Gold Standard for the Global Goals

TEMPLATE

KEY PROJECT INFORMATION & PROJECT DESIGN DOCUMENT (PDD)

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VERSION **v. 1.2**

RELATED SUPPORT

- **TEMPLATE GUIDE Key Project Information & Project Design Document v.1.2**

This document contains the following Sections

KEY PROJECT INFORMATION

GS ID of Project	GS12112
Title of Project	Liki Pinangawan Muaralaboh Geothermal Power Plant
Time of First Submission Date	06/12/2022
Date of Design Certification	TBD
Version number of the PDD	1.0
Completion date of version	27/03/2023
Project Developer	PT Supreme Energy Muara Laboh Electrabel NV/SA
Project Representative	Prijandaru Effendi
Project Participants and any communities involved	N/A
Host Country (ies)	Indonesia
Activity Requirements applied	☐ Community Services Activities ☒ Renewable Energy Activities ☐ Land Use and Forestry Activities/Risks & Capacities ☐ N/A
Scale of the project activity	☐ Micro scale ☐ Small Scale ☒ Large Scale
Other Requirements applied	"Renewable Energy Activity Requirements", Version 1.4
Methodology (ies) applied and version number	ACM0002 - "Consolidated baseline methodology for grid-connected electricity generation from renewable sources", Version 12.2.0 Standardized Baseline: Not Applicable
Product Requirements applied	☒ GHG Emissions Reduction & Sequestration ☐ Renewable Energy Label ☐ N/A
Project Cycle:	☒ Regular ☐ Retroactive

Table 1 – Estimated Sustainable Development Contributions

Sustainable Development Goals Targeted	SDG Impact (defined in B.6.)	Estimated Annual Average	Units or Products
13 Climate Action	Reduction in GHGs emissions	382,076	tCO_2e
7 Affordable and Clean Energy	Total net electricity generation supplied to the main grid from the geothermal powerplant	630,720	MWh
8 Decent Work and Economic Growth	Total number of jobs created	Construction phase: 1,800 employees Operational phase: 386 employees	Number

SECTION A. DESCRIPTION OF PROJECT

A.1 Purpose and general description of project

Liki Pinangawan Muaralaboh Geothermal Power Plant (hereinafter referred to as the project activity) is an 88.81MW greenfield geothermal power project in West Sumatera Province, along the Sumatera Fault System (SFS) in Indonesia. The project being implemented by PT Supreme Energy Muara Laboh (PT SEML) (hereinafter referred to as the project owner) is a grid connected geothermal power plant and supplies low emission power to the Sumatera grid (hereinafter referred to as the grid).

The project activity consists of one turbine of 88.81MW that is installed in the southern Muara Laboh resource area (WKP). The power plant generates electricity to export to the state-owned electricity company, PT Perusahaan Listrik Negara (herein referred to as PT PLN) via Sumatera Grid. The project activity has a net capacity of 80MW and PT PLN will buy this at 90% Take or Pay Energy (ToP).

Geothermal power is a renewable source of energy which displaces the fossil fuel fired power generation in the connected grid. Hence the project activity will reduce greenhouse gas emissions by producing electricity from a renewable resource with low carbon emissions. At the current point in time, the project activity has started the operation in 16/12/2019. The project activity is estimated to generate emission reductions equivalent to 382,076 tCO_2/year during the first crediting period. The actual amount of emission reductions may differ from this figure as they depend on the concentration of non-condensable gases in the steam (Project Emissions) and on the thermodynamic parameters of the extracted geothermal fluid.

As determined in Section B.4 (of the CDM PDD), the baseline scenario is same as the scenario existing prior to the start of the implementation of the project activity i.e. electricity delivered to the Sumatera grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources. The project boundary includes the CO_2 emissions from electricity generation in the fossil fuel fired power plants that are displaced due to the project activity and the emissions of CH_4 and CO_2 from non-condensable gases contained in geothermal steam.

Contribution of the project activity to Sustainable Development

The project is a geothermal power plant and hence diversifies the sources of electricity generation in the host country, which is important for meeting growing energy demands, and facilitates the transition away from diesel and coal-supplied electricity generation.

Contribution of the project activity to the social and economic conditions

The project intends to contribute significantly to the social and economic situation of the local people through creation of employment opportunities during the construction of the power plant besides providing employment opportunities during the operation of the plant. Approximately 1,800 people will be employed during the construction phase (Exploitation) and the number of total direct employees will be around 386 during operational phase (Utilization). Efforts will be made to source the material and labour locally to maintain local community participation.

Contribution of the project activity to the environment

The project activity utilizes available heat under the surface of earth as a source for power generation, which is considered a low emissions power source. The project activity displaces part of the electricity generated in Sumatera Grid, which is dominated by fossil fuel fired power plants, and thus reduce greenhouse gas emissions, thereby improving the air quality.

Contribution of the project activity to technological well being

The project activity utilizes environmentally safe and sound technology available in the geothermal power generation sector. The technology was procured from an Annex 1 country and hence technology transfer will take place from Annex 1 country to the host country

A.1.1. Eligibility of the project under Gold Standard

The proposed project falls under section 3.1.1 of *GS4GG Principles & Requirements* (Version 1.2), section 3 of *GS4GG Community Services Activity Requirements* (Version 1.2) and section 2 of *GS4GG GHG Emissions Reduction & Sequestration Product Requirements* (Version 2.0) with the following eligibility criteria:

Eligibility Criteria	Justification
(a) **Types of Projects** Section 3.1.1 of *GS4GG Principles & Requirements* (Version 1.2) Eligible projects shall include physical action/implementation on the ground. Pre-identified eligible project types are identified in the Eligibility Principles and Requirements section. Section 2 and 3.1 of *GS4GG Renewable Energy Activity Requirements* (Version 1.4) Section 5.1.1 of *GS4GG GHG Emissions Reduction & Sequestration Product Requirements (Version 2.1)* The Following Project types are eligible for issuance of Gold Standard VERs: a) Renewable Energy Supply; b) End-Use Energy Efficiency Improvement; c) Waste Handling & Disposal; d) Land Use and Forests.	The project meets the requirements of eligible project types as it is associated with methodology *ACM0002 Grid-connected electricity generation from renewable sources*. The project involves the establishment of a Geothermal Power Plant on the ground. The project generates geothermal energy and is thus a non-fossil fuel renewable energy project. The geothermal plant comprises of renewable geothermal energy generation units that supplies energy to a regional grid. Indonesia is classified as a Low Middle-income country[1]. However, a rule updated entered into force on 13/05/2020 that exempts Grid connected Renewable Energy projects seeking to transition from another carbon crediting scheme to GS4GG from the eligibility requirements listed in paragraph 2.1.3, of the Renewable Energy Activity Requirements[2]. This also only applies to projects that started their first crediting period with the original carbon crediting scheme from 01/01/2016 or later but before 24/01/2022. The project crediting period meets this requirement. The project qualifies as a Renewable Energy Supply project under the *GS4GG GHG Emissions Reduction & Sequestration Product Requirements (Version 2.0)*.

[1] https://datahelpdesk.worldbank.org/knowledgebase/articles/906519
[2] Rule Update: Eligibility Requirements for Renewable Energy Projects Transitioning to or Seeking Labelling under GS4GG (RU 2020 AR – RE V1.2)

(b) **Location of Project:** Section 3.1.1 of *GS4GG Principles & Requirements* (Version 1.2) Projects may be located in any part of the world. Section 3.2 of *GS4GG Renewable Energy Activity Requirements* (Version 1.4) Eligible projects may be located in any part of the world. Hydropower projects shall not be located in High Conservation Values (HCVs)12 areas. Please refer to Annex A for further information on hydropower projects Section 2.1.6 of *GS4GG GHG Emissions Reduction & Sequestration Product Requirements* (*Version 2.0*) Gold Standard VER Projects may be located in any host country or state. However, where host countries or states have mandatory operational schemes to reduce GHG emissions in any form (e.g. cap & trade, carbon tax etc.), Projects shall only be eligible if the Project Developer has either: (a) provided Gold Standard with satisfactory justification that no double counting of emission reductions occur or (b) has committed to retiring eligible units equal to the quantity of Gold Standard VERs. Refer to Annex A of this document.	The project location is in Indonesia (refer to section A.2 for the detailed project area and boundary. Indonesia has not yet put in place a cap-and-trade scheme but is still in the process of establishing one. The **Presidential Regulation No. 98/2021** on the **Instrument for the Economic Value of Carbon for Achievement of the NDC and Control of Carbon Emissions in Development** is a new regulation that serves as a legal framework for domestic carbon pricing regulations which lays out a skeleton for the upcoming ETS which will operate in conjunction with a carbon tax. While several pilot ETS were implemented for the power sector between April-August 2021, there is not yet been a final implementation of an ETS. In addition, the location of the GPS coordinates of the exploration area of the project activity are delineated and will prevent the system to be counted in another project activity to be part of any other voluntary market or emission reduction mechanism. The project is transitioning from the CDM to the GS4GG and thus will no longer issue credits under the CDM. Documentary evidence will be provided where any risk of double counting exists in line with Section 15 of the *GS4GG GHG Emissions Reduction & Sequestration Product Requirements* (*Version 2.0*).
(c) **Project Area, Project Boundary and Scale:** Section 3.1.1 of *GS4GG Principles & Requirements* (Version 1.2) The Project Area and Project Boundary shall be defined. Projects may be	The project location is in Indonesia (refer to section A.2 for the detailed project area and boundary). Indonesia has not yet put in place a cap-and-trade scheme but is still in the process of establishing one. The

developed at any scale although certain rules, requirements and limitations may apply under specific Activity Requirements, Impact Quantification Methodologies and Products Requirements. In order to avoid double counting the Project shall not be included in any other voluntary or compliance standards programme unless approved by Gold Standard (for example through dual certification). Also, if the Project Area overlaps with that of another Gold Standard or other voluntary or compliance standard programme of a similar nature, the project shall demonstrate that there is no double counting of impacts at design and performance certification (for example use of similar technology or practices through which the potential arises for double counting or misestimation of impacts amongst projects). Section 3.3 of *GS4GG Renewable Energy Requirements* (Version 1.4) Project Area and Boundary shall be defined in line with the applicable Methodologies and Product Requirements. The definition of scale is the same for all Projects, except Microscale. Section 3.1.1 a of *GS4GG GHG Emissions Reduction & Sequestration Product Requirements (Version 2.1)* Gold Standard VER Projects may be located in any host country or state. However, where host countries or states have mandatory operational schemes to reduce GHG emissions in any form (e.g. cap & trade, carbon tax etc.), Projects	Presidential Regulation No. 98/2021 on the Instrument for the Economic Value of Carbon for Achievement of the NDC and Control of Carbon Emissions in Development is a new regulation that serves as a legal framework for domestic carbon pricing regulations which lays out a skeleton for the upcoming ETS which will operate in conjunction with a carbon tax. While several pilot ETS were implemented for the power sector between April-August 2021, there is not yet been a final implementation of an ETS. In addition, the location of the GPS coordinates of the exploration area of the project activity are delineated and will prevent the system to be counted in another project activity to be part of any other voluntary market or emission reduction mechanism. The project is transitioning from the CDM to the GS4GG and thus will no longer issue credits under the CDM. Documentary evidence will be provided where any risk of double counting exists in line with Section 15 of the GS4GG *GHG Emissions Reduction & Sequestration Product Requirements* (Version 2.0) The project turbine has a gross production capacity of 88.81 MW and a net capacity of 80 MW. This exceeds the small-scale threshold of 15 MW. Thus, the project is designated as large-scale according to the *GS4GG GHG Emissions Reduction & Sequestration Product Requirements (Version 2.0)*.

shall only be eligible if the Project Developer has either: (a) provided Gold Standard with satisfactory justification that no double counting of emission reductions occur or (b) has committed to retiring eligible units equal to the quantity of Gold Standard VERs. Refer to Annex A of this document. Section 9.1.1 of *GS4GG GHG Emissions Reduction & Sequestration Product Requirements (Version 2.1)* Standard VER Projects may be "large scale", "small scale" (for the applicability of methodologies and tools only) or "microscale". Scale is defined in the relevant Gold Standard Activity Requirements. "Large scale" and "small scale" projects are defined in accordance with UNFCCC rules. Section 9.2.2 of *GS4GG GHG Emissions Reduction & Sequestration Product Requirements* (*Version 2.1*) Small scale Projects are defined as follows in UNFCCC rules: Renewable energy Project capacity < = 15 MW End-use energy efficiency project improvement< = 180 GWh_{th} Waste handling & disposal project GHG reduction < = 60,000 tCO_2eq per annum All Project exceeding the small-scale thresholds are defined as large scale.	
(d) **Host Country Requirements** Section 3.1.1 of *GS4GG Principles & Requirements* (Version 1.2) Projects shall be in compliance with applicable Host Country's legal, environmental, ecological and social regulations.	The project location is in Indonesia (refer to section A.2 for the detailed project area and boundary). Indonesia has not yet put in place a cap-and-trade scheme but is still in the process of establishing one. The Presidential Regulation No. 98/2021 on the Instrument for the Economic Value of Carbon for Achievement of the NDC and

Section 3.3 of *GS4GG Renewable Energy Requirements* (Version 1.4) Project Area and Boundary shall be defined in line with the applicable Methodologies and Product Requirements. Section 3.1.1 a of *GS4GG GHG Emissions Reduction & Sequestration Product Requirements (Version 2.1)* Gold Standard VER Projects may be located in any host country or state. However, where host countries or states have mandatory operational schemes to reduce GHG emissions in any form (e.g. cap & trade, carbon tax etc.), Projects shall only be eligible if the Project Developer has either: (a) provided Gold Standard with satisfactory justification that no double counting of emission reductions occur or (b) has committed to retiring eligible units equal to the quantity of Gold Standard VERs. Refer to Annex A of this document.	Control of Carbon Emissions in Development is a new regulation that serves as a legal framework for domestic carbon pricing regulations which lays out a skeleton for the upcoming ETS which will operate in conjunction with a carbon tax. While several pilot ETS were implemented for the power sector between April-August 2021, there is not yet been a final implementation of an ETS. In addition, the location of the GPS coordinates of the exploration area of the project activity are delineated and will prevent the system to be counted in another project activity to be part of any other voluntary market or emission reduction mechanism. The project is transitioning from the CDM to the GS and thus will no longer issue credits under the CDM. Documentary evidence will be provided where any risk of double counting exists in line with Section 15 of the GS4GG *GHG Emissions Reduction & Sequestration Product Requirements* (Version 2.0) The project has a gross production capacity of 88.81 MW and a net capacity of 80 MW. This exceeds the small-scale threshold of 15 MW. Thus, the project is designated as large-scale according to the *GS4GG GHG Emissions Reduction & Sequestration Product Requirements (Version 2.0)*.
(e) **Contact Details** Section 3.1.1 of *GS4GG Principles & Requirements* (Version 1.2) As part of the Project Documentation the Project Developer shall provide (i) name and (ii) contact details of all Project Participants; AND in case of an	The project participant' contact details are provided in Appendix 2. PT Supreme Energy was founded in 2007 by professionals with long experience and knowledge in energy sector in Indonesia and is a private entity rather than an organisation.

organization (iii) the legal registration details and (iv) documentation by the governing jurisdiction that proves that the entity is in good standing (defined as being a legal or other appropriate entity registered in or allowed to operate within the required jurisdiction and with no evidence of insolvency or legal/criminal notices placed against it or any of its Directors). Gold Standard retains the right (at its own discretion) to refuse use of the Standard where reputational concerns are highlighted.	
(f) **Legal Ownership** Section 3.1.1 of *GS4GG Principles & Requirements* (Version 1.2) Full and uncontested legal ownership of any Products that are generated under Gold Standard Certification, (for example carbon credits) shall be demonstrated. Where such ownership is transferred from project beneficiaries this must be demonstrated transparently and with full, prior and informed consent (FPIC). Note that for certain Project types there is a requirement for full and uncontested legal land title/tenure to be demonstrated. These are contained within specific Activity or Product Requirements. All projects shall immediately report to Gold Standard any land title/tenure disputes arising.	A Power Purchase Agreement (PPA) is present between the state-owned company Persero and PT Supreme Energy Muara Laboh. Persero is the company that PT Supreme Energy Muara Laboh will be supplying energy to. The Modalities of Communication Statement (MoC) also provides the nomination of the main focal point from PT Supreme Energy Muara Laboh. The PD owns the entirety of the project area. The PD has officially land certificates that have been approved and issued by the government. No disputes or contested rights have been declared prior to project implementation.
(g) **Other Rights** Section 3.1.1 of *GS4GG Principles & Requirements* (Version 1.2) As well as legal title and ownership, the Project Developer shall also demonstrate where required uncontested legal rights and/or permissions concerning changes in use of other resources required to service the Project (for example, access rights,	The PD owns the entirety of the project area. The PD has officially land certificates that have been approved and issued by the government. No disputes or contested rights have been declared prior to project implementation. Further explanation on the potential risks of the project to relevant Safeguarding Principles are presented in **Appendix 1.**

water rights etc.). Any known disputes or contested rights must be declared immediately to Gold Standard by the Project Developer and resolved prior to further project implementation in affected areas.	
(h) **Official Development Assistance (ODA) Declaration** Section 3.1.1 of *GS4GG Principles & Requirements* (Version 1.2) All Project Developers applying for project activities located in a country named by the OECD Development Assistance Committee's ODA recipient list and seeking Gold Standard Certification for carbon credits shall declare the Official Development Assistance (ODA) support. The Project Developer shall follow the GHG Emissions Reduction & Sequestration Product Requirements and submit the declaration at the time of Design Certification. Section 6.1.1 and 6.1.2 of *GS4GG GHG Emissions Reduction & Sequestration Product Requirements (Version 2.1)* Projects are ineligible for carbon crediting under Gold Standard if the ODA assistance is provided to the project under the condition that the credits generated by the Project will be transferred, either directly or indirectly, to the donor country providing ODA support. Project Developer submitting a Project located in a country named by the OECD Development Assistance Committee's ODA recipient list shall sign and submit the ODA Declaration.	The project owner has signed the ODA declaration template and confirms that no ODA is provided under the condition the credits generated by the project will be transferred, either directly or indirectly, to the donor country providing ODA support.
(i) **Suppressed Demand**	Suppressed demand baseline is not applicable to the project since this is a large-scale project.

Section 3.1.3 of *GS4GG Renewable Energy Activity Requirements* (Version 1.4) Certain Impact Quantification methodologies allow projects to account for a Suppressed Demand scenario when establishing a baseline. In such cases, the application of the Suppressed Demand baseline is limited to small scale and microscale projects.	

A.1.2. Legal ownership of products generated by the project and legal rights to alter use of resources required to service the project

Supreme Energy had full and uncontested legal ownership of the VERs that are generated from the Gold Standard Certification of this project. The PD owns the entirety of the project area and possess official land certificates that have been approved and issued by the government.

A.2 Location of project

Pauh Duo Subdistrict, Solok Selatan Regency, West Sumatera Province, Republic of Indonesia. The project activity is located at Liki Pinangawan Muaralaboh Geothermal Working Area, about 100 km southeast of Padang, the capital city of West Sumatera. The GPS coordinates of the exploration area of the project activity are:

- Longitude: 1010 02’ – 1010 08’ East
- Latitude: 010 28’ – 010 36’ South

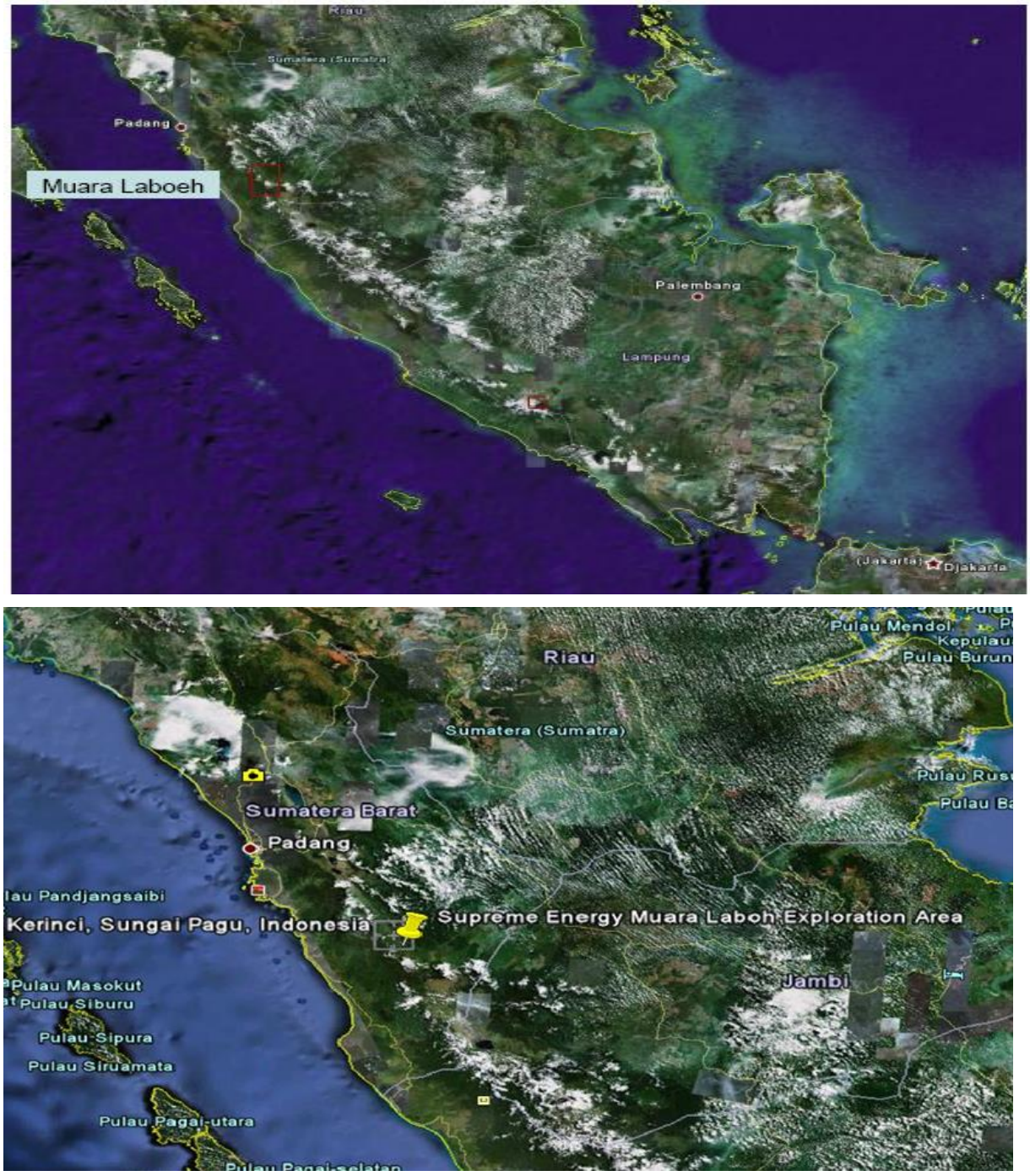

Figure. A.4.1. *Location map of Liki Pinangawan Muaralaboh Geothermal Power Plant, Pauh Duo Subdistrict, West Sumatera*

A.3 Technologies and/or measures

Geothermal power uses naturally occuring heat within the earth to produce steam to rotate the turbine and generate electricity. The technology which applies in the project

activity to produce net 80MW power is the direct use of the steam (generating additional steam through double flashing in separators) in an open cycle steam turbine.

Steam is separated from the water-dominated resource through "flashing" in steam separators and after passing through steam scrubbers, the steam is directed to the steam turbine coupled to the generator. This is the most common technology for high temperature geothermal fluids (above 180°C). The water separated from steam in the separator (brine) and the steam condensed in the condenser after passing through the turbine are re-injected to the reservoir.

The technology is technically sound and environmentally safe as demonstrated by succesfull installations around the world. The direct open steam cycle (steam turbine) has historically been the conventional technology used worldwide in most high temperature geothermal power plants. The technology was procured from an Annex 1 country and hence technology transfer took place from Annex 1 country to the host country. The technology supplier will conduct a comprehensive training for the employees to make sure the plant is properly maintained and operated efficiently.

Geothermal power plant development can be broadly divided into the following five phases:

1. Preliminary survey
2. Exploration
3. Feasibility Study
4. Exploitation
5. Utilization

The power plant uses one condensing steam turbine, with an installed capacity of 88.81MW, coupled with the generator. The main equipments to be installed in the project activity are as follows:

- Condensing steam turbine
- Main generator
- Gas extraction system (GES)
- Cooling water systems (CW)
- Generator step-up transformer and step-down transformers
- Scrubbers
- Plant DCS (Distributed Control System)

- SAGS (Steamfield Above Ground System)

A common emergency diesel generator will be set up. The system is capable of meeting the starting and operational demands for essential services required to maintain the generating unit and the steam field in a safe condition and ready to be re-started once start-up power is re-established.

The geothermal power equipments typically have lifespan of 30 years[3]. In the case of project activity, the average lifetime of the project activity is estimated to be 30 years based on the Preliminary Development Plan for the project activity[4] and it is in line with the contractual period agreed with PLN.

As suggested by the Preliminary Development Plan, the plant capacity factor of the project activity is 98% and the availability factor is 96% and both combination results a service capacity factor of 94%[5] and the steam flowrate is estimated to be 158kg/s[6]. The PP will enter into a 90%[7] take-or-pay agreement of the net installed capacity (80MW) with PT PLN so that the yearly amount of electricity to be purchased by PT PLN from the project has been fixed. PT PLN is not obliged to pay for the extra kWh generated over the agreed amount of electricity and it is of the interest of the PP not to produce less this amount because otherwise it will be penalized.

[3] http://www.os.is/gogn/unu-gtp-sc/UNU-GTP-SC-02-23.pdf

[4] Final Report – Preliminary Development Plan for the Muara Labuh Geothermal Resource, West Sumatra, Indonesia, Sinclair Knight Merz, June 2009 – page 67

[5] Final Report – Preliminary Development Plan for the Muara Labuh Geothermal Resource, West Sumatra, Indonesia, Sinclair Knight Merz, June 2009 – page 35

[6] Performance Test Report

[7] As per Tender document released by the local government of Solok regency and confirmed by Letter of Intent (LOI) for electricity purchase by PT PLN dated 29/03/2011

Process Diagram of Power Plant is shown below:

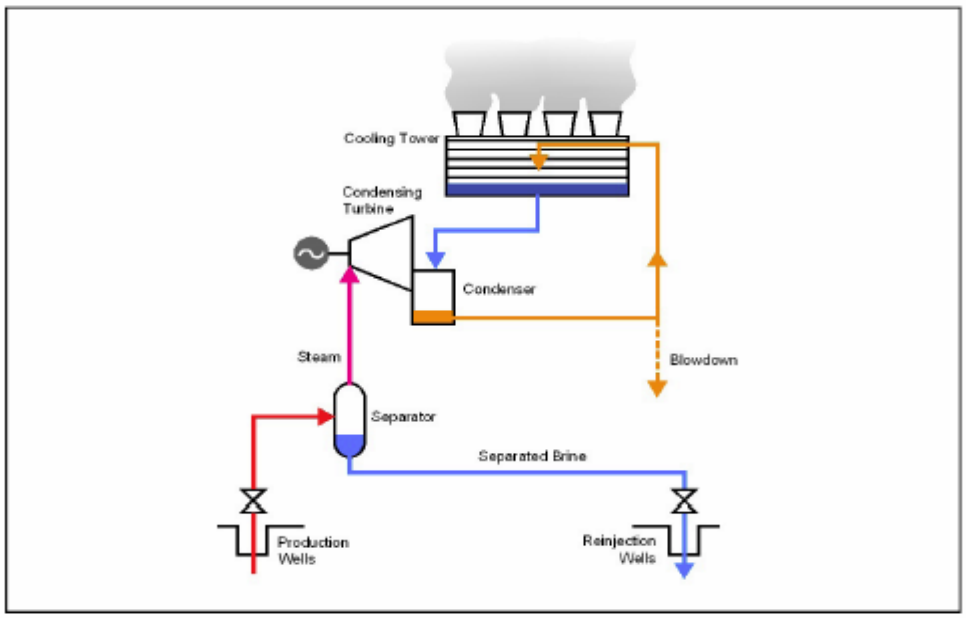

***Figure. A.4.3**. Process Flow Diagram – Condensing Steam Turbine Power Plant*

The project activity is the installation of a new grid-connected geothermal power plant (greenfield). In the absence of the project activity, the demand of electricity would have otherwise been met by the generation of power by the operation of grid-connected power plants and by the addition of new power generation sources in the Sumatera grid. Hence the baseline emissions are calculated as per the approved methodology based on the CO_2 emissions from electricity generation in fossil fuel fired power plants connected to Sumatera grid that are displaced due to the project activity. The fugitive emissions of $CH_4$and $CO_2$from non-condensable gases (NCG) contained in geothermal steam and CO_2 emissions from combustion of fossil fuel of the emergency diesel generator are taken into account for the project emissions of the geothermal power plant.

In case of the project activity, the baseline scenario is the same as the scenario existing prior to the start of implementation of the project activity.

The quantity of net electricity generation supplied by the project plant to the Sumatera grid will be metered by 2 bidirectional meters, main meter and check meter, located at Substation of Muara Laboh Power Plant 150kV, with accuracy class of 0.2. The measurement procedures to be applied are in compliance with the provisions of the Power Purchase Agreement.

The calculation of steam quantities produced are conducted based on the measurement of the steam flow in the main steam line from the separators wells with Venturi flow meter.

The quantity of diesel combusted by the emergency diesel generator is based on the measurement of the flow meter installed at the output of the diesel storage tank.

Non-condensable gases sampling is carried out in production wells and at the steam field-power plant interface. The gas portion is then analyzed using gas chromatography to determine the content of the residuals including CH_4 and CO_2.

A.4 Scale of the project

The project activity has a production capacity of up to 80 MW of power through the direct use of steam. This is more than 15 MW. As per section 9.1.2 of GS4GG GHG Emissions Reduction & Sequestration Product Requirements (Version 2.1), it's a large-scale GS VER project.

A.5 Funding sources of project

The project activity does not involve any public funding or Official Development Assistance (ODA) from Annex 1 countries.

SECTION B. APPLICATION OF APPROVED GOLD STANDARD METHODOLOGY (IES) AND/OR DEMONSTRATION OF SDG CONTRIBUTIONS

B.1. Reference of approved methodology (ies)

Approved consolidated baseline and monitoring methodology ACM0002 - "Consolidated baseline methodology for grid-connected electricity generation from renewable sources", Version 12.2.0, EB 65 Annex 16

The project activity also refers to the latest approved versions of the following tools:

- Version 02.2.1 - Tool to calculate the emission factor for an electricity system, EB 63 Annex 19
- Version 06.0.0- Tool for the demonstration and assessment of additionality, EB 65 Annex 21
- Version 02 - Tool to calculate project or leakage CO2 emissions from fossil fuel combustion, EB 41 Annex 11.

B.2. Applicability of methodology (ies)

The project activity meets the applicability criterion mentioned in the applicable methodology as follows:

S. No.	Criteria	Justification
1.	This methodology is applicable to grid-connected renewable power generation project activities that: (a) install a new power plant at a site where no renewable power plant was operated prior to the implementation of the project activity (greenfield plant); (b) involve a capacity addition; (c) involve a retrofit of (an) existing plant(s); or (d) involve a replacement of (an) existing plant(s).	The project activity is the installation of a new geothermal power plant (greenfield plant) connected to Sumatera grid and hence conforms to this criterion.
2.	The project activity is the installation, capacity addition, retrofit or replacement of	The project activity is the installation of a new

	a power plant/unit of one of the following types: hydro power plant/unit (either with a run-of-river reservoir or an accumulation reservoir), wind power plant/unit, geothermal power plant/unit, solar power plant/unit, wave power plant/unit or tidal power plant/unit.	geothermal power plant and hence conforms to this criteria.
3.	In the case of capacity additions, retrofits or replacements (except for wind, solar, wave or tidal power capacity addition projects which use Option 2: on page 11 to calculate the parameter $EG_{PJ,y}$): the existing plant started commercial operation prior to the start of a minimum historical reference period of five years, used for the calculation of baseline emissions and defined in the baseline emission section, and no capacity expansion or retrofit of the plant has been undertaken between the start of this minimum historical reference period and the implementation of the project activity.	This criterion is not applicable as the project activity is a new power plant and not a capacity addition, retrofit or replacement.
4.	In case of hydro power plants, one of the following conditions must apply: • The project activity is implemented in an existing reservoir, with no change in the volume of reservoir; or • The project activity is implemented in an existing reservoir, where the volume of reservoir is increased and the power density of the project activity, as per definitions given in the Project Emissions section, is greater than 4 W/m^2; or	This criterion is not applicable as the project activity is a geothermal power plant.

	• The project activity results in new reservoirs and the power density of the power plant, as per definitions given in the Project Emissions section, is greater than 4 W/m^2.	
5.	In case of hydro power plants using multiple reservoirs where the power density of any of the reservoirs is lower than 4 W/m^2 all the following conditions must apply: • The power density calculated for the entire project activity using equation 5 is greater than $4W/m^2$; • Multiple reservoirs and hydro power plants located at the same river and where are designed together to function as an integrated project1 that collectively constitute the generation capacity of the combined power plant; • Water flow between multiple reservoirs is not used by any other hydropower unit which is not a part of the project activity; • Total installed capacity of the power units, which are driven using water from the reservoirs with power density lower than 4 W/m^2, is lower than 15MW; • Total installed capacity of the power units, which are driven using water from reservoirs with power density lower than 4 W/m^2, is less than 10% of the total installed capacity of the	This criterion is not applicable to the project activity since the project activity is the installation of a new geothermal power plant.

	project activity from multiple reservoirs.	
6.	In the case of retrofits, replacements, or capacity additions, this methodology is only applicable if the most plausible baseline scenario, as a result of the identification of baseline scenario, is "the continuation of the current situation, i.e. to use the power generation equipment that was already in use prior to the implementation of the project activity and undertaking business as usual maintenance".	This condition is not applicable since the project activity is the installation of a new geothermal power plant.

The version of the methodology is not applicable under the following conditions:

S. No.	Criteria	Justification
1	Project activities that involve switching from fossil fuels to renewable energy sources at the site of the project activity, since in this case the baseline may be the continued use of fossil fuels at the site;	The project activity is a greenfield geothermal power plant and hence is applicable under the methodology.
2	Biomass fired power plants;	The project activity is a geothermal plant and hence is applicable under the methodology.
3	Hydro power plants that result in new reservoirs or in the increase in existing reservoirs where the power density of the power plant is less than 4 W/m^2.	The project activity is a geothermal plant and hence is applicable under the methodology.

The project activity therefore fulfils all the above conditions and hence is applicable under the chosen methodology ACM0002, version 12.2.0.

In addition, the project activity meets the applicability conditions included in the tools referred to as follows:

Applicability conditions of Tool to to calculate the emission factor for an electricity system version 02.2.1:

S. No.	Criteria	Justification
1.	This tool may be applied to estimate the OM, BM and/or CM when calculating baseline emissions for a project activity that substitutes grid electricity, i.e. where a project activity supplies electricity to a grid or a project activity that results in savings of electricity that would have been provided by the grid (e.g. demand-side energy efficiency projects).	The project activity supplies electricity to Sumatera grid and hence this tool may be applied to estimate the OM, BM, and CM when calculating the baseline emissions for the project activity.
2.	Under this tool, the emission factor for the project electricity system can be calculated either for grid power plants only or, as an option, can include off-grid power plants. In the latter case, the conditions specified in Annex 2 - Procedures related to off-grid power generation should be met. Namely, the total capacity of off-grid power plants (in MW) should be at least 10% of the total capacity of grid power plants in the electricity system; or the total electricity generation by off-grid power plants (in MWh) should be at least 10% of the total electricity generation by grid power plants in the electricity system; and that factors which negatively affect the reliability and stability of the grid are primarily due to constraints ingeneration and not to other aspects such as transmission capacity.	The emission factor the project electricity system is calculated for grid power plants only.
3.	In case of CDM projects the tool is not applicable if the project electricity system is located partially or totally in an Annex I country.	The project electricity system (Sumatera Grid) is not located partially or totally in an Annex I country.

Applicability condition of Tool to calculate project or leakage CO_2 emissions from fossil fuel combustionversion02:

S. No.	Criteria	Justification
1	This tool provides procedures to calculate project and/or leakage CO_2 emissions from the combustion of fossil fuels. It can be used in cases where CO_2 emissions from fossil fuel combustion are calculated based on the quantity of fuel combusted and its properties. Methodologies using this tool should specify to which combustion process j this tool is being applied.	In the case of the project activity, the CO_2 emissions from fossil fuel combustion are calculated based on the quantity of diesel oil combusted for electricity generation in the geothermal power plant.

B.3. Project boundary

Source		GHGs	Included?	Justification/Explanation
Baseline scenario	Source 1 CO2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity.	CO_2	Yes	This gas is included in the project boundary as this was produced in the baseline by the operation of fossil fuel fired power plants connected to the Sumatera grid.
		CH_4	No	The methodology considers this as a minor emission source and hence has been excluded for simplification.
		N_2O	No	The methodology considers this as a minor emission source and hence has been excluded for simplification.
Project scenario	Source 1 For geothermal power plants, fugitive emissions of CH4 and CO2 from non-condensable gases contained in geothermal steam.	CO_2	Yes	Main emission source
		CH_4	Yes	Main emission source
		N_2O	No	The methodology considers this as a minor emission source and hence has been excluded for simplification.
	Source 2 CO2 emissions from combustion of fossil fuels for electricity generation in solar thermal power plants and geothermal power plants	CO_2	Yes	Main emission source from the fossil fuel combusted for emergency diesel generator. This gas is included in the project emission and will be monitored at actual.
		CH_4	No	The methodology considers this as a minor emission source and hence has been excluded for simplification.
		N_2O	No	The methodology considers this as a minor emission source and hence has been excluded for simplification.

B.4. Establishment and description of baseline scenario

As described in the methodology, the baseline for greenfield renewable energy power plants is: *"If the project activity is the installation of a new grid-connected renewable power plant/unit, the baseline scenario is the following:*

Electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in the "Tool to calculate the emission factor for an electricity system".

Hence the baseline scenario is that the electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources to the Sumatera grid in Indonesia.

To calculate the emission factor of the Sumatera grid, the data has been taken from the Agency for the Assessment and Application of Technology (BPPT) and Directorate General of Electricity and Energy Utilization (DJLPE)[8] under the Ministry of Environment of Indonesia as Indonesian DNA and the approach specified in the *Tool to calculate the emission factor for an electricity system*, version 02.2.1 has been adopted.

"for determining the electricity emission factors, if the DNA of the host country has published a delineation of the project electricity system and connected electricity systems, these delineations should be used".

The parameter values are summarized below:

Parameter	**Value** *(in tCO_2/MWh)*
Operating margin	0.905
Build margin	0.581
Combined margin	0.743

The detailed calculations are presented in Annex 4.

[8]Recently changed into Directorate General of Electricity

B.5. Demonstration of additionality

The following section demonstrates that the project activity is not a part of the baseline scenario by drawing on version 06.0.0 of *"Tool for the demonstration and assessment of additionality"* for demonstration of additionality.

Applicable geographical area covers the entire host country of Indonesia.

Step 1: Identification of alternatives to the project activity consistent with current laws and regulations

Sub-step 1a: Define alternatives to the project activity:

As per the Tool for the demonstration and assessment of additionality version 06.0.0, *project activities that apply this tool in context of approved consolidated methodology ACM0002, only need to identify that there is at least one credible and feasible alternative that would be more attractive than the proposed project activity.*

The demonstration of the baseline scenario (in section B.4.) incorporated the steps contained within this section and the plausible baseline scenarios correspond to the alternatives that are related to technology and circumstances as well as to the investor. The project activity is being set up by an Independent Power Producer (IPP) and hence in the absence of the project activity the plausible alternatives are mentioned below. Other alternatives like coal, wind, hydro power plants etc have not been considered plausible alternatives in the case of the project activity since as per the additionality tool these are not alternatives for an IPP (see footnote 7 of the *"Tool for the demonstration and assessment of additionality"* version 06.0.0). In the case the project activity was being set up by a public utility, these would have been plausible alternatives. However, since the project is being set up by an IPP, the plausible alternatives are limited to:

1. *The project activity undertaken without CDM i.e. the construction of a new geothermal power plant of 88.81MW connected to the Sumatera grid, implemented without CDM status.*

Under this scenario the project will generate low emission power and cause emission reduction by displacing equivalent power generation from fossil fuels. However, the project cannot be implemented without CDM benefits due to the investment barrier, which is analyzed in detail under Step 2.

2. *Continuation of the current situation i.e. electricity will continue to be generated by the existing generation mix operating in the Sumatera grid.*

Under this alternative, the increasing demand of electricity would be met by increasing the installed capacity through the possible expansion of existing power plants as well as construction of new power plants in accordance with the current policies and regulations of host country, Indonesia. This is a realistic and credible scenario.

In conclusion the feasible alternative scenario for the project activity is Alternative (2).

Sub-step 1b: Consistency with mandatory laws and regulations:

The alternative outlined above conforms to the local and national policies and hence is credible.

Step 2: Investment analysis

The investment analysis has been undertaken in compliance with EB62 Annex 05 - *"Guidelines on the Assessment of Investment Analysis, Version 05.0".*

Sub-step 2a: Determine appropriate analysis method

As established in Section B.4, in the absence of the project activity the electricity would have been supplied to third party users from operational or planned generation in the Sumatera grid. No investment has to be made by the independent power producer (IPP) in the absence of this geothermal power project. Therefore as per paragraph 19, Annex 05, EB 62, Guidelines on the assessment of investment analysis, a benchmark approach is considered appropriate for the project activity. Hence Option III, benchmark analysis has been used to demonstrate additionality for the project activity.

Sub-step 2b: Option III. Apply benchmark analysis

To analyze the feasibility of the project, the project proponent has conducted a project internal rate of return (IRR) analysis and compared it with a suitable benchmark.

The project activity could be implemented by an entity other than the project participant and hence a standard market benchmark is suitable. The Indonesian Ministry of Finance together with the Japan International Cooperation Agency (JICA) and West Japan Engineering Consultants, Inc. published a "Study on Fiscal and Non-fiscal Incentives to Accelerate Private Sector Geothermal Energy Development in the Republic of

Indonesia", in July 2009. The study has determined that the Project IRR should be a minimum of 17.10% for an IPP to invest in a geothermal power project in Indonesia[9]. The benchmark presented in the study of JICA has been derived from a WACC (weighted average cost of capital) calculation, using parameters that are standard in the market. This study is supplied by relevant national authority, and it is applicable to the project activity and the type of IRR calculation. This is selected as a transparent and conservative appropriate benchmark.

The domestic capability of the host country is weak in almost all the major areas of geothermal development from resource identification to operation of geothermal power generation facilities. The level of domestic participation in all parts of the value chain of geothermal resource development is low, and project costs remain high as a result. Geothermal energy development involves various kinds of risks since it is a development of underground resources. Technically, each stage of geothermal project activity has some risks, as follows:

a) Exploration stage cost overruns due to access road construction difficulty, geographical problems and unfavorable drilling success rate etc.

b) Development stage cost overruns due to depth of production wells, capacity of production wells, characteristics of the geothermal fluid, non-condensable gas concentration, unfavorable production well drilling success rate, and construction material price increases etc.

c) Operation stage degradation of performance due to faster than expected declines in wellhead pressure and/or flow rates etc.

Indonesia has abundant potential geothermal resources of about 28,000 MW but less than 4% has been utilized. Since the early 1970s, the Government of Indonesia has made efforts to promote geothermal resources. It has done this through the appointment of PT Pertamina, the National Energy Company to conduct exploration, exploitation, and utilization of steam from geothermal resources to produce energy.

[9]Page 6-13 of Fiscal and Non-fiscal Incentives to Accelerate Private Sector Geothermal Energy Development in the Republic of Indonesia, in July 2009

This was regulated based on the Presidential Decree No.16/1974, Presidential Decree No.22/1981, Presidential Decree No.23/1981, Presidential Decree No. 45 in 1991 and Presidential Decree No.49/1991. Yet despite this change, geothermal development remains a small contributor to overall power generation.

The private sector is hesitant to invest in the sector due to legal uncertainty, amongst other risks discussed above.

In the early to mid-1990s, private sector contracts committed to provide close to half of the national target of geothermal power. These contracts were made by entering into Joint Operation Contracts (JOCs) with state owned oil and gascompany PT Pertamina and Power Purchase Agreements (PPAs) with PT PLN. However, the 1997 Financial Crisis caused a number of contracts to be suspended, cancelled or renegotiated.

Since the Financial Crisis, private developers and lenders have hesitated to invest in geothermal business due to a lack of trust in the existing legal framework in protecting business arrangements and contracts and uncertainty on taxation regulations. The law No. 44 of 1960 on Oil and Gas used to regulate the geothermal sector but the new Oil and Gas Law, passed on 23/10/2001, removed geothermal development as an area of oil and gas regulation. In 2003, Parliament passed a Geothermal Law, supplemented by a number of implementing regulations. However, certain voids still exist in the regulatory framework, resulting in lack of clarity and certainty for the investors.

Despite a flurry of government initiatives in the last few years two critical issues remain unaddressed:

a) The environmental benefits and the high initial cost of developing geothermal power, compared with building coal fired power plants, meaning that economic incentives for harnessing the benefits and bridging the cost gap are needed to promote investments in geothermal power. The high initial capital investment includes initial exploration and the commitment to purchase a large portion of the eventual fuel supply at start-up in the form of development wells. Thus, geothermal contracts require base load status and long-term price security in order to justify development. A guarantee from government is required to ensure that PLN will meet its obligations because PLN still survives on government subsidy.

b) The exploration risks associated with developing upstream geothermal resources, which, without proper mitigation mechanisms or compensation, often deter investments in the sector.

In addition to the above, geothermal energy development involves significant risks during the surface survey, resource confirmation and development stages. Since a project has little chance of obtaining financial support in the early stages, its early-stage development needs to be conducted with equity alone and the project developer needs to bear all the risks. Only after a certain level of progress has been made on the project, the project can apply for funding from banks.

Sub-step 2c: Calculation and comparison of financial indicators (only applicable to Options II and III):

The financial calculations presented for the IRR analysis include all the relevant revenues and costs associated with the project. The project activity's only source of revenue is the sale of generated electricity to PT PLN. All the assumptions have been taken from the various studies prepared for the project activity during the investment decision process of the project activity which have been compiled in the P85 investment decision document. In line with the paragraph 3 of the guidance on investment analysis, the project IRR analysis has been done for a period of 30 years in accordance with the technical lifetime of the project actvity.

As mentioned in Section A.2, the concentration of non-condensable gases and the thermodynamic characteristics of the geothermal fluid (enthalpy in particular), the injectivity of the injection wells, the exact depth and success rate of the production wells, the EPC and financing costs and many other parameters are not known today. These variations and uncertainties all contribute to the high risk of this project which is borne by the project owner.

The project IRR without taking into account CER revenues is 9.52% which is below the chosen conservative benchmarkof 17.10%, thus the project activity is found to be financially unattractive for the project owner to undertake.

Project IRR without CDM	9.52%
Benchmark	17.10%

The investment analysis has been carried out following the most recent guidance on investment analysis. The land cost has not been depreciated and added back as revenue at the end of the assessment period. All the input parameters were applicable at the time of investment decision and conservative values have been taken. The input parameters of the investment analysis have been highlighted in the table below with their sources:

S. No.	Parameter	Unit	Value	Source
1	Plant Installed capacity	MW	88.81	Turbine Data Sheet
2	Plant net capacity	MW	80	Feasibility Study (FS) was approved by Government of Indonesia on 20/02/2017
3	Annual electricity for sale (90% of production at Plant net capacity)	MWh	630,720	FS/calculated
4	Electricity tariff	c.USD/kWh	13	FS
5	Royalty to be given to government	% of gross revenue	2.50	Letter of Directorate General of Mineral, Coal and Geothermal No. 496/84/DJB/2008 regarding proposal of new regulation to supersede Government Regulation No.45/2003
6	Take or Pay (ToP) energy of net capacity	%	90	FS
7	Operation & Maintenance cost	c.USD/kWh	1.7	FS
8	Overhead cost	c.USD/kWh	0.2	FS
9	Make up wells	USD million/well	7.50	FS

		(Every 5 years)		
10	Major well work-over	USD million/well (Every 3 years)	2.1	FS
11	Plant overhaul	USD million/year (Every 3 years)	1	FS
12	Corporate Income Tax	%	25	Law No. 36/2008 on Income Tax
13	Tax incentive for Dividend	%	10	Government Regulation on Tax No. 1/2007 superseded by Government Regulation on Tax No.62/2008
14	Depreciation	Year	8	Government Regulation on Tax No. 1/2007 superseded by Government Regulation on Tax No.62/2008
15	Accelerated depreciation rate	%	25%	Government Regulation on Tax No. 1/2007 superseded by Government Regulation on Tax No.62/2008
16	Inflation	%	2.5%	US CPI
17	Portion of electricity tariff to be escalated	%	100%	FS
18	Tariff escalation per year	%	1.8%	US PPI, (average value of last 24 years used in the forecast)
19	Investment cost (excluding total sunk costs of 3.66 USD million	USD million	451	FS

	of feasibility study and geology and geophysic study costs)			
20	Debt ratio before construction Equity ratio before construction	% %	0% 100%	FS
21	Debt ratio during construction Equity ratio during construction	% %	65% 35%	FS
22	Interest rate	%	6.75%	The available interest rate atCentral Bank of Indonesia forinvestment loan in the periodof March 2009 – end ofFebruary 2010 http://www.bi.go.id/seki/tabel/ TABEL1_27.xls
23	Grace period	Year	1	Loan term as per lending option available for the construction and operation stage of a geothermal powerproject[10]
24	Repayment period	Year	7	

[10] http://www.nrel.gov/geothermal/financing/construction.html.

A "mini-perm" loan is a senior debt facility with a term that is longer than typical bank debt but shorter than longterm "permanent" facilities. These facilities are typically payable over five to seven years and include a balloon payment at the end of the facility. In this case, the facility has a 7-year term: 2 years of construction and 5 years of production.

25	Phasing of equity financing	Year	2 (before construction)	P85 investment decision document
26	Phasing of debt financing	Year	2 (during construction period)	P85 investment decision document

Sub-step 2d: Sensitivity analysis

The robustness of the conclusion drawn above has been tested by subjecting critical assumptions to reasonable variations. The sensitivity analysis has been done in accordance with EB 62, Annex 05 '*Guidelines on the Assessment of Investment Analysis'* paragraph 20 and 21. The project IRR of the project activity is driven by the following variables:

1. Investment cost
2. Tariff
3. Operation and Maintenance cost
4. Electricity generation

The impacts were analyzed in the range of ± 10% and the corresponding impacts have been highlighted in the tables and graphs below.

Investment cost

The investment cost has been given a variation of -15% and +35% as per the accuracy estimation of the investment cost suggested by the underlying Preliminary Development Plan which is considered more appropriate in the case of the project activity. This variation has covered the ± 10% range suggested by the '*Guidelines on the Assessment of Investment Analysis'*. The results of the variation are tabulated below:

	Project IRR without CDM		
Variables	**-15%**	**0%**	**35%**
Investment cost	11.05%	9.52%	7.05%

Tariff

The results of the tariff variation are tabulated below:

	Project IRR without CDM		
Variables	**-10%**	**0%**	**10%**
Base Tariff	8.36%	9.52%	10.70%

Operation and Maintenance cost

The operation and maintenance cost affects the IRR of the project activity as decrease in the cost would allow an increase in the revenues associated with the project activity. The operation and maintenance cost has been given a variation of ±10% and the results are tabulated below:

	Project IRR without CDM		
Variables	**-10%**	**0%**	**10%**
Operational and Maintenance Cost	9.74%	9.52%	9.44%

Electricity generation

This variable covers the possibility of increase or decrease of the electricity generation by 10% of the contractual Take or Pay (ToP) offtake level. The results of the variation are tabulated below:

	Project IRR without CDM		
Variables	**-10%**	**0%**	**10%**
Electricity generation	8.63%	9.52%	10.48%

It is evident from the above that even under the most optimistic conditions; the project IRR does not cross the chosen benchmark.

Step 3: Barrier analysis

Investment analysis has been undertaken.

Step 4: Common practice analysis

Common practice analysis acts as a credibility check to complement the investment analysis done in Step 2. According to the *"Tool for the demonstration and assessment of additionality version 06.0.0"* –

"*Projects are considered similar if they are in the same country/region and/or rely on a broadly similar technology, are of a similar scale, and take place in a comparable environment with respect to regulatory framework, investment climate, access to technology, access to financing, etc.*"

The common practice analysis is discussed through the following sub-steps:

Sub-step 4a: Analyze other activities similar to the proposed project activity:

The identification of similar activities has focused on the operational geothermal power plants in Indonesia at the time the investment decision was taken for the project activity. The host country, Indonesia, is chosen as the appropriate region and applicable geographical area for comparison of power plants. The analysis excludes the geothermal power plants which have been published on the UNFCCC website for global stakeholder consultation or already registered with the UNFCCC.

For measures that are listed in paragraph 6 of version 06.0.0 of *"Tool for the demonstration and assessment of additionality*:

Step 1: Calculate applicable output range as +/- 50% of the design output capacity of the proposed project activity.

The project activity has a design output of 88.81MW, and therefore the applicable output range is 44MW – 133MW.

Step 2: In the applicable geographical area, identify all plants that deliver the same output or capacity, within the applicable output range calculated in Step 1, as the proposed project activity and have started commercial operation before the start date of the project. Note their number N_{all}. Registered CDM project activities and project activities undergoing validation shall not be included in this step.

For the common practice analysis, the project proponents have taken the data published by Dewan Nasional Perubahan Iklim (DNPI, National Council on Climate Change) on

17/03/2010 which contained the list of all power plants operational in Indonesia. In total there were 90power plants in Indonesia that had started commercial operation before the start date of the project and that are within the applicable output range (N_{all} = 90**)**. The list is provided below:

No	Grid	Power Plant	Owner	Fuel Type	Operating year	Installed Capacity (MW)
1	Sumatera	PLTU Tarahan 1	PLN	coal & HSD	2007	100
2	Sumatera	PLTU Tarahan 2	PLN	coal & HSD	2007	100
3	Sumatera	PLTG Meppo Gen (IPP)	IPP	Gas	2007	80
4	Sumatera	PLTA Musi 1	PLN	Hydro	2006	72
5	Sumatera	PLTA Musi 2	PLN	Hydro	2006	72
6	Sumatera	PLTA Musi 3	PLN	Hydro	2006	72
7	Sumatera	PLTG Rental Inderalaya	PLN	HSD	2004	50
8	Sumatera	PLTA BESAI #1	PLN	Hydro	2001	45
9	Sumatera	PLTA BESAI #2	PLN	Hydro	2001	45
10	Sumatera	PLTU OMB #1	PLN	COAL	1996	100
11	Sumatera	PLTU OMB #2	PLN	COAL	1996	100
12	Sumatera	GT-21 BELAWAN* (Combined Cycle)	PLN	HSD & GAS	1995	130
13	Sumatera	PLTU BASAM #4	PLN	COAL & HSD	1994	65
14	Sumatera	PLTU BASAM #3	PLN	COAL & HSD	1994	65
15	Sumatera	GT-22 BELAWAN	PLN	Gas	1994	130
16	Sumatera	GT-11 BELAWAN	PLN	Gas	1993	118
17	Sumatera	PLTU-3 BELAWAN	PLN	Coal	1989	65
18	Sumatera	PLTU-4 BELAWAN	PLN	Coal	1989	65
19	Sumatera	GT-12 BELAWAN	PLN	Gas	1988	129
20	Sumatera	PLTU BASAM #1	PLN	Coal & HSD	1987	65
21	Sumatera	PLTU BASAM #2	PLN	Coal & HSD	1987	65
22	Sumatera	PLTU-1 BELAWAN	PLN	Coal	1984	65
23	Sumatera	PLTU-2 BELAWAN	PLN	Coal	1984	65
24	JAMALI	Priok 3	PLN	HSD, MFO	1972	50

25	JAMALI	Priok 4	PLN	HSD, MFO	1972	50
26	JAMALI	Perak 4	PLN	HSD, MFO	1978	50
27	JAMALI	Perak 3	PLN	HSD, MFO	1978	50
28	JAMALI	Tambak Lorok 2	PLN	HSD, MFO	1978	50
29	JAMALI	Tambak Lorok 1	PLN	HSD, MFO	1978	50
30	JAMALI	Muara Karang 2	PLN	HSD, MFO	1979	100
31	JAMALI	Muara Karang 1	PLN	HSD, MFO	1979	100
32	JAMALI	Muara Karang 3	PLN	HSD, MFO	1980	100
33	JAMALI	Gresik 2	PLN	HSD, MFO	1981	100
34	JAMALI	Gresik 1	PLN	HSD, MFO	1981	100
35	JAMALI	Kamojang 2	PLN-Pertamina	Geothermal	1987	55
36	JAMALI	Kamojang 3	PLN-Pertamina	Geothermal	1987	55
37	JAMALI	PB Soedirman 3	PLN	Hydro	1988	60
38	JAMALI	PB Soedirman 2	PLN	Hydro	1989	60
39	JAMALI	PB Soedirman 1	PLN	Hydro	1989	60
40	JAMALI	Gresik GT 23	PLN	HSD & GAS	1992	112
41	JAMALI	Gresik GT 13	PLN	HSD & GAS	1992	112
42	JAMALI	Tambak Lorok GT 1.2	PLN	HSD	1993	110
43	JAMALI	Tambak Lorok GT 1.3	PLN	HSD	1993	110
44	JAMALI	Tambak Lorok GT 1.1	PLN	HSD	1993	110
45	JAMALI	Muara Karang GT 13	PLN	HSD & GAS	1993	108
46	JAMALI	Muara Karang GT 12	PLN	HSD & GAS	1993	108
47	JAMALI	Muara Karang GT 11	PLN	HSD & GAS	1993	108
48	JAMALI	Priok GT 1.3	PLN	HSD & GAS	1993	130
49	JAMALI	Priok GT 1.1	PLN	HSD & GAS	1993	130
50	JAMALI	Priok GT 1.2	PLN	HSD & GAS	1993	130
51	JAMALI	Gresik GT 33	PLN	HSD & GAS	1993	112
52	JAMALI	Drajat 1	Chevron - Pertamina	Geothermal	1994	55

53	JAMALI	Gunung Salak 2	Chevron - Pertamina	Geothermal	1994	60
54	JAMALI	Gunung Salak 1	PLN	Geothermal	1994	60
55	JAMALI	Priok GT 2.1	PLN	HSD & GAS	1994	130
56	JAMALI	Priok GT 2.3	Chevron - Pertamina	HSD & GAS	1994	130
57	JAMALI	Priok GT 2.2	Chevron - Pertamina	HSD & GAS	1994	130
58	JAMALI	Tambak Lorok GT 2.1	Chevron - Pertamina	HSD	1996	110
59	JAMALI	Tambak Lorok GT 2.2	Chevron - Pertamina	HSD	1996	110
60	JAMALI	Gunung Salak 3	PLN	Geothermal	1997	60
61	JAMALI	Gunung Salak 4	PLN	Geothermal	1997	66
62	JAMALI	Gunung Salak 6	PLN	Geothermal	1997	66
63	JAMALI	Gunung Salak 5	IPP	Geothermal	1997	66
64	JAMALI	Grati GT 1.2	IPP	HSD & GAS	1997	101
65	JAMALI	Grati GT 1.1	PLN	HSD & GAS	1997	101
66	JAMALI	Gilimanuk 1	Star-Pertamina	HSD	1997	134
67	JAMALI	Grati GT 1.3	PLN	HSD & GAS	1998	101
68	JAMALI	Cikarang STG 1	GDE	Gas	1999	62
69	JAMALI	Cikarang STG 2	PLN	Gas	1999	62
70	JAMALI	Drajat 2	PLN	Geothermal	2000	90
71	JAMALI	Wayang Windu 1	PLN	Geothermal	2000	110
72	JAMALI	Grati GT 2.1	PLN-Pertamina	HSD	2002	101
73	JAMALI	Dieng 1	Star-Pertamina	Geothermal	2002	60
74	JAMALI	Pemaron 1	PLN	HSD	2004	49
75	JAMALI	Pemaron 2	PLN	HSD	2005	49
76	JAMALI	Drajat 3	PLN	Geothermal	2007	110
77	JAMALI	Kamojang 4	PLN	Geothermal	2008	60
78	JAMALI	Wayang Windu 2	PLN	Geothermal	2009	117
79	JAMALI	Pemaron	PLN	HSD	2010	59
80	Kalimantan	PLTU Asam-asam	PLN	Hydro	2000	65
81	Kalimantan	PLTU Asam-asam	PLN	Hydro	2000	65

82	Sulawesi	PLTG GT 21	PLN	Gas	2008	61
83	Sulawesi	PLTG ST 18*	PLN	Gas	1998	52
84	Sulawesi	PLTD SUPPA	PLN	Diesel	1998	62
85	Sulawesi	PLTG GT 11	PLN	Gas	1997	46
86	Sulawesi	PLTG GT 12	PLN	Gas	1997	46
87	Sulawesi	PLTA BAKARU 1	PLN	Hydro	1990	63
88	Sulawesi	PLTA BAKARU 2	PLN	Hydro	1990	63
89	Sulawesi	PLTD Sewatama Bitung	PLN	Diesel	2002	61
90	Nusa Tenggara	PLTU Jerajang Lombok	PLN	Coal	2012	50

Step 3: Within plants identified in Step 2, identify those that apply technologies different that thetechnology applied in the proposed project activity. Note their number N_{diff}.

Indonesia has 8 types of power plants, namely – geothermal, hydro, mini hydro, diesel, gas, coal, gas turbine, and steam turbine.

As per the definition of "different technologies" in paragraph 9 of Tool for the demonstration and assessment of additionality version 06.0.0, all the power plants of hydro, mini hydro, diesel, gas, coal, gas turbine and steam turbine have different "energy source/ fuel" and hence are different from the project activity.

There are fifteen(15) geothermal projects identified from Step 2 that satisfy the same fuel condition as the project activity and are in the applicable output range as described in Step 1 above., However, as also defined in the version 06.0.0 of *"Tool for the demonstration and assessment of additionality*, one of the aspects which differentiates between similar project activities which have the same output delivery is the investment climate in the date of the investment decision, inter alia: access to technology; subsidies or other financial flows; promotional policies; and legal regulations. The identified geothermal projects differ from the project activity as below:

1. Wayang Windu 1,2- It was developed by Magma Nusantara Limited (MNL) under the JOC with PT Pertamina. Due to the Asian Economic crisis the project was handed over to the bank creditors (Credit Suisse First Boston and Deutsche Bank) following its failure to repay loans in 2001. In 2005, Star Energy, a domestic oil

company acquired the project from the bank and operates it since then. It is evident that the project was initially implemented by state owned company and later taken over by the bank due to financial unattractiveness of the project. Hence the project is not similar to the project activity at Muara Laboh which is being developed by private investment.

2. Salak Phase I – It was built by PT PLN which is a state-owned company and had better access to financing thereby reducing the risks associated with the implementation of the project activity. Hence the power plant is not found comparable to the project activity.

3. Salak Phase II – It was constructed under the Joint Operation Contract (JOC) between Unocal Geothermal of Indonesia Ltd and PT Pertamina. Since 2006, Unocal was acquired by PT Chevron which took over the operation and maintenance of the steam field. Since this power plant also had access to financing due to the involvement of the state-owned company, PT Pertamina, hence is not similar to the project activity.

4. Kamojang Unit 2&3- The power plants have had better access to financing due to the ownership of state owned company. Furthermore Kamojang Unit II and III have been financed by the World Bank and hence not similar to the project activity which is promoted by an IPP.

5. Drajat 1,2,3 - It was built by PT PLN which is a state-owned company and had better access to financing thereby reducing the risks associated with the implementation of the project activity. Hence the power plant is not found comparable to the project activity.

6. Dieng 1 – It was developed by PT. Geo Dipa Energi which the shareholders are Government of Indonesia (GoI) and PT. PLN. Therefore, it is not comparable to project activity.

Since the above identified projects are also proven to be different technologies from the project activity in the respect of its investment climate, the identified number of N_{diff} is noted as 90.

Step 4: Calculate factor F=1-Ndiff/Nall representing the share of plants using technology similar to the technology used in the proposed project activity in

all plants that deliver the same output or capacity as the proposed project activity. The proposed project activity is a "common practice" within a sector in the applicable geographical area if the factor F is greater than 0.2 and Nall-Ndiff is greater than 3.

Drawing on the result of previous steps, N_{all} = 90, and N_{diff} = 90, thus factor F=1-N_{diff}/N_{all} is calculated as zero.

As per paragraph 9 of the guideline – "*The proposed project activity is a "common practice" within a sector in the applicable geographical area if the factor F is greater than 0.2 and N_{all}-N_{diff} is greater than 3*." However, since in the case of the project activity F = 0 and N_{all}-N_{diff} = 0, therefore the project activity is concluded not a common practice in the applicable geographical area i.e. the host country Indonesia.

Sub-step 4b: Discuss any similar Options that are occurring

No similar power plants were found to operate in the host country. Based on the above steps, it can be established that the project activity is additional and requires CDM revenues for its successful implementation.

B.5.1 Prior Consideration

N/A

B.5.2 Ongoing Financial Need

Investment analysis and common practice analysis have both been conducted in section B.5 above. The project will demonstrate ongoing financial need again upon renewal of the crediting period.

B.6. Sustainable Development Goals (SDG) outcomes

Relevant Target/Indicator for each of the three SDGs

Sustainable Development Goals Targeted	Most relevant SDG Target	SDG Impact Indicator (Proposed or SDG Indicator)
13 Climate Action	Integrate climate change measures into national policies, strategies, and planning	GHG reductions (tCO_2e)
7 Affordable and clean energy	By 2030, increase substantially the share of renewable energy in the global energy mix	Net renewable electricity generation that is produced and fed into the grid and/or consumed
8 Decent work and economic growth	By 2030, achieve fully and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value	Total jobs generated as a result of the project

B.6.1 Explanation of methodological choices/approaches for estimating the SDG Impact

SDG13

Baseline emissions

Baseline emissions include only CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity. The methodology assumes that all project electricity generation above baseline levels would have been generated by existing grid-connected power plants and the addition of new grid-connected power plants.

The baseline emissions are calculated as follows:

$$BE_y = EG_{PJ,y} * EF_{grid,CM,y} \quad (1)$$

Where:

Bey Baseline emissions in year *y* (tCO_2/yr)

$EG_{PJ,y}$ Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year *y* (MWh/yr)

$EF_{grid,CM,y}$ Combined margin CO_2 emission factor for grid connected power generation in year *y.* This is calculated using the latest version of the "Tool to calculate the emission factor for anelectricity system" (tCO_2/MWh)

Calculation of $EG_{PJ,y}$

The project activity is a Greenfield renewable energy project. Hence the net electricity generation is calculated as follows:

$$EG_{PJ,y} = EG_{facility,y} \quad (2)$$

Where:

$EG_{PJ,y}$ Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year *y* (MWh/yr)

$EG_{facility,}$ Quantity of net electricity generation supplied by the project plant/unit to the grid in year *y* (MWh/yr)

Project emissions

For most renewable power generation project activities, *PEy* = 0. However some project activities such as geothermal power plants may involve project emissions. These emissions shall be accounted for as project emissions by using the following equations from the applied methodology:

$$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y} \quad (3)$$

Where:

PE_y Project emissions in year *y* (tCO_2e/yr)

$PE_{FF,y}$ Project emissions from fossil fuel consumption in year *y* (tCO_2/yr)

$PE_{GP,y}$ Project emissions from the operation of geothermal power plants due to the release of non-condensable gases in year *y* (tCO_2e/yr)

$PE_{HP,y}$ Project emissions from water reservoirs of hydro power plants in year *y* (tCO_2e/yr)

Since the project activity is not a hydro power plant, the project emissions from water reservoirs are not considered further.

Fossil Fuel Combustion ($PE_{FF,y}$)

For geothermal power plants which also use fossil fuels for electricity generation, CO_2 emissions from the combustion of fossil fuels shall be accounted for as project emissions ($PE_{FF,y}$). Small amounts of High Speed Diesel (HSD) will be fired in emergency generator set to start-up the turbines and to provide back-up electricity in case of blackout or turbine-trip. For ex-ante emissions the project emissions from the diesel combusted in the diesel generator has been considered zero. The parameter will be monitored ex-post and the project emissions taken into account at actual.

These project emissions will be monitored and will be calculated as per the "*Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion, version 02*", using the following equations:

$$PE_{FF,y} = PE_{FC,y} \quad (4)$$

$$PE_{FC,y} = \sum FC_y \times COEF_y \quad (5)$$

Where:

$PE_{FC,y}$ CO_2 emissions from diesel combustion in process, during the year y (tCO_2/yr)
FC_y Quantity of diesel combusted in the process, in year y (mass or volume unit/yr)
$COEF_y$ CO_2 emission coefficient of diesel, in year y (tCO_2/mass)

Option B of the tool is chosen to calculate the CO_2 emission coefficient $COEF_y$ based on net calorific value and CO_2 emission factor of the fuel type, as follows:

$$COEF_y = NCV_y * EF_{CO2,y} \quad (6)$$

Where:

NCV_y Weighted Average net calorific value of diesel in year *y* (GJ/m^3)
$EF_{CO2,y}$ CO_2 emission factor of diesel(tCO_2/GJ)

Emissions of non-condensable gases from the operation of geothermal power plants ($PE_{GP,y}$*)*

For geothermal project activities, the fugitive emissions of carbon dioxide and methane due to release of non-condensable gases from produced steam shall be taken into account. Non-condensable gases in geothermal reservoirs usually consist mainly of CO_2 and H_2S. They also contain a small quantity of hydrocarbons, including predominantly CH_4. In geothermal power projects, non-condensable gases flow with the steam into the power plant. A small proportion of the CO_2 is converted to carbonate/bicarbonate in the cooling water circuit. In addition, parts of the non-condensable gases are reinjected into the geothermal reservoir. However, as a conservative approach, the applied methodology suggests to assume that all noncondensable gases entering the power plant are discharged to atmosphere via the cooling tower. Fugitivecarbon dioxide and methane emissions due to well testing and well bleeding are not considered, as they arenegligible.

$PE_{GP,y}$ is calculated as follows:

$$PE_{GP,y} = \left(w_{steam,CO2,y} + w_{steam,CH4,y} * GWP_{CH4}\right) * M_{steam,y} \quad (7)$$

Where:

PEGP,y Project emissions from the operation of geothermal power plants due to the release ofnon-condensable gases in year *y* (tCO_2e/yr)

$w_{steam,CO2,y}$ Average mass fraction of carbon dioxide in the produced steam in year *y* (tCO_2/t steam)

$w_{steam,CH4,y}$ Average mass fraction of methane in the produced steam in year *y* (tCH_4/t steam)

$GWPCH_4$ Global warming potential of methane valid for the relevant commitment period (tCO_2e/tCH_4)

$M_{steam,y}$ Quantity of steam produced in year *y* (t steam/yr)

Leakage

No leakage emissions are considered. As per the methodolgy these emissions sources are neglected.

Emission reductions

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y \quad (8)$$

Where:

ER_y	Emission reductions in year *y* (tCO_2e/yr)
BE_y	Baseline emissions in year *y* (tCO_2/yr)
PE_y	Project emissions in year *y* (tCO_2e/yr)

SDG 7

The project activity utilizes available heat under the surface of earth as a source for power generation which is considered a very low emissions power source. The project activity will be able to displace part of the electricity generated in Sumatera Grid, which is dominated by fossil fuel fired power plants, and thus reduce GHG emissions for improving air quality. The net electricity production from the geothermal power plant provides an indicator for the provision and affordable and clean energy.

SDG 8

The project contributes significantly to the social and economic conditions of the local population through the creation of employment and local business opportunities during the construction of the power plant as well as during the operation of the plant. This can be monitored through determining the number of total jobs generated during both the construction and operational phase of the project through disclosing employment contracts and type of employment. The sourcing of the material and labour will mainly occur locally to encourage local community involvement and participation in the project. Moreover, with the reliability of electricity supply from PLN, the project will improve socioeconomic conditions and people's welfare.

B.6.2 Data and parameters fixed ex ante

SDG13

Data/parameter	GWP, CH_4
Unit	tCO2e/tCH_4
Description	Global warming potential of methane valid for the relevant commitment period
Source of data	IPCC 2006
Value(s) applied	For the first commitment period: 21 t CO_2/tCH_4
Choice of data or Measurement methods and procedures	This is in accordance with the applied methodology ACM0002.
Purpose of data	The data is used to calculate baseline emission reductions.
Additional comment	-

Data/parameter	$EF_{grid,CM,y}$
Unit	tCO2/MWh
Description	Combined margin CO_2 emission factor for grid connected power generation in year y
Source of data	Published data by BPPT
Value(s) applied	0.743
Choice of data or Measurement methods and procedures	Calculated according to "Tool to calculate the emission factor for an electricity system", Version 02.2.1.
Purpose of data	The data is used to calculate baseline emission reductions.
Additional comment	This parameter has been fixed *ex-ante*

Data/parameter	$EF_{grid,OM,y}$
Unit	tCO_2/MWh
Description	Operating margin CO_2 emission factor for grid connected power generation in year y
Source of data	Published data by BPPT
Value(s) applied	0.905 for ex-ante estimate of emission reductions.
Choice of data or Measurement methods and procedures	Calculated according to "Tool to calculate the emission factor for an electricity system", Version 02.2.1.
Purpose of data	The data is used to calculate baseline emission reductions.
Additional comment	This parameter has been fixed *ex-ante*

Data/parameter	$EF_{grid,BM,y}$
Unit	tCO2/MWh
Description	Build margin CO_2 emission factor for grid connected power generation in year y
Source of data	Published data by BPPT
Value(s) applied	0.581 for ex-ante estimate of emission reductions.
Choice of data or Measurement methods and procedures	Calculated according to "Tool to calculate the emission factor for an electricity system", Version 02.2.1.
Purpose of data	The data is used to calculate baseline emission reductions.
Additional comment	This parameter has been fixed *ex-ante*

Data/parameter	Density of diesel oil
Unit	kg/m^3
Description	Density of diesel oil
Source of data	Energy Statistics Manual, IEA, 2004 Table A3.8 page 181
Value(s) applied	843.9
Choice of data or Measurement methods and procedures	Density of diesel oil = 843.9 kg/m^3
Purpose of data	The data is used to calculate baseline emission reductions.
Additional comment	-

B.6.3 Ex ante estimation of SDG Impacts

SDG 7

For ex ante estimation, the data is estimated based on the total amount of electricity that Supreme has agreed to supply to the main regional grid based on the net production capacity of the power plant annually. Actual measurements will come from bidirectional meters which can be cross-checked by obtaining records on the amount of electricity that is sold.

SDG 8

The number of people employed by the project will be reported for each monitoring period through keeping track of employees on the number of employees on an excel spreadsheet. This will be cross checked using employment contracts and training records of employees. For ex ante estimation of jobs created, 1,800 people were employed during the construction phase and 386 people are employed for the operational phase of the project.

SDG 13

Baseline Emissions

$$BE_y = EG_{PJ,y} * EF_{grid,CM,y}$$

$$EG_{PJ,y} = EG_{facility,y}$$

The net installed capacity of the power plant is 80 MW, with the Take or Pay (ToP) energy at 90% and 8760 operating hours, the annual net generation is 1,734,480 MWh/year.

$EG_{facility,y}$ = installed net capacity x operational hours x % Take or Pay
= 80MW x 8760 hours/year x 90%
= 630,720 MWh/year

$EF_{grid,CM,y}$ = 0.743 tCO_2/MWh (Sumatera Grid)

BEy = 630,720 MWh/year x 0.743 tCO_2/MWh
= 468,625 tCO_2/year

Project emissions

Fossil Fuel Combustion ($PE_{FF,y}$*)*

$$PE_{FF,y} = PE_{FC,y}$$

$$PE_{FC,y} = \sum FC_y \times COEF_y$$

For ex-ante emissions the project emissions from the diesel combusted in the diesel generator has been considered zero. The parameter will be monitored ex-post and the project emissions considered at actual.

$$COEF_y = NCV_y * EF_{CO2,y}$$

$COEF_y$ = 36.54 GJ/m^3 x 0.0748 tCO_2/GJ
= 2.73 tCO_2/m^3

$PE_{FC,y}$ = 0 m^3/year x 2.73tCO_2/m^3

$PE_{FC,y}$ = 0 tCO_2/year

Emissions of non-condensable gases from the operation of geothermal power plants ($PE_{GP,y}$*)*

$$PE_{GP,y} = \left(w_{steam,CO2,y} + w_{steam,CH4,y} * GWP_{ch4}\right) * M_{steam,y}$$

wsteam,CO2,y	Average mass fraction of carbon dioxide in the produced steam in year *y* (tCO_2/t steam)
wsteam,CH4,y	Average mass fraction of methane in the produced steam in year *y* (tCH_4/t steam)
GWPCH4	Global warming potential of methane valid for the relevant commitment period (tCO_2e/tCH_4)
Msteam,y	Quantity of steam produced in year *y* (t steam/yr)

$$PE_{GP,y} = \left(w_{steam,CO2,y} + w_{steam,CH4,y} * GWP_{ch4}\right) * M_{steam,y}$$

$PE_{GP,y}$ = (0.0019tCO_2/t steam + 0 tCH_4/t steam * 21) * 4,484,419 t steam/year
= 86,549 tCO_2/year

$$PE_y = PE_{FF,y} + PE_{GP,y}$$

Where:

$PE_{,y}$	Project emissions in year *y* (tCO_2/yr)
$PE_{FF,y}$	Project emissions from fossil fuel consumption in year *y* (tCO_2/yr)
$PE_{GP,y}$	Project emissions from the operation of geothermal power plants due to the release ofnon-condensable gases in year *y* (tCO_2/yr)

Project emissions ($PE_{,y}$) = 0 tCO_2/year +86,549 tCO_2/year (High Entalphy case)
= 86,549 tCO_2/year

Leakage

No leakage emissions are considered.

Emission Reductions

$$ER_y = BE_y - PE_y$$

Emission reductions (ERy) = 468,625 tCO_2/year - 86,549 tCO_2/year

= 382,076 tCO_2/year

B.6.4 Summary of ex ante estimates of each SDG Impact

SDG 7

Year	Baseline estimate	Project estimate	Net benefit
Year 1	0 MWh	630,720 MWh	630,720 MWh
Year 2	0 MWh	630,720 MWh	630,720 MWh
Year 2	0 MWh	630,720 MWh	630,720 MWh
Year 4	0 MWh	630,720 MWh	630,720 MWh
Year 5	0 MWh	630,720 MWh	630,720 MWh
Total	**0 MWh**	**630,720 MWh**	**630,720 MWh**

SDG 8

Year	Baseline estimate	Project estimate	Net benefit
Year 1	Construction phase: 0 employees Operational phase: 0 employees	Construction phase: 1,800 employees Operational phase: 386 employees	Construction phase: 1,800 employees Operational phase: 386 employees
Year 2	Construction phase: 0 employees Operational phase: 0 employees	Construction phase: 1,800 employees Operational phase: 386 employees	Construction phase: 1,800 employees Operational phase: 386 employees
Year 2	Construction phase: 0 employees Operational phase: 0 employees	Construction phase: 1,800 employees Operational phase: 386 employees	Construction phase: 1,800 employees Operational phase: 386 employees
Year 4	Construction phase: 0 employees	Construction phase: 1,800 employees	Construction phase: 1,800 employees

	Operational phase: 0 employees	Operational phase: 386 employees	Operational phase: 386 employees
Year 5	Construction phase: 0 employees Operational phase: 0 employees	Construction phase: 1,800 employees Operational phase: 386 employees	Construction phase: 1,800 employees Operational phase: 386 employees
Total	**Construction phase: 0 employees** **Operational phase: 0 employees**	**Construction phase: 1,800 employees** **Operational phase: 386 employees**	**Construction phase: 1,800 employees** **Operational phase: 386 employees**

SDG13

Year	Baseline estimate	Project estimate	Net benefit
Year 1	468,625	86,549	382,076
Year 2	468,625	86,549	382,076
Year 2	468,625	86,549	382,076
Year 4	468,625	86,549	382,076
Year 5	468,625	86,549	382,076
Total	**2,343,125**	**432,745**	**1,910,380**
Total number of crediting years			
Annual average over the crediting period	468,625	86,549	382,076

B.7. Monitoring plan

B.7.1 Data and parameters to be monitored

SDG 13

Data / Parameter	$w_{steam,CO2,y}$
Unit	tCO_2/t steam
Description	Average mass fraction of carbon dioxide in the produced steam in year y
Source of data	Site records
Value(s) applied	0.019
Measurement methods and procedures	Non-condensable gases sampling should be carried out in production wells and at the steam field-power plant interface using ASTM Standard Practice E1675 for Sampling 2-Phase Geothermal Fluid for Purposes of Chemical Analysis (as applicable to sampling single phase steam only). The CO2 and CH4 sampling and analysis procedure consists of collecting non-condensable gases samples from the main steam line with glass flasks, filled with sodium hydroxide solution and additional chemicals to prevent oxidation. Hydrogen sulphide (H2S) and carbon dioxide (CO2) dissolve in the solvent while the residual compounds remain in their gaseous phase. The gas portion is then analyzed using gas chromatography to determine the content of the residuals including CH4. All alkanes' concentrations are reported in terms of methane.
Monitoring frequency	At least every 3 months and more frequently, if necessary
QA/QC procedures	As per ASTM Standard Practice E1675
Purpose of data	The Data/Parameter is required to calculate the baseline emission
Additional comment	All data collected as part of monitoring will be archived electronically and be kept at least for 2 years after the end of the last crediting period.

Data / Parameter	$w_{steam,CH4,y}$

Unit	tCH4/t steam
Description	Average mass fraction of methane in the produced steam in year y
Source of data	Site records
Value(s) applied	0
Measurement methods and procedures	Non-condensable gases sampling should be carried out in production wells and at the steam field-power plant interface using ASTM Standard Practice E1675 for Sampling 2-Phase Geothermal Fluid for Purposes of Chemical Analysis (as applicable to sampling single phase steam only). The CO2 and CH4 sampling and analysis procedure consists of collecting non-condensable gases samples from the main steam line with glass flasks, filled with sodium hydroxide solution and additional chemicals to prevent oxidation. Hydrogen sulphide (H2S) and carbon dioxide (CO2) dissolve in the solvent while the residual compounds remain in their gaseous phase. The gas portion is then analyzed using gas chromatography to determine the content of the residuals including CH4. All alkanes' concentrations are reported in terms of methane.
Monitoring frequency	At least every 3 months and more frequently, if necessary
QA/QC procedures	As per ASTM Standard Practice E1675
Purpose of data	The Data/Parameter is required to calculate the baseline emission
Additional comment	All data collected as part of monitoring will be archived electronically and be kept at least for 2 years after the end of the last crediting period.

Data / Parameter	$M_{steam,y}$
Unit	t steam/yr
Description	Quantity of steam produced in year y

Source of data	Site records
Value(s) applied	4,484,419
Measurement methods and procedures	The steam flow in the main steam line from the separators wells should be measured with a Venturi flow meter (or other equipment with at least the same accuracy). Measurement of temperature and pressure upstream of the Venturi meter is required to define the steam properties. The calculation of steam quantities will be conducted on a continuous basis and should be based on international standards. The measurement results will be summarized transparently in regular production reports.
Monitoring frequency	Daily
QA/QC procedures	Calibration: following the technical specification/requirement of the manufacturer but at least every three years
Purpose of data	The Data/Parameter is required to calculate the baseline emission
Additional comment	All data collected as part of monitoring will be archived electronically and be kept at least for 2 years after the end of the last crediting period. 100% of the data will be monitored.

Data / Parameter	FC_y
Unit	m3/year
Description	Quantity of diesel combusted in the process, in year y (diesel generator)
Source of data	Onsite measurement
Value(s) applied	0
Measurement methods and procedures	A flow meter will be installed at the output of the diesel storage tank. The reading will be taken everyday and recorded in logbooks by operator.

Monitoring frequency	Monitoring continuously and recording daily. The data will be aggregated monthly.
QA/QC procedures	The consistency of metered fuel consumption quantities should be cross-checked based on purchased quantities and stock changes. Calibration: following the technical specification/requirement of the manufacturer but at least every three years
Purpose of data	The Data/Parameter is required to calculate the baseline emission
Additional comment	All data collected as part of monitoring will be archived electronically and be kept at least for 2 years after the end of the last crediting period. 100% of the data will be monitored.

Data / Parameter	NCV_y
Unit	GJ/m^3
Description	Net calorific value of diesel in year y
Source of data	Table 1.2, Chapter 1, Volume 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Value(s) applied	36.54
Measurement methods and procedures	The IPCC data gives an NCV of 43.3TJ/Gg at the upper limit of the uncertainty at a 95%confidence interval. The unit is then converted to 36.54 GJ/m^3 by multiplying it with diesel density of 843.9 kg/m^3.
Monitoring frequency	Any future revision of the IPCC Guidelines should be taken into account
QA/QC procedures	-
Purpose of data	The Data/Parameter is required to calculate the baseline emission
Additional comment	-

Data / Parameter	$EF_{CO2,y}$

Unit	t CO_2/GJ
Description	CO_2 emission factor of diesel
Source of data	Table 1.4, Chapter 1, Volume 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Value(s) applied	0.0748
Measurement methods and procedures	The IPCC data gives a value of 74,800 kg/TJ at the upper limit of the uncertainty at a 95%confidence interval (CO2 emission factor). The units are converted to tCO2/GJ.
Monitoring frequency	Any future revision of the IPCC Guidelines should be taken into account
QA/QC procedures	--
Purpose of data	The Data/Parameter is required to calculate the baseline emission
Additional comment	

SDG 13 & SDG 7

Data / Parameter	$EG_{facility,y}$
Unit	MWh/year
Description	Quantity of net electricity generation supplied by the project plant/unit to the grid in year y
Source of data	Site records
Value(s) applied	630,720
Measurement methods and procedures	There will be 2 bidirectional meters, main meter and check meter, located at Substation of Muara Laboh Power Plant 150kV, with accuracy class of 0.2. The measurement procedures to be applied are in compliance with the provisions of the Power Purchase Agreement. The bidirectional meters will measure the electricity export and the electricity import. The quantity of net electricity supplied to the grid by the power plant

	will be calculated based on the electricity export deducted by the electricity import.
Monitoring frequency	Continuous measurement and monthly recording
QA/QC procedures	Cross check measurement results with records for sold electricity and imported electricity. The energy meters will be calibrated each year in line with the host country accuracy level regulations.
Purpose of data	The Data/Parameter is required to calculate the baseline emission
Additional comment	All data collected as part of monitoring will be archived electronically and be kept at least for 2 years after the end of the last crediting period. 100% of the data will be monitored.

SDG 8

Data/parameter	Number of jobs created locally
Unit	Number
Description	Refers to the total number of jobs generated as a result of the project implementation including the construction and operational phase.
Source of data	Record keeping spreadsheet
Value(s) applied	Will be reported for each monitoring period. For ex ante estimation, 1,800 jobs were created during the construction phase and there are 386 people employed during the operational phase.
Measurement methods and procedures	The number of jobs created will be recorded. The source of data is recorded in an Excel spreadsheet, and it will be cross checked by employment contracts. The spreadsheet will enable employees to be categorised as part-time, full-time, permanent, and/or temporary.
Purpose of data	To demonstrate contribution to SDG 8.
Additional comment	N/A

B.7.2 Sampling plan

Not Applicable

B.7.3 Other elements of monitoring plan

In accordance with the methodology, all the data collected during the crediting period will be archived electronically and kept for at least two years after the end of crediting period. 100% of the parameters mentioned in B.7.1 will be monitored (if not indicated differently) and the energy meters will be calibrated annually to ensure low uncertainty in the monitored data.

Monitoring procedures

Emission reductions are claimed on the net electricity supplied to the Sumatera grid by the project activity. The project owners will follow procedures laid by government entity PT PLN in the Power Purchase Agreement to monitor the energy parameter. On the project emissions, the monitoring procedures will follow the procedures as described in the tables of the section B.7.1 above.The power plant manager will analyze the data every month and report to the head office.

The organisational set up for the CDM operational and monitoring management structure is described in the following figure:

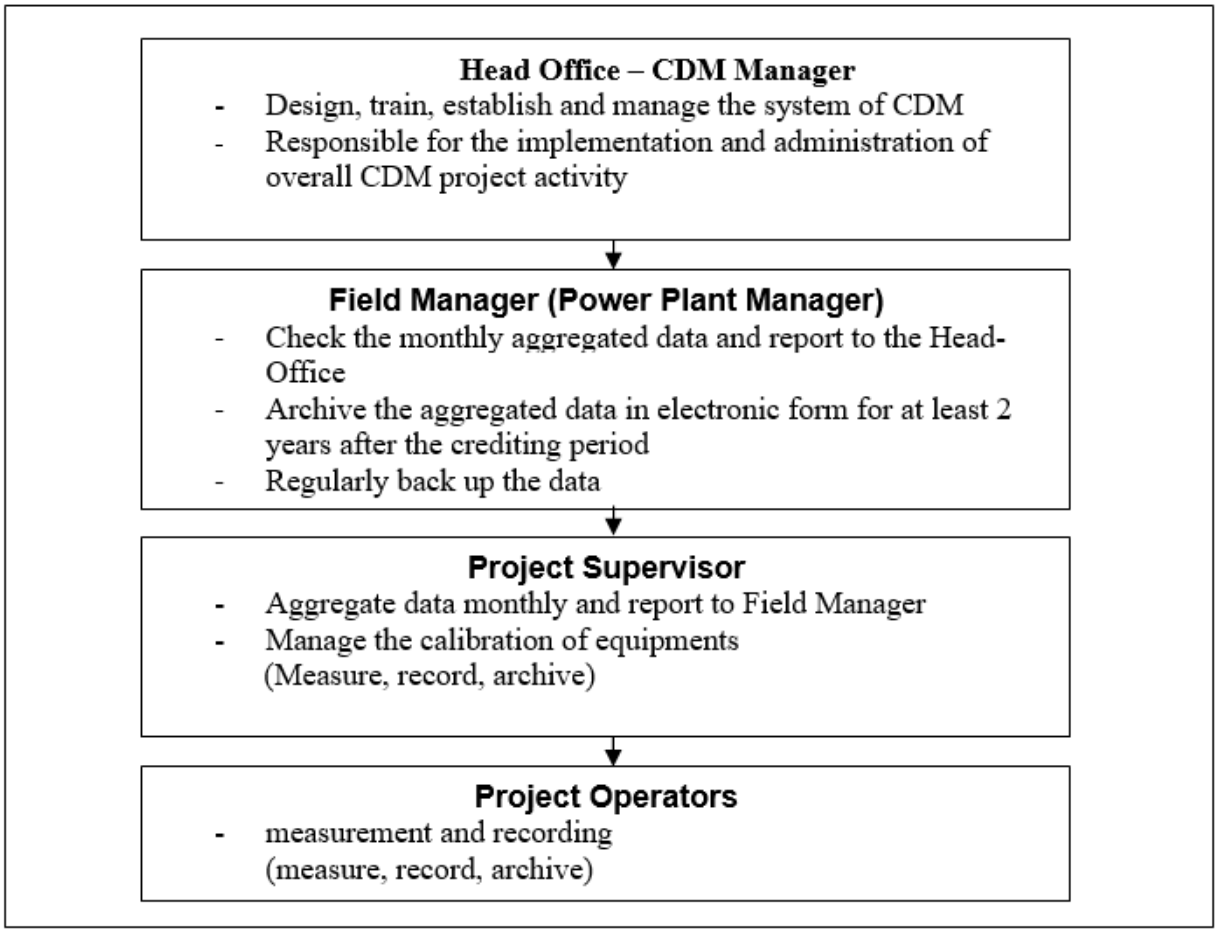

Figure. B.7.2.1 CDM operational and management structure

Period of archiving

The data will be archived electronically every month and invoices of electricity sales to PT PLN will be maintained. The project will employ highly skilled workers and periodic training of employees would ensure that they are well equipped to handle emergency situations.

Calibration of monitoring equipment

The energy meters will be calibrated annually as per national standards and in compliance with the provisions of the Power Purchase Agreement. The calibration of other monitoring equipment will follow the technical specification/requirement of the manufacturer but at least once in every three years. The calibration certificates will be made available to the DOE doing the periodic verification of the project activity.

Training requirements

The suppliers of the equipment will train the staff in- charge to ensure that the equipment will be efficiently maintained and correctly operated. Apart from this, the equipment supplier will provide complete manuals and documentation providing details for the maintenance schedule and the required activities associated with it. Periodic training will be undertaken at the project activity site to ensure proper operation of the power plant and monitoring of the parameters.

SECTION C. DURATION AND CREDITING PERIOD

C.1. Duration of project

C.1.1 Start date of project

15/08/2012

C.1.2 Expected operational lifetime of project

30 years

C.2. Crediting period of project

C.2.1 Start date of crediting period

16/12/2019

C.2.2 Total length of crediting period

5 years. The crediting period may be renewed twice in line with the Renewable Energy Activity Requirements v1.4.

SECTION D. SUMMARY OF SAFEGUARDING PRINCIPLES AND GENDER SENSITIVE ASSESSMENT

D.1 Safeguarding Principles that will be monitored

A completed Safeguarding Principles Assessment is in Appendix 1, ongoing monitoring is summarised below.

Principles	Mitigation Measures added to the Monitoring Plan
Principle 1 Human Rights	Not required
Principle 2 Gender Equality and Women's Rights	Not required
Principle 3 Community Health, Safety, and Working Conditions	Not required
Principle 4 Cultural Heritage, Indigenous Peoples, Displacement and Resettlement	Not required
Principle 5 Corruption	Not required
Principle 6 Economic Impacts	Not required
Principle 7 Climate and Energy	Not required
Principle 8 Water	Not required
Principle 9 Environment, Ecology, and Land Use	A Biodiversity action plan and critical habitat assessment program including installed camera traps and endangered species monitoring is implemented.

D.2. Assessment that project complies with GS4GG Gender Sensitive requirements

Question 1 - Explain how the project reflects the key issues and requirements of Gender Sensitive design and implementation as outlined in the Gender Policy.	The project reflects the key gender issues and requirements of Gender Sensitive design and implementation. To ensure a gender sensitive design and implementation, the stakeholder consultation was conducted with a gender-sensitive approach to ensure that the promotion of information sharing equitably between stakeholders who are men and women. On the implementation level, the project has hired local people to carry out the project. The project ensures sure that no barriers are preventing women from being employed.
Question 2 - Explain how the project aligns with existing country policies,	The project does not involve and is not complicit in any form of discrimination based on gender, race, religion, sexual orientation or any other basis. The project respects all women's

strategies and best practices.	rights including reference to *Articles 5&6* of the *Act of the Republic of Indonesia No. 13/2003* stating that emphasises equal opportunities for employment and treatment from employers as well as other regulations and policies. All these regulations and policies embrace the general equality and social inclusion principles.
Question 3 - Is an Expert required for the Gender Safeguarding Principles & Requirements?	No gender experts will be required for the Gender Safeguarding Principles & Requirements. The project does not contribute to any form of discrimination against women or reinforce gender-based discrimination and/or inequalities. Gender equality will be achieved to ensure that women have equal opportunities and will ensure equal pay.
Question 4 - Is an Expert required to assist with Gender issues at the Stakeholder Consultation?	No experts will be required to engage assist with gender issues at the stakeholder consultation. A separate workshop was organised for women in order to provide a space for women to voice their concerns and to ensure they are playing a significant role in shaping the development of the project. Refer to Appendix 1 of the PDD for more details of the results for Safeguarding Principles Assessment.

SECTION E. SUMMARY OF LOCAL STAKEHOLDER CONSULTATION

The below is a summary of the 2-step GS4GG Consultation for monitoring purposes. Please refer to the separate Stakeholder Consultation Report for a complete report on the initial consultation and stakeholder feedback round.

E.1 Summary of stakeholder mitigation measures

N/A since no concerns were raised and most safeguarding principles are low risk.

E.2 Final continuous input / grievance mechanism

Method	Include all details of Chosen Method (s) so that they may be understood and, where relevant, used by readers.
Continuous Input / Grievance Expression Process Book (mandatory)	There is a call centre present whereby stakeholders are able to express their concerns and comments. There is also a grievance logbook present as another method for stakeholders to report their grievances. Stakeholders are able to check the status of their grievances after lodging them.
GS Contact (mandatory)	help@goldstandard.org
Other	N/A

APPENDIX 1 - SAFEGUARDING PRINCIPLES ASSESSMENT

Complete the Assessment below and copy all Mitigation Measures for each Principle into SECTION D above. Please refer to the instructions in the Guide to Completing this Form.

Assessment Questions/ Requirements	Justification of Relevance (Yes/potentially/no)	How Project will achieve Requirements through design, management or risk mitigation.	Mitigation Measures added to the Monitoring Plan (if required)
Principle 1. Human Rights			
1. The Project Developer and the Project shall respect internationally proclaimed human rights and shall not be complicit in violence or human rights abuses of any kind as defined in the Universal Declaration of Human Rights 2. The Project shall not discriminate with regards to participation and inclusion	Yes	The project respects internationally proclaimed human rights including dignity and cultural property. The project is not complicit in human rights abuses, as the project does not force people to make changes in cultural habits, where the country follows the labour laws and does not interfere with the operation of worship. This principle has been contained in SEML's Code of Conduct policy. Also, in almost all Services Contract Agreement (exhibit J) issued by SEML.	Not required.
Principle 2. Gender Equality			
1. The Project shall not directly or indirectly lead to/contribute to adverse impacts on gender equality and/or the situation of women	Yes	The Local Stakeholder Consultation rounds promoted the attendance of women so that they are well informed and involved in the design of the project. A specific focus group discussion for a women's group was held in October 2016. One of the main points discussed during the focus	Not required.

2. Projects shall apply the principles of non-discrimination, equal treatment, and equal pay for equal work 3. The Project shall refer to the country's national gender strategy or equivalent national commitment to aid in assessing gender risks 4. (where required) Summary of opinions and recommendations of an Expert Stakeholder(s)		group discussion was the involvement of women groups in the geothermal plan development. The women during the FGD expressed their concerns and needs, which included respecting the local culture as well as fairness and transparency in the recruitment process and CSR Programs. Gender Equality are part on company values and code of conduct policy.	
Principle 3. Community Health, Safety and Working Conditions			
1. The Project shall avoid community exposure to increased health risks and shall not adversely affect the health of the workers and the community	Yes	The technology is technically sound and environmentally safe as demonstrated by successful installations around the world. The technology supplier will conduct a comprehensive training for employees to make sure the plant has properly maintained and operated efficiently. SEML has SHE chartered and strict policy as well as received several awards related with SHE category from Government & other institutions.	Not required.
Principle 4.1 Sites of Cultural and Historical Heritage			
Does the Project Area include sites, structures, or objects with historical, cultural, artistic, traditional or religious values or intangible forms of culture?	No	The geothermal project area does not include sites, structures, or objects with historical, cultural, artistic, traditional, or religious values or intangible forms of culture.	Not required.

		The project also does not utilize cultural heritage, including the knowledge, innovations, or practices of local communities.	
Principle 4.2 Forced Eviction and Displacement			
Does the Project require or cause the physical or economic relocation of peoples (temporary or permanent, full or partial)?	No	PD has identified the vulnerable Project Affected People (former land/crops owner). The PD has been monitoring those through SEML ISDP Livelihood Restoration Program. It has not led to the physical or economic relocation of people from their land.	Not required.
Principle 4.3 Land Tenure and Other Rights			
a. Does the Project require any change, or have any uncertainties related to land tenure arrangements and/or access rights, usage rights or land ownership? b. For Projects involving land use tenure, are there any uncertainties with regards to land tenure, access rights, usage rights or land ownership?	No	The PD owns all the project area. The PD has official land certificates issued by the government	Not required.
Principle 4.4 - Indigenous people			
Are indigenous peoples present in or within the area of influence of the Project and/or is the Project located on land/territory claimed by indigenous peoples?	No	People have the same and equal access to clean and renewable energy. No one will be affected directly or indirectly in a negative way by the project.	Not required.

Principle 5. Corruption			
1. The Project shall not involve, be complicit in or inadvertently contribute to or reinforce corruption or corrupt Projects	Yes	SEML applies strict code of conduct policy, as well as Company Values strengthen & enforcement. The project will comply with Indonesia's *Corruption Eradication Law* as well as *Law No.11 of 1980* on the Criminal Act of Bribery. Indonesia is also a signatory of the United National Convention against Corruption.	Not required.
Principle 6.1 Labour Rights			
1. The Project Developer shall ensure that all employment is in compliance with national labour occupational health and safety laws and with the principles and standards embodied in the ILO fundamental conventions 2. Workers shall be able to establish and join labour organisations 3. Working agreements with all individual workers shall be documented and implemented and include: a) Working hours (must not exceed 48 hours per week on a regular basis), AND b) Duties and tasks, AND	Yes	The project strictly complies with the following regulations: • Regulation No. 7 of 1964 of the Minister of Labour on conditions of health, cleanliness, and lighting in workplaces • Law No. 13 of 2003 concerning Labour Law • Guideline and Procedure for Occupational Safety Inspection of Installations, Instruments and Techniques Used in Natural Oil and Gas Exploitation and Geothermal Resource Exploitation. • International standard i.a.: IFC Principles, ADB safeguard, etc.	Not required.

c) Remuneration (must include provision for payment of overtime), AND d) Modalities on health insurance, AND e) Modalities on termination of the contract with provision for voluntary resignation by employee, AND f) Provision for annual leave of not less than 10 days per year, not including sick and casual leave. 4. No child labour is allowed (Exceptions for children working on their families' property requires an Expert Stakeholder opinion) 5. The Project Developer shall ensure the use of appropriate equipment, training of workers, documentation and reporting of accidents and incidents, and emergency preparedness and response measures		Workers have the freedom to express their opinions through establishing and joining labour organisations. The project abides by the Child Protection law (No. 23/2002) that eliminates child labour and enforces the protection of children and young persons. The PD frequently reports related with Labour and SHE implementation including report of any incidents happened to authorized government institution and lenders. PD's Human Resource policy and mutual working Agreement captures all the appropriate working conditions. The PD also frequently reports to the Government. The technology supplier has conducted a comprehensive training for employees to make sure the plant is properly maintained and operated efficiently.	
Principle 6.2 Negative Economic Consequences			
1. Does the project cause negative economic consequences during and after project implementation?	No	The costs of construction of the power plant are covered by the project owner and proponents. In addition, the project owner will bear the cost of equipment maintenance, project certification	Not required.

		fees, and the cost of the project monitoring capacity required. The project will be economically feasible through the sale of emission reduction credits.	
Principle 7.1 Emissions			
Will the Project increase greenhouse gas emissions over the Baseline Scenario?	No	The project will produce geothermal power which is a renewable source of energy and displaces the fossil fuel fired power generation in the connected grid under the business-as-usual scenario. The project will generate emission reductions based on the difference generated in emissions between the power generation generated in the connected grid in the business-as-usual scenario in comparison to the emissions displaced by geothermal energy being supplied to grid.	Not required.
Principle 7.2 Energy Supply			
Will the Project use energy from a local grid or power supply (i.e., not connected to a national or regional grid) or fuel resource (such as wood, biomass) that provides for other local users?	No	The project involves the instalment of the power plant which will generate electricity to export to a national/regional grid instead of using energy from the grid.	Not required.
Principle 8.1 Impact on Natural Water Patterns/Flows			
Will the Project affect the natural or pre-existing pattern of watercourses, groundwater and/or the watershed(s) such as high seasonal flow variability,	No	Geothermal implements close loop technology and implements deep drilling which are not disturbing surface water.	Not required.

flooding potential, lack of aquatic connectivity or water scarcity?			
Principle 8.2 Erosion and/or Water Body Instability			
a. Could the Project directly or indirectly cause additional erosion and/or water body instability or disrupt the natural pattern of erosion? b. Is the Project's area of influence susceptible to excessive erosion and/or water body instability?	No	Geothermal implements deep drilling which are not disturbing surface water. The steam after rotates the turbine, will be injected back to subsurface using the injection wells. In addition, SEML also conducts frequent slope stability measures and environment monitoring activity.	Not required.
Principle 9.1 Landscape Modification and Soil			
Does the Project involve the use of land and soil for production of crops or other products?	No	The project does not involve the production, harvesting, and/or management of living natural resources by small-scale landholders and/or local communities.	Not required.
Principle 9.2 Vulnerability to Natural Disaster			
Will the Project be susceptible to or lead to increased vulnerability to wind, earthquakes, subsidence, landslides, erosion, flooding, drought or other extreme climatic conditions?	No	Geothermal is green, environment friendly and sustainable energy.	Not required.
Principle 9.3 Genetic Resources			
Could the Project be negatively impacted by or involve genetically modified organisms or GMOs (e.g., contamination, collection and/or harvesting, commercial development,	No	The project does not involve any GMOs or genetically modified organisms since it solely focuses on the production of geothermal power.	Not required.

or take place in facilities or farms that include GMOs in their processes and production)?			
Principle 9.4 Release of pollutants			
Could the Project potentially result in the release of pollutants to the environment?	No	There is unlikely to be a release of pollutants into the environment since geothermal energy does not burn fuel to generate electricity. Geothermal plans emit 97% less acid rain-causing sulfur compounds and about 99% less carbon dioxide than fossil fuel power plants of similar sizes[11].	Not required.
Principle 9.5 Hazardous and Non-hazardous Waste			
Will the Project involve the manufacture, trade, release, and/ or use of hazardous and non-hazardous chemicals and/or materials?	No	The project activity does not involve chemicals or materials subject to international bands or phase-outs. It does not involve manufacture, trade, release, and/or use of hazardous and non-hazardous chemicals and/or materials.	Not required.
Principle 9.6 Pesticides & Fertilisers			
Will the Project involve the application of pesticides and/or fertilisers?	No	Since the project is a renewable energy project and not a land-use project, it will not involve the application of pesticides and/or fertilizers.	Not required.
Principle 9.7 Harvesting of Forests			

[11] Geothermal energy and the environment - U.S. Energy Information Administration (EIA)

Will the Project involve the harvesting of forests?	No	The project does not involve any harvesting of forests.	Not required.
Principle 9.8 Food			
Does the Project modify the quantity or nutritional quality of food available such as through crop regime alteration or export or economic incentives?	No	The project activity does not involve the modification of the quantity or nutritional quality of food available.	Not required.
Principle 9.9 Animal husbandry			
Will the Project involve animal husbandry?	No	The project does not involve any animal husbandry as it is a renewable energy project.	Not required.
Principle 9.10 High Conservation Value Areas and Critical Habitats			
Does the Project physically affect or alter largely intact or High Conservation Value (HCV) ecosystems, critical habitats, landscapes, key biodiversity areas or sites identified?	No	The project area is located outside the HCV and total land usage is only less than 1% than the total of the Geothermal concession area (small footprint). However, SEML has the biodiversity action plan and critical habitat assessment.	Not required.
Principle 9.11 Endangered Species			
a. Are there any endangered species identified as potentially being present within the Project boundary (including those that may route through the area)? b. Does the Project potentially impact other areas where endangered species may be present through transboundary affects?	Potentially	Since the project area is located side by side with the conservation forest area, therefore the presence of endangered species is most likely.	The PD has biodiversity action plan and critical habitat assessment program including installed camera trap and endangered species monitoring.

			SEML also cooperates with the Ministry of Environment and Forestry to protect the buffer area of conservation area through a Biodiversity Offset Program which includes Forest Rehabilitation, Revegetation, Ecosystem Revitalization and Fauna Monitoring.

APPENDIX 2- CONTACT INFORMATION OF PROJECT PARTICIPANTS

Organization name	PT Supreme Energy Muara Laboh
Registration number with relevant authority	-
Street/P.O. Box	Jl. Raya Iskandarsyah Raya no. 1A
Building	Menara Sentraya, 23rd floor
City	Jakarta
State/Region	
Postcode	12160
Country	Indonesia
Telephone	+62 21 2788 2222
E-mail	relations@supreme-energy.com
Website	https://www.supreme-energy.com/
Contact person	Mr. Prijandaru Effendi
Title	Executive Vice President Relations & Support Services
Salutation	Mr
Last name	Effendi
Middle name	
First name	Prijandaru
Department	N/A
Mobile	N/A
Direct tel.	N/A
Personal e-mail	effendi@supreme-energy.com

APPENDIX 3- LUF ADDITIONAL INFORMATION

Risk of change to the Project Area during Project Certification Period:	
Risk of change to the Project activities during Project Certification Period:	
Land-use history and current status of Project Area:	
Socio-Economic history:	
Forest management applied (past and future)	
Forest characteristics (including main tree species planted)	
Main social impacts (risks and benefits)	
Main environmental impacts (risks and benefits)	
Financial structure	
Infrastructure (roads/houses etc):	
Water bodies:	
Sites with special significance for indigenous people and local communities - resulting from the Stakeholder Consultation:	
Where indigenous people and local communities are situated:	
Where indigenous people and local communities have legal rights, customary rights or sites with special cultural, ecological, economic, religious or spiritual significance:	

APPENDIX 4-SUMMARY OF APPROVED DESIGN CHANGES

Permanent Changes

1. Change to the project design

In this revised PDD, PP request for changes to the project design, it changes the design of net capacity of 220MW to 80 MW. This change caused by the unexpected result during exploration phase, namely:

- Actual well success rate dropped from 67% to 17%,
- which result in sky-rocketing drilling cost, due to more depth, additional stimulation well, longer period of well testing and additional scope of well testing.

Based on above fact, it made Project Participant to changes project design from initial net capacity of 2x110 MW into 80 MW + 140MW. The prolonged delay resulting Project Participant to proceed with the net capacity of 80 MW. PP still confidence that the 140 MW is supported with good geothermal resource, however it takes longer time.

The project with a net capacity of 80 MW began operation on 16/12/2019.

According to CDM project standard for project activities version 02.0, CDM-EB93-A04-STAN para 241 point b, changes to a registered CDM project activity may include decrease in the capacity specified in the registered PDD.

As requested in para 242, PP shall report in the revised PDD the impacts of the proposed or actual changes to the registered CDM project activity on the following:

Impact of the change	Justification
The applicability and application of the applied methodologies	The applicability of the ACM0002 - "Consolidated baseline methodology for grid-connected electricity generation from renewable sources", Version 12.2.0, EB 65 Annex 16 has been demonstrated in the section B.2. Therefore, the change does not impact on the applicability of the methodology.
The additionality of the project activity	The PDD section B.5 has demonstrated that the change of net capacity from 220 MW to 80 MW doesn't impact on additionality of the project. Therefore, the project remains additional.
The scale of the project activity	The design net capacity change from 220 MW to 80 MW doesn't change the scale of the project. The project remains Large-scale project.

2. **Permanent changes to the registered monitoring plan**

In this revised PDD, also involves permanent changes to the registered monitoring plan. As explained in the section B.7.1, there are changes in values which further explained below:

- $w_{steam,CO2,y}$ the value is changes following capacity changes from 220 MW to 80 MW.
- $M_{steam,y}$ the values is changes following capacity changes from 220 MW to 80 MW.
- $EG_{facility,y}$the values is changes following capacity changes from 220 MW to 80 MW.

The changes above is accordance to CDM project standard for project activities version 02.0, CDM-EB93-A04-STAN para 238. Further Project shall demonstrate and justify the changes:

Impact of the change	Justification
Change to monitoring plan	Change values of $w_{steam,CO2,y}$, $M_{steam,y}$, $EG_{facility,y}$ are due to changes following capacity changes. The changes are in line with the methodology ACM0002.

3. Corrections

Following the changes to project design from net capacity of 2x110MW into 80MW, some parameters and data need to be updated. The updated data and information discussed below:

Data/Information	Update	
	Registered PDD	PRC
Install Capacity (MW)	234	88.81
Net Capacity (MW)	220	80
Number of Turbine	2	1
Steam flow rate (Kg/s)	280	158
Information of input parameters of investment analysis available on section B.5		
Annual electricity for sale (MWh)	1,734,480	630,720
Electricity tariff (c.USD/kWh)	9.40	13
Operation & Maintenance cost (c.USD/kWh)	1.2	1.7
Overhead cost (c.USD/kWh)	0.12	0.2
Make up wells (USD million/well)	6.50	7.50
Major well work-over (USD million/well)	1.2	2.1
Plant overhaul (USD million/year)	2	1
Inflation (%)	2.92	2.5
Portion of electricity tariff to be escalated (%)	25	100
Tariff escalation per year (%)	2.3	1.8
Investment cost (USD million)	794	451
Baseline Emission (tCO_2/yr)	1,288,719	468,625
Project Emission (tCO_2/yr)	295,290	86,549

Emission Reduction (tCO_2/yr)	993,428	382,076

The impacts of updated information above have been discussed in the point 1 above. The updated information above is accordance with Project Standard for project activities CDM-EB93-A04-STAN version 02.0 para 232.

4. Deviation Request – Change in Crediting Period

The PP submitted a deviation request and received approval from GS4GG prior to transitioning to the GS4GG to change the crediting period from **18/09/2015-17/09/2022** to **16/12/2019-15/12/2026**. Since the project will be transitioning to the GS4GG from the CDM, the crediting period has been shortened in this updated PDD to a 5-year cycle of **16/12/2019 -15/12/2024**.

The initial start date of the project activity of the Liki Pinangawan Muaralaboh Geothermal Power Plant was 15th of August 2012. Whilst the official crediting period start date with the CDM is 18th September 2015 (as presented in the CDM PDD, in the 1st Monitoring Report on the CDM registry project page: CDM: Liki Pinangawan Muaralaboh Geothermal Power Plant (unfccc.int), the project did not start operation until 16th December 2019. However, the PD has been focusing its attention on other issues and the project has not requested a change of the CP to the CDM executive board. This was due to a delay in the progress of the project and therefore impacted to the negotiation of the Emission Reductions Purchase Agreement (ERPA) and a post-registration design change in the capacity of the power plant from 234 MW, initially planned when the project was initially submitted to the CDM in May 2012 (ref. date of registration request), to 88.81 MW. The design change was approved on 14th April 2021 (as can be seen on the project CDM page: CDM: Liki Pinangawan Muaralaboh Geothermal Power Plant (unfccc.int)) and as explained in the Permanent Changes section.

It is understood that the total duration of the crediting period shall not exceed the maximum crediting period allowed under relevant GS4GG activity requirements according to paragraph 6.3.1 of the *GHG Emissions Reduction & Sequestration Product Requirements v.2.1*. This includes the period for which the project has issued emission reductions for under other standard. The project has not issued any emission reductions under the CDM.

The impact of the deviation was assessed and included in the Deviation Request that received approval from GS4GG as shown below:

1. **Project Design**

Explanation:

Changes will be made to the start date of the operation of the project. The Location of the project activity will remain the same as well as the technology employed by the project activity. The baseline and monitoring methodology will remain the same and is aligned with the applied methodology (ACM0002).

2. **Safeguarding principles assessment**

Explanation:

The project will be evaluated against the Safeguarding Principles and Requirements V1.2 during the transition process. To ensure the project complies with the safeguarding principles, an assessment of the social, economic, and environmental aspects will be re-validated during the transition process. The CP start date change is not expected to have any impact on safeguards and their assessment. The project is only postponed in time.

3. **SDG assessment**

Explanation:

The SDG impact of the project will be assessed during the GS transition process. At least 3 SDGs will be selected, and a monitoring plan will be established accordingly. The CP start date change is not expected to have any impact on safeguards and their assessment. The project is only postponed in time. SDG impact also will.

4. **Emission reductions**

Explanation:

Based on the latest PDD, the ex-ante calculation of emission reductions will not change since the design of the project, the capacity or the outputs will not change, from the registered CDM project. This can be evaluated during the gap analysis to analyze the gaps between GS4GG requirements and the conditions the project had to fulfill for registration with the CDM.

5. **Monitoring frequency**

Explanation:

The monitoring frequency is not expected to change with the CP start date change. It will be updated to reflect the new start date and as per required by the methodology. This can be evaluated during the gap analysis to analyze the gaps between GS4GG requirements and the conditions the project had to fulfill for registration with the CDM.

6. **Data quality**

Explanation:

The data quality will remain in line with the requirement of the applied methodologies and the CP start date change is not expected to change this. This can be evaluated during the gap analysis to analyze the gaps between GS4GG requirements and the conditions the project had to fulfill for registration with the CDM.

7. **Potential risk or any other relevant aspect of the project**

Explanation:

There is no current risk of any other relevant aspect of the project with a change in the start date. This can be evaluated during the gap analysis to analyze the gaps between GS4GG requirements and the conditions the project had to fulfill for registration with the CDM.

Revision History

Version	Date	Remarks
1.2	14 October 2020	Hyperlinked section summary to enable quick access to key sections Improved clarity on Key Project Information Inclusion criteria table added Gender sensitive requirements added Prior consideration (1 yr rule) and Ongoing Financial Need added Safeguard Principles Assessment as annex and a new section to include applicable safeguards for clarity Improved Clarity on SDG contribution/SDG Impact term used throughout Clarity on Stakeholder Consultation information required Provision of an accompanying Guide to help the user understand detailed rules and requirements
1.1	24 August 2017	Updated to include section A.8 on 'gender sensitive' requirements
1.0	10 July 2017	Initial adoption