	Project design document form (Version 11.0)
BASIC INFORMATION	
Title of the project activity	Potrero Hydropower Plant, Peru
Scale of the project activity	☒ Large-scale ☐ Small-scale
Version number of the PDD	12~~1~~
Completion date of the PDD	17~~5~~/12/2020~~01/11/2020~~
Project participants	Empresa Eléctrica Agua Azul S.A.
Host Party	Peru
Applied methodologies and standardized baselines	ACM0002 Consolidated baseline methodology for grid-connected electricity generation from renewable sources (Version 12.3.0) Standardized Baseline: Not applicable
Sectoral scopes	1 : Energy industries (renewable - / non-renewable sources)
Estimated amount of annual average GHG emission reductions	95,644 tCO_2e

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SECTION A. Description of project activity

A.1. Purpose and general description of project activity

The Project "Potrero Hydropower Plant, Peru" (hereafter referred to as the "Project") is a run of river hydroelectric power plant located in the Province of San Marcos, Region of Cajamarca, in Peru (Host Country), and it is to be implemented by the company named "Empresa Electrica Agua Azul S.A.". The total installed capacity of the Project will be of 20.86 MW, with an expected net electricity generation of 147,215 MWh per year.

The Project aims to generate renewable electricity by using water from the Crisnejas River, who receives its water from two main river basins, Cajamarca River basin (111.9 km of length) and Condebamba River basin (92.7 of length). This energy will be supplied to the National Interconnected Electricity Grid (SEIN). The reduction of baseline emissions results from the displacement of electricity generated by power plants within the SEIN, which include fossil/fuel power plants emitting CO_2. The spatial extent of the Project boundary is the SEIN.

The project considers the construction of a substation located in the left margin of Crisnejas River, called Potrero substation (less than 200 meters away from Power House). The project will implement 2 horizontal Francis turbines for a nominal water flow maximum of 9 m^3 /s[1]. A transmission line of 60 kV and 4.97 kms length will be installed between the Potrero substation and the Aguas Calientes substation[2].

The Project CDM starting date is expected to be on 15/01/2013, when the access route contract will be signed. The construction of civil works is expected to start on 01/06/2013 and commercial operations in 01/06/2016[3]. The Project is expected to avoid the emission of 95,644 tons of carbon dioxide equivalent (tCO_2e) per year, which will amount to 669,508 tCO_2e for the first crediting period of 7 years, generating the equivalent amount of greenhouse gas (GHG) emission reductions (ERs). The GHG emissions of the proposed Project activity will be negligible; thus there will be no need to monitor them, and this will not be taken into account when calculating CERs.

The Project will have an expected minimum operating lifetime of 50 years. The proposed Project activity has all applicable permissions and authorizations required for its construction and operation, and it also complies with all the environmental requirements mandated by the Ministry of Energy and Mines (MINEM). The Project contributes to sustainable development by:

a) Creating a source of renewable energy in a sustainable way.
b) Employing local labor in the construction phase and later in the operation of the plant.
c) Expanding the national electricity grid's capability.

[1] DGE (2012). Concession file submitted to the Ministry of Energy and Mines (MINEM) for the concession approval (page 95)

[2] DGE (2012). Concession file submitted to the Ministry of Energy and Mines (MINEM) for the concession approval (page 89)

[3] DGE (2012). Concession file submitted to the Ministry of Energy and Mines (MINEM) for the concession approval (pages 109, 110). The construction start date has been moved to June due to delays in the licence processes, and because the estimated construction time is around three years, the commercial operations start date will be affected accordingly.

d) Increasing the commercial activity of the community due to the fact that the construction and operation activities in the area will require services such as food, transportation, among others.
e) Helping Peru improve its hydrocarbon trade balance by reducing the consumption of oil derivates for electricity generation.
f) Helping the SEIN keep thermal power plants shut down and/or on stand-by for power generation, thus displacing expensive generation fired by heavy fuel, diesel, coal and natural gas, while reducing GHG emissions.
g) Contributing to local and national fiscal accounts through the payment of taxes
h) Committing to a social agenda as described in detail in section G of this document.
i) Improving the infrastructure in and around the Project area due the Project activities.

A.2. Location of project activity

Host party: Peru
Region of Cajamarca / Province of San Marcos

District of Eduardo Villanueva

The Project will be located in the north of Peru, in the district of Eduardo Villanueva, Province of San Marcos, Region of Cajamarca. The hydroelectric power plant's intake will be located in the town Aguas Calientes, at approximately 1,950 m.a.s.l., while the discharge will be located in the place called Potrero, at approximately 1,625 m.a.s.l[4]. The intake structure will be developed in the Crisnejas River. The Project is located at the following geographical coordinates:

Table 1: Project Coordinates[5]

Item	Expected Location	Expected Location (equivalent geographical coordinates)	Altitude
Water intake(1)	UTM WGS84 9 174 661 North 822 399 East	Longitude : -66.0793 Latitude : -7.4570	1,950 m.a.s.l.
Water discharge(1)	UTM WGS84 9 174 299 North 825 835 East	Longitude:- -66.0482 Latitude : -7.4600	1,625 m.a.s.l.
Power house(2)	UTM PSAD 56 9 174 283 North 824 238 East	Longitude: -66.0632 Latitude : -7.4598	1,810 m.a.s.l.
Substation (2)Potrero	UTM PSAD 56	Longitude: -66.0627 Latitude : -7.4603	1,825

[4] Hydrological study approval (Resolution No. 0302-2011-ANA-AAA-VI MARAÑON dated 29/12/2011 and pre-operative study (2012).

[5] The coordinates are approximations before construction and could be subject to move due to the uncertainty associated with the geological foundations variations will be non-significant). The pre-operative study of the project contains the coordinates of the power house and substations (Kiev Asociados, 2012), and the hydrological study approval has the coordinates of the water intake and devolution (Resolution No. 0302-2011-ANA-AAA-VI MARAÑON dated 29/12/2011).

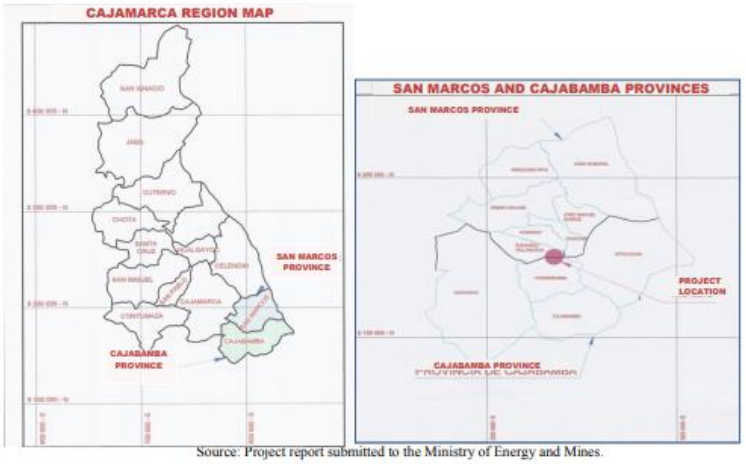
	9 174 342 North 824 183 East		m.a.s.l.
Substation [(2)]Aguas Calientes	UTM PSAD 56 9 175 235 North 819 689 East	Longitude: -66.1039 Latitude : -7.4520	2,000 m.a.s.l.

The location of the Project can be seen in the following figures:

Figure 1: Project macro- location in Peru

Source: Project report submitted to the Ministry of Energy and Mines

Figure 2: Project regional and micro location in Cajamarca



Source: Project report submitted to the Ministry of Energy and Mines.

A.3. Technologies/measures

The Project will be a run-of-the-river hydropower technology that utilizes the water flow of the Crisnejas River to generate electricity. The water is directly diverted from this river through a submerged intake because it is appropriated to the emplacement configuration and the river slope. Then, the water goes to an absorbing channel which captures the water through the absorbing grillages when it crosses the river channel. The captured water goes through a rock-removal, that retain the rocks passing the absorbing grillages, before going through the intake gates to the derivation channel (that return the excess water to the river).After this, the water goes through sand trap, then through a head-race channel (940 meters length) to a tunnel (790 meters length with a rectangular form and with a circular vault with concrete coating), and then, the water goes into the loading chamber to guarantee hydraulic charge, avoiding air from causing cavitation and efficiency loss. Finally, water will be fed through the penstock (455 meters lenth) into the downstream turbines to transform the potential energy of water into mechanical energy. The measuring equipment will be located in the substation. It is important to mention that the Project is not considering any reservoir or regulation tank for its normal operation[6].

The Project will have a design flow of maximum 18 m3 /s (9 m3 /s per turbine) diverted from Crisnejas river, and a net head of 126.288 m. There will be two turbines with a nominal capacity of 10.228 MW each, along with two generators each with rated power 11,590 kVA which totalizes a 20.86[7] MW capacity of Potrero Hydropower plant. The net electricity production will be of 147,215 MWh/year and will be injected into the Interconnected National Electric Grid (SEIN) through a 4.97 km transmission line of 60 KV (Potrero – Aguas

[6] Environmental Impact Declaration for the Potrero Hydropower Plant (pages 89 to 92) and DGE (2012). Concession file submitted to the Ministry of Energy and Mines (MINEM) for the concession approval (page 85)

[7] Rated capacity of each turbine: 10.228 MW

Rated power output per generator: 11590 kVA , power factor : 0.90 that implies total real power 11590*0.9=10431 kW i.e. 10.431 MW and for two generators, total installed capacity is 10.431*2=20.86 MW

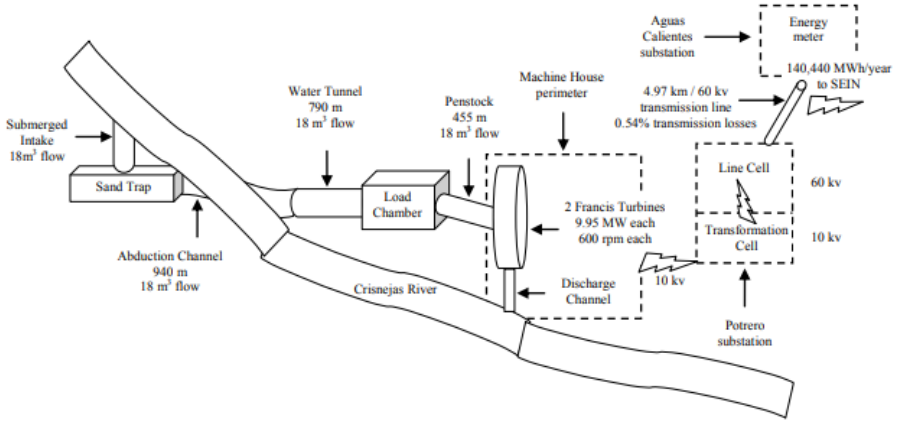
Calientes). Aguas Calientes substation connects the Project to the SEIN: Cajamarca – San Marcos – Cajabamba[8].

The head race channel, the tunnel, load chamber and all civil works and electromechanical equipment, will be located at the left margin of the river. The Project will employ two new horizontal Francis turbines, with a nominal speed of 600 rpm, a nominal capacity of 9 m^3 per second each, a nominal potency of 10.228 MW each and a lifetime of 30 to 50 years, as known in the energy industry[9]. Each generator (two generators, one for each turbine) has the same lifetime of the turbine, a speed of 600 RPM,and a tension of 10 kV.

The equipment efficiency (turbine and generator) is going to depend on the finally signed contract with the selected supplier (the project is not in this stage yet). However, the Project developer has indirectly included the specific efficiencies in the load factor of the Project.

The energy meter is going to be placed in Aguas Calientes SE (substation), in order to monitor the net energy (even discounting transmission losses) that is finally supplied to the SEIN. The described process is illustrated in the figure below:

Figure 3. Project diagram



Characteristic	Value	Unit
Installed Capacity(1)	20.86[10]	MW
Head-race Channel(1)	940	m
Water Tunnel(1)	790	m

[8] DGE (2012). Concession file submitted to the Ministry of Energy and Mines (MINEM) for the concession approval (page 89).

[9] The lifetime of the turbines was obtained from the market information and project owner knowledge and compared with a benchmark analysis of manufacturers/distributors of the specific type of Francis turbines used in the project. This information can be found in: http://factory.dhgate.com/alternative-energy-generators/horizontal-shaft-francis-turbine/water-turbine/hydro-turbinep42804620.html http://sclida.en.alibaba.com/featureproductlist.html http://sclida.en.alibaba.com/product/504927309-209843737/Turbine_with_synchronous_generator.html. In the referenced web links, it also states that both generator and turbine have the same lifespan, because they are an integrated system.

[10] Increased capacity is 20.86 MW

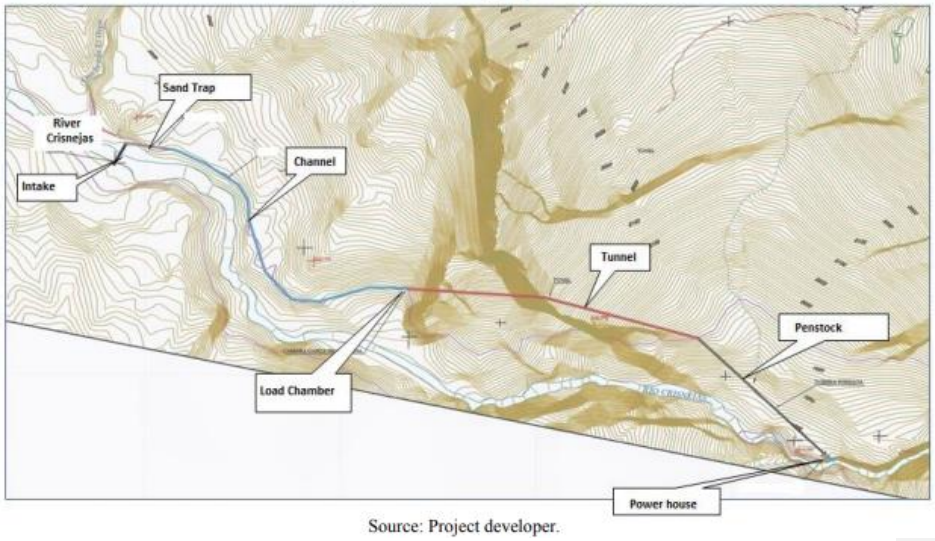
Penstock	455	m
Turbine Type	Francis horizontal axis	2 turbines
Turbine Rated Net Head	126.288	m
Turbine and generator lifetime	50	years
Load factor	81	%
Transmission losses	0.54	%
Expected Net Energy Generation	147,215	MWh

DGE (2012). Concession file submitted to the Ministry of Energy and Mines (MINEM) for the concession approval, pages 85 – 95.

It is important to mention that without the project, the SEIN will supply electricity according to the existing and future mix of power plants connected to it. Therefore, in the baseline scenario, the SEIN would have the capacity to provide the same type and level of energy than the one provided by the project.

All the equipment will be bought new from manufacturers outside Peru. There is no certainty in the precedence of the equipment, but the most attractive proposal is from a manufactured in India[11]. The technical knowledge used to operate the project is based on the professionals of the company, external engineering companies and the manufacturer of the equipment. Therefore, there is a technology and know-how transfer from other countries, but there is no transference of used equipment or use of public funding from the host country or other countries.

Figure 4. Detailed project map



Source: Project developer.

The baseline scenario is the continuation of current practice according to the methodology, therefore identical to the scenario existing prior to the implementation of the project activity.

[11] bfl proposal annexure –I.

A.4. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Republic of Peru (host Party)	Empresa Eléctrica Agua Azul S.A.(Private entity)	No

A.5. Public funding of project activity

The Project has not received and will not receive any type of public funding or public financial help.

A.6. History of project activity

The PP hereby confirms that:

(a) The proposed CDM project activity is neither registered as a CDM project activity nor included as a component project activity (CPA) in a registered CDM programme of activities (PoA);
(b) The proposed CDM project activity is not a project activity that has been deregistered.

Also the PP hereby declares that:

(a) The proposed CDM project activity is not a CPA that has been excluded from a registered CDM PoA;
(b) A registered CDM project activity or a CPA under a registered CDM PoA whose crediting period has or has not expired (hereinafter referred to as former project) exists in the same geographical location as the proposed CDM project activity.

A.7. Debundling

Not applicable

SECTION B. Application of methodologies and standardized baselines

B.1. References to methodologies and standardized baselines

Version 12.3.0 of ACM0002: *Consolidated baseline methodology for grid-connected electricity generation from renewable sources* (EB 58).

Version 02.2.1 of the Tool to calculate the emission factor for an electricity system (EB 63/Annex 19)[12].
Version 06.1.0 of the Tool for demonstration and assessment of additionality (EB 69/Annex 20)[13].

B.2. Applicability of methodologies and standardized baselines

[12] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v2.2.1.pdf/history_view-Web link last accessed on 12/03/2012

[13] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v6.0.0.pdf/history_view-Web link last accessed on 12/03/2012.

The Project satisfies the applicable conditions of ACM0002 (version 12.3.0) because it is a new power plant at a site where no renewable power plants were operated prior to the implementation of the project activity (Greenfield plant).

The applicability conditions are described in the table below:

Table 3: Applicability of the proposed project to ACM0002

Applicability conditions	Fulfillment of conditions
The project activity is the installation, capacity addition, retrofit or replacement of 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.	The proposed project activity is the installation of a new run of river hydropower plant.
In the case of capacity additions, retrofits or replacements (except for capacity addition projects for which the electricity generation of the existing power plant(s) or unit(s) is not affected): 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 addition or retrofit of the plant has been undertaken between the start of this minimum historical reference period and the implementation of the project activity;	Not applicable. No capacity additions, retrofits or replacements are implemented in the proposed project.
In case of hydro power plants: • At least one of the following conditions must apply: o The project activity is implemented in an existing single or multiple reservoirs, with no change in the volume of any of the reservoirs; or o The project activity is implemented in an existing single or multiple reservoirs, where the volume of any of reservoirs is increased and the power density of each reservoir, as per the definitions given in the Project Emissions section, is greater than 4 W/m^2 after the implementation of the project activity; or o The project activity results in new single or multiple reservoirs and the power density of each reservoir, as per the definitions given in the Project Emissions section, is greater than 4 W/m^2 after the implementation of the project activity. 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 after the implementation of the project activity all of the following conditions must apply: • The power density calculated for the entire project activity using equation 5 is greater than 4 W/m^2; • All reservoirs and hydro power plants are located at the	There is no reservoir or regulating tank in the Project, nor is constructed in an existing reservoir.

same river and were designed together to function as an integrated project that collectively constitutes the generation capacity of the combined power plant; • The water flow between the multiple reservoirs is not used by any other hydropower unit which is not a part of the project activity; • The total installed capacity of the power units, which are driven using water from the reservoirs with a power density lower than 4 W/m^2, is lower than 15 MW; The total installed capacity of the power units, which are driven using water from reservoirs with a power density lower than 4 W/m^2, is less than 10% of the total installed capacity of the project activity from multiple reservoirs.	
The methodology is not applicable to the following: ○ 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; ○ Biomass fired power plants; ○ 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.	• Not applicable. • Not applicable. • Not applicable.
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".	•Not applicable

B.3. Project boundary, sources and greenhouse gases (GHGs)

The greenhouse gases and emission sources included in or excluded from the project boundary are shown in the table below:

	Source	GHG	Included?	Justification/Explanation
Baseline	The Power Grid electricity production from the host country	CO_2	Yes	According ACM0002, only CO_2 emissions from electricity generation should be accounted.
		CH_4	No	Minor emission source according to ACM0002.
		N_2O	No	According ACM0002, only CO_2 emissions from electricity generation should be accounted.
Project activity	Project activity	CO_2	No	Minor emission source according to ACM0002
		CH_4	No	Minor emission source according to ACM0002
		N_2O	No	Minor emission source according to ACM0002

According to methodology, the project boundary encompasses the Project power plant and all power plants connected physically to the electricity system that the Project is connected to. The electricity system is defined according to the *Tool to calculate the emission factor for an electricity system*.

Hence, the Project boundary is the area of the concession of the hydroelectric power plant. Since the Project is connected to the national grid, this will be included in the project boundary. This is done because the electricity meter is going to be placed in Aguas Calientes SE (substation), in order to monitor the net energy (energy produced in Potrero power plant minus internal consumption and minus transmission losses) supplied to the SEIN, as mentioned in section A.3.

Figure 5: Project boundary

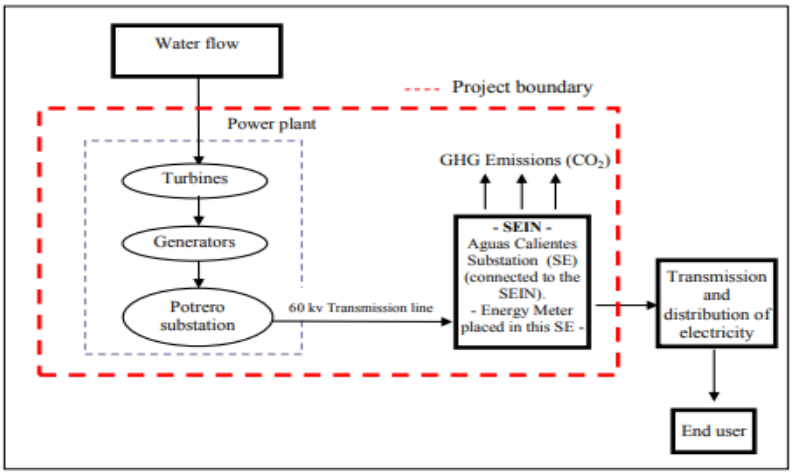
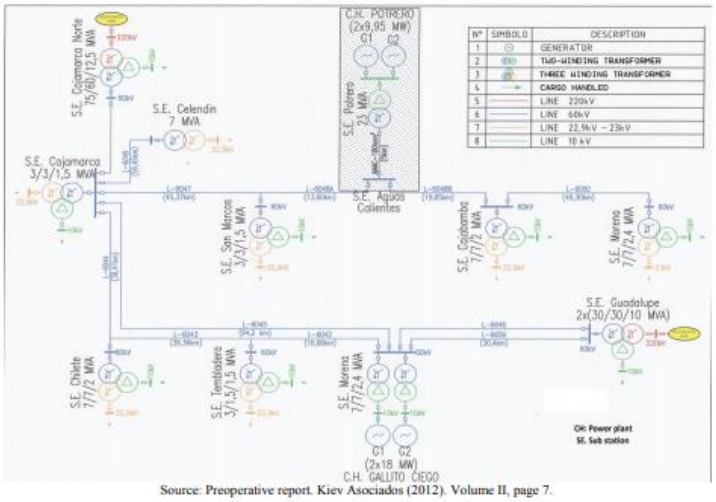


Figure 6: Project flowchart



Source: Preoperative report. Kiev Asociados (2012). Volume II, page 7.

B.4. Establishment and description of baseline scenario

According to the methodology ACM0002, if the Project is the installation of a new grid-connected renewable power plant/unit, the baseline scenario is the following:

The electricity delivered to the grid by the Project 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.

The Project consists of the installation of a new grid-connected renewable power plant that connects with and delivers electricity to - the SEIN. Therefore, according to the *Tool to Calculate the Emission Factor for an Electricity System*, the delineation of the Project electricity system is the SEIN.

As per the methodology ACM0002, the baseline scenario of the Project is the provision of an equivalent amount of annual energy to the SEIN by the existing grid-connected power plants and the addition of new grid-connected power plants. For a detailed analysis please refer to Section B.5.

The most relevant national/sectoral policies related to the proposed project activity are:

- Energy Concession Law 25844[14]. The Peruvian electric market is ruled by the Energy Concession Law 25844 since 1992.
- Regulation for Environmental Protection in Energy Activities N°29-94-EM[15]. Regulating the environmental conditions in the electric market.

[14] Web link: http://www.minem.gob.pe/minem/archivos/file/Electricidad/normatividad/dl25844.pdf (Law 25844 updated with the current modifications)..

[15] Web link: http://www.osinerg.gob.pe/newweb/uploads/Publico/2.DS-029-94-EM-Reg.Proteccin%20Amb.pdf. Download at July 2012

- Legislative decree 1002[16] from 2008. Energy regulation aiming to introduce non-conventional renewable sources in the energy matrix. Sets the possibility to develop renewable energy tenders with benefits for the projects that are finally selected (fulfills the requirements). These tenders are public with no specific periodicity and the benefits will only apply to the projects winning the tender.

There is no energy, environmental or water regulation that considers the implementation of hydro power plants as mandatory. It can be seen in the webpages of the main institutions related to the electric market, that there is no internal, sectoral or national regulation.

B.5. Demonstration of additionality

Demonstration of prior consideration of the CDM:

According to the Guidelines on the Demonstration and Assessment of Prior Consideration of the CDM (version 03), now part of the Clean Development Mechanism Project Cycle Procedure (Version 01.0)[17] new project activities starting after 02/08/2008 must notify the Designated National Authority (DNA) and the UNFCCC in writing about the commencement of the Project activity. The Project was announced to the UNFCCC secretariat on 03/02/2012 and received on 18/02/2012.[18]

The real and continued actions taken to secure CDM status of the Project can be demonstrated by the elements presented in the following table. The milestones demonstrate that CDM income was the key factor that allowed the Project to obtain its needed investment, as the investor's (Empresa Eléctrica Agua Azul S.A.) interest is the acquisition of the emission reduction certificates (CERs) that the Project should generate.

Table 4: Actions towards CDM status of the Project

Date	Key Event	Comment
29/12/2011	Hydrological study approval	Approved by the National Water Authority (ANA). This document is needed in order to have the definitive concession.
03/02/2012	Prior Consideration of the CDM.	Empresa Eléctrica Agua Azul S.A. sent the filled form of the Potrero Hydropower Plant to the UNFCCC and Peruvian DNA (MINAM).
18/02/2012	Prior Consideration of the CDM.	The UNFCCC published the Project's Prior Consideration of the CDM on the UNFCCC website.

[16] Web link: http://www2.osinerg.gob.pe/MarcoLegal/docrev/D.%20Leg.%201002-CONCORDADO.pdf. Download at July 2012. It can be considered as a E- policy for the projects that win the tender, but is in force after November 2001, therefore need not be taken into account in identifying a baseline scenario.

[17] http://cdm.unfccc.int/filestorage/5/0/V/50V3N2XFTR48PDJKZECMLYQOU1I7SA/eb65_repan32.pdf?t=d1R8bTBzbGNuf DCAdjecY7t0UxFXD_v5lnKp- Web link last accessed on 12/03/2012.

[18] According to UNFCCC Prior Consideration Search http://cdm.unfccc.int/Projects/PriorCDM/notifications/index_html

14/03/2012	Local Stakeholder Consultation.	The local stakeholder consultation meetings, undertaken by the Project Developer and the National Environmental Fund (FONAM) were initiated and held on 14/03/2012, in Province of San Marcos.
14/02/2012	Contract with ÉcoRessources	A contract was signed between Empresa Eléctrica Agua Azul S.A. and ÉcoRessources for the development of the CDM documentation.
04/05/2012	Request for Definitive Concession Submitted to Minister of Energy and Mines	The request for the Project's definitive concession is expected to be submitted to the Ministry of Energy and Mines.
05/06/2012	Documents submitted for the National Approval Process at the Peruvian DNA.	This kick-starts the process for the Peruvian Letter of Approval.
15/01/2013	Signature of access route contract.	The project has a difficult access to the power plant location therefore the contract to develop the access routes is expected to be the first milestone of the project. Since this is over 4 million USD dollars, is considered the potential CDM starting date of the project.
First Trimester of 2013	Construction contracts	The project aims to start construction on June 2013.
01/06/2013	Start of Construction	The dates are defined in pre-operative studio of the project and project developer's estimation
01/06/2016	Start of power plant operation	

The additionality of the Project is demonstrated on the basis of the *Tool for demonstration and assessment of additionality*.

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 ACM0002, *Consolidated baseline methodology for grid-connected electricity generation from renewable sources*, since the Project activity is the installation of a new grid-connected renewable power plant, the baseline scenario is the electricity delivered to the grid by the project activity that 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 calculations described in the *Tool to calculate the emission factor for an electricity system*.

Therefore, two alternative scenarios are evaluated:

Scenario 1: Implementation of the Project as a hydroelectric power generation plant without CDM income.

Scenario 2: Continuation of the current practice, whereas the Project participants do not invest and that power is generated by the operation of grid-connected power plants and by the addition of new generation sources.

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

The scenarios identified above are in compliance with all applicable legal and regulatory requirements, including the Electric Concessions Law[19]. Some relevant articles of this law are described below:

a) Article 1: Electricity generating activities can be developed by people or legal entities, i.e. private companies, whether they are Peruvian nationals or foreigners, as long as the legal entities are incorporated under Peruvian laws.

b) Article 3: A concession is required for the development of hydropower plants if their installed capacity is greater than 500 kW.

c) Article 4: An authorization is required to develop fossil fuel-fired power plants with an installed capacity greater than 500 kW.

d) Article 6: The concessions and authorizations can be granted by Peru's Ministry of Energy and Mines (MINEM).

e) Article 7: Electricity generating activities that do not require a concession or authorization can be developed freely provided they comply with technical standards and adhere to the conservation of environmental quality and cultural heritage. The developer of such activities should inform the MINEM of the project activity and its technical characteristics.

f) Article 9: The Peruvian government seeks to preserve the environmental quality and cultural heritage of the country, as well as the rational use of natural resources in the development of activities related to generation, transmission and distribution of electricity.

All Peruvian projects shall apply this law in order to have the concession approval; therefore any energy project is plausible under this regulation.

The Regulation for Environmental Protection in Energy Activities N°29-94-EM has to be applied by every energy project in Peru, therefore any energy alternative is in accordance with this law and is plausible.

The Legislative decree 1002[20] will apply to any project that wins the renewable energy tenders in Peru, the participation in these tenders is completely optional and the

[19] http://www2.osinerg.gob.pe/MarcoLegal/pdf/LEYCE-DL25844.pdf - Web link last accessed on 12/03/2012.

[20] This is a national regulation that promotes the use of renewable energetic resources (RER) in Peru, therefore, gives an advantage to less-intensive technologies over more emissions-intensive technologies, otherwise known as a regulation that decrease GHG emissions (called type E-). Since this regulation was implemented in May 2, 2008 (after decision 17/CP. 7, 11 November 2001) it does not need to be taken into account in identifying a baseline scenario, according to paragraph 93 section b) of EB 65, Annex 4 and paragraph 45 section b) of EB 65, Annex 5. Therefore, it is not taken into account for the electric tariff determination, neither the sensitivity analysis. Available at: http://intranet2.minem.gob.pe/web/archivos/dge/publicaciones/compendio/DLEG-1002-2008.pdf. Last consulted on October 11, 2012.

process and its results are publicly available by OSINERG[21].Therefore any energy alternative is in accordance with this law and is plausible.

Therefore, under Step 1 both alternative scenarios are plausible.

Step 2: Investment Analysis

The objective of this section is to evaluate the financial attractiveness of the Project without CDM income.

Sub-step 2a: Determine appropriate analysis method

The Project generates revenue from electricity sales and the alternative to the Project activity is the continuation of electricity supply from the existing generation in the grid, and this does not require an investment by the Project developer. Therefore, the only alternative of the Project developer is making no investment and a benchmark analysis is appropriate, based on the *Tool for the demonstration and assessment of additionality* and the *Guidelines on the Assessment of Investment Analysis* (paragraph 19: If the proposed baseline scenario leaves the project participant no other choice than to make an investment to supply the same (or substitute) products or services, a benchmark analysis is not appropriate and an investment comparison analysis shall be used. If the alternative to the project activity is the supply of electricity from a grid this is not to be considered an investment and a benchmark approach is considered appropriate).

Sub-step 2b: Option III. Apply Benchmark Analysis

The financial indicator that will be used is the Project's post-tax internal rate of return (IRR). The Project IRR is compared to an established benchmark, which is a post-tax discount rate of 12% that has been selected as a benchmark to evaluate the economic viability of an investment in the electricity sector in Peru. This 12% discount rate is established by the government in the Electric Concessions Law as the reference rate to evaluate investments in the power sector. This rate has also emerged in several studies as well as in official governmental decisions related to project investment evaluation[22]. The discount rate is used by private stakeholder in the Peruvian electricity sector[23] as well as by the government, within the electric concession law, to evaluate new investments in the power sector.

[21] Supervisory Agency for Investment in Energy and Mining ("Organismo Supervisor de la Inversion en Energía y Mineria"). www.osinerg.gob.p

[22] Law 25844 – Electric Concessions Law. Article 79, Page 40. The specific discount rate for the electric sector determined by the Ministry of Energy and Mines within the Peruvian Electric Concession Law is used principally by the electric sector regulator assessing the opportunity cost of investment for the new additions to the system in order to forecast and determine the regulated tariff in Peru. A copy of the concession law will be provided to the DOE.

[23] CDM registered projects have used this benchmark i.e. Rehabilitation of the Callahuanca hydroelectric power station (registration Nº:1245), Carhuaquero IV hydroelectric power plant (registration Nº:1424), La Virgen hydroelectric plant (registration Nº:1445), Poechos II hydroelectric plant project (registration Nº:1836), La Joya hydroelectric plant (registration Nº:1889), El Platanal (registration Nº:2426), Santa Cruz I Hydroelectric Power Plant (registration Nº: 2405), Huanza Hydroelectric Project (registration Nº: 4306), Yanapampa Hydroelectric Power Plant (registration Nº: 3545) and Santa Cruz II Hydroelectric Power Plant (registration Nº: 3337). In addition two solar power plants registered as CDM use this benchmark (registration No: 5721 and N°: 5722).

The Electric Concession Law "Ley de Concesiones Eléctricas", Decree Law 25844 considers a specific discount rate for the electric sector and is used principally by the electric sector regulator assessing the opportunity cost of investment for the new additions to the system in order to forecast and determine the regulated tariff in Peru. In addition, there are several other governmental regulations not related to tariffs that use 12% as the rate for the opportunity cost for the evaluation of new investments and which reflect the minimum expected return for investments in the electric sector in Peru. Independent studies such as one performed by the World Bank in 2009 (Presentation of a World Bank Study regarding the Economic and Technical feasibility of Hydropower in Peru) uses the benchmark of 12% as one to determine the viability of the projects[24]. Terms of reference developed by the Ministry of Energy and Mines for rural electrification projects formally considers 12% as the discount rate for project evaluation and comparison[25]. The investment guidelines for investment in electrification projects, developed by the Ministry of Economy and Finance, establish that private profitability indicators consider that the IRR calculation is with a 12% discount rate[26]. The Peruvian electric infrastructure company for rural electrification projects considers 12% as discount rate for renewable projects as stated in a document resuming the status of wind projects[27]. The Peruvian Central Reserve (BCR) issued the "Study for the electric supply BCR" dated September 2008 regarding the evaluation of future power additions in 2008-2012 to the electric sector (in page 26 a discount rate of 12% for financial analysis of investment for power alternatives including hydropower)[28]. A study made by OSINERG in November 2005 related to the dynamics in electricity generation investment in Peru stated that investments are evaluated with a discount rate of 12%[29].

Previously Peruvian registered CDM projects forwarded a letter from the Peruvian DNA dated 22 July 2009 saying that there are several official documents of relevant institutions that consider the discount rate 12% adequate to evaluate the viability of a hydropower project and a letter from the Ministry of Energy and Mines, confirming that the 12% discount rate is used for private evaluation of energy projects in the National System for Public investment (that is not related to any type of energy tariff regulation or determination), and that is also used to forecast the referential plan for the next additions in the electric sector.

Sub-step 2c: Calculation and comparison of financial indicators

[24] Web link http://siteresources.worldbank.org/INTPERUINSPANISH/Resources/EnriqueCrousillat_Sesion2.pdf. Download at July 2011

[25] Web link. http://dger.minem.gob.pe/ArchivosNormasTecnicas/TR-Perfil_Integrado.pdf. Download at July 2011

[26] Web link. http://www.mef.gob.pe/contenidos/inv_publica/docs/instrumentos_metod/energia/Guia_SimplificadaElectrificacion_Rural.pdf. Download at July 2011.

[27] Web link. http://intranet2.minem.gob.pe/web/archivos/ogp/GVEP/velasquez.pdf. Download at July 2011

[28] Web link. http://www.bcrp.gob.pe/docs/Proyeccion-Institucional/Encuentro-de-Economistas/XXVI-EE-2008/XXVI-EE2008-S10-Paper-Barco-Iberico-VeraTudela-Vargas.pdf. Download at July 2011

[29] Web link http://www.osinerg.gob.pe/newweb/uploads/Estudios_Economicos/Dinamica%20de%20la%20Inversion%20en%20Generaci on.pdf. Download at July 2011

The main parameters of the IRR analysis are based on conservative assumptions available to the Project developer at the time of the investment decision, and are shown below:

Table 5: Main parameters for the calculation of financial indicators

Parameters	Unit	Value	Data Source
Electricity Price – peak hours	USD per kWh	0.046600	OSINERGMIN Resolution Nº 037-2012-OS/CD. Fixed prices applicable for the period between 01/05/2012 and 30/04/2013[30].
Electricity Price – Off peak hours	USD per kWh	0.042772	OSINERGMIN Resolution Nº 037-2012-OS/CD. Fixed prices applicable for the period between 01/05/2012 and 30/04/2013.
Generated Power Capacity Tariff	USD per kW per month	6.042363	OSINERGMIN Resolution Nº 037-2012-OS/CD. Fixed prices applicable for the period between 01/05/2012 and 30/04/2013.
Generation capacity	MW	20.86	(Empresa Eléctrica Agua Azul S.A., 2011) Project Profile: Potrero Hydropower Plant. Actual Installed Capacity at site.
Load Factor	%	81	Concession file submitted to the Ministry of Energy and Mines (MINEM) for the concession approval (page. 95)
Transmission Losses	%	0.54%	Concession file submitted to the Ministry of Energy and Mines (MINEM) for the concession approval page 114 and Pre-Operative Studio Volume I page 14[31]
Initial Investment – Civil Works	USD Mio.	20.56	Based on proposal for access road and reference documents/contracts on superficial and underground civil works[32].
Initial Investment: Machinery & Equipment	USD Mio.	11.22	Based on proposal for turbines, generators and accessories, plus documents/contracts for electrical panels, butterfly valve, overhead travelling crane, substation and transmission line[33].

[30] http://www2.osinerg.gob.pe/Resoluciones/pdf/2012/OSINERGMIN%20No.037-2012-OS-CD.pdf – Web link last accessed on 15/06/2012

[31] Weighted average of the simple average losses in the dry season (7 months) and wet season (5 months)

[32] Definitive study access and campsite Vera y Moreno S.A, Contract OC 0002 Superficial civil works with ERD S.A, Contract OC 0001 Underground civil works with ERD S.A.,

[33] BFL proposal annexure –I, Contract EM 0002-2011 overhead travelling crane - ERD S.A, Contract CON PER CH PIZ EQP 001 0-ERD S.A - electrical p

Construction services	USD Mio.	2.66	Based on a Technical assistance contract[34].
Social Responsibility	USD Mio.	0.15	Based on the Social Investment Plan of the project participant.
Contingencies	USD Mio.	1.27	Based on developer experience and electric market information and formal information submitted for the concession approval[35].

Parameters	Unit	Value	Data Source
Operation & Maintenance Costs	USD Mio. Per year	0.44	Based on O & M documentations and contracts[36].
Insurance Costs	% of investment	0.40 %	Based on developer experience and electric market information.
Overhauling Costs	USD Mio. per year every 5 years	0.107	Project developer internal calculations based on other hydropower projects in Peru.
Contribution to OSINERG	% of income per year	1.00	Executive Order No. 136-2002-PCM, dated 24/12/2002[37].
Water Tariff	% of electricity tariff per year	1.00	Law 25844 – Rulebook for the Electric Concessions Law. Article 214, Page 92[38].
Contribution to COES	% of income per year	0.75	COES (Committee of Economic Operation of the System) Administrative Procedure 8A[39].
Depreciation – Civil Works	% per year	5	Rulebook for the Income Tax Law, Chapter VI, Article 22: Sets the standard depreciation rates per category[40]
Depreciation – Machinery & Equipment	% per year	10	Rulebook for the Income Tax Law, Chapter VI, Article 22: Sets the standard depreciation rates per category[41].

[34] Pizarras Technical assistance contract

[35] Contrasted with a benchmark analysis using the registered CDM hydroelectric projects.

[36] O & M contract and budget of the project developer

[37] http://www.osinerg.gob.pe/newweb/uploads/JARU/CD/008fiscalizacion/ds136-2002-pcm.pdf – Web link last accessed on 12/03/2012.

[38] http://www2.osinerg.gob.pe/MarcoLegal/pdf/REGLACE.pdf

[39] http://www.coes.org.pe/dataweb2/2008/DO/PROCEDIMIENTOS/Proced_admin_8a.pdf - Web link last accessed on 12/03/2012

[40] http://www.sunat.gob.pe/legislacion/renta/reglamento.html# - Web link last accessed on 12/03/2012

[41] http://www.sunat.gob.pe/legislacion/renta/reglamento.html# - Web link last accessed on 12/03/2012.

Amortization	% per year	50	Income Tax Law, Chapter VI, Article 37, subsection g): Gives the option to select a proportionally amortization over a maximum period of 10 years or to fully amortize in the first year. The client selected to amortize over a two year period[42].
Income Tax	% per year	30	Income Tax Law, Chapter VII, Article 55[43].
Distribution of Income to Workers	% per year	5	Law 892, Article 2[44].
Discount Rate	%	12	Law 25844 – Electric Concessions Law, Article 79, Page 40[45].
Exchange Rate	S/. per USD	2.691	OSINERGMIN Resolution Nº 037-2012-OS/CD. Fixed prices applicable for the period between 01/05/2012 and 30/04/2013.

Parameters	Unit	Value	Data Source
CER Price	EUR	7.93	Price based on midpoint of Highest Price and Lowest Price of last 52 weeks' range[46].
Emission Factor	tCO_2e /MWh	0.64969	Calculated in accordance to the CDM rules, with latest available data.
Technical Lifetime of Project	Years	50	(Empresa Eléctrica Agua Azul S.A., 2011) Project Profile: Potrero Hydropower Plant.
Inflation rate	%	2	Inflation Report – June 2012 of the Central Bank of Peru[47].
Total debt percentage	%	60	Based on Debt contract.
Debt percentage 1	%	62.96	Based on the portion that "Tramo 1" and "Tramos 2" of the Debt contract represents over the Total Debt.
Debt percentage 2	%	37.04	Based on the portion that "Tramo 1" and "Tramos 2" of the Debt contract represents over the Total Debt.
Interest 1	%	6.99	Interest applicable to "Tramo 1".

[42] http://www.sunat.gob.pe/legislacion/renta/tuo.html# - Web link last accessed on 25/09/2012

[43] http://www.sunat.gob.pe/legislacion/renta/ley/capvii.htm - Web link last accessed on 12/03/2012.

[44] http://www.mintra.gob.pe/contenidos/archivos/prodlab/D.%20Leg.%20892%2011-11-96.pdf - Web link last accessed on 12/03/2012

[45] http://www2.osinerg.gob.pe/MarcoLegal/pdf/LEYCE-DL25844.pdf - Web link last accessed on 12/03/2012.

[46] According to information found in: http://www.bloomberg.com/quote/BNSCER:IND/chart

[47] https://www.bcrp.gob.pe/publicaciones.html

Interest 2	%	6.59	Interest applicable to “Tramo 2”.
Debt term 1	Years	15	Based on Debt contract.
Debt term 2	Years	12	Based on Debt contract.
6 month Libor	%	0.74	Median of the Interquartile Range (with 95% confidence) of the historical 6 month Libor from January 1st 2012 to August 6th 2012 (obtained from economic indicators of Costa Rica Central Bank)[48].

A forecast of the Marginal Costs in the energy system[49], developed by the Ministry of Energy and Mines (MINEM), was intended to be used in order to determine the electricity price in the project evaluation. Since the forecast tariff is expected to be lower than USD 30 per MWh (USD 0.03 per kWh), the existing tariffs of USD 0.0466 per kWh for peak hours and USD 0.042772 per kWh for off-peak hours where used as a conservative approach. Both tariffs where fixed prices determined by OSINERGMIN, applicable for the period between 01/05/2012 and 30/04/2013, in the respective generation bar, or connection point, to the grid (in Cajamarca).

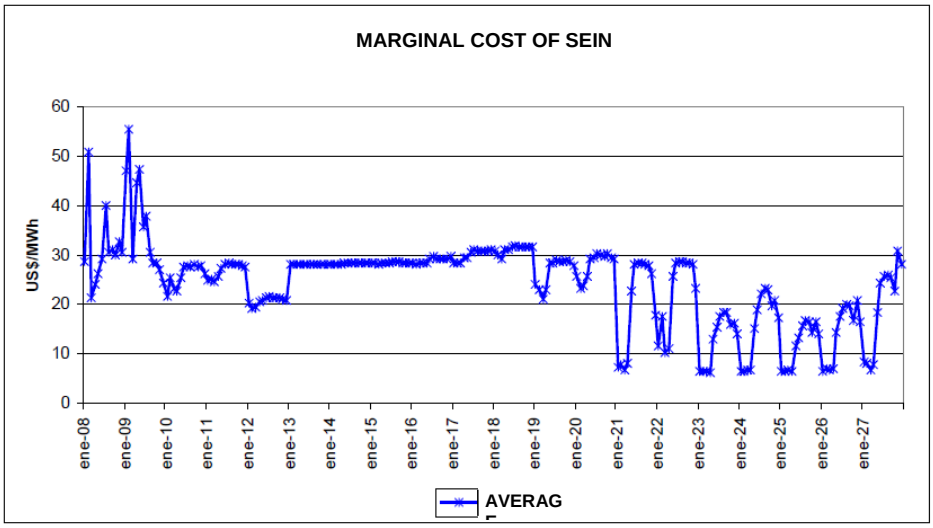
Therefore, despite the electricity tariff forecasted by the MINEM represent better the expected future tariff trend (20 year evaluation horizon), the project developer use the actual fixed tariffs determined by OSINERGMIN, because these are higher, represent a conservative assumption and are the existing real tariffs available at the moment of the project evaluation.

The following figure shows the tariff trend forecasted by the MINEM:

Figure 7: Forecast Average Marginal Cost of SEIN 2008-2028

[48] http://indicadoreseconomicos.bccr.fi.cr/indicadoreseconomicos/Cuadros/frmVerCatCuadro.aspx?idioma=1&CodCuadro=%2 0342 - Web link last accessed on 14/08/2012

[49] The energy from the generators will be valued at the Marginal Cost as per Law 25844 – Electric Concessions Law, Article 19, Page 88.



Source: Reference Electricity Plan 2008 - 2017[50]

Also, it is important to mention that article 70, subsection c) of the Law Decree 25844 considers the residual value for every company as zero (0)[51] and the equipment operational lifetime is no longer than the project evaluation horizon.

A comparison of the IRR for the proposed Project activity without CDM revenues and the financial benchmark IRR (12%) is shown below. Without CDM revenues, the IRR of the total Project investment is 10.35%, which is below the benchmark level. Therefore, the proposed Project can be considered as financially unattractive to investors.

The table below compares the financial indicator without CER revenue:

Table 6: Comparison of financial indicator without CER revenue

Item	Unit	Without CER revenue	Benchmark
IRR	%	10.82	12.00

Sub-step2d: Sensitivity Analysis

For the proposed Project activity, the following financial parameters were taken as uncertainty factors for the sensitivity analysis as they constitute around or more than 20% of the Project revenues and expenses:

1. Energy Sales (from variations in the spot price of energy)
2. Energy Sales (from variations in the load factor)
3. Initial investment

[50] MINEM. Web link: http://www.minem.gob.pe/publicacion.php?idSector=6&idPublicacion=280, Reference Electricity Plan 2008-2017, page 167.

[51] Law 25844 – Electric Concessions Law. Article 70, subsection c) Page 37. http://www2.osinerg.gob.pe/MarcoLegal/pdf/LEYCE-DL25844.pdf - Web link last accessed on 02/06/2012.

4. O & M

Table 7 shows the results assuming that these parameters values may fluctuate within the range between - 10% and +10%:

Table 7: Sensitivity Analysis with -/+10% fluctuation

Item	Variation	
	- 10.0%	**+ 10.0%**
Energy Sales – Price of energy (Spot)	9.78 %	11.84 %
Energy Sales – Generation (Load Factor)	9.78%	11.84 %
Initial Investment	12.02%	9.82%
Running Costs	10.93%	10.27%

In all cases, the proposed Project activity failed to reach the established Project IRR benchmark of 12% with variations of -/+10% of all the selected parameters except in case of initial investment, as recommended by paragraph 21 of the "*Guidelines on the assessment of investment analysis*"; however, as the project capacity increases by about 4.82%, the decrease of project running cost by 10% is highly unlikely and can be ruled out; hence the project activity IRR is well below the established benchmark IRR of 12% in all selected parameters as recommended by paragraph 21 of the "*Guidelines on the assessment of investment analysis*".

Therefore, it can be concluded that the Project alone (scenario 1 – the proposed Project activity undertaken without CDM revenues) is not sufficiently attractive for private investors. Therefore, this scenario is not considered the most probable baseline scenario.

Step 4: Common practice analysis
Step 1: Calculate applicable output range as +/-50% of the design output or capacity of the proposed project activity.

The project activity has been analysed based on installed capacity, and then the range will be between 9.95 MW and 29.85 MW.

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.

The applicable geographical is the one covered by the SEIN, and considers only the projects that have started commercial operation before the start date of the project and are connected to the grid. Information used in the present analysis has been given by COES annual statistical report, information send via CD and formal letter of submission or online documents[52].

Registered CDM project activities and projects activities undergoing validation are not included in the evaluation.

[52] Website: http://www.coes.org.pe/. 2011 statistics: http://www.coes.org.pe/wcoes/coes/salaprensa/estadistica_anual.aspx. Web link last accessed: 14/06/2012.

The following table details the operative power plants in the SEIN, their type, installed capacity and CDM condition. The project plants in bold are in the range determined in Step1.

Table 8: Operative power plants in the SEIN

Power Plant	Technology	Energy source/fuel	Installed Capacity (MW)	CDM Status
Paramonga	**TV**	**Bagasse**	**23.0**	**-**
Pías	Francis	Hydro	6.3	Registered
Platanal	Pelton	Hydro	220.0	Registered
Chimay	Francis	Hydro	142.8	-
Yanango	Francis	Hydro	42.3	-
Huanchor	**Francis**	**Hydro**	**18.4**	**-**
Callahuanca	Pelton	Hydro	82.6	-
Huampani	Francis	Hydro	31.4	-
Huinco	Pelton	Hydro	258.4	-
Matucana	Pelton	Hydro	120.0	-
Moyopampa	Pelton	Hydro	75.4	-
Santa rosa	TG	Natural Gas	446.7	-
Ventanilla	CC	Natural Gas	522.0	Registered
Malacas	TG	Natural Gas	135.7	-
Charcani I	Francis	Hydro	1.8	-
Charcani II	Francis	Hydro	0.6	-
Charcani III	Francis	Hydro	4.2	-
Charcani IV	**Francis**	**Hydro**	**15.5**	**-**
Charcani V	Pelton	Hydro	145.4	-
Charcani VI	Francis	Hydro	9.0	-
Chilina	CC	Diesel 2	48.5	-
Mollendo	Diesel	Residual 500	31.7	-
Pisco	TG	Natural Gas	74.8	-
Machupicchu	Pelton	Hydro	90.5	-
Caña Brava	Kaplan	Hydro	5.3	Registered
Cañon del pato	Pelton	Hydro	246.6	-
Carhuaquero	Pelton	Hydro	95.1	-
Carhuaquero IV	Pelton	Hydro	10.0	Registered
Chiclayo Oeste	**Diesel**	**Residual 6**	**26.7**	**-**
Chimbote	**Tg**	**Diesel 2**	**21.0**	**-**
Las Flores	Tg	Natural Gas	192.5	-
Piura	Diesel - Tg	Residual 6 - Diesel 2	34.7	-
Aricota I	**Pelton**	**Hydro**	**23.8**	**-**
Aricota II	**Pelton**	**Hydro**	**11.9**	**-**
Independencia	**TG**	**Natural Gas**	**22.9**	**-**
Mantaro	Pelton	Hydro	798.0	-
Restitucion	Pelton	Hydro	210.4	-
Emergencia Trujillo	Diesel	Diesel 2	64.0	-
Tumbes	**Diesel**	**Residual 6**	**18.7**	**-**
Yuncan	Pelton	Hydro	130.1	At validation
Chilca	TG	Natural Gas	559.8	-
Ilo1	Diesel	Diesel 2	238.6	-
Ilo2	TV	Coal	135.0	-
La Joya	Francis	Hydro	10.0	Registered
Kallpa	TG	Natural Gas	629.0	-

Roncador	Francis	Hydro	3.8	-
Huaycoloro	Diesel	Biogas	4.8	-
San Gaban II	Pelton	Hydro	110.0	-
Bellavista	Diesel	Diesel 2	4.8	-
Taparachi	Diesel	Diesel 2	6.7	-
Santa Cruz	Francis	Hydro	7.0	Registered
Santa Cruz II	Francis	Hydro	7.0	Registered
Purmacana	Francis	Hydro	1.8	-
Oquendo	TG	Natural Gas	31.0	-
San Nicolás	TG - TV	Diesel 2	68.5	-
Poechos ii	Kaplan	Hydro	10.0	Registered
Cahua	Francis	Hydro	43.6	-
Gallito Ciego	Francis	Hydro	34.0	-
Malpaso	Francis	Hydro	54.4	-
Oroya	Pelton	Hydro	9.0	-
Pachachaca	Pelton	Hydro	9.0	-
Pariac	Francis	Hydro	4.9	-
Yaupi	Pelton	Hydro	108.0	-
Huayllacho	Pelton	Hydro	0.3	-
Misapuquio	Pelton	Hydro	3.9	-
San Antonio	Francis	Hydro	0.6	-
San Ignacio	Francis	Hydro	0.5	-
Aguaytia	TG	Natural Gas	191.9	-

Source: COES. Table 3.1 of the 2011 Statistic Report (available in the COES webpage)

As per the previous table, N_{all} = is 9

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

As can be seen in table 8:

- Power plants Paramonga (bagasse), Chiclayo Oeste and Tumbes (Residual fuel oil) and Independencia (natural Gas) are power plants with a different technology and energy/fuel source.
- Charcani IV is a hydro power plant implemented between 1959 and 1970. Therefore the power plant construction and investment decision was made in a different regulatory and economic framework. The energy sector was significantly modified with the Electric Concessions Law in 1992 (desegregation in distribution, transmission and generation activities and companies, creation of a wholesale market and regulated market, concession system, among others). In addition the project owner of Charcani IV is now Egasa[53], which is a public company created in 1994 under private law and is part of the FONAFE Corporation[54]. In Peru, FONAFE is responsible for regulating and directing the business activities of the government, and then all productive companies where the government is the major shareholder are part of the corporation. By doing this, projects have to comply with special requirements in order to be implemented, e.g. fulfilling SNIP

[53] EGASA http://www.egasa.com.pe. Charcani IV description on: http://www.egasa.com.pe/esp/institucional/instalaciones/instalaciones.detalle.php?id=4. Web link last accessed on 14/06/2012

[54] Fonafe webpage: http://www.fonafe.gob.pe/portal?accion=empresas&t=1&i=5&o=01&m=3. Web link last accessed on 14/06/2012.

procedures (project evaluation system for governmental projects) [55] .As a conclusion, Charcani IV faced a different investment climate in the date of the investment decision and is owned by a company with a different management structure compared to the company Empresa Electrica Agua Azul S.A. which is entirely private.

- Aricota I and Aricota II have the same conditions as Charcani IV since the projects were implemented in 1966 and 1967. Now are owned by the public company under private law named Egesur[56] that is also part of FONAFE[57]. In addition both projects operate with Pelton turbines while the proposed project will use Francis turbines.

Considering the previous paragraphs, 8 projects identified in Step 2 apply a different technology as per the Additionality Tool, then N_{diff} = is 8.

Step 4: Calculate factor F=1-N diff /N all 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 result of the applicable two formulas is:
a) $F = 1 - N_{diff} / N_{all} = 1- 8/9 = 0.11$
b) $N_{all} - N_{diff} = 9 – 8 = 1$

The result of a) is below 0.2 and the result of b) is below 3, then the project activity is not considered a common practice and is additional.

Even with revised range between 10.43 MW and 31.29 MW,
a) $F = 1 - N_{diff} / N_{all} = 1- 8/10 = 0.2$
b) $N_{all} - N_{diff} = 10 – 8 = 2$

The result of a) is 0.2 and the result of b) is below 3, then the project activity is not considered a common practice and is additional.

B.6. Estimation of emission reductions

B.6.1. Explanation of methodological choices

The emission reductions are calculated following the guidance of the methodology ACM0002, as follows:

$$ER_y = BE_y - PE_y$$

Where:
ER_y: Emission reduction in year y (tCO_2)

[55] http://www.mef.gob.pe/index.php?option=com_content&view=article&id=306&Itemid=100883. - Web link last accessed on 12/03/2012 and http://www.fonafe.gob.pe/portal?accion=c&t=13&i=103&n=1&o=103&m=2 Web link last accessed on 14/06/2012.

[56] EGESUR: http://www.egesur.com.pe. Web link last accessed on 12/03/2012. Aricota I http://www.egesur.com.pe/pages/instal/aricota1.aspx and Aricota II in http://www.egesur.com.pe/pages/instal/aricota2.aspx

[57] Fonafe webpage: http://www.fonafe.gob.pe/portal?accion=empresas&t=1&i=2&o=01&m=3. Web link last accessed on 14/06/2012.

BE_y: Baseline Emission in year y (tCO_2)

PE_y: Project emission in year y (tCO_2)

I. Project Emissions (PE_y)

For most renewable energy project activities project emission are neglected and following the methodology, as the Project is a run-of-the-river project and do not have a reservoir, it does not lead to any GHG emissions; therefore project emission are considered equal to zero.

As per the methodology, the only project emission sources are the ones related to

- Project emissions from fossil fuel consumption in year y (tCO_2). This source was created for geothermal and solar thermal projects, which also use fossil fuels for electricity generation. Since the project does not use fossil fuels in the operation, this source is zero.

- Project emissions from the operation of geothermal power plants due to the release of non- condensable gases in year y (tCO_2e). This source was created for geothermal projects therefore it does not apply to the proposed project activity.

- Project emissions from reservoirs of hydro power plants in year y (tCO_2e). This source was created for hydro power project activities that result in new single or multiple reservoirs and hydro power project activities that result in the increase of single or multiple existing reservoirs, project proponents shall account for CH4 and CO2 emissions from the reservoirs, estimated as follows. Since the proposed project activity is a run of river project this emissions are considered zero.

II. Leakage

Following the applied methodology no leakage emissions are considered. The main emissions potentially giving rise to leakage in the context of electric sector projects are emissions arising due to activities such as power plant construction and upstream emissions from fossil fuel use (e.g. extraction, processing, and transportation). These emissions sources are neglected.

III. Baseline Emissions (BE_y)

The baseline emission is calculated as the product of electrical energy baseline ($EG_{BL,y}$), expressed in MWh, produced by the renewable generating unit and multiplied by the grid emission factor:

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

Where:

BE_y : Baseline Emission in year *y* (tCO_2).

$EG_{PJ,y}$: 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* calculated using the latest version of the *Tool to calculate the emission factor for an electricity system* (tCO_2/MWh).

Calculation of $EG_{PJ,y}$

The calculation of $EG_{PJ,y}$ is different for (a) Greenfield plants, (b) retrofits and replacements, and (c) capacity additions. The case of the project activity is described next:

Due to the fact that the Project involves the installation of a new grid-connected renewable power plant/unit at a site where no renewable power plant was operated prior to the implementation of the project activity (Case (a) Greenfield plant), then:

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

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).

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

The PDD will use $EG_{PJ,y}$ as the parameter for the project net electricity fed into the grid.

Calculation of the emission factor (EF) of the national electricity grid

The *Tool to calculate the emission factor for an electricity system* determines the CO_2 emission factor for the displacement of electricity generated by power plants in an electricity system by calculating the "operating margin", "build margin" and "combined margin" through the following 6 steps:

Step 1: Identify the relevant electric power system.
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) emission factor

Step 1: Identify the relevant electric power system
The Project supplies energy to the National Interconnected Electric Grid (SEIN), therefore it will displace electricity from the SEIN. Hence, the identified electricity power system is 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)
There are 2 options in the Tool to choose from:

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.

Because the data from grid connected power plants is available, Option I is chosen for the calculation of the grid emission factor.

Step 3: Select a method to determine the operating margin (OM)
Out of four options for the OM, the Dispatch Data Analysis OM (OM-DD) was selected. 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 ($EF_{grid,OM\text{-}DD,y}$) used was provided by the Tool as follows:

$$EF_{grid,OM\text{-}DD,y} = (\Sigma_h EG_{PJ,h} * EF_{EL,DD,h}) / EG_{PJ,y}$$

Where:

$EF_{grid,OM\text{-}DD,y}$: Dispatch data analysis operating margin CO_2 emission factor in year *y* (tCO_2/MWh).
$EG_{PJ,h}$: Electricity displaced by the project activity in hour *h* of year *y* (MWh).
$EF_{EL,DD,h}$: CO_2 emission factor for grid power units in the top of the dispatch order in hour *h* in year *y* (tCO_2/MWh).

$EG_{PJ,y}$: Total electricity displaced by the project activity in year *y* (MWh).
h : Hours in year y in which the project activity is displacing grid electricity.
y : Year in which the project activity is displacing grid electricity.

Because there is no available data of hourly fuel consumption, the hourly emissions factor is calculated based on the energy efficiency of the grid power unit and the fuel type used, as follows:

$$EF_{EL,DD,h} = (\Sigma_n EG_{n,h} * EF_{EL,n,y}) / \Sigma_n EG_{n,h}$$

Where
$EF_{EL,DD,h}$: CO_2 emission factor for power units in the top of the dispatch order in hour h in year y (tCO_2/MWh).
$EG_{n,h}$: Net quantity of electricity generated and delivered to the grid by power unit n, in hour h (MWh).
$EF_{EL,n,y}$: CO_2 emission factor of power unit n, in year y (tCO_2/MWh)
n :Power units at the top of the dispatch order
h :Hours in year y in which the project activity is displacing grid electricity.

To determine the set of grid power units ***n*** that are at the top of the dispatch order 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 at the top x% of total electricity dispatched in the hour ***h***, where x% is equal to the greater of either:

a) 10%,
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 CO_2 emission factor of the power unit ($EF_{EL,m,y}$) is calculated as per the guidance for the simple OM, using the **option A2**.

$$EF_{EL,m,y} = (EF_{CO2,m,y,i} * 3.6) / \eta_{m,y}$$

Where:
$EF_{EL,m,y}$: CO_2 emission factor of power unit m in year y (tCO_2/MWh).
$EF_{CO2,m,y,I}$: Average CO2 emission factor of fuel type i used in power unit m in year y (tCO_2/GJ).
$\eta_{m,y}$: Average net energy conversion efficiency of power unit m in year y (ratio).
m : 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
In terms of vintage data, to calculate the build margin emission factor, Option 2 shall be chosen for the proposed Project.

Option 2*: For the first crediting period, the build margin emission factor shall be updated annually, ex post, including those units built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available. For the second crediting period, the build margin emissions factor shall be calculated ex ante, as described in Option 1, 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.*

$$EF_{grid,BM,y} = (\Sigma_m EG_{m,y} * EF_{EL,m,y}) / \Sigma_m EG_{m,y}$$

Where:
$EF_{grid,BM,y}$: Build margin CO_2 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).
$EF_{EL,m,y}$: CO_2 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, 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 ($SET_{5\text{-units}}$) and determine their annual electricity generation ($AEG_{SET\text{-}5\text{-}units}$, in MWh);
b) Determine the annual electricity generation of the project electricity system, excluding power units registered as CDM project activities (AEG_{total}, 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 AEG_{total} (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) ($SET_{\geq 20\%}$) and determine their annual electricity generation ($AEG_{SET\text{-}\geq 20\%}$, in MWh);
c) From $SET_{5\text{-units}}$ and $SET_{\geq 20\%}$ select the set of power units that comprises the larger annual electricity generation (SET_{sample}); Identify the date when the power units in SET_{sample} started to supply electricity to the grid. If none of the power units in SET_{sample} started

to supply electricity to the grid more than 10 years ago, then use SET $_{sample}$ to calculate the build margin. Ignore steps (d), (e) and (f).
d) Exclude from SET $_{sample}$ the power units which started to supply electricity to the gridmore 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 (SET $_{sample-CDM}$) the annual electricity generation (AEG $_{SET-sample-CDM}$, 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-sample-CDM ≥ 0.2 × AEG $_{total}$), then use the sample group SET $_{sample-CDM}$ to calculate the build margin. Ignore steps (e) and (f).
e) Include in the sample group SET $_{sample-CDM}$ 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 (SET $_{sampleCDM}$->10yrs).

Out of SET $_{5-units}$ and SET $_{≥20\%,}$ the latter group was selected as SET $_{sample}$ due to the fact that it includes the larger annual electricity generation.

Step 6: Calculate the combined margin (CM) emission 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) shall be used as the preferred option:

$$EF_{grid,CM,y} = EF_{grid,OM,y} * W_{OM} + EF_{grid,BM,y} * W_{BM}$$

Where:
W_{OM} : Weighting of OM emission factor (%).
W_{BM} : Weighting of BM emission factor (%).
For the proposed Project, the following default values are used:
$W_{OM} = 0.5$ and $W_{BM}=0.5$[58]

[58] According to the Tool to calculate the emission factor for an electricity system: • Wind and solar power generation project activities: W_{OM} = 0.75 and W_{BM} = 0.25 (owing to their intermittent and non dispatchable nature) for the first crediting period and for subsequent crediting periods; • All other projects: W_{OM} = 0.5 and W_{BM} = 0.5 for the first crediting period, and W_{OM} = 0.25 and W_{BM}=0.75 for the second and third crediting period, unless otherwise specified in the approved methodology which refers to this tool

B.6.2. Data and parameters fixed ex ante

The Project does not have any ex ante parameters.

B.6.3. Ex ante calculation of emission reductions

The baseline emission factor was calculated ex-ante in a transparent and conservative manner as a combined margin (CM) consisting of an average of the operating margin (OM) and the build margin (BM), according to the procedures prescribed in the Tool to calculate the emission factor for an electricity system and explained in section B.6.1.

Emission Reductions
The estimated annual Emission Reductions (ER) for the Project were calculated as follows:

$$ER_y = BE_y - PE_y$$

ER_y : Emission reductions in year y (tCO_2)

BE_y : Baseline Emissions in year y(tCO_2)

PE_y : Project Emissions in year y(tCO_2)

I. Project Emissions (PE_y)

For most renewable energy project activities, project emissions are neglected, and following the methodology as the Project is a run-of-the-river project, it does not lead to any GHG emissions; therefore project emissions are considered equal to zero.

$$PE_y = 0$$

Leakage
As mentioned in section B.6.1., following the applied methodology no leakage emissions are considered.

Baseline Emissions
The baseline emission is calculated as the product of the electrical energy baseline $EG_{BL,y}$ expressed in MWh, produced by the renewable generating unit and multiplied by the grid emission factor:

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

Where:
BE_y : Baseline Emission in year y (tCO_2).
$EG_{PJ,y}$: 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 CO2 emission factor for grid connected power generation in year y calculated using the latest version of the Tool to calculate the emission factor for an electricity system (tCO_2/MWh).

Calculation of $EG_{PJ,y}$
The calculation of $EG_{PJ,y}$ is different for (a) Greenfield plants, (b) retrofits and replacements, and (c) capacity additions. The case of the project activity is described next:
Due to the fact that the Project involves the installation of a new grid-connected renewable power plant/unit at a site where no renewable power plant was operated prior to the implementation of the project activity (Case (a) Greenfield plant), then:

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

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

Net electricity generation as a result of the project activity is calculated as an "approximation" of the total electricity that the Project would have generated in a year. The net electricity generation is estimated to be 147,215 MWh per year.
$EG_{facility,y}$ = *147,215 MWh per year*
$EG_{PJ,y} = EG_{facility,y}$ = *147,215 MWh per year.*

Calculation of emission factor (EF) of the national electricity grid

As explained in section B.6.1 and using the Tool to calculate the emission factor for an electricity system, the CO_2 emission factor for the displacement of electricity generated by power plants in an electricity system was obtained by calculating the "operating margin", "build margin" and "combined margin", which include the following 6 steps:

Step 1: Identify the relevant electric power system

The electricity generation will be supplied to the National Interconnected Electric Grid (SEIN), therefore the Project will displace electricity from the SEIN. Hence, the identified electricity power system is the SEIN.

The SEIN is the only electric grid in Peru. Therefore, it is the only grid that covers the national territory. It disaggregates in four main geographic zones (North, Middle North, Center and South) that are interconnected by transmission lines to form the national grid named SEIN[59]. There are no regional systems in South America.

If the SEIN exports or imports electricity in the future, this information will be used in the grid emission calculation process as per stated in the Tool to calculate the emission factor for an electricity system.

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

Because the data of grid connected power plants is available, Option I will be chosen for calculating the grid emission factor

Step 3: Select a method to determine operating margin (OM)
Out of four options for the OM, the Dispatch Data Analysis OM (OM -DD) was selected. The Simple OM method cannot be used since low cost, must-run resources constitute more than 50% of total grid generation in Peru[60]. Furthermore, it was not necessary to use either the Simple Adjusted OM approach or the Average OM approach because detailed dispatch data is available.

[59] Reference Electricity Plan 2008-2017, page 6.

[60] COES Annual Statistics Report (2010). Table Nº 2.2A. According to this table, thermal generation in 2010 totalled 13,462.27 GWh, which represents 41.52% of total generation; while, hydro generation totalled 18,964.56 GWh, which represents 58.48% of total generation. Therefore, low cost must-run resources constitute more than 50% of total grid generation in Peru. http://www.coes.org.pe/wcoes/coes/estadistica/estadanual.aspx - Web link last accessed on 10/10/2011.

Step 4: Calculate the operating margin (OM) emission factor according to the selected method

For this calculation the hourly generation in 2011 was used, as it was the most recent data available. At the time that the Project's baseline study was completed, the hourly generation data did not yet exist for one entire year. Therefore, it was assumed that the project activity will generate 140,440 MWh/year. Considering this assumption, the variables were defined as follows:

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

$$EF_{grid,OM\text{-}DD,y} = (\Sigma_h EG_{PJ,h} * EF_{EL,DD,h}) / EG_{PJ,y}$$

Where:

EF $_{grid,OM\text{-}DD,y}$: Dispatch data analysis operating margin CO_2 emission factor in year y tCO_2/MWh).

EG $_{PJ,h}$: Electricity displaced by the project activity in hour h of year y (MWh).

EF $_{EL,DD,h}$: CO_2 emission factor for grid power units in the top of the dispatch order in hour h in year y (tCO_2/MWh).

EG $_{PJ,y}$: Total electricity displaced by the project activity in year y (MWh).

h : Hours in year y in which the project activity is displacing grid electricity.

y : Year in which the project activity is displacing grid electricity.

The hourly emissions factor is determined based on the energy efficiency of the power unit and the fuel type used. The electricity displaced by the Project activity is estimated to be 147,215 MWh per year.

$EG_{PJ,y}$ is an "estimation" of the total electricity generated by the Project in 2011.

$EG_{PJ,y}$ = 147,215 MWh

$EG_{PJ,h}$ is an "approximation" of the total electricity generated by the Project in each hour of 2011. It was calculated by dividing the Project's estimated generation by 8,760 hours in a year.

$EG_{PJ,h}$ = 147,215 / 8,760

$EG_{PJ,h}$ = 16.805 MWh

The emission factor for power units at the top of the dispatch order in each hour is calculated as follows:

$EF_{EL,DD,h} = (\Sigma_n EG_{n,h} * EF_{EL,n,y}) / \Sigma_n EG_{n,h}$

Where:

EF $_{EL,DD,h}$: CO_2 emission factor for the power units at the top of the dispatch order in hour h in year y (tCO_2/MWh).

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

EF $_{EL,n,y}$: CO_2 emission factor of the power unit n in year y (tCO_2/MWh).

n : Power units at the top of the dispatch order.

h : Hours in year y in which the project activity is displacing grid electricity.

To determine the set of grid power units n that are at the top of the dispatch order 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 generation by grid power plants during that hour h.

To calculate the emission factor of the power unit ***(EF $_{EL,m,y}$)***, the formula 3 of the Tool to calculate the emission factor for an electricity system was used (option A2).

$$EF_{EL,m,y} = (EF_{CO2,m,y,i} * 3.6) / \eta_{m,y}$$

Where:

EF $_{EL,m,y}$: CO_2 emission factor of power unit m in year y (tCO_2/MWh).
EF $_{CO2,m,y,i}$: Average CO_2 emission factor of fuel type i used in power unit m in year y (tCO_2/GJ)[61] .
$\eta_{m,y}$: Average net energy conversion efficiency of power unit m in year y (ratio).
m : All power units serving the grid in year y except low-cost/must-run power units.
y : Applicable year during monitoring (ex-post option).

Using the above formula, each emission factor has been calculated for all thermal plants, and the following table shows the $EF_{EL,m,y}$ of the all thermal units of the SEIN.

Table 9: Emission Factors for Thermal Units in the SEIN in the year 2011

POWER UNITS	TECHNOLOGY	FUEL	$\eta_{m,y}$ (%)(1)	$EF_{CO2,m,i,y}$ (2) KgCO2/TJ	$EF_{EL,m,y}$ (3) (tCO_2/MWh)
AGUAYTÍA TG1	gas turbine / natural gas	natural gas	30.3%	54,300	0.6444
AGUAYTÍA TG2	gas turbine / natural gas	natural gas	30.1%	54,300	0.6499
BELLAVISTA ALCO	diesel 2 / residual	diesel 2	31.2%	72,600	0.8388
BELLAVISTA MAN1	diesel 2 / residual	diesel 2	38.0%	72,600	0.6874
CHICLAYO OESTE	diesel 2 / residual	diesel 2	35.8%	72,600	0.7292
CHILCA1 TG1	gas turbine / natural gas	natural gas	35.2%	54,300	0.5559
CHILCA1 TG2	gas turbine / natural gas	natural gas	34.5%	54,300	0.5658
CHILCA1 TG3	gas turbine / natural gas	natural gas	33.2%	54,300	0.5891
CHILINA SULZ12	diesel 2 / residual	diesel 2	39.3%	72,600	0.6648
CHILINA TV2	steam turbine / residual	residual 500	21.0%	46,200	0.7918
CHILINA TV3	steam turbine / residual	residual 500	22.6%	46,200	0.7351
CHIMBOTE TG1	gas turbine / diesel	diesel 2	22.7%	72,600	1.1498
CHIMBOTE TG3	gas turbine / diesel	diesel 2	23.5%	72,600	1.1116
CICLO COMBINADO	combined cycle gas - steam turbine	Diesel 2	28.3%	72,600	0.9242
HUAYCOLORO	gas turbine/landfill gas	landfill gas	39.5%	46,200	0.4211
ILO1 CATKATO	diesel 2 / residual	diesel 2	41.7%	72,600	0.6268
ILO1 TG1	gas turbine / diesel	diesel 2	30.3%	72,600	0.8617
ILO1 TG2	gas turbine / diesel	diesel 2	32.7%	72,600	0.8001
ILO1 TV2	steam turbine / residual	residual 500	33.2%	46,200	0.5004
POWER UNITS	**TECHNOLOGY**	**FUEL**	**$\eta_{m,y}$ (%)(**	**$EF_{CO2,m,i,y}$ (2)**	**$EF_{EL,m,y}$ (3) (tCO_2/MWh)**

[61] Obtained from the IPCC default values at the lower limit of the uncertainty at a 95% confidence as provided in table 1.4 of Chapter 1 of Vol.2 of the "2006 IPCC Guidelines on National GHG Inventories", because no available national data can be obtained.

				KgCO2/TJ	
1. ILO1 TV3	steam turbine / residual	residual 500	35.3%	46,200	0.4712
2. ILO1 TV4	steam turbine / residual	residual 500	33.4%	46,200	0.4973
3. ILO2 TV1	steam turbine / coal	coal	40.0%	87,300	0.7861
4. INDEPENDENCIA	gas turbine / natural gas	natural gas	37.5%	54,300	0.5207
5. KALLPA TG1	gas turbine / natural gas	natural gas	33.3%	54,300	0.5865
6. KALLPA TG2	gas turbine / natural gas	natural gas	33.6%	54,300	0.5817
7. KALLPA TG3	gas turbine / natural gas	natural gas	33.8%	54,300	0.5776
8. LAS FLORES	gas turbine / natural gas	natural gas	30.8%	54,300	0.6357
9. MALACAS TG1	gas turbine / natural gas	natural gas	19.4%	54,300	1.0102
10. MALACAS TG2	gas turbine / natural gas	natural gas	21.6%	54,300	0.9059
11. MALACAS2 TG4	gas turbine / natural gas	natural gas	27.5%	54,300	0.7114
12. MOLLENDO	diesel 2 / residual	residual 500	42.7%	46,200	0.3897
13. OQUENDO	cogeneration / natural gas	natural gas	33.6%	54,300	0.5826
14. PISCO TG1	gas turbine / natural gas	natural gas	27.7%	54,300	0.7055
15. PISCO TG2	gas turbine / natural gas	natural gas	27.9%	54,300	0.7016
16. PIURA 1	diesel 2 / residual	diesel 2	35.7%	72,600	0.7315
17. PIURA 2	diesel 2 / residual	diesel 2	30.4%	72,600	0.8604
18. PIURA TG	gas turbine / diesel	diesel 2	19.8%	72,600	1.3172
9. SAN NICOLAS CUMMINS	diesel 2 / residual	diesel 2	37.9%	72,600	0.6896
20. SAN NICOLÁS TV1	steam turbine / residual	residual 500	28.4%	46,200	0.5858
21. SAN NICOLÁS TV2	steam turbine / residual	residual 500	28.9%	46,200	0.5761
22. SAN NICOLÁS TV3					

	steam turbine / residual	residual 500	29.7%	46,200	0.5602
23. SANTA ROSA TG8	gas turbine / natural gas	natural gas	34.5%	54,300	0.5660
24. SANTA ROSA UTI5	gas turbine / natural gas	natural gas	28.7%	54,300	0.6804
25. SANTA ROSA UTI6	gas turbine / natural gas	natural gas	26.7%	54,300	0.7312
26. SANTA ROSA WTG TG7	gas turbine / natural gas	natural gas	30.5%	54,300	0.6413
27. TAPARACHI	gas turbine / diesel	diesel 2	35.2%	72,600	0.7429
28. TRUJILLO NORTE	diesel 2 / residual	diesel 2	37.9%	72,600	0.6898
29. TUMBES	diesel 2 / residual	diesel 2	44.1%	72,600	0.5932
30. VENTANILLA CICLO COMBINADO	combined cycle gas turbine	natural gas	50.5%	54,300	0.3874

The information on the hourly generation of all plants in the SEIN and their associated emission factors was entered using Excel software and organized in columns where the position of the columns was determined by the monthly grid dispatch merit order. This organization helped identify the plants that fall within the top x% of grid dispatch order each hour of the year. The resulting DDA-OM emission factor was calculated as follows: $EF_{grid,OM\text{-}DD,y} = (\Sigma_h EG_{PJ,h} * EF_{EL,DD,h}) / EG_{PJ,y}$

$EF_{grid,OM\text{-}DD,y}$ = 106,321.17 / 147,215

$EF_{grid,OM\text{-}DD,y}$ = 0.72222 tCO_2/ MWh

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

The build margin emissions factor is the generation-weighted average emission factor (tCO_2/MWh) of all power units m during the most recent year y for which power generation data is available, calculated as follows:

$EF_{grid,BM,y} = (\Sigma_m EG_{m,y} * EF_{EL,m,y}) / \Sigma_m EG_{m,y}$

Where:

$EF_{grid,BM,y}$: Build margin CO_2 emission factor in year y (tCO_2/MWh).
$EG_{m,y}$: Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh).
$EF_{EL,m,y}$: CO_2 emission factor of power units m in year y (tCO_2/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, for BM calculations the sample group of power units m used should be determined as per the following procedure, consistent with the data vintage 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 ($SET_{5\text{-}units}$) and determine their annual electricity generation ($AEG_{SET\text{-}5\text{-}units}$, in MWh);
(b) Determine the annual electricity generation of the project electricity system, excluding power units registered as CDM project activities ($AEG_{total,}$ 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 AEG $_{total}$ (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) (SET $_{\geq 20\%)}$ and determine their annual electricity generation (AEG $_{SET-\geq 20\%,}$ in MWh);
(c) From SET $_{5\text{-units}}$ and SET $_{\geq 20\%}$ select the set of power units that comprises the larger annual electricity generation (SET $_{sample}$); Identify the date when the power units in SET $_{sample}$ started to supply electricity to the grid. If none of the power units in SET $_{sample}$ started to supply electricity to the grid more than 10 years ago, then use SET $_{sample}$ to calculate the build margin. Ignore steps (d), (e) and (f).

Out of SET $_{5\text{-units}}$ and SET $_{\geq 20\%,}$ the latter group was selected as SET $_{sample}$ due to the fact that it includes the larger annual electricity generation.

Moreover, none of these power plants started to supply energy to the grid more than ten years ago.

Table 10: Capacity addition in the SEIN (2006-2011)

POWER PLANT	Date of Entry to SEIN	Technology	Installed Capacity (MW)	2011 Energy Generation (GWh)
PISCO TG1	Oct-10	Gas Turbine/Natural Gas	37.40	139.30
INDEPENDENCIA	Oct-10	Diesel/Natural Gas	22.93	97.35
PISCO TG2	Sep-10	Gas Turbine/Natural Gas	37.40	161.76
SANTA CRUZ II	Jun-10	Hydro	7.00	33.32
LAS FLORES	May-10	Gas Turbine/Natural Gas	192.50	296.40
POECHOS II	Apr-10	Hydro	10.00	54.66
RONCADOR	Apr-10	hydro	3.80	19.46
EL PLATANAL	Mar-10	Hydro	220.00	1,224.11
KALLPA TG3	Mar-10	Gas Turbine/Natural Gas	233.00	1,538.51
PARAMONGA	Mar-10	Gas Turbine/Biomass	23.00	84.31
LA JOYA	Oct-09	Hydro	10.00	27.08
SANTA ROSA TG8	Sep-09	Natural Gas turbine	200.00	971.63
CHILCA1 TG3	Aug-09	Natural Gas turbine	199.80	827.42
TRUJILLO NORTE	Jul-09	Diesel 2 / Residual	64.00	151.77
KALLPA TG2	Jun-09	Natural Gas turbine	216.00	1,359.04
OQUENDO	Mar-09	Natural Gas turbine	31.00	134.68
SANTA CRUZ I	Feb-09	Hydro	7.00	27.43
CAÑA BRAVA	Feb-09	Hydro	5.31	27.82
CARHUAQUERO	May-08	Hydro	10.00	76.66

IV				
CHILCA1 TG2	Jul-07	Natural Gas Turbine	180.00	1,001.80
KALLPA TG1	Jul-07	Natural Gas Turbine	180.00	1,096.10
CHILCA1 TG1	Dec-06	Natural Gas Turbine	180.00	1,001.32
VENTANILLA TG 3 & TG 4 & TV	Oct-06	Combined cycle	522.00	3,435.87
SANTA ROSA UTI 6	Aug-06	Natural Gas Turbine	59.60	52.73
SANTA ROSA UTI 5	Jun-06	Natural Gas Turbine	59.60	60.80
SANTA ROSA I	Jan-06	Hydro	1.02	0.00

In the table above it can be seen that most of the additions to the SEIN are thermal generation units, and that even the larger power plants are thermal. However, to identify the SETsample power plants ($SET_{5\text{-}units}$, $SET_{\geq 20\%}$) and calculate de BM, the CDM registered projects should be excluded (El Platanal, La Joya, Santa Cruz I, Santa Cruz II and Poechos II), therefore the set of five power plants built most recently that are considered to calculate the BM are: Pisco TG1, Pisco TG2, Independencia, Roncador and Las Flores.

The $SET_{5\text{-}units}$ power plants have an annual generation of 714.28 GWh, which represents 2.03% of the total annual generation (35,218.83 GWh). The annual generation of $SET_{\geq 20\%}$ power plants is 6,787.12 GWh, which represents 22.4%; therefore the second group was selected to calculate the BM. In the following table it is shown how the SET_{sample} power plants have been chosen to calculate the BM

Power Plant	***Date of Entry To SEIN***	***Plant Type***	***Most recent year generation (GWh)***	***Most recent year generation (%)***	***AEG $_{SET\geq 20\%}$ (GWh)***	***$SET_{\geq 20\%}$ (%)***	***$AEG_{SET\text{-}5\text{-}units}$ (GWh)***	***$AEG_{SET\text{-}5\text{-}units}$ (%)***
PURMACANA	Mar-11	Hydro	3.68	0.01%	3.68	0.01%	3.68	0.01%
PISCO TG1	Sep-10	Natural Gas turbine	139.30	0.46%	142.99	0.47%	139.30	0.47%
INDEPENDENCIA	Oct-10	Diesel/Natural Gas	97.35	0.32%	240.34	0.79%	97.35	0.79%
PISCO TG2	Sep-10	Gas Turbine/ Natural Gas	161.76	0.53%	402.10	1.33%	161.76	1.33%
LAS FLORES	May-10	Gas Turbine/Natural Gas	296.40	0.98%	698.50	2.31%	296.40	2.31%
RONCADOR	Apr-10	hydro	19.46	0.06%	717.96	2.37%		
KALLPA TG3	Mar-10	Natural Gas turbine	1,538.51	5.08%	2,256.47	7.45%		
PARAMONGA	Mar-10	Biomass	84.31	0.28%	2,340.78	7.73%		
SANTA ROSA TG8	Sep-09	Natural Gas turbine	971.63	3.21%	3,312.4	10.93 %		

					1			
CHILCA1 TG3	Aug-09	Natural Gas turbine	827.42	2.73%	4,139.84	13.66 %		
TRUJILLO NORTE	Jul-09	Diesel 2 / Residual	151.77	0.50%	4,291.61	14.17 %		
KALLPA TG2	Jun-09	Natural Gas turbine	1,359.04	4.49%	5,650.65	18.65 %		
OQUENDO	Mar-09	Natural Gas turbine	134.68	0.44%	5,785.33	19.10 %		
CHILCA1 TG2	Jul-07	Natural Gas Turbine	1,001.80	3.31%	6,787.12	22.40 %		
KALLPA TG1	Jul-07	Natural Gas Turbine	1,096.10	3.62%				

Due to the fact that the SET $_{sample}$ is SET $_{\geq 20\%}$ power plants, the BM is calculated as follows:
According to the Tool to calculate the emission factor for an electricity system, the BM is calculated using the following formula:

$$EF_{grid,BM,y} = (\Sigma_m EG_{m,y} * EF_{EL,m,y}) / \Sigma_m EG_{m,y}$$

Where:
$EF_{grid,BM,y}$: Build margin CO_2 emission factor in year y (tCO_2/MWh).
$EG_{m,y}$: Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh).
$EF_{EL,m,y}$: CO_2 emission factor of power unit m in year y (tCO_2/MWh).
m : Power units included in the build margin.
y : Most recent historical year for which power generation data is available.

To calculate the BM, the selected set of plants (SET $_{\geq 20\%)}$ was organized according to their annual generation output (the annual generation was provided by COES) and the corresponding emission factor (the emission factor of the power plants included in the BM was calculated using option A2 for the simple OM). Using the formula, the BM is 0.57717 tCO_2/MWh.

$\Sigma_m EG_{m,y}$= 6,787,122.05
$\Sigma_m EG_{m,y} * EF_{EL,m,y}$ = 3,917,341.21
$EF_{grid,BM,y}$ = 3,917,341.21/ 6,787,122.05
$EF_{grid,BM,y}$ = 0.57717 tCO2/MWh

Table 12: BM Calculation

SET $_{sample}$ (SET $_{\geq 20\%)}$	EG $_{m,y}$ (MWh)	EF $_{EL,m,y}$ (tCO_2/MWh)
PURMACANA	3,683.49	0.00000
PISCO TG1	139,303.78	0.70554
INDEPENDENCIA	97,352.36	0.52067
PISCO TG2	161,759.90	0.70157
LAS FLORES	296,400.01	0.63567
RONCADOR	19,461.73	0.00000
KALLPA TG3	1,538,511.34	0.57756
PARAMONGA	84,307.67	0.00000
SANTA ROSA TG8	971,634.49	0.56603

CHILCA1 TG3	827,423.17	0.58907
TRUJILLO NORTE	151,774.14	0.68976
KALLPA TG2	1,359,037.48	0.58170
OQUENDO	134,675.71	0.58259
CHILCA1 TG2	1,001,796.79	0.56579

$\Sigma EG_{m,y} X EF_{EL,m,y}$	3,917,341.21
$\Sigma EG_{m,y}$	6,787,122.05
$EF_{grid,BM,y}$	**0.57717**

Step 6: Calculate the combined margin (CM) emission factor
The Baseline Emission Factor was calculated as a CM, which is the simple average[62] of the OM and the BM. All margins are expressed in tCO_2/MWh.

$$EF_{grid,CM,y} = (EF_{grid,OM,y} * W_{OM}) + (EF_{grid,BM,y} * W_{BM})$$

$EF_{grid,CM,y}$ = ($EF_{grid,OM,y}$ * 0.5) + ($EF_{grid,BM,y}$ * 0.5)
$EF_{grid,CM,y}$ = (0.72222 * 0.5) + (0.57717 * 0.5)
$EF_{grid,CM,y}$ = 0.64969 tCO_2/MWh
The resulting Baseline Emission Factor ($EF_{grid,CM,y}$) for the year 2011 is 0.64969 tCO_2/MWh

Calculation of Project's Emission Reductions Prior to Validation

I. Project emissions (PE_y)

PE_y = 0 tCO_2e/year

II. Leakage

Following the applied methodology, leakage was not considered.

III. Baseline emissions (BE_y)

The baseline emission is calculated as the product of the electrical energy generation that is produced and fed into the grid as a result of the implementation, $EG_{PJ,,y}$ (expressed in MWh), produced by the renewable generating unit and multiplied by the grid emission factor.

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

Where

BE_y : Baseline Emission in year y (tCO_2).
$EG_{PJ,y}$: 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 calculated using the latest version of the Tool to calculate the emission factor for an electricity system (tCO_2/MWh).

[62] The default weights of 50%-50% were kept

Due to the fact that the Project involves the installation of a new grid-connected renewable power plant/unit at a site where no other renewable power plant was operated prior to the implementation of the project activity, then:

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

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).

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

Net electricity generation as a result of the project activity is calculated as an "approximation" of the total electricity that the Project would have generated in 2011. The net electricity generation is estimated to be 140,440 MWh per year.

$EG_{facility,y} = 147,215$ MWh

$EG_{PJ,y} = EG_{facility,y} = 147,215\ 0$ MWh

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

$BE_y = 147,215\ 0$ MWh * 0.64969

$BE_y = 95,644\ tCO_2/year$

Emission Reductions (ER_y)

Finally, the emission reductions are:

$ER_y = BE_y - PE_y$

$ER_y = 95,644 – 0$

$ER_y = 95,644\ tCO_2/year$

B.6.4. Summary of ex ante estimates of emission reductions

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
01/06/2016 to 31/12/2016	47,822	0[63]	0	47,822
01/01/2017 to 31/12/2017	95,644	0	0	95,644
01/01/2018 to 31/12/2018	95,644	0	0	95,644
01/01/2019 to 31/12/2019	95,644	0	0	95,644
01/01/2020 to 31/12/2020	95,644	0	0	95,644
01/01/2021 to 31/12/2021	95,644	0	0	95,644
01/01/2022 to 31/12/2022	95,644	0	0	95,644
01/01/2023 to 31/05/2023	47,822	0	0	47,822
Total	669,508	0	0	669,508

[63] In the registered PDD, baseline emissions were erroneously mentioned as project emissions but in this document, this has been corrected

Total number of crediting years	7			
Annual average over the crediting period	95,644	0	0	95,644

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data/Parameter	$EG_{Gross,y}$
Data unit	MWh
Description	Gross electricity supplied by the project to the grid in year y
Source of data	On site (measured by an electricity meter: Transferencias i.e. REGISTROS DE MEDIDORES EN BORNES DE GENERACIÓN CADA 15 MINUTOS DE POTENCIA ACTIVA (MW) (English Translation - RECORDS OF METERS IN GENERATION TERMINALS EVERY 15 MINUTES OF ACTIVE POWER (MW))
Value(s) applied	147,215
Measurement methods and procedures	The project will use a bidirectional meter that will measure the gross electricity supplied to the grid by the project activity. Therefore, the gross electricity supplied to the grid will be measured continuously and recorded at least each hour. A high level of accuracy of the measurements will be achieved due to the use of high-precision equipment. The project electricity meter is an electronic device with a precision class of 0.2 (as required by COES)[64]. The meters will be located at the power plant substation. The proportion of data to be monitored is 100% and the data will be archived electronically.
Monitoring frequency	Daily
QA/QC procedures	Measuring equipment will be verified with calibrated pattern or calibrated according to relevant industry standards or national regulation[65]. COES requirements in Peru on energy meter[66] specifies meter requirements like Precision class: 0.2 and ability to measure (amongst other data) active and reactive energy, though it does not specify anything on meter calibration frequency. However, the technical specification [67] of energy meter by manufacturer says that the meter self-calibrates in every 10 seconds; hence no meter calibration records are required or the meter does not to be calibrated by any external agency. The meter readings are cross-checked with records of electricity sold as available from official reports (COES statistics)[68]
Purpose of data	Calculation of baseline emissions
Additional comment	Data will be kept for at least two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later. Complete

[64] COES Procedure No. 20, Annex C, page 20. See http://www.coes.org.pe/coes/Procedimientos/procedimientos.asp - Web link last accessed on14/06/2012.

[65] At the moment the verification regulation is RM Nº 496-2005-MEM/DM from the Ministry of energy and Mines. This regulation does not set the periodicity of the verification

[66] PROCEDIMIENTO TECNICO COES - PR-20. Page 135, Section 3.1

[67] https://electroind.com/products/Nexus_1500+/pdf/brochures/Nexus-1500+-Meter-Brochure_E154718.pdf

[68] https://www.coes.org.pe/Portal/Publicaciones/Estadisticas/ (for sample sheet - Estadisticas Anuales - 2017 - 01 EXCEL - 08 - PRODUCCIÓN CON ENERGÍAS RENOVABLES EN EL SEIN - 8.4 A , Comité de Operación Económica del Sistema Interconectado Nacional (COES SINAC), a company operating mainly in the Electric Power sector in Peru. The National Interconnected System Financial Operation Committee (COES) is a private Peruvian nonprofit organization made up of generators, distributors, and free users)

	information of every year during the crediting period will be available from the COES during the first six months of the following year.

Data/Parameter	$EG_{Aux,y}$
Data unit	MWh
Description	The quantity of auxiliary electricity consumption in the CDM project activity in year y
Source of data	On site (measured by an electricity meter: Transferencias i.e. REGISTROS DE MEDIDORES EN BORNES DE GENERACIÓN CADA 15 MINUTOS DE LOS SERVICIOS AUXILIARES (MW) (English Translation - RECORDS OF METERS IN GENERATION TERMINALS EVERY 15 MINUTES OF THE AUXILIARY SERVICES (MW))
Value(s) applied	0
Measurement methods and procedures	The project will use a unidirectional meter that will allow to measure the auxiliary electricity consumed by the Project (in case the Project consumes electricity from the grid). Therefore, the auxiliary electricity consumed by the project will be measured continuously and recorded at least each hour. A high level of accuracy of the measurements will be achieved due to the use of high-precision equipment. The project electricity meter is an electronic device with a precision class of 0.42 (as per manufacturer's specification). ~~required by COES~~). The project will measure the auxiliary consumption and auxiliary consumption data will be subtracted from gross electricity generated in the project activity to get the net electricity supplied to grid by the project activity. The proportion of data to be monitored is 100% and the data will be archived electronically.
Monitoring frequency	Daily
QA/QC procedures	Measuring equipment will be verified with calibrated pattern as per manufacturer's specifications. ~~or calibrated according to relevant industry standards or national regulation – according to COES requirements in Peru . COES requirements in Peru on energy meter[69] specifies meter requirements like Precision class: 0.2 and ability to measure (amongst other data) active and reactive energy, though it does not specify anything on meter calibration frequency. As per manufacturer, meter accuracy class is 0.4s and Moreover, the technical specification of energy meter by manufacturer[70] says that the meter is factory calibrated. However,~~ manufacturer's recommendation says that the interval between two calibrations should be twenty-four months. The auxiliary consumption data are obtained from records of meter in generation terminals every 15 minutes of auxiliary services (MW) as recorded onsite. ~~that is approved by COES. COES data is authentic data for auxiliary power consumption.~~
Purpose of data	Calculation of baseline emissions
Additional comment	Data will be kept for at least two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later. Complete information of every year during the crediting period will be available from the COES during the first six months of the following year.

Data/Parameter	**$EG_{facility,y}$**
Data unit	MWh
Description	The quantity of net electricity supplied to grid by the CDM project activity in year y
Source of data	On site (measured by an electricity meter: Transferencias i.e. RECORDS OF

~~69 "PROCEDIMIENTO TECNICO COES - PR-20". Page 135, Section 3.1~~

~~70 "Multimedidor Eléctrico MMW02 Manual de Operación & Instalación", Section 9.3, page 58,~~

	METERS IN GENERATION TERMINALS EVERY 15 MINUTES OF ACTIVE POWER (MW) and AUXILIARY SERVICES (MW)
Value(s) applied	147,215
Measurement methods and procedures	This is a calculated parameter. $\mathbf{EG_{facility,y}} = EG_{Gross,y} - EG_{Aux,y}$
Monitoring frequency	Continuous monitoring and Monthly recording
QA/QC procedures	Not applicable as this is a calculated parameter
Purpose of data	For the calculation of baseline emissions
Additional comments	Data will be kept for at least two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later. Complete information of every year during the crediting period will be available from the COES during the first six months of the following year.

Data/Parameter	$EF_{grid, CM, y}$
Data unit	tCO_2e / MWh
Description	CO_2 emission factor of the grid electricity in year y.
Source of data	COES records and project developer records.
Value(s) applied	0.64969
Measurement methods and procedures	This value is calculated. A combined margin (CM) will be used, 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". This is included for reference purposes as in the ex-post calculation this monitoring parameter should be monitored each year during the crediting period, as per the "Tool to calculate the Emission Factor for an electricity system".
Monitoring frequency	Annual
QA/QC procedures	Calculated using data available (emission factors and annual statistics), that is monitored 100% by COES.
Purpose of data	Calculation of baseline emissions
Additional comment	Data will be kept for at least two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later.

Data/Parameter	$EG_{PJ, h}$
Data unit	MWh
Description	Electricity displaced by the project activity in hour h of year y.
Source of data	Project records and/or COES.
Value(s) applied	Data used is presented in the spreadsheet for "Grid Emission Factor calculation"
Measurement methods and procedures	Directly measured and/or based on the information provided by COES. The proportion of data to be monitored is 100% and the data will be archived electronically.
Monitoring frequency	Data will be monitored every 15 minutes and aggregated in an hourly and annual basis.
QA/QC procedures	Information of invoices of electricity sold to the grid will be cross-checked with metered information and/or COES information. To ensure consistency, if applicable other records may be used if necessary
Purpose of data	Calculation of baseline emissions
Additional comment	Data will be kept for at least two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later.

Data/Parameter	$EG_{n, h}$
Data unit	MWh
Description	Electricity generated and delivered to the grid by power units n in hour h.
Source of data	Project records and/or COES.

Value(s) applied	Data used is presented in the spreadsheet for "Grid Emission Factor calculation
Measurement methods and procedures	Directly measured and/or based on the information provided by COES. The proportion of data to be monitored is 100% and the data will be archived electronically.
Monitoring frequency	Annual
QA/QC procedures	Data will be monitored every 15 minutes and aggregated in an hourly and annual basis.
Purpose of data	Calculation of baseline emissions
Additional comment	Data will be kept for at least two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later.

Data/Parameter	$EG_{m,y}$
Data unit	MWh
Description	Net quantity of electricity generated and delivered to the grid by power unit m in year y.
Source of data	Data provided by COES.
Value(s) applied	Data used is presented in the spreadsheet for "Grid Emission Factor calculation"
Measurement methods and procedures	The proportion of data to be monitored is 100% and the data will be archived electronically.
Monitoring frequency	Annual
QA/QC procedures	Is official data
Purpose of data	Calculation of baseline emissions
Additional comment	Data will be kept for at least two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later.

Data/Parameter	$\eta_{m,y}$
Data unit	--
Description	Average net energy conversion efficiency of power unit m in year y (ratio).
Source of data	Data provided by COES.
Value(s) applied	Data used is presented in the spreadsheet for "Grid Emission Factor calculation"
Measurement methods and procedures	Each year this data will be checked with the last available annual report of COES. The proportion of data to be monitored is 100% and the data will be archived electronically.
Monitoring frequency	Annual
QA/QC procedures	If the data used is significantly lower than the default value of the applicable technology, project proponents 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	Calculation of baseline emissions
Additional comment	Data will be kept for at least two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later..

Data/Parameter	$EF_{CO2,m,i,y}$
Data unit	tCO_2/GJ
Description	Average CO_2 emission factor of fuel type i used in power unit m in year y.
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) applied	Data used is presented in the spreadsheet for "Grid Emission Factor calculation"
Measurement methods and procedures	--

Monitoring frequency	Annual
QA/QC procedures	Every update of IPCC reports will be taken into account.
Purpose of data	Calculation of baseline emissions
Additional comment	Data will be kept for at least two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later. There is no information provided by the fuel supplier of the power plants in invoices, or regional or national average default values, therefore IPCC default values are suitable for these parameters.

B.7.2. Sampling plan

Not applicable. The project will not implement a sampling approach to the data and parameters monitored in section b.7.1

B.7.3. Other elements of monitoring plan

The monitoring methodology follows the ACM0002 definition, which states that "the monitoring shall consist of metering the electricity generated by the renewable energy technology." However, for more accuracy the emission factor will be calculated ex-post according to the *Tool to Calculate the Emission Factor for an Electricity System*.

The Project activity will need special monitoring equipment. The project will implement a Monitoring Plan and use pre-programmed spreadsheets for the emission reduction calculation. The Project Proponent will define a person responsible for the monitoring of the entire data required. Three main participants are identified for the MP, being:

- The Operation Department: Obligated to ensure that sufficient and accurate information is available to calculate ERs in a transparent manner, and that adequate information is collected and maintained to facilitate verification of accounted ERs.
- The Maintenance provider: Maintenance and calibrations of the measuring equipment will be developed as required by the methodology with a specialized firm, and will follow applicable requirements of the COES as well as manufacturer's specifications.
- General Manager: The General Manager will have final responsibility for all aspects related to data measurements and the monitoring of data recordings.

COES, the dispatch center, will provide the data for the annual ex-post calculation of the Project's ERs, and the energy generation of the Project will be provided by the Project developer. Further details of the MP are available in Appendix 5.

SECTION C. Start date, crediting period type and duration

C.1. Start date of project activity

15/01/2013
This is the date when the access roads contracts are expected to be signed.

C.2. Expected operational lifetime of project activity

50 years[71]

[71] (Empresa Eléctrica Agua Azul S.A., 2011) Project Profile: Potrero Hydropower Plant.

C.3. Crediting period of project activity

C.3.1. Type of crediting period

Renewable crediting period – first period.

C.3.2. Start date of crediting period

01/06/2016

C.3.3. Duration of crediting period

7 years, with two renewable periods.

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

In the case of Peru, according to the updated Electric Concessions Law (Law No. 25844), for the development of hydroelectric power plants of over 500 kW a concession is required (Article 3), however when the generation is undertaken with renewable resources and is less than 20MW, the presentation of an Environmental Impact Assessment (EIA) is not required (Article 38) as only a Sworn Declaration related to environmental conservation has to be submitted to the Ministry of Energy and Mines as part of the File submitted for the concession approval [68] . Nevertheless, the project owner is developing an Environmental Impact Declaration DIA for the proper management of any environmental impact[69]. In addition, as part of the Project's implementation process, the Hydrological Study undertaken for the National Water Authority (ANA) contemplates by law[70] a social and environmental description.

Potential environmental impacts identified by the DIA are not considered to be significant. A summary of them are listed below:

Construction Stage

- Air quality. Non-significant impacts due to emissions, noise and electromagnetic radiation.
- Top soil loss, quality and compression. Minor impacts since permanent facilities are located over a reduced size of land and are temporal.
- Water quality. Non-significant impacts since water flows are not near the project and the use is of small magnitude.
- Vegetation, flora and fauna alteration. Minor impact due to the magnitude of the affected area and the area in use during the construction. There are no protected species.
- Temporal and permanent landscape alteration. Minor impact due to the magnitude of the facilities. Are of small magnitude and reversible.
- There is no impact on potential archeological remains in the project site.
- There is no major impact on the social activities since the project is not developed near communities.
- Generation of temporal job opportunities and increase in the economic dynamic of the surrounding areas since they have the opportunity to provide different services.
- Economic use of land

Operation Stage

- Air quality. Non-significant impacts from emissions, noise and electromagnetic radiation due to maintenance since these are sporadic.
- Soil quality. Impacts are considered of small magnitude, scope and intensity.
- Water quality and availability. The project will not reduce the water quality and availability during operation and any potential contamination is made not near water sources.

- Flora and fauna. Not significant impact since the project location has minimal vegetation and has local fencing for the installations (that are close to the access roads).
- Landscape alteration for the presence of the facilities considered not significant due to the magnitude of them.
- Archeological remains. The impact is not existent.
- There is no major impact on the social activities since the project will operate in a confined area near communities.
- Local job creation for complementary services during the operation and maintenance of the power plant and increment of economic dynamics due to improvements in energy supply.

A set of mitigation, restoration, prevention and maximization measures are part of the DIA in development in order to minimize negative impacts and increase the effects of the positive ones. In addition, a Monitoring Plan, a Contingency Plan and an Abandonment Plan are detailed.

The hydrological study contemplates a water analysis that concludes that the current characteristics are optimal for hydro generation and that the ecological flow of the river is 4.3 m^3/s. In addition, the study states that the project will benefit the local economy, increase local incomes, the environmental impact is considered not significant: the project will not modify the natural watercourse, will not create a reservoir, is not located in a protected area or over existing archeological remains. In addition between the water intake and devolution points, there are no productive activities using water for agriculture or industrial purposes.

Finally, transmission line's impacts are assessed in a separate basis. The Energy Concession Law considers that a concession is needed when the transmission facilities impact governmental assets and /or require the use of easement (right of way) for its implementation (Article 3o). In these cases, the regulation requires the approval of an Environmental Impact Assessment (Article 25o). The Ministry of Energy and Mines (MINEM) will have the final decision about the necessity to submit an EIA or a DIA (according to the specific characteristics of the project). The project will have to develop an EIA in order to be operative[74].

D.2. Environmental impact assessment

The EIA developed for the project (not required by law as stated in section D.1) is in progress and the Results will be updated during the validation process.

SECTION E. Local stakeholder consultation

E.1. Modalities for local stakeholder consultation

The project developer has presented the project activity to the local stakeholders since the beginning. During the hydrological study, a resume of the approval request document was published in the local newspapers, local Municipalities and other facilities[75].

To organize the Local Stakeholder Consultation of Potrero Hydropower project, informative posters were located in public places. A public announcement was made through the local newspaper on March 2nd, 2012[76] and a local radio network. Seventeen authorities and representatives of the communities received a written invitation for the workshop on February 28th. The public consultation was held on the Municipality of Eduardo Villanueva on Wednesday March 14th, 2012 at 11:00 am.

During this meeting, the project developer shared information on climate change, the greenhouse gas effects, the Clean Development Mechanism and the environmental and social benefits of the Project, as well as a technical explanation of the Project.

They then listened to the concerns of the more than 200 inhabitants that attended the workshop (local authorities, community leaders and population). All the information gathered from the meeting and the responses given were compiled.

The workshop was developed in a context of social conflict between a mining project[77] and the habitants of Cajamarca, therefore the number of assistants were more than expected since they considered it was a mining conference (more than 200 assistants). As a result, the inhabitants did not signed an assistance list (fear of the final destination of the list with their names and signatures[78]). After an initial negative reaction of the assistants, they listened to the project presentations and participated with their comments and doubts. At the end, there was a consensus with local authorities and community leaders that the project will have a positive impact in the municipality (a record was sign by them) and they agreed to have a second Workshop to allow the habitants of Eduardo Villanueva Municipality bring proposals and improve the Social Investment Plan in coordination with the representatives of Empresa Eléctrica Agua Azul S.A.. All the details of the process will be available to the DOE by request.

E.2. Summary of comments received

The Project has been received positively by the local stakeholders since they understood that the project is independent from the mining company in conflict with the people and that will not reduce the water availability in the region. The stakeholders' concerns and questions were discussed and answered thoroughly in this first workshop. The main topics discussed were:

- Description of the project owner (considering that the stakeholders have social problems with mining companies). The project developer explained that the owner is a non-mining company, only developing renewable energy projects.
- Relation of the project with the other dam project and with the mining project "La Morena" in La Libertad Region. The project developer explained that there is no relation with these projects.
- Information about the final use of the energy and impact in the water availability for irrigation and human consumption. The project developer explained that the electricity is for the national interconnected grid (not directly to any mine), will use a low amount of water (approved by the National Water Authority) and that the water is not consumed nor polluted.
- Existence of a mitigation plan in case of droughts (will they stop the operations of the plant?). The project developer explained that there is an ecological flow that has to be respected during the project operation.
- Effects in water quality for inhabitants of the low part of the watershed. The project developer explained that that the water is not consumed nor polluted.
- Development of additional workshops in different locations. The project developer agreed on having future additional workshops to improve the communication with the stakeholders.

As a result of this consultation process the local authorities considered that the project does not have significant impacts since it is a renewable energy project. They agreed to support the implementation of the CDM Project. Since the project is in and early state and is developed in parallel with social conflicts with mining companies in the region, the stakeholders requested additional workshops in order to understand better the project conditions and impacts. As evidence of the workshop, there is an Act signed by local stakeholder's main authorities

E.3. Consideration of comments received

The comments of the local stakeholders were taken into account and have been considered in the elaboration project development. The project owner made clear that Empresa Eléctrica Agua Azul S.A. is a private company not related to Mining Companies, and that their business line is electrical generation that will be injected to the National Interconnected System. During the event, the Project Owner clarified about low effects on water availability, as the project will only use 18 cubic meters of the river´s water flow, which has much higher water flow.

The project owner is developing an Environmental Impact Declaration (DIA) even when this is not requested by law in for the proper management of any environmental impact (see Section D.1) and this document will have formal approval by the Ministry of Energy and Mines. Therefore, there will be formal information (in addition to the hydrological study) to corroborate that the project is not having significant impact in the environment and water quality or flow.

The project owner has committed to develop additional workshops in order to continue a communicational regime during the project implementation process and improve the formulation of a Social Investment Plan with them. These commitments with the local stakeholders are subject to the Project's registration as a CDM project activity. At this moment, the social investment plan of the project considers a US$ 115,000 budget during the construction for water facilities in the local communities and a minimum budget of around US$ 57,000 per operative year for improvement activities in the education and health facilities, and the implementation of different social projects.

SECTION F. Approval and authorization

The LoA was issued in July 9th, 2012 by the Peruvian DNA (Ministry of Environment – MINAM).

PERÚ | Ministerio del Ambiente | Vice Ministerio de Desarrollo Estratégico de los Recursos Naturales | Dirección General de Cambio Climático, Desertificación y Recursos Hídricos

"Decenio de las Personas con Discapacidad en el Perú"
"Año de la Integración Nacional y el Reconocimiento de Nuestra Diversidad"

July 09th, 2012

LETTER Nº 179-2012-DGCCDRH/DVMDERN/MINAM

Mr.
POMPEYO AGUIRRE PÉREZ
General Manager
Empresa Eléctrica Agua Azul S.A.
Av. La Encalada 1275 – Of. 1105
Santiago de Surco -

Dear Mr. Aguirre:

On behalf of the Designated National Authority of Peru for the Kyoto Protocol, I am pleased to inform you our positive opinion for the project submitted under File N° 09472-2012, on Mary 24th 2012, "*Potrero Hydropower Plant, Peru*" in order to continue the project cycle approval for the Clean Development Mechanism of the Kyoto Protocol. It has been verified that the project contributes to national sustainable development and harmonizes with Peru's national environmental policy.

Through this letter of approval, the transfer of certified emission reductions by the requesting company to the correspondent Annex B Party of the Kyoto Protocol as a result of the voluntary CDM project activities, is voluntarily accepted and authorized. In this regard, *"Empresa Eléctrica Agua Azul S.A."* is recognized and authorized as a participant for the CDM project *"Potrero Hydropower Plant, Peru"*.

This document should be used with no other purposes that to be submitted as part of the prerequisite for registration with the Clean Development Mechanism Executive Board of the Kyoto Protocol, that was ratified by the Peruvian Government in Congressional Resolution N° 27824 (2002).

This letter of approval will not be valid if the project presented by designated operational entity is not validated by the Executive Board of the Clean Development Mechanism.

Sincerely yours,

Eduardo Durand López-Hurtado
General Director
Department of Climate Change,
Desertification and Water Resources.
Ministry of Environment.

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San Isidro, Lima 27, Perú
T. (511) 611 6000

Appendix 1. Contact information of project participants

Organization name	Empresa Eléctrica Agua Azul S.A.
Country	Peru
Address	La Encalada 1257, of. 1105, Lima 33, Peru
Telephone	511-4340966
Fax	511-4377659
E-mail	eherrera@aluzcleanenergy.com
Website	---
Contact person	Mr. Enrique Soria Herrera

Appendix 2. Affirmation regarding public funding

The Project has not received, and will not receive any type of public funding or public financial help.

Appendix 3. Applicability of methodologies and standardized baselines

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Appendix 4. Further background information on ex ante calculation of emission reductions

BASELINE INFORMATION

The table below shows EFELs calculations with actual 2011 Net Energy Conversion Efficiency (NECs) from the Annual Statistics (Estadística Anual de Operaciones) developed by COES. In the monitoring, EFELs should be updated using the latest Annual Statistics.

EFELs calculations 2011

POWER UNITS	TECHNOLOGY	FUEL	$\eta_{m,y}$ (%) (1)	$EF_{CO2,m,i,y}$ (2) KgCO2/TJ	$EF_{EL,m,y}$ (3) (tCO_2/MWh
AGUAYTÍA TG1	GAS TURBINE / NATURAL GAS	NATURAL GAS	30.3%	54,300	0.6444
AGUAYTÍA TG2	GAS TURBINE / NATURAL GAS	NATURAL GAS	30.1%	54,300	0.6499
BELLAVISTA ALCO	DIESEL2 / RESIDUAL	DIESEL 2	31.2%	72,600	0.8388
BELLAVISTA MAN1	DIESEL 2 / RESIDUAL	DIESEL 2	38.0%	72,600	0.6874
CHICLAYO OESTE	DIESEL 2/RESIDUAL	DIESEL 2	35.8%	72,600	0.7292
CHILCA1 TG1	GAS TURBINE / NATURAL GAS	NATURAL GAS	35.2%	54,300	0.5559
CHILCA1 TG 2	GAS TURBINE / NATURAL GAS	NATURAL GAS	34.5%	54,300	0.5658
CHILCA1 TG 3	GAS TURBINE / NATURAL GAS	NATURAL GAS	33.2%	54,300	0.5891
CHILINA SULZ12	DIESEL 2/RESIDUAL	DIESEL	39.3%	72,600	0.6648

CHILINA TV2	STEAM TURBINE / RESIDUAL	RESIDUAL 500	21.0%	75,500	1.2940
CHILINA TV3	STEAM TURBINE / RESIDUAL	RESIDUAL 500	22.6%	75,500	1.2013
CHIMBOTE TG1	GAS TURBINE / NATURAL GAS	DIESEL 2	22.7%	72,600	1.1498
CHIMBOTE TG3	GAS TURBINE / NATURAL GAS	DIESEL 2	23.5%	72,600	1.1116
CICLO COMBINADO	COMBINED CYCLE GAS - STEAM TURBINE	DIESEL 2	28.3%	72,600	0.9242
HUAYCOLORO	GAS TURBINE/LANDFILL GAS	LANDFILL GAS	39.5%	46,200	0.4211
ILO1 CATKATO	DIESEL 2/RESIDUAL	DIESEL 2	41.7%	72,600	0.6268
ILO1 TG1	GAS TURBINE / DIESEL	DIESEL 2	30.3%	72,600	0.8617
ILO1 TG2	GAS TURBINE / DIESEL	DIESEL 2	32.7%	72,600	0.8001
ILO1 TV2	STEAM TURBINE / RESIDUAL	RESIDUAL 500	33.2%	75,500	0.8177
ILO1 TV3	STEAM TURBINE / RESIDUAL	RESIDUAL 500	35.3%	75,500	0.7700
ILO1 TV4	STEAM TURBINE / RESIDUAL	RESIDUAL 500	33.4%	75,500	0.8126
ILO1 TV1	STEAM TURBINE / COAL	RESIDUAL 500	40.0%	87,300	0.7861
INDEPENDENCIA	GAS TURBINE / NATURAL GAS	NATURAL GAS	37.5%	54,300	0.5207
KALLPA TG1	GAS TURBINE / NATURAL GAS	NATURAL GAS	33.3%	54,300	0.5865
KALLPA TG2	GAS TURBINE / NATURAL GAS	NATURAL GAS	33.6%	54,300	0.5817
KALLPA TG3	GAS TURBINE / NATURAL GAS	NATURAL GAS	33.8%	54,300	0.5716
LAS FLORES	GAS TURBINE / NATURAL GAS	NATURAL GAS	30.8%	54,300	0.6357
MALACAS TG1	GAS TURBINE / NATURAL GAS	NATURAL GAS	19.4%	54,300	1.0102
MALACAS TG2	GAS TURBINE / NATURAL GAS	NATURAL GAS	21.6%	54,300	0.9059
MALACAS 2TG4	GAS TURBINE / NATURAL GAS	NATURAL GAS	27.5%	54,300	0.7114
MOLLENDO	DIESEL 2 / RESIDUAL	RESIDUAL 500	42.7%	75,500	0.6368
OQUENDO	COGENERATION / NATURAL GAS	NATURAL GAS	33.6%	54,300	0.5826
PISCO TG1	GAS TURBINE / NATURAL GAS	NATURAL GAS	27.7%	54,300	0.7055
PISCO TG2	GAS TURBINE / NATURAL GAS	NATURAL GAS	27.9%	54,300	0.7016
PIURA 1	DIESEL 2 / RESIDUAL	DIESEL 2	35.7%	72,600	0.7315
PIURA 2	DIESEL 2 / RESIDUAL	DIESEL 2	30.4%	72,600	0.8604

PIURA TG	GAS TURBINE / DIESEL	DIESEL 2	19.8%	72,600	1.3172
SAN NICOLAS CUMMINS	DIESEL 2 / RESIDUAL	DIESEL 2	37.9%	75,500	0.6896
SAN NICOLAS TV 1	STEAM TURBINE / RESIDUAL	RESIDUAL 500	28.4%	75,500	0.9574
SAN NICOLAS TV 2	STEAM TURBINE / RESIDUAL	RESIDUAL 500	28.9%	75,500	0.9414
SAN NICOLAS TV 3	STEAM TURBINE / RESIDUAL	RESIDUAL 500	29.7%	75,500	0.9154
SANTA ROSA TG8	GAS TURBINE / NATURAL GAS	NATURAL GAS	34.5%	54,300	0.5660
SANTA ROSA UTI 5	GAS TURBINE / NATURAL GAS	NATURAL GAS	28.7%	54,300	0.6804
SANTA ROSA UTI 6	GAS TURBINE / NATURAL GAS	NATURAL GAS	26.7%	54,300	0.7312
SANTA ROSA WTG TG7	GAS TURBINE / NATURAL GAS	NATURAL GAS	30.5%	54,300	0.6413
TAPARACHI	GAS TURBINE / DIESEL	DIESEL 2	35.2%	72,600	0.7429
TRUJILLO NORTE	DIESEL 2 / RESIDUAL	DIESEL 2	37.9%	72,600	0.6898
TUMBES	DIESEL 2 / RESIDUAL	DIESEL 2	44.1%	72,600	0.5932
VENTANILLA CICLO COMBINADO	COMBINED CYCLE GAS TURBINE	NATURAL GAS	50.4%	54,300	0.3874

(1) CD COES data 2011: Efficiency
http://www.coes.org.pe/wcoes/coes/estadistica/estadanual.aspx
(2) IPCC default values

The table above includes the emission factor formulas. Actual NECs, as well as data on technology and fuel, were obtained from COES. All this data was publicly available by COES and is published at the COES website in its annual statistics.

Justification of the usage of COES information system data for baseline calculation:
The baseline calculation disregarded the data that is not collected by COES and deemed COES data to be the best approximation of total SEIN data on both generation and installed capacity additions. It was also deemed to be the best data to allow a good monitoring practice because of two reasons:
1. There is no better quality data on generation in the SEIN than what is being presently collected by COES. Information on plants connected to the SEIN but not registered with COES regarding generation and installed capacity additions is provided by the plants' management periodically to the MINEM. However, this data does not pass through a verification or validation process, nor is it required to comply with technical standards as rigorously as COES requires from the power plants that are its own members;

2. The limitations of MINEM's final annual reports and data availability would not allow for good monitoring practice.

Appendix 5. Further background information on monitoring plan

This report presents the Monitoring Plan (MP) for the Project activity. The MP defines a standard against which the performance in terms of the Project's ERs will be monitored, following the selected methodology ACM0002 (version 12.3.0) and in compliance with all relevant requirements

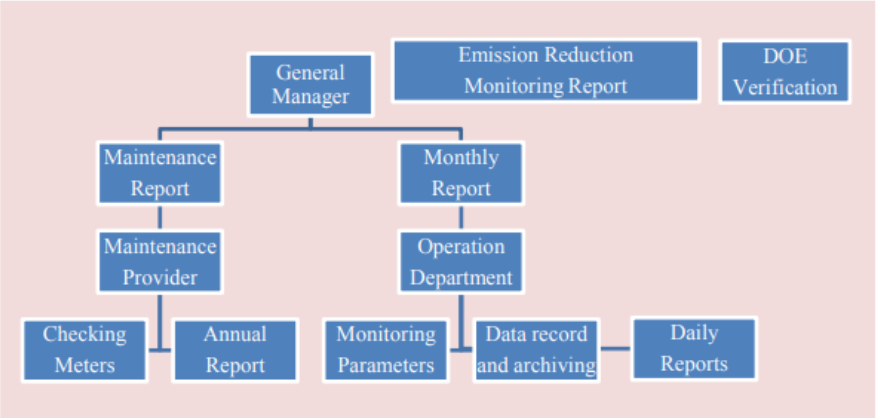
of the CDM of the Kyoto Protocol. Both the Baseline and the MP are subject to monitoring procedures.

The MP identifies key performance indicators of the Project activity and sets out the procedures for metering, monitoring and calculating the ERs generated by the Project activity annually. Adherence to the instructions in the MP is necessary for the project operator to successfully measure and track the impact of the Project activity, and to prepare all data required for the periodic audit and verification process that must be undertaken to confirm the attainment of the corresponding ERs.

Organizational:

The following figure outlines the operational and management structure that the project proponent will implement to monitor the emission reductions generated by the project activity. The Project Proponent will define a person responsible for the monitoring of the entire data required.

Organization Monitoring



Appendix 6. Summary report of comments received from local stakeholders

Please refer to Section E.2 and E.3

Appendix 7. Summary of post-registration changes

The following revisions have been done in registered PDD and submitted for Post-Registration Changes according to Type of Changes

Type of Change	Reason for change	Changes in PDD
Corrections	1.As the CDM PDD template changes from the time of preparation of registered PDD to the time of preparing revised PDD for addressing Post-registration Changes	1. Editorial changes as per PDD Template version 11.0
	2. As the project activity underwent some permanent	2. Revised general description of the project activity in Section A.1 in order to

	changes during project implementation stage, these changes need to be addressed in Section A.1 in general description of the project 3. There has been a change in information regarding issuance of Letter of Approval from host country from the registered PDD and this change has to be mentioned in shown in PDD	justify the changes occurred during project implementation stage. 3.Change in the statement regarding Letter of Approval (LoA) from host country in Section F.
Change in Project Design	1.Project design change has taken place through the change in technical specification for some cases viz. turbine capacity, generation capacity and turbine speed has changed and due to change in installed capacity, estimated net annual electricity generation has also changed – these changes need to be mentioned in PDD 2.The change in project installed capacity has an impact on project financial indicators and these change have to be mentioned in PDD 3. The change in project installed capacity results in change in estimated net electricity generation and hence the estimated emission reductions calculation – these changes have to be presented in PDD	1. Revised technical description in Section A.3. as per changes in project design. Change of each turbine nominal capacity from 9.95 MW to 10.228 MW. Addition of generator capacity as 11590 KVA and change of total installed capacity from 19.9 MW to 20.86 MW. Turbine speed corrected as 600 RPM. Changes in net electricity generation due to change in capacity and subsequently emission reductions are changed. 2. Revised description of establishment of project additionality in Section B.5. in accordance with changes in financial indicators for the project. 3. Revision in Section B.6.3 and B.6.4 due to change in $EG_{PJ,y}$ and BE_y in accordance with the change in project design.
Change in Monitoring Plan	1. As per the actual site-practice the monitoring parameters include gross electricity generation and auxiliary electricity consumption along with the net electricity generation – these changes took place after registration of project activity in CDM – in order to reflect these changes the list of monitored parameters in Section B.7.1 of PDD have to be revised. 2.The actual practice of calibration(calibration frequency) of energy meter for measuring gross electricity generation is different from registered PDD – hence this change needs to addressed in PDD 3. There is an inclusion of auxiliary electricity consumption in the list of monitored parameters in PDD and the calibration of	1. Inclusion of Monitoring Parameter $EG_{gross,y}$ and $EG_{aux,y}$ in Section B.7.1 in accordance with the change in monitoring plan. $EG_{facility,y}$ is difference of $EG_{gross,y}$ and $EG_{aux,y}$. 2. For Gross Electricity meter which is self-calibrated and hence no any calibration records required. Calibration frequency for Gross Electricity meter is mentioned as Meter self-calibrates every 10 seconds. 3. For Auxiliary electricity meter, calibration frequency is mentioned as 24 months as per Manufacturers recommendation.

	auxiliary energy meter (monitoring equipment for auxiliary electricity consumption) is as per Manufacturer's specification – these changes need to address in PDD. 4. The invoices of project are mentioned as amount in soles (host country currency) and electricity quantity (gross and auxiliary electricity) are not mentioned	4. The cross checking source for gross energy is revised from invoices to records of sold electricity as invoices does not mention electricity quantity.

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In accordance with CDM Project Cycle Standard Version 02.0 para 242, the impacts of the changes to the to the registered CDM project activity on the key project parameters have been explained below:

Criteria	Impact of the change in CDM project activity
The applicability and application of the applied methodologies, the applied standardized baselines and the other applied methodological regulatory documents with which the project activity has been registered;	The change in the CDM project activity (change in installed capacity from 19.9 MW to 20.86 MW) does not impact the applicability of the methodology – the installed capacity of the project after post registration change is 20.86 MW that is still above 15MW (the threshold of small-scale project activity) and the project activity supplies electricity (generated from renewable source) to grid – hence the methodology along with methodological regulatory documents is still applicable to this project.
The compliance of the monitoring plan with the applied methodologies, the applied standardized baselines and the other applied methodological regulatory documents	The change in the CDM project activity (project monitoring plan) does not impact the compliance of the monitoring plan with the applied methodologies, the applied standardized baselines and the other applied methodological regulatory documents - the monitoring methodology follows the ACM0002 definition, which states that "the monitoring shall consist of metering the electricity generated by the renewable energy technology.", after change to the project activity, the monitoring still

	consist of metering the electricity generated by the renewable energy technology.
The level of accuracy and completeness in the monitoring of the project activity compared with the requirements contained in the registered monitoring plan	The change in the CDM project activity does not impact the level of accuracy and completeness in the monitoring of the project activity compared with the requirements contained in the registered monitoring plan – the change in the CDM project activity includes change in calibration frequency of monitoring equipment, but it is in accordance with the national regulation of host country and manufacturer's specification, so the level of accuracy and completeness in the monitoring of the project activity maintained in the monitoring plan after change in the CDM project activity
The additionality of the project activity	Project IRR (without CER) of the CDM project after the change in project capacity (10.82%) is still well below the benchmark IRR (12.0%); in sensitivity analysis also, with the variation of +/- 10% of the selected parameters, project IRR remains below the benchmark in all cases but one (in case of -10% of initial investment, project IRR exceeds benchmark to some extent but as the project has undergone change in installed capacity, the decrease of initial investment by 10% is very unlikely, hence sensitivity analysis after the change in project also show that project IRR does not exceed benchmark IRR even after variation in key parameters). Besides, common practice analysis considering the increase in installed capacity also shows that the project is not a common practice. Considering these two points, it can be concluded that the change in CDM project does not impact the additionality of the project activity
The scale of the project activity	Project installed capacity after the change is 20.86 MW - hence the project falls in the category of large-scale project and it was a large scale before the change as well, so the change in project does not impact the scale of the project activity

There are two other ~~is another~~ Post Registration Change related to monitoring plan that would go in issuance track. As per para 1.c of Appendix (Indicative list of post-registration changes that may be suitable for approval under the issuance track) of "CDM project standard for project activities" version ~~these~~02.0 these corrections are being submitted under issuance track.~~:~~

Reason for Change	Change in PDD
1. There is a correction~~deviation~~ in accuracy	1. The description of Measurement methods

class of monitoring equipment for the parameter Quantity of Auxiliary Electricity Consumption. ~~from that mentioned in PDD.~~	and procedures and QA/QC procedures for parameter $EG_{AUX,y}$ i.e. Quantity of Auxiliary Electricity Consumption has been revised in section B.7.1 of PDD– the accuracy class is in accordance with the manufacturer's specification (i.e. 0.4~~s~~).
2. There is a correction in QA/QC procedures of the parameter Quantity of Auxiliary Electricity Consumption ~~from that mentioned in PDD~~ with regard to source of data.	2. QA/QC procedures of the parameter Auxiliary Electricity Consumption has been revised in section B.7.1 of PDD.

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Document information

Version	*Date*	*Description*
11.0	31 May 2019	Revision to: • Ensure consistency with version 02.0 of the "CDM project standard for project activities" (CDM-EB93-A04-STAN); • Make editorial improvements.
10.1	28 June 2017	Revision to make editorial improvement.
10.0	7 June 2017	Revision to: • Improve consistency with the "CDM project standard for project activities" and with the PoA-DD and CPA-DD forms; • Make editorial improvement.
09.0	24 May 2017	Revision to: • Ensure consistency with the "CDM project standard for project activities" (CDM-EB93-A04-STAN) (version 01.0); • Incorporate the "Project design document form for small-scale CDM project activities" (CDM-SSC-PDD-FORM); • Make editorial improvement.
08.0	22 July 2016	EB 90, Annex 1 Revision to include provisions related to automatically additional project activities.
07.0	15 April 2016	Revision to ensure consistency with the "Standard: Applicability of sectoral scopes" (CDM-EB88-A04-STAN) (version 01.0).
06.0	9 March 2015	Revision to: • Include provisions related to statement on erroneous inclusion of a CPA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Provisions related to the Host Party; • Make editorial improvement.

Version	*Date*	*Description*
05.0	25 June 2014	Revision to: • Include the Attachment: Instructions for filling out the project design document form for CDM project activities (these instructions supersede the "Guidelines for completing the project design document form" (Version 01.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and Appendix 1; • Change the reference number from F-CDM-PDD to CDM-PDD-FORM; • Make editorial improvement.
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.
04.0	13 March 2012	Revision required to ensure consistency with the “Guidelines for completing the project design document form for CDM project activities” (EB 66, Annex 8).
03.0	26 July 2006	EB 25, Annex 15
02.0	14 June 2004	EB 14, Annex 06b
01.0	03 August 2002	EB 05, Paragraph 12 Initial adoption.

Decision Class: Regulatory
Document Type: Form
Business Function: Registration
Keywords: project activities, project design document