

Inception Report

Wind Energy Development in Indonesia: Investment Plan

UNOPS - ETP

EAPMCO/TH/2023/002 - RFP/2022/44553

V3.0

8 June 2023



Pondera

Headquarters Nederland

Amsterdamseweg 13
6814 CM Arnhem
088 – pondera (088-7663372)
info@ponderaconsult.com

Mailbox 919
6800 AX Arnhem

Office South East Asia

Jl. Mampang Prapatan XV no 18
Mampang
Jakarta Selatan 12790
Indonesia

Office North East Asia

Suite 1718, Officia Building 92
Saemunan-ro, Jongno-gu
Seoul Province
Republic of Korea

Office Vietnam

7th Floor, Serepok Building
56 Nguyen Dinh Chieu Street, Da Kao Ward,
District 1 Ho Chi Minh City
Vietnam

Title page

Document type

Inception Report

Project name

Wind Energy Development in Indonesia:
Investment Plan

Version number

V3.0

Date

8 June 2023

Project number

EAPMCO/TH/2023/002 - RFP/2022/44553

Client

UNOPS - ETP

Author

Chandra Soemitro, Sergio Simanjuntak, Brent
Elemans - Pondera

Reviewed by

Robbert Groenen - Pondera
Eric Arends - Pondera

Disclaimer

The study makes use of generally accepted principles, models and information that were available at the time of writing this report. Adjustments in the principles, models or data used may lead to different outcomes. The nature and accuracy of the data used for the study largely determines the accuracy and uncertainties of the calculated results. Pondera is not liable for lost income or damage suffered by client(s) and/or third parties from claims based on data not originating from Pondera. This report has been prepared with the intention that it will solely be used by the client and only for the purpose for which the report was drawn up. The information contained in this report may not be used for any other purpose without written permission from Pondera. Pondera is not responsible for any consequences that may arise from the improper use of the report. The responsibility for the use of (the analysis, results and findings contained within) the report lies with the client. The Legal relationship with clients - architect, engineer and consultant - in accordance with DNR 2011, applies at all times. Pondera works with a quality management system that is certified by EIK in accordance with the ISO 9001:2015 standard.

Table of contents

1	Introduction and project background	2
1.1	Inception report introduction	2
1.2	Southeast Asia Energy Transition Partnership	2
1.3	Consultant introduction	3
1.4	Project background	6
2	Scope of the project	8
2.1	Objectives of the Project	8
2.2	Deliverables under the Project	8
3	Methodology and workplan	11
3.1	Workplan for Wind Power Technical Working Group (TWG)	11
3.2	Workplan for Component 1: Stocktake and Sector Development Roadmap	13
3.3	Workplan for Component 2: Permitting Assessment and Regulation Development Support	16
3.4	Workplan for Component 3: Wind energy potential mapping, gap analysis and site selection	18
3.5	Workplan for Component 4: Investment Opportunities Guide for Indonesian Wind Projects and Access to Finance Report	27
3.6	Gender Equality and Diversity	29
4	List of deliverables	30
5	Mapping of key stakeholders, outreach/communications strategy, and donor coordination strategy	31
5.1	Key stakeholders	31
5.2	Outreach and communications	31
5.3	Donor coordination strategy	32
6	Project management, organizational chart, and key consultants	33
6.1	Organization chart	33
6.2	Expertise and responsibly allocation	33
6.3	Management structure and project management controls	34
6.4	Key consultants	36
7	Risks, mitigations, and assumptions	37
7.1	Data acquisition	37
7.2	Data processing and storage	38
7.3	Project meetings	39
7.4	Preliminary HAZID and risk assessment	39
8	Monitoring and evaluation framework	41
9	Client – Contractor collaboration	42
9.1	Progress meetings Pondera – ETP	42
9.2	Feedback on draft deliverables	42
9.3	Required assistance from ETP	42

1 Introduction and project background

1.1 Inception report introduction

On 3 May 2023, UNOPS and Pondera signed the contract for consultancy services on Wind Energy Development in Indonesia: Investment Plan. This project has been awarded to Pondera (as the main contractor of the consortium, to be further introduced in this report) based on the proposal submitted to UNOPS. This inception report was written to align the expectations of the Southeast Asia Energy Transition Partnership (ETP) with Pondera's understanding of the project. ETP is a multi-donor partnership formed by governmental and philanthropic partners to accelerate sustainable energy transition in Southeast Asia in line with the Paris Agreement and Sustainable Development Goals. UNOPS is the fund manager and host of ETP Secretariat. The submitted proposal serves as the basis for the inception report. In this report, the contents of the proposal were updated with the newest insights and supplemented with explanations on how the project will be managed.

1.2 Southeast Asia Energy Transition Partnership

The following text is extracted from ETP UNOPS RFP for this project.

The Southeast Asia Energy Transition Partnership (ETP), is a five-year, multi-stakeholder platform that aims to accelerate the energy transition in Southeast Asia towards 2025. ETP program delivery is expected to contribute to the achievement of the UN's Sustainable Development Goals (SDGs) and the 2030 Paris climate goals by bringing together the Governments, Development Partners, and Philanthropies. ETP aims to empower its partner countries towards an energy system that ensures environmental sustainability, economic growth, and energy security. To achieve this goal, ETP will mobilize and coordinate the necessary technical and financial resources to create an enabling environment and address impediments to renewable energy (RE), energy efficiency (EE), and sustainable infrastructures in the region.

ETP also aims to deliver joint action, improved coordination, and dialogue to accelerate the energy transition in the region through its four pillars, e.g., aligning policy with climate commitments, de-risking RE and EE investments, expanding sustainable and resilient infrastructures, and knowledge and capacity development. ETP Members have come together to fund ETP to (1) support an improved delivery environment to accelerate the energy transition in Southeast Asia, (2) improve coordination between other relevant initiatives, including capital investments and technical assistance, and (3) to promote communication and knowledge sharing on energy transition among stakeholders in the region.

ETP is initially focusing on Indonesia, the Philippines and Vietnam, which are the countries in the region with the highest energy demand, a substantial pipeline for fossil fuel-based projects, and significant and cost-effective potential for renewable energy and energy efficiency. ETP provides High-Level Technical Advisory Support, Holistic Support to Governments on financing and technical needs, capacity and skill development, and facilitation of dialogues in all related areas. A Secretariat, incorporated into UNOPS will support the Steering Committee (SC) and facilitate the implementation of SC's decisions. The Secretariat will operate as per defined Terms of Reference approved by the SC. The Secretariat will undertake day-to-day management and operation of the ETP Fund: (1) it launches Calls for Proposal and carries out proposals assessments; (2) it provides assistance and support to

implementing partners; (3) facilitates the design, development, and implementation of an overall M&E strategy; (4) monitors the progress made by each project during the implementation phase.

1.3 Consultant introduction

The project is executed by Pondera, a company that has a strong expertise in wind energy development in Indonesia. In addition, we involve four sub-contractors for specific parts of the project: Witteveen+Bos, the Indonesian Institute for Energy Economics (IIEE), PT Quadran Energi Rekayasa, and PT BITA BINA SEMESTA (the scope distribution for each party is defined in Chapter 6.2). With all parties Pondera has successfully worked before on other renewable energy projects in the Netherlands and Indonesia. Each consultant is described in the following sections. Pondera will be in the lead for the project and be the point of contact for ETP / UNOPS.

1.3.1 Pondera

Pondera was founded in 2007 as a consultancy company in the Netherlands, working on renewable energy projects. In the 15 years that followed, we have grown into a company of 70 experts in wind energy, solar energy, geothermal energy, and green hydrogen production. Our core business is providing consultancy services for our clients who are looking for renewable energy solutions. As visualized in Figure 1, our services spans throughout the project lifecycle, starting from the initiation stage up to the project's end-of-life. Pondera has worked as a consultant for over 10 GW of renewable energy projects.

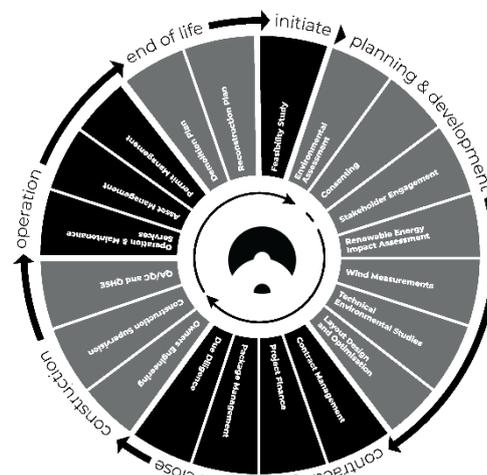


Figure 1: An overview of Pondera's services

To strengthen Pondera's international presence and enter the Asia Pacific market, Pondera established branch offices in Vietnam, South Korea, and Indonesia. The Jakarta branch office was founded in 2016 under the name of PT Pondera South East Asia (PSEA). Consisting of a mixed team of Dutch and Indonesians, PSEA has been pushing for the energy transition in Indonesia since its establishment. Similar to the head office in the Netherlands, it provides consultancy services specifically for wind energy development. In addition, it works on grassroots developments of innovative renewable energy technology for Indonesia, e.g. offshore wind, offshore floating solar PV, and green hydrogen. To achieve such developments, PSEA has established partnerships with Indonesian state-owned enterprises such as Pertamina Power Indonesia (Pertamina NRE), PLN Indonesia Power (a subsidiary of PLN, the state electricity company), and Pelindo.

PSEA also acts as the initiator of a small-scale wind farm project in Sumba Island, in which PSEA maintains good relations with a network of stakeholders (i.e. PLN, ministries, funders, and embassies). This is made possible, among others, by the strategic role of PSEA's founder and President Director (Mr. Chandra Soemitro) as the Chairman of the Advisory Board of the Indonesia Wind Energy Association (Asosiasi Energi Angin Indonesia or AEAI) since 2017.

1.3.2 Witteveen+Bos

Witteveen+Bos (W+B) is an established name (75 years) in the European onshore and offshore wind and energy transition industry. As an international and independent consultancy firm, we support project developers, regulators, grid operators and contractors in defining their strategy, executing their projects and optimizing their design solutions. Our main goal is to balance risk and opportunities in concerns of societal benefits, environmental and economic aspects. We are active in projects from the early design to the final implementation, with experts in the technical, environmental and social fields. Developers and governments approach us for engineering and consultancy assignments in small and large-scale wind energy projects with regard to desktop and feasibility study, wind farm layout, spatial and environmental constrains, infrastructures design, geology and geotechnics, foundation design, Nature Inclusive Design (NID), Environmental and Social Impact Assessments, permitting procedures, stakeholder management and civil engineering.

PT Witteveen Bos Indonesia (PT WBI) is part of the Witteveen+Bos group. PT WBI has an office in Jakarta for over 42 years and is an Indonesian Limited Liability Company (PT PMA) since 2015. PT WBI provides a wide range of civil engineering, water management and environmental engineering services, mainly to international investors, large Indonesian companies seeking international engineering quality and international donor organizations like Asian Development Bank and World Bank. Currently, 45 engineers and consultants work in our Jakarta office, the majority being Indonesian nationals with international degrees and/or extensive international training to safeguard international quality levels.

While we are an established name in wind energy services in Europe (being involved in many onshore and offshore windfarms), our track record in Indonesia is similar to the general status of wind energy in Indonesia: under development. Nevertheless, we are proud to be selected (2021) as lead consultant for a Bankable Feasibility Study on a Wind Farm in North Sumatra. In this project, the scope of work of our company focuses on the overall management and technological, planning and (civil-) engineering aspects. Having executed many civil engineering and infrastructure projects throughout Indonesia, we offer a strong, experienced engineering team which has an excellent understanding of the Indonesian natural conditions. We understand the topographic, geologic, seismic and other natural challenges and can translate these challenges into impacts on wind farms.

1.3.3 Indonesian Institute for Energy Economics (IIEE)

The Foundation of Indonesian Institute for Energy Economics (IIEE) was established on February 24th, 1995, as a non-profit, non-governmental organization (NGO). IIEE was developed as an Indonesian think-tank to enhance the study of energy economics as well as to motivate and support national policies about prudent development and the utilization of energy resources in Indonesia. IIEE provides inputs, suggestions, and recommendation to the Indonesian government; as well as engages stakeholders to contribute to the process of development and implementation of energy economics policies.

IIEE is concerned with the management and utilization of energy resources. IIEE conducts research, disseminates its study results, and facilitates stakeholder dialogues to help improve energy policy and planning in Indonesia. IIEE also provides trainings on energy modelling and planning, as well as sharing sessions concerning various aspects of the energy economic policies, also knowledge dissemination to communities. The recent contribution of IIEE in the energy policy, modelling, and planning area was the involvement of IIEE in the joint technical team for the revision of draft of national energy planning (RUEN) and the development process of Provincial Energy Planning (RUED-P) both in national and provincial level. IIEE was also involved in a wider public outreach programs to contribute to the expansion of energy access in remote area by using indigenous renewable energy and energy efficiency implementation in the education sector. Several projects of IIEE are shown on the table below.

Table 1: Track record of IIEE

	Projects	Period	Client
1	Indonesian 2050 Pathway calculator	2015	UK
2	Supporting RUEN technical team	2016	ICED II-USAID
3	Coaching & technical assistance RUED	2017-2018	DEN & KESDM
4	Development of the profile of GHG emissions form the Indonesia Power and industry sector	2017-2018	TUV NORD-AMC
5	The need of investment in Indonesia energy sector: Case study of RUEN	2018-2019	SHELL UPSTREAM
6	Technical assistance for Calculation of Energy Resilience and Independence-ESDM Strategic Plan Draft 2020-2024 (Draft Renstra ESDM 2020-2024)	2019	ICED II-USAID
7	Development of Regional Energy Plan Monitoring and Evaluation Platform	2020	ICED II-USAID
8	Mainstreaming of MTRE3 studies (RUED, GHG Inventory, SEC, RAD-GRK Review, MACC) into the draft Regional Medium Term Development Plans (RPJMD) in 4 Provinces (Riau, Jambi, West Sulawesi, East Nusa Tenggara)	2021	GEF, UNDP MTRE3
9	Energy Efficiency and Energy Conservation Awareness Raising in the Education Sector, Including an Energy Saving Competition	2022	ETP UNOPS
10	Study on Electricity and Infrastructure Planning of Small Island – Phase 1: Electricity Demand in Selayar Islands	2022-2023	USAID Sinar
11	Development of web-based platform and mobile application for monitoring-evaluation-reporting (MER) of electricity programs	2022-2023	USAID Sinar
12	Development and utilization of web-based platform for monitoring-evaluation-reporting (MER) of sub-national energy planning and implementation process	2022-2023	USAID Sinar

1.3.4 PT Quadran Energi Rekayasa

The initiator, pioneer, and founder of PT Quadran Energi Rekayasa is Dr. Ir Nanang Hariyanto who is the Head of the Electrical Power System and Distribution Laboratory STEI – ITB. Together with several alumni of the laboratory, he founded Quadran in 2015. Quadran is a based in Bandung and consists of

more than 20 Indonesian experts in electrical power system, electrical and mechanical engineering, SCADA and IT, and social research. The core services they provide are listed in the figure below.

	POWER PLANT INTERCONNECTION STUDY		
	GRID IMPACT STUDY		POWER SYSTEM PLANNING
	RENEWABLE ENERGY STUDY		POWER OPERATION CONSULTATION
	POWER SYSTEM REGULATION		GENERATOR TESTING & COMMISSIONING

Figure 2: Core services of PT Quadran Energi Rekayasa

1.3.5 PT BITA BINA SEMESTA

BITA is an Indonesian national consultant company established in 1989. BITA provides study and planning consultancy services for various development and construction works. This entails spatial planning and permitting, due-diligence assignments and environmental – and social studies. The projects undertaken vary in size and scope, from the study phase of initiation to project implementation. BITA also established relationships with several international organizations such as JICA, WORLD BANK, AUSAID, ADB, and others in developing Indonesia. It also conducts environmental planning and studies for various national and international clients. BITA employs 35 consultants and approximately 135 sub-cons and freelancers (under our SCM/CoP).

Since its inception, BITA has worked for and in conjunction with many notable foreign companies. Our clients vary from private sectors, government institutions, state owned companies, and multi-national companies as well as many other national companies from different sectors of activities such as industry, mining and oil and gas, etc. BITA also has experience in collaboration with international consultants. BITA has a broad track of experience in the development of Indonesia, including in the area of environmental studies, regional planning for urban activities, tourism, industry, mining, and infrastructure planning (survey and planning). BITA also has working partnerships with certified laboratories and research institutions, i.e. ALS Laboratory, Sucofindo Laboratory, Binalab Laboratory, LIPI – Bogor and other University Research Institutions. BITA is a registered and certified AMDAL (Environmental Impact Assessment) consultant at the Indonesian Ministry of Environment and Forestry.

1.4 Project background

Parts of the following text are extracted from ETP UNOPS RFP for this project.

Indonesia has set the targets for emission reduction and Net Zero Emissions by 2060 or sooner. By 2025, the share of renewable energy is targeted at 23% with an electrification ratio up to 100% in 2022. To achieve these targets, various renewable energy sources must be exploited. Wind, as a significant resource derived from Indonesia’s topography and geography, is noted as the second-biggest renewable energy source in terms of estimated potential to help the country reaching the national energy mix target. According to the National Energy Council (or Dewan Energi Nasional; 2022), the wind energy resource potential in Indonesia is currently about 154.9 GW. Meanwhile, IRENA (2022) estimates the wind energy potential to be 19.6 GW (onshore) and 589 GW (offshore). Yet, the

utilization of wind energy in the country is lagging far behind its potential: total installed wind farm capacity at the time of writing this report is 147 MW, which is contributed by two wind farms in Sulawesi (PLTB Sidrap 75 MW and PLTB Tolo 72 MW). This massive underutilization shows an ample opportunity for wind energy to be developed in Indonesia.

Accelerating the development of Indonesia's wind energy is not a straightforward process. The current landscape of Indonesia's wind sector, which is epitomized by multiple stakeholders with varying interests and the current regulatory regime, creates a high uncertainty for developers and financiers to invest in this sector. One of the factors that contribute to such uncertainty is the limited availability of information on the wind data and its energy potential. This factor was identified by ETP during a Wind Technical Working Group (TWG) event in February 2022, in which the public and private sector were involved to explore the current state of play with regards to the Indonesian wind power sector.

The limited information availability means that competing developers need to put a costly and risky upfront investment to perform wind resource assessment in order to develop a thorough business case and fulfill PLN's project tender requirements. Potential loss after making such an investment does not only lie in cases where the developer loses the tender, but also in cases where there is no certainty on when or if the tender is going to be conducted. Therefore, it can be inferred that another factor that hampers wind energy development stems from the absence of a wind sector roadmap.

Based on the two main factors above, it is evident that a technical assistance for the Government of Indonesia and the relevant stakeholders is needed to reduce the uncertainty, i.e. by de-risking wind energy projects, and accelerate wind energy development. ETP facilitates this assistance by means of coordination efforts and technical studies such as this study. Fundamentally, this study looks into aggregating previous wind energy studies, deriving a sector-specific roadmap, and making concrete wind project prospectuses that encompass technical, financial, and regulatory aspects.

2 Scope of the project

The following chapter is extracted from ETP UNOPS RFP for this project.

2.1 Objectives of the Project

The objectives of this study include to:

- a. gather, stocktake and compile previous studies and work with regards to the wind sector in Indonesia;
- b. determine a stepwise roadmap for the development of the wind sector in Indonesia;
- c. consolidate a selection of suitable sites with the highest potential for wind energy development (referring to the potential sites stated on PLN Electricity Business Plan/RUPTL and from the reference studies available, e.g. from MEMR, and other agencies);
- d. analyse the suitability and quality of selected sites for installation and long-term operation of a commercially viable wind power project;
- e. identify and develop a comprehensive report listing potential financing sources to support the pilots and requirements to access such financing;
- f. inform improved policies and regulations and create a favourable business climate to attract investments.

The overarching outcomes of this study are to:

- a. establish a wind sector development roadmap to guide the sectors development, highlighting gaps and impediments and offering a systematic approach that can be adopted by all stakeholders;
- b. encourage informed decision-making on the development of wind energy in Indonesia;
- c. streamline the permitting and regulatory processes for wind project development;
- d. attract donor and business investment through provision of preliminary feasibility analysis.

2.2 Deliverables under the Project

The study will cover site selection (based on the potential sites stated on PLN Electricity Business Plan/RUPTL) focusing in Jamali system (Sukabumi, Yogyakarta, and Tuban) and Sumatera system (Aceh Besar and Padang Sidempuan), de-risk projects sufficiently to allow subsequent feasibility studies to be conducted, and prepare an action plan to develop wind energy generation, focusing on the onshore developments, in the regions of high potential across Indonesia. The result will be delivered and promoted to the government and private investors as well as made available for easy access as public information to encourage investment in wind energy potential usage in Indonesia.

It is expected that the consultant will have a strong and permanent on ground presence in Indonesia. Whilst it is accepted that international consultants will be involved in the project, the project lead should be based in-country, and sufficient resources should be assigned in order that in-person stakeholder engagement can occur. All deliverables will first be submitted in English, with translation to Bahasa required after the reports have been analyzed. Each deliverable will be submitted in publishable report format, and will be accompanied with a catchy powerpoint presentation.

The study will conduct the key activities as elaborated in the following sub-paragraphs.

2.2.1 Wind Power Technical Working Group (TWG)

The consultant will set up, manage and convene a Wind Power Technical Working Group (TWG) bringing together all key stakeholders relevant to wind power development. The TWG will be under the guidance of the Government of Indonesia, and will seek to integrate with other coordination platforms such as JETP Secretariat. The consultant will have the responsibility of:

- a. Preparing a list of invitees inclusive of government, development partners and private sector stakeholders
- b. Issuing invites, agendas, and organising appropriate speakers
- c. Minuting meetings and circulating minutes and shared presentations and documents
- d. Hosting events in a hybrid manner, at a minimum frequency of one every 3 months. Include supporting events' logistics with these considerations:
 - Minimum 6 hybrid TWGs;
 - Meeting room, translation, refreshments for 20 pax without lunch;
 - Online access via Zoom/Teams etc.

2.2.2 Component 1: Stocktake and Sector Development Roadmap

Design an action plan that clearly defines priorities of actions, timeline, and key stages to deliver a successful wind energy development in Indonesia. Specific deliverables under this component include:

- a. Working closely with the government, development partner agencies, and related stakeholders (association, academician, etc.) through various types of engagement such as Focus Group Discussion (FGDs), in-depth interviews, public consultation, and expert review.
- b. Reviewing previous initiatives and the collation of work done by Gol and development partners.
- c. Performing secondary data collection and analysis.
- d. Conducting comparative studies.
- e. Preparation of a document library and summary reports, the document library serving as a depository throughout the project.
- f. Preparation of a stepwise roadmap to the development of the wind sector which will be widely shared and endorsed by Gol.

2.2.3 Component 2: Permitting Assessment and Regulation Development Support

Permitting Requirement Review: This entails a review of the permitting requirements (including land clearance issue), costs and timing to secure permits to develop and operate a wind facility on the site. The consultant is expected to assess the current status and barriers in the permitting process and to engage with relevant stakeholders to support the upgrade and development of such policies. The output will be an analysis of the current conditions and set of detailed recommendations, including proposed analysis and upgrade of current policy and regulation, in order that if implemented, the barriers posed through permitting, and regulations would have been removed.

2.2.4 Component 3: Wind energy potential mapping, gap analysis and site selection

Completion of component 3 will result in wind profile assessment to provide the justification for defining the specific site areas, project next steps and a highlighting of the gap in available data. This includes the wind turbine and balance of plant, substation, interconnection, roads and access. Specific deliverables under this component include:

- a. Wind profile assessment: Compile all available wind resource data currently available and determine the scope required for further studies. The collected wind data is to be correlated with long-term off-site wind data sources (with the annual minimum average wind speed of 6 m/s), and an estimate of the probable average annual energy produced by a wind project. The output will be the determination of suitable sites that would lead to techno-economically feasible wind projects, as well as a gap analysis highlighting the further studies needed before they are considered derisked. This is expected to include a selection of sites that would require met-mast installation, amongst other survey work.
- b. Utility Interconnection and Transmission Feasibility Assessment: Assessment of the likely interconnection scheme for the project, the available capacity, and the timing associated with this approach.
- c. Construction Assessment: Assessment of the costs and time based on visual inspection and available data for geotechnical considerations.
- d. Technology Selection & Evaluation: This activity will include the evaluation of potential wind turbine technologies that would be suitable to the wind resource and site conditions, and that are economically well suited to the location and market conditions. This activity also includes selection of the technology, expected capital costs, installation costs, and operating costs.
- e. Economic Feasibility Analysis: An economic model will be prepared to incorporate an estimated income, capital costs, and operating costs.
- f. Overview of social and environmental impact assessment: General assessment of likely impact of the project on the environment and social configuration.

Whilst this component is mainly a desk review of available literature and a consolidation and analysis of collected data, it would also be required that the consultant make field visits and factor such costs into the proposal, as well as the costs for any data acquisition.

2.2.5 Component 4: Investment Opportunities Guide for Indonesian Wind Projects and Access to Finance Report

Component 4 builds on and pulls together Component 1, 2 and 3 consolidating findings and further developing technically, into a publishable report that will serve as a guideline to investment in the Indonesian Wind Sector. It will result in the presentation of multiple wind sites, listing their potential and assessing against available data the techno-feasibility and development maturity of each. The report will list details of various potential sources of finance and the methods to access such finance. The report should be written with both SOEs and Private Sector in mind. The output will serve as a guide for potential investors, demonstrating multiple derisked projects and proposed pathways to take the projects forward. The report will include, but not be limited to:

- a. List of Wind Projects: Detailing status, investment attractiveness and next steps in order to develop further, drawing on Outputs of Component 2
- b. Permitting processes: A chapter detailing the permitting process as determined through Component 3
- c. Financing Options: A list of potential sources of finance and methodologies on how to access such sources.

3 Methodology and workplan

Based on the pre-defined scope of the project, Pondera has designed a methodology and workplan to execute the expected studies. In the following subparagraphs, the methodology and workplan is explained for each component. The chapter is concluded with a brief statement of our commitment to gender equality and diversity.

3.1 Workplan for Wind Power Technical Working Group (TWG)

The client conducted a Wind Power Technical Working Group (TWG) in February 2022. The TWG brought together the public and private sector to explore the current state of play with regards to the Indonesian wind power sector. It was determined through that meeting that the client would proceed with technical assistance aimed at driving the wind sector forward, through a combination of coordination efforts and technical studies. Under this project, the coordination process will be continued by holding 6 TWG events under the guidance of the Government of Indonesia and will seek to integrate with other coordination platforms such as JETP Secretariat.

A coordination process will be carried out with the client to obtain a list of potential participants from TWG in February 2022, as well as to identify potential topics for the TWG event to be used as material for the preliminary proposed agenda. Therefore, the stakeholders involved in TWG can stay connected. Potential participants will be engaged, and in parallel, a consultation process may be carried out with the Directorate of Various New and Renewable Energy of the Ministry of Energy and Mineral Resources as a form of confirmation for TWG participants.

The 6 TWG events will carry various themes that are tailored to the needs of the 4 project Components: 1) Stocktake and sector development roadmap, 2) Permitting assessment and regulation development support, 3) Wind energy potential mapping, gap analysis and site selection, and 4) Investment opportunities guide. These themes will be discussed and finalized with the Ministry of Energy and Mineral Resources (MEMR), who is the beneficiary of this project.

In TWG Event I, the main activity is Kickoff meeting and facilitating the TWG formation. This will take place after the 1st month of the project. This event will also be used to get an alignment of problem definition, medium- and long-term sectoral objectives, and process guidance for the roadmap to be made in Component 1. In the 4th month, TWG Event II will be held to conduct Roadmap publishing and dissemination, i.e. publication of the roadmap to related parties. By conducting this event, we seek to obtain the stakeholders' approval and commitment to the roadmap. In the 6th month, TWG Event III will be held for gathering important inputs from the stakeholders on Permitting assessment and regulation development support.

The preliminary outcome of Wind energy potential mapping, gap analysis, and site selection will be discussed in TWG Event IV, which will be held in the 8th month to solicit input from the stakeholders. TWG Event V in the 11th month will go over the same topic as in the previous TWG event in order to obtain some final feedback and verification from the stakeholders. In the 15th month and as the project period ends, TWG Event VI will be held with the topic of Investment opportunities guide for Indonesian wind projects and access to finance. The topic also serves as the reference for conveying policy recommendations that combine the results of the activities of Component 1, 2, 3 and 4. It is noteworthy that depending on further agreements with MEMR, ETP, and UNOPS, some TWG events might be

conducted in Makassar and combined with a site visit to PLTB Sidrap or PLTB Tolo. The whole process under the TWG is depicted in the following Figure 3.

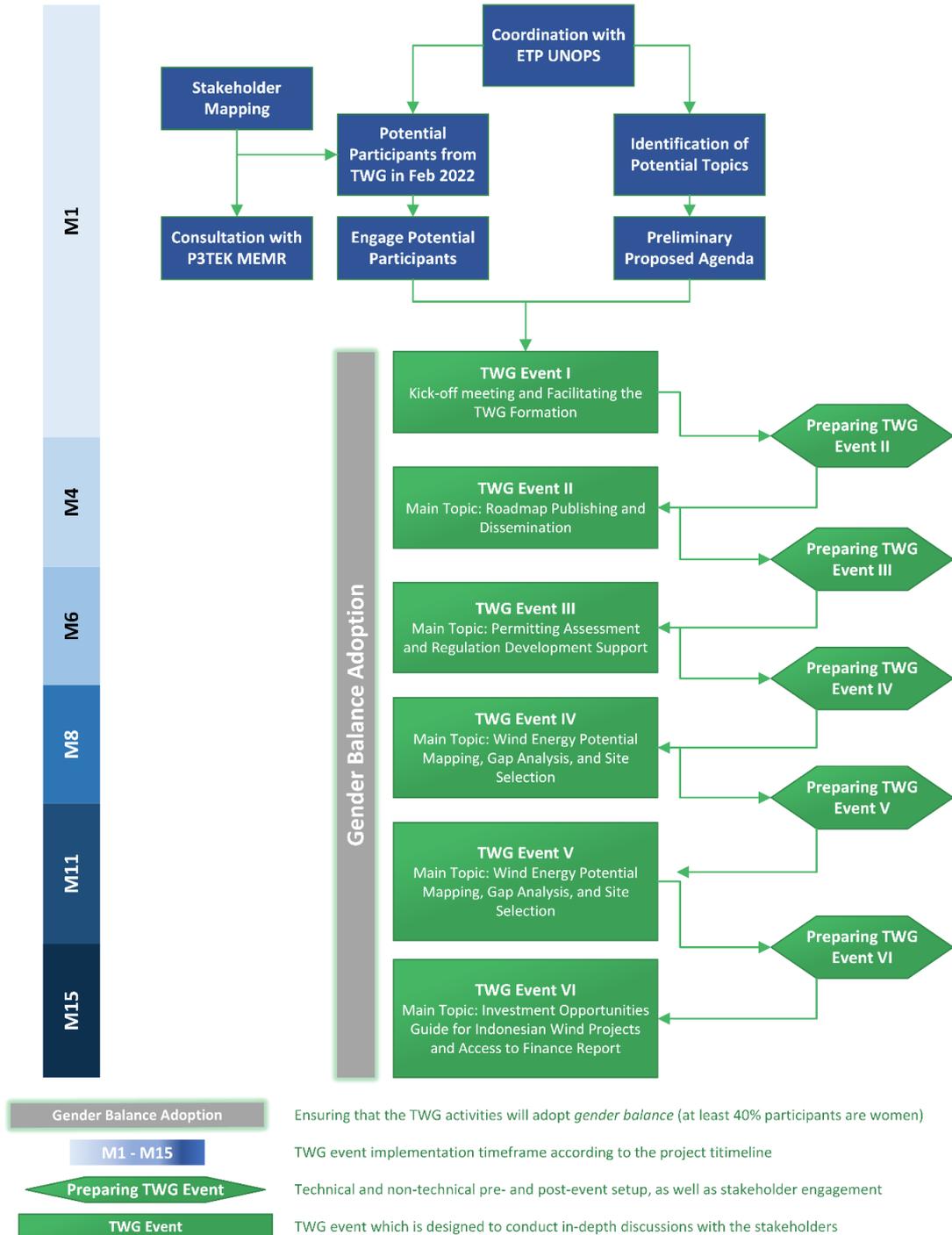


Figure 3: Our approach to Wind Power TWG events

3.2 Workplan for Component 1: Stocktake and Sector Development Roadmap

For Component 1, we propose a participatory approach to establish a multi-faceted roadmap for Indonesia's wind energy sector. This participatory approach relies upon an active involvement from the stakeholders, i.e. the actors who have a stake in the roadmapping process and are affected by the result of this roadmap. The approach was selected because prior to devising the roadmap, the relevant stakeholders should first align their objectives in this sector. Subsequently, the stakeholders can discuss and agree upon the pathway(s) to reach the objective by means of a roadmap. Moreover, the multi-faceted roadmap means that the roadmap will cover several aspects pertaining to the sector, such as:

- technology (e.g. wind turbine R&D and electricity infrastructure)
- industry (e.g. manufacturing capability, supply chain, and knowledge diffusion), and
- institutions (e.g. regulations, policies, norms, and values).

In this manner, a comprehensive and concrete sectoral roadmap can be established and guide each stakeholder through stepwise actions towards the final objectives.

The roadmap will be drafted in six steps as listed below and illustrated in Figure 4. It is noteworthy that a document library will be prepared at each step to maintain information/data traceability. The library will also include reports in which we summarize the activities within each step. Access to the library may be provided to the relevant stakeholders.

1. Relevant stakeholders will be selected by building upon the stakeholder mapping (from the Inception Report) and involving the Wind Power Technical Working Group (TWG). Among others, we envision that the involved parties would include representatives from the Government of Indonesia (preferably from relevant ministries), the House of the Representatives, state-owned electricity company, development partner agencies, wind energy association (including private entities, experts, and NGOs), and academicians (universities and knowledge institutes). A diverse background of the relevant stakeholders will be ensured. This is further explained in Section 3.6.
2. A kick-off meeting for these stakeholders will be conducted to agree on a problem definition, medium- and long-term sectoral objectives, and process rules. Stakeholders are involved early in the process to foster enhanced legitimacy, co-ownership, and knowledge sharing when formulating the roadmap. Furthermore, process rules shall be set as a guideline for parties throughout the roadmapping exercise. These rules are founded on some agreed principles (e.g. transparency and consensual decision-making) and can outline the different topics for which (parallel or sequential) sub-group discussions can be held. Examples of such topics are technology development, wind resources and potential, power system integration, permitting & environmental impact, policies and regulations on electricity, human resources, and financing mechanisms and support.

3. Stocktaking of previous studies and initiatives pertaining to the different topics will begin with primary data collection through engagement activities with the stakeholders. There are several methods to conduct these activities, such as sub-group FGDs, expert interviews and consultation, and public dialogues. The goal is to obtain the lessons learned from past activities in the sector. After aggregating the data, gaps will be identified and addressed in the following step.
4. The primary-sourced data will be complemented by secondary data collection by means of desk research, which can also be extended to further consultation to experts/stakeholders whenever the required data or relevant information is still publicly unavailable. Previous studies/reports related to the topics will be critically analysed on its assumptions and methodology to ensure sufficient data quality is maintained. After combining the primary- and secondary-sourced data, comparative studies using studies at different locations will be executed to shed light on information gaps in terms of region, period, scope and/or depth. Additionally, the comparative studies can also highlight the effects of regional characteristics (e.g. the local residents' perception, available wind resource, and infrastructure conditions) on wind energy development, so that a tailored approach for regions with similar characteristics can be developed and included in the roadmap. This step collects both qualitative and quantitative data which will serve as an input not only for the roadmapping exercise, but also for Component 2 to 4 of this project.
5. The multi-faceted roadmap will be formulated with input from the relevant stakeholders and TWG. Considering the current status and problems (Step 2), lessons learned (Step 3), information gaps (Step 4), and medium- and long-term objectives (Step 2) on wind energy development, we can finally arrive at an action plan that includes stepwise targets and recommendations for each actor in terms of technology, industry, and institutions. Importantly, these targets are time-sensitive: they are coupled to a timeline within the roadmap. The targets are also paired with quantitative (e.g. a certain installed wind farm capacity and LCOE by 2030) and/or qualitative (local turbine manufacturing capability) indicators of success. Consequently, the stakeholders can together periodically evaluate the activities within this sector to ensure timely achievement of these targets and adjust the methodology whenever more responsive and corrective actions are needed. This may include opportunities for stakeholders to give feedback on the preliminary result prior to publishing the agreed-upon roadmap.
6. The formulated roadmap will be published and disseminated through a hybrid event in which journalists from prominent media outlets may be invited (subject to PLN and government approvals). In the event, we aim to obtain an endorsement from the Government through the relevant ministries as their representatives partake in the roadmapping exercise.

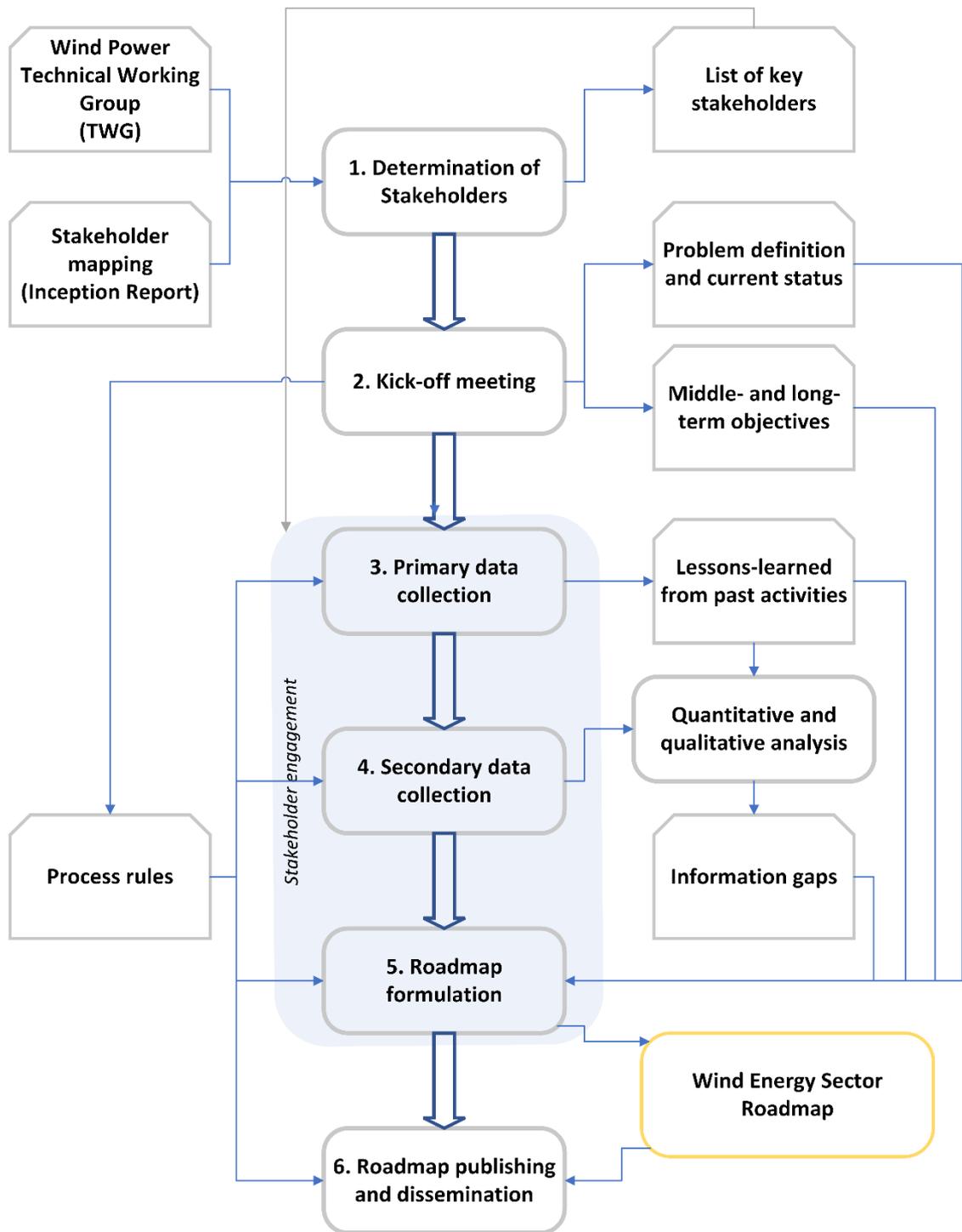


Figure 4: Our approach to formulate the sector development roadmap

3.3 Workplan for Component 2: Permitting Assessment and Regulation Development Support

We execute the Permitting Requirement Review for the two relevant levels:

- the overall regulatory framework in which wind energy must be developed, and
- the site-specific permitting aspects.

3.3.1 Overall regulatory framework

The Ministry of Energy and Mineral Resources (ESDM or MEMR) regulates the renewable energy sector, while the Indonesian state-owned enterprise PLN is appointed as provider of electricity for public interests. The Ministry of Environment and Forestry (KLH) has the authority to formulate and implement policies related to the environmental and forestry sectors. This includes authorising the utilisation of forest areas for the development of wind turbines and electricity transmission lines in remote and protected areas.

A key position in wind farm planning is designated for the Electricity Supply Business Plan (RUPTL). Projects that are not included in this plan will not be supported by ESDM and PLN.

Indonesia does not have a specific legal framework for wind energy, but several relevant regulations regarding (renewable) energy also determine the framework for wind energy. For instance, in ESDM regulations No. 17 and No. 50 of 2017, the principles of renewable power purchase are regulated. Other relevant regulations are the ESDM Regulation No. 4 of 2020, which directs PLN to prioritize the purchase of renewable energy and allows for direct appointment of projects. The Presidential Regulation of the Republic of Indonesia (Perpres) No. 112 of 2022 concerning the Acceleration of Renewable Energy Development for the Provision of Electricity regulates the so-called feed-in tariffs. At the project level, PLN has implemented a procurement process for the selection of IPP's for wind energy projects involving PLN subsidiaries, i.e. PT PLN Indonesia Power and PT PLN Nusantara Power, under a mandatory / strategic partner scheme.

Finally, two main master plans are regularly issued to detail national objectives in terms of development of generation, transmission and distribution infrastructure:

- a. The National Electricity General Plan, as lastly issued through ESDM Decree No. 143K/20/MEM/2019 on the National General Plan of Electricity from 2019 until 2038; and
- b. The RUPTL, which is PLN's 10-year development plan of electricity generation, transmission and distribution assets nationwide. This plan is updated annually. Currently, the RUPTL 2021-2030 is guiding the development.

Activities

We will evaluate the current overall framework and PLN procurement process based on our own experiences and execute interviews with current developers of wind energy in Indonesia (like UPC, Infunde, etc.). We will also evaluate the RUPTL on the quota for renewable energy in the provinces where the potential sites are located. We will produce a series of observations and recommendations on friction points in the development of wind energy in Indonesia. Our preliminary results will be presented during TWG Event III for validation purposes and additional information stocktake.

Deliverables

The description of the regulatory framework and the friction points in the development of wind energy in Indonesia will be presented in a memo 'Component 2: Permitting Assessment and Regulation Development *Support*'. The results will also be integrated in Component 4: Investment Opportunities Guide. The memo will contain a concise SWOT on the regulatory framework on wind energy in Indonesia.

3.3.2 Site-specific permitting aspects

Three site-related permitting aspects are relevant in this project:

- Spatial plans: some land use plans do not allow wind farms to be built at certain locations (like national parks);
- Land use and land ownership: intense land use may pose conflicts with wind farms (farms, villages) while nearby land use also may pose restrictions (like landing and take-off zones of airports, military facilities with radar zones). Formal and customary land ownership are also important factors, although the footprint of wind farms is limited; and
- Environmental and biodiversity legislation.

The project will require a wide range of permits, which among others include:

- Capital Investment Registration for foreign investors
- Business ID Number (Nomor Induk Berusaha / NIB)
- Electricity Supply Business License (IUPTL)
- Location Permit based on KKPR (Kesesuaian Kegiatan Pemanfaatan Ruang based on PP No. 21/2021 and Permen Agraria/Kepala BPN No. 13/2021)
- Borrow-Use Permit in forests for non-forestry activities (Ministry of Forestry)
- Building Approval (Persetujuan Bangunan Gedung / PBG based on PP No. 16/2021)
- Environmental Approval (Persetujuan Lingkungan based on PP No. 22/2021 and Permen LHK No. 4/2021)
- Import license and permits for migrant workers

Technical approvals and recommendations must also be obtained from the relevant government institutions. These licenses, approvals and recommendations are generally obtained from the regional government. There may be small differences in the licenses, approvals and/or recommendations required from region to region, due to differences in the provisions of the relevant regional government regulations and adopted policies.

Activities

Per site we will evaluate the current spatial plans (mainly national and provincial; district Rencana Detail Tata Ruang / RDTR when available) and assess whether wind farms are allowed. We will also review the land ownership and, when this information is readily available, also customary rights. We will identify relevant biodiversity and environmental legislation and their potential impact on wind farm development. Finally, we will prepare a permitting plan based on known lead times and estimates. We will prepare a plan based on an optimistic scenario and a worst-case scenario. Finally, we will provide an initial assessment of permitting complexity per site ('no major problems expected', 'permitting will be major challenge'), potential issues and recommended mitigation strategy. Our preliminary results will be presented during TWG Event III for validation purposes and additional information stocktake.

Deliverables

The results of the site-specific permit assessment will be integrated in the overall site assessments (Component 4: Investment Opportunities Guide) and in the earlier mentioned memo ‘Component 2: Permitting Assessment and Regulation Development Support’.

3.4 Workplan for Component 3: Wind energy potential mapping, gap analysis and site selection

Indonesia onshore wind energy opportunities are concentrated in a number of regions on so-called wind “hotspots”, where wind speeds are higher. These “hotspots” typically correlate with the terrain’s topography. For example, wind speeds are higher at mountain tops and between two mountain ridges where the air flow is consolidated.

The Indonesian state-owned grid operator PLN has shortlisted some regions that have such potential. The shortlist is published annually (except for the years during the COVID-19 pandemic) in a 10-year electricity business plan called the RUPTL. Among the listed regions, this study will focus on three regions in the Jamali system (Sukabumi, Yogyakarta, and Tuban) and two regions in the Sumatera system (Aceh Besar and Padang Sidempuan). These five regions correspond to the latest eleven RUPTL-entries as displayed in Table 2.

Table 2: Selection of regions allocated for wind energy (PLTB) in accordance with the RUPTL 2021-2030

No.	Province	Region (Remark)	Capacity (MW)	COD Target	Status	Developer
1	Jawa Barat	Sukabumi	670	n/a	Potential	n/a
2	DI Yogyakarta	Gunung Kidul	10	n/a	Potential	n/a
3	DI Yogyakarta	Samas Bantul	50	n/a	Potential	n/a
4	Jawa Timur	Tuban	66	n/a	Potential	n/a
5	Jawa Timur	Tuban	140	n/a	Potential	n/a
6	Aceh	-	55	2024	Planning	PLN
7	Aceh	-	55	2025	Planning	PLN
8	Aceh	(Distributed wind generation)	148	n/a	Potential	n/a
9	Sumatera Utara	-	55	2024	Planning	PLN
10	Sumatera Utara	-	55	2025	Planning	PLN
11	Sumatera Utara	(Distributed wind generation)	88	n/a	Potential	n/a

The regions selected by PLN (RUPTL-entries) are often vast areas with a large variability of wind speeds. In general, PLN has not done a (pre-) feasibility study for the regions and has not pinpointed specific onshore wind sites within the region. To deliver the study objective “consolidate a selection of suitable sites with the highest potential for wind energy development”, it is essential to first narrow down the suitable sites in these regions. From our experience, choosing suitable locations for wind farm development in Indonesia is complex. For instance, mountainous terrain has higher wind speeds; however, these terrains also give accessibility and constructability challenges. A stepwise approach to

select a wind farm site is therefore essential to determine both the technical and the economic viability of a location considering the entailed complexities. For this purpose, we have designed a blueprint of site selection scheme to analytically assess the regions and to select the suitable sites. This blueprint is visualized in Figure 5 and explained further in the next paragraphs. In the study, we will apply this standardized approach for each region listed in Table 2.

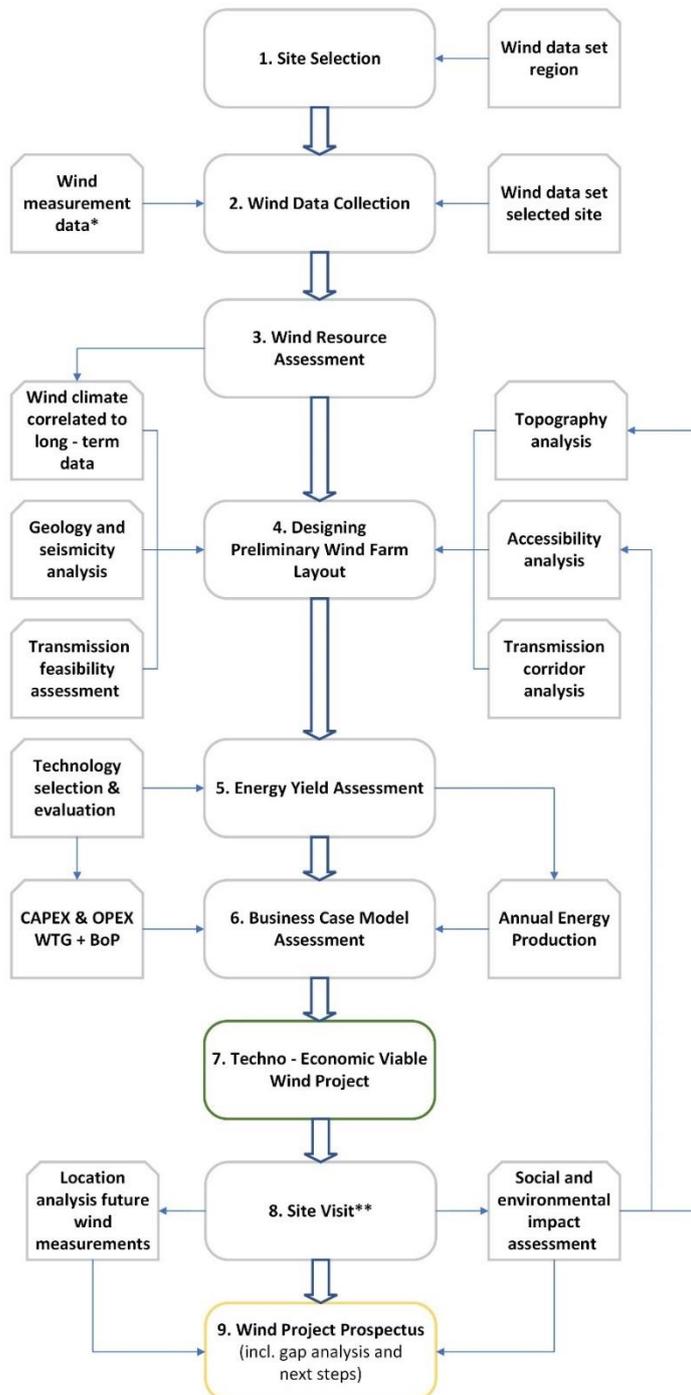


Figure 5: Blueprint of site selection scheme for onshore wind farm (*see Step 2, ** see Step 8)

Step 1: Site Selection

We assess the wind resource in the region and select an area (within the region) with the highest annual average wind speeds. A minimum threshold of 6 m/s at a hub height of 100 m is set to select the areas with the most potential. Additionally, the selected areas are assessed based on the wind direction: it is preferred to have the wind blowing consistently in a prevailing direction. We use publicly available wind datasets as the underlying data for this procedure. In addition to the windspeed- and wind direction-based selection, we also apply the following criteria:

- The wind farm capacity (number of MW) mentioned in the RUPTL for each region (RUPTL-entry) serves as the starting point. If selecting a site with a smaller capacity (compared to the amount listed in RUPTL) is likely to increase the financial and technical viability of the project (e.g. due to higher wind speeds or less complex terrain conditions), then we continue site selection using that site (with the smaller capacity).
- For each region listed in Table 2, we aim to select one wind farm site (a single continuous area) based on one transmission system. Having several sub-sites with long interconnection cables will significantly increase the project's complexity and cost, and hence, this would lower the project's viability.
- If we conclude that a region has no potential for wind farm development (i.e. not meeting the threshold values) in site selection, we will substantiate this conclusion and stop the wind farm assessment for that specific region.
- Volcanic and seismic criteria: we propose to avoid locations close to active volcanoes with a high risk of ash deposits and avoid locations in active seismic zones with earthquakes of MMI (Modified Mercalli Scale) VII 'very strong' and higher.

Step 2: Wind Data Collection

A long-term reference dataset will be used for each of the specified sites from Step 1. This can be either reanalysis data (ERA5) or mesoscale data (EMD WRF). To ensure that the selected sites are intercomparable, the most suitable reference model will be used as the basis for analysis. Determining the most suitable reference mode entails a comparison of various grid data points in proximity to the selected site. Subsequently, the most suitable model for further analysis is applied, either by selecting one nearby grid data point or by performing a weighted interpolation of several grid points.

* It is unclear whether wind data based on on-site measurements is available for these regions. On-site and accurate wind data can decrease energy yield uncertainty significantly and improve project bankability.

Step 3: Wind Resource Assessment

Based on the selected dataset from Step 2, a long-term mean wind speed distribution (or 'wind resource') is determined for each site from windPRO modelling software. The wind resource is then used for predicting future average wind conditions during the prospective wind farm's lifespan (25-30 years).

Step 4: Designing Preliminary Wind Farm Layout

A preliminary wind farm layout design for a promising site requires the consideration of three aspects:

- Construction assessment: detailed information of the physical site conditions to assess the construction complexity and thus costs of the wind farm;

- Wind flow model reliability: the terrain complexity of the site greatly affects the reliability of the wind flow modelling, which could require additional analysis (see Wind flow modelling in complex terrain)
- Transmission layout: a feasible transmission layout developed with a single line diagram that defines the interconnectivity of the windfarm and the transport of electricity to the grid.

These three aspects are elaborated in the subsequent paragraphs, by incorporating them we provide a thoroughly substantiated preliminary wind farm layout for each site.

Construction Assessment

Objective

Construction aspects in itself may not lead to technical Red Flags (e.g. termination of a project) as wind farms can be constructed in almost any location. However, investment and operational costs (and thus economic feasibility) are greatly dependent on construction aspects.

The aim of the construction assessment is therefore less on constructability, and more on the impact of construction on the CAPEX and OPEX of a site.

Based on financial data from the (few) existing and planned wind farms in Indonesia, the CAPEX varies between 1.5 million USD per MW for ready-to-construct accessible locations, to 2.5 million USD per MW for rough and inaccessible sites.

Four critical construction aspects:

- Topography: slope steepness (alignment of access roads, costs of road construction), crest morphology (space for a construction site);
- Accessibility: distance to ports (for landing turbine components), road conditions (transport of potentially 70-m long turbine blades requires space in all dimensions), potential blockages (bridges, urban areas);
- Geology and seismicity: stable geotechnical conditions (risks of landslides, rockfalls), seismic vulnerability of the site, proximity to active volcano's;
- Distance to existing grid: topography and accessibility of the transmission corridor to the existing grid that has sufficient capacity to accommodate the wind farm.

Activities

For each of the selected sites, we will undertake a rapid assessment of these four construction aspects. The assessment will mostly be done through a desk study, using public data like satellite images and Demnas (the national elevation database) and technical studies like seismic assessments and electric grid studies. Additional information will be gathered on a one-day site visit (further explanation in Step 8).

More in detail, we will research, map, and evaluate:

- Topography: we will prepare a general terrain map with slope and crest conditions based on Demnas and satellite images. This map is used to plot the wind farm's turbine layout (aiming for capacity from the RUPTL), using a standard rule-of-thumb distance in between turbines. We aim for the optimal layout based on expected yield (wind speed) and terrain complexity (topography).

- Accessibility: this aspect can be subdivided into two parts: 1) connection to the site and 2) internal road connections:
 - Site connection: we will plot the most likely road connection between the site and nearest commercial port where the major turbine components (like turbine blades, nacelle, casings) must be offloaded. During the site visit, we will use this road to get a general impression of the suitability and any major obstacles;
 - For the internal road structure, we will prepare a conceptual road layout based on Denmas and a maximum gradient of 10% (the maximum slope for trucks and trailers) when using unpaved, gravel access roads;
- Geology and seismicity: we will use public geological maps and seismic data from BMKG (The Indonesian Agency for Meteorology, Climatology, and Geophysics) for an initial assessment. Together with the topography and satellite data, we will assess whether specific geologic risks (landslides) are to be expected, like volcanic activities;
- Existing grid: we will use data on the existing transmission lines to plan an initial transmission corridor and, together with satellite and Demnas data, we will assess the complexity of this transmission corridor to the wind farm.

Geotechnical considerations

The Request for Proposal puts some emphasis on assessing geotechnical conditions. We assume that this refers to the geological conditions (including seismic risks) of a site rather than specific geotechnical conditions under the individual wind turbines. Based on our experience in previous projects, we can confirm that wind turbines can be constructed in a wide range of geotechnical conditions, ranging from soft soils to hard rock and rarely become an exceptional cost factor.

Wind flow modelling in complex terrain

When modelling the wind flow through a wind farm, it is crucial to understand the complexity of the terrain of the wind farm site and its surroundings. When slopes of hills or mountains are too steep, the standard wind flow modelling will generate very inaccurate results. A solution for creating still sensible results while working with complex terrain is by using Computational Fluid Dynamics modelling (CFD-modelling). In this step, we finetune the long-term wind resource for the sub-sites that are categorized as complex terrain sites, generating much more accurate results. Based on an early assessment of the eleven regions, we assume that CFD-modelling is necessary for five sites. For these five sites, we have included the cost of the additional modeling in the offer.

Utility Interconnection and Transmission Feasibility Assessment

We will do a check between the envisioned capacity of the wind farm and the available capacity on the existing grid. However, for this we are dependent on the information that PLN shares on the capacity, and we require ETP's assistance to request this information at PLN. Subsequently, based on the preliminary wind farm layout we design a Single Line Diagram (SLD). In this SLD we include the envisioned cable dimensions (material, length, and width), necessary substations, main transformer station, and proposed point of connection at the PLN grid. We calculate this based on the capacity of the wind turbines and total envisioned capacity of the wind farm, using our load flow calculation model. In case the wind farm is likely to be executed in tranches (a string with multiple wind turbines connected to it), we will include the time phasing to ensure that single tranches can be connected to the grid. Conducting a grid impact study is not part of the current scope and can be executed as part of the feasibility study of each of the individual projects.

Step 5: Energy Yield Assessment (EYA)

Once the preliminary wind farm layout is designed, we can calculate the energy yield on the envisioned wind farm. Based on our knowledge of the wind turbine types currently available in the market, we created a list of the most appropriate turbines for the site's wind resource. For the most suitable wind turbine (highest expected yield and worldwide track record), we calculate the gross Annual Energy Production (AEP). The AEP is calculated based on the long-term wind resource, the selected wind turbine's power curve(s), and the on-site terrain characteristics. The wind farm's efficiency is evaluated through an energy loss analysis. The following energy loss categories are assessed:

- Wake effects: expected losses caused by wind shading of individual wind turbines
- Availability: expected losses due to maintenance and sub-optimal operation, based on available warranty information
- Electrical: expected losses based on calculated cable and transformer losses
- Environmental: expected losses caused by weather or terrain effects (e.g. blade contamination).
- Efficiency: blade degradation losses during due to corrosion and a decrease of the aerodynamic properties of the blades over the course of the wind farm's operational life
- Curtailment: due to noise, shadow flicker, bat/bird mitigation and grid capacity.

The losses are quantified using standard assumptions for relevant energy loss factors. A more detailed approach to certain loss factors can be suggested depending on the available information.

Incorporating data and model uncertainties leads to an increase in the reliability of an EYA. For instance, the uncertainty from the mesoscale data that generated the annual wind speed for the specific sites will lead to a range of outcomes with their own probability. Therefore, to show the reliability of the EYA outcomes, the AEP will be reported, as well as P50, P75 and P90 values. This method will reflect the sensitivity of the input data (e.g. wind speeds) on the AEP outcomes.

Step 6: Business Case Model Assessment

For the many wind farm development projects we have been involved in, we are very experienced in using a very thorough and elaborate business case model used for financing wind farms. In general, acquiring financing for a wind farm requires such a thorough model because it aims to take away as much uncertainty as possible. However, for this preliminary study on the feasibility of wind farms, this business case model would be too elaborate, considers too many unknowns, and might be too complex for public use. Therefore, we will design a light version of the business case model which matches the detail- and uncertainty level of early-stage wind farm development. The outcome will still clearly indicate the economic feasibility of each assessed wind farm, in terms of Internal Rate of Return (IRR), Debt Service Coverage Ratio (DSCR), and net profit. Furthermore, the model has the ability to do a sensitivity analysis on the input factors with the highest uncertainties (e.g. AEP whereas based on model data). We will also investigate the impact of (potential) tax reliefs / holidays are for renewable energy projects based on current regulations.

The following parameters are included in the business case model:

Revenue:

- This parameter is the expected revenue from selling electricity to PLN. The revenue is derived by multiplying the AEP of the wind farm by the PPA (Power Purchase Agreement) Tariff based on the applicable tariff regulations.

Cost:

- DEVEEX
 - Permitting
 - Land acquisition
 - Studies (e.g. wind measurements, Environmental Impact Assessment)
 - PPA negotiations
 - Contracting
 - Acquire financing
- CAPEX (including construction)
 - Wind turbine (including transport, crane use, etc.)
 - Foundation
 - Crane hardstands
 - Access roads
 - Transmission system (cabling and transformer stations)
 - Construction management
- OPEX
 - Maintenance
 - Operational services
 - Insurances
 - Tax (including potential tax reliefs / holidays for renewable energy)

Financial parameters:

- Debt – equity ratio
- Debt tenor
- Debt interest rate
- Corporate tax rate
- Depreciation term

Because the envisioned wind farms are still in the early stages of development, it requires us to make assumptions and use standard cost factors for some of the cost factors in the business case model. However, we have extensive experience in calculating business cases for wind farms and therefore are able to limit the uncertainties in these assumptions. For the assumptions, we clearly substantiate the reasoning and the remaining uncertainty it entails.

Step 7: Techno-Economic Viable Wind Project

Based on the outcome of the business case model for each specific envisioned wind farm, we will elaborate whether we expect that the combination of the technical design and financial factors leads to a viable wind project. This also includes a sensitivity analysis that shows which factors make the business case sensitive to uncertainties.

Step 8: Site Visit

** We will conduct a visit to the envisioned wind farms sites that clearly demonstrate techno-economic viability, as assessed in Step 7. When this is not the case, a site visit is unnecessary: the visit will not change the techno-economic viability. During a full day site visit, the site of the envisioned wind farm will be subjected to a brief visual inspection. The goal of the site visit is three-fold:

- Validate and further investigate the topography and accessibility of the site as part of the construction assessment (Step 4). We will also use a drone to obtain a ‘birds-eye view’ of the area. Specific points of attention are the aspects which cannot be assessed using satellite images:
 - Conditions of roads leading to the site;
 - General impressions of the site: (intensity of) land use, forest conditions (degraded, primary);
 - Any issues which may affect the construction.
- Validate and further investigate the social and environmental circumstances of the site (elaborated below);
- Site survey in order to find a suitable location for conducting wind measurements. Our technicians are trained for such a survey for both LiDAR and met mast wind measurements. Nevertheless, the measurements fall outside the scope of this study considering its limited period.

Social and environmental conditions

The key biodiversity, socio-economic and environmental impacts of onshore wind farms are well-known. Most onshore wind farms in Indonesia are planned at mountainous areas. As these areas are less affected by human activities (farming, urbanisation), significant biodiversity values can often be found in these areas. Impact assessment on biodiversity is therefore an important aspect of the visit. Key impacts of wind farms are summarized in the table below.

Table 3: Key impacts of wind farms

Phase	Aspect	Impact
Construction	Biodiversity	Fragmentation of habitats by road construction
		Destruction of critical habitats (high, mature trees, nesting areas)
		Impact on water resources (springs, streams)
		Disruption due to construction (noise, vibrations, disturbance)
	Socio-economic	Loss of access by current users, loss of land use (formal and informal land use), identification of the local vulnerable and indigenous groups
	Environmental	Construction noise, dust, water pollution, oil spills
Increased risks of landslides as roads disrupt natural soil conditions		
Damage to vegetation and habitats by road tailings		
Operation	Biodiversity	Bird and bat strikes (turbine blades, transmission lines)
		Fragmentation of habitats (tree-dwelling species)
		Deterioration of natural conditions (noise, flickering, human presence)

		Increased poaching, logging and animal trafficking due to improved access via wind farm roads
	Socio-economic	Improved access to site leading to encroachment, squatting, poaching, illegal logging
		Denied access for existing users due to tightened wind farm site security
		Long-term (local) economic impact of the wind farm
	Environmental	Waste disposal, hazardous waste (lubricants, oils, transformer fluids)
		Hydrological impacts on springs, streams
		Accelerated erosion and sedimentation on turbines sites and access roads
		Noise, flickering

In the biodiversity, socio-economic and environmental assessment, we will assess to what extent these aspects are relevant in the selected sites and whether there are significant variations between the sites.

To substantiate our conclusions, we will undertake the following activities:

- Prepare high level profiles based on publicly available data, complemented with site visit information and interviews with local experts:
 - biodiversity profile per site: description of habitats, spatial plan status of area, vulnerability of habitats, species of conservation concern (SCC; endangered species);
 - socio-economic profile: estimation of residents and socio-economic profile, land use profile, significance of the site for local communities;
 - environmental profile: environmental baseline of the site, vulnerability of the site for disturbance and pollution.
- Assess impacts of wind farms and determine the absolute and relative vulnerability (which site is more vulnerable for impacts compared to other sites?) and options for mitigation.
- Prepare recommendations.

Step 9: Wind Project Prospectus

For each of the envisioned wind farms that clearly shows an expected techno-economic viability (based on Step 7 and confirmed in Step 8), a wind project prospectus will be written. This includes the following chapters:

- Wind profile: Characteristics of the wind resource available (based on Step 1, 2, and 3).
- Preliminary wind farm layout: Based on Step 4 including the specifications of the suitable wind turbines and SLD.
- Site conditions: A memo containing a high-level technical assessment which includes:
 - Maps of the site with general topographic characteristics (elevation, morphology, slopes, land use), a layout of turbines locations, access roads, transmission corridor, and road connections to nearest port;
 - Technical assessments and observations on geologic and seismic conditions, other relevant site conditions.

- Energy yield assessment: The calculation of the AEP and the energy loss analysis (based on Step 5).
- Business case: A fact sheet that summarizes all relevant input and results of the business case model for the envisioned wind farm and its sensitivity (based on Step 6).
- Environmental and social assessment: Based on Step 8, an environmental, biodiversity, and social assessment memo containing a high-level assessment will be prepared containing the following information per site:
 - A biodiversity, socio-economic and environmental profile;
 - Assessment of potential impacts.
- Site specific permitting aspects (based on Component 2) including potential issues and recommended mitigating actions.
- Gap analysis: Based on all the uncertainties, unknowns, and missing data, a gap analysis is presented including recommendations on solutions to “fill the gaps”. This will at least include recommendations for conducting (additional) wind measurements and additional site surveys.
- Project roadmap: A list of recommended next steps to develop the wind project.

Besides the project-specific prospectuses, we also generate an overall comparison table of all the envisioned wind farms. In this manner, a quick comparison between all the projects can be made based on the techno-economic viability level.

3.5 Workplan for Component 4: Investment Opportunities Guide for Indonesian Wind Projects and Access to Finance Report

The wind sector can play a significant role in the Indonesian energy transition. To materialize this opportunity, it is required that donors and developers/investors fund the most promising projects in the sector. It is therefore essential that a comprehensive overview of the most promising opportunities for the development of these wind farms is available to such financiers. Building on the output of Component 1, 2, and 3, in this Component 4 we will create a holistic, comprehensive, publishable report which provides this overview to potential financiers. The workflow of Component 4 can be seen in the flow chart below in Figure 6.

1. The first part of this report will consist of a concise summary of the permitting requirements, based on the findings from Component 2. It will explain the impact of the existing regulatory framework on the investment attractiveness of wind projects in Indonesia. This part will also include a list of policy recommendations, with the aim of encouraging investments into the Indonesian wind sector.
2. The second part of this report consists of a project prospectus for each identified Techno–Economically Viable Wind Project from Component 3. These prospectuses will include a rating (on a scale from 1 to 5) on several key investment indicators, complemented with a brief explanation of why a certain rating has been given to an indicator of a potential project. Apart from giving an instant, informative insight into the attractiveness of a site to potential investors, the rating also facilitates relative comparison between the sites.

Indicative examples of such investment indicators include the stage of the project preparation, financial return expectations, expected regulatory challenges, expected geographical and technological challenges, the local infrastructure, supply chain and support system, and the

expected environmental and social impact. Based on the current status of the project, the prospectus will also provide an overview of the next steps to be taken for each site.

3. The third part of this report will create an overview of the financial landscape for renewable energy projects in Indonesia. It consists of the following elements:

a. An introduction to the landscape for the financing of wind projects in Indonesia: What type of financiers are (potentially) active in the sector? Which of these financiers are targeting wind energy projects? What goals are these financiers aiming to achieve? This element will include topics such as risk-return trade-offs, prevalent investment criteria, types of financing, etc. Various financing mechanisms will be analyzed, in which the perspective of both the financier and the developer will be taken into account (since only win-win situations will materialize in practice).

b. An overview of the role of donors in the renewable energy sector. What are their objectives? How do they aim to achieve those? This element will provide insight into various topics, such as how donors can overcome “chicken-and-egg” problems related to the introduction of new technologies; how to improve the environmental and/or social impact of potential projects, etc. This overview will also include a gap analysis, revealing the gaps which ought to be addressed by future development projects.

c. A list of (potential) financiers for wind projects will be created. This will include a methodology on how to access these financiers, supported by an overview of the criteria which projects will need to meet to secure financing from such sources. This list will include private investors, as well as public and private blended finance providers and donors.

d. A guide on the financial and non-financial options to de-risk wind projects in Indonesia. This guide will include both a theoretical analysis of how (blended) financing solutions can de-risk projects, as well as a practical list of de-risking tools which (potential) investors and developers in the sector see as a catalyst to increase their investments.

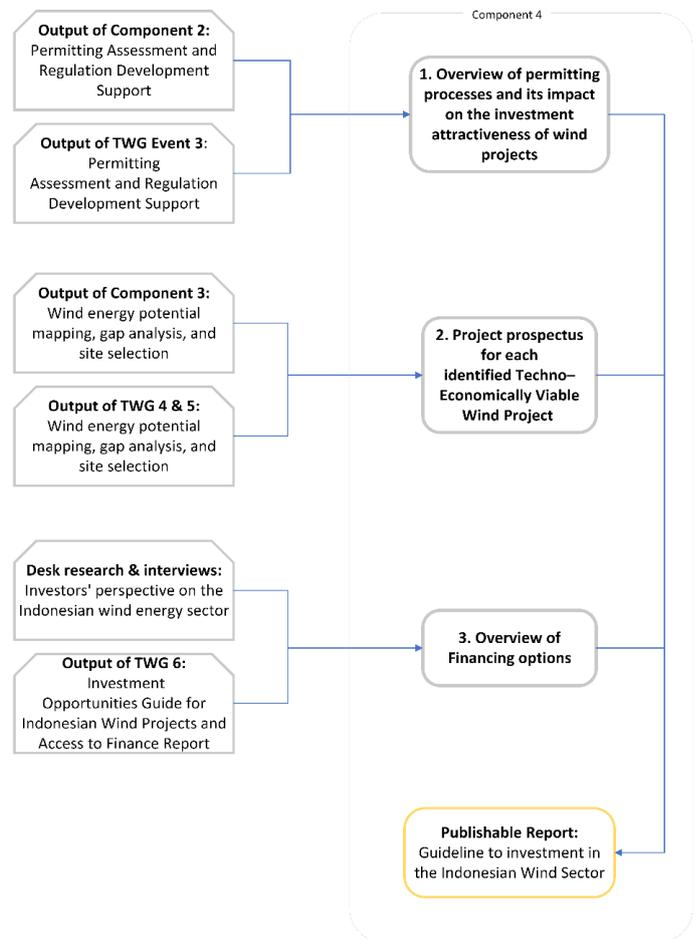


Figure 6: Flow chart of Component 4

3.6 Gender Equality and Diversity

This project aims to play a role in transforming this inequality by promoting gender diversity through all facets of this project. Firstly, the project will be implemented by a diverse team, namely, with at 4 / 8 of the senior consultants of the main project team are female. Secondly, the project covers mainly technical engineering and financial/investment topics. These two fields will be of key importance in the development of a new energy system, and women have historically been underrepresented in those two fields. For a diverse workforce to lead and implement the energy transition in Indonesia, it will be essential that female talents get the chance to grow in these technical fields. To illustrate this, the Project Lead (Chandra Soemitro) is running a program which supports young (male & female) talents with practical and theoretical training. In addition, learning on the job is key to obtaining the required skills. The consortium members are actively searching for female technical staff in our Indonesia offices. We offer flexible working hours, so that high-skilled work can be combined with taking care of a family.

Thirdly, the project will ensure that women's groups are represented in stakeholder sessions and that all genders are well represented in the working groups, to avoid that any discrimination or marginalisation of any personality and/or group will be caused by the recommended policy measures. Therefore, the activities within TWG events and stakeholder engagements in Component 1 will aim for a gender balance (at least 40% of the participants to be women). It is noteworthy that the record of attendees at events or meetings will always be gender-disaggregated. In our Social and Environmental Impact Assessments, special attention will be given to the impact that the project may have on the communities who live nearby a project site, to avoid any negative impact on gender equality and on the vulnerable and indigenous groups. Finally, we aim to formulate recommendations for ensuring or even improving inclusivity of these groups in the next project development steps.

4 List of deliverables

The deliverables which we will submit as part of this project are listed in the table below.

Table 4: This project's deliverables, their contents, and deadlines

Deliverable	Content	Deadline
Inception Report	Current document	30 May 2023
Milestone Report 1	<ol style="list-style-type: none"> 1. A narrative summary of the project progress to date; 2. Final Stocktake and Sector Development Roadmap (Component 1) in accordance with Chapter 3; 3. Updates as to the status of the other tasks; 4. Update of the Results Based Monitoring Framework; 5. Submissions of all MoM, reporting and presentations from the TWG held so far and other stakeholder engagements. 	30 August 2023
Milestone Report 2	<ol style="list-style-type: none"> 1. A narrative summary of the project progress to date; 2. Final Permitting Requirement Review (Component 2) in accordance with Chapter 3; 3. Updates as to the status of the other tasks; 4. Update of the Results Based Monitoring Framework; 5. Submissions of all MoM, reporting and presentations from the TWG held so far and other stakeholder engagements. 	30 November 2023
Milestone Report 3	<ol style="list-style-type: none"> 1. A narrative summary of the project progress to date; 2. Final Wind energy potential mapping, gap analysis and site selection (Component 3) in accordance with Chapter 3; 3. Updates as to the status of the other tasks; 4. Update of the Results Based Monitoring Framework; 5. Submissions of all MoM, reporting and presentations from the TWG held so far and other stakeholder engagements. 	30 May 2024
Milestone Report 4 and Final Report	<ol style="list-style-type: none"> 1. A narrative summary of the project progress to date; 2. Final Investment Opportunities Guide (Component 4) in accordance with Chapter 3; 3. Updates as to the status of the other tasks; 4. Update of the Results Based Monitoring Framework; 5. Submissions of all MoM, reporting and presentations from the TWG held so far and other stakeholder engagements. 	30 July 2024

5 Mapping of key stakeholders, outreach/communications strategy, and donor coordination strategy

5.1 Key stakeholders

The following key stakeholders have been identified in relation with this project:

- a. The Research and Development Centre for Electricity, Renewable Energy, and Energy Conservation Technology, Ministry of Energy and Mineral Resources (P3TEK-MEMR) is the leading government agency conducting the wind potential mapping and techno-economic analysis of wind power development.
- b. Directorate General of Electricity (DGE)-MEMR, provides the electricity regulation framework, which also can provide technical assistance and data support, especially related to the grid study and national and regional electricity plan, as well as guiding the electricity PPA.
- c. Directorate General of New and Renewable Energy and Energy Conservation (DGNREEC)-MEMR, will facilitate socio-economic support such as the investment permit, land clearance issue, workforce, etc. DGNREEC may also advise the business scheme for wind power.
- d. The State Electricity Company (PLN) is a vertically integrated electricity company. PLN set out the annual electricity business plan indicating the potential RE electricity development. PLN owns the main control centre managing the various renewable energy supplying the system.
- e. Directorate of Energy Resources, Mineral, and Mining, Bappenas has the role to ensure the renewable energy sources mapping to be included into the national development plan as well as a source to reduce the emissions.
- f. Directorate Electricity Infrastructure, Bappenas, has the role for integrating the electricity infrastructure development into the national development plan and assessing its interaction and impact for the economy and other sectors, e.g. industry, commercial, etc.
- g. Ministry of Investment/BKPM for their role on Online Single Submission (OSS) system for licensing
- h. Agrarian Affairs and Spatial Planning (ATR/BPN) and Ministry of Environment and Forestry, to get firsthand information related to licensing
- i. Local governments for site specific circumstances
- j. Development partners
- k. Investors (to be further identified in Component 4)
- l. Independent Power Producers (IPP)
- m. PLN subsidiaries (Indonesia Power, Nusantara Power)
- n. Pertamina Power Indonesia
- o. Wind Energy Association
- p. NGO's
- q. Academicians (universities and knowledge institutes)

5.2 Outreach and communications

We aim to involve the key stakeholders as much as possible to our activities under this project. We foresee a major role for them already for the Stocktake and Sector Development Roadmap study (Component 1) for which we select the most relevant stakeholders to be invited in the Kick-off meeting (TWG Event I). For each of the 6 TWG events we will organize, we make the most suitable selection of key stakeholders relevant for the subject to be discussed in the particular TWG event. To communicate with the key stakeholders, we envision a close collaboration with the ETP project team based in

Jakarta. To approach certain stakeholders, we require the right endorsement letters, which can be arranged with support from ETP and MEMR.

5.3 Donor coordination strategy

Aside from the deliverables to be submitted as defined in Chapter 4, we intend to engage ETP funders, its local representatives, and relevant development partners as much as possible throughout the project. The goal is to communicate the progress of the project to them, as well as to identify opportunities to connect or align their activities with the project. In order to achieve this, we will create for a slide deck for each of the 4 components in which we clearly explain the results through text and visualizations. Moreover, for each component we will design a one-page flyer that can be printed and shared in meetings with the parties and during TWG meetings. We ask assistance from ETP to share with us mailing lists of the relevant parties that are interested in receiving these slide decks and digital flyers via email and or to upload materials on the website.

If it fits within the communication strategy of ETP, we intend to publish monthly a LinkedIn post about our progress. We envision a short update accompanied by a photo of a TWG meeting, interview with key stakeholders or a site visit. This can be posted from the Pondera LinkedIn page, for which we ask our employees, partners, and ETP to share the post to create a maximum attention. We ask for approval from ETP management before any publication. ETP can share this content also via Twitter.

Furthermore, in each of our outreach activities we communicate a point of contact (likely our project manager) so that the ETP funders, its local representatives, and relevant development partners can easily approach us for additional questions, suggestions, or alignment purposes. In this way, we welcome future collaborations with ETP donors as a follow-up to this project. ETP is kept informed about any of the outreaches as a result of this.

6 Project management, organizational chart, and key consultants

6.1 Organization chart

As elaborated in Chapter 1 (Consultant introduction), the project will be executed by Pondera having a branch office in Indonesia, i.e. PT Pondera South East Asia. For specific elements in the project, we collaborate with our four trusted partners (Witteveen + Bos, IIEE, Bita and Quadran) which are subcontracted for this assignment.

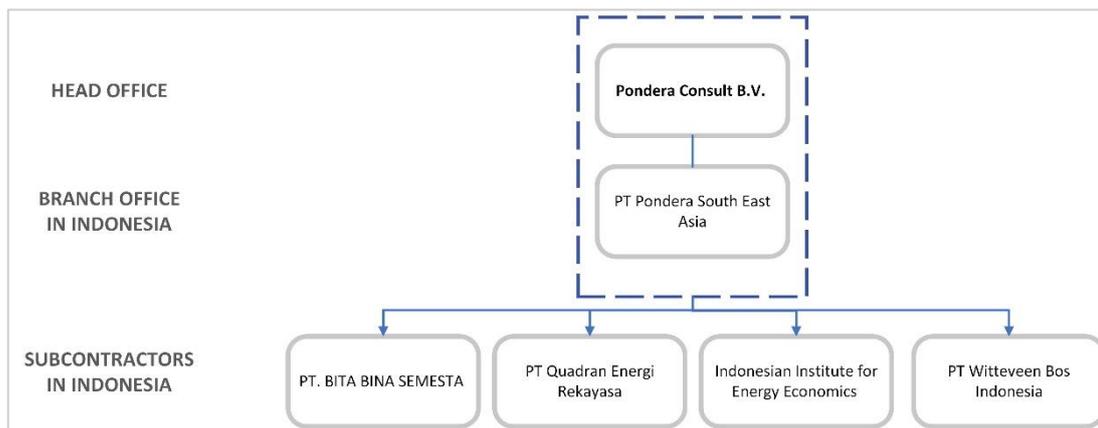


Figure 7: Organizational structure

6.2 Expertise and responsibly allocation

Pondera and the subcontractors have specific expertise to be applied to the assignment. In Figure 8, we have matched the involved parties to the parts of the assignment based on the expertise (marked with a ✓). It can be derived from the figure that we specifically make sure that more than one party has the expertise to complete each deliverable. This enables us to do quality control on each other's work and thus ensure that the quality meets expectations. Nevertheless, we chose to give one party the final responsibility for each deliverable (marked by a ⚙️). The responsibility allocation of is based on the core expertise of each project partner. In this manner, the most experienced/knowledgeable party holds the coordinating responsibility of the final version of a specific deliverable.

Deliverables	Pondera	Witteveen + Bos	BITA	Quadran	IIEE
<i>Inception Report</i>	✓ ⊛	✓	✓	✓	✓
<i>Wind Power Technical Working Group</i>	✓	✓			✓ ⊛
<i>Component 1 Stock take and Sector Development Roadmap</i>	✓ ⊛	✓			✓
<i>Component 2 Permitting Assessment and Regulation Development Support</i>	✓	✓	✓ ⊛		
<i>Component 3: Wind energy potential mapping, gap analysis and site selection</i>					
<i>a. Wind profile assessment:</i>	✓ ⊛	✓			
<i>b. Utility Interconnection and Transmission Feasibility</i>	✓	✓		✓ ⊛	
<i>c. Construction Assessment</i>	✓	✓ ⊛	✓		
<i>d. Technology Selection & Evaluation</i>	✓ ⊛	✓			
<i>e. Economic Feasibility Analysis</i>	✓ ⊛	✓			
<i>f. Overview of social and environmental impact assessment</i>	✓	✓ ⊛	✓		
<i>Component 4 Investment Opportunities Guide for Indonesian Wind Projects</i>	✓ ⊛	✓	✓	✓	✓

Figure 8: Matrix of expertise and responsibilities

6.3 Management structure and project management controls

Although partnering with multiple companies for this assignment expands our pool of expertise, we understand that it could also increase the complexity in terms of management controls. To maintain control and deliver the project to our high standards, we use the following approach which consists of three key elements:

- Project Board in Indonesia:** We establish three-person Project Board based in Indonesia. The main force of this board is our project team lead Chandra Soemitro, who is in accordance with the requirements based in Indonesia. To assure continuity and a bigger span of control, we have also assigned a deputy team lead, Brent Elemans, who is also a resident of Indonesia and has extensive experience in wind energy development in Indonesia. Chandra and Brent have been working together for many years for several renewable energy projects in Indonesia. Finally, we have assigned a quality controller, Sergio Simanjuntak, who will be responsible to ensure that the quality of any deliverable meets our standards before being submitted to the Client. Together, the three persons form the Project Board and act as the focal point for the Client. This is illustrated in Figure 9. The other involved consultants from Pondera will be managed by this Project Board.

- Deliverable responsibility:** Based on Figure 8, it is evident that several deliverables will be completed by two or more consortium partners. To assure management control, we allocated a single party who takes on the coordinating responsibility for each deliverable's delivery (illustrated in Figure 8). In other words, the responsible party coordinates with the other parties on the required input and quality checks. Each deliverable is sent by the responsible party to the Project Board before it is submitted to the Client.
- Project Management Team:** Each of the five partners appoints a project manager to represent its own company. Together, these project managers form a Project Management Team (PMT). This is illustrated in Figure 9. The purpose of this group is to keep control and regularly evaluate planning, budgeting, quality, and ways of collaboration (i.e. in the first place the PMT meetings are not used for discussions on the content of deliverables). The PMT will have at least one meeting per month chaired by the Project Team Lead.

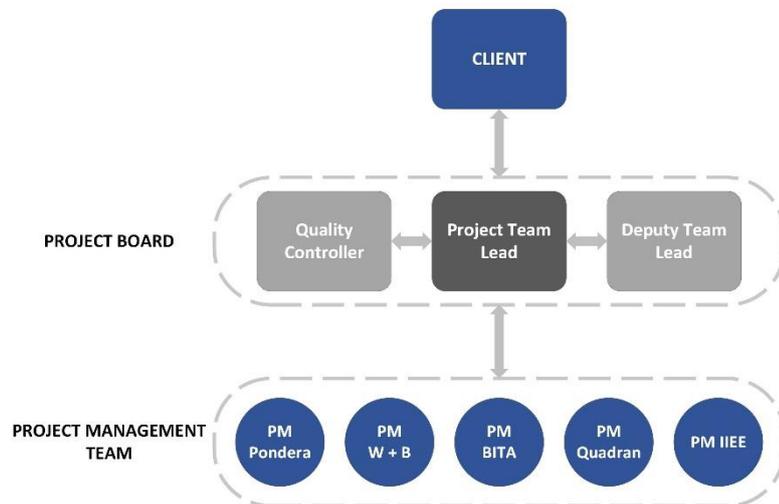


Figure 9: Project management structure

6.4 Key consultants

In the following table, the key consultants are listed including their residence, role, and involvement in which part of the project.

Table 5: Key consultants taking part in this project

Name	Gender	Company	Residence	Role	Involvement
Ir. Chandra Soemitro	M	Pondera	Indonesia	Team lead	Full
Brent Elemans Msc	M	Pondera	Indonesia	Deputy team lead	Full
Sergio Simanjuntak Msc	M	Pondera	Indonesia	Quality controller	Full
Robbert Groenen Msc	M	Pondera	Indonesia	Financing consultant	Component 4
Eric Arends Msc	M	Pondera	The Netherlands	Onshore wind consultant (project development)	Component 1-4
Mariëlle de Sain Msc	F	Pondera	The Netherlands	Onshore wind consultant (policy and permitting)	Component 1-2
Marjolein Pigge Msc	F	Pondera	The Netherlands	Onshore wind consultant (policy and permitting)	Component 1-2
Bas Verkerk Msc	M	Pondera	The Netherlands	Wind resource / modelling expert	Component 3
Jori Dreef Msc	F	Pondera	The Netherlands	Wind resource / modelling expert	Component 3
Victor Koenen Msc	M	Witteveen + Bos	Indonesia	Civil / geotechnical expert	Component 3
Nurisa Msc	F	Witteveen + Bos	Indonesia	Civil / geotechnical expert	Component 3
Nataliawati Siahaan Msc	F	IIEE	Indonesia	Roadmap expert	Component 1 and TWG
Azis Pusakantara	M	IIEE	Indonesia	Roadmap expert	Component 1 and TWG
Totok Partono	M	IIEE	Indonesia	Roadmap expert	Component 1 and TWG
Agus Siswanto Msc	M	BITA	Indonesia	Permitting expert	Component 2
Dr Sudarmono Sasmono	M	Quadran	Indonesia	Grid specialist	Component 3

7 Risks, mitigations, and assumptions

We strongly uphold quality monitoring and assurance on the study's process and results. Pondera has an internal quality assurance management system which complies with ISO standards. Furthermore, Pondera is certified for ISO 9001:2005 on the quality management system (QMS) of advisory and consultancy work pertaining to renewable energy, climate, spatial planning, and environment. The system is built upon the Plan Do Check Act (PDCA) cycle and is explained in the QMS handbook.

PDCA consists of the following parts:

- Plan: The QMS handbook contains an agreed upon working method and goals to reach a certain quality of work.
- Do: Execution of work always adheres to the methods being prescribed in the QMS handbook.
- Check: Internal and external audits are performed to review and ensure that the work complies with the QMS handbook.
- Act: A routine management review is conducted to facilitate adjustments and improvements to the QMS handbook based on the audit result.

Furthermore, our subcontractor W+B is also certified for ISO 9001: 2015 on the QMS of all consultancy and engineering services in the field of water, infrastructure, environment, and construction. This internationally recognized certification highlights the level of quality management that we will apply to the subcontractors and will employ throughout the activities in this study.

We also realize that working with subcontractors poses a challenge in maintaining quality, as there exist interfaces between us and our partners. One way to ensure the work quality is to clearly define the roles and responsibilities of each party for every deliverable and to formulate a (project) management structure that governs the interactions between the working parties in completing each deliverable.

To ensure that all subcontractors adhere to the ISO 9001 standards, an integrated quality assurance plan has been developed for this study. We acknowledge that one of the major risks in this study is related to the utilized data, and therefore, the quality assurance plan extensively covers data acquisition, processing, and storage. Another aspect of the plan pertains to internal and external project meetings. The subsequent paragraphs will elaborate on key parts of the quality assurance plan.

7.1 Data acquisition

It is important to get the correct input data because input data quality will eventually affect the study's result. Thus, the input data specification shall be decided before the study is initiated. Some data specifications are already reflected in our plan of approach for each Component. Moreover, the data gathered from the work of subcontractors will also be scrutinized. This is done by a quality check and verification on the completeness, correctness, and origin of the data. The data can only be processed once it has passed the check on all three aspects. Additionally, we will use our standard purchasing conditions with definitive requirements on the work's scope (depth and breadth), planning, and price. This will mitigate the possible risk of having subcontracting dispute and ensure timely submission of the deliverables.

7.2 Data processing and storage

Processing and storing data must be done in a professional and structured way to assure the deliverables' quality. We will ensure that the relevant personnel/staff have obtained the necessary skills and training to process the data. The software, methods, and data structure related to data processing will also be agreed upon in our initial working meetings. Furthermore, there are several additional measures to be implemented related to data processing and storage:

- **Document naming format.** Project documents will be stored using a uniform naming format to ease everyone's understanding of the document's date and status. The format is **yyyymmdd filename vx.y-status**. The following conditions apply for document naming:
 - yyyymmdd: the current date or last date of the version (if there is no version change or major change in date)
 - filename: the file name as designated by the main author; the name should be kept brief and describe the document's subject/content
 - vx.y: the two-digit version number; x increases when the document version has been finalized and is shared externally, whereas y increases when a new version is created internally (e.g. for internal review)
 - status: this can either be:
 - unverified: if the document has been drafted by the main author and has not been reviewed by another expert
 - verified: if the document has been reviewed by another expert as a means of quality control
 - final: if the document has been received and approved by the client
 - The document name can only be changed by the document's main author.
- **Document control table.** Each document to be submitted to the client will be accompanied by a document control table. The table's format is shown below:

Table 6: Format of document control table

Document title	[document title]	Document name	[document name]
Position	Person-In-Charge	Date	Signature
Author	[Name]	[Date]	[Signature]
Project Team Lead	[Name]	[Date]	[Signature]
Deputy Team Lead	[Name]	[Date]	[Signature]
Quality Controller	[Name]	[Date]	[Signature]
Project Manager	[Name]	[Date]	[Signature]

- **Document review form.** For every review by the persons listed in the document control table, a document review form shall be submitted to the main author. This is done to keep track of corrections throughout the drafting process. The form shall consist of at least the following information:
 - Name, position, document title, and document name
 - Scope of review (e.g. detailed review on all aspects, or solely focused on some particular aspects of the document)
 - Main findings, remarks, and conclusions
 - Identified risks
- **Document sharing platform.** All documents will be shared through an online platform (e.g. Microsoft SharePoint) with limited access (only to the relevant parties/persons). This enables live synchronization of documents, tracking of changes, and secured document distribution. Within the platform, the documents will be organized in folder structures.

- **Document format.** Documents in progress (not yet finalized) will be stored in their native format (e.g. CAD, GIS shapefiles, etc.), whereas finalized documents will be stored as PDF.

7.3 Project meetings

Meetings on the project (internal and external) can be divided into several types as shown in the table below. The Person-In-Charge (PIC) for each meeting is responsible for preparing the meeting agenda, attending the meeting, and drafting and distributing the minutes of meeting.

Table 7: Coordination meetings planned as part of this project

Type of meeting	Frequency (duration)	Participants	PIC	Methods
Kick-off	Once, at the beginning of the project (2 hours)	Client Project Team Lead Deputy Team Lead Quality Controller Project Managers	Project Team Lead Deputy Team Lead	Physical meeting (possibly combined with Teams meeting)
Progress update	Weekly (1 hour)	Deputy Team Lead Quality Controller Project Managers	Deputy Team Lead	Teams meeting
Progress evaluation	Monthly (2 hours)	Project Team Lead Deputy Team Lead Quality Controller Project Managers	Project Team Lead Deputy Team Lead	Physical meeting (possibly combined with Teams meeting)
Project HAZID and risk (re-)assessment	Bi-monthly, starting at the beginning of the project (1 hour)	Project Team Lead Deputy Team Lead Quality Controller Project Managers	Deputy Team Lead Quality Controller	Physical meeting (possibly combined with Teams meeting)
Client satisfaction and evaluation	5 times, after inception report and each milestone report submission (2 hours)	Client Project Team Lead Deputy Team Lead Quality Controller Project Managers	Project Team Lead Deputy Team Lead Quality Controller	Physical meeting (possibly combined with Teams meeting)

As mentioned in the table above, project risk assessment and mitigation will be conducted in the bi-monthly Project HAZID and risk (re-)assessment meeting. Project risks, as exemplified by wind data inconsistency and limited access to the techno-economically viable sites, must be addressed by the participants early in the project. In the first meeting, the participants will map out all the risks that may affect the project, gauge their likelihood of occurrence, assess the possible consequences, and outline their respective preventive and corrective measures. The result of this activity serves as a practical guideline in handling project risks. In the next meetings, participants will evaluate the guideline's effectiveness and make changes as necessary. This procedure makes sure that risks which may be encountered in the study would be mitigated or be dealt with sufficiently.

7.4 Preliminary HAZID and risk assessment

An early identification of hazard and risk has been developed as part of this report. The table below displays the preliminary result. This result will later be checked and consulted with our subcontractors periodically.

Table 8: The result of preliminary HAZID and risk assessment

No	Hazard/ Risk	Sources	Threat	Consequences	Likelihood	Preventive Action	Corrective Action
1	Cooperation with subcontractors	Project execution	Failure of subcontractor to produce deliverables on time and with sufficient quality	Delayed submission of deliverables to client	Low	Enforce our quality assurance plan, align parties' expectations early, and sign a binding agreement with our subcontractors	Finalize the deliverable based on our expertise, or hire another subcontractor of the same quality
2	Analysing input data	Project execution	Human error in performing analysis	Erroneous output data in the deliverable	Low	Implement our quality assurance plan	Revise and repeat the analysis to eliminate error
3	Stakeholder engagement	Project execution	Refusal of participation by stakeholder(s) in TWG events and interviews	Missing input data for the project	Medium	Approach the stakeholders timely, and by leveraging the endorsement of MEMR, involve ETP fully in our approach, and prepare a list of alternative stakeholders as backup	Approach alternative stakeholders
4	Legitimation of roadmap	Formulating sector roadmap	Unable to achieve a consensus on the roadmap	Delayed submission of roadmap	Low	Establish process rules to guide the entire process, and consult periodically with and seek endorsement from MEMR via ETP	Communicate with the finalized roadmap with MEMR endorsement via ETP
5	Assessment of land acquisition issues	Permitting assessment	Lacking information on land ownership	Missing insights on permitting for the wind site	Low	Seek for endorsement from MEMR via ETP to contact relevant (local) government authorities which own the data	Use alternative/proxy data sources to infer the land ownership data
6	Wind data collection	Identification of wind energy potential	Low detail level of model wind data	Less accurate calculation of wind potential	High	Early identification of the detail level of the model wind data.	Investigate the possibility of acquiring primary wind data from already-conducted measurements on site, or expansion of the scope of work with short term wind measurements on site using a LiDAR. However, the use of available model data as a fallback scenario still enables us to execute the project but with a lower certainty level of the outcomes.
7	Transmission system analysis	Identification of wind energy potential	PLN refuses to provide required data on the current transmission system	Missing information on the available capacity on the grid.	Medium	Collaborate closely with ETP and MEMR to approach PLN for the required input.	Include assumed grid capacity in the report with a recommendation for future grid impact study.
8	Site visit	Identification of wind energy potential	Limited access to wind site	Unable to validate findings of construction assessment, social and environmental circumstances, and to check for suitable locations for wind measurement	Medium	Collect information (desk study) about access profiles and only prioritize visits to promising wind sites, and consult with ETP and MEMR to help with access permit obtainment	Use alternative data sources (e.g. Google Earth, digital topography data)

8 Monitoring and evaluation framework

We will utilize the client’s Results-Based Monitoring Framework (RBMF) which is tailored to this project (see table below). The framework enables monitoring and management of results which foster inclusivity and transparency, as well as the adoption of a long-term view on the achievement of the client’s objective. Consequently, the results can stimulate learning and continuous improvement, not only for decision-making and project management throughout the project, but also for future projects. The framework will be utilized to gauge whether the expected project output is met and whether the output contributes to Strategic Outcome 2, i.e. de-risking EE/RE investments. This monitoring and evaluation process is based on the indicators and target as defined by the client. Data sources and means of verification will also be investigated and included in the framework. It is also noteworthy that the RBMF will be updated for every milestone report submission.

Table 9: Results-Based Monitoring Framework (RBMF) to be used in this project

Strategic outcome 2: De-risking EE/RE investments					
ETP Outcome	Project Output(s)	Indicator	Target	Achievement	Data Source and Means of Verification
Increased flow of public and private investments to RE and EE projects in the power and end-user sectors.	Output 1: List of potential wind power projects	Indicator 1: Potential increase of megawatts through proposed projects	450 MW	(to be updated)	Data source: Indonesia wind potential map (P3TEK-MEMR), Geoportal ESDM, and other sources
		Indicator 2: # of investment projects prepared	5	(to be updated)	
	Output 2: Roadmap of wind power investment	Indicator 3: # of roadmaps developed	1	(to be updated)	Means of verification: to indicate the potential of wind power development and current development plan

9 Client – Contractor collaboration

9.1 Progress meetings Pondera – ETP

To keep track of the progress of the project, align activities, and receive feedback from the client, we will attend bi-weekly progress meetings with the ETP UNOPS team. The meeting will be organized by the ETP UNOPS team either online or offline. In advance, Pondera will propose a draft agenda and during the meeting Pondera will make minutes to be shared within 2 days after the meeting. In case more frequent meetings are needed, we are flexible to attend. Furthermore, we will also attend progress meetings with beneficiaries of the project (e.g. MEMR) when ETP requests this. Also, for those meetings, Pondera will make the minutes of meeting. To keep close communication between ETP and Pondera, a WhatsApp group is established to quickly align on small matters. However, formal communication is done via e-mail and meetings.

9.2 Feedback on draft deliverables

In Chapter 4, we have defined which deliverables will be submitted. This considers final deliverables. However, we intend to submit draft deliverables the latest 2 weeks in advance of the deadline of the final deliverables. We kindly request the ETP UNOPS team to provide feedback of the draft deliverable within 5 working days after submission of the draft deliverable. This gives Pondera 5 working days to incorporate the feedback in the final deliverable or to plan a clarification call on the feedback.

9.3 Required assistance from ETP

The intention of Pondera is to collaborate as closely as possible with the ETP UNOPS team. This is not only to establish a good alignment on the project, but also to enquire the vital assistance from ETP UNOPS within the project. The following assistance is needed:

- Arrange endorsement letters in order to speak with and / or invite government officials;
- Introduce Pondera to relevant key stakeholders (if not yet within Pondera's network);
- Act as intermediary between Pondera and the project beneficiaries (e.g. MEMR);
- Leverage ETP's network to share our outreach and communications;
- Request vital information from key stakeholders, e.g. grid specifications of PLN; and
- Provide feedback on Pondera's draft deliverables.

