ENERGY TRANSITION PARTNERSHIP

Powering Prosperity and Enabling Sustainability in South East Asia

1 GW SOLAR MAPPING AND DEVELOPMENT PLAN (INDONESIA)

Deliverable 1. Inception report

Prepared by:

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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 **PT Inovasi Dinamika Pratama (Inovasi), SolarGIS, Environmental Resources Mangament (ERM), PT Quadran Solusi Enjinering (Quadran) and PwC Indonesia (PwC)**

D1. INCEPTION REPORT

Deliverable #1

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D1. Inception Report (v1.0)	Report	Draft	13/Dec/2023

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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), Lavalette Erica (PwC), Andre Susanto (Inovasi), Arryati Ramadhani (ERM) and SOLARGIS.

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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 achieving the UN's Sustainable Development Goals (SDGs) and the Paris Climate Agreement objectives, ETP works in Southeast Asia, focusing 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.

For this project, ETP is working with the Ministry of National Development Planning (BAPPENAS) to support Indonesia's renewable energy transition planning. This project aims to increase solar photovoltaic (PV) technology use in Indonesia. This will become the catalyst for Indonesia's stakeholders in accelerating further solar PV project implementation resulting in reduced emissions and meeting the country's goal of achieving net-zero emissions in the power sector by 2050.

Indonesia has set a target of generating 23%[1] of its energy from renewable sources by 2025 or 52% of new additional installed capacity by 2030[2], 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[3] and 6.4 GW[4] 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 the Ministry of National Development Planning (BAPPENAS), MEMR, and the state-owned electricity company (PLN) to support decision-making on investments in large-scale solar PV development in the JAMALI grid and lessons 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

[1] The Indonesian National Energy Policy (Presidential Regulation No. 79/2014 on the National Energy Policy (Kebijakan Energi Nasional, KEN))

[2] Indonesian Ministry of Energy and Mineral Resources website: https://www.esdm.go.id/id/media-center/arsip-berita/dirjen-ebtke-kapasitas-terpasang-pembangkit-ebt-2022-lebihi-target

[3] Indonesian Ministry of Energy and Mineral Resources website: https://ebtke.esdm.go.id/post/2021/08/26/2945/bidik.kapasitas.terpasang.36.gw.ini.sederet.keuntungan.pengembangan.plts.atap

[4] Draft National Electricity General Plan (RUKN) 2015-2034

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 field data taken from calibrated pyranometers as well as additional information from Indonesia's national meteorological agency, MEMR, NASA, and other entities. The data will be used to validate and improve the accuracy of the mathematical modeling currently available from SolarGIS. GIS analysis of the potential locations will be based on validated SolarGIS irradiation data and the proximity of the highest irradiation locations across Java to PLN substations. Additional factors such as zoning maps, elevation data, soil type, and others will be used to further eliminate locations that are physically, legally, or otherwise not viable to build solar PV projects on.

b. Grid assessment and Impact evaluation: Once the locations are prioritized based on GIS data, a grid assessment and an impact evaluation will be conducted to ensure that the selected solar PV sites and the substations do not affect the grid operation stability. This analysis will be conducted based on the individual solar PV project's impact on the grid as well as collectively as an integrated 1 GW solar PV project to the Java grid.

c. Environmental and Social Impact Assessment: Additionally, environmental and social factors will be analyzed to ensure that the project locations continue to be viable. ESIA section of site prioritization will describe the potential sites' biophysical and socio-economic landscape, including delineation of and use patterns, general overview of land tenure, livelihoods, and identification of biodiversity aspects such as protected areas and habitat types. It will also evaluate identified infrastructures to support the Project construction, identify the potential existence of cultural heritage sites, and compliance with national and regional spatial planning regulations, and identify potential impacts on the environment and climate change. It will also review national regulatory and international performance standards

requirements.

d. 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.

e. Pre-feasibility document of the 1GW Solar PV development in Indonesia. The document will include challenges, opportunities, and impediments relevant for solar PV development in Indonesia. A set of recommendations will also be developed to address the challenges, as well as the stakeholders relevant to implement the recommended solutions.

These outputs are subject to change based on stakeholder inputs, data to be collected, and information to be obtained once the project is ongoing. This inception report was developed and designed based solely on the methodologies proposed by TTA and its consortium and has been agreed upon by UNOPS-ETP. TTA and its consortium will communicate with UNOPS-ETP when changes to the approach, methodology, and potentially outputs are required in order to achieve the project's goals, outcomes, and objectives.

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. Following 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.

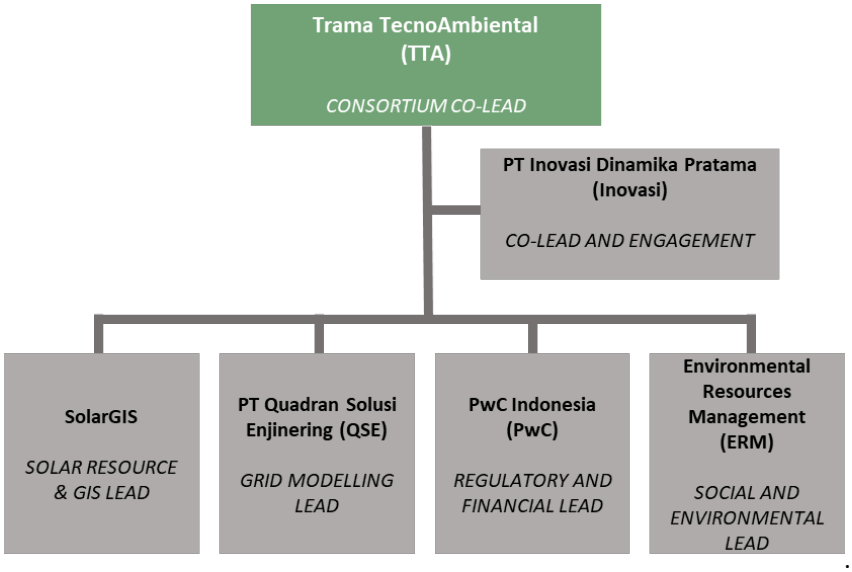


Figure 1. Consortium's organizational chart

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.

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.

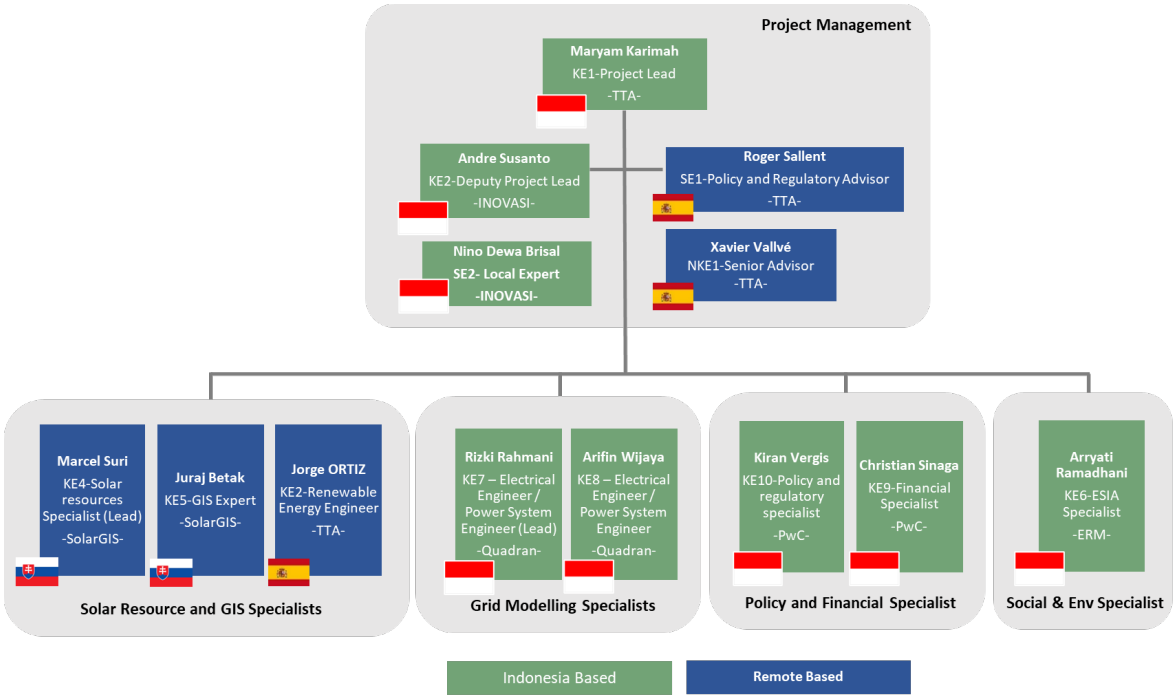


Figure 2. Consortium's organizational chart with key personnel

2.1. Partner's introduction

2.1.1. PT Inovasi Dinamika Pratama (Inovasi)

PT Inovasi Dinamika Pratama (Inovasi), an Indonesian social entrepreneurship established in 2016, specializes in harnessing technical, social, and economic innovations to empower rural communities for economic development. Inovasi boasts a robust track record of experience in renewable energy projects and rural electrification across Indonesia and Southeast Asia. Their team has conducted technical, social, and economic studies in over 500 remote communities, collaborating with esteemed organizations such as the Asian Development Bank, World Bank, GIZ, Hivos, and various private sector companies and government agencies.

In the technical realm, Inovasi excels in off-grid electricity system design and implementation, solar PV minigrid operation and maintenance, and project implementation support services, including managing engineering design, procurement, logistics, installation, and commissioning of renewable energy projects. On the social front, they have developed socio-techno-economic business models for rural communities, conducted impactful assessments of energy access projects, and focused on productive energy use and rural community entrepreneurship. In terms of economic and regulatory expertise, Inovasi offers project development support services, including market research, feasibility studies, and policy and regulatory assistance.

In the last 3 years Inovasi has assisted their clients contributing to feasibility studies for more than 5.5 GWp of solar PV projects in Indonesia and SE Asia region. These feasibility studies are on behalf of private sector developers and investors; the projects include cross-border international solar PV electricity export, large scale solar PV interconnected to a multi-GW isolated grid electricity network, GW scale power wheeling project, and integration of solar PV to a large mining power grid.

One of their recent projects in 2022 involved conducting preliminary assessments for ±100 MW Floating PV, ±100 MW Wind Turbine, and ±150 GWh 18 h Pumped Hydro Storage, along with installing measurement instruments for solar and wind. This project showcased their proficiency in site selection criteria development, GIS analysis, and engagement with stakeholders such as IESR, MEMR, and PLN. Moreover, Inovasi's experience in conducting surveys and installations in remote and scattered locations, including the installation of pyranometers at various sites, demonstrates their capability to handle challenges in diverse geographical settings.

2.1.2. SOLARGIS

Since 2010, SOLARGIS has been at the forefront of solar irradiance data and software solutions, empowering stakeholders in the solar energy industry to make bankable investments. They are renowned for their rigorous data validation process, resulting in low data uncertainties and making their solar resource database the most accurate and reliable on the market.

SOLARGIS's mission is rooted in delivering precision, simplifying energy assessment, maximizing profitability for solar investors, and enhancing transparency throughout the project lifecycle. Their key advantages include:

- **Accurate Solar Resource Data:** SOLARGIS boasts the highest accuracy and reliability among available solar databases, validated through numerous independent studies.
- **End-to-End Support:** With data available for past, present, and future periods, SOLARGIS supports energy assessment from project inception to daily management.
- **High-Level Detail:** Their high-resolution data offers a superior representation of typical and extreme weather conditions, improving the accuracy of solar energy simulations.
- **Global Validation:** SOLARGIS data has been validated at over 200 locations worldwide, and their model validation is continually expanding, providing reliable data for various climate regions.

f.

SOLARGIS is dedicated to promoting environmentally friendly energy technologies and continually strives for excellence in its services, emphasizing customer satisfaction, long-term partnerships, and a commitment to quality management. Their focus on sustainability aligns with the global shift towards sustainable production and consumption in the energy sector. SolarGIS experience in Indonesia includes Indonesia's solar resources map by the WB and ESMAP.

2.1.3. PT Quadran Solusi Enjinering (QSE)

PT Quadran Solusi Enjinering (QSE) is a national consulting firm with international experience, specializing in Electrical Power System Study, encompassing Power System Engineering and Planning. Established in 2019, our headquarters are in Bandung, Indonesia, and we operate as a subsidiary of PT Quadran Energi Rekayasa, also headquartered in Bandung.

In terms of power systems, covering generation, transmission, distribution, and load, QSE recognizes the vital role of sustainable energy. We stand ready to address the challenges pertaining to the stability, availability, and reliability of these systems. Our Electrical Power System Study services span five domains: **Grid Interconnection Study, Renewable Energy Study, Power System Planning, Power System Operation, and Feasibility Study**.

Our team of experts possesses comprehensive competence in power systems, having tackled a multitude of cases across Indonesia, from major systems like **Java-Bali, Sumatra, Kalimantan, South Sulawesi, to smaller, isolated ones such as Nusa Tenggara and Maluku**. QSE maintains a rich database of network data, alongside economic data for expansion planning and production cost simulations. With state-of-the-art resources, we conduct power system analysis across a wide time spectrum, from milliseconds (for protection systems) to annual scales (for planning).

To bolster our technical prowess, our team members are proficient in utilizing power system software tools like DIgSILENT PowerFactory for analysis and stability and PLEXOS for planning and expansion planning. In essence, QSE is your go-to consulting partner, equipped with the full array of resources needed for comprehensive electrical studies.

2.1.4. PwC Indonesia (PwC)

PwC Indonesia is the leading provider of professional services to the resources sector and has been advising energy, utilities, and mining companies for over 30 years. PwC has a strong team focusing on the power sector and publishes an annual guide to Investment & Taxation in the sector. **In the renewable energy sector, PwC has considerable experience in developing and managing programs covering many types of services for international development agencies** such as for KfW in the Support for Infrastructure Investments in Indonesia

(S4I) Assistance for the establishment of Indonesia's Development Bank project. **We have also advised the Government and the private sector on energy transition and major power and utilities infrastructure projects at both strategic and implementation levels**.

Through our work as Knowledge Partner for the Business Twenty (B20) Energy, Sustainability and Climate Taskforce as part of Indonesia's G20 Presidency 2022, we understand not just the government's point of view, but also the perspective of the state-owned enterprises and the private sector, including the discrepancy between the Government of Indonesia (GOI) and private sector's objectives, which needs to be addressed in reforming the policy. In doing the assignment, we were also tasked to draft some policy papers and actions required for the energy transition policy reforms, which were developed through our engagement with the relevant stakeholders. In addition to that, we have also assisted in analysing the single royalty tariff on coal-mining companies, including assessment of the potential impact of changes in the royalty policies, the correlation between the coal royalty tariff and its economy-wide impacts, and the alternative fiscal measures.

We are also currently engaged in the **Affordable and Sustainable Energy Transition project on behalf of the Asian Development Bank (ADB)**, where we analyse the required actions and related policy adjustment in regard to the energy transition as well as calculate the financial impact of the agreed energy transition scenario. Details of our experience can be found in the following section.

2.1.5. Environmental Resources Management (ERM)

ERM is a leading global provider of environmental, health, safety, risk, social consulting servicesvand sustainability related services (https://www.erm.com/). ERM has been operating in Indonesia since 1998 and maintains a permanent office in Jakarta, comprising a team of over 45 dedicated professionals, collaborating very closely with our global expertise of 8,000 people in 35+ countries and territories working out of over 140 offices, bringing specialty in environmental and social sciences, planning, engineering, natural and earth sciences, economics and business management. Over the past three years, we have worked for more than 50 per cent of the Global Fortune 500 delivering innovative solutions for business and selected government clients helping them understand and manage the sustainability challenges facing the world today.

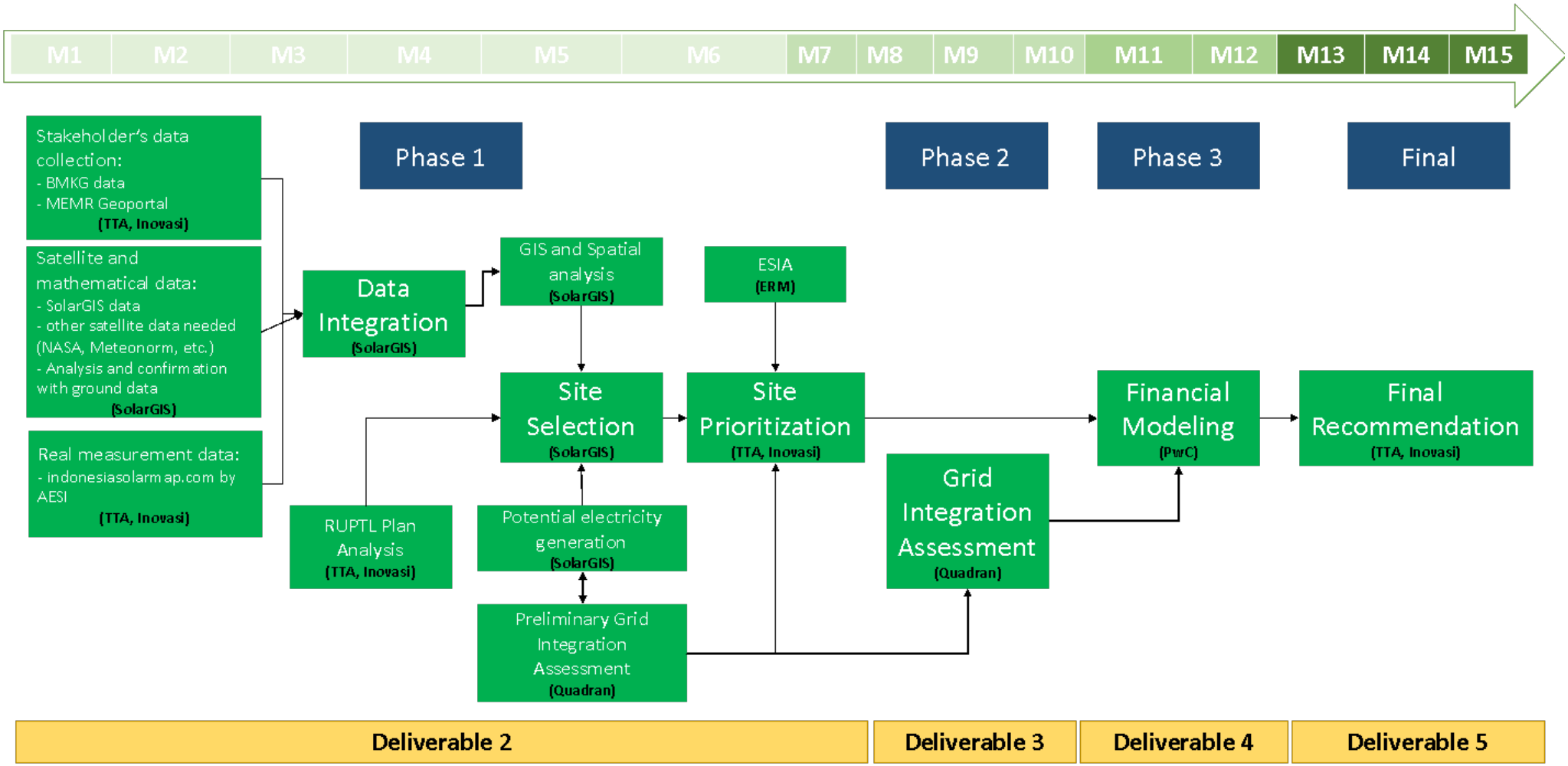
With our deep understanding of Indonesia's culture, business practices, regulatory requirements, and international standards, we assist both local and international clients in staying informed about environmental trends, identifying material risks and opportunities, and developing sustainability strategies to gain a competitive edge. Our extensive track record showcases successful support provided to investors and project developers throughout the entire development lifecycle. This experience enables us to incorporate valuable insights into our methodologies and advice, enhancing the quality of assessments, instilling confidence, and reducing costs for our clients. Furthermore, our expertise is amplified by our extensive involvement in diverse projects across the country. Leveraging our first-hand experience within the local context, we are able to hit the ground running, offering valuable insights and recommendations from the outset.

3. Scope Management

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

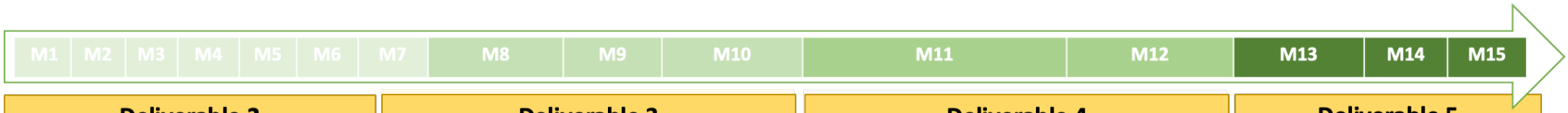
ACTIVITY	SUB-ACTIVITIES	DELIVERABLES
1. Project Scoping	1.1 Kick-off Meeting	*D1. Inception report*
	1.2 Donors' program mapping	
	1.3 Inception Report	
2. Phase 1 Report: Solar Irradiance Mapping	2.1 Preliminary Desk Study and Data Collection	*D2. Solar Irradiance Mapping and Accessible Database*
	2.2 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:



The consultant proposes to conduct the activities as per the following:

Figure 3. Flowchart of main project activities.



Deliverable 2	Deliverable 3	Deliverable 4	Deliverable 5
Report on Solar Irradiance Mapping and accessible database	**Report on Grid Integration Assessment**	**Review and Recommended solutions on the impediments of Solar PV development**	**Pre-Feasibility Study with Regulatory and non-Regulatory Analysis**
What are the optimal placements for solar PV installations in Jamali Indonesia? Irradiation data and potential locations will be selected based strictly on high irradiation locations and proximity to PLN substations. A Multi Criteria Decision Matrix will be developed to further refine and prioritize the locations.	❖ **What would be the impact of the solar PV installations on the existing grid if located if the sites identified in deliverable 2?** ❖ **What is the effective capacity planning of the existing grid systems ? What is the ability of the current infrastructure to handle current and future energy demands including the integration of renewable energy sources?** ❖ **If validated on a technical point of view, are the selected viable to be implemented on a economic and environmental factor?** The grid assessment aims at addressing/identifying technical, economical and environmental challenges of the existing power systems and in. It aims also to estimate the integration of renewable energy and assess if any of the sites initially selected would affect it negatively.	❖ **To what extend the sites selected would be viable?** ❖ **Would private sector actors be able to implement the solar PV installation in the sites located?** What are the challenges and opportunities for the solar PV development in Indonesia? Who are the relevant stakeholders involved in the solar PV development in Indonesia and what are their roles and responsibilities? What are the impediments that holding the solar PV projects development in Indonesia? How to overcome those barriers? What kind of actions that can accelerate the solar PV projects development in Indonesia? When should these actions be done? How can the relevant stakeholders be involved in overcoming the impediments or in solving the challenges and accelerating the solar PV development in Indonesia?	❖ **How can the relevant stakeholders be involved to address the challenges and accelerate the development?** ❖ **What are the recommendations to make the solar PV projects in Indonesia attractive to the investor and bankable?** ❖ **What kind of financing and investment mechanism is best for the selected solar PV project?**

Figure 4. Flowchart of deliverables' objectives

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

This deliverable should provide answers/solve the following:

- What are the optimal placements for solar PV installations in Jamali Indonesia?

Irradiation data and potential locations will be selected based strictly on high irradiation locations and proximity to PLN substations. A Multi Criteria Decision Matrix will be developed to further refine and prioritize the locations.

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.

3.1.1. 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 5. 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.

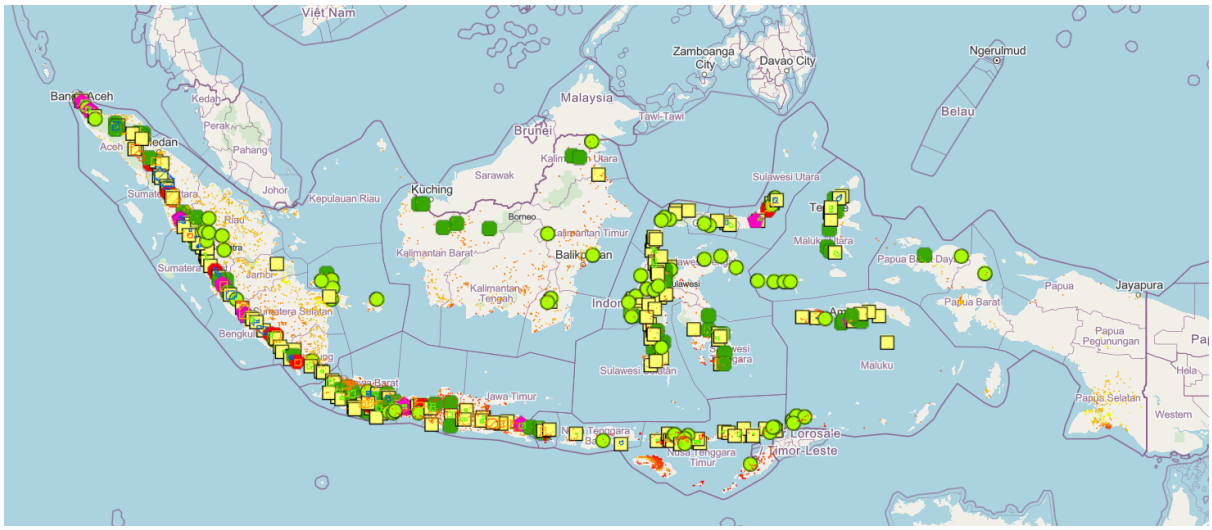


Figure 6. MEMR Geoportal

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.

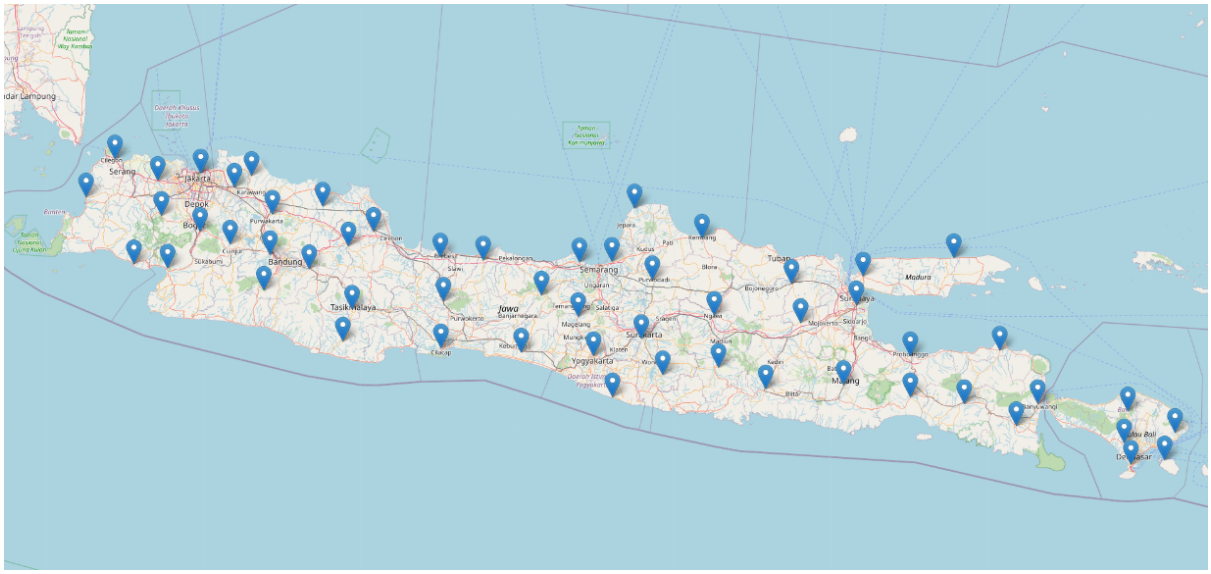


Figure 7. Solar irradiance measurement from indonesiasolarmap.com (AESI)

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.

3.1.2. 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.

3.1.3. 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 ETP 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.

3.1.4. 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 Decision Analysis Matrix (MCDA) 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.

3.1.5. 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 analysis 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 PSs is 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 are** below.
- Description of Indonesian environmental and social governance requirements concerning solar projects and batteries of the proposed scale, including relevant regulations for land acquisition.
- Desktop socio-environmental assessment of the proposed project location based on a land-use map, indicating high-level risk assessment and mitigation. ETP will ask BAPPENAS to request a land use map and zoning for the ATR-BPN based on the consultant's proposals.
- 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 in place to identify land requirements and satisfy them.

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

ESIA Scope and Expected Output

- **Regulatory review**: a review of the relevant regulations to establish the context and landscape within which the project operates, enabling a relevant and meaningful study.
    - Check compliance with National Spatial Planning – analyse whether the site complies with National Spatial Planning regulations. This involves analyzing whether the site is located within a Protected Rice Field, as stipulated by the Decree of the Minister of Agrarian Affairs and Spatial Planning/Head of the National Land Agency Number: 1589/SK-HK.02.01/XII/2021 which outlines the Protected Rice Fields Map in Regencies/Cities in several provinces. This regulation aims to control the conversion of rice fields into non-agricultural functions, which in this project pose as a risk to site prioritization. It is recommended to generate data from https://bhumi.atrbpn.go.id/.
    - Check compliance with Regional Spatial Planning – provide mapping and an analysis on whether the site is compliant with regional spatial planning regulations.
    - Check compliance with Forest Land Tenure – analyse whether the site complies with forest land tenure regulations. This is necessary to determine whether the area falls within non-forest areas, which are also known as areas for other land uses (APL). The areas under APL are formally designated as privately owned land. It is recommended to generate data from https://sigap.menlhk.go.id/sigap/peta-interaktif
    - Regulatory review. Should cover requirements of Indonesia and international safeguards that Client may wish to apply e.g. IFC (International Finance Corporation) and ADB (Asia Development Bank).
- **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.
    - Biophysical and social-economic description of the area, including the preliminary identification of the ecosystem's services and the vulnerability to climate changes.
    - Patterns of land use for the areas on which the project has direct and indirect influence.
    - Provide a land use and land cover map, demarcating various land uses, and identifying general habitat types.
    - Potential sources and availability of water and other supporting infrastructures for construction.
    - Biodiversity data from global databases including identified protected area, species and habitats of concern, present a preliminary opinion on whether these are likely to trigger Critical Habitat or PBFs and to which extent these could present a risk to the implementation of the Project.

- **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.
    - Cultural Heritage – identify potential cultural heritage sites within the vicinity of the project site, such as archaeological value, national heritage, or historic building (if any).
    - Livelihood sources, including informal economic activities and reliance on common resources for all affected households.
    - General overview of formal and informal tenure conditions for residential, agricultural, and commercial use of land.
    - Identify potential opportunities for livelihood improvements and economic development.
    - Identification of potential impacts relevant to the activity, including environmental impact and climate change-related, if applicable.
    - Delineation of the areas on which the project has direct and indirect influence.

Key requirements of each performance standard are provided in **Table 2. IFC Performance Standards and Key Requirements are** below.

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. 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.

Performance standards (PS)	Key Requirements
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

Part 1 Decision				
	Excluded	**Critical High Risk (Category A)**	**High Risk (Category B+)**	**Moderate Risk (Category B)**	
Guidance	If the opportunity has (or has historically had) any of the elements, then it should not be considered eligible for investment.	If the opportunity has any of the elements, then the IFC performance Standards require that an independent environmental or social impact assessment of the entire project/company is required. The social and environmental impacts will often overlap, so the expert assessment will usually cover both environmental and community issues.	Where the opportunity has any of the elements, the Project must ensure a detailed assessment of the particular environmental, social or governance risks identified have been identified. To obtain maximum assurance, this will usually be done by an independent consultant.	If the opportunity has any of the elements, the Project should involve appropriate experts in identifying and addressing the risks identified. This expertise can be internal if the Project staff have the knowledge and experience required, but it must be fully documented.
		the Project should only proceed if they are confident that an internationally compliant ESIA is in place / will be commissioned that identifies ways in which these risks can be mitigated and an ESMS can be put in place to ensure ongoing stakeholder engagement and risk monitoring.	the Project should only proceed if they are confident that the Client will commission or there is an existing, internationally compliant expert report that identifies ways in which these risks can be mitigated and a Client/Project ESMS can be put in place to ensure ongoing stakeholder engagement and risk monitoring.	the Project should only proceed if a full management plan is in place for mitigating these risks, including an ESMS which ensures ongoing monitoring.
Decision	**the Project will not proceed with the opportunity.**	**E&S Due Diligence Required before signing Contracts.** Further details must be gathered based on the questions below to ensure that roles and responsibilities are identified/assigned to mitigate E&S risks.	**E&S Due Diligence Required before signing Contracts.** Further details must be gathered based on the questions below to ensure that roles and responsibilities are identified/assigned to mitigate E&S risks.	**E&S Due Diligence Required before signing Contracts.** Further details must be gathered based on the questions below to ensure that roles and responsibilities are identified/assigned to mitigate E&S risks.
Environment	▪ Destruction or conversion of critical habitat (note 2)	▪ Any environmental impact that is diverse, unprecedented, and difficult to mitigate	▪ Loss of biodiversity within the project	▪ Use of hazardous chemicals/ significant waste generation

Part 1 Decision				
	Excluded	Critical High Risk (Category A) / High Risk (Category B+)	Moderate Risk (Category B)	
		▪ Significant loss of biodiversity, not only within the project boundaries but outside	▪ Unsustainable use of scarce water resource	▪ A moderate increase in noise levels
		▪ Diversion of water/drainage patterns and lack of water table replenishment, as a result of ground clearance and earthworks resulting in significant environmental impacts that cannot be easily mitigated	▪ Significant noise levels causing disturbance to wildlife and humans	
		▪ Development of project in a 'Critical Habitat' as per IFC PS6 para 16		
		▪ Loss of agricultural/livestock/other productive use land		
Questions	1. Is the project within, near to or is (likely to) impact an internationally / nationally ecologically or culturally important features such as tropical forests, coral reefs, natural protection areas, wetlands, natural/near-natural forests, important cultural heritage sites, e.g. UNESCO World Heritage Sites, Ramsar sites, National Parks, important bird and biodiversity areas (IBA), Key Biodiversity Areas (KBA)?			
	2. Has an EIA/ ESIA been undertaken of the project if applicable (e.g. not needed for rooftop installations)? If yes, has it been conducted to IFC PS or local standards?			
	a. Does the ESIA identify and assess the applicable E aspects and impacts as defined by the IFC PSs?			
	b. Does the ESIA define the Area of Influence of the project?			
	c. Does the ESIA consider all the key stages in the project life – pre-construction, construction, operations and decommissioning?			
	d. Has the ESIA considered all related activities and facilities within the proposed project's Area of Influence?			
	e. Does the ESIA consider the E risks posed by third-parties involved in the project (e.g. clients, contractors and suppliers)?			
	f. Does the ESIA consider cumulative E impacts?			
	g. Does the ESIA consider E risks of Associated Facilities, e.g. transmission lines?			
	h. Was the ESIA conducted by experienced and qualified persons?			
	3. Does or likely will the project:			
	a. Require significant land take and is this land protected (as per Q1) or used productively and will result in loss of economic livelihood (see Social)			
	b. Use significant quantities of energy or other resources during construction/operations?			
	c. Discharge pollutants into air, water, land (including routine, non-routine or accidental release) at the local, regional or transboundary level?			
	d. Generate significant quantities of waste, during construction/operations?			
	e. Require significant pesticide use, e.g. ground clearance/asset maintenance?			
	4. Is the client a significant consumer of water? If yes, has the source of water been assessed for its sustainability and potential impact on other users? Has the cumulative impact of construction/operations been taken into account?			
	5. Might the project (particularly construction phase) be discharging pollutants into an already polluted 'ambient' environment and depending on the Client activities? If so, has the project ESIA considered these and ensure the implications are included in the Categorisation Assessment.			
Permitting	▪ Client has not performed / obtained legally required EIA /	▪ Client has performed / obtained legally required EIA / Permit but not compliant	▪ Client has performed / obtained legally	▪ Client has performed / obtained legally required EIA / Permit but not

	Part 1 Decision			
	Excluded	**Critical High Risk (Category A)**	**High Risk (Category B+)**	**Moderate Risk (Category B)**
	Permit (unless is in Tender scope for the Project to complete)	with IFC and other Category A risks identified	required EIA / Permit but not compliant with IFC and other Category B+ risks identified	compliant with IFC and other Category B risks identified
Social	▪ Depriving communities of land and natural resources (e.g., forest resources) needed for their livelihood and cultural identity	▪ A social impact that is diverse, unprecedented and difficult to mitigate	▪ Social conflict	▪ Inadequate consultation with local people
	▪ Encroachment on land owned or claimed by Indigenous Peoples without Full Prior Informed Consent	▪ Impact on the setting of Culture Heritage / designated sites or direct impacts on below ground archaeological deposits due to ground disturbances	▪ Diversion of resources (energy, water) away from local communities	▪ Ownership of significant tracts of land (>5,000 ha)
	▪ Forced resettlement		▪ An influx of migrants or use of external workforce over local workforce leading to conflict in the area as a result of Client / the Project activities	▪ Disputes over benefit-sharing with local communities
	▪ Involuntary Land Acquisition		▪ Client employs armed guards to protect its property	▪ Inadequate grievance mechanisms in place for local communities
			▪ Recent fatal accidents	▪ Specific reasons to expect discrimination against particular groups (ethnic, gender) in the work-force
			▪ Voluntary Resettlement	▪ Potential for the client to pay below the minimum wage
				▪ Locality and availability of nearest emergency services and impact on local communities
Questions	1. Is the project within, near to or is (likely to) impact an internationally / nationally recognised indigenous people and their land / use of land, including cultural heritage such as sacred land?			
	2. Has an EIA/ ESIA been undertaken of the project if applicable (e.g. not needed for rooftop installations)? If yes, has it been conducted to IFC PS or local standards?			
	a. Does the ESIA identify and assess the applicable Social aspects and impacts as defined by the IFC PSs?			
	b. Does the ESIA define the Area of Influence of the project?			
	c. Does the ESIA consider all the key stages in the project life – pre-construction, construction, operations and decommissioning?			
	d. Has the ESIA considered all related activities and facilities within the proposed project's Area of Influence?			
	e. Does the ESIA consider the Social risks posed by third-parties involved in the project, e.g. job opportunities for local residents. What is the implication for the Project?			
	g. Does the ESIA consider Social risks of Associated Facilities, e.g. transmission lines and land rights?			

Part 1 Decision				
	Excluded	Critical High Risk (Category A)	High Risk (Category B+)	Moderate Risk (Category B)
	h. Was the ESIA conducted by experienced and qualified persons?			
	3. Does or likely will the project:			
	a. Require significant land take and is this land protected (as per Q1) or used productively and will result in loss of economic livelihood (see also Environment)			
	b. Require resettlement? Including Associated Facilities?			
	c. Create an impact on and including removal of cultural heritage? Impact may include new infrastructure that blocks access to cultural locations.			
	d. Is deemed controversial by local residents/stakeholders or there are known disputes with the Client?			
	4. Will the Client employ its own staff at any stage of the Project (particularly Operations), or use non the Project contractors, and may trigger some of the items highlighted above, such as wage concerns or lack of equality in job opportunities?			

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** projects have minimal or no adverse environmental or social risks and impacts.	Require compliance with applicable laws

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

3.1.6. 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. To safeguard grid stability, there are some analysis that will be done such as dynamic stability analysis and quasi dynamic analysis. By conducting those analyses we can confirm that there is no stability limit stated in the grid code will be violated. In case if there is grid violation, mitigation such as installing battery will be recommended. 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 and any relevant charts 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.

3.1.7. 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.

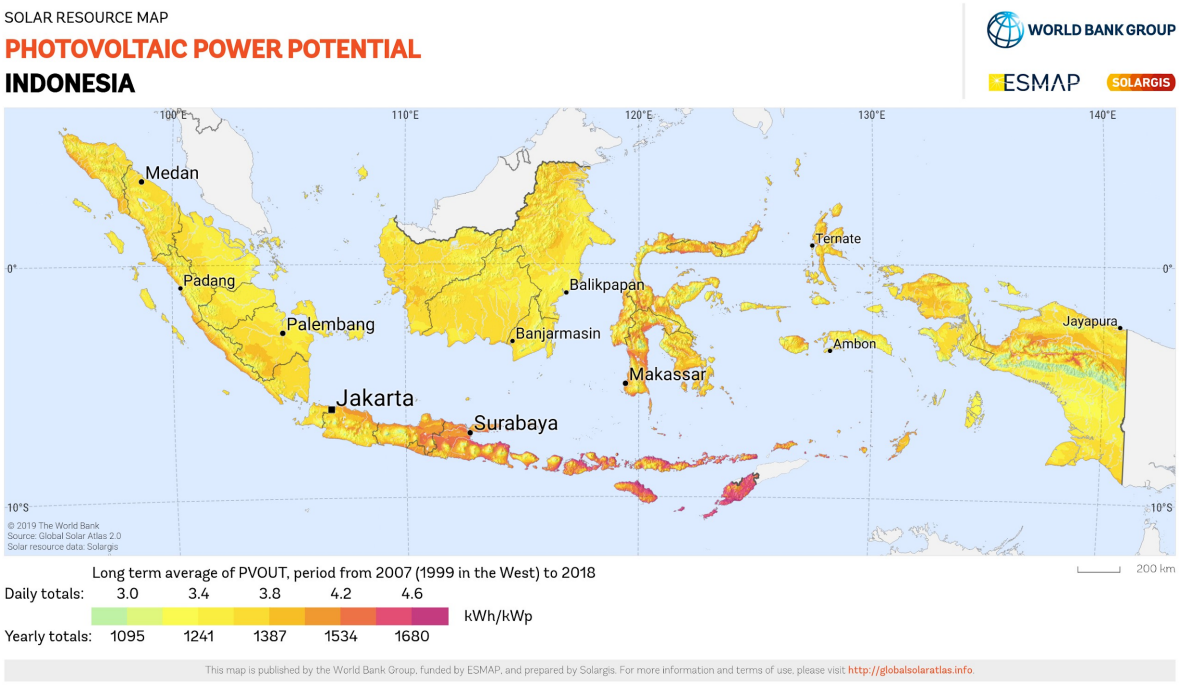


Figure 8. Indonesia's solar resources map

3.1.8. 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.

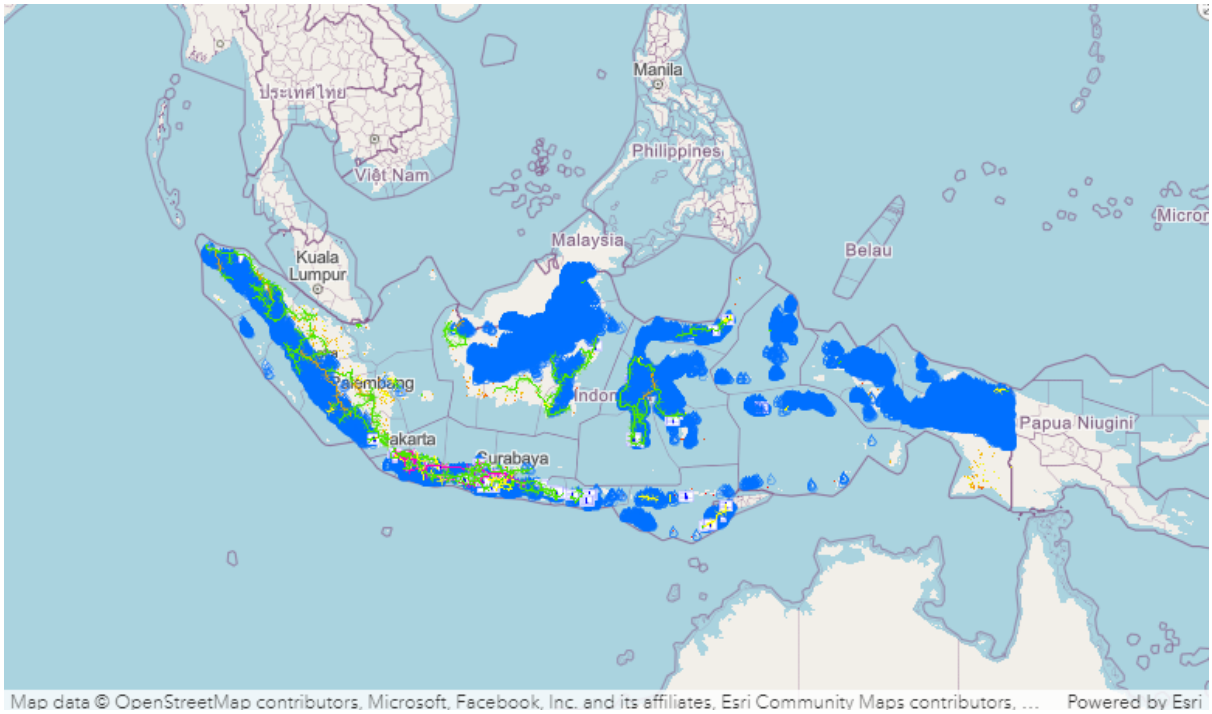


Figure 9. New and Renewable Energy Potential Map (MEMR Geoportal)

Upon ETP 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 ETP. 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 MCDA 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.

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

This deliverable should provide answers/solve the following:

- What would be the impact of the solar PV installations on the existing grid if located if the sites identified in deliverable 2?
- What is the effective capacity planning of the existing grid systems? What is the ability of the current infrastructure to handle current and future energy demands including the integration of renewable energy sources?

- ❖ If validated on a technical point of view, are the selected viable to be implemented on a economic and environmental factor?

The grid assessment aims at addressing/identifying technical, economical and environmental challenges of the existing power systems and in. It aims also to estimate the integration of renewable energy and assess if any of the sites initially selected would affect it negatively.

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.

3.2.1. 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.

3.2.2. 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/

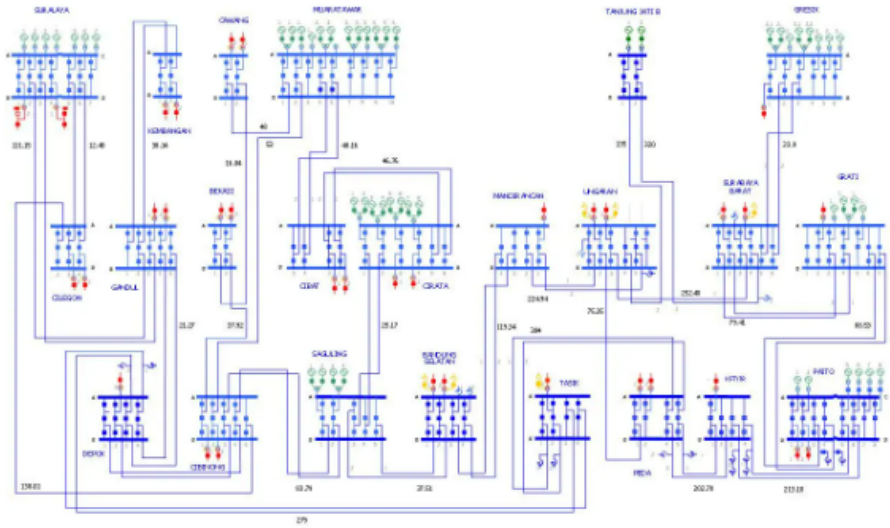


Figure 10. DIgSILENT PowerFactory Model example

3.2.3. 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.

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

This deliverable should provide answers/solve the following :

- To what extend the sites selected would be viable?
- Would private sector actors be able to implement the solar PV installation in the sites located?
- What are the challenges and opportunities for solar PV development in Indonesia?
- Who are the relevant stakeholders involved in the solar PV development in Indonesia and what are their roles and responsibilities?
- What are the impediments that hold the solar PV projects development in Indonesia? How to overcome those barriers?
- What kind of actions that can accelerate the solar PV projects development in Indonesia? When should these actions be done?
- How can the relevant stakeholders be involved in overcoming the impediments or in solving the challenges and accelerating the solar PV development in Indonesia?

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.

3.3.1. 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 3. 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
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. 26 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

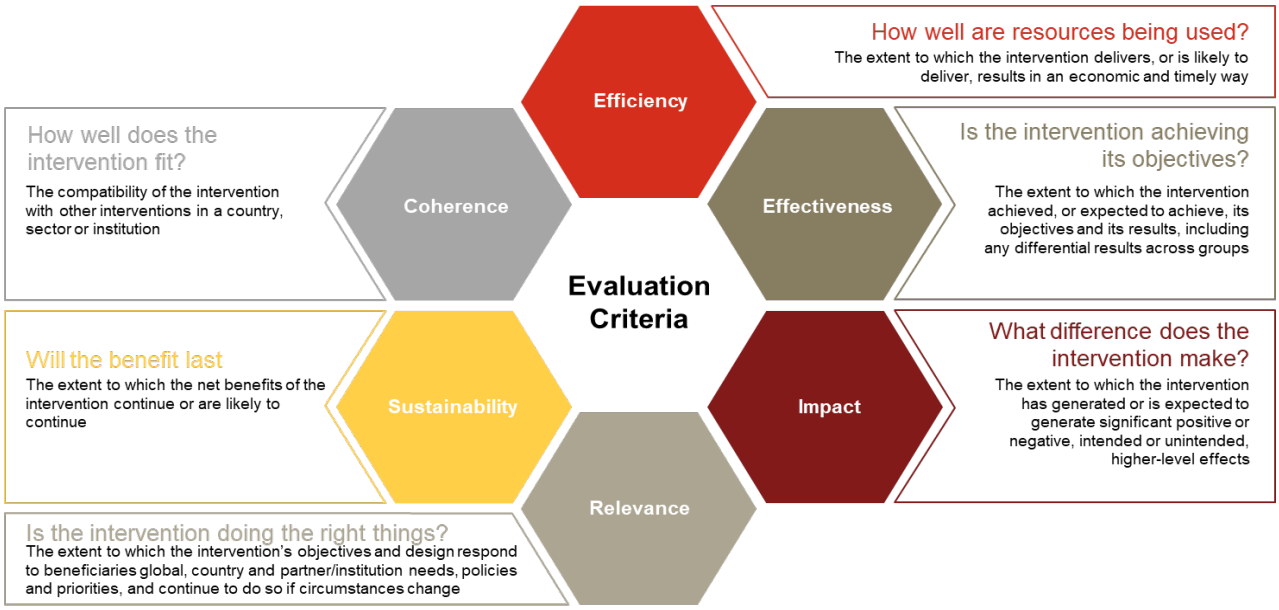
The above list will be updated and elaborated in more detail in the next stage ensure a holistic approach is undertaken in preparing the regulations analysis findings. The key output of this activity is the list of relevant regulations and policies that will serve as input to the gap analysis and review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

3.3.2. 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[5] 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 ETP, 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 a later stage under Phase 3. The finalization of objectives will be subject to consultation with ETP 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.

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

3.3.3. Solar PV Development Challenges and Opportunities Analysis

This task requires to assess of 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 a 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 4 below presents several examples of initial high-level gaps in each preliminary area defined in this assignment.

Table 4. Preliminary 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 have a more transparent governance and mechanism policies for energy sector	Lack of support policies, overlapping coordination, and governance between GoI bodies	• Identify overlapping policies/regulations or those that need clarification • Coordinate with relevant stakeholders for relevant policies alignment
2	Sector financial sustainability	To ensure financial sustainability for the solar PV development in selected locations	Tariff mechanisms for electricity, existing policies related with energy subsidies, supporting policies for private sector participation	• Calculate the required investment for the solar PV development and identify potential source of funding • Discuss with relevant stakeholders on the tariff mechanism and available subsidy
3	Solar PV Development	To have more solar PV development as means to increase renewable energy portion in the energy mix	Fiscal and financial impacts, local regulation, existing policy concerning DMO, innovative financing, challenges in technology deployment due to local content requirement	• Identify regulations relevant to renewable energy expansion and available incentives, especially for solar PV development • Identify policies/regulations that might hinder the development and proposed actions to address the challenges
4	Grid/system enhancement (distribution and transmission)	To ensure that the grid can accommodate the solar PV development to the planned scale	Incentives mechanism to private sector expenditure, inadequacy of infrastructure	• Analyse the current state of the grid and whether it is now sufficient for the solar PV development or needs improvement

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.

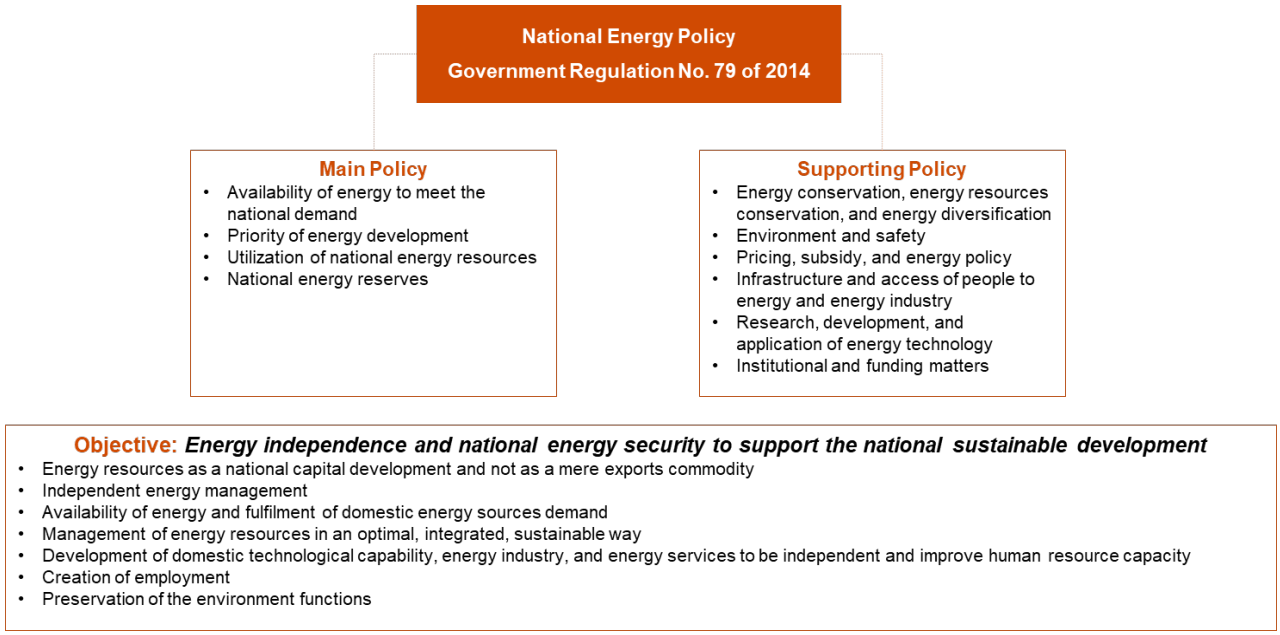
3.3.4. Preparation of Feasible Recommendations to Address the Impediments

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.

3.3.5. 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.

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

This deliverable should provide answers/solve the following :

- How can the relevant stakeholders be involved to address the challenges and accelerate the development?
- What are the recommendations to make the solar PV projects in Indonesia attractive to the investor and bankable?
- What kind of financing and investment mechanism is best for the selected solar PV project?

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.

3.4.1. 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 that might affect the financial aspects for the 1 GW Solar PV development, such as:

- required permits for land acquisition for solar PV development in the selected sites or relevant local regulations on land acquisition mechanism and price (if any)
- regulation of the Ministry of Home Affair on local infrastructure development budget allocation through the Special Allocation Budget/Dana Alokasi Khusus/"DAK"
- other existing local regulations such as governor/head of regency regulations, etc relevant to the project
- the allowable tariff for solar PV development based on the Presidential Regulation no. 112/2022

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.

3.4.2. 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.

3.4.3. 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.

3.4.4. 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. Table below presents the example of potential financing and investment mechanisms for the report.

Table 5. Potential Financing and Investment Mechanism

No	Selected Solar PV Projects	Potential financing and Investment Mechanisms	Pro	Cons
1	TBU	Option 1	TBU	TBU
		Option 2	TBU	TBU
		Option 3	TBU	TBU
2	TBU	Option 1	TBU	TBU
		Option 2	TBU	TBU
		Option 3	TBU	TBU

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

3.5. 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.

3.5.1. 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.

3.5.2. 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 ETP program to ensure the working group's involvement from the very beginning of the process.

The TWG establishment will consist of identifying member institutions and inviting each institution to assign a representative who is empowered to actively participate on behalf of the institutions. Once the TWG members and representatives have been established, a series of TWG meetings will be conducted and led by the project to gather valuable insights and enhance stakeholder engagement that is encouraged to be sustained beyond the period of this project. The TWG meetings are expected to have the following purpose and topics:

Table 6. Technical working group summary

	Discussion Topic	Purpose
1	**Kick-off TWG meeting**	To establish the framework of the TWG, align expectations, roles and responsibilities, and to provide a background of the project's goals and objectives
2	**Irradiation data for Indonesia**	To inform the stakeholders of the available irradiation data for Indonesia from SolarGIS and how the quality and accuracy of the satellite data can be improved by integrating data from qualified calibrated pyranometers on specific locations on the ground. To engage with the stakeholders to assist the project team to obtain existing pyranometer based irradiation data to validate existing satellite data and how this can benefit the Indonesian government, the public sector, and solar PV stakeholders
3	**Electricity grid data for Java**	To inform the stakeholders of the importance of having the electricity grid data for the project so that an accurate grid impact study to integrate 1 GW of solar PV projects can be conducted To engage with the stakeholders to assist the project team to obtain existing grid data including substation information in areas of high irradiation suitable for solar PV project installations.
4	**Environmental and social assessment**	To inform and engage with the stakeholders of the environmental and social assessment methodologies of solar PV projects. The project aims to develop a guideline for the Environmental and Social Impact Assessment that are applicable to the 1 GW solar PV projects and accepted by lenders, investors, and government institutions for environmental permit issuance
5	**Site selection of the 1 GW solar PV projects**	To inform and engage with the stakeholders of the final site selection of the solar PV projects. Inputs from the stakeholders will be sought and the final site selection will incorporate and if necessary adapted to integrate their inputs
6	**Socialization of the Pre-Feasibility Document**	To inform and seek inputs from the stakeholders of the draft Pre-Feasibility Document as the final deliverable of this project. The final version of the deliverable documents will incorporate the inputs of the TWG members as applicable

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.

The TWG and its activities will be designed to ensure that a gender-balanced view and inclusion of vulnerable and disadvantaged groups' voices are represented. In the selection process of the TWG members, Inovasi will encourage the inclusion of women and members of disadvantaged groups from each institution invited to be a member. During TWG's activities such as FGDs and working group meetings, the invitations for participants will provide opportunities to cater to an inclusive group. This includes selecting venues that are handicap friendly, providing translation services to Indonesian and English languages, and ensuring that those requiring sign language translation can request such a service and be provided during the events.

All written documentation, guidelines, and publicly available materials will be available in both English and Indonesian languages to ensure all stakeholders can access the information easily. To encourage gender-balanced participation and capacity development, during the design of the publicly available materials, all care will be taken to ensure that female views are represented. This may include photos and graphics depicting women participating in solar PV project-related activities to encourage more women to be active in solar PV-related employment fields.

Lastly, during the social assessment methodology development and implementation, Inovasi and ERM will ensure that the data being collected includes representation of females and disadvantaged groups. This includes providing confidential protection email addresses to write to as well as WhatsApp phone numbers that can be accessed by those who are afraid to speak up during public focus group discussions and data collection activities.

Ensuring inclusivity and gender balance is the general aspiration and goal of all consultation and communication being undertaken by this project. To achieve this, many components and best practices from the United Nation's free, prior, and informed consent guidelines will be utilized and adapted. The guideline the project aims to use[6] is the same one that also applies to activities supported by the UN partner agencies to the UN-REDD Programme in their role as a Delivery Partner under the FCPF Readiness Fund (FAO and UNDP).

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.

3.5.3. 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

[6] Guidelines on Free, Prior and Informed Consent (UN-REDD) – The Implementation Project (narf.org) - https://un-declaration.narf.org/unredd-fpic/

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. A detailed weekly work plan is available in a separate file from the inception report.

	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 7. 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' 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 an 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 8. Key Stakeholders in Solar PV Development

No	Stakeholder	Roles and Responsibilities
1	**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.
2	**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
3	**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.
4	**Ministry of Agrarian Affairs and Spatial Planning (KATR/BPN)**	Responsible for determination on land allocation for projects development and approval of land permits
5	**Ministry of Public Works and Housing ("MPWH")**	MPWH owns several dams in Indonesia. Therefore, for floating solar PV development, permit from MPWH needs to be obtained prior to the commencement of the development.
6	**Coordinating Ministry for Maritime and Investment Affairs ("MarVest")**	MarVest oversees several strategic projects, including energy-related ones. The ministry can also provide support for strategic projects' acceleration and other required supports.
7	**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.

No	Stakeholder	Roles and Responsibilities
8	**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.
9	**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.
10	**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.
11	**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
12	**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.
13	**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.
14	**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 9. RACI Matrix

Tasks	Bappenas	MEMR	PLN	MoF	MSOE	MoI	MoHA	BPN	MPWH*	MarVest
Develop policy related to technical aspects	C, I	R, A	A, C, I	I	I	I	I	-	I	I
Approve solar PV development roadmap	C, I	R, A	A, C, I	I	I	I	C, A	C	C, I	C, I
Develop policy related to local government investment	R, C, I	I	I	A, C	I	I	R	-	C, I	I
Adjust policy relevant to the local content in solar PV development	C, I	C, I	C, I	I	C	R	C, I	-	C, I	I
Investment bankability of the solar PV development	R, C, I	R, I	C, I	C	I	A, C	I	-	-	C, I
Required permits for solar PV development land acquisition/availability	C, I	C, I	C, I	-	I	I	C, I	R, A	-	C, I

*Note: *) MPWH will only be consulted and informed for aspects relevant to floating solar PV development*

The above findings will be further expanded in the later stage, along with the stakeholder's roles and responsibilities, potential interest, and influence especially with regards to the energy transition and decarbonization in Indonesia.

INITIAL SKEHOLDERS 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.

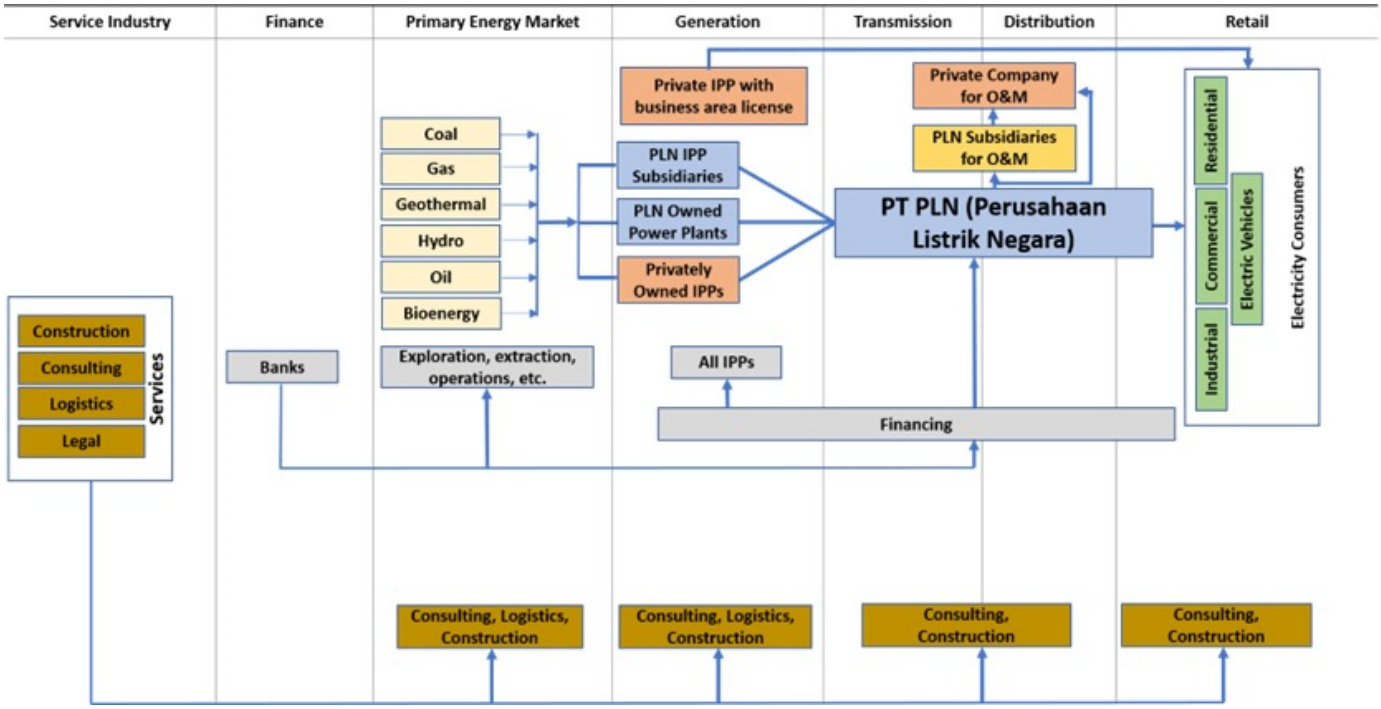


Figure 13. Power sector swimlace

6.2. 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 6.1 and 3.4.2.

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

Table 10. Stakeholders' engagement plan

Stakeholder	Purpose for Engagement	Influence on PV Projects	Stakeholder Key Concerns	Engagement
National Development Planning Agency ("Bappenas")	To ensure buy-in and ensure PV projects are part of the national planning for energy transition	Medium	Coordination and planning with other ministries	Face-to-Face meeting, FGD participant, and part of TWG
Ministry of Energy and Mineral Resources ("MEMR")	To ensure buy-in and obtain inputs on how to apply for the various MEMR permits	High	Grid stability, impact on PLN, and emission reduction targets	Face-to-Face meeting, FGD participant, and part of TWG
PT PLN (Persero)	To ensure buy in, obtain grid data, substation location, an inputs on grid conditions and preference	High	Grid stability, impact on generation cost, impact on oversupply	Face-to-Face meeting, FGD participant, and part of TWG

	on solar PV project implementation			
Ministry of Agrarian Affairs and Spatial Planning (KATR/BPN)	To ensure buy-in and obtain inputs on how to apply for zoning permit and land purchase process	High	Land use and zoning, land ownership transfer	Face-to-Face meeting, FGD participant, and part of TWG
Ministry of Public Works and Housing ("MPWH")	To ensure buy-in, inputs on water rights use for floating solar PV projects	Medium	Solar PV projects may hinder access to water rights use	Face-to-Face meeting, FGD participant
Coordinating Ministry for Maritime and Investment Affairs ("MarVest")	To ensure buy-in	Medium	Investment	Face-to-Face meeting, FGD participant
National Energy Council("DEN")	To ensure solar PV projects are well-integrated into the national and regional energy plans	Low	Coordination with national and regional energy plans	Face-to-Face meeting, FGD participant
Ministry of Finance ("MoF")	To ensure buy-in, inputs on PLN subsidy mechanisms and how it might be affected by solar PV projects, and potential state loss calculations when PLN must pay the take or pay penalties	Medium	Additional costs to the state, losses to the state	Face-to-Face meeting, FGD participant, and part of TWG
Ministry of Industry ("MoI")	To ensure buy-in, inputs on local content requirements	Medium	Compliance to local content requirements	Face-to-Face meeting, FGD participant
Independent Power Producers ("IPPs")	To ensure buy-in, inputs on project development costs, criteria for project viability, and current barriers	High	Very few projects are available to be developed, financed, and implemented	Face-to-Face meeting, FGD participant, and part of TWG
Investors/Lenders	To ensure buy-in, inputs on project bankability, investment criteria	High	Very few projects are available to be financed	Face-to-Face meeting, FGD participant, and part of TWG

6.3. Alignment with other donors' activities

6.3.1. 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.

6.3.2. 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.

The donor mapping, as well as the detailed stakeholder's identification process, will be conducted during the first 2 months of the project. The organization of the first TWG, which will require ETP's validation of the invitees, will help consolidating the final list of project stakeholders. The relevant donors will be included in the stakeholder engagement plan and managed accordingly. The resulting stakeholder engagement plan will be presented to ETP for validation as a separate document.

7. Risk management

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 their level of impact from 1 to 3 (1=Low; 2=Medium; 3=high) and level of likelihood from 1 to 3 (1=Low; 2=Medium; 3=high)

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.

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

Category	Risk	Impact *(From 1 to 3)*	Likelihood *(From 1 to 3)*	Risk response: Preventive action / Corrective action
Project management	**Stakeholder engagement** Lack of other stakeholders' support, resulting in the project outcomes not being considered or integrated into future decision-making processes relevant to the stakeholder.	**3**	**2**	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.
	Communication and dissemination Inadequate communication with other stakeholders, which may lead to the results of the project not being utilized or recognized for potential project implementation or policy changes.	**2**	**1**	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.
	Cooperation with subcontractors/consortium members	**2**	**1**	TTA, Inovasi, and PwC have worked on other projects in the past and have been part of other consortium for several proposals in recent times. There is a proven track record of being able to work well together between the three entities. Inovasi have worked on the same project with ERM. SolarGIS is a well-known company supplying irradiation data that is very motivated to work on this project as they will be able to validate their mathematical models for irradiation throughout Java Island. Lastly, Quadran is an Indonesian company with extensive relevant experience in the industry within Indonesia and known to TTA and Inovasi.
	Applicability and viability of the resulting pre-feasibility study Data availability and access to stakeholders are assumed to be available. Lack of access to data and stakeholder will delay the project	**2** Results of the pre-feasibility study is misaligned with actual conditions faced by stakeholders and practitioners	**2**	TTA and its consortium members are well-versed and have significant experience with implementing solar PV projects in Indonesia, the region, and globally. In the case that some of the data, information, and/or stakeholders are not accessible, the consortium members will be able to provide proxies and/or educated estimation to ensure that the resulting pre-feasibility study and/or roadmap is applicable to the conditions in Indonesia related to this project.
HAZID (Hazard identification	**Travel hazards (land and air)** Accidents during travel within the city and to new cities can delay the project	**2**	**1**	Potential travel routes for this project is within large cities and Java island with good infrastructure Ensure that flights are booked for tickets that fly during daylight and from reputable airlines as much as possible.

Category	Risk	Impact *(From 1 to 3)*	Likelihood *(From 1 to 3)*	Risk response: Preventive action / Corrective action
				Cars and taxis used by the team members will be through applications to ensure that the routes are clear and there is an easy way to track the travel Other travel means will be utilizing reputable vendors/providers (bus, train, ferry, etc) and as much as possible will be done during daylight time
	Slip, trip, and fall hazards on the way to/from and during stakeholder meetings Personal accident can cause mediocre or heavy injury that delay the project	**2**	**1**	Stakeholders are typically located in well-developed areas Ensure that meetings with stakeholders are conducted in well-developed areas, during daylight hours, and avoid meetings when there is bad weather
	Covid or other infections affecting team members due to frequent meetings Infectious diseases can affect the team members' health in such a way that delay the project	**2**	**1**	Team members are typically well informed of sanitation practices and have access to online meeting accounts. Ensure that team members observe health, safety, and sanitation practices to avoid common infections. When practical, conduct meetings online that can also be recorded for other team members. Access to online meeting accounts will be available to all team members. Sanitation practice materials will be accessible to all team members as required
Risk and threat assumption for environmental and social risk category: In this stage, prior to specific site selection, we assess the baseline risk and threat levels in the Jawa, Madura, Bali region as medium. This evaluation takes into account the diverse nature of the region, encompassing high-density developed areas and rural, high-nature zones. This diversity can trigger environmental and social factors, potentially elevating the risk level. Depending on site-specific conditions, the likelihood may vary between medium and high risk.				
Environmental	**Geology/Soil** Potential changes to soil via compaction and erosion of soil	**2** Impact on biodiversity-ecosystem and GHG emissions	**2**	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	**2** It might impact local ecosystems, soil quality, or habitats	**2**	Prioritize degraded or non-arable land, conduct thorough environmental impact assessments, and implement land restoration where necessary
	Biodiversity Impact Solar farms deployed	**2** The solar farm could disrupt local flora and fauna and affect biodiversity	**2**	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	**2** It could strain local water resources or affect water quality	**2**	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

Category	Risk	Impact *(From 1 to 3)*	Likelihood *(From 1 to 3)*	Risk response: Preventive action / Corrective action
	Climate and Flood Risks Changes in land use	**2** It might influence local microclimates or exacerbate flood risks	**2**	Conduct climate risk assessments, implement proper drainage systems, and consider flood-resistant design elements
Social	**Land Ownership and Displacement** Land acquisition	**2** It might lead to disputes or displacement of local communities	**2**	Participate in transparent and fair land acquisition processes, provide adequate compensation, and engage with affected communities
	Indigenous Communities	**2** Potential impacts on indigenous communities' cultural heritage, livelihoods, and land rights	**2**	Conduct cultural impact assessments, ensure informed consent, and involve these communities in decision-making processes
	Economic Displacement and Livelihoods Land-use change (land opening) for solar	**2** Change in livelihood	**2**	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	**2** Women and marginalized groups might face disproportionate impacts or limited access to project benefits	**2**	Implement social-inclusive approaches, ensure inclusive participation, and provide opportunities for local employment and skill development
	Cultural Heritage The discovery of cultural heritage sites	**2** It may disrupt project timelines, and contruction plans and trigger legal requirements	**2**	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 Presence of solar PVs, landing points, and transmission lines	**2** Potential impacts to visual and landscape value	**2**	Employ natural barriers such as vegetation to shield solar PVs, landing points, and transmission lines, reducing their visual impact

Category	Risk	Impact *(From 1 to 3)*	Likelihood *(From 1 to 3)*	Risk response: Preventive action / Corrective action
	There is resistance to solar PV development from local communities	**2** The possibility of project delay or cancellation	**2**	To conduct public consultation in potential locations
Regulatory	**Laws and regulations** Changes in relevant laws and regulations, that may cause project delay or cancellation.	**2**	**3**	Conduct a thorough regulatory analysis and map potential regulations that will significantly influence Project implementation.
	Policy support and implementation mechanism Lack of policy support or implementation mechanisms; or the necessary support or mechanisms are not in place for their implementation	**3**	**2**	Engage 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 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.
Financial and commercial	The development in the proposed locations is not bankable and/or cannot meet economic and/or financial feasibility	**3**	**2**	Calculate the cost estimation for development in the proposed locations and consider the lenders' perspective to understand
Interface	Mismatch or change of the timeline/project objectives due to alignment with other donor projects, i.e., ADB and AFD that may cause project delay or cancellation	**2**	**1**	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	**2**	**1**	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	**3**	**1**	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	**3**	**2**	To mitigate this risk, it is important to ensure that the data is collected from multiple sources and that the data is validated.

Category	Risk	Impact *(From 1 to 3)*	Likelihood *(From 1 to 3)*	Risk response: Preventive action / Corrective action
	could lead to inaccurate irradiance data			
	Limited access to study sites.	**3**	**1**	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.	**3**	**2**	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.	**3**	**2**	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.	**3**	**1**	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 11. Initial risk assessment matrix

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 grounds 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.

TTA's main partner in Indonesia, Inovasi, has a woman serving as the managing director and has women team members as well as opening job opportunities to disadvantaged groups and women. Inovasi's team members include those belonging to minority religious groups, minority groups, and women.

Operations and project implementation approaches

g. **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.
h. **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.
i. **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 following Spanish law and our internal policies.
j. **Inclusive Project Design:** At all stages of the project, the consortium should ensure 1) Inclusive stakeholder engagement 2) Gender-responsive data collection 3) accessibility and affordability 4) community impact assessment.

For example, for deliverables 2 and 3, Phase 1 and 2, TTA must ensure that the solar irradiance mapping and grid assessment process involves the active participation of diverse stakeholders, including women, marginalized communities, and other socially excluded groups. It also must seek their input to understand their energy needs and priorities. Then, for the data collection activities, the consortium must collect disaggregated data based on gender and other social indicators to understand the specific energy needs and challenges faced by different groups. This data can inform decision-making and help in designing inclusive energy solutions.

The Environmental and Social Impact Assessment during the site prioritization would take into account community impact assessment and GEDSI aspects through assessing environmental, and social-economic activities relevant to energy provision, renewable energy, and potential phases of the Project. It can also identify thorough social impact assessments of how grid projects may affect different social groups and therefore identify potential positive and negative impacts on local communities, with a focus on vulnerable populations.

During phase 3, deliverable 4 about the review and Recommended Solutions of the Impediments of Solar PV Development will take into account accessibility and affordability. It aims at assessing the accessibility of energy services for all members of the community, considering factors such as income levels, geographical location, and social status. While validating the financial viability of the solar PV installation, it should ensure that energy solutions are affordable and do not disproportionately burden vulnerable groups.

Deliverable 4 will include also an analysis of the following:

- Relevant regulations on the requirement to include women and/or another marginal group for the solar PV development
- challenges and opportunities that solar PV development have on roles of women and marginal group

Overall, 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.

Stakeholder engagement throughout the project will always be aware and make every effort to be gender balanced. In addition to gender balance awareness, TTA's consortium team members will strive to be aware and make every effort to invite input from disadvantaged groups and minorities. Invitations to focus group discussions, interviews, and communication with project stakeholders will be sent to gender-balanced participants, and those from disadvantaged groups and minorities. The same care will be taken to ensure that the invitations to join the Technical Working Group will be inclusive of all groups.

8.1.2. In the Environmental and Social Impact Assessment

Establishing an energy grid must ensure inclusivity. While implementing climate change solutions can lead to positive changes, there is a potential of adverse effects on vulnerable groups (women, children, indigenous peoples, local communities, and the elderly who might be disproportionately impacted or struggle to benefit compared to others). Analyzing the environmental and social impacts during project initiation helps anticipate both positive changes and potential risk.

The Environmental and Social Impact Assessment would take into account GESI aspects through assessing environmental, social-economic activities relevant to energy provision, renewable energy and potential phases of the Project. Potential GESI aspects commonly found through the phases of renewable energy sectors are as described below.

Screening Phase

Evaluating baseline social conditions in potential sites, such as local economic activities, sources of income, gender ratios, age groups, education levels

Early Construction Phase

Relevant GESI aspects in the early construction phase in Solar PV projects comprise the high potential for local workers required in site clearing and preparation. Assessing local economic activities and sources of income can be an early indication of potential land-use changes and potential impacts on jobs due to changes in land use. The readiness of local workers employability can also be assessed through identifying the characteristics of gender, age groups and education level of the local community.

Post-Construction Phase

Potential workforce assimilation in post-construction phase and implementation comprises the demand for skilled workers for operation officer, analysing gender ratios, age demographics, and education levels will help understand the local workforce, encouraging inclusive participation in the energy sector across genders. While some tasks, such as regular panel cleaning and land maintenance, may need less skilled workers, they are pivotal for ensuring peak performance of PV systems. Some best practices for PV projects involve establishing collaborations with Local Government-Owned Enterprises, which provide local workers and offer training to prepare and equip them with skills for the energy provision market.

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.

INDICATOR	TARGET
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 12. 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.

8.3. Project Communication Plan

	Purpose	Method	Frequency/Period	Participant
Kick-off Meeting	Confirm goals, deliverables, and objectives	Hybrid with overseas consortium members	Once at the start of the project	TTA consortium members and UNOPS ETP team
Internal Project Meeting	Review status of project and coordinate working deliverables	Online meeting with overseas consortium members	Weekly	TTA consortium member
Activities Summary Report	Communicate project activities and progress	Email	Monthly	TTA consortium members and UNOPS ETP team
Monthly Update	Update ETP on the project's progress	Hybrid with overseas consortium members	Monthly for the first and last 3 months of the project	TTA consortium members and UNOPS ETP team
Quarterly Update	Update ETP on the project's progress	Hybrid with overseas consortium members	Quarterly between month 4 and 15 of the project	TTA consortium members and UNOPS ETP team

Table 13. Communication plan

During the kickoff meeting TTA will inform ETP of the main contact info from TTA and the co-lead's contact info from Inovasi. The presence of two main contact info from the project that are regularly accessible by ETP will ensure good communication between TTA and its consortium members with the UNOPS ETP team.