SIEMENS

Inception Report

Revised version

United Nations Office for Project Services (UNOPS)

Integrating Battery Energy Storage System (BESS) into the Grid for Energy Transition

ENERGY TRANSITION PARTNERSHIP

Project Title	Integrating Battery Energy Storage System (BESS) into the Grid for Energy Transition
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Editor(s)	Brendan Onah Mohammed Hafez Dr. Martti van Blijswijk Chandra Agung Ramadhan,
Release (technical)	Thibault LHuby
Office address	Siemens AG Smart Infrastructure Grid Software Energy Business Advisory Siemenspromenade 10 91058 Erlangen, Germany
Phone	+491734634980
E-Mail	thibault.lhuby@siemens.com

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Executive Summary

Siemens has been contracted by the UNOPS Energy Transition Partnership (ETP) to conduct an assessment of Indonesia’s Battery Energy Storage System (BESS) ecosystem, through grid model-based and business models analyses, development of national standards and policy, as well as implementing capacity building initiatives, over a 14-month period.

BESS could play a significant role in Indonesia power system, as a key enabler to support an expected growing renewable penetration accounting for ~42% of installed capacity by 2060 (Setiawan, 2025) and to provide necessary ancillary services to the grid (e.g. frequency control, voltage control, investment deferral). BESS have already proven being key assets in several regions, such as the USA, Australia, Germany or China, supporting decarbonization while providing economic benefits to the involved parties. Large solar power plants, wind farms, and power systems can all benefit from BESS's efficient support in absorbing excess grid electricity, lowering transmission pressure, managing the continuous transmission domain, and overcoming natural fluctuations in renewable energy sources (Thanh et al., 2023).

Achieving these results was made through appropriate regulatory reforms and policies, financial incentives, coordinated planning, investment on the grid and developing local value chains.

Siemens has been selected by the UNOPS Energy Transition Partnership (ETP) Program as implementing partner to conduct an assessment of Indonesia’s Battery Energy Storage System (BESS) ecosystem, through grid model-based and business models analyses, development of national standards and policy, as well as implementing capacity building initiatives, over a 14-month period.

This project is therefore structured around 5 phases (excluding the redaction of the inception report). The development of National Standards will ensure that BESS are integrated safely to the Indonesia grid and will minimize risks associated with its interconnection (e.g. power quality issues from the inverter). A thorough techno economic analysis, leveraging Plexos and PSS/E will be made to evaluate costs and benefits (technical and financial) of incorporating BESS in Indonesia, including LCOE and LCOS analyses. Based on the previous results, an integrated policy framework customized to Indonesia’s needs will be developed to ensure successful deployment of BESS projects from the start. Finally, a capacity building program will be developed, strengthening Indonesia’s capabilities in pursuing its BESS integration journey.

This project will be delivered through close collaboration with the Ministry of Energy and Mineral Resources. As such, multiple workshops and interviews are being planned along the project.

1 Introduction

1.1 Context

The United Nations Office for Project Services (UNOPS) and Siemens have entered into a contract for consultancy services on integrating Battery Energy Storage Systems (BESS) into the grid to support Indonesia's energy transition. The objective is to conduct a comprehensive analysis of BESS in Indonesia by delivering model-based grid assessments, developing a specialized BESS business model, formulating an integrated policy framework and roadmap, contributing to national standards (SNI) development, and implementing capacity-building initiatives.

In this report, the contents of the proposal are updated with the newest insights from the beneficiary and UNOPS and supplemented with explanations on how the project will be delivered.

The Southeast Asia Energy Transition Partnership (ETP) is a technical assistant program, hosted by the United Nations Office for Project Services. ETP partners with governments, philanthropies, private sector and civil society to harness the vast untapped potential of renewable energy into the energy mix in the Southeast Asian region. The program mobilizes and coordinates the necessary technical and financial resources to create an enabling environment for renewable energy, energy efficiency, and sustainable infrastructures to support the transition from using fossil fuels to renewable sources of energy to advance climate action in Southeast Asia. To contribute to the achievement of the UN's Sustainable Development Goals (SDGs) and the Paris Agreement objectives, ETP works in Southeast Asia, with a focus on three priority countries, namely Indonesia, the Philippines, and Vietnam.

ETP's strategy is built around four interrelated pillars of strategic engagement that are squarely aligned to address the barriers to energy transition:

- **policy alignment with climate commitments:** Supporting the development and implementation of regulatory frameworks and policies that promote low-carbon energy systems.
- **de-risking energy efficiency and renewable energy investments:** Creating an enabling investment climate through financial de-risking measures and innovative financing instruments that unlock private and public capital for renewable energy and energy efficiency projects.
- **extending Smart Grids:** Modernizing and expanding grid infrastructure to ensure a reliable and resilient power system by facilitating integration of variable renewable energy (VRE) sources
- **just transition:** Fostering an equitable and inclusive energy transition, ensuring that social, economic and environmental considerations underpin the shift to a green economy

1.2 Problem Statement

Indonesia is characterized by (i) high electricity demand (482 TWh in 2024) (Republic of Indonesia, 2024), (ii) expected to grow fourfold by 2060 (1813 TWh in 2060), (iii) high renewable growth expected to represent 42% of installed capacity by 2060 (Setiawan, 2025) and (iv) islanded grids. Front-of-the meter BESS could play critical roles for the Indonesian power grid at both generation and network levels:

- When collocated with a power production source, in particular variable renewables, BESS can ensure higher power quality through **load smoothing**, as well as increasing production asset utilization with **capacity firming** and **arbitrage.** It could also support conventional production sources with **black start**, **peak capacity** and **load following** capabilities, ensuring high power reliability and utilization of the asset
- As standalone assets, BESS plays crucial roles for **frequency and voltage regulation.** They can also relieve the grid from **congestion** and help to **defer large investments in the transmission and distribution network**

ETP is actively supporting MEMR in integrating BESS into the national grid to enhance grid stability and accelerate renewable integration, furthermore, support Indonesia expedite its energy transition efforts.

This project will support MEMR DG NREEC and DGE including technical committee to develop SNI (national standard) for BESS. These standards are essential for ensuring safety, reliability, and efficiency in the deployment of battery storage technologies. By facilitating dialogue between government agencies, industry experts, and financial institutions, ETP, through this project analysis is helping to create a favorable environment ; this project will analyze necessary steps need to enable BESS development in Indonesia. This targeted support not only bolsters Indonesia's renewable energy capacity but also contributes to the broader goal of reducing coal dependency and lowering carbon emissions.

Moreover, the integration of BESS is a key component of Indonesia's broader grid modernization roadmap. ETP's efforts in this area aim to demonstrate the technical and financial viability of BESS projects, thereby de-risking investments and catalyzing further deployment of clean energy technologies. By aligning these initiatives with national energy policies and international climate commitments, ETP is paving the way for a robust and sustainable energy system in Indonesia.

1.3 Project Objectives

This project aims at developing **an effective national framework for the integration of BESS into Indonesia's energy infrastructure**. It will conduct detailed model-based analyses to evaluate how BESS can enhance grid stability, reliability, and efficiency. Additionally, the project will develop a tailored business model, create an integrated policy framework and roadmap, establish national standards (SNI) for BESS, and implement capacity building through workshops. Together, these components aim to drive effective integration, regulation, and scaling of a sustainable BESS ecosystem in Indonesia.

The project aims to facilitate the integration of Battery Energy Storage Systems (BESS) in Indonesia through several key initiatives:

- **Assessment and Model-Based Analysis:** Conducting comprehensive evaluations and simulations to understand how BESS can enhance grid stability, reliability, and efficiency.
- **Tailored Business Model Development:** Creating a BESS business model that aligns with Indonesia's specific energy requirements, regulatory environment, and socio-economic conditions.
- **Integrated Policy Framework and Roadmap:** Developing a strategic plan and policy framework to guide the systematic integration of BESS into Indonesia's energy infrastructure.

- **Drafting National Standards (SNI) for BESS:** Formulating a set of Indonesian National Standards to ensure the uniformity, safety, and reliability of BESS installations.
- **Capacity Building and Training Programs:** Implementing educational initiatives to enhance the knowledge and skills of stakeholders involved in BESS management, operations and related software implementation.

The figure below provides summary the status quo/problem statement, and key questions for successful BESS integration and consequently the Consultant scope of work

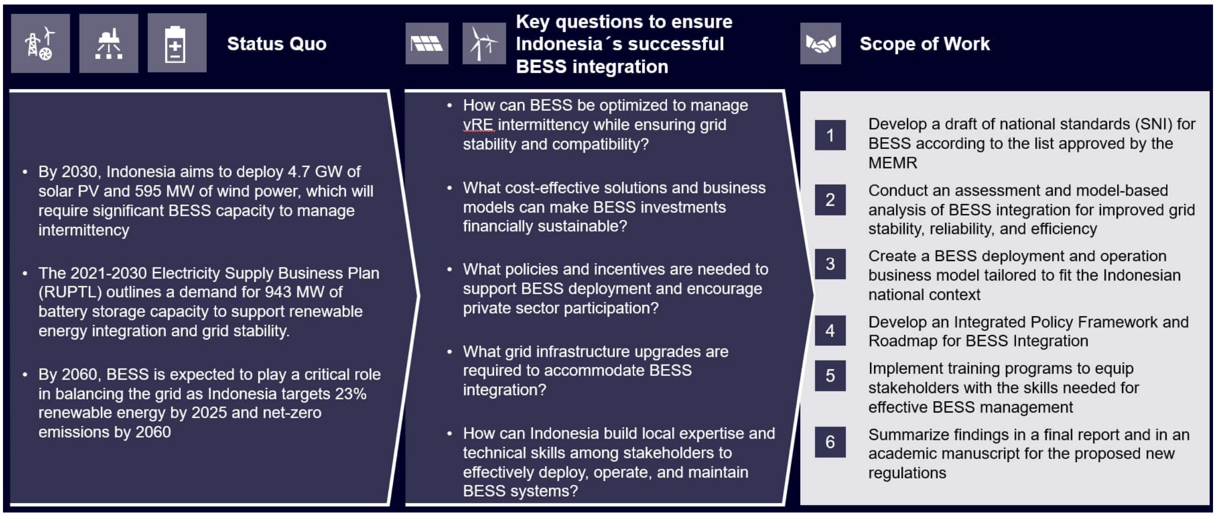

Figure 1-1 Project objectives and scope of work. (**Source:** Siemens)

1.4 Inception Report Structure

The inception report which is the first contractual milestone of the project is based on the kick-off mission (slides attached at the end of the report) on February 11th, 2025, virtually on Google Meet with key stakeholders of UNOPS, Siemens (Germany, Indonesia and Vietnam), and local support experts; and two additional kick-off meetings that took place with representatives of Siemens, UNOPS-ETP and the following beneficiaries:

- Directorate of Various New and Renewable Energy (DNRE) at the Directorate General of New, Renewable Energy and Energy Conservation (DGNREEC) MEMR on 13th of February 2025
- Directorate of Electricity Engineering and Environment at the Directorate General of Electricity (DGE) on 14th February 2025

Both of above meetings were the first physical meeting allowing Siemens to introduce the team and greet with beneficiaries from the Ministry. Certain strategies of data requirement and project framework were discussed within these kick-off meetings.

This report aims to establish the as-is situation, present the refined version of the technical proposal covering the project scope, key objectives, work plan, required resources, as well as the project key stakeholders and project organization, along with the challenges and risks that may occur, and the development of discussions with the beneficiaries at the Ministry of Energy and Mineral Resources (MEMR) including the Directorate of New and Renewable Energy (DNRE), the Directorate General of New, Renewable Energy and Energy Conservation (DGNREEC), and the Directorate of Electricity Business Development at the Directorate General of Electricity at the DGE.

The report is structured as follows:

- ***Part 1: Introduction and Context***: This section serves as an introductory part of the report, presenting an overview of the project and its background. It outlines the objectives, significance, and purpose of the project, providing the necessary context for the subsequent sections that delve into the specific aspects of the report.
- ***Part 2: Project Scope and Work Packages***: This section defines the scope of the project, outlining the boundaries and extent of the work to be undertaken.[2] It identifies the specific tasks and work packages that will be carried out, providing a clear roadmap for the project's execution. This section ensures that all stakeholders have a comprehensive understanding of the project's objectives and deliverables; and
- ***Part 3: Project Management Plan***: The Project Management Plan is a detailed section that encompasses various aspects of project management. It includes the project timeline, outlining the key milestones, activities, and deadlines. Additionally, it presents the data collection plan, stakeholder roles and responsibilities, reporting and communication procedures, and strategies for identifying and mitigating project risks.
- ***Part 4: Communication Plan***: UNOPS project communication plan documentations comprise a comprehensive suite of guidelines, templates, and strategic directives that ensure clear, consistent, and effective communication both within UNOPS and with external stakeholder

1.5 BESS Overview

As power systems shift towards higher share of intermittent renewable energy driven by decarbonization needs, and coupled with increasing demand of power, grid-scale (>1 MWh) Battery Energy Storage Systems (BESS) have emerged as a critical component in ensuring power system flexibility (IEA, 2024).

Figure 1-2 shows that new installations of grid-scale BESS in 2022 doubled those of 2021, up from ~15 to ~30 GW, mostly used for short-term balancing/operating reserves, grid ancillary services, deferral of grid investment and restoring operations after a blackout. The deployment of grid-scale battery storage systems is projected to reach ~1 TW globally by 2030 under the Net Zero scenario (IEA, 2023).

[2] Also covers progress covered in each task until the date of writing this report.

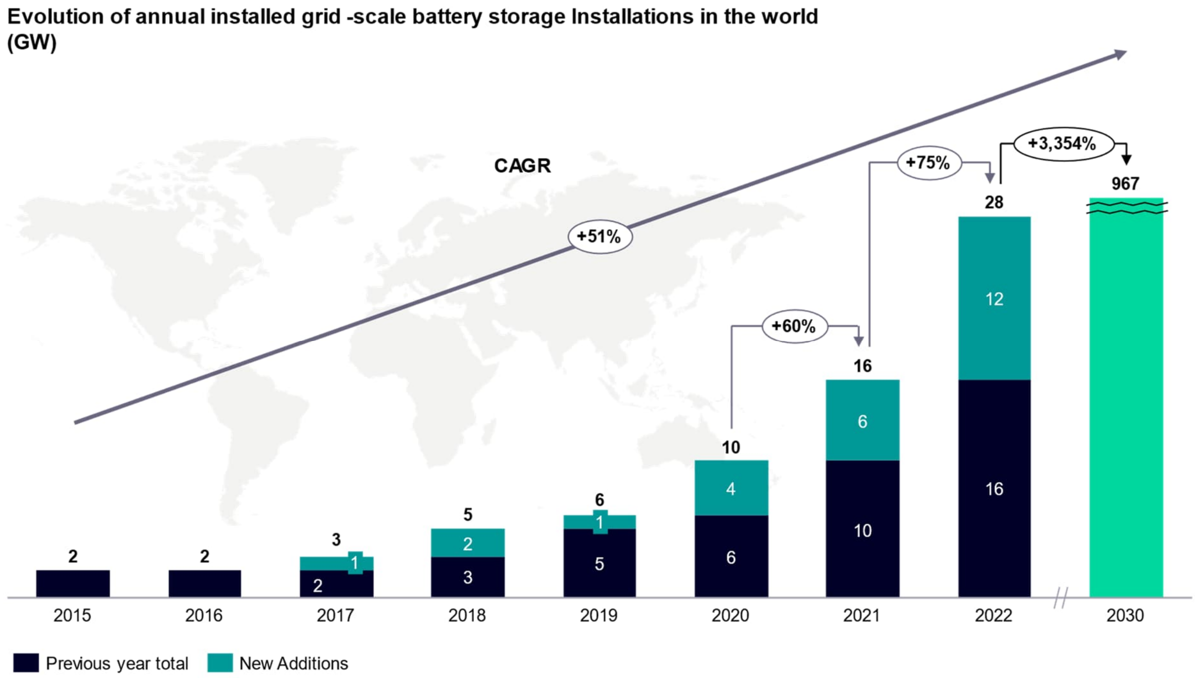

Figure 1-2 Global development of grid-scale battery storage installations (**Source:** Siemens own figure based on data from IEA).

China and USA accounted respectively for 40% and 35% of new installations. Rapid development of the EV industry and standalone BESS has resulted in decreasing of lithium-ion battery pack costs to a record low of $139/kWh in 2023. (BloombergNEF, 2023). BESS appear now as cost-effective solutions to solve grid-related issues, such as grid ancillary services, supporting the integration of renewable energy or enabling energy arbitrage.

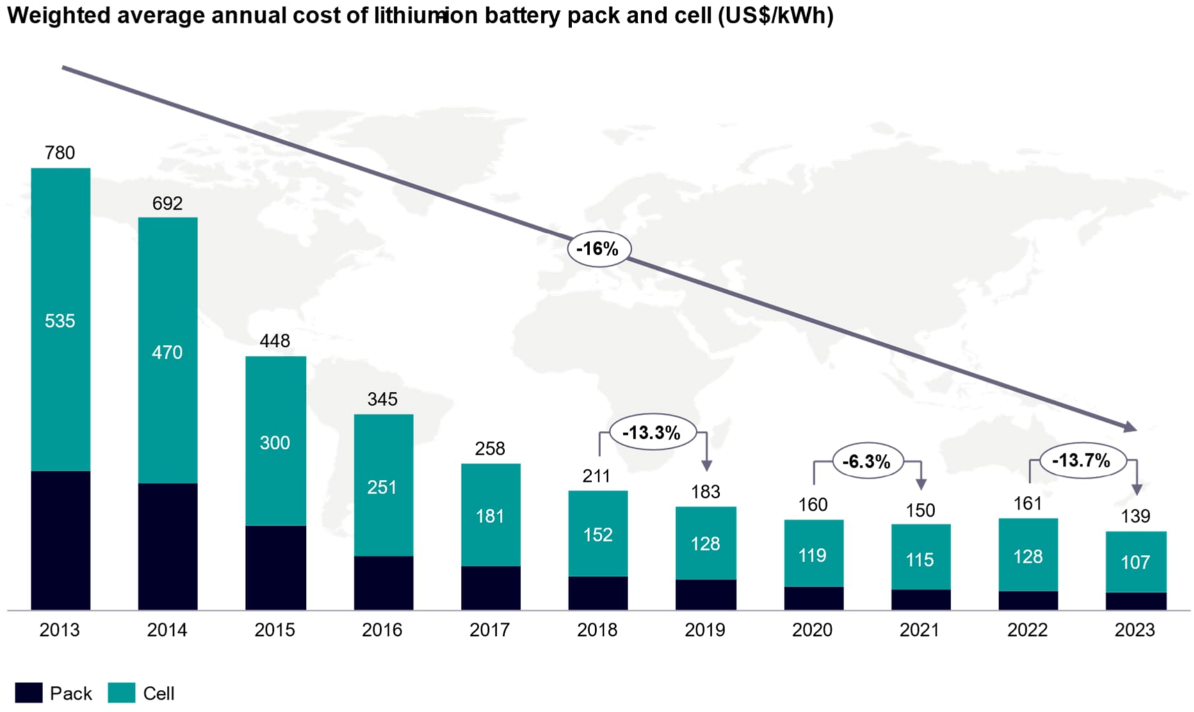

Figure 1-3 Decreasing cost of lithium-ion battery pack and cell (Siemens own figure based on data from Bloomberg NEF).

Several countries are supporting battery storage deployment through targets, subsidies, regulatory reforms and R&D support (IEA, 2025). Through the introduction of Inflation Reduction Act (IRA), the USA more than doubled their deployment of BESS nationwide. FERC Order 841 and 222, also mandates the removal of barriers to the participation of BESS in the capacity, energy, and ancillary service markets operated by Regional Transmission Organizations (RTOs) and Independent System Operators (ISOs). In addition, several initiatives on state-level are currently in place to spur additional investment in grid-scale BESS.

eWith a solid national strategy and a thorough implementation plan, Indonesia could achieve great milestones in their journey towards BESS integration.

1.6 Electricity Sector in Indonesia Overview

Indonesia, the largest economy in Southeast Asia, faces unique challenges in its power system due to its island-based geography, reliance on fossil fuels, and growing energy demand. Indonesia's electricity generation remains overwhelmingly fossil fuel based, although there are gradual efforts to boost renewables.

Figure 1-4 highlights that fossil fuels, primarily coal account for over 85.7% of the country's electricity production. Within that fossil share, coal is dominant over 56.48%, with natural gas 24.69% and oil 4.24%. In contrast, renewable sources make up about 14.3% of the electricity mix. Hydropower is the leading renewable source, followed by biomass/waste and geothermal energy. Wind and solar contribute very little at present (< 1%), though their capacities are slowly increasing as Indonesia seeks to harness its significant renewable potential (Ministry of Energy and Mineral Resources, Directorate General of Electricity, 2024).

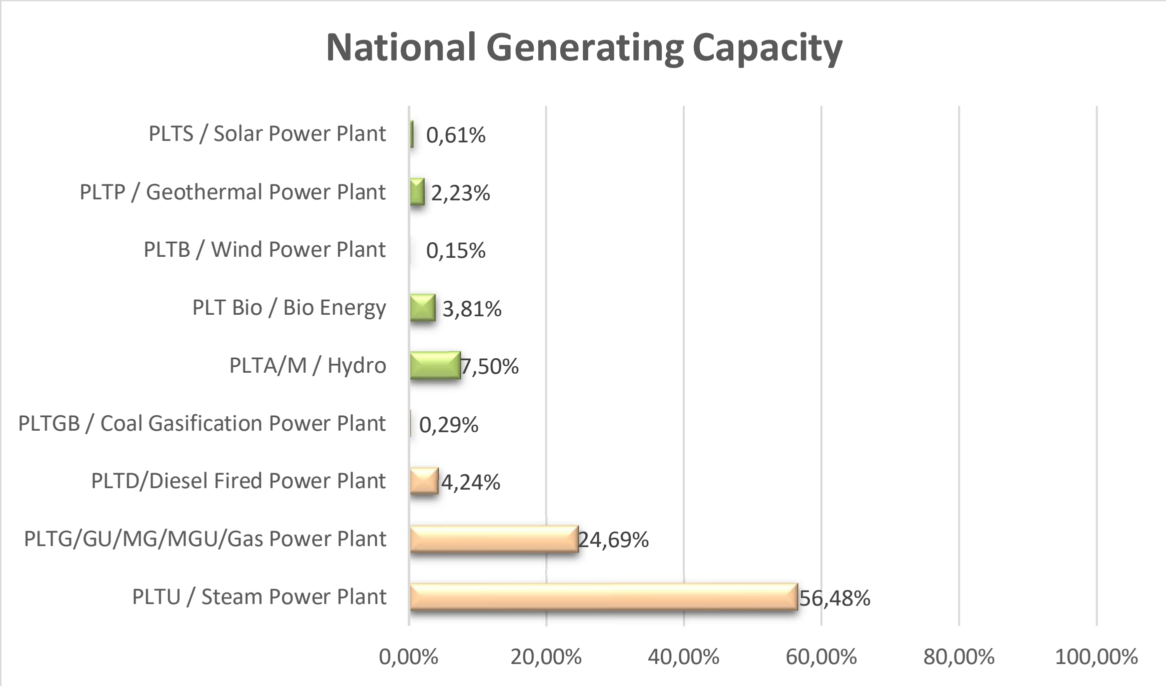

Figure 1-4 National Generating Capacity in 2023 (**Source:** Electricity Statistics 2023 Edition No. 37 Ministry of Energy and Mineral Resources, Directorate General of Electricity / Statistik Ketenagalistrikan Tahun 2023 Edisi No. 37 Kementrian Energi dan Sumber Daya Mineral, Direktorat Jenderal Ketenagalistrikan)

Energy is responsible for most of climate change-causing greenhouse gas emissions, mostly from the burning of fossil fuels. Despite efforts to reduce these emissions, 638 Mt CO_2 was emitted from fuel combustion in Indonesia in 2022 with 43.8% of total CO_2 emissions from Energy Industry, Transportation 24.64%, Construction and Manufacturing 21.46%, other sectors 4.13% (Ministry of Energy and Mineral Resources, 2020).

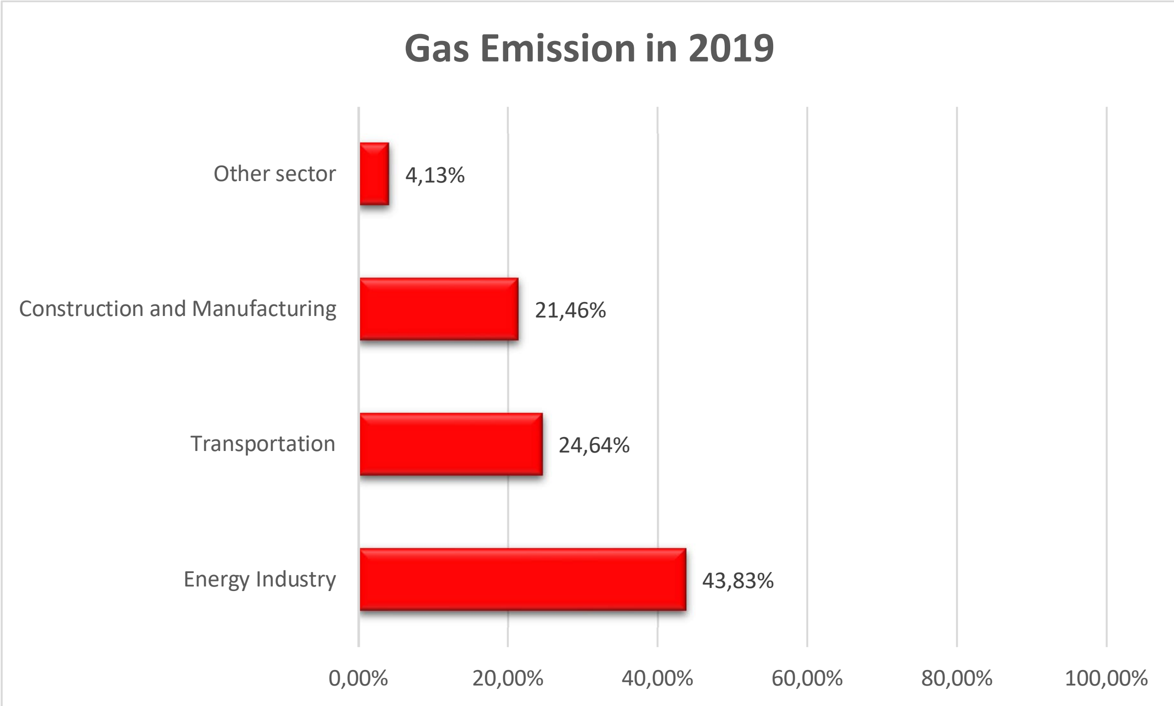

Figure 1-5 CO2 emissions by fuel, Indonesia, 2020 (**Source:** Energy Sector GRK Emissions Inventory Report 2020 Rev 19 March 2021, MEMR / Laporan Inventarisasi Emisi GRK Sektor Energi 2020 Rev 19 Maret 2021, KESDM)

In its Enhanced Nationally Determined Contributions (NDCs) in 2022, Indonesia increased emission reduction target from 29% in First NDC and Updated NDC to 31.89% unconditionally and from 41% in the Updated NDC to 43.20% conditionally on international support. This Enhanced NDC aims to align with Indonesia's Long-Term Low Carbon and Climate Resilience Strategy (LTS-LCCR) 2050 with a vision to achieve net-zero emission by 2060 or sooner (UNFCCC, 2022). In 2023, the Indonesian government managed to reduce GHG emissions in the energy sector by 127.67 million tons of CO2e in 2023, where the realization exceeded the target of 109.64% of the set of 116 million tons of CO2e (KESDM, 2024)

The Ministry of Energy and Mineral Resources (MEMR) in alignment with the state-owned electricity firm PT PLN (Persero) published the PLN's Electricity Supply Business Plan (RUPTL) 2021–2030, demonstrating a significant shift towards a greener energy future for Indonesia. The plan allocates 51.6% of new power capacity to renewable energy sources, with a target of adding 20.9 GW of renewable energy capacity by 2030. BESS is poised to play a critical role in this transition to ensure grid stability (EMBER, 2024). Furthermore, there are national strategic initiatives, the expansion of battery-powered electric vehicles, and the anticipated demand for green hydrogen fuel in the future. These factors contribute to a rising requirement for electricity at both regional and national levels, necessitating the development of a provision plan by the Central Government, local authorities, and private sector entities (Republic of Indonesia, 2024).

Integrating BESS into Indonesia power grid is a complex process that require proper planning, with developing the adapted policies, regulations and financing capabilities, as well as ensuring capacity building within the country. Valuable insights from countries like the United States, Australia, Germany, Japan, and the United Kingdom that have pioneered effective strategies to integrate Battery Energy Storage Systems (BESS) into national power grids. Several renewable energy power plants with a combination of BESS have been built and inaugurated in several regions of Indonesia, one of which is in the National Capital City (IKN) with a capacity of 50 MW Alternating Current (MWac) or 72-Megawatt Peak (MWp) with BESS technology of 10.32 MWh. This solar power plant is designed to support the peak load of the Nusantara Capital City (IKN) which ranges from 7-10 MW, thus ensuring the sustainability of clean energy supply for the IKN area and the Kalimantan interconnection system. Key elements of their approaches include:

- **Regulatory Reform & Policy Leadership**: Adapting market rules to allow storage to participate actively in grid services.
- **Financial Incentives**: Using subsidies, tax credits, soft loans from banks and credit institutions as well as grants to reduce upfront costs for offtakers and stimulate investment including soft loan from domestic bank/financial institution.
- **Integrated Planning**: Coordinated, multi-agency efforts that align grid modernization with renewable energy goals.
- **Grid Infrastructure Strengthening**: Upgrading transmission and distribution networks to support the dynamic needs of storage.
- **Development of Local Expertise**: Leveraging research institutions, pilot projects, and industry collaborations to build capacity and innovation

2 Project Scope, Methodology, and Workplan

2.1 Overview of project scope and deliverables

High level project approach and methodology

1 Project inception and communication documents development

WP-01.1: Kick-off meeting
- Team mobilization
- stakeholder onboarding
- Prioritize stakeholder objectives
- Project management
- Monitoring and Evaluation inclusive of organizational chart detailing key personnel, roles and responsibilities
- Development of communication documents

2 National BESS standard development

WP-02.1: Analyze in alignment with MEMR, the current Indonesian energy policies and technical guidelines related to energy storage

WP-02.2: Conduct a review of existing Battery Energy Storage System (BESS) standards from international bodies & organization s(EC, IIEEE, and ISO) and derive insights for Indonesia
- Benchmark against global best practice

WP-02.3: Develop National standards specifically for BESS to support development of BESS in Indonesia
- Adapt and translate international standards (IEC TS 629332–2:2022 & IEC TS 629333-1:2018) to local context

WP-02.4: Workshop on national standards (SNI) for BESS integration in Indonesia

3 Techno-economic analysis of BESS integration

WP-03.1: Feasibility study for BESS market development
- Use case evaluation
- Optimal locations for BESS integration

WP-03.2: Perform network studies
- Detailed energy modelling
- Steady-state and dynamic analysis

WP-03.3: Financial evaluation of BESS scenarios and business model development
- Levelized cost of electricity (LCoE)
- Net present cost
- Capital and operational expenditure
- Business models (industry, PPPs, etc.)

WP-03.4: Perform risk and environmental impact assessment

WP-03.5: Techno-economic analysis workshops

4 Integrated Policy Framework and Roadmap for BESS Integration

WP-04.1: BESS policy and regulatory framework assessment
- regulatory environment
- industry standards
- technical requirements

WP-04.2: Gap analysis and international best practice benchmarking
- policy gaps
- regulatory frameworks, incentives, and policies

WP-04.3: Economic analysis and project funding mechanisms
- Power Purchase Agreement (PPA)
- international financing

WP-04.4: Develop BESS integration roadmap
- Timeline and Milestones
- Phased Integration Plan
- Technical Guidelines
- Resource Allocation Plan

WP-04.5: Organize and facilitate consultation workshops

5 Capacity building and project finalization

WP-05.1: Develop capacity building program
- Develop training material - presentations, manuals, handouts, case studies, and practical exercises
- Refine training materials in alignment with relevant stakeholders

WP-05.2: Conduct onsite training for relevant stakeholders
- Technical aspects
- Economic and financial aspects
- Policy and regulatory framework
- Grid integration
- Safety protocols
- Operational best practices

WP-05.3: Prepare the final project report
- Report drafting
- Comments/feedback integration
- Final report
- Project closure workshop

Deliverable schedule

Month 1
- Detailed work plan
- Monitoring and evaluation plan
- Kick-off meeting report

Month 2-6
- Draft of national standards (SNI) for BESS
- Workshop on national standards (SNI) for BESS integration in Indonesia

Month 2-9
- Assessment and model-based analysis of BESS integration for enhanced grid stability, reliability, and efficiency
- BESS deployment and operation business model tailored to fit the Indonesian national context
- Techno-economic analysis workshops

Month 11
- Integrated policy framework and roadmap for BESS
- Consultation workshops

Month 13
- Training programs for BESS management

Month 14
- Final report and Academic Manuscript for Proposed New Regulation

Figure 2-1 Scope of services and Implementations approach of the assignment.

2.2 Phase 1: Project inception and communication documents development

	WPs	Activity	Geo.	Month 1			
WP-01: Project Inception and	WP-01.1	Preparation of interviews and data request	DE				
		Virtual kick off preparation and meeting	DE				
		Kick off with beneficiaries	IN				
		Project workplan	DE				
		Communication plan	DE				
		Monitoring and Evaluation template	DE				
		Project Inception report	DE				

Onshore activity
Offshore activity
Deliverable

2.2.1 Project kick-off, stakeholder onboarding and objective prioritization

Summary of WP-01.1

Tools: Stakeholder interviews, discussions, questionnaires

Deliverables:

- Inception report
- Kick-off meeting slides

Description: The project activities were initiated through the **virtual kick-off meeting held on February 11th, 2025**. The meeting served as the official start of the project, covering (i) introduction of all the teams (UNOPS and Siemens); (ii) project approach; and (iii) methodology, tools, and project execution plan.

During the kick-off meeting with UNOPS team, the UNOPS team introduced themselves, provided background information on the ETP, its governance structure, strategic objectives and project background. The UNOPS team also presented the contract management notes, communication requirements and contacts of UNOPS relevant stakeholders.

Siemens presented their team, project objectives, and approach to project implementation and data gathering, highlighting the core data requirements and documentation needs throughout the various phases of the project (kick-off meeting slides attached). The meeting aimed to create transparency regarding data needs, address data gaps, and reach alignment on the selection of specific grid segments for further analysis.

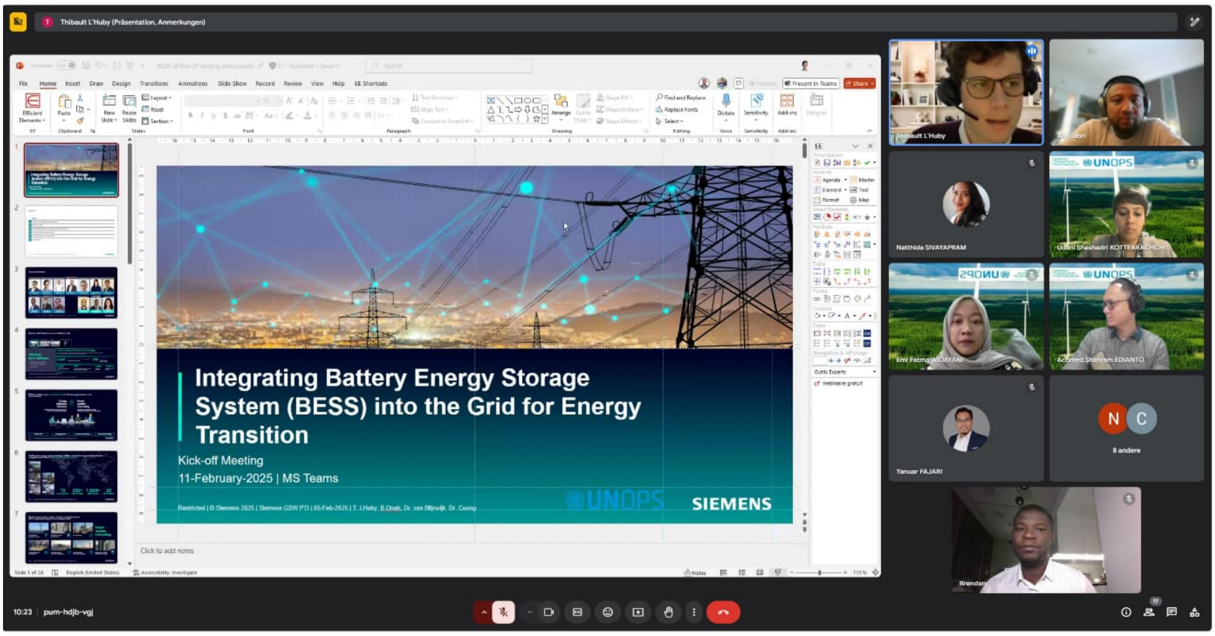

Figure 2-2 Siemens presentation during the kick-off meeting **(Source:** UNOPS**)**

The **working modalities** for the project execution were thoroughly discussed and aligned upon. To this effect,

- Single points of contact were identified on Siemens and UNOPS side.
- **Weekly or biweekly progress update meeting** is planned as a means of regular communication.

To facilitate efficient collaboration, a **common document management structure**, including a shared folder and defined access rights, was established. There are several points during the kick off meeting with Ministry of Energy and Mineral Resources (MEMR), recommends that studies always refer to the Regulations in Indonesia such as the National Electricity General Plan (RUKN), MEMR Ministerial Regulations, National Electricity Supply Business Plan (RUPTL), doing Techno-Economic Analysis on Electricity Tariffs for the impact of integrating BESS into the Grid, considering the BESS that has been implemented in tropical countries to be studied in the Indonesian environment, and also the components should be easy to find in Indonesia market.

Figure 2-3 Kick-off meeting with Directorate of Various New and Renewable Energy, DG NREEC, MEMR on 13th February 2025 (Source: Siemens)

Figure 2-4 Directorate of Electricity Engineering and Environment, DGE MEMR on 14th February 2025

The Consultant will provide **the inception report**, incl. an executive summary, identifying the current sector trends, developments and challenges.

2.3 Phase 2: National BESS standard development

Tools: N/A

Deliverables:

- Draft of national standards (SNI) for BESS
- 8 full day of technical committee meetings in 4 locations (Jakarta, Bogor, Depok, Tangerang) will be held in Jakarta or it can be flexible depending on the beneficiaries

This output aims at defining standards for BESS deployment in Indonesia, including but not limited to safety, reliability and efficiency, based on current state of BESS technology and international best practices. The technology focus will be given on Lithium-based batteries (including NMC and LFP technologies). Novel technologies, such as RedOx flow batteries, are excluded from the scope of this proposal.

2.3.1 Assess current Indonesian energy policies and technical guidelines related to energy storage

Description: A first meeting will take place with the Consultant team and relevant MEMR participants will refine the desired outcomes for the establishment of national standards on BESS equipment and deployment in Indonesia, in particular on safety, quality, environmental aspects, performances, testing and grid interoperability. Key external stakeholders (including, but not limited to, relevant PLN personnel, manufacturers, industry experts, university researchers, komite Teknis BESS, other government agencies) relevant to the delivery of this work package will also be identified during the kick-off. Prior to the kick-off, the Consultant will provide a list of desired profiles and expertise for interviewing as well as a data request that will be shared with MEMR in order to facilitate the identification phase during the kick-off.

Following the kick-off workshop, the Consultant team will engage in interviewing the identified internal and external stakeholders to evaluate the current status of applicable norms for BESS deployment in Indonesia and requirements to achieve the desired outcome. The Consultant will in the meantime review available documents, studies, reports, on existing standards which would be provided by the MEMR.

2.3.2 International Benchmarking of International best practices on BESS standards

Deliverable: List of relevant international standards and norms identified as well as their applicability in selected geographies

Description: The Consultant will review the main applicable standards in the BESS industry, including, but not limited to:

- IEC norms, such as safety and operations security tests (IEC TS 62933-2-2:2022) and for performances and grid interfaces (IEC TS 62933-3-1:2018);
- IEEE norms, such as BESS connectivity (IEEE 1547-2018), performance (IEEE 1679.1-2017) and operability (IEEE 2030.2-2015);IEC Norms, Planning and performance assessment of electrical energy storage systems (IEC TS 62933-3-2:2023)

- UL standards for safety and reliability approvals (UL 1973), thermal runway management (UL 9540A)
- ISO norms for quality aspects (e.g. ISO 9001)
- Any other norms, such as maximum noise level at a certain distance or acceptance level of electromagnetic perturbations

The Consultant will also define with the MEMR the main geographies to be benchmarked with and will highlight the applicable norms and standards within these geographies. Geographies may include the USA, Germany or China as they are the most advanced in BESS deployments, and countries such as Thailand, which have similar characteristics as Indonesia.

2.3.3 Develop National standards specifically for BESS to support development of BESS in Indonesia

Deliverable: Draft of national standards (SNI) for BESS according to the list agreed by MEMR

Description: By comparing on the insights from WP02-1 (desired outcomes) and WP02-2 (benchmark of best practices), the Consultant will conduct a gap analysis and will draft a list of International Standards that would be needed to support the deployment of BESS in Indonesia to achieve the desired outcomes. The list of identified international standards will be then reviewed and validated by the MEMR.

Following the review, the Consultant will check with MEMR regarding updates to International Standards and adapt & translate the international standards into national standards in the SNI report, which will include:

- Translation and adaptation of applicable IEC standards, including IEC TS 62933-2-2:2022 and IEC TS 62933-3-1:2018, covering part of safety testing, performances testing and grid interfacing
- Translation and adaptation of any other identified norms or standards (e.g. from IIEEE, UL) relating to safety, environmental aspects, quality, performances and interoperability

The SNI report will later be validated by the MEMR.

2.3.4 Technical Committee Meetings on specific IEC norms for BESS integration in Indonesia

Deliverable: Organization and moderation of 8 Technical Committee Meetings

Description: Following validation of the SNI by the MEMR, the Consultant will organize 8 full days of Technical Committee Meetings (TCM) in Jakarta, Bogor, Depok and Tangerang. These meetings will be presented in Bahasa Indonesia. Each TCM will be focused on the translation and adaptation for the Indonesian market of the IEC TS 62933-2-2:2022 and IEC TS 62933-3-1:2018 norms. Each TCM will last one full day.

Prior to the TCMs, the Consultant and the MEMR will jointly collaborate to define the list of participants (minimum 20 per TCM), ensuring that information will be disseminated efficiently during the TCM.

2.4 Phase 3: Techno-economic analysis of BESS integration

Deliverables:

- A comprehensive report that details the economically ideal range for BESS deployment on the level of individual Indonesian regions.
- Maps, charts, and visualizations generated from PLEXOS data showing high-priority BESS locations, their corresponding capacities, and the services they would provide.
- Scenario analysis demonstrating how optimal locations and scales change under different future scenarios.

Tools: PLEXOS

Description: The first step of this phase is to understand and estimate the benefits of deploying BESS on Indonesian electricity grid, by both analyzing various use cases (with and without collocated renewable resources) and revenue streams and identifying optimal location to serve these use cases. The second analysis focuses on cost-benefit analysis versus a reference baseline scenario where BESS are not installed on the grid.

	WPs	Activity	Geo.	Month					
				2	3	4	5	6	7
WP-03: Techno economic analysis	WP03-1	Grid data and energy market collection	IND						
		Geographical and RE data collection	DE						
		Use cases identification	DE						
		Techno economic analysis	DE						
		Sensitivity analysis	DE						
	WP-03.2	Data collection	IND						
		PSSE Model setup	IND						
		Steady state analysis	IND						
		Dynamic studies	IND						
		Grid congestion management	IND						
	WP-03.3	Data collection from literature	DE						
		LCOE Model setup	DE						
		Report redaction	DE						
		Techno economic workshops and policy brief	DE						
	WP-0:	Business models elaboration	DE						
		Report redaction	IND						
	WI	Business models workshops and policy brief	IND						

Onshore activity
Offshore activity
Deliverable

2.4.1 Identify and evaluate use cases including optimal locations and scales for BESS deployment in Indonesian power system

In this task, we will identify and evaluate a variety of use cases for utility-scale BESS deployment within Indonesia's power system using PLEXOS, a powerful, industry-standard software for modeling energy markets and systems. This process aims to select the most suitable locations and optimal scales for BESS installations aligning with Indonesia's energy transition goals.

BESS provides a source of flexibility that is especially relevant in the presence of higher shares of variable renewables. Unlike conventional power plants, the power output of these sources typically does not follow the patterns of demand. Both renewable generation and demand exhibit fluctuations on an hourly, daily, and seasonal basis.

In order to use a model simulation to analyze the benefits that BESS can provide, it is necessary to model the operation of a power system with a sufficiently small time step that captures the variations in both renewable supply, the demand for electricity, and the constraints that affect the technical capacity as well as costs of conventional power plants to adjust their output in response. The use of a one-hour time step is typically appropriate for analyzing the effects of integrating higher shares of renewables in the system and the role of BESS. It enables capturing the weather variations that affect renewable power output and the (dis)charging characteristics of batteries that can typically store or provide electricity for a period measured in hours.

Modeling the Indonesian power system with a one-hour time step requires that input data is available with hourly granularity. Most crucially this requirement relates to electricity demand patterns and availability patterns of renewables. For other parameters Siemens expects to be capable of making founded assumptions that will not substantially affect the conclusions of this study. Any such assumptions will be presented and discussed with the UNOPS team before their implementation in our power system models.

The Indonesian power system is not a single, fully integrated grid but consists of a collection of different power systems on many different islands. It is relevant to take the specificities of different islands regarding demand patterns and generation capacities into account in order to arrive at meaningful recommendations regarding the integration of BESS. Siemens intends to model different regions of Indonesia individually provided that differentiated data for each of these regions is made available. The integration of BESS into the grid will also involve the Directorate of Electricity Business Development that handles the regulation of grid rules.

Our modeling approach consists of the following steps:

Data Collection and Pre-Processing:

Power System Data: We will collaborate closely with PT PLN (Persero) and other stakeholders to collect vital data on Indonesia's generation, load, and grid infrastructure to enable the construction of a power system model using the PLEXOS software that accurately represents the system's capabilities to accommodate the load over 8760 hours of the year. Part of the data is likely to come from PLN, such as the long term scenario for 2045 and 2060. This will include:

- Region-specific demand profiles and growth projections.
- Evaluate scenario assumptions for 2030, 2045, and 2060.
- Installed thermal generation capacity information, including technical plant parameters.
- Renewable energy capacity information, including solar, wind, hydro, and geothermal power plants, including availability patterns and constraints.
- Transmission constraints between regions.

Geographical and Renewable Energy Resource Data: Through PLEXOS's Geographic Information System (GIS) capabilities, we will integrate the data that was provided on **solar irradiation and wind patterns.** By leveraging meteorological datasets to assess the spatial-temporal variability in renewable resource availability, we ensure that the effect of locational and temporal variability of solar and wind infeed is adequately considered, as these are likely to be important drivers for the business case of BESS.

Electricity Market Data: Gathering data on demand patterns and other economic variables essential for determining the feasibility of BESS projects in different market conditions.

Use Case Identification and Evaluation:

Using PLEXOS's extensive simulation capabilities, we will explore utility-scale BESS use cases individually for different regions of Indonesia: Jamali, Sumatra, Kalimantan, Sulawesi and other systems Maluku, Papua, Nusa Tenggara, Madura, Nias, Mentawai, Simeulue, Sabang, Thousand Islands (Pulau Seribu), Ternate, Ambon, and Morotai. A small number of other isolated grids may be considered individually as well.

The analysis of BESS use cases will consider:

- **Energy arbitrage:** Analyzing the viability of BESS for energy arbitrage (i.e., charging when electricity prices are low and discharging during peak price periods), particularly in Indonesia's largest load centers such as Jakarta.
- **Load shifting and peak shaving:** Evaluating the potential of BESS to shift loads from peak to off-peak hours to alleviate grid stress and reduce curtailment of renewable energy during high generation periods.
- **Spinning and non-spinning reserves:** Assessing BESS participation in reserve markets, enabling PLN to maintain system reliability with reduced reliance on traditional fossil-based spinning reserves including smoothing, ancillary services, etc.

Use cases will only focus on utility-scale applications. Behind-the-meter (BTM) use cases (such as Time of Use, BTM Peak shaving, self-consumption) will be considered on an aggregated level.

Techno-Economic Optimization of BESS Sizing and Location:

Scenario Definition: Based on data collection and input received from the UNOPS team and from the MEMR, we will define energy system scenarios for the years 2030, 2045, and 2060, considering factors such as:

- **Varying renewable energy penetration levels.**
- **Conventional generation capacities, including the (gradual) phase-out of coal-fired power plants**.
- **Demand development and patterns.**
- **Different grid conditions and levels of congestion, including the level of inter-island connectivity.**
- **Economic drivers, such as fuel prices.**

The contents of the scenarios that are to be used for simulation will be discussed with the UNOPS team prior to their implementation and use in the PLEXOS model. Siemens will make any adjustments requested by UNOPS and MEMR to ensure that the scenarios, which form the basis for all following conclusions, are aligned with the expected development of the Indonesian power system and the policy goals set by relevant authorities.

Optimization via PLEXOS:

- Using PLEXOS's Mixed-Integer Programming (MIP) solver, we will optimize the size, location, and operational strategy of BESS to maximize system reliability and cost-effectiveness.
- The model will simulate various market and operational conditions, optimizing BESS operations for a wide array of services such as capacity support, load leveling, and frequency response.
- We will incorporate regional differences in demand profiles, renewable energy development assumptions, and grid conditions to ensure that BESS deployment is regionally tailored.

Sensitivity Analysis and Robustness Testing:

Sensitivity analysis will be performed to assess the impact of key variables (e.g., fuel prices, renewable energy expansion rates, regulatory changes) on the optimal BESS configuration. We will run sensitivity analyses to account for uncertainties in:

- **F**uture renewable energy penetration rates in combination with the gradual phase-out of coal-fired electricity generation.
- Variations in demand growth.
- Cost of installing BESS.

Robustness Testing: Simulations will also consider extreme conditions such as:

- **High renewable generation volatility** (e.g., cloudy days or low-wind conditions).
- **Stress testing for high-demand periods** (e.g., holiday seasons, industrial peaks).

2.4.2 Perform detailed energy modelling and network studies for BESS integration with renewables

Deliverables:

- A detailed technical report summarizing the results of steady-state and dynamic network studies using PSSE.
- Load flow and stability analyses demonstrating the impacts of BESS on grid performance.
- Dynamic response simulations showing how BESS improves grid stability, frequency regulation, and voltage support.
- Recommendations for optimal BESS control strategies and operational protocols to maximize the benefits of BESS integration with renewable energy.

- Simulated scenarios visualized in the form of PSSE plots, tables, and graphs to illustrate the performance of the grid under different conditions.

Tools: PSS®/E

Description: The primary focus of this task is to conduct detailed energy modeling and network studies using PSSE (Power System Simulator for Engineering) to assess the technical feasibility and impact of integrating BESS into Indonesia's grid, particularly in conjunction with large-scale renewable energy sources. The study will focus on grid stability, reliability, and resilience under various scenarios of BESS and renewable energy integration.

Detailed Process:

Energy Modeling with PSS/E:

Model Setup:

- Utilize PSSE to simulate Indonesia's transmission and distribution network under different BESS integration scenarios. The simulation will include both steady-state and dynamic models of BESS in combination with large renewable energy plants.
- Model different BESS configurations (e.g., central storage at transmission hubs vs. distributed storage at load centers).

Scenario Definition:

- Define multiple integration scenarios that vary BESS sizes, locations, and control strategies (e.g., fast frequency response, voltage support, energy arbitrage).
- Include different levels of renewable penetration to understand the interaction between renewables and BESS across a range of operating conditions.

Steady-State Analysis:

Load Flow Studies:

- Perform power flow analyses under various loading conditions to assess the ability of the grid to handle large-scale BESS deployments.
- Evaluate the impact of BESS on voltage profiles, power flows, and losses, particularly in regions with high renewable energy penetration.
- Analyze grid bottlenecks and weak points that could be alleviated by strategically located BESS.

Voltage Stability:

- Perform voltage stability studies to assess BESS's ability to maintain voltage levels within acceptable limits during high renewable generation periods or in regions where the grid is already strained.
- Simulate scenarios with sudden variations in renewable generation (e.g., rapid drop in solar or wind output) and analyze the role of BESS in mitigating such events.

Dynamic Studies:

Frequency Response Studies:

- Simulate the dynamic performance of the grid with BESS providing fast frequency response following disturbances (e.g., generator trips or large load rejections).
- Quantify the contribution of BESS to frequency regulation, ensuring that the grid can recover quickly from frequency excursions caused by intermittent renewables.

Transient Stability Analysis:

- Perform transient stability analysis to assess the grid's resilience to large-scale disturbances, such as loss of a major power plant or a critical transmission line.
- Simulate the BESS response under different fault conditions (e.g., short circuits, load shedding) to ensure that BESS deployment improves grid stability without introducing new vulnerabilities.

Integration with Renewable Energy:

- Assess the interaction between BESS and renewable energy sources, particularly their combined impact on system inertia, reserve margins, and power quality.
- Study the coordinated dispatch of BESS and renewables to minimize curtailment of renewable energy during periods of high generation and low demand.

Grid Congestion Management:

Congestion Relief:

- Use PSSE to simulate how BESS can alleviate transmission congestion, especially in areas with high renewable generation and limited grid capacity.
- Model how BESS can enable better utilization of renewable energy by storing excess generation during off-peak periods and discharging during peak demand periods, reducing the need for curtailments or expensive grid upgrades.

2.4.3 Carry out financial evaluation of BESS deployment scenarios considering use cases incl. LCOE

Description: Objective is to calculate high level investment requirements for each scenario developed in WP 3.2.3.2, which must be compared to a baseline scenario where renewables and BESS are not prioritized versus fossil fuel power plants. The Consultant will then evaluate the additional levelized cost of electricity (LCOE) from BESS deployment for all these scenarios.

Prior to the analysis, the Consultants will gather from literature reviews, its own experience from the BESS sector and from industry expert interviews the necessary data. Key data include:

- CAPEX (USD/kWh) for BESS, Balance of Plant (BoP) and power containment systems (PCS)
- DEVEX (USD/kWh) for project development, EPC, groundwork, personnel salaries
- OPEX (USD/year) for maintenance, software licenses, insurance
- Cost of capital (WACC)

A detailed data request will be provided to the Client beforehand.

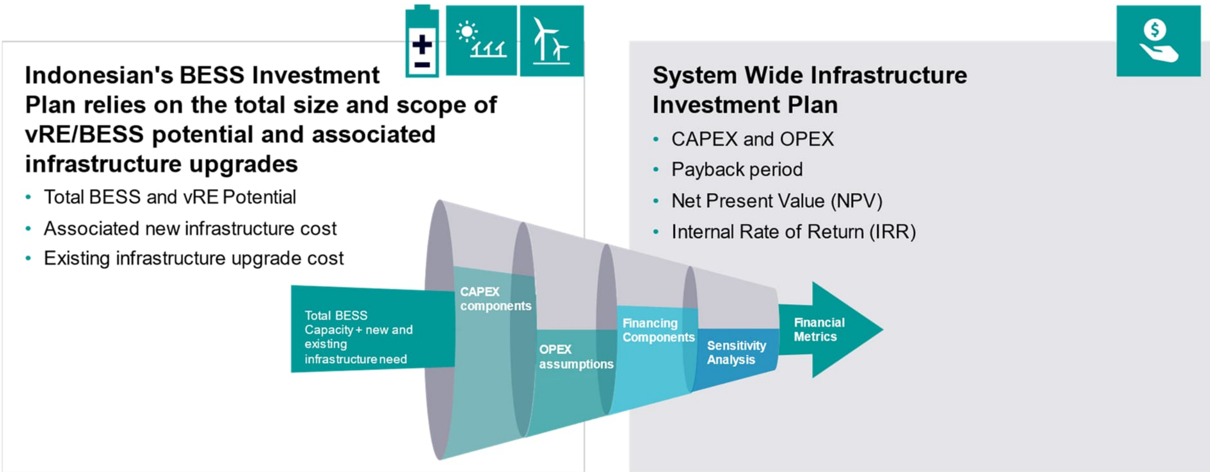

Figure 2-5 Our holistic financial model will evaluate all the cost components relevant for BESS integration. (**Source:** Siemens)

The LCOE of BESS will be compared to the added value or saved costs on Indonesian Power system versus the baseline scenario and consolidated in Net Present Value (NPV) calculation.

Finally, a detailed sensitivity analysis will be carried out to investigate the influence of individual cost and value streams on the investment program NPV (while isolating all others).

Once the investment scenarios have been considered for all scenarios, the Consultant shall identify, in close consultation with the UNOPS team and relevant stakeholders, the optimal scenario for the BESS expansion plan for Indonesia. Key metrics for evaluating the most optimal scenario will be defined and agreed with the client and may include one or multiple of the following criteria:

- Maximization of the NPV
- Minimization of CO2 emissions
- Minimization of grid outage times
- Minimization of upfront CAPEX

Results will be presented in a report and disseminated in two half-day Hybrid workshops organized in the Jabodetabek region. If The Client agree, Hybrid workshops can be combined with those in WP-03.5.

2.4.4 Identify and evaluate BESS deployment and operation business models tailored to fit the Indonesian national context

Description: In this work package, we will develop and evaluate the business models necessary to effectively deploy BESS in Indonesia. The business model for BESS integration depends largely on the identified use cases in WP 03-1. BESS business models are based on two main revenue streams:

- **Power revenues ($/kW):** BESS are remunerated based on their ability to deliver power during short periods of time, or to maintain available power on demand. Use cases include capacity firming, primary frequency reserve, demand response
- **Energy revenues ($/kWh):** BESS are remunerated for every kWh discharged to the grid, for energy arbitrage and energy shifting, or secondary frequency reserve

The Consultant will identify existing business models in key geographies (such as the USA, Germany, the UK, South Africa or Australia) and select with the MEMR those which are relevant for Indonesian market, considering applicable regulations and energy market design.

The identified business models will be prioritized in alignment with UNOPS and MEMR to derive the models suited to Indonesian market conditions, customer types, and regulatory environments. Three models will be identified based on prioritization for in-depth analysis. For each model, a blueprint contractual and financial structure will be developed, with the following approach:

- **Definition of the scope of the project:** parties involved, assets to be financed, size, technology, geography, duration/term, etc.
- **Identification of market barriers to private sector participation:** technical, regulatory, financial, etc.
- **Business model design** to include
    - revenue streams.
    - payment processes.
    - scope of responsibilities for partners to include acquisition, installation, financing, maintenance, operation, post-implementation handover.
    - Additional technology required for the business models
    - risk mitigation, management and transfer.
- **Outline of a blueprint contractual and financing structure:** contracts to be put in place between the public and private parties involved, money flows, government / third-party support required, etc.

Applicability of the financing solutions, including financial incentive-based solutions will be an important factor for consideration.

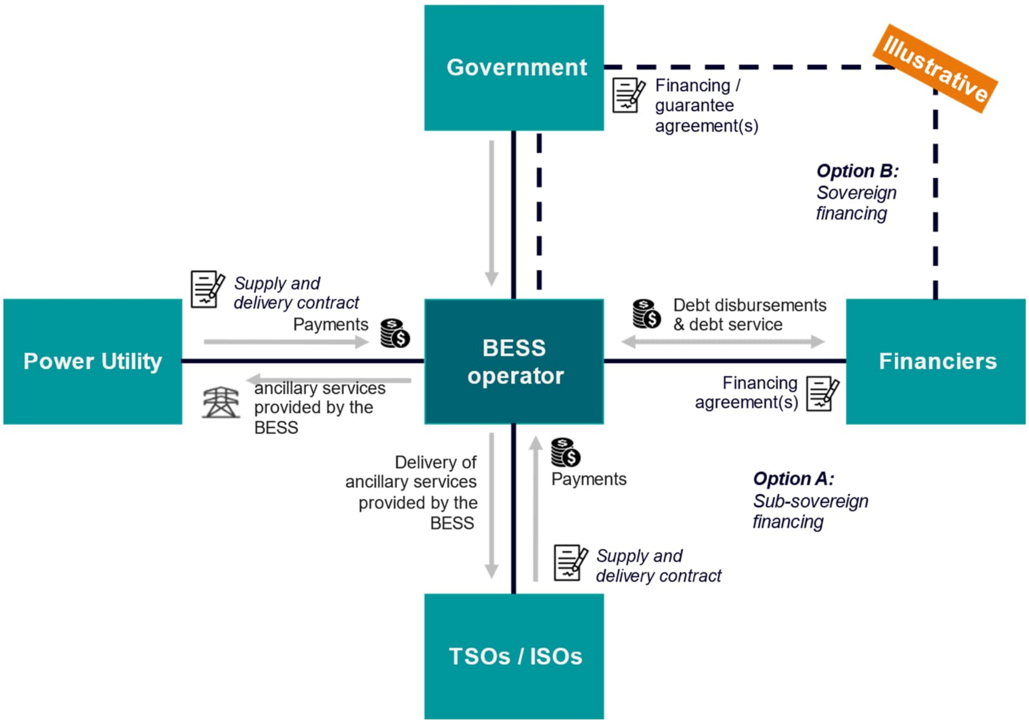

Figure 2-6 Exemplary for options for financing. (**Source:** Exemplary results by Siemens).

Deliverable: List of tailored business models and associated blueprint contractual structure for Indonesian market

2.4.5 Carry out techno-economic analysis workshops

Two half-day workshops will be organized in the Jabodetabek region in hybrid mode where there will be live interpreter along with. Each workshop will cover half day duration where the output from the assessment with model-based analysis of BESS Integration and the BESS deployment and operation business model in Indonesia will be disseminated. It is considered as to cover the gender equality and social topics; the workshop participants shall be considering the minimum percentage of women participants.

The list of the participants will be coordinated prior the workshop invitation is sent out. The feedback of this workshop will be also part of the report provided post workshop event.

2.5 Phase 4: Integrated Policy Framework and Roadmap for BESS Integration

Description: To effectively integrate BESS into the grid, it is important to have strong transactional and institutional frameworks in place. These frameworks need to be flexible and adaptable to accommodate the variable nature of renewable energy. For example, they may need to allow for the buying and selling of electricity on short-time scales, such as hourly or even minute-by-minute, to match supply with demand. Furthermore, these frameworks need to provide a clear and stable policy environment that encourages investment in BESS, while also ensuring that the integration of BESS into the grid is done in a way that is fair, efficient, and sustainable.

This includes regulations on issues such as grid access, pricing, and interconnection. Therefore, in this task, the readiness of the Indonesian market and institutional framework for BESS integration will be assessed and benchmarked against regional and global best practices to identify their key gaps and shortcomings. Thereafter, a suite of recommendations is designed to maximize the smooth BESS integration potential in Indonesia.

	WPs	Activity	Geo.	Month 8	Month 9	Month 10	Month 11
WP-04: Integrated Policy framework and BESS roadmap	WP-04.1	Mobilization with MEMR stakeholders	DE				
		Interviews of relevant stakeholders	DE				
		Identification of pain points	DE				
	WP-04.2	Benchmark of existing policies	DE				
		Gap analysis for each icentive	DE				
		Results presentation to MEMR	DE				
	WP-04.3	Review and recommendation on PPA structure	DE				
		Review and recommendation on financing structure	DE				
		Review and recommendation on subsidies and funding	DE				
	WP-0	Overall Policy framework elaboration	DE				
		Review with the MEMR	DE				
	WP-0	BESS integration roadmap	DE				
		Pilot sites identification	DE				
	WI	Technical workshops	IND				

Deliverable:

- Integrated policy framework
- Roadmap for BESS deployment in Indonesia
- Pilot sites identification

2.5.1 Assess the current regulatory framework governing energy storage and renewable integration and identify policy gaps

Description: For the As-Is assessment, the existing market situation of the BESS in Indonesia is assessed in terms of contract documentations, regulatory frameworks, and ease-of-doing business. It will further include the following activities:

- Identify potential barriers and hurdles for private investors. It will include a special emphasis on the commonly found issues such as lack of regulations and market participation rules, lack of business case transparency, availability of required capabilities (project delivery, skilled workforce), flexibility of business models, degree of prevalence of practices related to insurances, hedging etc.
- Review existing market structures for BESS procurements in Indonesia. It will mainly include a review of procurement processes such as competitive bidding (tender, location-specific demand), direct award (bilateral contracts), RE auctions (allowing trading mechanism to supply capacity for the given demand). Additionally, prevalence of different contract types,

e.g., build, own, operate, transfer (BOOT) or PPA along with practices in different contract stages will also be evaluated.

- Furthermore, market obstacles for distributed generation such as regulatory and organizational matters, access to soft loans, approach towards technological innovation will be evaluated.

2.5.2 Identify regulatory gaps and opportunities for incorporating BESS, such as energy storage mandates, market incentives, and grid codes, based on international best practices

Description: Similarly to work performed in WP 02, the Consultant will benchmark applicable regulations and policies in selected geographies, such as the USA, China, Germany or South Africa.

This benchmark will focus, but will not be limited to, on the following policies and their impact in the relevant regions:

- Direct investment incentives, such as tax credits or grants for BESS / renewable deployments
- Other tax rebates, such as exemption of green taxes
- Public tenders, such as innovation tenders
- Creation of public infrastructure funds
- Electricity market access for aggregators / VPPs
- Adoption of Feed-in tariffs and Contract for Differences
- Adoption of Guarantee of Origins for BESS
- Implementation of green taxes on electricity paid by consumers, such as *EEG levies* in Germany
- Grid fees exemptions

In a second step, for each identified incentive, the Consultant will evaluate the required steps for it to be implemented in the Indonesian market as well as the costs for the main stakeholders. In a third step, the Consultant will share and validate its findings with MEMR stakeholders

2.5.3 Create a Power Purchase Agreement (PPA) guidance specific to BESS, including funding mechanisms, such as public-private partnerships (PPP), international financing, and subsidies.

Description: The Consultant will develop a comprehensive PPA guidance, which will include:

- A review of the different PPA options and recommendation on the structure of the PPA (e.g. Feed-in tariff, merchant PPA, Pay-as-consumed, Contract for Differences, Hybrid PPA)
- A review and recommendation on asset financing options for BESS, depending on the options chosen for the PPA structure (e.g. PPP setup, creation of SPVs)
- A review and recommendation on public funding, with subsidies and tax levies

The PPA guidance report will be established in closed collaboration with the MEMR and other relevant governmental agencies (e.g. Ministry of Finance, Ministry of National Development Planning).

Deliverable: Recommendation on PPA and funding structure for BESS

2.5.4 Develop a policy framework for BESS integration, customized to Indonesia's context and based on international best practices, including regulatory framework proposals to encourage widespread BESS adoption

Description: Based on the scenarios developed in WP 03, the identified steps in WP 04-2 and the recommended PPA structure in WP 04-3, the Consultant will prioritize regulations and incentives to ensure deployment target are met. Furthermore, The Consultant will evaluate the feasibility of creating a government agency responsible for:

- Supervision of BESS procurement processes involving coordination of plans, formulating, and implementing tenders, setting targets, negotiation with winning bidders, monitoring and evaluation, as well as liaising with all relevant international and national stakeholders.
- Design and enforcement of the regulatory framework, jointly with the local regulatory authority.
- Financing of pilot projects to enable quick scaling-up post validation of proof-of-concept.
- Spearhead education and awareness campaigns incl. establishment of training and certification schemes.

Other initiatives will be evaluated: establishing a green fund for pilot projects, establish framework for public tendering of BESS.

Evaluated measures should support First-of-a-Kind investments in the country, pilot projects and ensure sustainable business foundations for BESS deployment in the long term.

The Consultant will plan for 2 reviews with the MEMR stakeholders.

Deliverable: Indonesia’s policy framework for BESS integration

2.5.5 Establish Roadmap for BESS integration with clear milestones, timelines, and performance indicators

Description: The Consultant will develop a clear roadmap for BESS integration with subsequent phases. The roadmap will include:

- Objectives of each phase, measured with clear KPIs, such as, but not limited to, capacity built in MW, capacity in the pipeline of project, average cost per project and subsidy amounts, project completion time
- Identification of main stakeholders per phase and relative roles to ensure roadmap deployment success
- Possible corrective actions, should specific KPIs not be met

Illustrative – Roadmap for BESS deployment

	1 First of a kind deployments	2 Pilot projects deployments	3 Public tendering	4 Full merchant deployments
Time	24 months	24 months	36 months	n.a.
Descri-ption	• Small units (< 100 kWh) to be deployed to validate the technology fit for Indonesia Power system and gain experience on all project development steps as well as interoperability with the grid • These projects have usually high marginal costs and do not serve a specific use case • Possible sites: local universities	• Larger units (up to 1 MWh) to be deployed to validate the use cases identified in WP 03-1 (e.g. ancillary services, co-location with renewables, grid islanding) • Participants in pilot projects (e.g. project developers, EPC) will gain hands on experience with limited risks	• Preliminary sites analysis performed by MEMR • Issuance of tenders • Setup of PPPs to deploy BESS at pre-selected sites, partially funded by subsidies and/or PPA • Private bidders to answer the tenders	• Sites analysis, project development, EPC, operations are all performed by private companies, which gain revenues with optimal operations strategies on power market
Funding	Pubic	Public	Public & Private	Private
Resources planning	XX €mn Lithium BESS + inverters + BMS / EMS XX personnel required for deployment and maintenance	XX €mn Lithium BESS + inverters + BMS / EMS transformers + ground work XX personnel required for deployment and maintenance	XX €mn Lithium BESS + inverters + BMS / EMS transformers + ground work XX personnel required for deployment and maintenance	n.a.
KPIs / Milestones	3 FoaKs Ability to deliver 1 FoaK in 18 months	10 Pilots At least 1 pilot per Use Case Ability to deliver 1 Pilot in 18 months At least 3 different companies involved in the pilots	Total installed cost < XX USD/kWh Subsidy share < X % of total installed costs At least 2 offers per tender	n.a.

Illustrative

The Consultants will also provide more details regarding the pilot projects deployment phase, including candidate sites and project deployment frameworks

After review with the MEMR, the Consultant will organize two half-day workshops to present the main findings.

Deliverables:

- Phased BESS deployment roadmap, with key milestones and Integrated resources planning
- List of potential pilot projects

2.5.6 Organize and perform stakeholder workshop

Two half-day workshops will be organized in the Jabodetabek region in hybrid mode where there will be live interpreter along with. Each workshop will cover half day duration where the output from the Integrated Policy Framework and Roadmap for BESS Integration will be disseminated.

It is considered as to cover the gender equality and social topics; the workshop participants shall be considering the minimum percentage of women participants. The list of the participants will be coordinated prior the workshop invitation is sent out. The feedback of this workshop will be also part of the report provided post workshop event.

2.6 Capacity building and project finalization

2.6.1 Develop capacity building program

Description: Based on inputs from previous sections, literature reviews, and expert interviews, the Consultant will develop training materials covering on project development, project financing, subsidy mechanisms, technical topic, grid integration, maintenance, operations and safety to ensure smooth deployment of BESS in the country. To enhance audience learning, the Consultant proposes to do live demonstrations of its main software (PSS Sincal and PLEXOS) used for phase 3.

Deliverables: Training materials

2.6.2 Conduct onsite training for relevant stakeholders

The training materials will be developed based on the objectives goals which is to enhance the knowledge and capabilities of the trainees. These will include the presentations which will be led by the expert trainer, where there will also be the group discussions, simulations and hands on exercises during the training session.

Delivering the commitment of the gender and social aspects, we shall manage to make proper proportion in range of 35% women as the trainees. The list of the trainees shall be coordinated and the training materials e.g. ppt file presentation, manuals, handouts, exercises shall be submitted 2 weeks in advance to obtain approval from the ETP and government beneficiary prior to the training being conducted.

The training program shall cover the technical aspects of BESS, the grid integration, safety protocols, maintenance, operational best practices, cross-regional insights within Southeast Asia.

2.6.3 Prepare the final project report and closure

Description: The Consultant will summarize all previous findings into a single report, including an executive summary, the project background, the methodology employed, the main assumptions used, the engagement of stakeholders, clear summary of findings and recommendations, assessment of impact on Indonesia power system and economy, lessons learned and future steps. Three reviews will be planned with the Client, the MEMR and other relevant stakeholders.

Following its edition, a final workshop will be organized by the Consultant to share the main findings with relevant stakeholders.

Deliverables:

- Final report
- Final report presentation in a workshop

2.7 Gender Equity and Diversity

At Siemens, we are deeply committed to promoting gender equality and social inclusion (GESI) as a fundamental part of our mission. Our approach is aligned with the United Nations Sustainable Development Goals (SDGs), particularly Goal 5 (Gender Equality) and Goal 10 (Reduced Inequalities), ensuring that all individuals, regardless of gender, social status, or background, have equal access to opportunities and resources.

- **Gender Equality:** We strive to ensure gender-balanced representation in all aspects of our operations and programs. This includes promoting leadership opportunities for women, addressing gender disparities in hiring, equal pay, and career advancement, and fostering a workplace culture that values the contributions of all employees. We systematically integrate gender-sensitive practices into program design, implementation, monitoring, and evaluation to ensure that women's voices and needs are prioritized.
- **Social Inclusion:** Our policies and practices focus on reducing barriers for marginalized groups, including persons with disabilities, ethnic minorities, indigenous populations, and other vulnerable communities. We actively engage with stakeholders to understand the unique needs of these groups, and we design our interventions to be inclusive, accessible, and culturally sensitive. Our programs are evaluated based on their impact on social inclusion, ensuring that no one is left behind.
- **Capacity Building:** To sustain our commitments, we continuously invest in capacity-building initiatives for our staff, partners, and beneficiaries, providing training on GESI frameworks and ensuring that these principles are embedded in all stages of project cycles. We collaborate with local and international gender and inclusion experts to strengthen our strategies and improve outcomes.
- **Accountability and Monitoring:** We have established clear indicators and metrics to track our progress in mainstreaming gender equality and social inclusion. Regular assessments, feedback mechanisms, and audits ensure that our commitments translate into tangible outcomes. We report transparently on our achievements and challenges, fostering accountability to both our stakeholders and the communities we serve.

In conclusion, gender equality and social inclusion are at the core of our operations, shaping our policies, programs, and partnerships. We are dedicated to creating an environment that empowers all individuals, regardless of their gender or social status, to thrive and contribute meaningfully to society. It is considered as to cover the gender equality and social topics; the workshop participants shall be considering the minimum percentage of women participants. The list of the participants will be coordinated prior the workshop invitation is sent out. Moreover, one of the team members in this project is represented by women.

3 Project management plan

3.1 Project Timeline

Siemens has refined the project timeline, to incorporate the discussions held with UNOPS in the kick-off meeting

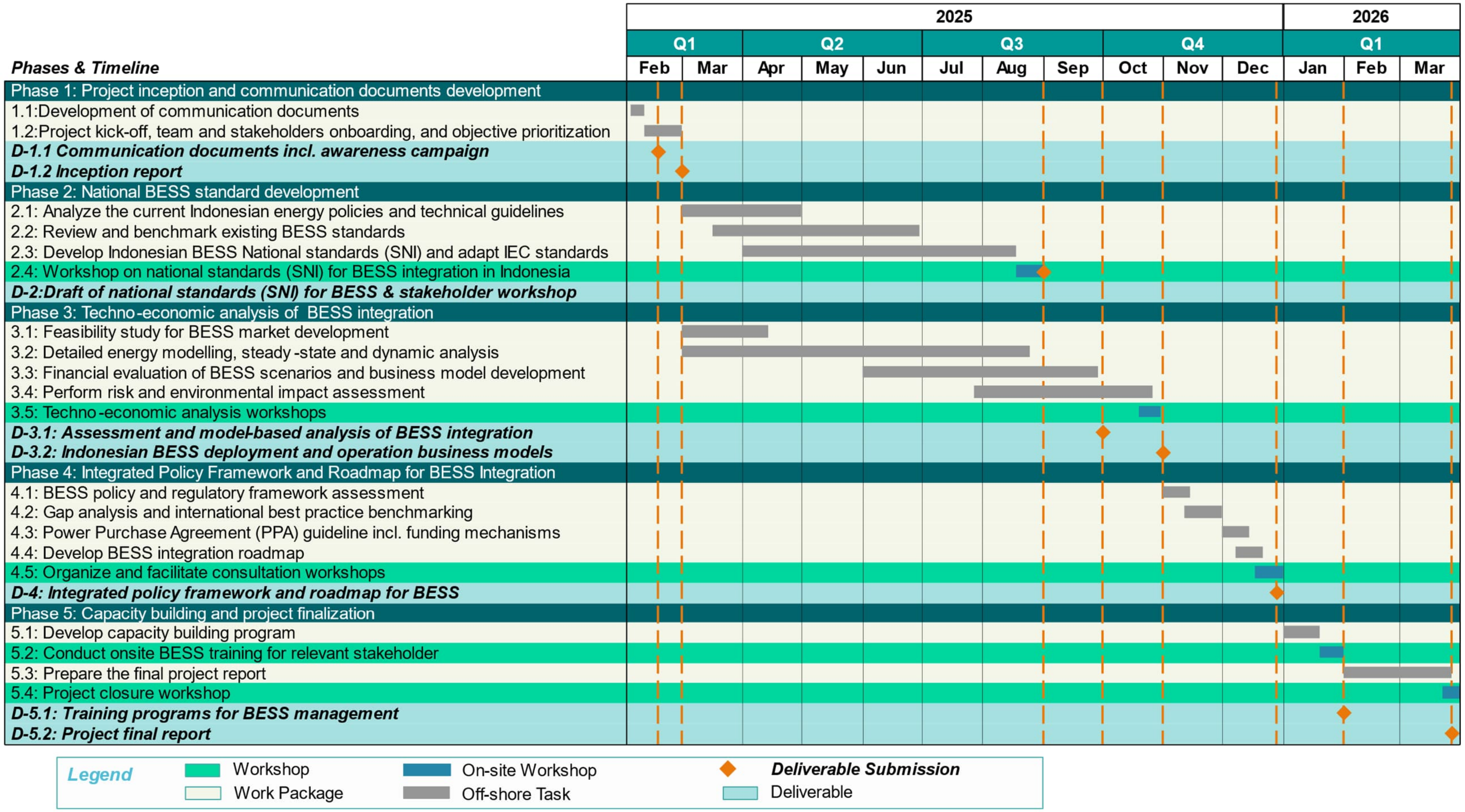

Figure 3-1 Refined Project workplan. (**Source:** Siemens).

3.2 Project Steering

To steer the mission and ensure a common consensus between involved stakeholders, our proposed experts will be integrated into the existing structure at the strategic level via our team leader and at the operational level via the international and local experts.

The pool of experts presented in the organizational structure, in Figure 3-2 will guide and support the project as required

Figure 3-2 Experts composition from Siemens and local partners to implement the project

Table 3-1 Project Core and supporting team from Siemens

S/N	Role	Contact Person	Contact
1	Team Lead	Ahmed Elguindy	ahmed.elguindy@siemens.com
2	Energy Policy Specialist (Siemens fo-cal contact)	Thibault L'Huby	thibault.lhuby@siemens.com

3	Local Energy Policy specialist	Ade Firmansyah	
4	BESS Technical Specialist	Tarik Donlagic	tarik.donlagic@siemens.com
5	Energy Market Specialist	Martti van Blijswijk	martti.van-blijswijk@siemens.com
6	Local Energy Market Specialist	Vita Listyaningrum	vita@ee.its.ac.id
7	Energy Modeller	Cuong Nguyen Mau	cuong.nguyen_mau@siemens.com
8	Energy Modeller	Brendan Onah	brendan.onah@siemens.com
9	Energy Modeller	Ontoseno Penangsang	ontosenop@ee.its.ac.id
10	Energy Modeller	Chandra Agung Ramadhan	chandra-agung.ramadhan@siemens.com
Siemens Project Support Team			
11	BESS Technical Specialist	Ahmed Amin	ahmed.amin@siemens.com
12	Energy Policy Specialist	Mohamed Hafez	mohamed.hafez@siemens.com
13	Energy Market Specialist	Hagar Abdelnabi	hagar.abdelnabi@siemens.com

Table 3-2 Project Management Team from Siemens

S/N	Role	Contact Person	Contact
1	Project Manager	Renold Partogi	renoldpartogi.lumbantoruan@siemens.com

2	Commercial Project Manager	Elice Hartati	elice.hartati@siemens.com
3	Commercial Project Specialist	Naura Kretya Aulia	naura-kretya.aulia@siemens.com
4	Marketing Specialist and Social Media Engagement	Vania Hutagalung	vania.hutagalung@siemens.com

Table 3-3 project steering team from UNOPS

S/N	Role	Contact person	Contact
1	Technical project implementation/ Monitoring	Emi Fatma Widayani	emiw@unops.org
2	Contract management & payment	Natthida Bachalski Ruy	natthidas@unops.org xiaoyul@unops.org
3	Deliverables extension request	Emi and Natthida	emiw@unops.org natthidas@unops.org
4	Contract amendment	Emi, Natthida and Chandany	chandanyu@unops.org
5	RBMF reporting	Nhung Nguyen	nhungthin@unops.org
6	Communication materials/ media related	Sheshadri	udanik@unops.org

3.3 Data Collection Plan

Siemens has developed a comprehensive data collection plan to gather the necessary information for the BESS integration study in Indonesia. The plan includes multiple sources of data, as shown in Figure 3-3 ensuring a thorough and robust analysis. Here is an expansion of each point in the data collection plan:

- **Previous Reports (UNOPS, ETP):** Siemens will review relevant prepared by the ETP and others as shared. These reports provide valuable insights into the country's climate conditions, development priorities, and investment strategies for the electricity sector. Siemens will extract relevant data from these re-ports to inform the study.
- **Ministry of Energy and Mineral Resources:** The ministry will be the main beneficiary and pivot point of contact to provide existing and produce new electricity and energy policies including RUKN, KEN, RUEN, etc.
- **PLN :** In cases where the required data is not available from the previous reports, Siemens will collaborate with PLN, Ministry of Electricity and the Statistics Office in Indonesia. Siemens will conduct interviews with key stakeholders, consult annual reports, etc. local

sources will provide specific information on the current energy landscape, infrastructure, policies, and market dynamics.

- **Siemens Data**: If the necessary data is still not available, Siemens will leverage its own data resources by utilizing project-related experiences and data from similar local or regional initiatives. To maintain confidentiality, the data will be anonymized and aggregated to ensure compliance with privacy and data protection regulations.
- **Expert Judgment:** In situations where historical or specific data is lacking, Siemens will rely on expert judgment. The experts will extrapolate older data using documented assumptions, considering any changes in the energy landscape over time. Regional averages will be used where older data is not available, ensuring a reasonable estimation of the required information. However, these assumptions will need validation and verification by UNOPS to ensure accuracy and reliability.

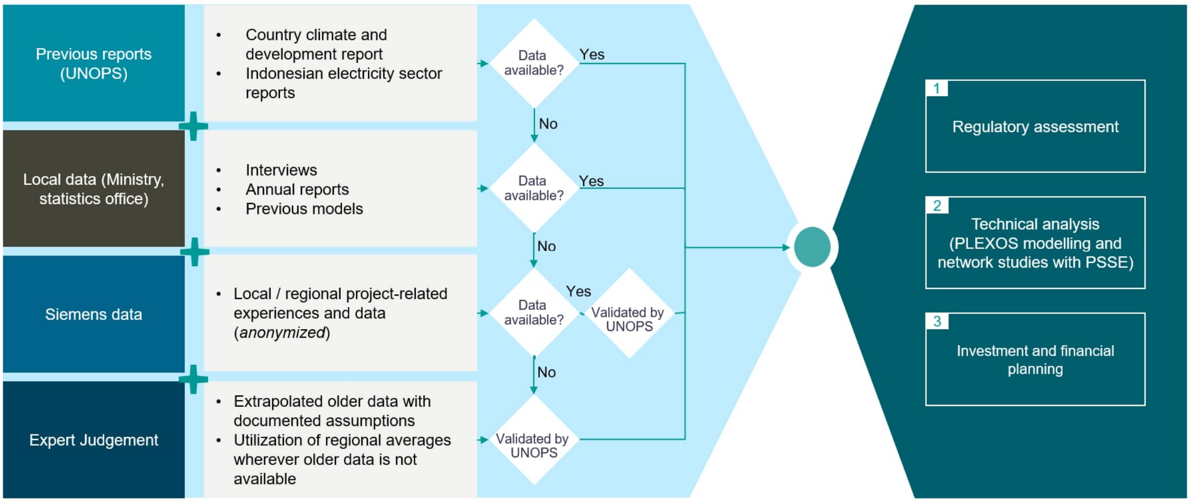

Figure 3-3 Siemens Data Collection Plan.

3.4 Reporting and deliverable submission

This reporting and communication plan aims to establish effective channels of communication, data exchange, and collaboration among the key stakeholders involved in the BESS Integration Study project as shown below.

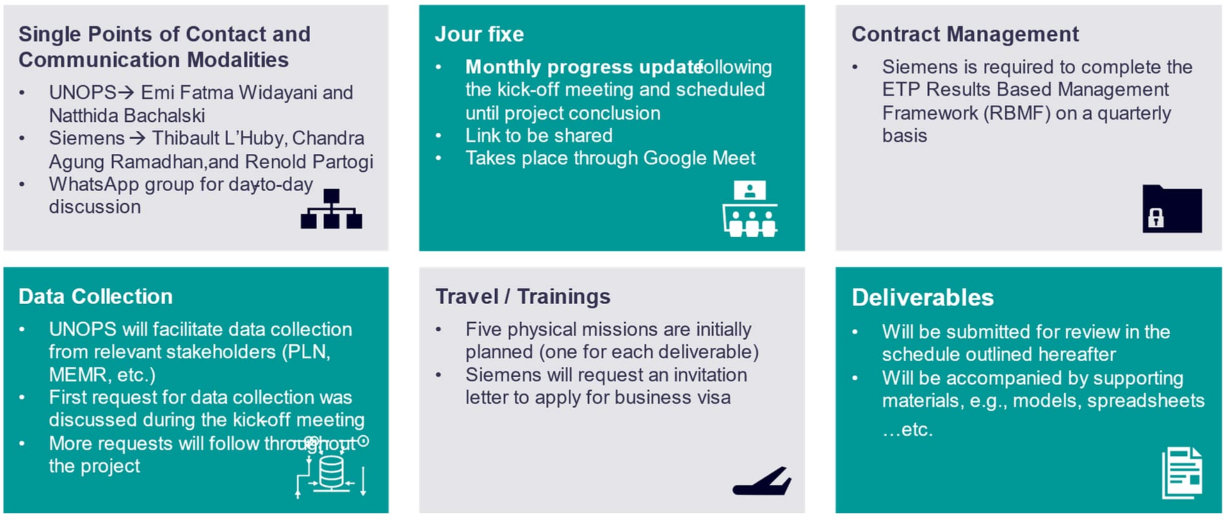

Figure 3-4 Working Modalities.

Single Points of Contact and Communication Modalities:

- **UNOPS:** The designated point of contact Emi Fatma Widayani and Natthida Bachalski. The focal points of the sub-tasks were identified during the kick-off meeting as shown earlier in Table 3-3.
- **Siemens:** Thibault L'Huby will be the primary point of contact from Siemens. Any project-related communication or queries can be directed to him.

WhatsApp Group: A WhatsApp group will be created by UNOPS to facilitate day-to-day discussions among the project team members, if needed.

Jour Fixe:

- Biweekly progress meetings will be scheduled starting from the kick-off meeting and will continue until the project conclusion per ETP provided template.
- A shared link will be provided to all participants to access the meeting.
- The meetings will be conducted using Google Meet to facilitate remote participation and collaboration.
- Reporting: The implementing partner is required to complete the ETP Results Based Management Framework (RBMF) on a quarterly basis,

Deliverables:

- A public-facing, **publishable Executive Summary** must be submitted with each deliverable.
- **A public-facing PPT presentation** highlighting key information must be submitted with each deliverable.
- All project deliverables and presentations must be submitted in English and local language (per the TOR and contract)

- **Naming of the email subject**: Contractor | Project name (short) | Submission of Milestone no
- All project deliverables will be submitted **for review based on the outlined schedule**.
- Deliverables review process initially **takes approximately 10 days turnaround** time from date of deliverables submission.
- **Delays**: For delays in deliverables submission, please ensure to write to us to seek approval for an extended submission deadline
- Supporting materials such as models, spreadsheets, and relevant documentation will accompany the deliverables to provide a comprehensive understanding of the analysis and recommendations.

Invoicing:

- Invoice should only be submitted after the deliverable is accepted and approved for payment by ETP.
- A public-facing PPT presentation highlighting key information must be submitted with each deliverable.
- Reimbursable costs should be invoiced with a table capturing the cost categories and with supporting documents. Currency exchange rate conversion to USD must be based on UNORE at the time of expenses incurred.
- For transportation or travel, the contractor must opt for the most economical and direct route (economy class ticket).

3.5 Risk mitigation strategies and assumptions

Risk1: Limited information about the energy infrastructure, resource potential, regulatory framework, or market conditions.

> **Mitigation Strategy:** Conduct a comprehensive data collection process, engage with relevant stakeholders, and leverage existing studies and reports. If data gap persists, validate data from the local entities and governmental agencies to obtain accurate and up-to-date data.

Risk 2: Limited information on regulatory frameworks and policies.

> **Mitigation Strategy:** Stay updated with the latest regulatory developments and engage with relevant government authorities to gain insights into ongoing policy discussions.

Risk 3: Inaccuracy of Assumptions and Projections.

> **Mitigation Strategy:** Collate all the data and assumptions and get them validated, ensuring they are based on reliable data and industry best practices. Clearly communicate the underlying assumptions and limitations in the report.

4 Communication Plan

The consultant has formulated the communication plan outlining the strategy for engagement of key stakeholders, ensuring project visibility and disseminating key updates throughout the project lifecycle.

The consultant is responsible for implementing the communication activities in coordination with the ETP team ensuring the following:

- Provide timely and transparent updates on project progress.
- Enhance stakeholder engagement through diverse communication channels.
- Ensure the dissemination of key project insights and outcomes to relevant audiences.
- Maintain a structured and consistent approach to project communication.

4.1 Communication plan deliverables & schedule

Table 4-1 Brief overview of communication aspects.

No	Communication Item	Description	Frequency Quantity	Responsibility
1	Social Media Posts	The Consultant will draft a 100-word text and provide at least 2 photos per post. ETP will publish the content on LinkedIn, Facebook, and Twitter.	1 post per platform per public workshop/event	Consultant (drafting), ETP team (publishing)
2	Press Releases	The Consultant will prepare a 500-word press release, which ETP will publish on its website.	1 per public workshop/event	Consultant (drafting), ETP team (publishing)
3	Articles for ETP Website	The Consultant will write impactful articles, each accompanied by at least 3 high-quality photos/graphics. ETP will publish them on its website.	2 total – 1 by mid-project, 1 upon project completion	Consultant (drafting), ETP team (publishing)
4	Project Wrap-Up Presentation	A 15–20-minute recorded presentation summarizing key project highlights, including a slide deck. This will be featured as a knowledge item on the ETP website.	1 upon project completion	Consultant (preparing content), ETP team (publishing)
5	Database of Project Photographs / videos	A collection of 15-20 high-quality images per workshop/event/activity, including action shots of key speeches, activities, and participant engagement.	15-20 images per workshop/event/activity	Consultant (capturing & organizing images)

4.2 Key stakeholders' analysis and outreach

The active involvement of key stakeholders throughout the project is crucial to ensuring its successful implementation. Their participation will facilitate smoother decision-making, enhance collaboration, and strengthen the overall impact of the project.

Stakeholder engagement will be especially critical during Phases 2, 3, and 4, as their contributions will provide essential input data required for effective project execution. Their insights, expertise, and feedback will help refine strategies, mitigate risks, and align project activities with local needs and expectations.

The identified key stakeholders, along with initial mapping, are presented in the figure below.

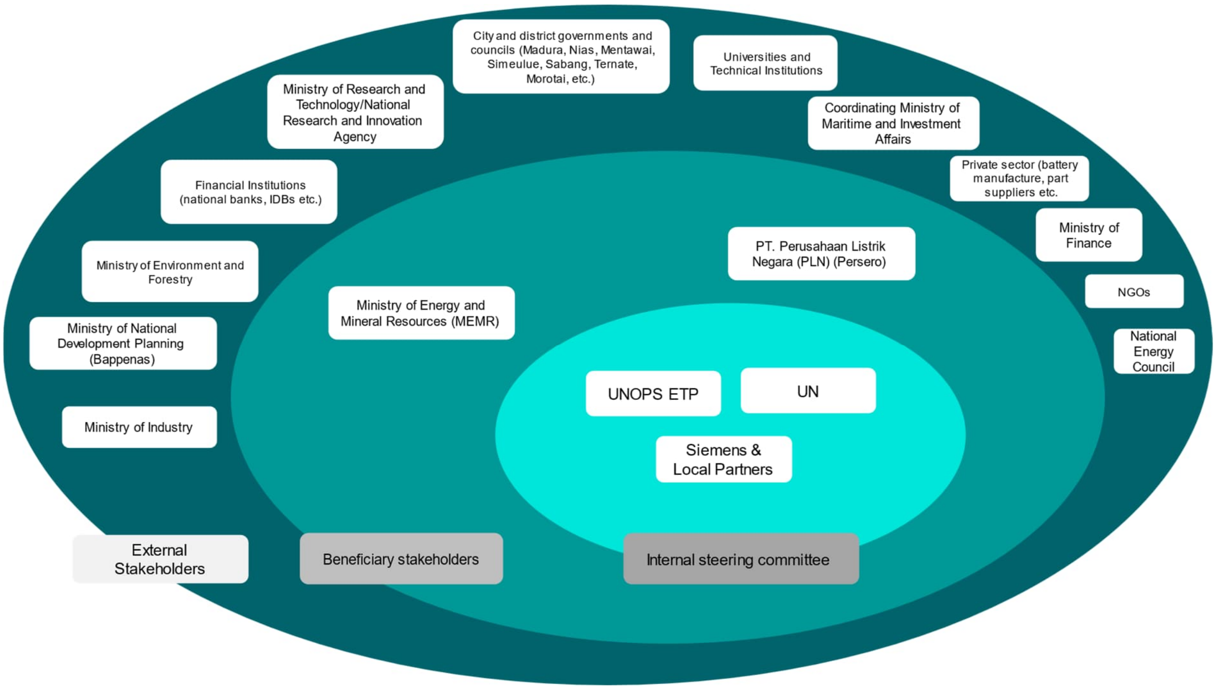

Figure 4-1 Preliminary stakeholder mapping

4.3 Donor coordination strategy

ETP funders, local representatives, and relevant development partners will be actively engaged throughout the project to communicate progress and identify opportunities for collaboration or alignment with their activities.

To achieve this, Siemens will create a slide deck for each of the main project deliverables, clearly presenting results through text and visualizations. Additionally, Siemens will prepare press releases with accompanying photos for each public event and workshop. We request ETP's assistance in providing mailing lists of relevant stakeholders interested in receiving these promotional materials.

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