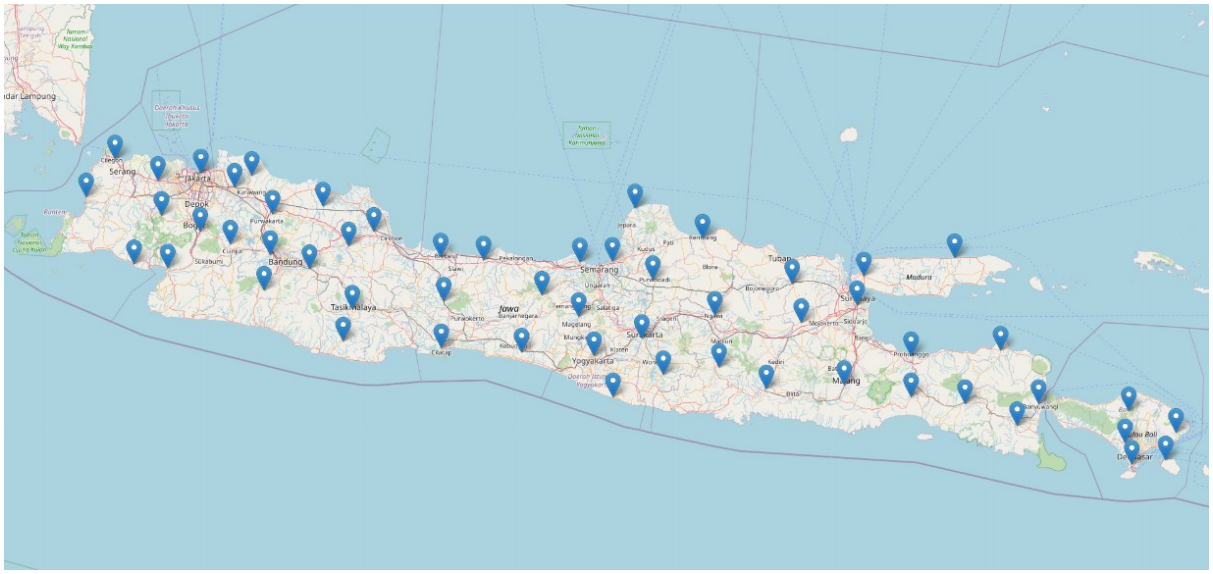


Figure 6. Solar irradiance measurement from indonesiasolarmap.com (AESI)

The integration between SolarGIS and other satellite data with those three local data from BMKG, MEMR, and direct measurements from https://indonesiasolarmap.com/ will improve the accuracy significantly.

3.2.2. Data Integration

By harmonizing and integrating data from SolarGIS, BMKG, MEMR, and direct measurements from https://indonesiasolarmap.com/ by AESI, our methodology ensures a substantial enhancement in accuracy. This collaborative data synergy guarantees the superior quality of our solar irradiance mapping.

Throughout the integration process, we implement robust validation procedures to cross-reference and verify data accuracy. This step ensures that the integrated dataset is consistent, reliable, and free from inconsistencies. Following data integration, we synthesize the information into a cohesive and comprehensive dataset. This

synthesis includes the spatial and temporal alignment of data layers, allowing for seamless analysis of solar irradiance patterns and potential energy generation.

3.2.3. Site Selection

The next crucial phase in Phase 1, which focuses on solar irradiance mapping, is the site selection process. In this activity, sites will be chosen based on a combination of factors, including the RUPTL plan and the potential solar PV energy resources available within the JAMALI regions. Our goal is to identify approximately 100 specific locations, each with the capacity to contribute to a total of 1 GW of solar PV capacity.

GIS AND SPATIAL ANALYSIS

The site selection process commences with a comprehensive GIS and spatial analysis. This method empowers the consultants to pinpoint potential solar installation sites across the JAMALI regions. By harnessing geospatial data, we consider various factors, including terrain, land use, proximity to existing infrastructure, and other critical variables influencing location suitability for solar deployment. This analysis will utilize ESRI's platform, which is also employed by the MEMR geoportal. This will ensure optimized data sharing and future data integration through the MEMR geoportal platform. This analysis will also enable UNOPS to have higher data resolution than the current publicly available data. This enhanced data can optimize solar PV project planning, and it can be published publicly to attract more investors and developers.

EXAMINATION OF ENERGY CONTENT

We conduct a thorough examination of the energy content of available resources in the identified areas including in dams and lake locations. This step involves an assessment of solar irradiance levels, which is essential for understanding the solar energy potential of each site. By analyzing solar irradiance data, we gain insights into the energy-capturing capacity of different regions. The examination can also encompass the exploration of various potential business models and technologies available for deploying 1 GW of solar PV in JAMALI. This includes investigating options like freshwater floating solar PV, which involves assessing the suitability of lakes and man-made reservoirs for this purpose.

MONTHLY IRRADIANCE AND POTENTIAL ELECTRICITY GENERATION

Our methodology includes the analysis of monthly high, low, and average levels of irradiance for each selected site. This granular approach allows us to assess the seasonal variations in solar radiation, providing a clear picture of potential electricity generation throughout the year. It ensures that our recommendations are optimized to account for varying solar conditions. For reference, the Global Solar Atlas, a product of SolarGIS, features a resolution of 250m x 250m, which is suitable for planning purposes. Through data integration with stakeholders' information and direct measurements, the consultant can provide, at the very least, the same resolution or even higher, with greater data accuracy.

The geographical analysis will help to assess technical potential, including the potential electricity generation capacity (in MW), potential power generation (in GWh), and suitable land and water area, considering the performance of a PV system, geographical constraints, and technology-specific limitations. We will focus on solar power generation variability, which is very significant in equatorial tropics due to fast-changing clouds. We will also analyze atmospheric aerosols as a result of forest and vegetation fires in the region. Variability analysis and potential data will be directly used in Phase 2 activities. Additionally, the analysis will consider power wheeling and sleeved power purchase agreement (PPA) arrangements, exploring the feasibility of installing solar PV systems at locations farther away from electricity demand centers, provided they are near PLN's existing transmission lines or substations for connection.

3.2.4. Site Prioritization

Once the selection process culminates in identifying locations capable of contributing to a total of 1 GW of solar PV capacity, our next step is their prioritization. This crucial phase of the project involves assessing these sites based on multiple factors, with a focus on environmental and grid assessments.

A Multi-Criteria matrix will be developed by identifying the relevant selection factors. This matrix will enable the project to analyze and prioritize the 100 locations for further assessment. Each location will receive a score indicating its potential for success based on the assessment and analysis. For instance, there may be locations

with very high irradiation but situated in mountainous areas. The mountainous terrain serves as a go/no-go criterion, and thus, within the MCDA matrix, such sites will be promptly disqualified.

SolarGIS will be responsible for preparing the methods of site prioritization with the support of Inovasi. Our prioritization methodology will be tailored to comprehensively evaluate the technical and environmental viability of each selected site. This evaluation is essential to ensure that the chosen locations align with sustainability and regulatory standards.

An integral component of this prioritization phase is the preliminary grid assessment. This early assessment reflects the alignment between Phase 1 and Phase 2 of the project. In essence, Phase 2 initiates even before Phase 1 concludes, as a portion of Phase 2's objectives is an essential part of the Phase 1 analysis.

This strategic approach allows us to streamline the project's progress and ensures that site prioritization is not solely based on solar resources feasibility but also considers grid integration requirements. It emphasizes the project's efficiency and the synchronization of its key phases.

3.2.5. Environmental and Social Impact Assessment

Activity Lead: ERM

The prioritization process takes into account the environmental impact of each site, considering factors such as protected areas, land use patterns, and terrain characteristics. This approach ensures that our selected sites adhere to environmental regulations and minimize ecological impact. A layer of environmental data would be added to geographic ana. lysis to ensure that the proposed areas are not protected areas.

ERM, as the consultant, will conduct high-level screening to provide the Project with further clarity around the Environmental and Social considerations required across the selected sites. The purpose of the screening exercise is to identify potential significant effects on environmental and social receptors/resources as a result of the project. These risks are items that the consultant anticipates would be of relevance to the region or area based on our experience with local expectations and regulations.

The screening will fulfill the following objectives:

- Description of E&S framework and requirements concerning IFC Performance Standards. IFC requires projects to adopt and implement eight (8) points of environmental and social performance standards, and IFC PS's are considered to be good practice for many financial institutions to address E&S requirements for projects. Key requirements of each performance standard are provided in **Table 3. IFC Performance Standards and Key Requirements** below.
- Description of Indonesian environmental and social governance requirements concerning solar/battery projects of the proposed scale, including relevant regulations with respect to land acquisition.
- Desktop socio-environmental assessment of the proposed project location based on land-use map (provided by the client), indicating high-level risk assessment and mitigation.
- Support the Client's high-level review of demonstrating an understanding of the process for purchasing land and securing the required land access rights at different geographical locations in Indonesia, and demonstrating a plan is in place to identify land requirements and satisfy them.

The following sections aim to provide an overview of the proposed scope of work including ERM's proposed approach and methodology to execute the Project.

- **Regulatory review**: a review of the relevant regulations will help to establish the context and landscape within which the project operates, enabling a relevant and meaningful study.
- **Environmental screening**: Based on our experience in similar power generation in the region, we have learned that understanding potential environmental impact, especially about biodiversity and climate change, early in the project lifecycle is critical to manage and mitigate risks. ERM will review project details and select focus assessment parameters which can include Biodiversity, Water Quality, Waste Discharge, Air Quality, Dust, Noise, and Climate/Flood Risk.
- ERM will apply a qualitative screening of potential impacts using secondary data sources (i.e. Satellite Imagery, Academic Papers, Official Government Resources, News Articles).

- **Social screening**: The Project activities, including the footprint, construction, and operation activities and timelines will impact the local community on the selected sites and surrounding areas. An initial screening will assist in identifying the potential impacts and opportunities that the Project may bring, including impacts on socio-environmental and socio-cultural values, impacts on natural heritage, potential development opportunities, land use, shared infrastructure uses, etc. This step will help to inform future engagement and consultations with the local communities, which is a key step in obtaining approvals and permits for the development.

Table 2. IFC Performance Standards and Key Requirements

Performance standards (PS)	Key Requirements
PS 1: Assessment and Management of Environmental and Social Risk and Impacts	IFC PS1 requires identifying and assessing environmental and social risks and impacts of any given Project. It shall cover all relevant environmental and social risks and potential impacts outlined in PS 2 through 8. The Project must adopt a mitigation hierarchy to anticipate and avoid, or where avoidance is not possible, minimize, and where residual impacts remain, compensate/offset for risks and impacts to workers, affected communities, and the environment. IFC PS1 promotes improved E&S performance of clients through the effective use of Environmental and Social Management Systems (ESMS). In addition to meeting the IFC PS 1 requirements, the Project must comply with applicable national law, including those laws implementing host country obligations under international law.
PS 2: Labour and Working Conditions	The key elements for compliance with IFC PS2 include, human resources policy and its management; direct and contractual worker management; working conditions and terms of employment; retrenchment; freedom to form and join workers' organizations; internal grievance mechanism; protection of workforce to avoid child labor and forced labor; non-discrimination and equal opportunity considerations (including local hiring preferences); occupational health and safety procedures and mechanisms; and procedure for managing contractors and suppliers.
PS 3: Resource Efficiency and Pollution Prevention	IFC PS 3 outlines a Project-level approach to resource efficiency and pollution prevention and control in line with internationally disseminated technologies and practices. Key element of compliance in IFC PS3 includes greenhouse gas emissions; water consumption; air and water emissions; noise as well as ambient air quality; waste management; hazardous materials management; and pesticide use and management.
PS 4: Community Health, Safety, and Security	The two key aspects of IFC PS4 concern community health and safety and security personnel requirements. IFC PS4 requires the Project to evaluate the potential for community impacts associated with the Project and avoid or minimize risks/impacts on community health and safety, particularly with regards to infrastructure, equipment, hazardous materials safety, natural resource issues related to the ecosystem services utilization, and exposure to disease. The performance standard also requires the assessment of risks posed by its security arrangements to those within and outside the Project site.
PS 5: Land Acquisition and Involuntary Resettlement	Key requirements of the IFC PS 5 include Compensation and Benefits for Displaced Persons; Community Engagement; Resettlement and Livelihood Restoration Planning and Implementation; Grievance Mechanism for physical and Economic Displacement.
PS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	To ensure that biodiversity is protected and conserved and that sustainable management and use of natural resources is used wherever feasible throughout the Project lifecycle.

Performance standards (PS)	Key Requirements
	The key concerns required by the IFC PS6 include, protection and conservation of biodiversity through assessment and management of modified and natural habitat, critical habitat, legally protected and internationally recognized areas and invasive alien species; management of ecosystem services; management of living natural resources, and supply chain management.
PS 7: Indigenous People	Require the Project to anticipate and avoid adverse impacts to the Indigenous People, including People screening and impact assessment, maintain relationships based on Informed Consultation and participation (ICP), obtain FPIC if the Project is significantly affected by the Project, and promote sustainable development benefits and opportunities.
PS 8: Cultural Heritage	IFC PS8 requires sites to make efforts to protect cultural heritage from any adverse impacts of Project activities and to support the preservation of cultural heritage. In this case, the issue is being assessed in terms of impacts on IPs.

Note: only relevant Performance Standards will be used for the site prioritization ie. IFC PS 5 to IFC PS 8

We will conduct project screening on potential sites, this step involves evaluating the project's scope, location, activities, and potential environmental and social impacts and helps identify which IFC PS aspect is applicable for each selected site. We then scope the defining boundaries of the assessment, as well as identifying key issues and stakeholders and evaluating the current environmental and social conditions in the site area. And followed with impact assessment, involving predicting and evaluating the potential environmental and social impacts of the project. It considers both direct and indirect effects throughout the project life cycle, from construction to operation and decommissioning. We then categorize the potential sites into the following categories:

Risk Category	Description	Action point
Excluded	Significant E&S Risk, ineligible for financing or investment due to their significant, irreversible, or unacceptable environmental and social risks and impacts	No Go site
Category A	**Critical high risk** Site with potentially significant adverse environmental and social risks and impacts, which are diverse, irreversible, or unprecedented	Requires Due Diligence and development of Mitigation action (ESMP)
Category B+	**High Risk** Site with potentially adverse social or environmental impacts that are generally beyond the site boundaries, largely reversible, and can be addressed through relevant mitigation measures	Requires Due Diligence and development of Mitigation action (ESMP)
Category B	**Moderate Risk** Site with moderate environmental and social risks and impacts, largely reversible, and readily addressed through mitigation measures	Requires Due Diligence and development of Mitigation action (ESMP)
Category C	**Low Risk**	Require compliance with applicable laws

	projects have minimal or no adverse environmental or social risks and impacts.

All the assessments, findings, and plans are documented in an Environmental and Social Impact Assessment (ESIA) report.

3.2.6. Grid Integration Assessment for Phase 1

Activity Lead: Quadran

As a key partner responsible for grid impact assessment, Quadran plays a pivotal role in harmonizing this activity with Phase 2 objectives. This alignment ensures a harmonized transition between project phases and optimizes the technical feasibility of each selected site.

The primary objective of grid assessment during this phase is to ascertain the technical feasibility of the identified sites. This involves conducting a comprehensive supply and demand assessment, considering essential technical parameters like load flow and stability analysis. We recognize that project viability isn't solely contingent on whether the generated capacity meets demand but also hinges on the grid's ability to integrate this capacity.

Our approach emphasizes the importance of optimizing capacity while safeguarding grid stability and enhancing the grid's performance rather than straining it. By evaluating the present data and considering future planning up to 2030, we ensure that our solar PV development project aligns with long-term sustainability, both in terms of capacity and grid reliability.

The result of the Grid Impact Assessment will be presented in Excel basis along with ESIA. One of the primary outputs of this prioritization activity is the identification of preferred areas suitable for the establishment of large-scale solar PV plants. These selected locations are where we propose to inject significant solar PV capacity into the grid.

3.2.7. Determine Data's Spatial and Temporal Resolution

In this step, we will engage with stakeholders at various administrative levels to determine the most suitable spatial and temporal resolution for the data hosted on the MEMR Geoportal. This engagement aims to align the data's granularity with the specific needs and requirements of local stakeholders. We will ensure that the data's resolution is optimized to facilitate effective decision-making and resource planning.

The example of SOLARGIS work for solar resource map in Indonesia funded by the World Bank and ESMAP. The resolution of this publication is 250m x 250m (same as Global Solar Atlas), providing optimal data for solar irradiance for planning purposes. This means that a single 10 MW solar PV field can be treated as a single irradiation value. Therefore, for this project, the consultant proposes a resolution of at least 250m x 250m, subject to guidance from stakeholders and clients.

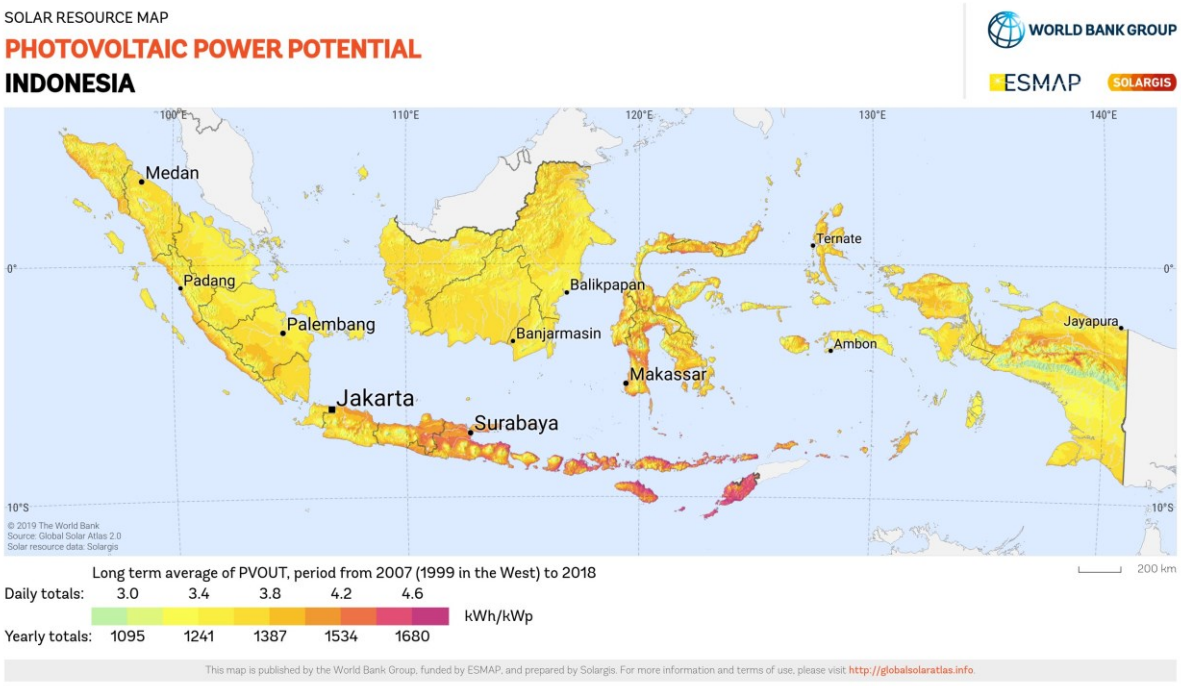


Figure 7. Indonesia's solar resources map

3.2.8. Energy Production Mapping Publication

The consultants will compile and prepare a comprehensive dataset for seamless integration into the MEMR Geoportal. To achieve this, the consultants will utilize ESRI's ArcGIS, a platform that is also utilized by MEMR Geoportal. This approach ensures that the data can be seamlessly integrated with MEMR's existing infrastructure, enhancing accessibility and usability.

Following the completion of energy production mapping, the subsequent step is to share this valuable information with stakeholders. The consultants will create detailed energy production maps, offering deep insights into solar potential within the JAMALI regions. These maps will be made accessible to the public through the MEMR Geoportal. To facilitate this, close coordination and collaboration with MEMR will be conducted, ensuring an efficient data-sharing process.

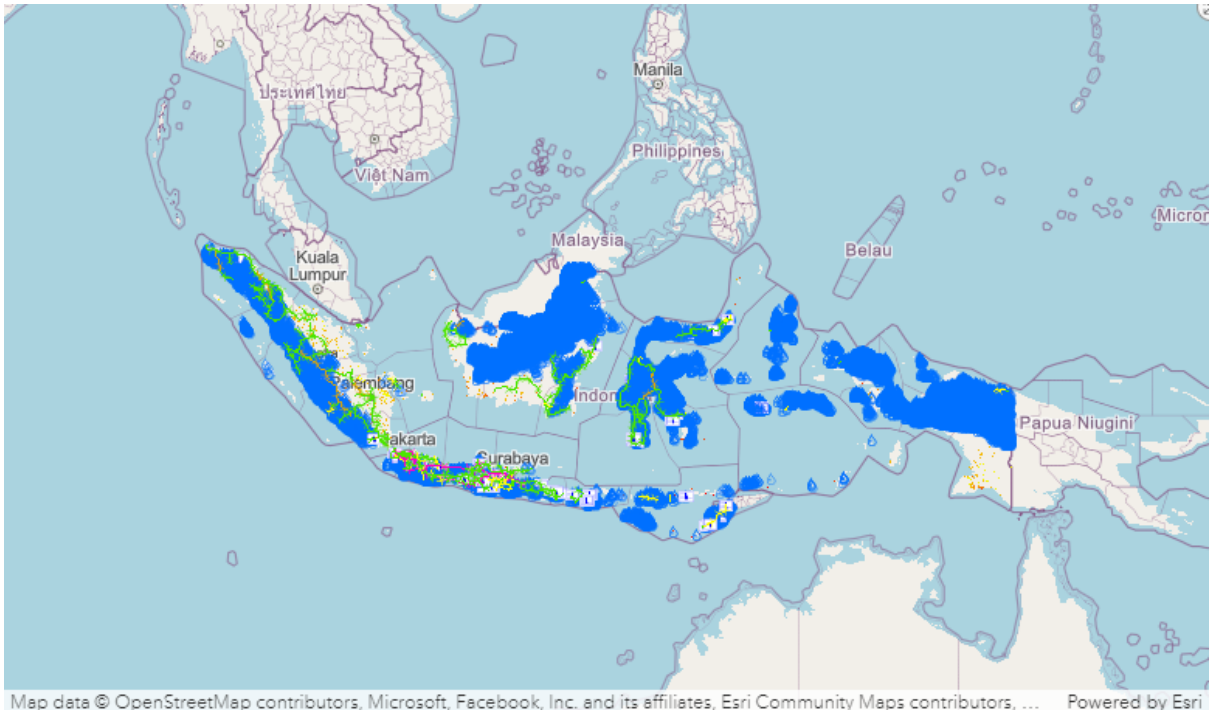


Figure 8. New and Renewable Energy Potential Map (MEMR Geoportal)

Upon UNOPS approval, the consultant proposes publishing the results of solar irradiance data mapping and solar PV potential development on an inclusive website that will be publicly accessible. The purpose of this website is to attract investors and developers to undertake solar PV projects in Indonesia while also assisting them in the technical preparations for solar PV development. This approach enhances data accuracy and reduces the preliminary workload for data collection and analysis on their part. Furthermore, this open-access website helps these stakeholders identify potential risks and initial strategies for financially viable projects.

This website will remain publicly accessible for an additional two years after the project's completion, upon agreement with UNOPS. It will be designed to facilitate GIS filtering activities for private sector companies, allowing them to select high irradiation locations, identify soil types, avoid protected forest areas, and steer clear of residential and other challenging zoning areas for solar PV power plant development. By incorporating these features into the new website, using data obtained from this project's results, private sector companies, donor agencies, local governments, and other stakeholders will have the means to evaluate highly promising locations beyond the initial 100 identified in this project.

One of the website's key features is the presentation of the Multi-Criteria analysis developed and utilized in this project to identify and prioritize the top 100 locations within JAMALI. Importantly, the presence of this website does not preclude sharing the information gathered through this project with relevant government agencies, which may involve publishing the pertinent data on MEMR's Geoportal OneMap website.

3.3. Deliverable 3. Phase 2 Report: Grid Integration Assessment

Activity Lead: Quadran

Phase 2 will be led by Quadran, with TTA providing essential support. Quadran boasts extensive experience as a leader in grid integration assessments in Indonesia, having collaborated closely with PLN on numerous projects. Notably, their involvement in the "Provision of Consultancy Services for the Study of the Readiness of the Electricity System for Photovoltaic Solar Power Integration in JAMALI Systems" demonstrates their prowess in conducting such studies, making them well-equipped for this phase.

Quadran will deploy two seasoned experts, as electrical engineers/power system experts for the grid integration assessments. In conjunction with Quadran's expertise, TTA's PV specialist will actively coordinate and provide valuable feedback throughout the grid integration assessment process.

The objective of the grid integration assessment is to identify the 1 GW solar potential in JAMALI and verify that the irradiance will be sufficient to meet the demand and can be integrated into the JAMALI power system without problem. In detail, the purposes of the study are:

1. To conduct in-depth grid analysis and evaluate the system's performance when interconnecting the 1 GW solar potential to the JAMALI system.
2. To identify all risks involved when interconnecting such solar power plants.
3. To mitigate problems that may occur when interconnecting solar plants.

The activity is a follow-up to the Phase 1 grid integration assessment, serving as an iterative process for site selection and site prioritization.

3.3.1. Data Collection and Preparation

Power system data (existing and expansion) will be based on the published document: RUPTL 2021-2030 (or the latest one at the time this contract is signed). Any other type of data will be obtained by engaging with PLN for data acquisition.

The data required for this study is as follows:

a. Existing grid infrastructure: power plants (type and capacity), transmission system (route, length, and conductor size/capacity), substations (capacity). At this point, Quadran has existing and updated data that is already in the server in the software DIgSILENT format.
b. Demand profile and growth forecast (based on RUPTL 2021-2030) for each substation and total system in the COD year of the solar plant.
c. Grid expansion plan (based on RUPTL 2021-2030).
d. Solar irradiance data will be obtained from the result of Phase 1.

3.3.2. Power System Modelling

Power system modeling will be based on the data gathered in the first step combined with the consultant's previously owned data to create a model as representative as possible. Any missing data will use assumptions based on best practice/typical data or acknowledged references.

a. Power system modeling will focus on the JAMALI system around the solar power plant interconnection point (the solar will be modeled as one equivalent solar inverter, interconnection point, up to the PLN grid).
b. The power system software which is utilized for the power system modeling is DIgSILENT PowerFactory and PLEXOS. DIgSILENT will be used for load flow analysis, quasi-dynamic analysis, and system strength index calculation. PLEXOS will be used for hosting capacity analysis.

SOFTWARE

PLEXOS

PLEXOS by Energy Exemplar will be used for conducting generation capacity expansion planning. The tool can perform multi-area expansion planning and the operating performance of the expansion plan will be evaluated by conducting dispatch analysis using the same tool.

Further complete information about PLEXOS is detailed at http://energyexemplar.com/

DIgSILENT PowerFactory

For power system analysis, will use DIgSILENT PowerFactory from DIgSILENT GmbH. PowerFactory is a leading power system analysis software application for use in analyzing generation, transmission, distribution, and industrial systems. In this study, DIgSILENT will produce complete output from a power system analysis in the form of load flow, and stability for the Java-Bali system.

Further complete information about DIgSILENT PowerFactory is detailed at https://www.digsilent.de/en/

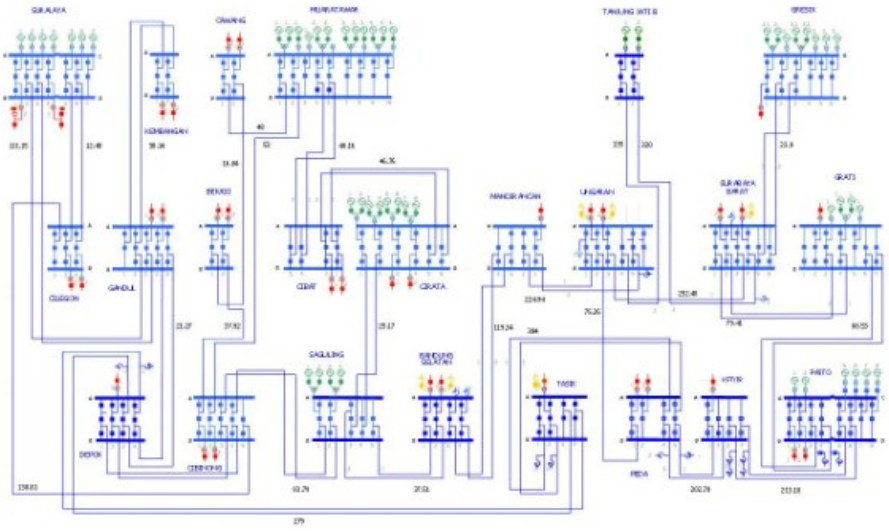


Figure 9. DIgSILENT PowerFactory Model example

3.3.3. Grid Study and Analysis

This activity aims to do an in-depth technical analysis of the JAMALI grid. This activity also includes the below analysis that would be incorporated and covered in the technical assessment.

- A high-level analysis to explore the integration of solar energy with other resources, such as existing power plants or energy storage systems. This analysis aims to mitigate supply disruptions and address intermittency issues.
- Assessment of how to strengthen the existing grid infrastructure to accommodate the integration of 1 GW of solar PV capacity. This assessment may involve upgrades, reinforcements, or changes in grid design to ensure reliability.
- The technical non-regulatory factors, including technological considerations, infrastructure readiness, and policy-related challenges, will be thoroughly analyzed. Recommendations will be developed to address these factors and optimize the integration of solar energy into the grid.

In terms of the technical assessment itself, the grid study will be conducted based on several analyses, such as:

a. Hosting Capacity Analysis

Hosting capacity is the maximum limit of distributed generation (in this case, solar power plant) that can be added to a system without changing control or repairing/upgrading equipment in the system to maintain reliability when there is an additional solar power plant in the system.

b. Production Cost Simulation

Production simulations are conducted to estimate the allocation of electric energy production to generating units to meet the load of the electric power system at any time and calculate the production costs associated with this energy production.

c. Load Flow Analysis

Load flow analysis will be done both before and after the interconnection of the solar power plant. The irradiance data that is needed for the simulation will be obtained based on the Phase-1 report by SolarGIS.

This analysis will observe and compare the power evacuation flow, losses, the loading of the distribution lines, and the profile of voltage of the feeder before and after the interconnection.

d. Short Circuit Analysis

Short circuit analysis is conducted to assess the increase of short-circuit current level provoked by the interconnection of the solar plant in the COD year.

- If breaker ratings are available, the results shall be compared to the breaker ratings to conclude if the solar plant cause any violation.
- The short circuit currents study will calculate the short circuit current levels in the interconnection point of the solar plant both before and after its connection.
- The study will be conducted in peak load conditions, with all system elements (generation units and transmission links) in service, as it is the most conservative situation, in accordance with IEC 60909.
-

e. Dynamic Stability Analysis

Stability analysis is done to determine system performance if there is a sudden imbalance between load and generation. Several simulation conditions will be considered:

- The dynamic stability will be conducted before and after the interconnection of the solar plant.
- This dynamic stability study will be conducted for day load conditions.

Based on the frequency deviation resulting from the load and generation imbalance, the system stiffness of the JAMALI system can be calculated.

f. Quasi Dynamic Analysis

The quasi-dynamic analysis will be done to assess the JAMALI system frequency response to the intermittency of the solar power plant.

The simulation is carried out in the short term based on the available production simulation and load curve. The purpose of this analysis is to observe and evaluate several parameters in the system, such as generator response, voltage profile, line loading, frequency deviation, etc, when there is a change in the system, such as the switching conditions between steady-state and transient in the system. Frequency deviation tolerance bands are to be as per grid code within 50 Hz ± 0.2 Hz.

g. Conclusion and Recommendations for Mitigation Solutions

For each item that will be analyzed, when there are problems with the electrical aspects, mitigation solutions will be made as recommendations to solve these problems.

3.4. Deliverable 4. Phase 3 Report: Review and Recommended Solutions of the Impediments

Activity Lead: PwC

Phase 3 of the project will be led by PwC, in close collaboration with TTA, and INOVASI. The rationale for this collaborative approach is to build upon the progress made in previous phases and ensure alignment between regulatory and non-regulatory challenges, as well as technical and non-technical aspects of solar PV development. PwC will contribute two experts specializing in policy and regulatory matters and financial analysis, both of which are highly relevant to the objectives of Phase 3.

We understand that the objective of this phase is to analyze the existing conditions of solar PV development, including investigating the challenges of developing large-scale solar PV projects in Indonesia, especially within the JAMALI grid. PwC work under ADB for the Affordable and Sustainable Energy Transition (ASET), has involved a detailed review of the barriers to accelerated adoption of renewable energy, across governance frameworks, institutional structures, market models, procurement models, and ease of financing, and design of a basket of policy reform measures to address these barriers. Thus, we will bring this experience to the tailored methods for this assignment.

3.4.1. Stakeholders Engagement

STAKEHOLDER IDENTIFICATION

The consultants will first identify the relevant stakeholders along with their role in the power sector and their level of involvement during this assignment by using the RACI matrix. Afterward, upon approval from UNOPS and key beneficiaries, we will conduct Initial Stakeholders Briefing ("ISB") to clarify the roles and responsibilities of each stakeholder for solar PV development in Indonesia, as well as to secure wide buy-in from the stakeholders for the findings that will be followed up throughout the engagement.

Our stakeholder identification would involve secondary research and regular consultation with UNOPS and the key beneficiaries. The preliminary stakeholders identified in Indonesia's solar PV development are as follows.

Table 3. Key Stakeholders in Solar PV Development

No	Stakeholder	Roles and Responsibilities
1	**Ministry of Energy and Mineral Resources ("MEMR")**	MEMR is charged with creating and implementing Indonesia's energy policy, including the National Electricity General Plan (Rencana Umum Ketenagalistrikan Nasional – "RUKN") and regulating the power sector through the DGE and the DGNREEC. The MoEMR is also responsible for preparing and implementing regulations related to electricity, the NRE, and energy conservation, and endorsing PLN's RUPTL
2	**PT PLN (Persero)**	PLN is responsible for most of Indonesia's power generation with exclusive powers over the transmission, distribution, and supply of electricity to the public. PLN is regulated and supervised by the MoEMR, the Ministry of State-Owned Enterprises ("MoSOE") and the MoF.
3	**National Development Planning Agency ("Bappenas")**	Bappenas has a role in conceptualizing energy sector programs for the national development plan. Within Bappenas is also the Directorate for Public-Private Partnerships (PPP), which facilitates cooperation on infrastructure projects between the Government and private investors.
4	**National Energy Council("DEN")**	DEN is responsible for assisting the government regarding energy policy formulation, planning, and execution. The council plays a crucial role in preparing the national energy policy. They operate in close coordination with governmental bodies, stakeholders, and international partners, ensuring the alignment of energy strategies with national development objectives and facilitating the monitoring and evaluation of policy implementation.
5	**Ministry of Finance ("MoF")**	The MoF approves tax incentives that may be offered by the Government for a power project as well as any Government guarantees. The Directorate of Government Support Management and Infrastructure Financing (Direktorat Pengelolaan Dukungan Pemerintah dan Pembiayaan Infrastruktur) within the MoF is responsible for reviewing government support, providing technical guidance, evaluating the financing, and maintaining investor relations. The MoF also recommends the maximum level of electricity subsidy to PLN in the national budget and reviews loan arrangements entered into by PLN including the Government's guarantees of PLN's loans.
6	**Ministry of State-Owned Enterprise ("MSOE")**	The MoSOE supervises PLN's management, sets its corporate performance targets, approves its annual budget, and assesses the achievement of those targets.
7	**Ministry of Industry ("MoI")**	The MoI regulates the minimum local content of components used in electrical power network and generation, including from renewable sources, e.g. PV panels, battery storage, cables, etc.

No	Stakeholder	Roles and Responsibilities
8	**Ministry of Home Affairs ("MoHA")**	The MoHA holds the responsibility of coordinating the development and supervising the administration of local government and projects at the regional level, with regard to planning, budgeting, organizing, implementing, reporting, and evaluating
9	**Relevant local government**	The local government is responsible for the development of their respective area, in accordance with their authority. Development of solar PV in a specific area should obtain permission from the local government, including ensuring that the solar PV development is aligned with the local government's spatial planning.
10	**Independent Power Producers ("IPPs")**	IPPs have roles as investors and/or developers of power plants in Indonesia, either through private means or in cooperation with PLN.
11	**Industry associations APLSI, METI**	Industry associations consist of business players in specific sectors and act as platforms that facilitate communication between business entities or private sectors with relevant Government institutions. Industry associations are also often invited to provide inputs or recommendations to policy-making in their respective sector

Further analysis with regards to the identification and assessment of their influence and level of involvement will be conducted during this assignment, including involving industry associations, academia, operators, and the private sector through the RACI matrix, which describes the participation by various roles in completing tasks or deliverables for a project or business process. It is used for clarifying and defining roles and responsibilities in cross-functional or departmental projects and processes. RACI is an acronym derived from the four key responsibilities most typically used: Responsible, Accountable, Consulted, and Informed. The illustrative matrix is depicted below.

Table 4. Illustrative RACI Matrix for Stakeholders Identification

Tasks	MEMR	PLN	MoF	MSOE	Bappenas	MoI	MoHA
Develop policy related to technical aspects	I	I	A	I	I	I	I
Approve solar PV development roadmap	R	A, C, I	A	I	I	I	C, A
Develop policy related to local government investment	I	I	A, C	I	I	I	R
[Task 5]	I	I	I	A, C	I	I	I
[Task 6]	I	I	I	I	I	A, C	I

The output of this step would be a matrix of stakeholders including their roles and responsibilities, potential interest, and influence especially with regards to the energy transition and decarbonization in Indonesia.

INITIAL STAKEHOLDERS BRIEFING

Based on the 4.1.1 output, upon agreement from UNOPS, we will hold an Initial Stakeholders Briefing to brief the relevant stakeholders on the project, their respective roles and responsibilities, to understand the extent of their involvement, as well as to obtain support for the project and agreed timeline.

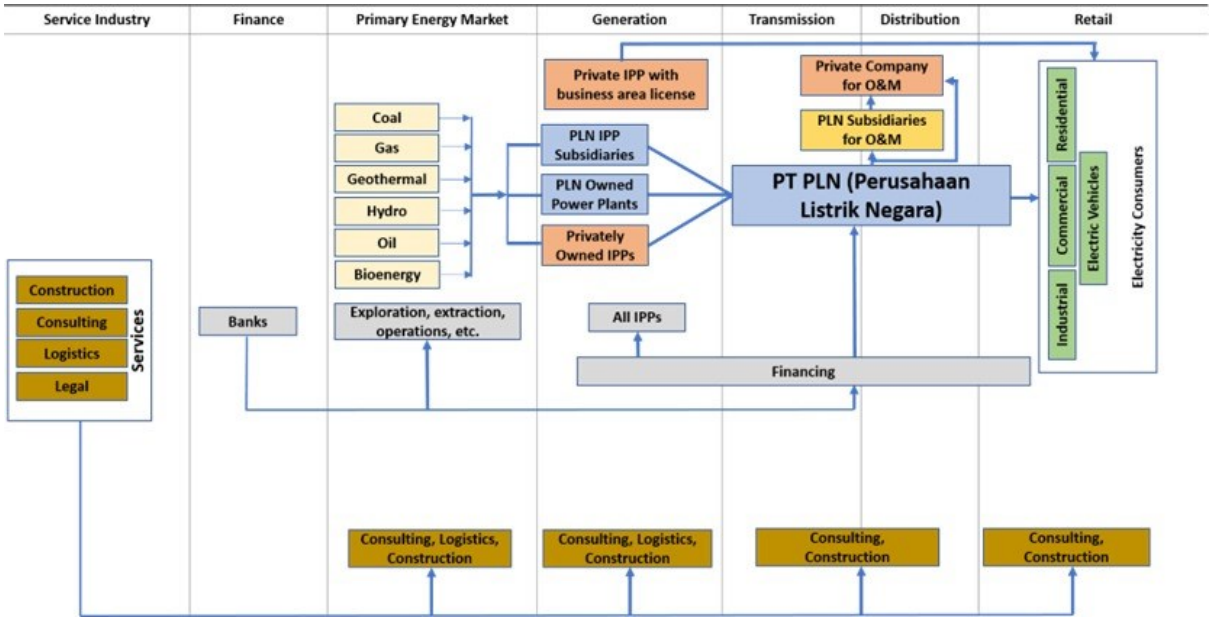


Figure 10. Power sector swimlace

3.4.2. Regulatory Analysis

This task requires taking into account the regulatory factors (i.e. legal and regulatory elements) and their gaps regarding the solar energy electricity price, transparency of the Power Purchase Agreement (PPA), local content requirements, and other aspects that impede the development of solar PV in Indonesia.

In conducting the assignment to achieve the outcome of Phase 3, we would conduct an identification of relevant existing regulations and policies related to solar PV development in Indonesia, including taking into account the global goals manifested in the Sustainable Development Goals ("SDGs"). The regulatory framework for solar PV development in Indonesia would typically include the following key elements:

a. The PLN and independent power producers ("IPP") roles and responsibilities
b. Procurement for public infrastructure
c. Tariff and generation cost (BPP)
d. Project scheme (e.g. Build-Operate-Transfer/BOT, Build-Operate-Own/BOO)
e. Foreign ownership limitation
f. Local content requirement

We will identify the policies and regulations through desktop research as well as inputs from our Policy and Regulatory Specialist, leveraging his experience in the power sector. This will be further enhanced through our discussion with the key stakeholders as identified in previous activities via Technical Working Groups (TWG). Some relevant regulations that will need to be analyzed during the project are as follows:

Table 5 Several Relevant Regulations/Frameworks related to Solar PV Development in Indonesia

No	Regulation/Framework	Remarks	Potential Improvement Points
1	Presidential Regulation No. 112 of 2022	The latest regulation concerning the acceleration of renewable energy development for the provision of electricity, as one measure to entice investments and to accelerate the RE mix target, as well as the reduction of GHG emissions.	Potential inclusion of specified feed-in tariff in place of ceiling tariffs

No	Regulation/Framework	Remarks	Potential Improvement Points
2	MEMR Regulation No. 20/2020 Grid Code GDE, 2017	This regulation requires all intermittent renewable energy power plants to continuously operate and generate uninterrupted power. Instead of utilizing battery or other storage technologies to cope with the intermittency issue, PLN optimizes the use of thermal power plants.	TBU
3	MEMR Regulation No. 16 of 2021	The regulation encourages solar rooftop deployment to accelerate the achievement energy mix target	Provision of recognition mechanism for banking charges, or value of temporal shifting generation
4	MoI Regulation No. 04/2017, No. 5/2017	This regulation stipulates the minimum local content of equipment used in solar PV power plants	Enabling and supporting the environment to incentivize the use of local content
5	MEMR Regulation No. 4/2020 (amendment to MEMR Regulation No. 53/2018 and No. 50/2017)	This regulation stipulates the maximum tariff and minimum capacity/availability factor of renewable energy sources, the Independent Power Producer (IPP) selection/bidding process, and the power purchase scheme.	Electricity tariff to attract investment

The above list will be updated and elaborated in more detail during our assignment to ensure a holistic approach is undertaken in preparing the regulations analysis findings. The key output of this activity is the list of relevant regulations and policies that will serve as input to the gap analysis and review that we will conduct in the later activities, as depicted below.

Table 6. Illustrative regulation policy matrix

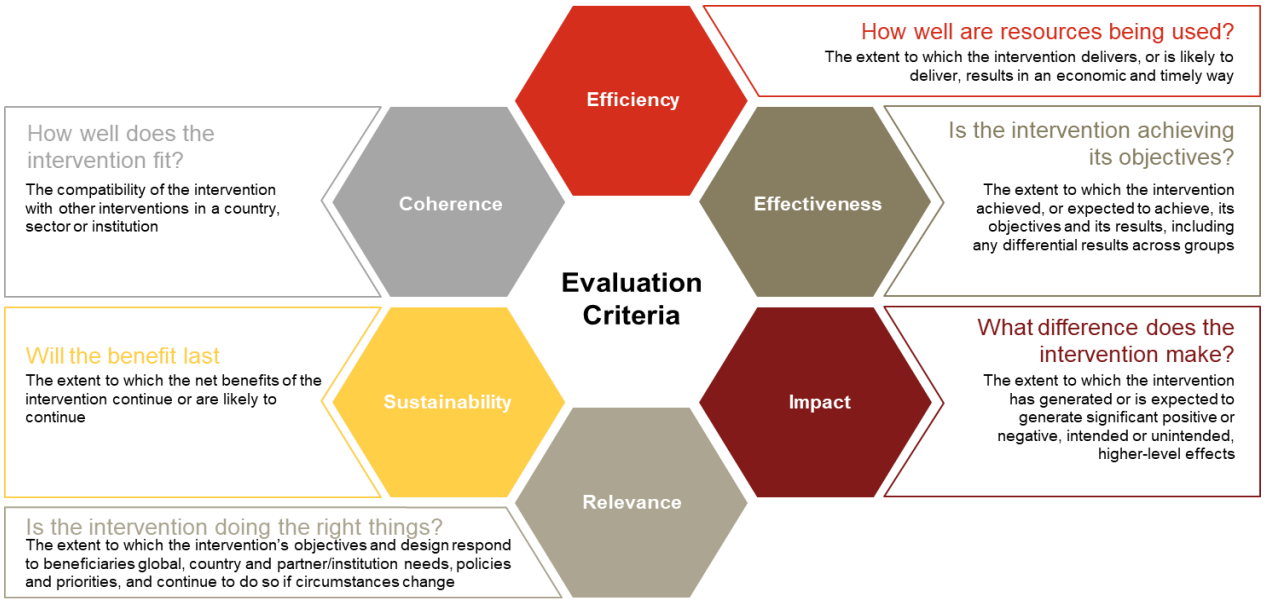
No	Policy/Regulation	Policy Theme	Existing Arrangement	Suggested Improvement
1	Law no. 30 Year 2009	Governance	[TBU]	[TBU]

3.4.3. Non-regulatory Analysis

The requirement for this task is to identify other non-regulatory barriers to solar PV development in Indonesia, such as social (including gender mainstreaming), technological infrastructure, and socio-economic, environmental, and political risks. Our approach for this task is to conduct an analysis of the existing condition and FGD with relevant stakeholders to obtain input and feedback.

ANALYZE THE EXISTING CONDITION

In undertaking this assignment, we will analyze the existing condition. Our analysis will involve consultation with key stakeholders, our key experts, and secondary research concerning the challenges and issues with regards to the energy sector in Indonesia, more specifically related to the preliminary areas mentioned in Sub-Task 4.2.1. In parallel with the regulatory framework identification in the preceding activity, we will identify the expected outcome of each regulation or policy and assess the existing condition against several key aspects[1] based on OECD's Six Evaluation Criteria, as shown in Figure 7.



Source: OECD (2021)

Figure 11. Evaluation Criteria

At this stage, we will update the list of the stakeholders identified in the previous activity and map them based on the regulatory framework and their authority, generated in the previous activity. The existing condition will be analyzed against the evaluation criteria as proposed above, subject to the approval of UNOPS, as well as the required improvement. The analysis will result in the gaps analysis report, which will be discussed with TWG later.

FOCAL GROUP DISCUSSIONS WITH RELEVANT STAKEHOLDERS

The FGD will facilitate discussion with relevant stakeholders identified in 4.1.1 to obtain inputs on the objectives and expected outcome

We would conduct several FGDs throughout the assignment. The first FGD at this stage would aim to collect and identify various perspectives of stakeholders, including their aspirations which would be integrated into the policy matrix and actions. This FGD is expected to also inform the expected objectives and outcomes of each stakeholder, which will be input to the policy matrix development as well. In the second FGD, we will confirm our findings on the analysis of existing conditions which has been conducted in the previous activity.

The output of this activity would be a list of initial objectives and expected outcomes that will further be analyzed at the later stage under Phase 3. The finalization of objectives will be subject to consultation with UNOPS and the key beneficiaries.

The FGDs by default will be conducted through online platforms, such as Google Meet or Zoom. However, where necessary, we will conduct offline FGDs that will target the attendance of the identified stakeholders.

[1] OECD. Applying Evaluation Criteria Thoughtfully. 2021. Paris: OECD Publishing

3.4.4. Solar PV Development Challenges and Opportunities Analysis

This task requires to assess challenges, impediments, and opportunities from the current gaps in solar PV development based on regulatory and non-regulatory aspects.

For this task, we will conduct gaps analysis between existing conditions that we have identified from previous activities and the expected objectives obtained from the FGDs. The identified gaps will serve as input to the next activity related to the feasible suggestions to address the impediments, including the strategy, activity plans, investment scheme, and suitable financing mechanism for PLN and IPP. At this stage, we will identify in more detail issues and challenges that will need to be addressed. Table 7 below presents several examples of initial high-level gaps in each preliminary area defined in this assignment.

Table 7. Example of Gaps Analysis between Existing Condition and Expected Outcome

No	Preliminary Areas of Support	Outcome	Example of Gap	Follow Up Actions
1	Sector governance, efficiency, and transparency	To be identified	Lack of support policies, overlapping coordination, and governance between GoI bodies	To be identified
2	Sector financial sustainability	To be identified	Tariff mechanisms for electricity, existing policies related with energy subsidies, supporting policies for private sector participation, high-interest rates of loans, and collateral requirements	To be identified
3	Renewable energy expansion	To be identified	Fiscal and financial impacts, local regulation, existing policy concerning DMO, innovative financing challenges in technology deployment due to local content requirement	To be identified
4	Distributed energy generation and energy efficiency	To be identified	Lack of supporting policy, monitoring application for distributed energy, energy service company ("ESCO") models with private participation and financing	To be identified
5	Grid/system enhancement (distribution and transmission)	To be identified	Incentives mechanism to private sector expenditure, inadequacy of infrastructure	To be identified
6	Sector transition and decarbonization	To be identified	Lack of coordinated regulatory framework and coordination	To be identified

The gap analysis will take into account several considerations that we will deep dive into, including the assessment of economic, environmental, and social impacts, and ESG safeguards needed for deployment of 1GW

solar PV, including the need for changes to governance frameworks and institutional structures and capacity building that will fit into the evaluation criteria as described in 4.3.1. Moreover, we will also integrate the analysis from Phase 2 which includes the technical challenges of solar PV development in Indonesia.

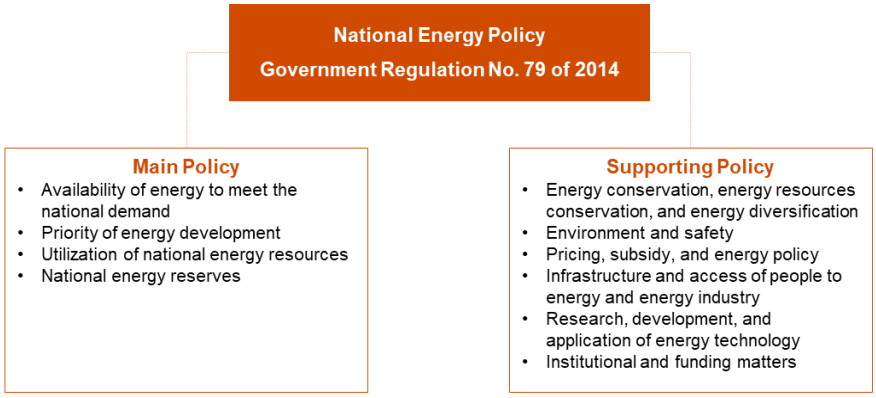
3.4.5. Preparation of Feasible Recommendations to Address the Impediments

Based on the gap analysis conducted previously, several key recommendations would be identified. We suggest four critical policy themes that will be analyzed in more detail in this engagement:

a) institutional and governance,
b) financial sector sustainability and private sector participation,
c) technology advancement, and
d) ESG

Several policy actions that we will later aim to identify are those concerning the enabling environment for Renewable Energy ("RE") technology ie. solar rooftop, carbon tariff, and the consideration of the feed-in tariff for RE as previously discussed in the previous section. The key policy themes will also take into account several guiding principles set out in Government Regulation No. 79 of 2014 on National Energy Policy as shown in the following figure and Indonesia's NDC to achieve Net Zero.

Figure 12. Summary of National Energy Policy – Government Regulation No 79 of 2014



The development of recommendations will also examine several key considerations including expected increase in energy demand, promotion of renewable energy and energy efficiency, private sector participation as well as gender barriers and policy opportunities for women empowerment in energy sector regulation. For each recommendation, we would also identify responsible stakeholders.

RISK ASSESSMENT

The consultant will conduct a risk assessment on the gaps identified from the previous step to determine the level of priority for the recommended solutions. Following the identification of gaps and impediments to solar PV development in Indonesia, we will analyze the risks associated with each of the recommendations. The risk identification will involve consultation with stakeholders and our team and pool of experts, and secondary research. This activity will be conducted in parallel with TWG carried out during Sub-task 4.3.2. The risks identified will be assessed based on the 3x3 probability and impact matrix and will be qualitative to inform the magnitude of each associated risk, as illustrated below.

Probability of Occurence		High	Medium	Low
Potential Impact	High	Red	Red	Orange
	Medium	Red	Orange	Green
	Low	Orange	Green	Green

The level of priority for the recommended policy actions will be determined based on the risk level, potential risk mitigation measures, and the responsible PIC capacity and subject to consultation and subject to approval from UNOPS and key beneficiaries.

Table 8. Example of Risk Assessment Table

No	Category	Risk	Likelihood (H/M/L)	Impact (H/M/L)	Risk Level (H/M/L)	Risk Mitigation	Risk Allocation
1	Risk category	Risk event description 1	Likelihood of event 1	Potential impact due to the risk event 1	Priority based on assessment of the likelihood and impact	Mitigation strategy for risk 1	Party(-ies) responsible for managing risk 1
		Risk event description n	Likelihood of event n	Potential impact due to the risk event n	Priority based on assessment of the likelihood and impact	Mitigation strategy for risk n	Party(-ies) responsible for managing risk n

3.4.6. Roadmap Development

This activity aims to develop the roadmap to overcome solar PV development impediments and challenges. Based on the priority agreed on previous activity, we will develop a roadmap containing the agreed proposed solutions that will be followed up based on the level of priority analyzed at previous stage and inputs from stakeholders. The roadmap will also include the estimated indicative timeline for when the solution can be implemented.

3.5. Deliverable 5. Final Report: Pre-Feasibility Study with Regulatory and non-Regulatory Analysis

Activity Lead: TTA and PwC

The final deliverable of this solar PV development project in Indonesia focuses on conducting a comprehensive pre-feasibility study with a detailed regulatory and non-regulatory analysis. This phase builds upon the insights gained from previous activities, including irradiance mapping, grid assessment, and impediment review. The primary goal is to assess the feasibility of establishing utility-scale solar PV power plants on selected sites within the JAMALI region. This deliverable would be led by TTA with support from all partners as a conclusion of the study. The following methods outline how these objectives will be achieved.

3.5.1. Regulatory and Non-regulatory Analysis of Solar PV Development

The objective of this task is for the consultants to do a comprehensive regulatory and non-regulatory analysis of solar PV developments on the proposed sites, including current regulations and procedures for solar PV connected to the grid, levelized cost of electricity (LCOE), the payback period, and initial and maintenance costs for the economic factor. This task is highly related to the Phase 3 report, thus PwC would structure the work for this section.

The work will commence by identifying existing regulations or regulatory frameworks related to solar PV development in the selected sites (e.g., regulation of the Ministry of Home Affair on local infrastructure development budget allocation through the Special Allocation Budget/Dana Alokasi Khusus/"DAK" or potentially existing local regulations such as governor/head of regency regulations, etc relevant to the project) as identified in Phase 1, that might affect the financial feasibility of the development. PwC will assess the regulatory framework and non-regulatory commercial and financial aspects for the 1 GW solar PV development, while other partners will analyze the technical regulatory and non-regulatory aspects of it as stated in Phase 1 methods. The outcomes of the analysis will be presented in the form of an opportunity and issues list. This will include potential mitigation strategies for any identified issues. In parallel, the technical partners (i.e., Inovasi and Quadran) will assess the required capex and opex for the solar PV development in selected sites, including consideration of the technology options and local content requirements.

The capex and opex from the technical workstream will be input for the financial analysis. PwC will develop a high-level financial model to calculate the investment feasibility through LCOE, the potential payback period, and the targeted Internal Rate of Return (IRR). As part of the analysis, sensitivity analysis on technology options and origins will also be conducted to explore the most cost-effective implementation.

This task combines regulatory and non-regulatory assessments, technical evaluations, and financial modeling to provide a comprehensive understanding of the financial feasibility of the 1 GW solar PV development project in the JAMALI region. The integration of findings from multiple disciplines ensures a holistic analysis that informs decision-making and maximizes project success.

3.5.2. FGDs with stakeholders

The objective of this task is to collect stakeholders' perspectives and data to gather views on the regulatory and non-regulatory factors that affect investment opportunities and confirm the preliminary findings. The consultants will prepare and organize the FGD, in the form of TWG, to obtain inputs on the preliminary findings. This is also to obtain inputs and approval from the beneficiaries and other relevant stakeholders on assumptions that will be used for the financial analysis. This TWG will be conducted after a comprehensive regulatory and non-regulatory analysis of solar PV development in Indonesia. Moreover, the results of the financial analysis will also be discussed in a later TWG to obtain feedback and improvement points for the model update, this includes assumptions used in financial analysis, such as costs, tariffs, and incentives.

3.5.3. Investment Opportunities Analysis

This task involves a comprehensive analysis of the investment opportunity for 1 GW of solar PV infrastructure in the JAMALI region. The objective is to provide a clear understanding of the project's financial viability and identify regulatory and non-regulatory gaps that need to be addressed. Additionally, a set of recommendations will be developed to mitigate these gaps and enhance the feasibility of the project.

Based on Task 5.2, the investment opportunity in the JAMALI region will be identified, which already considers the legal, technical, and financial feasibility. A set of mitigations on the regulatory gaps, proposed PICs for each recommended mitigation, and an indicative timeline required to implement the mitigation will also be provided.

3.5.4. Financing and Investment Mechanisms Mapping

The objective of this activity is to determine potential financing and investment mechanisms for the selected solar PV projects identified. The consultants will develop a high-level investment strategy that outlines the options of financing mechanisms for each solar PV project. **¡Error! No se encuentra el origen de la referencia.** presents the example of potential financing and investment mechanisms for the report.

The result from tasks 5.3 and 5.4 would complete the site recommendation for 1 GW solar PV development in Indonesia.

3.6. Deliverable 6. Solar PV Technical Working Group (TWG)

Activity Lead: INOVASI

The preparation and organization of this deliverable will be led by Inovasi, TTA's local partner, with the other partners responsible for the substantive aspects and content of the TWGs. Inovasi will collaborate with all other partners to plan these activities and provide the necessary support.

3.6.1. Planning

- **Preparation of Invitee List:** The consultants will prepare a comprehensive list of invitees for the TWG, ensuring representation from government agencies, development partners, and private sector stakeholders as identified during the kick-off.
- **Invitations and Agendas:** Invitations will be issued to the identified stakeholders, along with detailed agendas for each TWG meeting.
- **Speakers and Presentation Coordination**: The consultants will organize appropriate speakers for each meeting and coordinate their presentations and documents.
- **Meeting Logistics:** Meeting logistics will include provisions for a full-day meeting room, and refreshments for up to 50 participants (including lunch), integrated into the online meeting platform.

3.6.2. Technical Working Group (TWG)

The TWG will operate under the guidance of the Government of Indonesia to ensure alignment with national energy development goals. Additionally, the TWG will seek opportunities to integrate and collaborate with existing coordination platforms, such as the JETP Secretariat, to leverage synergies and avoid duplication of efforts. The TWGs will serve as effective tools to gather valuable insights from stakeholders and enhance stakeholder engagement. The consultant will engage with the stakeholders early in the process and establish the working group under the UNOPS program to ensure the working group's involvement from the very beginning of the process.

As outlined in the ToR, the TWGs will be conducted at least five times for this project, with the flexibility to increase the number of TWGs as needed based on the TWG's topic and purpose. The insights from the working group discussions will play a crucial role in our pre-feasibility study, helping us refine risk mitigation strategies and assess their financial implications. In addition to the TWG, we will organize focus group discussions, as mentioned in our methods, involving stakeholders including investors and developers. These sessions will encourage active participation, providing them with a confidential platform to share their experiences, challenges, and successes in developing and investing in Indonesian solar PV projects.

Detailed minutes of TWG meetings, including presentations and shared documents, will be prepared and circulated to all participants. The TWG activities will align with the project phases, ensuring that stakeholders are well-informed and actively engaged at every stage of the project.

3.6.3. Capacity Buildings and Workshops

Capacity-building sessions and workshops may be integrated into TWG events to enhance stakeholders' knowledge and skills in solar PV development. These workshops will also encompass report dissemination. The report dissemination process will be conducted to finalize each phase report. Its objective is to share the approach of the specific assignment and the results of each phase, enabling clients, stakeholders, and beneficiaries to provide constructive feedback for the consultants to use in finalizing the report.

Moreover, for Phase 3 and the final report, during the preparation of the roadmap, we will conduct workshops and capacity-building with the targeted stakeholders, as identified in Subtask 4.1.1. We will assess the knowledge gap of the nominated PICs identify the required capacity building based on the gaps analysis and record the knowledge gaps analysis results in the table as illustrated below. Then we will develop customized training programs tailored to the identified needs.

To assess the knowledge gaps, we will develop a set of questionnaires relevant to each stakeholder's role and responsible for understanding their current understanding of the project or aspects relevant to the project. The questionnaire will also ask areas where the stakeholder needs further capacity building. The questionnaire will be first discussed with UNOPS before being distributed to the relevant stakeholders. We will also discuss with the stakeholders areas where they would like to prioritize for capacity building.

4. Time management

The following schedule is proposed to undertake the assignment, being the first project month December 2023.

	Workplan	Responsible	Project Month														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
D1	**Project scoping**	**TTA & INOVASI**															
Task 1.1	Conduct Kick Off Call	ALL															
Task 1.2	Outreach to other donors	TTA, Inovasi															
Deliverable	Inception Report	TTA, Inovasi															
D2	**Phase 1 Report: Solar Irradiance Mapping and Accessible Database**	**SolarGIS**															
Task 2.1	Preliminary Desk Study and Data Collection	TTA, Inovasi															
Task 2.2	Data Integration	SolarGIS															
Task 2.3	Site selection: GIS and spatial analysis	SolarGIS															
Task 2.4	Site selection: Examination of the energy content	SolarGIS															
Task 2.5	Site selection: Monthly irradiance and potential electricity generation	SolarGIS, TTA															
Task 2.6	Site prioritization: Environmental and Social Assessment	ESIA Specialist															
Task 2.7	Site prioritization: Preliminary Grid Impact Assessment	Quadran															
Task 2.8	Determine data's spatial and temporal resolution	SolarGIS, Inovasi															
Task 2.9	The energy production mapping publication	SolarGIS, Inovasi															
Task 2.10	Phase 1: Report Dissemination	SolarGIS, TTA,															
Task 2.11	Phase 1 Report	SolarGIS, TTA, Inovasi, ERM															
D3	**Phase 2 Report: Grid Integration Assessment**	**Quadran**															
Task 3.1	Data collection and preparation	Quadran															
Task 3.2	JAMALI Grid and PV Plants Modelling	Quadran															
Task 3.3	Grid study and Grid analysis	Quadran															
Sub-task 3.3.1	Map the typical daily electricity supply and demand within the proposed 100 sites in the JAMALI regions	Quadran															
Sub-task 3.3.2	Conduct a high-level analysis to integrate solar energy by combining it with other resources or battery to reduce the risk of supply problems or intermittent power.	Quadran															
Sub-task 3.3.3	Analyse the non-regulatory factors	Quadran															
Task 4	Phase 2: Report Dissemination	Quadran															
Deliverable	Phase 2 Report	Quadran															
D4	**Phase 3 Report series: Review and Recommended Solutions of the Impediments of Solar PV Development**	**PwC**															
Task 4.1	Engage with the local and national stakeholders	TTA, PwC, Inovasi															
Sub-task 4.1.1	Stakeholder identification	PwC															
Sub-task 4.1.2	Initial Stakeholders Briefing	All															
Task 4.2	Regulatory analysis	PwC															
Task 4.3	Non-regulatory aspects analysis	PwC, Inovasi,															
Subtask 3.1	Analyse the existing condition	PwC, Inovasi															
Subtask 3.2	FGDs with stakeholders	TTA, PwC, Inovasi, Quadran															
Task 4.4	Assessment of challenges and opportunities of Solar PV Development	PwC															
Task 4.5	Preparation of feasible recommendations to address the impediments	PwC															
Sub-task 4.5.1	Risk Assessment	PwC															
Task 4.6	Roadmap Development	TTA, PwC, Inovasi															
Task 4.7	Capacity Building and Workshop	TTA, PwC, Inovasi															
Deliverable	Phase 3 Report	TTA, PwC, Inovasi															
D5	**Final Report: Pre-Feasibility Study with Regulatory and non-Regulatory Analysis**	**TTA & INOVASI**															
Task 5.1	Regulatory and Non-regulatory Analysis of Solar PV Development	All															
Task 5.2	FGDs with stakeholders	All															
Task 5.3	Investment opportunities analysis	All															
Task 5.4	Financing and invesrment mechanism mapping	All															
Task 5.5	Final: Capacity building and workshops to comprehensively prepare the investment solar PV roadmap	All															
Deliverable	Final report drafting and finalization	All															
D6	**Technical Working Group**	**TTA & INOVASI**															
Task 6.1	Preparing a list of invitees inclusive of government, development partners and private sector stakeholders	All															
Task 6.2	Other TWGs as required	As needed															

Table 9. Workplan activities

5. Quality Management

TTA conducts organizational planning, operations, activities, and resources control under the Project Integrated Management System to respond to both technical and organizational aspects of its projects.

The process of tasks and resources planning and project control at TTA consists of the following activities:

- Control of the schedule (planning and control): Construction and review of the plan, identification of tasks completed and not completed according to plan, verification of the allocation of resources, re-evaluation of the critical path, adjustments to the plan
- Risk Control: Planning and Control Risk
- Change Control: Application for change, approval, and monitoring of changes
- Quality Control: quality requirements, activities of quality control activities, quality assurance, bug tracking
- Control Problems: Process for handling and tracking of incidents, escalation procedure
- Project records definition, standards, and procedures (version control, distribution, archiving, or destruction). Structure of the Records.

The project deliverables will undergo a thorough review process involving the entire team, with a final evaluation by a TTA expert for quality assurance. Our Regional Team Leader for Asia-Pacific will validate the deliverables before submission to the client and may seek senior inputs from our Managing Director for strategic or critical matters.

We are fully committed to integrating feedback from stakeholders, including the client, into our project documentation as deemed necessary, further strengthening our project management controls and ensuring a successful project outcome.

6. Stakeholders Management

6.1. Stakeholders engagement plan

Stakeholder engagement will be an essential part of the assignment to ensure that the final report is fit for purpose and to facilitate the endorsement and sense of ownership of the resulting 1GW Solar Mapping and Development plan in Indonesia. Stakeholders might be engaged in different stages of the assignment depending on their needs.

The approach for stakeholder engagement is described in sections 3.4.1 and 3.5.2.

ETP/UNOPS has discussed with several institutions/ministries their desire for this study. ETP will facilitate all forms of coordination between distinct ministries.

6.2. Alignment with other donors' activities

6.2.1. Alignment with ADB and AFD

The donor mapping has been developed to identify areas for contributions and to prevent duplication. The potential duplication with activities related to energy transition has been identified to be with the activities led by the Asian Development (ADB) Bank and Agence Francaise de Development (AFD). Indeed, AFD and ADB are collaborating on a multi-criteria analysis (MCA) framework to help PLN identify the optimal location for a solar PV power plant. The technical assistance is planned to start in 2024. This project is therefore closely related to their collaboration.

TTA recognizes the importance of aligning this project with other donor initiatives, in priority initiatives led by AFD and ADB to maximize the impact of solar PV development in Indonesia. The mapping of other donors' programs will be conducted as part of this assignment to allow more collaborative action on solar PV development in Indonesia

The strategic approach for a successful collaboration with ADB and AFD will follow :

- **An early outreach to ADB is required to ensure the projects will become complementary after the submission of the report** A first alignment meeting should be validated at the beginning of 2024 since the technical assistance for ADB and AFB projects will start at this time of the year.

  In this first meeting, the following should be validated by the consortium of this project, ADB, and AFD for maximizing the positive impact on the beneficiaries being addressed:
  - Common objectives: shared goals and align mission and activities
  - Shared values: build mutual understanding and strong collaboration
  - Strategic alignment: align priorities and ensure the project's activities contribute to these priorities
  - Communication and reporting: Regular communication and reporting mechanisms are established to keep the organization informed about the progress of the project.
- **Regular communication and reporting** with a frequency to be agreed on the first meeting. At least when each organization is finalizing a deliverable to the respective projects.

6.2.2. Alignment with other donors' activities

The consultant will establish a comprehensive database and donor program mapping document, detailing donors, beneficiaries, sector of assistance, and assistance outcomes. we will initiate early outreach to these donors to explore synergies and ensure our projects complement each other. In this activity we will Conduct visits to institutions known to have received assistance, documenting the assisting parties and the impact of

their support. Continuously update the list of institutions as new information arises. Seek feedback from donor agencies regarding their contributions.

Any synergies AFTER the donor mapping will be explored and the donors will be invited to align their mission/goals/outcomes with this project.

7. Risk Management

The following table summarizes some of the project risks identified at this stage, together with the proposed mitigation actions.

Risk category	Definition	Mitigation action
Environmental	**Geology/Soil**	
	Potential changes to soil via compaction and erosion of soil, impacting biodiversity ecosystem and GHG emissions	Implement measures such as using appropriate construction equipment and techniques to minimize soil compaction during site preparation, assure erosion control, and biodiversity protection, conduct GHG reduction strategies and monitoring
	Land Use Change	
	Conversion of land for solar farms might impact local ecosystems, soil quality, or habitats	Prioritize degraded or non-arable land, conduct thorough environmental impact assessments, and implement land restoration where necessary
	Biodiversity Impact	
	Solar farms could disrupt local flora and fauna, affecting biodiversity	Prioritize area that is not located in protected lands (mangroves, peatlands, or home to native and protected species), implement buffer zones, employ native plant species in landscaping, and conduct habitat assessments to mitigate biodiversity loss
	Water Usage and Quality	
	Water usage during panel manufacturing and maintenance could strain local water resources or affect water quality	Prioritize location with adequate water supply and/or water access to local communities, Implement water-efficient technologies, monitor water usage, and utilize recycled or treated water where feasible
	Climate and Flood Risks	
	Changes in land use might influence local microclimates or exacerbate flood risks	Conduct climate risk assessments, implement proper drainage systems, and consider flood-resistant design elements
Social	**Land Ownership and Displacement**	
	Land acquisition might lead to disputes or displacement of local communities	Participate in transparent and fair land acquisition processes, provide adequate compensation, and engage with affected communities
	Indigenous Communities	

Risk category	Definition	Mitigation action
	Potential impacts on indigenous communities' cultural heritage, livelihoods, and land rights	Conduct cultural impact assessments, ensure informed consent, and involve these communities in decision-making processes
	Economic Displacement and Livelihoods Change in livelihood due to land-use change (land opening) for solar	Categorize baseline livelihood characteristics in each site and prioritize according to the sensitivity of the communities' activity, Implement programs that support livelihood diversification
	Gender and Socioeconomic Impacts Women and marginalized groups might face disproportionate impacts or limited access to project benefits	Implement social-inclusive approaches, ensure inclusive participation, and provide opportunities for local employment and skill development
	Cultural Heritage The discovery of cultural heritage sites may disrupt project timelines, and contruction plans and trigger legal requirements	Conduct thorough heritage impact assessments before project initiation to identify potential cultural heritage sites, incorporate flexible project plans to accommodate potential alterations due to the discovery of cultural heritage
	Landscape and Visual Potential impacts to visual and landscape value due to the presence of solar PVs, landing points, and transmission lines	Employ natural barriers such as vegetation to shield solar PVs, landing points, and transmission lines, reducing their visual impact
	There is resistance to solar PV development from local communities	To conduct public consultation in potential locations
Regulatory	The possibility of project delay or cancellation due to changes in relevant laws and regulations.	Conduct a thorough regulatory analysis and map potential regulations that will significantly influence Project implementation.
	Change in regulation that might affect the commercial aspect of the project	Monitoring sector developments and regulations related to the renewable energy sector, specifically to solar PV development.
	Lack of policy support or implementation mechanisms	is a risk caused by the necessary support or mechanisms are not in place for their implementation, even if the project identifies suitable policies or recommendations, mitigation is done by engaging with policymakers, relevant government agencies, and development financial institutions throughout the project to ensure their buy-in and commitment to implementing the study's recommendations. Provide clear and actionable

Risk category	Definition	Mitigation action
		policy proposals, supported by evidence and best practices, to facilitate the adoption and implementation of the proposed measures. Collaborate with stakeholders to develop implementation plans and identify the necessary resources, regulatory changes, or capacity-building initiatives required for effective policy implementation.
Project management	Lack of stakeholder engagement	This may result in the project outcomes not being considered or integrated into future decision-making processes. To mitigate the risk, this project will establish strong relationships with key stakeholders –especially MEMR, PLN, and Bappenas– ensure their active involvement and alignment with project goals, increasing the likelihood of utilizing project outcomes. Regular communication and involving stakeholders in decision-making processes enhance stakeholder buy-in and facilitate the integration of project findings into future policies and projects.
	Inadequate communication and dissemination	may lead to the results of the project not be utilized or recognized for potential project implementation or policy changes. To mitigate this, a comprehensive communication strategy, including targeted materials and diverse channels, ensures effective dissemination of project findings to relevant stakeholders. Organizing seminars, conferences, and workshops enables direct engagement with stakeholders, enhancing the recognition and utilization of project outcomes.
Financial and commercial	The development in the proposed locations is not bankable and/or cannot meet economic and/or financial feasibility	Calculate the cost estimation for development in the proposed locations and consider the lenders' perspective to understand
Interface	Project delay or cancellation due to mismatch or change of the timeline/project objectives due to alignment with other donor projects, i.e., ADB and AFD	Coordinate with ADB and AFD prior to commencing the project to ensure alignment of the project timeline and objective
Technology	The technology offered is not sustainable and cannot meet the Project objectives/or is still not available in Indonesia/is not suitable for the Indonesia landscape	Determine technology selection criteria that are in accordance with the project's requirements, availability, and applicability in Indonesia
Resource variability risk / Intermittency risk	Solar data inconsistency due to natural intermittency	A mitigation measure to address this is coordinating with relevant stakeholders to obtain secondary data to supplement the potential gaps.
	Satellite remote sensing could be affected by cloud cover and atmospheric conditions which could lead to inaccurate irradiance data.	To mitigate this risk, it is important to ensure that the data is collected from multiple sources and that the data is validated.

Risk category	Definition	Mitigation action
	Limited access to study sites.	A mitigation measure to approach this is by making a priority list containing information about each location, its access profiles, and other relevant indicators.
	Equipment deployment limitations could lead to inaccurate irradiance data.	This could happen due to the lack of equipment or the equipment's malfunction. To mitigate this risk, it is important to ensure that the equipment is functioning properly and is deployed in the right location.
	Lack of historical accumulation of irradiance data could lead to inaccurate predictions.	This could happen due to the lack of data or the data being outdated. To mitigate this risk, it is important to ensure that the data is up-to-date and accurate.
	Lack of wide spatial distribution of irradiance data could lead to inaccurate predictions.	This could happen due to the lack of data or the data being outdated. To mitigate this risk, it is important to ensure that the data is up-to-date and accurate.

Table 10. Risks and mitigations table

8. Others

8.1. Sustainability, gender and social inclusion considerations

8.1.1. Consortium commitment

Our company ensures and demands from its suppliers and partners, equality of opportunity and treatment in respect of employment and occupation without discrimination on grounds of race, color, sex, religion, political opinion, national extraction or social origin, and such other ground as may be recognized under the national law of the country or countries where the performance, in whole or in part, of a contract takes place.

TTA activities do not directly work with children or vulnerable adults. Child labor is explicitly prohibited at TTA, as it follows Spanish law.

In congruence with Spanish law and the principle of respecting human dignity, sexual harassment or any other form of harassment by a TTA manager or employee is not tolerated. We encourage our team and network of expert collaborators to report any sexual abuse, exploitation, or harassment they are aware of.

TTA operates globally, our activities are subjected to the laws, rules, and regulations of all countries and multilateral organizations. We have a responsibility to respect and be aware of the different laws in each territory, including culture and religion, insofar as these are not in conflict with international human rights standards.

TTA is fully committed to supporting women in the energy sector, as **this project would be led by TTA's in-house staff which is a woman**. TTA is eager to provide more opportunities for women to grow and accelerate their contribution, experience, and exposure to the energy sector globally. We also employ women ESIA specialists for this project. s

Operations and project implementation approaches

- **Equality in Employment and Partnerships:** A strict policy against discrimination based on race, color, sex, religion, political opinion, national extraction, or social origin is in place at our company. This dedication encompasses not only our staff but also our partners and suppliers. To ensure that all project participants are treated fairly and equitably, we collaborate with partners who share our commitment to equality and inclusion.
- **Child Labor and Vulnerable Populations:** While our activities do not directly involve children or vulnerable adults, we are unwavering in our stance against child labor. We strictly adhere to Spanish law, which prohibits child labor in all forms. Our operations are designed to ensure that no child is engaged in any aspect of our work. We take proactive measures to verify and certify that child labor is not employed by any of our suppliers or subcontractors.
- **Respect for Human Dignity:** TTA places paramount importance on human dignity. Sexual harassment or any other form of harassment within our organization is prohibited. We maintain a workplace environment that is safe, respectful, and free from harassment. Sexual harassment and other forms of harassment are swiftly investigated and dealt with in accordance with Spanish law and our internal policies.
- **Inclusive Project Design:** We take care to take into account the various needs and viewpoints of all stakeholders when implementing our projects. Designing projects with gender considerations ensures that they do not unintentionally maintain or exacerbate gender disparities. As mentioned above, the proposed project lead for this project is a woman, proofing TTA's commitment to promoting inclusive project design. Moreover, TTA and partners will also support the involvement of stakeholders who are women or disabled to empower them as an important part of the energy transition effort.

8.1.2. In the Environmental and Social Impact Assessment

Establishing an energy grid from sustainable sources supports both mitigation and adaptation efforts in this changing climate. Implementing climate change adaptation and mitigation solutions can produce positive changes. However, while implementing solutions for climate change adaptation and mitigation can yield positive changes, there exists the potential for adverse effects on vulnerable groups—such as women, children, indigenous peoples, local communities, and the elderly—who may be disproportionately impacted or limited in benefiting from these initiatives compared to other groups. These positive changes and potential adverse effects can be anticipated through an in-depth analysis of environmental and social impact assessment in project initiation.

Within the energy sector, environmental and sustainability concerns encompass a range of issues. These include considerations of protected areas, land-use change, biodiversity, climate-related risks, as well as impacts on water and air quality, dust, and noise post-construction. Similarly, social considerations involve factors such as the gender and age distribution of the affected population, the presence of indigenous communities, land ownership dynamics, and the aftermath of energy utilization, notably addressing gender participation in energy use and the risk of energy poverty.

In conducting a comprehensive Environmental and Social Impact Assessment (ESIA), our approach entails a high-level study through ERM. This assessment will encompass:

- Social Impact Assessment covering a comprehensive set of factors, as highlighted in the Gender Equality and Social Inclusion (GESI) framework, encompassing demographic details based on gender and age, settlement characteristics, public infrastructure, indigenous communities, and land ownership.
- Environmental Impact Assessment, addressing various facets including protected areas, land-use alterations, biodiversity impacts, climate and flood risks, water and air quality, as well as dust and noise levels.
- Adherence to Indonesian regulations governing the aforementioned sectors.

8.2. Monitoring and evaluation

8.2.1. Results-based Monitoring Framework and Risks

The Results of the Project are monitored through the following Framework. The assignment reports will update the achievement of the indicators.

Project Name: One GW Solar PV Mapping and Development Plan

IMPACT

- Increasing the share of RE in the total primary energy supply (TPES)
- Additional RE (non-combustible) installed capacity (GW)

OUTCOME

1. Policy alignment with climate commitments
2. De-Risking RE and EE Investments

4. Knowledge and Awareness Building

OUTPUT

1.1. National RE and EE policies, regulations, standards, and energy plans reflect a clear commitment to the Energy Transition agenda and are integrated into sectoral plans to contribute to the achievement of the Paris Agreement
1.2. National Fiscal policies, regulations, and Investment policies have undergone reforms to create an

Investment Climate that is conducive to investment flow into RE/EE and improves its energy transition readiness for capital and investments.

2.2. De-risked project finance is accessible via financial institutions generating a pipeline of large-scale RE/EE projects

4.1. Stakeholders (relevant Government entities, Public sector companies, Financial institutions, Private entities, Academia, and Consumers) involved in the RE/EE value chain, are knowledgeable and better informed to advance the energy transition agenda

INDICATOR	TARGET
IN 1.1-01 - No. of new/revised RE and EE policies, laws, regulations, and/or technical standards endorsed and adopted by the national government in coordination with relevant institutions to promote large-scale solar PV installations.	IN 1-01 - 1 revised RE policies, laws, regulations, and/or technical standards endorsed and adopted by the national government in coordination with relevant institutions to promote solar PV installations.
IN 1.1-02 - National energy plans reflect an ambition towards increasing the share of RE/VRE, improving EE, and phasing out fossil fuels.	IN 1.1-02 - 1 National energy plans reflect an ambition towards increasing the share of 1 GW solar power.
IN 1.1-03 - No. of RE and EE policies, laws, regulations, and/or technical standards developed/revised and presented to the government entities.	IN 1.1-03 - 1 RE and EE policies, laws, regulations, and/or technical standards developed/revised and presented to the government entities.
IN 1.2-01 - No. of RE and EE-related financing frameworks and fiscal reforms developed and presented to the government entities	IN 1.2-01 - 2 RE and EE-related financing frameworks and fiscal reforms developed and presented to the government entities to support the development of 1 GW solar power.
IN 1.3-02 – Improved dialogue among government ministries and departments for a coordinated response to Energy Transition	IN 1.3-02 – Technical Working Group (TWG) is established to improve dialogue among government ministries and departments related to the national energy policy
IN 2.2-01 - No. of new and existing, national and international, financing options/instruments de-risked and opened for private and blended financing	IN 2.2-01 - At least 1 new or existing financing options/instruments de-risked and opened for private and blended financing
IN 4.1-01 – No. of studies, research, and new evidence gathered and published, for raising awareness, improving the knowledge base, driving decisions, and dissemination.	IN 4.1-01 – 4 studies, research, new evidence gathered and published, for raising awareness, improving knowledge base, driving decisions, and dissemination.

Table 11. Monitoring framework

ACTIVITIES

- Conduct a literature review and gap analysis of existing studies.
- Map and assess the location to develop a total of 1 GW of solar power production sites.
- Assess the JAMALI power grid's feasibility.
- Facilitate a technical working group.
- Examine regulatory and non-regulatory factors to create a solar PV development plan.
- Conduct a pre-feasibility study for a minimum 1 GW solar power investment.