



**Monitoring report form for CDM programme of activities
(Version 03.0)**

Complete this form in accordance with the instructions attached at the end of this form.

MONITORING REPORT

Title of the PoA	Tunki Small Scale Hydropower Program of Activities	
UNFCCC reference number of the PoA	6198	
Version numbers of the PoA-DD applicable to this monitoring report	5	
Version number of this monitoring report	2.3	
Completion date of this monitoring report	05/11/2019	
Monitoring period number	Fifth	
Duration of this monitoring period	01/01/2018-31/12/2018 (including both dates)	
Monitoring report number for this monitoring period	2	
Coordinating/managing entity	Carbonbay GmbH & Co. KG	
Host Parties	Host Party of the PoA	Is this the host Party of a CPA covered in this monitoring report? (yes/no)
	Peru	Yes
Applied methodologies and standardized baselines	Methodology AMS-I.D. ver. 17 – Grid connected renewable electricity generation	
Sectoral scopes	1	
Amount of GHG emission reductions or net anthropogenic GHG removals achieved by all CPAs covered in this monitoring report in this monitoring period	Amount achieved before 1 January 2013	Amount achieved from 1 January 2013
	N.A.	4,586
Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the CPA-DDs for the CPAs covered in this monitoring report	9,513	

PART I Monitoring of programme of activities (PoA)

SECTION A. Description of PoA

A.1. General description of PoA

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The Tunki Small Scale Hydropower Program of Activities aims the development of a series of grid connected small hydroelectric projects in Peru.

The Tunki PoA supports the development of new small scale hydropower projects in Peru connected to the Peruvian National Electricity Grid (SEIN). Each small-scale CDM Program Activity (referred to as CPA) under this PoA comprises one or more hydropower plant projects having a combined installed capacity of no more than 15 MW in the case of new facilities or a capacity addition, replacement or retrofit of no more than 15 MW for the total plant capacity in the case of existing facilities, considering the threshold for small-scale CDM projects. This PoA is a voluntary action being coordinated and managed by Carbonbay GmbH & Co. KG.

A.1.1. Corresponding generic component project activities (CPAs)

Title and reference number of the corresponding generic CPA	Version of the PoA-DD	Sectoral scopes	Applied methodologies and standardized baselines
Hydro Power Plant – Tunki PoA CPA #, version 1.0*	5	1	AMS-I.D. ver. 17– Grid connected renewable electricity generation Tool to calculate the emission factor for an electricity system. Version 2.2.1

A.1.2. CPAs included in the PoA

Title and UNFCCC reference number of the CPA	Version of the PoA-DD	Title and reference number of the corresponding generic CPA	Crediting period type and duration	Covered in this monitoring report? (yes/no)
6198-0001: Coelvihidro 1 Hydro Power Plant, Quipico – Tunki PoA CPA # 1	5	Hydro Power Plant– Tunki PoA CPA #, version 1.0	Renewable 19/09/2013 - 18/09/2020	No
6198-0002: Canchayllo Hydro Power Plant, Pachacayo – Tunki PoA CPA #2	5	Hydro Power Plant– Tunki PoA CPA #, version 1.0	Renewable 01/01/2015 - 31/12/2021	No
6198-0003: Langui II Hydro Power Plant, Hercca – Tunki PoA CPA #4	5	Hydro Power Plant– Tunki PoA CPA #, version 1.0	Renewable 01/06/2015 - 31/05/2022	yes
6198-0004: Zaña Hydro Power Plant, Monte Seco1 – Tunki PoA CPA #3	5	Hydro Power Plant– Tunki PoA CPA #, version 1.0	Renewable 01/10/2016 - 30/09/2023	no

A.2. Coordinating/managing entity

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SECTION B. Implementation of PoA

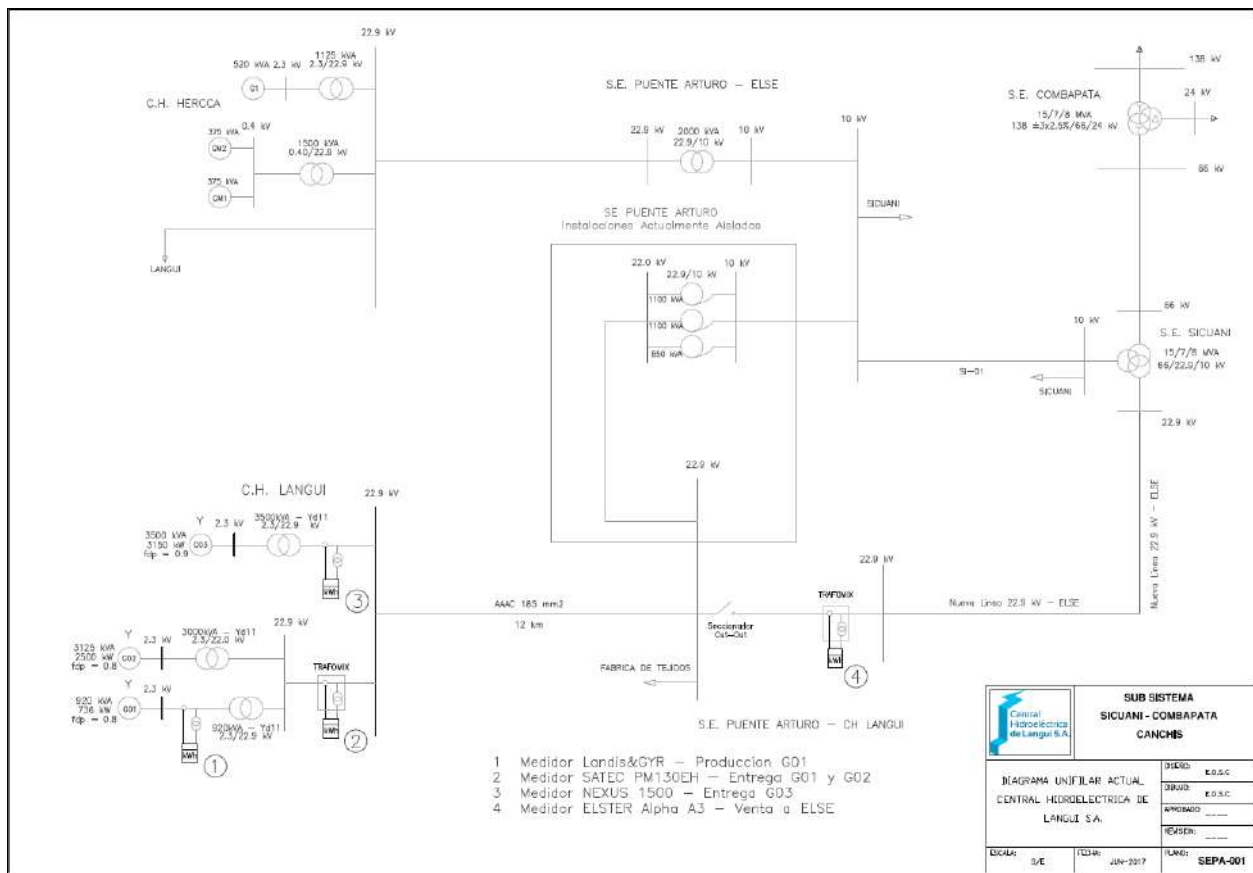
B.1. Description of implemented PoA

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In general, there has not been any event during the monitoring period that affects the applicability of the methodology in any of the CPAs requesting emission reductions. Implementation of the CPA has been performed as follows:

6198-0003: The starting date of the CPA is set as 19/11/2013, date in which the contract for financial support was signed. The delivery of electricity to the national grid started on 16/06/2015.

The project supplies the energy generated to the national Peruvian electricity grid. Line diagram with the connection of the project to the grid is presented below:



At the site the following class 0.2 meter are present:

Sub-station meter	Nexus
Since 14 November 2016 Schlumberger SV3AT meter is replaced by ELSTER ALPHA A3 meter to record the data at the substation Puento Arturo Serial number: 13443767	Nexus 1500– this meter records the data for the generator 3 Serial Nr: 148-0132929430 New device installed on 16/06/2015 Calibration valid for 3 years till

Class: 0.2 New calibration on 08/05/2019, valid until 07/05/2022.	15/09/2017, initial calibration on 16/09/2014 Class: 0.2 New calibration on 08/05/2019, valid until 07/05/2022..
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B.2. Post-registration changes to PoA

B.2.1. Corrections

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Following correction was done to the registered PoA DD 6198:

Under the section E.6.2.- II - Grid Emission factor of the PoA DD, to calculate the build margin emission factor, it was chosen 'Option 1' which is calculating it ex ante based on the most recent information available on units already built for sample group at the time of CDM- PDD submission to the DOE for validation. However the parameter 'EFgrid,BM,y' was mentioned under the section E.7.1. which includes data and parameters to be monitored by each SSC-CPA. This parameter has now been indicated under the right section in the PoA DD and generic CPA DD. There were some typographical errors with the parameters used in the calculation of operating margin emission factor which have been corrected now. The parameters EGm,y and EFEL,m,y were also removed from the parameters to be monitored as they are used for calculation of Build margin emission factor which is a fixed ex-ante value.

The above mentioned correction was not proposed during this verification and was already approved by the CDM EB.

B.2.2. Inclusion of monitoring plan

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N:A.

B.2.3. Permanent changes to the registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other methodological regulatory documents

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N.A.

B.2.4. Changes to programme design

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N.A.

B.2.5. Changes specific to afforestation or reforestation activities

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N.A.

PART II Monitoring of CPAs

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SECTION C. Implementation of CPAs

C.1. Description of implemented CPAs

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All CPAs belonging to the Tunki PoA are small scale hydro power projects located in Peru.

6198-0003:

(a) Purpose of the specific-case CPA(s) and the measures taken for GHG emission reductions or net GHG removals by sinks;

The Component Project Activity (CPA) is a capacity expansion of a 3.236 MW small-scale run of the river power plant to 6.386 MW. The generated electricity is delivered to the national grid, reducing GHG emissions.

(b) Description of the technology employed and installed equipment and/or infrastructure, including information requested by the eligibility criteria;

The existent power plant, named Langui I, consist of two (2) Francis horizontal axis turbines of 736 kW and 2,500 kW respectively. Langui II consists of 1 Francis turbine with an installed capacity of 3.15 MW. The design flow is 3 m³/s and a net height of 115.70 m. The water is taken from the same source of Langui I, the Langui Layo lagoon, start of the Hercca River, after optimization works performed at the water intake constructions.

(c) Relevant dates for the specific-case CPA(s) (e.g. construction, commissioning, continued operation periods, etc.):

The starting date of the CPA is set as per 19/11/2013, the date, on which the contract for financial support was signed. The delivery of electricity to the national grid started on 16/06/2015.

(d) Total GHG emission reductions or net GHG removals by sinks achieved in this monitoring period for the specific-case CPA(s), including information on how double counting is avoided.

During the presented monitoring period from 01/01/2018 to 31/12/2018, the project has generated **7,946.47 MWh** electricity, for which **4,586 CERs** have been claimed.

C.2. Location of CPAs

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The boundaries of the programme is the host country Peru.

6198-0003: Langui II Hydro Power Plant, Hercca – Tunki poA CPA #4

The location of the project is the district of Langui, province of Canas, Cusco, Peru.

The project coordinates are:

Item	Location (decimals)
Power house	-14.355278, -71.295833
Water intake	-14.357222, -71.313333
Water devolution	-14.354722, -71.295833

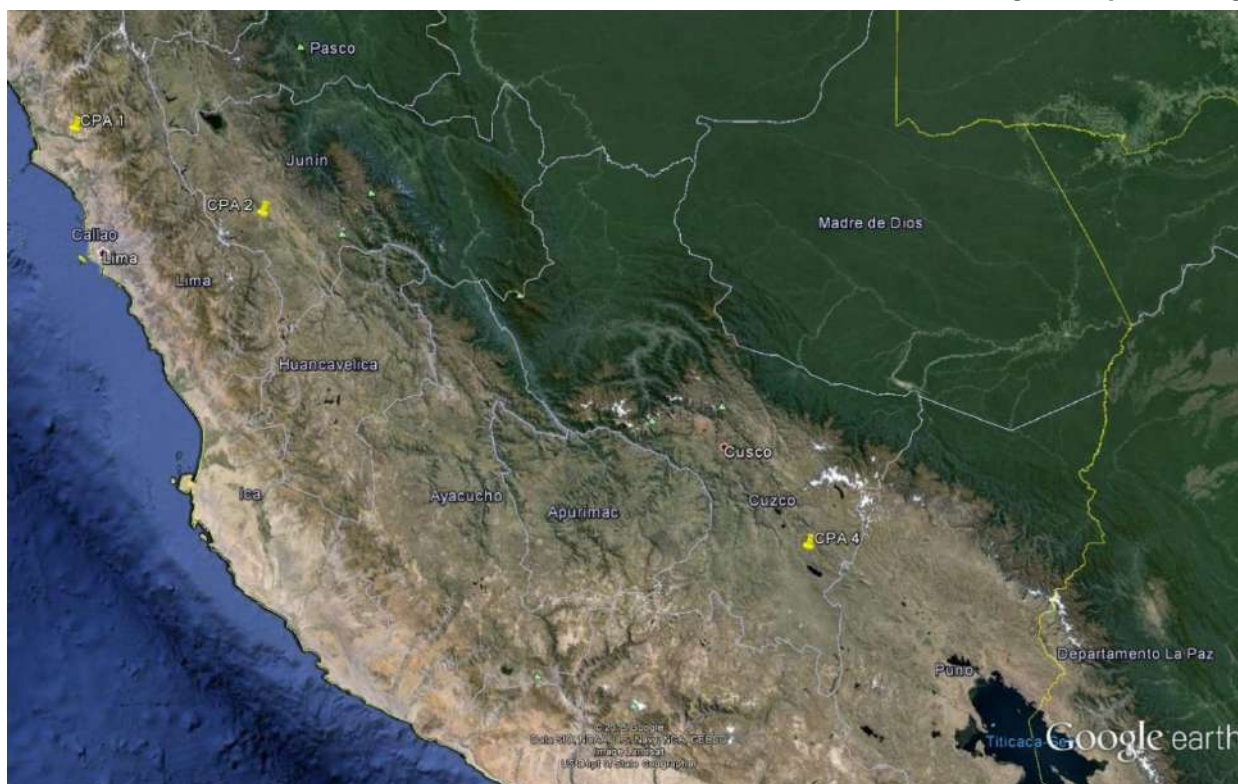


Figure 1: Location of power houses included to the PoA

C.3. Post-registration changes to CPAs

C.3.1. Temporary deviations from the monitoring plans in the included CPA-DDs, applied methodologies, standardized baselines or other methodological regulatory documents

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N.A.

C.3.2. Corrections

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PRC Ref. No.: PRC-6198-002 (approved on 13/08/2019):

Following corrections were made to CPA 6198-0003 and the PRC ref No. PRC-6198-002, approved on 13th August 2019:

- Minor spelling and removing of space between words and paragraphs.
- Change of fonts used in the document where different fonts were initially used.
- Using the latest format of the CDM-CPA-DD-FORM (Version 09.0) which is used for this document)
- Correction to the document version number and the date of the completion of the CDM CPA-DD.
- Included information in sections of the CPA-DD form (version 09.0), which was not part of the CPA-DD form for used for version 5.5 of the CPA-DD.
- Correction of the installed capacity of the the project activity to 6.386 MW as compared to 6.54 MW mentioned in the version 5.5 of the CPA-DD.
- Correction of the installed capacity of 2 existing generators from 787.89 kW to 736 kW (for generator 1) and from 2604 kW to 2500 kW (for generator 2)
- Correction in the ex-ante estimates of the emission reductions from 10,047 tCO₂e (in the version 5.5 of CPA-DD) to 9,513 tCO₂e.

- Correction in the value of $EG_{PJ, facility, y}$ and $EG_{BL, capacity\ addition, y}$ as compared to the values mentioned for these parameters in version 5.5 of CPA-DD.
- Corrections in summary of ex ante estimates of emission reductions.
- Update of the contact information provided in Appendix 1 for CPA Implementer.

Following changes were approved by CMD EB during the second (2nd) monitoring period of CPA 3 (approved by EB on 29/08/2017):

- Emission calculation in the revised CPA-DD. In the initial CPA-DD, under section B.6.3, in the baseline emission calculation formula, the subscript was written as retrofit instead of capacity addition, since the project activity is a capacity addition project and not a retrofit project.
- The estimated amount of GHG emission reductions which is changed to the annual value of 10047 tCO₂.
- The monitored frequency of the parameters $EG_{n, h}$ (Electricity generated and delivered to the grid by power units n in hour) have been corrected to Hourly, which was erroneously written as yearly in the previous CPA-DD and $EG_{m, y}$ (Net quantity of electricity generated and delivered to the grid by power unit m in year y) have been corrected to Annually which was erroneously written as “COES registers information every 15 minutes” in the previous CPA-DD.
- The description mentioned under “Values applied” for the ex-ante parameters $EG_{historical}$ (annual average historical net electricity generation by the existing renewable energy plant) and $\sigma_{historical}$ (standard deviation of the annual average historical net electricity generation by the existing renewable energy plant) have been corrected, since in the earlier CPA DD it was erroneously mentioned that the values will be updated up to to the day before the project start which has been corrected to “This data is the information up to the month before the project started summing 5 years of historical information as per guidelines of the PoA and applicable methodology”.
- There were some typographical errors (with the notation of the parameters) with the parameters used in the calculation of operating margin emission factor which have been corrected now. The parameters $EG_{m, y}$ and $EFEL_{m, y}$ were also removed from the parameters to be monitored as they are used for calculation of Build margin emission factor which is a fixed ex-ante value.
- The corrected CPA-DD mentioning the capacity of project as 3.15 MW is submitted with the verification Report. Since as per Appendix 1 of VVS, version 09.0, prior approval is not required in this case, as this change in the installed capacity does not affect the Scale, Applicability and Additionality of the project, and thus, the change has been accepted by the assessment team.

C.3.3. Changes to the start date of the crediting period

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N.A.

C.3.4. Inclusion of monitoring plan

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N.A.

C.3.5. Permanent changes to the included monitoring plans, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other methodological regulatory documents

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PRC Ref. No.: PRC-6198-002 (approved on 13/08/2019):

Following permanent changes from the registered monitoring plan og the registered CPA-DD were proposed before the start of 05th verification of CPA 3 (6198-0003):

- Revision in calibration frequency of energy meters used to monitor parameter $EG_{PJ, facility, y}$ and $EG_{BL, capacity addition, y}$.
- Revision in QA/QC procedures for parameters $EG_{PJ, facility, y}$ and $EG_{BL, capacity addition, y}$.
- Revision in QA/QC procedures for parameters $EG_{PJ, h}$.
- Revision in Management Structure and Responsibilities under other elements of monitoring plan
- Revision in data collection method under other elements of monitoring plan
- Addition of information in data calibration method under other elements of monitoring plan

C.3.6. Changes to project design

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Following changes were approved by CMD EB during the second (2nd) monitoring period of CPA 3 (approved by EB on 29/08/2017):

- The installed capacity of the turbine was not exactly the same as the one described in the initially registered CPA-DD. The correct capacity is 3,027 KW of turbine and 3.15 MW of alternator (3500 KVA x power factor of 0.9). As per the CDM glossary of terms/36/, the end capacity of the installed unit is the final capacity of the project i.e. the installed capacity of the Alternator or generator which is 3500 KVA (or 3.15 MW).
- The corrected CPA-DD mentioning the capacity of project as 3.15 MW is submitted with the verification Report. Since as per Appendix 1 of VVS, version 09.0, prior approval is not required in this case, as this change in the installed capacity does not affect the Scale, Applicability and Additionality of the project, and thus, the change has been accepted by the assessment team.

Please note that the above mentioned Post-Registration Change is not being proposed as part of this verification.

C.3.7. Changes specific to afforestation or reforestation CPA

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N.A.

SECTION D. Description of monitoring system of CPAs

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Management Structure and Responsibilities

The CPA owner is the overall responsible for daily monitoring and reporting of net electricity generation and has the obligation to follow the PoA requirements in its local management system. The Operational Chief of the power plant is the responsible person for reporting the monitoring data in a monthly basis and assure the correct maintenance and operation of the measuring and monitoring equipment, including the existence of appropriate calibration certificates if necessary. The electricity meter installed at the grid injection point at the substation is used as crosscheck.

For **6198-0003**: The electricity supplied by the project activity to the grid will be measured by a calibrated electricity meter located at the substation. The meter readings of the Puente Arturo substation meter are being recorded in monthly intervals by the operator utility of the grid. These readings take place independently from the project owner and are provided to the project owner for review and consideration. The readings are used as crosscheck against the meter readings of the power plant. Data will be monitored continuously, recorded hourly and consolidated on a monthly basis as required by the applicable methodology.

Data Recording: All data collected is recorded monthly into an electronic spreadsheet.

Data Calibration: All measurements will be conducted with equipment certified to national or IEC standards and calibrated according to the national standards and reference points or IEC standards and recalibrated at appropriate intervals according to manufacturer specifications but at

least once in three years in case of the relevant Puente Arturo as well as the relevant project capacity addition meter.

Data Report: Data recorded (main value) and the data from the meters located at each unit (control value) will be consolidated on a monthly basis and will be checked for quality control. If there are discrepancies in the data, the source of the variation will be identified, whatever is the main measured value or the control value. The data report will be consolidated monthly and will be verified by the General Manager.

Data Archives: The data recording, the data report and the invoices will be archived, together with this monitoring plan. All data collected as part of monitoring should be archived electronically and be kept at least for 2 years after the end of the last crediting period or the last issuance of CERs, whichever occurs later.

Data Quality Assurance and Control

An internal procedure to secure the correctness of data will be employed. Data and reports will be checked internally to secure correctness of data. In case of mistakes, corrective actions will be applied to avoid future similar mistakes.

Training and Monitoring Personnel

All people that participate in the monitoring process will be suitably qualified and trained in the operation and maintenance of the plant. They will also receive a training session on the application of the monitoring plan.

Emission factor calculation

The combined margin emission factor used in the emission reduction calculation will be the annually updated factor provided by the coordinating/managing entity. The factor will use information published by the local authorities.

Verification and Monitoring Results

The monitoring report will be prepared by the coordinating/managing entity. It contains the data report, the emission factor calculation and the results of the emission reductions of the project for a certain period.

Leakage monitoring:

No energy generating equipment is transferred from another activity developed in a non-Annex 1 Parties to this project and there is no existing equipment to be transferred to another activity.

The project activity involves electricity generation from hydro sources. The employed hydro energy generator can only convert hydro energy into electrical energy and cannot use any other input fuel for electricity generation. Thus, in no ways and means are required to monitor leakage from the project activity.

SECTION E. Data and parameters

E.1. Data and parameters fixed ex ante

6198-0003:

Data/Parameter	EF _{grid, BM, y}
Unit	tCO ₂ /MWh
Description	The build margin emissions factor
Source of data	Official data provided by the administrator of the grid or the relevant national authority (COES) publicly available in its website or directly sent to the coordinating/managing entity.

Value(s) applied	0.52572
Choice of data or measurement methods and procedures	Based on official information and PoA guidelines.
Purpose of data/parameter	Calculation of baseline emissions.
Additional comments	Data will be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later.

Data/Parameter	$EG_{\text{historical}}$
Unit	MWh
Description	Annual average historical net electricity generation by the existing renewable energy plant that was operated at the project site prior to the implementation of the project activity
Source of data	CPA owner information
Value(s) applied	15,469.96
Choice of data or measurement methods and procedures	There is a meter located at Puente Arturo substation to measure net generation of the power plant and any consumption. The historical net electricity of the power plant will be calculated by subtracting the electricity exported with the electricity imported by the CPA, both measured with calibrated meters.
Purpose of data/parameter	Baseline emissions calculation
Additional comments	-

Data/Parameter	$\sigma_{\text{historical}}$
Unit	MWh
Description	Standard deviation of the annual average historical net electricity supplied to the grid by the existing renewable energy plant that was operated at the project site prior to the implementation of the project activity.
Source of data	CPA owner information.
Value(s) applied	5,188.04
Choice of data or measurement methods and procedures	Data from electricity meters of the CPA owner and can be crosschecked.
Purpose of data/parameter	Baseline emissions calculation
Additional comments	-

E.2. Data and parameters monitored

Data/Parameter	$EG_{\text{PJ, facility, y}}$
Unit	MWh
Description	Quantity of net electricity supplied to the grid by the project facility in year y.
Measured/calculated/default	Measured by electricity meter
Source of data	Electricity meters
Value(s) of monitored parameter	6198-0003: 28,604.47

Monitoring equipment	6198-0003:	
	Sub-station meter	Nexus
	Since 14 November 2016 Schlumberger SV3AT meter is replaced by ELSTER ALPHA A3 meter to record the data at the substation Puento Arturo Serial number: 13443767 Class: 0.2 New calibration valid from 08/05/2019 to 07/05/2022.	Nexus 1500– this meter records the data for the generator 3 Serial Nr: 148-0132929430 New device installed on 16/06/2015 Calibration valid for 3 years 16/09/2014 – 15/09/2017 Class: 0.2 New calibration valid from 08/05/2019 to 07/05/2022.
Measuring/reading/recording frequency	6198-0003: The net electricity supplied to the grid will be measured continuously and recorded at least each month.	
Calculation method (if applicable)	N/A	
QA/QC procedures	Measuring equipment will be certified to national or IEC standards and calibrated according to the national standards and reference points or IEC standards and recalibrated according to manufacturer specifications but at least once in three years in case of the relevant Puento Arturo as well as the relevant project capacity addition meter. The meter readings of the Puento Arturo substation meter are being recorded in monthly intervals by the operator utility of the grid. These readings take place independently from the project owner and are provided to the project owner for consideration and invoicing purpose. These readings are being used as a crosscheck for internal meter readings. In case of divergence to internal meter readings, the Puento Arturo meter readings serve as reference for net-electricity delivery to the grid.	
Purpose of data/parameter	Calculation of the baseline emissions	
Additional comments	For: 6198-0003: Due to late calibration of both, the Nexus meter as well as the Sub-station meter, the readings were reduced by the maximal permissible error of 0.2% for the uncalibrated periods of the Monitoring Period (01/01/2018 – 31/12/2018)	

Data/Parameter	EG _{BL} , capacity addition, y
Unit	MWh
Description	Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year y
Measured/calculated/default	Calculated
Source of data	Parameter is calculated as per the requirements of the methodology. AMS-I.D equation 1
Value(s) of monitored parameter	CPA 3 (6198-0003): 7,946.47 MWh

Monitoring equipment	6198-0003:			
	<table border="1"> <tr> <td>Sub-station meter</td> <td>Nexus</td> </tr> <tr> <td>Since 14 November 2016 Schlumberger SV3AT meter is replaced by ELSTER ALPHA A3 meter to record the data at the substation Puento Arturo Serial number: 13443767 Class: 0.2 New calibration valid from 08/05/2019 to 07/05/2022.</td> <td>Nexus 1500– this meter records the data for the generator 3 Serial Nr: 148-0132929430 New device installed on 16/06/2015. Calibration valid for 3 years 16/09/2014 – 15/09/2017 Class: 0.2 New calibration valid from 08/05/2019 to 07/05/2022.</td> </tr> </table>	Sub-station meter	Nexus	Since 14 November 2016 Schlumberger SV3AT meter is replaced by ELSTER ALPHA A3 meter to record the data at the substation Puento Arturo Serial number: 13443767 Class: 0.2 New calibration valid from 08/05/2019 to 07/05/2022.
Sub-station meter	Nexus			
Since 14 November 2016 Schlumberger SV3AT meter is replaced by ELSTER ALPHA A3 meter to record the data at the substation Puento Arturo Serial number: 13443767 Class: 0.2 New calibration valid from 08/05/2019 to 07/05/2022.	Nexus 1500– this meter records the data for the generator 3 Serial Nr: 148-0132929430 New device installed on 16/06/2015. Calibration valid for 3 years 16/09/2014 – 15/09/2017 Class: 0.2 New calibration valid from 08/05/2019 to 07/05/2022.			
Measuring/reading/recording frequency	6198-0003: The parameter is calculated yearly in line with the requirements of the methodology.			
Calculation method (if applicable)	This parameter is calculated by subtracting the sum of parameters – $EG_{\text{historical}}$ (Annual average historical net electricity generation by the existing renewable energy plant that was operated at the project site prior to the implementation of the project activity) and $\sigma_{\text{historical}}$ (Standard deviation of the annual average historical net electricity supplied to the grid by the existing renewable energy plant that was operated at the project site prior to the implementation of the project activity) from total net electricity supplied to the grid by the project facility.			
QA/QC procedures	Measuring equipment will be certified to national or IEC standards and calibrated according to the national standards and reference points or IEC standards and recalibrated according to manufacturer specifications but at least once in three years in case of the relevant Puente Arturo as well as the relevant project capacity addition meter. The meter readings of the Puente Arturo substation meter are being recorded in monthly intervals by the operator utility of the grid. These readings take place independently from the project owner and are provided to the project owner for consideration and invoicing purpose. These readings are being used as a crosscheck for internal meter readings. In case of divergence to internal meter readings, the Puente Arturo meter readings serve as reference for net-electricity delivery to the grid.			
Purpose of data/parameter	Calculation of the baseline emissions			
Additional comments	Due to late calibration of the both, the Nexus meter as well as the Sub-station meter, the readings were reduced by the maximal permissible error of 0.2% for the uncalibrated periods of the Monitoring Period (01/01/2018 – 31/12/2018)			

Data/Parameter	$EF_{\text{grid,CM,y}}$
Unit	tCO ₂ /MWh
Description	Emission factor for the Peruvian interconnected grid (SEIN)
Measured/calculated/default	Calculated
Source of data	Official data provided by the administrator of the grid or the relevant national authority.
Value(s) of monitored parameter	6198-0003: 0.57723
Monitoring equipment	N/A
Measuring/reading/recording frequency	Yearly

CDM-PoA-MR-FORM

Calculation method (if applicable)	The baseline emission factor ($EF_{grid,CM,y}$) is calculated as a combined margin (CM), consisting of the combination of operating margin ($EF_{grid,OM,y}$) and build margin ($EF_{grid,BM,y}$) factors.
QA/QC procedures	N/A
Purpose of data/parameter	To calculate the baseline emissions.
Additional comments	The PoA CPAs uses the $EF_{grid,CM,y}$ calculated by the coordinating/managing entity with the most recent value. The value is updated using official information from the administrator of the national grid when the information is available. Complete information of every year during the crediting period is available by COES during the first six months of the following year. Data is kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later.

Data/Parameter	$EF_{grid,OM-DD,y}$
Unit	tCO ₂ /MWh
Description	The Dispatch Data Analysis OM emission factor
Measured/calculated/default	Calculated
Source of data	Official data provided by the administrator of the grid or the relevant national authority (COES) publicly available in its website or directly sent to the CME. Raw data for generation is based on the 15 minute records of every power plant.
Value(s) of monitored parameter	6198-0003: 0.6287
Monitoring equipment	N/A
Measuring/reading/recording frequency	Yearly
Calculation method (if applicable)	The dispatch data analysis operating margin emission factor ($EF_{OM-DD,y} = EF_{gridOM,y}$ in tCO ₂ e/MWh) is a method which involves the power unit that are actually dispatched at the margin during each hour h, where the power unit are separated in power unit in the top of the dispatch n and other power unit.
QA/QC procedures	N/A
Purpose of data/parameter	To calculate baseline emissions.
Additional comments	Data is kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later.

Data/Parameter	$EG_{PJ,h}$
Unit	MWh
Description	Total electricity dispatched by the project activity in hour h of year y.
Measured/calculated/default	Measured
Source of data	Project records
Value(s) of monitored parameter	See EF calculation sheet.

Monitoring equipment	6198-0003:	
	Sub-station meter	Nexus
	Since 14 November 2016 Schlumberger SV3AT meter is replaced by ELSTER ALPHA A3 meter to record the data at the substation Puento Arturo Serial number: 13443767 Class: 0.2 New calibration valid from 08/05/2019 to 07/05/2022.	Nexus 1500– this meter records the data for the generator 3 Serial Nr: 148-0132929430 New device installed on 16/06/2015 Calibration valid for 3 years 16/09/2014 – 15/09/2017 Class: 0.2 New calibration valid from 08/05/2019 to 07/05/2022.
Measuring/reading/recording frequency	The total electricity supplied to the grid is measured continuously and recorded at least each hourly according to COES requirements.	
Calculation method (if applicable)	N/A	
QA/QC procedures	Internal records will be crosschecked according to the following procedure: The meter readings of the Puente Arturo substation meter are being recorded in monthly intervals by the operator utility of the grid. These readings take place independently from the project owner and are provided to the project owner for consideration and invoicing purpose. These readings are being used as a crosscheck for internal meter readings. In case of divergence to internal meter readings, the Puente Arturo meter readings serve as reference for net-electricity delivery to the grid.	
Purpose of data/parameter	To calculate baseline emissions.	
Additional comments	For: 6198-0003: Due to late calibration of both, the Nexus meter as well as the Sub-station meter, the readings were reduced by the maximal permissible error of 0.2% for the uncalibrated periods of the Monitoring Period (01/01/2018 – 31/12/2018)	

Data/Parameter	$EF_{EL,DD,h}$
Unit	tCO ₂ /MWh
Description	CO ₂ emission factor of power unit in the top of the dispatch order in hour h in year y.
Measured/calculated/default	Calculated
Source of data	Data provided by COES.
Value(s) of monitored parameter	Data used is presented in the spreadsheet for Grid Emission Factor calculation.
Monitoring equipment	N/A
Measuring/reading/recording frequency	Hourly
Calculation method (if applicable)	To calculate $EF_{EL,DD,h}$ the second option is chosen because for the power units, data on fuel consumption is available. The proportion of data to be monitored is 100 % and the data is archived electronically.
QA/QC procedures	Official data.
Purpose of data/parameter	To calculate baseline emissions.
Additional comments	Data is kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later.

Data/Parameter	$EG_{n,h}$
Unit	MWh
Description	Electricity generated and delivered to the grid by power units n in hours h.
Measured/calculated/default	Measured
Source of data	Data provided by COES.

Value(s) of monitored parameter	Data used is presented in the spreadsheet for Grid Emission Factor calculation.
Monitoring equipment	N/A
Measuring/reading/recording frequency	Hourly
Calculation method (if applicable)	The proportion of data to be monitored is 100% and the data is archived electronically.
QA/QC procedures	Official data.
Purpose of data/parameter	To calculate baseline emissions.
Additional comments	Data is kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later.

Data/Parameter	$EF_{EL,n,y}$
Unit	tCO ₂ /MWh
Description	CO ₂ emission factor of power unit n in year y
Measured/calculated/default	Calculated
Source of data	Data provided by COES.
Value(s) of monitored parameter	Data used is presented in the spreadsheet for Grid Emission Factor calculation.
Monitoring equipment	N/A
Measuring/reading/recording frequency	Annually
Calculation method (if applicable)	The $EF_{EL,n,y}$ is determined for method the operating margin option A.2. The proportion of data to be monitored is 100% and the data is archived Electronically
QA/QC procedures	Official data.
Purpose of data/parameter	To calculate baseline emissions.
Additional comments	Data is kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later.

Data/Parameter	$\eta_{n,y}$
Unit	N/A
Description	Average net energy conversion efficiency of power unit m in year y (ratio)
Measured/calculated/default	Calculated
Source of data	Data provided by COES
Value(s) of monitored parameter	Data used is presented in the spreadsheet for Grid Emission Factor calculation.
Monitoring equipment	N/A
Measuring/reading/recording frequency	Each year this data is checked with the last available annual report of COES. The proportion of data to be monitored is 100% and the data is archived electronically.
Calculation method (if applicable)	N/A
QA/QC procedures	If the data used is significantly lower than the default value of the applicable technology, CPA owners should assess the reliability of the values, and provide appropriate justification if deemed reliable. Otherwise, the default values above shall be used.
Purpose of data/parameter	To calculate baseline emissions.
Additional comments	Data is kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later.

Data/Parameter	EF _{CO₂,n,i,y}
Unit	kgCO ₂ /TJ
Description	Average CO ₂ emission factor of fuel type if used in power unit m in year y
Measured/calculated/default	Default
Source of data	IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in Table 1.4 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Value(s) of monitored parameter	Diesel Oil = 72,600 Residual Fuel Oil = 75,500 Natural Gas = 54,300 Coal = 87,300
Monitoring equipment	N/A
Measuring/reading/recording frequency	Annually
Calculation method (if applicable)	N/A
QA/QC procedures	Every update of IPCC reports will be taken into account.
Purpose of data/parameter	To calculate baseline emissions.
Additional comments	Data is kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later.

Data/Parameter	W _{OM}
Unit	%
Description	Weighting of operating margin emissions factor
Measured/calculated/default	Default
Source of data	As indicated in the "Tool to calculate emission factor for an electricity system" v.2.2.1.
Value(s) of monitored parameter	The first crediting period, W _{OM} = 0.5 The second and third crediting period, W _{OM} = 0.25
Monitoring equipment	N/A
Measuring/reading/recording frequency	Annually
Calculation method (if applicable)	N/A
QA/QC procedures	N/A
Purpose of data/parameter	To calculate baseline emissions.
Additional comments	Data is kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later.

Data/Parameter	W _{BM}
Unit	%
Description	Weighting of build margin emissions factor
Measured/calculated/default	Default
Source of data	As indicated in the "Tool to calculate emission factor for an electricity system" v.2.2.1.
Value(s) of monitored parameter	The first crediting period, W _{BM} = 0.5 The second and third crediting period, W _{BM} = 0.75
Monitoring equipment	N/A
Measuring/reading/recording frequency	Annually

Calculation method (if applicable)	N/A
QA/QC procedures	N/A
Purpose of data/parameter	To calculate baseline emissions.
Additional comments	For projects that are not solar or wind power generation. Data will be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later.

Data/Parameter	Merit Order
Unit	Text
Description	The merit order in which power plants are dispatched by documented evidence
Measured/calculated/default	Data provided by COES.
Source of data	COES reports
Value(s) of monitored parameter	Data used is presented in the spreadsheet for Grid Emission Factor calculation.
Monitoring equipment	N/A
Measuring/reading/recording frequency	For each year, the variable cost of thermal plants in the SEIN that are in effect in December will be used. The proportion of data to be monitored is 100% and the data will be archived electronically.
Calculation method (if applicable)	N/A
QA/QC procedures	N/A
Purpose of data/parameter	To calculate baseline emissions.
Additional comments	Data will be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later.

E.3. Implementation of sampling plan

>>
N.A.

SECTION F. Calculation of emission reductions or net anthropogenic removals

F.1. Calculation of baseline emissions or baseline net removals

>>

For 6198-0003:

>> $BE_{\text{capacity addition, CO2,y}} = [EG_{\text{BL, capacity addition,y}}] * EF_{\text{CO2}}$

Where:

$EG_{\text{BL, capacity addition,y}} = EG_{\text{PJ, facility,y}} - (EG_{\text{historical}} + \sigma_{\text{historical}})$

$EG_{\text{BL, capacity addition,y}}$ = Quantity of net electricity supplied to the grid as a result of the implementation the CDM project activity in year y

(MWh) $EG_{\text{PJ, facility,y}}$ = Quantity of net electricity supplied to the grid by the project facility in year y (MWh).

$EG_{\text{historical}}$ = Annual average historical net electricity generation by the existing renewable energy plant that was operated at the project site prior to the implementation of the project activity (MWh).

Average of historical net electrical energy levels delivered by the existing facility, spanning all data from the most recent available year (or month, week or other time period) to the time at which the facility was constructed, retrofit, or modified in a manner that significantly affected output (i.e. by 5% or more), shall be used. To determine historical $EG_{\text{historical}}$, project participants chose option (a). The three last calendar years (five calendar years for hydro project) prior to the project implementation.

$\sigma_{\text{historical}}$ = Standard deviation of the annual average historical net electricity supplied to the grid by the existing renewable energy plant that was operated at the project site prior to the implementation of the project activity (MWh)

$$EG_{\text{BL, capacity addition, y}} = 28,604.47 \text{ MWh} - (15,469.96 \text{ MWh} + 5,188.04 \text{ MWh})$$

$$EG_{\text{BL, capacity addition, y}} = 7,946.47$$

$$BE_{\text{capacity addition, CO2,y}} = [EG_{\text{BL, capacity addition,y}}] * EF_{\text{CO2}}$$

$$BE_{\text{capacity addition, CO2,y}} = 7,946.47 \text{ MWh} * 0.57723$$

$$BE_{\text{capacity addition, CO2,y}} = 4,586 \text{ tCO}_2 \text{ (for the fifth monitoring period)}$$

The grid emission factor was calculated as follows (the exact description is included in the PoA-DD):

A combined margin (CM) is calculated, consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the 'Tool to calculate the Emission Factor for an electricity system' version 02.2.1. following six steps:

STEP 1	Identify the relevant electricity systems.
STEP 2	Choose whether to include off-grid power plants in the project electricity system (optional).
STEP 3	Select a method to determine the operating margin (OM).
STEP 4	Calculate the operating margin emission factor according to the selected method.
STEP 5	Calculate the build margin (BM) emission factor.
STEP 6	Calculate the combined margin (CM) emissions factor

Step 1: Identify the relevant electric power system

Each CPA will supply energy to the National Interconnected Electric Grid (SEIN), therefore, the identified electricity power system is the Peruvian National Electricity Grid (SEIN). The Project will displace electricity from an electricity distribution system (in this case, the SEIN) that is or would have been supplied by at least one fossil fuel fired generating unit.

Step 2: Choose whether to include off-grid power plants in the project electricity system (optional).

The tool provides 2 options, including Option I: Only grid power plants are included in the calculation. Option II: Both grid power plants and off-grid power plants are included in the calculation. All CPAs will use Option I for calculating the grid emission factor.

Step 3: Select an OM method.

Out of four options for the OM, the Dispatch Data Analysis OM (OM -DD) is selected as the option for all CPAs located in Peru. The Simple OM method cannot be used since low cost, must-run resources constitute more than 50% of total grid generation in Peru. Also, it was not necessary to

use either the Simple Adjusted OM approach or the Average OM approach, because detailed dispatch data is available.

Step 4: Calculate the operating margin emission factor according to the selected method.

The formula for the OM-DD emission factor ($EF_{grid,OM-DD,y}$) used, was provided by the Tool as follows:

$$EF_{grid,OM-DD,y} = \frac{\sum_h EG_{PJ,h} \times EF_{EL,DD,h}}{EG_{PJ,y}}$$

Where,

$EF_{grid,OM-DD,y}$ = Dispatch data analysis operating margin CO2 emission factor in year y (tCO2/MWh)

$EG_{PJ,h}$ = Electricity displaced by the CPA in hour, h, of year, y (MWh)

$EF_{EL,DD,h}$ = CO2 emission factor for grid power units in the top of the dispatch order in hour h, in year y (tCO2/MWh)

$EG_{PJ,y}$ = Total electricity displaced by the CPA in year, y (MWh)

h = Hours in year y, in which the CPA is displacing grid electricity

y = Year in which the CPA is displacing grid electricity

The hourly emissions factor is calculated based on the energy efficiency of the grid power unit and the fuel type used, as follows:

$$EF_{EL,DD,h} = \frac{\sum_n EG_{n,h} \times EF_{EL,n,y}}{\sum_n EG_{n,h}}$$

Where,

$EF_{EL,DD,h}$ = CO2 emission factor for power units in the top of the dispatch order in hour, h, in year, y (tCO2/MWh)

$EG_{n,h}$ = Net quantity of electricity generated and delivered to the grid by power unit, n, in hour, h (MWh)

$EF_{EL,n,y}$ = CO2 emission factor of power unit, n, in year, y (tCO2/MWh)

n = Power units in the top of the dispatch.

h = Hours in year, y, in which the CPA is displacing grid electricity.

To determine the set of grid power units n that are in the top of the dispatch at each hour h, the power units were stacked using the merit order. The group of power units, n, in the dispatch margin includes the units in the top x% of total electricity dispatched in the hour, h, where x% is equal to the greater of either

a) 10%, or

b) The quantity of electricity displaced by the project activity during hour h divided by the total electricity generations by grid power plants during that hour h.

The CO2 emission factor of power unit ($EF_{EL,m,y}$) is calculated as per the guidance for the simple OM, using the option A2.

$$EF_{ELn,y} = \frac{EF_{CO2,n,y,i} \times 3.6}{N_{n,y}}$$

Where,

$EF_{ELn,y}$ = CO2 emission factor of power unit m, in year y (tCO2/MWh)

$EF_{CO2,n,y,i}$ = Average CO2 emission factor of fuel type i used in power unit m, in year y (tCO2/GJ)

$N_{n,y}$ = Average net energy conversion efficiency of power unit m, in year y (ratio)

n = All power units serving the grid in year y except low-cost/must-run power units

y = Applicable year during monitoring (ex-post option)

Step 5: Calculate the build margin (BM) emission factor

The build margin emissions factor is the generation-weighted average emission factor (tCO₂/MWh) of all power units m, during the most recent year y, for which power generation data is available, calculated as follows:

$$EF_{\text{grid,BM},y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}}$$

Where,

$EF_{\text{grid,BM},y}$: Build margin CO₂ emission factor in year y (tCO₂/MWh)

$EG_{m,y}$: Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)

$EF_{EL,m,y}$: CO₂ emission factor of power unit m in year y (tCO₂/MWh)

m : Power units included in the build margin

y : Most recent historical year for which power generation data is available

According to the “Tool to calculate the emission factor for an electricity system”, version 02.2.1, the sample group of power units m used to calculate the build margin should be determined as per the following procedure, consistent with the vintage data selected above:

(a) Identify the set of five power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently (SET5-units) and determine their annual electricity generation (AEGSET-5-units, in MWh);

(b) Determine the annual electricity generation of the project electricity system, excluding power units registered as CDM project activities (AEGtotal, in MWh). Identify the set of power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently and that comprise 20% of AEGtotal (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) (SET≥20%) and determine their annual electricity generation (AEGSET-≥20%, in MWh);

(c) From SET5-units and SET≥20% select the set of power units that comprises the larger annual electricity generation (SETsample); Identify the date when the power units in SETsample started to supply electricity to the grid. If none of the power units in SETsample started to supply electricity to the grid more than 10 years ago, then use SETsample to calculate the build margin.

Ignore steps (d), (e) and (f). (d) Exclude from SETsample the power units which started to supply electricity to the grid more than 10 years ago. Include in that set the power units registered as CDM project activity, starting with power units that started to supply electricity to the grid most recently, until the electricity generation of the new set comprises 20% of the annual electricity generation of the project electricity system (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) to the extent is possible. Determine for the resulting set (SETsampleCDM) the annual electricity generation (AEGSET-sample-CDM, in MWh); If the annual electricity generation of that set is comprises at least 20% of the annual electricity generation of the project electricity system (i.e. $AEGSET\text{-sample-CDM} \geq 0.2 \times AEG\text{total}$), then use the sample group SETsampleCDM to calculate the build margin. Ignore steps (e) and (f).

Otherwise: (e) Include in the sample group SETsample-CDM the power units that started to supply electricity to the grid more than 10 years ago until the electricity generation of the new set comprises 20% of the annual electricity generation of the project electricity system (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation);

(f) The sample group of power units m used to calculate the build margin is the resulting set (SETsample-CDM->10yrs). Out of SET5-units and SET≥20%, the latter group was selected as SETsample due to the fact that it includes the larger annual electricity generation. In terms of vintage data, to calculate the build margin Option 1 shall be chosen for the proposed Project;

Option 1: For the first crediting period, calculate the build margin emission factor ex ante based on the most recent information available on units already built for sample group m at the time of CDM-PDD submission to the DOE for validation. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.

Step 6: Calculate the combined margin (CM) emissions factor. The calculation of the combined margin (CM) emission factor (EF_{grid,CM,y}) is based on one of the following methods:

- (a) Weighted average CM; or
- (b) Simplified CM.

The simplified CM method (option b) can only be used if:

- The project activity is located in a Least Developed Country (LDC) or in a country with less than 10 registered projects at the starting date of validation; and
- The data requirements for the application of step 5 above cannot be met.

The weighted average CM method (option a) should be used as the preferred option:

$$EF_{grid,cm,y} = EF_{grid,om,y} \times W_{om} + EF_{grid,bm,y} \times W_{bm}$$

Where:

w_{OM} : Weighting of OM emission factor (%)

w_{BM} : Weighting of BM emission factor (%)

For the proposed PoA, the following default values are used: w_{OM} = 0.5 and w_{BM} = 0.5.

Please refer to the 'Emission factor calculation sheet' for further details on the calculations done for the emission factor.

F.2. Calculation of project emissions or actual net removals

>>

No project emissions apply for the project activity as per the applied methodology.

F.3. Calculation of leakage emissions

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No leakage is accounted as per the applied methodology.

F.4. Calculation of emission reductions or net anthropogenic removals

CPA UNFCCC reference number	Baseline GHG emissions or baseline net GHG removals (t CO ₂ e)	Project GHG emissions or actual net GHG removals (t CO ₂ e)	Leakage GHG emissions (t CO ₂ e)	GHG emission reductions or net anthropogenic GHG removals (t CO ₂ e)		
				Before 01/01/2013	From 01/01/2013	Total amount
6198-0003	4,586	-	-	-	4,586	4,586
Total						

F.5. Comparison of emission reductions or net anthropogenic removals achieved with estimates in the included CPA-DDs

CPA UNFCCC reference number	Amount achieved during this monitoring period (t CO ₂ e)	Amount estimated ex ante for this monitoring period in the CPA-DD (t CO ₂ e)
6198-0003	4,586	9,513
Total	4,586	9,513

F.5.1. Explanation of calculation of “amount estimated ex ante for this monitoring period in the CPA-DD”

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Calculation is based on design figures including a design flow of water.

F.6. Remarks on increase in achieved emission reductions

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N.A.

F.7. Remarks on scale of small-scale CPAs

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All project activities have a maximal installed capacity of 15 MW per CPA as set forth in the applied Methodology AMS-I.D. ver. 17 – Grid connected renewable electricity generation. All CPAs therefore comply with the eligibility criteria and can be included. During annual verifications it has been reconfirmed that no increase of capacity exceeding the limit of 15MW installed capacity has ever been recorded.

Document information

<i>Version</i>	<i>Date</i>	<i>Description</i>
03.0	31 May 2019	Revision to: <ul style="list-style-type: none"> • Ensure consistency with version 02.0 of the “CDM project standard for programmes of activities” (CDM-EB93-A07-STAN); • Add a section on remarks on the observance of the scale limit of small-scale CPAs during the crediting periods; • Add "changes specific to afforestation or reforestation activities/CPA" as a possible post-registration changes; • Clarify the reporting of net anthropogenic GHG removals for A/R PoAs between two commitment periods; • Make structural and editorial improvements.
02.0	7 June 2017	Revision to: <ul style="list-style-type: none"> • Ensure consistency with version 01.0 of the “CDM project standard for programmes of activities (CDM-EB93-A07-STAN); • Make editorial improvements.
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