CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)
Version 03 - in effect as of: 22 December 2006

CONTENTS

Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
03	22 December 2006	• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.

SECTION A. General description of small-scale project activity

A.1 Title of the small-scale project activity:

Title: Ventana, Suba and Usaquen hydroelectric CDM bundled project
Version: 01.0
Date: 24/02/2012

A.2. Description of the small-scale project activity:

The project activity contemplates the production of clean hydroelectric power using a flow of water by means of the installation of three small run-of-river hydroelectric plants (Ventana, Suba and Usaquen) with a total installed capacity of 11.48 MW, in the water supply system of Bogota, Department of Cundinamarca. The energy generated will be sold to the National Interconnected System of Colombia.

For each power plant to be installed, the water will be derived from the main conduction pipeline (potable water supply system) in the point adjacent to the flow control valve. The derivation will be made by the installation of an accessory, driving the water through a closed steel pipeline, to a pressurized conduction penstock and up to the distributor where the flow is directed to horizontal Francis turbines. Each turbine will be hosted in a power house, with their respective generators, valves and control panels. A power substation will be located besides each power house. As the project plants are run-of-river hydro taking water from an existing water supply system, it is not necessary to build a reservoir.

The project will generate electricity for the colombian power grid without greenhouse gas (GHG) emissions. The power plants will have a net installed capacity of 7 MW (Ventana), 2.64 MW (Suba) and 1.8 MW (Usaquen), with an estimated power supply to the grid of 46,506 MWh, 19,965 MWh, and 12,350 MWh per year, respectively. Thus, the project will increase the supply of electricity to the grid, partially displacing thermal generation with a renewable source of energy, and consequently reducing GHG emissions. The project will reduce 29,544 tCO_2e/year and totaling, for the first crediting period (7 years), an approximate reduction of 206,811 tCO_2e.

The project is being implemented by Empresa de Acueducto y Alcantarillado de Bogotá (EAAB), a public utility created in 1995 with the purpose of managing the water supply and wastewater treatment in Bogotá. The design, engineering, construction and installation of the project is carried out by the engineering company Consorcio Generación Bogotá.

The participants of the project recognize that this project activity is helping Colombia to fulfil its goals of promoting sustainable development. Furthermore, the project is in line with host-country specific clean development mechanism (CDM) requirements because of the following reasons:

- replacement of fossil fuels for energy generation, resulting in the reduction of GHG and other pollutants that affect people's health;
- increase of electricity generation from renewable sources;
- increase of the reliability of the Colombian Power System;
- positive social impacts due to new employment during the construction, operation, and maintenance of the project activity;
- adequate and sustainable use of hydrological resources;
- additional public revenue which will generate local and national benefits

A.3. Project participants:

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Colombia (host) accessed the Kyoto Protocol on 2001	*Empresa de Acueducto y Alcantarillado de Bogotá, EAAB. (Public Company)*	*NO*
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party (ies) involved is required.		

A.4. Technical description of the small-scale project activity:

A.4.1. Location of the small-scale project activity:

A.4.1.1. Host Party(ies):

Colombia

A.4.1.2. Region/State/Province etc.:

Department of Cundinamarca

A.4.1.3. City/Town/Community etc:

Municipalities of Guasca and Bogota

A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale project activity:

The project is composed by three hydroelectric power plants which will use potable water in different points along the potable water supply system of Bogota. Two points of use are located in Bogota and one in the municipality of Guasca, Department of Cundinamarca. The geographical location of each hydroelectric power plant (coordinates UTM for generation units location) are:

- Ventana hydroelectric power plant:

Geo-coordinates		Town	Department
East	125,986	Guasca	Cundinamarca
North	111,411		

- Suba hydroelectric power plant:

Geo-coordinates		Town	Department
East	99,354	Bogota	Cundinamarca
North	112791		

- Usaquen hydroelectric power plant:

Geo-coordinates		Town	Department
East	104,364	Bogota	Cundinamarca
North	110,629		

The geographical project location is showed in the following figure.

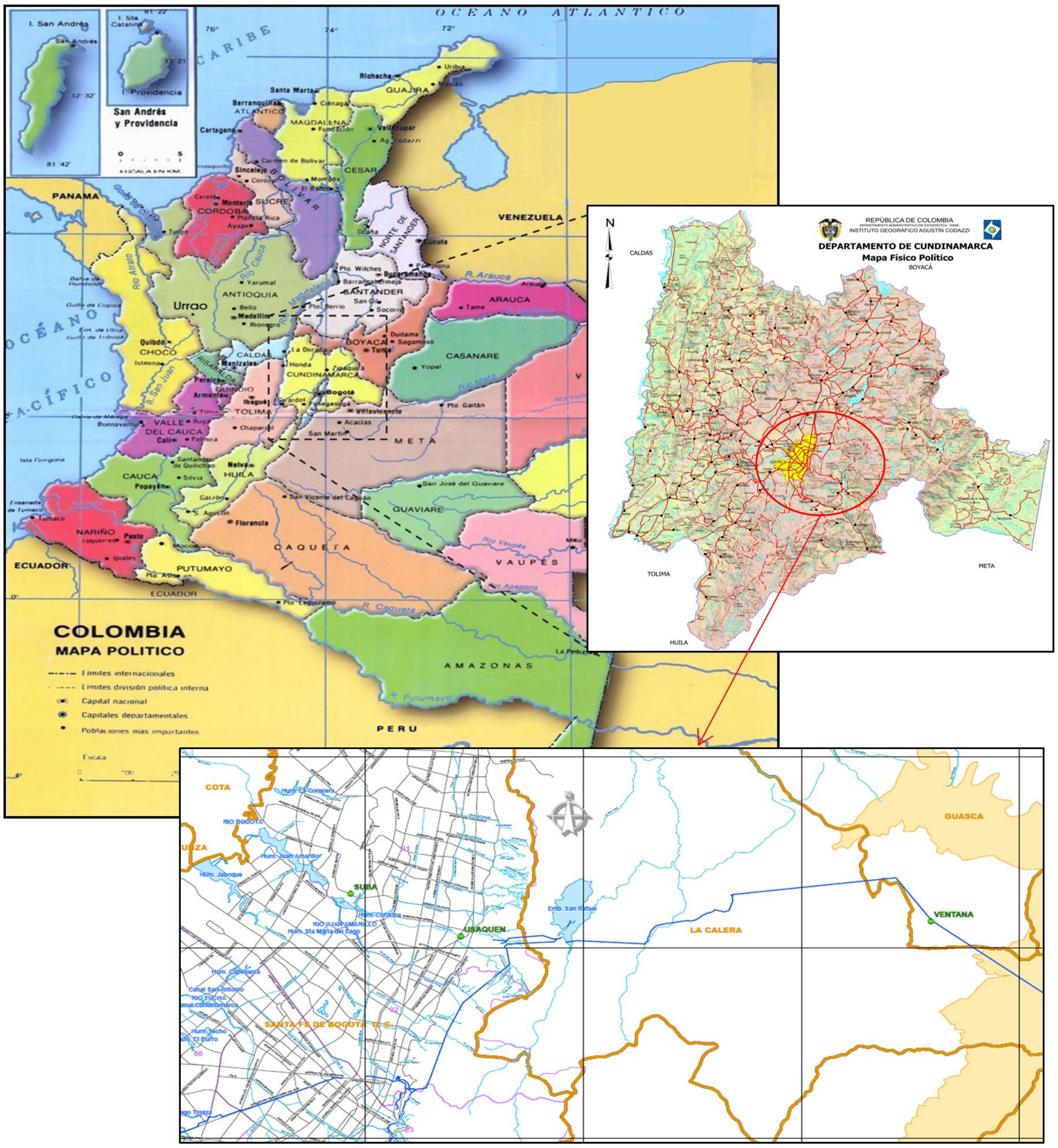

Figure: Geographical project location

A.4.2. Type and category (ies) and technology/measure of the small-scale project activity:

Type and category of the project:

The project to be implemented by EAAB falls under the following category:

- For the energy generation, the project is "small scale" (having less than 15 MW of installed capacity) with total installed capacity of 8.64 MW (sum of capacities of all hydroelectric power plants considered by the project), and falls under CDM sectoral scope 1 (energy industries - renewable/non-renewable sources), type I renewable energy project, category I.D grid connected renewable energy generation, according to the Appendix B of the Simplified Modalities and Procedures for Small Scale CDM project activities.

Technology/measure of the project:

The potable water supply system of Bogota is currently composed of three subsystems: supply, treatment and distribution. The supply subsystem collects, transports and stores untreated water. The water is stored through small reservoirs that supply the water treatment plants. This subsystem treats the water so that it may be delivered to users in the required quality. The main treatment plants are Wiesner, Tibitoc and Dorado, providing the 98% of the water required by the city and surrounding municipalities.

The distribution subsystem is responsible for transporting the treated water from the treatment plants to its final users. As this subsystem controls the water flow, it is responsible for controlling the hydraulic energy of the water (potential and kinetic), through structures that reduce pressure (PRS). PRS use dissipation valves to reduce water pressure in the system and regulate the flow to the storage and distribution tanks.

PRS use pressure reducing valves with electric and manual controls. EAAB identified the PRS that have adequate hydraulic conditions to make small hydroelectric uses by the replacement of the dissipation valves with turbines that could turn the hydraulic energy of the water into electricity.

Considering all the above information, the project considers the installation of three small run-of-river power plants in different PRS along the potable water supply system of Bogota, to replace dissipation valves. The PRS included in the project are Ventana, Suba and Usaquen (each PRS will host one power plant).

For each power plant being built, the following conditions have been defined:

Ventana hydroelectric power plant[1]

The power plant will be underground at the left side of the Howell-Bunger valve. An excavation will be necessary to install a penstock of 2.5 m diameter, before the valve house that will host the power house (includes the turbine, generator, valves and other fittings). Water will leave the power house through a 2.5 m diameter pipeline returning to the original flow. Since the project will use the existing valve house, the Howell-Bunger valve will be relocated.

[1] Document PCH-VTN-GE-VAR-006 "Informe de diseño PCH Ventana", 2011. Consorcio Generación Bogota.

Technical characteristics of the equipment:

Turbine: Francis, horizontal axis
Generator: synchronous
Nominal flow: 11.58 m^3/s
Design net head: 68.44 m
Nominal power: 7.04 MW
Energy to be delivered: 46,506 MWh/año

Suba hydroelectric power plant[2]

This plant will be located northwest of Bogota, in the control structure upstream the Suba tank and parallel to the valves house that contains two polijet valves. The power plant will be installed in parallel to the current dissipation pressure system. The plant will have a pressure pipe for the conveyance of water (flow diversion), a hydraulic turbine and a return pipe to deliver the water to the original flow (acting as a by-pass). It requires the construction of a surface powerhouse and the installation of a hydro-pneumatic control system (e.g. to handle overpressure during turbine startups). The connection to the National Interconnected System will be at the Morato substation (11.4 kV), owned by CODENSA, the city power utility.

Technical characteristics of the equipment:

Turbine: Francis horizontal axis
Generator: synchronous
Nominal flow: 5.64 m^3/s
Design net head: 45.36 – 52.18 m
Nominal power: 2.64 MW
Energy to be delivered: 19,965 MWh/año

Usaquen hydroelectric power plant[3]

This plant will be located northeast of Bogota, at the control structure Usaquen, downstream the control station Santa Ana. The power plant will be installed in parallel to the current dissipation pressure system (valves house). The plant will have a pressure pipe for the conveyance of water (flow diversion), a hydraulic turbine and a return pipe to deliver the water to the original flow (acting as a by-pass). As the turbine-generator will be located in the site where the pumping system of Usaquen was previously located, it will not be necessary to build a powerhouse. In addition, a hydro-pneumatic control system will be installed to ensure a smooth operation. The connection National Interconnected System will be made at the Usaquen substation (11.4 kV), owned by CODENSA.

Technical characteristics for the equipment:

Turbine: Francis horizontal axis
Generator: synchronous.
Nominal flow: 2.85 m^3/s
Design net head: 71.50 m.

[2] Document PCH-SUB-GE-VAR-005 "Informe de diseño PCH Suba", 2010. Consorcio Generación Bogota.
[3] Document PCH-USQ-GE-VAR-004 "Informe de diseño PCH Usaquen", 2010. Consorcio Generación Bogota

Nominal power: 1.80 MW
Energy to be delivered: 12,350 MWh/año

Project monitoring technology

For all three power plants (Ventana, Suba and Usaquen), the monitoring technology will be in compliance with national regulations (Resolution 025, 1995 - Measurement Code). Each energy measurement will be through two bidirectional energy meters of 0.2 accuracy, which comply with standards ANSI C12.20-1998 "American national standard for electrical meters, 0.2 and 0.5 accuracy classes for current classes 2 and 20" and IEC 60687 "Alternating current static watt-hour meters for active energy (classes 0.2 S and 0.5 S)". The power meters will be installed in the substation of each power plant.

Meters will be connected to an automatic control system and by modem to the power utility. Data storage will be made by internal memory. The internal memory of the meters is able to record several months of measurements. The long term data archiving will be made by data transfer to a local PC by telemetry/telephone or to the control centre managed by the operator through a specific communication channel (telephone line/modem). Data will be backed-up every month in magnetic media and stored for verification. Only authorized software will be available to handle monitored information. The meters will be installed on a protection panel with a sealed door and cover to avoid possible manipulation by non-authorized personnel.

A.4.3 Estimated amount of emission reductions over the chosen crediting period:

Year	Estimation of annual emission reductions in tCO2
2012*	7,673
2013	15,346
2014	15,346
2015	37,432
2016	37,432
2017	37,432
2018	37,432
2019**	18,716
Total estimated reductions (tCO2)	206,811
Total number of crediting years	7
Annual average of the estimated reductions over the crediting period (tCO2)	29,544

(*) 6 months operation (**) 6 months of operation

Table: Project emissions reductions

A.4.4. Public funding of the small-scale project activity:

The project activity does not involve the use of public funding from Annex I Parties.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large scale project activity:

Based on paragraph 2 of Appendix C of the Simplified Modalities and Procedures for Small-Scale CDM project activities (M&P), this project is not a debundled component of a large scale project activity or programme. The project participants have not registered or are not applying to register any other small-scale CDM project activity with the same project participants, in the same project category and technology/measure, registered within the previous two years and whose project boundary is within one km of the project boundary of Ventana, Suba and Usaquen hydroelectric CDM bundled project at the closest point.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the small-scale project activity:

The following approved baseline and monitoring methodology is applicable to the project activity:

AMS-I.D. “Grid connected renewable electricity generation” – version 17.

The following tool is applicable to the project activity:

“Tool to calculate the emission factor for an electricity system” - version 02.2.1.

B.2 Justification of the choice of the project category:

Appendix B of the simplified M&P for small-scale CDM project activities provides indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories. As per the M&P, the project activity falls under the following approved small scale methodology: AMS-I.D- *“Grid connected renewable electricity generation”* – for the renewable energy generation. The project activity is in compliance with the applicability conditions of the approved baseline methodology in the context since:

- The project activity is a renewable power project (hydroelectric project).
- The project activity corresponds to the installation of new power plants at a site where there was no renewable energy power plant operating prior to the implementation of the project activity (greenfield plant).
- The project activity is a run-of-river type hydro power plant, thus does not require the construction of a reservoir.
- The project activity is not a combined heat and power (co-generation) system.
- The project activity has an output capacity lower than 15 MW: the total installed capacity is 11.48 MW.
- The power generated by the project activity is supplied to a national grid that is or would have been supplied by at least one fossil fuel fired generating unit (National Interconnected System of Colombia).

B.3. Description of the project boundary:

According to AMS-I.D, and as referred to in Appendix B for small-scale project activities, the project boundary for a small-scale hydropower project that provides electricity to a grid encompasses the physical, geographical site of the renewable generation source. Therefore, for the project the boundary encompasses the water conduction system, the new turbine generator, and equipment required to export the electricity to the grid (transformers, substation, etc). A representation of the project boundary can be seen in the figure below.

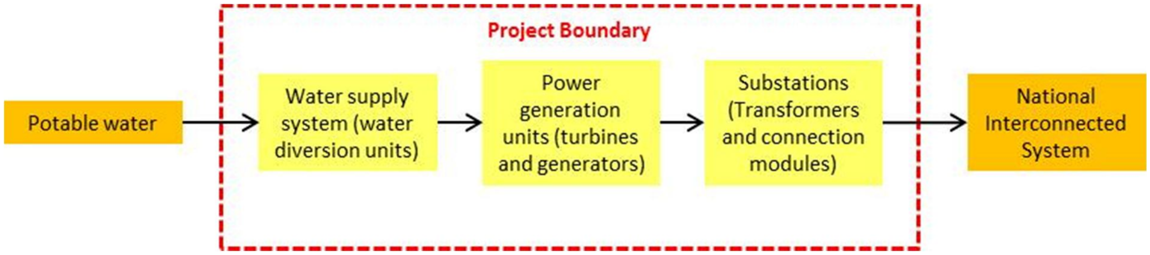

Figure: Project boundary definition

The baseline includes emissions related to the electricity produced by power plants to be displaced by the proposed project. This involves emissions from displaced fossil fuel used in the power plants connected to the National Interconnected System. In terms of GHG emissions, the project boundary considers only emissions of CO_2.

	Source	Gas	Included ?	Justification / explanation
Baseline	Energy generation in the Colombian National Interconnected Grid System	CO_2	YES	According to AMS.I.D, only CO_2 emissions from electricity generation using fossil fuels should be accounted for.
		CH_4	NO	Only CO_2 emissions are taken into account
		N_2O	NO	Only CO_2 emissions are taken into account
Project Activity	Energy generation in the project power plants	CO_2	NO	The emissions are excluded according to AMS.I.D. (There will be only renewable energy generation).
		CH_4	NO	The emissions are excluded according to AMS.I.D. (There will be only renewable energy generation).
		N_2O	NO	The emissions are excluded according to AMS.I.D. (There will be only renewable energy generation).

Table: Sources of GHG emissions

B.4. Description of baseline and its development:

As prescribed by AMS-I.D, the baseline scenario is that the electricity delivered by the renewable generating units to the grid would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources to the grid. Baseline GHG emissions are calculated as the product of the electricity delivered to the grid and the emission factor of the grid (measured in tCO2e/MWh) calculated in a transparent and conservative manner.

The baseline scenario identified corresponds to the continuation of the current situation in which the electricity is delivered to the National Interconnected System of Colombia. Energy that would have been generated by the project activity will be supplied by the operation of power plants that are currently connected to the grid, the addition of new generation capacity and energy imports. This system is composed of a combination of power plants that consume fossil fuels and plants that use renewable energy sources (mainly hydro).

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered small-scale CDM project activity:

CDM prior consideration

After seriously considering the benefits of the CDM in the decision to proceed with the project activity, the project developer developed continuing and real actions to secure CDM status in parallel to the project implementation. In the following table is presented a detailed timeline for the project.

CDM Actions prior to the project start date / Continuing actions to secure the CDM project status	
Date	**Key event**
Jul 2009	The Project Idea Note for the hydroelectric project activities Ventana, Suba and Usaquén was submitted to the local Designated National Authority (DNA) of Colombia to request the "No Objection Letter".
Aug 2009	The EAAB received from the local DNA the "No Objection Letter" for the project activity.
Sep 2009	The EAAB decided to start applying for CDM to decrease the risk and improve the financial return of the projects.
Oct 2009	The EAAB decided to include the CDM component in the public tender IT-794-2009 (process to hire a technical project developer).
Dec 2009	The EAAB notified the UNFCCC Secretariat and the local DNA of the commencement of the project activity and their intention to seek the CDM status.
Mar 2010	The preoperative stage (feasibility and design of the projects) started after the contractor Consorcio Generación Bogota (CGB) responded positively to the Work Initiation Act. This is the project starting date.
Oct 2010	The cooperation agreement between EAAB and Inter-American Development Bank (IADB) was signed, to support EAAB with the preparation of the CDM PDD.
Jan 2011	The construction of the power plants Suba and Usaquén started.
Jul 2011	The first CDM local stakeholder consultation (with local and national authorities) was held and inputs were incorporated in the project.
Aug 2011	The second CDM local stakeholder consultation (with communities and authorities of Bogota in the influence area of the projects Suba and Usaquen) was developed and inputs were incorporated in the project.
Sep 2011	The third CDM local stakeholder consultation (with communities and authorities of Guasca in the influence area of the project Ventana) was developed and inputs were incorporated in the project.
Sep 2011	The work on the PDD started.
Nov 2011	The project developer EAAB began planning the validation process with the DOE and starts the contractual arrangements.
Jun 2012	Expected date to start operation with Suba and Usaquen power plants.
Jan 2015	Expected date to start operation with Ventana power plant.

Table: Timeline for the project activity

Additionality analysis

According to the attachment A to appendix B of the simplified modalities and procedures for CDM small-scale project activities, project participants are required to provide an explanation showoff how the project activity would not have occurred in the absence of the CDM due to at least one of the identified barriers. Evidence to why the proposed project is additional has to be offered under the following categories of barriers: (a) investment, (b) technological, (c) prevailing practice and (d) other barriers.

Investment barrier: a financially more feasible alternative to the project activity would have led to higher emissions. This barrier evaluates the viability, attractiveness and financial/economic risks

associated with the alternatives to the project activity, considering the overall economics of the project and/or economic conditions in the country.

Technological barrier: a less technologically advanced alternative to the project activity involves lower risks due to the performance uncertainty or low market share of the new technology adopted for the project activity and so would have led to higher emissions. This barrier evaluates whether the technology is currently available, if there are adequate skills to operate it, if the application of the technology is a regional, national or global standard, and if there are technological risks associated with the project outcome being evaluated.

Barrier due to prevailing practice: prevailing practice or existing regulatory or policy requirements would have led to implementation of a technology with higher emissions. This assesses whether, in the absence of regulations, the project activity is the standard practice in the industry, if there is experience to apply the technology and if there are high-level management priorities for such activities.

Other barriers: emissions would have been higher without the project activity for another specific reason identified by the project participant, such as institutional barriers or limited information, managerial resources, organizational capacity, financial resources, or capacity to absorb new technologies.

The barrier analysis is carried out based on information available at the time when the decision of developing the project activity was taken, considering the relevant context and information from the project sponsors and official sources. The analysis has been based on the investment barrier and the barrier due to prevailing practice.

Investment barrier:

For Ventana, Suba and Usaquen hydroelectric CDM bundled project, the financial viability was the main condition to continue with the power plants implementation, therefore conditions such as the expected energy sale price, the technical feasibility to produce energy and the availability of hydraulic flows to the new plants, were duly assessed. The assessment was based on the assumptions related to the expected electricity prices used to incorporate the revenues from electricity sales into the financial analysis. These conditions were based on the expected behavior of electricity prices in the Colombian electricity market. In addition, the Internal Rate of Return (IRR) evaluation was linked to the projected electricity generation from each proposed power plant, which was directly related to the available water flow rate in the potable water supply system and the amount of electricity that this water flow could produce in the power plant.

For power plants considered by the project (Ventana, Suba and Usaquén), the company has invested in the installation of all the necessary infrastructure to deviate the water from the potable water supply system of Bogota to the power houses, the acquisition of turbines and generators for electricity generation and equipment to control their operation. The following table shows a detailed description of the project costs (separately for each power plant):

Installation of Ventana, Suba and Usaquen hydroelectric CDM bundled project	
	Estimated cost (US $)
Ventana hydroelectric power plant[4]	
Main equipment	4,053,454

[4] Document PCH-VTN-GE-VAR-005 "Informe de factibilidad PCH Ventana", Chapter 10 - Economic Survey, 2011. Consorcio Generación Bogota.

Complementary equipment	4,199,488
Civil works	5,154,248
Designs and engineering	1,748,965
Others (tax, administrative, others)	4,692,510
Total estimated cost	**19,848,665**
Suba hydroelectric power plant[5]	
Main equipment	1,707,963
Complementary equipment	1,689,213
Civil works	572,187
Designs and engineering	938,666
Others (tax, administrative, others)	1,389,277
Total cost estimated	**6,297,306**
Usaquen hydroelectric power plant[6]	
Main equipment	1,623,616
Complementary equipment	697,138
Civil works	217,003
Designs and engineering	828,746
Others (tax, administrative, others)	888,215
Total cost estimated	**4,254,718**
TOTAL	**30,400,689**

For the yearly operation and maintenance:

Yearly operation and maintenance costs	
Costs (yearly value, average of 21 years)	**Total estimated cost (US $/year)**
Ventana hydroelectric power plant[4]	
Labor and administration (only for the first year)*	171,206
Maintenance (1% of the equipment cost)	124,572
Operation cost (only energy consumption)	3,274
Suba hydroelectric power plant[5]	
Labor and administration (only for the first year)**	128,405
Maintenance (1% of the equipment cost)	45,862
Operation cost (only energy consumption)	3,079
Usaquen hydroelectric power plant[6]	
Labor and administration (only for the first year)**	128,405
Maintenance (1% of the equipment cost)	31,330
Operation cost (only energy consumption)	3,079
Total cost estimated	639,212

* For power plant Ventana, the value for Labor and administration considers for the first year US$171,206 and US$58,127 yearly
** For power plants Suba and Usaquen, the value for Labor and administration is considered only for the first year, since the power plants will be operated automatic and remotely (without personnel).

Table: Project cost considering the information provided by the project manager

Because of the high cost of the project and the financing structure of 100% equity, the project developer decided to apply for CDM to decrease the risks and improve the investment return. The financial analysis for the return was calculated using the parameters and assumptions determined by the contractor. The financial analysis for the return of the project was calculated using the parameters and assumptions showed in the following table.

Parameter	Ventana	Suba	Usaquen	Source/Comment
Electricity tariff (US/kWh)[7]	0.047	0.03808	0.03808	Feasibility report

[5] Document PCH-SUB-GE-VAR-004 "Informe de factibilidad PCH Suba", Chapter 10 - Economic Survey, 2010. Consorcio Generación Bogota.
[6] Document PCH-USQ-GE-VAR-003 "Informe de factibilidad PCH Usaquen", Chapter 10 - Economic Survey, 2010. Consorcio Generación Bogota.

Discount rate	13.34%	13.34%	13.34%	Resolution 312, 2005 (Official source)[8]
Energy to the grid	46,506 MWh	19,965 MWh	12,350 MWh	Feasibility report
Total investment (US$)	19,848,665	6,297,306	4,254,718	Feasibility report

Table: Financial analysis assumptions

Benchmark:

The *benchmark* used is the value provided in the appendix on the "Guideline on the assessment of investment analysis, version 05". The *benchmark* for Colombian projects belonging to group 1 (in which the power plants Ventana, Suba and Usaquen are included) is 12%.

Comparison of Equity IRR to the *benchmark*:

The equity IRR is compared to the *benchmark* to examine the financial viability of the project activity. The assessment of the project was considered separately for each power plant to be installed. The results in terms of equity IRR (without CERs) are Ventana 11.54%, Suba 11.2% and Usaquen 9.85%. These IRR values are lower than the *benchmark* of 12%; this means that the project activity is not viable and demonstrates that the CDM is necessary in order to make the investment more profitable.

As it can be observed in the following table, when the sale price of the CERs is considered in a range between the current values and the average values observed during 2011, we can observe that the power plant Usaquen becomes more financially attractive while the power plants Ventana and Suba exceeds the *benchmark*.

According to the above, with the inclusion of the CERs in the case of Usaquen the project IRR is lower than the benchmark; therefore it was necessary to prepare a sensitive analysis (for CERs prices). The next table shows a sensitive analysis regarding expected CERs prices.

CERs prices to be delivered on December 2016 (observed prices during 2011)[9]	Equity return considering CERs revenues		
	Ventana	Suba	Usaquen
6.00 €/tCO_2e	12.294%	12.450%	11.026%
8.00 €/tCO_2e	12.544%	12.861%	11.409%
10.00 €/tCO_2e	12.793%	13.270%	11.790%
11.00 €/tCO_2e	12.918%	13.473%	11.980%
12.00 €/tCO_2e	13.041%	13.677%	12.169%

The expected price of the CERs represents that EAAB´s Executive Board could change their investment evaluation decision; In the case of the power plant Usaquen the price for the ton of CO2 has to be higher than $15.6 in order to get the minimum IRR required by the company, while in the case of the power plants Ventana and Suba the price for the ton of CO2 has to be higher than $7.8 in order to get the minimum IRR. The inclusion of CERs can be considered as cushion for the company cash flow and also

[7] The power tariff is based on a study conducted by the contractor Consorcio Generación Bogota during the feasibility stage. The study considers the power tariff under two scenarios. The first scenario corresponds to the tariff offered by the local power utility EMGESA according to the power purchase conditions that currently exist for the Hydroelectric Santa Ana property of EAAB (this power plant is similar to the project plants). The second scenario corresponds to the tariff in the energy exchange market, in which large generators participate (but that the EAAB cannot participate). For the financial analysis on which the EAAB takes the decision was selected the power tariff of the first scenario. This approach is considered realistic and conservative.

[8] The Regulatory Commission of Drinkable Water and Basic Sanitation (which is in charge of the supervision and control of the public services companies such as EAAB) has established the discount rate applicable to the public services of aqueduct and waste water treatment (and related activities).

[9] Reference: www.barchart.com/quotes/futures/CQZ14 (6€/tCO_2e - US$7.8 with a conversion rate €/US of 1.3)

as an essential income to provide some backup to any unforeseen risks involved within the operation of the project.

To conclude, as it has been demonstrated in this investment analysis, the effect of the CERs contribution is financially significant and determinant for the financial feasibility of the project, since:

1. The CERs provide stability and certainty to the equity's cash flow while reducing its financial risk, and increasing the equity IRR from the IRR without CERs.
2. It is shown that the CERs contribute to a significant increase in equity value and, in a case in which CER market prices would return to levels prior to September 2011, to surpass the *benchmark* IRR level.

Barrier due to prevailing practice:

In general terms, the most important condition for the project activity relies on the fact that the hydroelectric power plants Ventana, Suba and Usaquen will be implemented using the existing infrastructure of the potable water supply system of Bogota[10], making the conditions for their installation and operation unique and specific, therefore the assessment of the prevailing practice must be realized considering those power plants that are similar than the project plants (it means power generation using a potable water supply infrastructure).

Until 2011, only one power plant associated to an existing potable water supply system (which can be comparable with the project) was installed in Colombia, being this Santa Ana. This plant belongs to EAAB and the CDM benefits were considered for their implementation (the project is currently registered as a CDM project activity)[11]. The number of hydro projects associated to a potable water supply system is limited compared to power plants using other technologies. This represents that the identification and construction of this kind of hydroelectric plants is not an attractive situation in Colombia, neither an easy issue to be carried out by investors.

Other situation that represents an additional risk for this project is that EAAB is a public utility created with the purpose of managing the water supply and wastewater treatment of Bogotá for which the energy generation results in a different business; thus, the investment in this kind of projects, results in a different core business from that of a potable water supply utility, making this not a common practice.

In conclusion, the usual practice in Colombia regarding the hydro generation, is the construction of generation plants with conventional technologies and configuration, which its implementation does not involve the risks identified in the construction of small hydroelectric plants associated to a potable water supply system. Therefore, in Colombia, the implementation of power plants such as Ventana, Suba and Usaquen cannot be considered a prevailing practice.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

Baseline Emissions

[10] The power plants in the project activity can be considered as a run of river type, but considering that these are different that those installed in the riverbed of a river because this plants use the water flow of a water supply system.

[11] This can be verified on http://cdm.unfccc.int/Projects/DB/TUEV-SUED1140544492.1/view

For AMS.I.D, the baseline emissions are the product of the energy generated and delivered by the power plan units and the emissions factor of the electricity system, as follows:

$$BE_y = EG_{BL,y} * EF_{CO_2,grid,y}$$

Where:

BE_{yy}	Baseline emissions in the year *y* (tCO_2e)
$EF_{CO2,grid,y}$	CO_2 emission factor of the grid in year y (tCO_2e/MWh)
$EG_{BL,Y}$	Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year *y* (MWh)

The emission factor must be calculated in a transparent and conservative manner as follows:

(a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures described in the 'Tool to calculate the emission factor for an electricity system', or

(b) The weighted average emissions (in kg CO_2e/kWh) of the current generation mix. The data of the year in which project generation occurs must be used.

For this project, option (a) above will be applied, which uses a combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the calculations described in the "Tool to calculate the emission factor for an electricity system". The calculation will be based on data from an official source (where available). According to the tool, the calculation of the emission factor is developed through the following six steps:

Step 1: Identify the relevant electricity power systems

The Colombian electricity distribution network is composed by 61 energy generators, 11 transmission operators, 57 net operators and 117 traders. The net capacity of the National Interconnected System is 13,456 MW, where the hydropower generation represents 63.4%, thermal generation represents 32.3% and the minor generators and cogeneration 4.2%. The National Dispatch Centre (NDC) of Colombia is part of XM (Compañía de Expertos en Mercados S.A. E.S.P.) and is responsible for the operation ensuring a reliable performance of the national grid. The following figure shows the distribution of the National Interconnected System of Colombia.

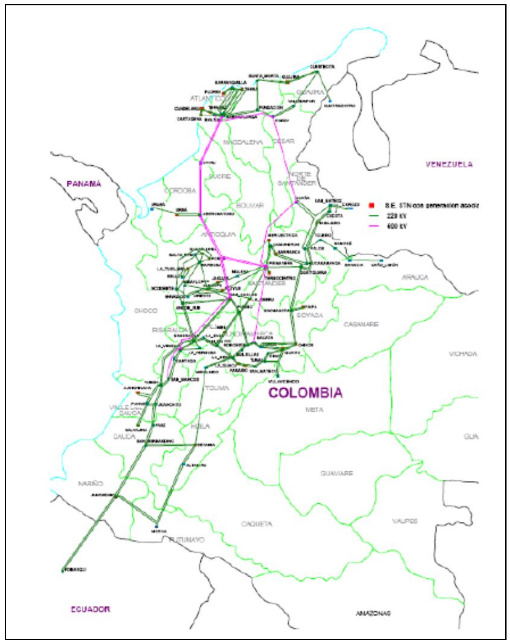

Figure: National Interconnected System of Colombia

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

Project participants may choose one of the options below for calculating the operating margin and build margin emission factors:

Option I: Only power plants inside the grid are included in the calculation.
Option II: Power plants in and outside the grid are both included in the calculation.

Option I has been selected for the emission factor calculation.

Step 3: Select a method to determine the operating margin (OM)

For the operating margin emission factor calculation, the simple adjusted method has been selected (option b of the tool) since public official information is available from the electricity generation units of Colombia (NDC and Unidad de Planeación Minero Energética - UPME). The *ex-post* approximation has been selected, using for its calculation series of data from the last year available in the beginning of the validation process.

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

The simple adjusted OM emission factor ($EF_{OM,adjusted,y}$, expressed in tCO_2/MWh) is a variation of the simple operating margin, where power plants (including imports) are separated in *low cost/must run* plants (*k*) and other sources (*m*). $EF_{OM,adjusted,y}$ will be calculated considering an *ex-post* approximation.

$$EF_{grid,OM\text{-}adj,y} = (1-\lambda_y)\cdot\frac{\sum_m EG_{m,y}\times EF_{EL,m,y}}{\sum_m EG_{m,y}} + \lambda_y\cdot\frac{\sum_k EG_{k,y}\times EF_{EL,k,y}}{\sum_k EG_{k,y}}$$

Where:

$EF_{grid,OM\text{-}adj,y}$	Simple adjusted operating margin CO_2 emission factor in year *y* (tCO_2/MWh)
λ_y	Factor expressing the percentage of time when *low-cost/must-run* power units are on the margin in year *y*
$EF_{ELm,y}$	CO_2 emission factor of power unit m in year *y* (tCO_2/MWh)
$EF_{EL,k,y}$	CO_2 emission factor of power unit k 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)
$EG_{,k,y}$	Net quantity of electricity generated and delivered to the grid by power unit *k* in year *y* (MWh)
m	All grid power units serving the grid in year *y* except low-cost/must-run power units.
k	All *low-cost/must run* grid power units serving the grid in year *y*
y	The relevant year as per the data vintage chosen in step 3

Where λ_y is:

λ_y = Number of hours low cost/must run plants are in the margin in year y / 8760 hours

The OM emission factor has been calculated using the data for 2010 (based on the ex-post approach, therefore the emission factor of the operating margin must be updated annually over the crediting period). Energy imports must be considered under the *low-cost/must-run* category.

Determination of $EF_{EL,m,y}$

The $EF_{EL,m,y}$ emission factor has been calculated based on the available information applying the following options:

- Option A1: If for a power unit *m* data on fuel consumption and electricity generation is available, the emission factor ($EF_{EL,m,y}$) was determined as follows:

$$EF_{EL,m,y} = \frac{\sum_i FC_{i,m,y}\times NCV_{i,y}\times EF_{CO2,i,y}}{EG_{m,y}}$$

Where:

$EF_{EL,m,y}$	CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh).
$FC_{i,m,y}$	Amount of fossil fuel type *i* consumed by power unit m in year *y* (mass or volume unit).
$NCV_{i,y}$	Net calorific value (energy content) of fossil fuel type *i* in year *y* (GJ/mass or volume unit).
$EF_{CO2,i,y}$	CO_2 emission factor of fossil fuel type *i* in year *y* (tCO_2/GJ).
$EG_{m,y}$	Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh).

m	All power units serving the grid in year *y* except *low-cost/must-run* power units.
i	All fossil fuel types combusted in power unit *m* in year *y*.
y	The relevant year as per the data vintage chosen in Step 3

- Option A.2: If for a power unit *m* data on electricity generation and types of fuels is available, the emission factor ($EF_{EL,m,y}$) was determined as follows

$$EF_{El,m,y} = \frac{EF_{CO2,m,i,y} * 3.6}{\eta_{m,y}}$$

Where:

$EF_{EL,m,y}$	CO_2 emission factor of the power unit *m* in year *y* (tCO_2/MWh).
$EF_{CO2,m,i,y}$	Average CO_2 emission factor of fuel type *i* used in power unit *m* in year *y* (tCO_2/GJ)[12].
$\eta_{m,y}$	Average net energy conversion efficiency of power unit *m* in year *y* (%)
m	All power units serving the grid in year *y* except *low-cost/must-run* power units.
y	The relevant year as per the data vintage chosen in Step 3.

Calculations have been developed considering the public information of the colombian electricity generation units (NDC and UPME).

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

The project participant has chosen Option b (*ex-post* emission factor calculation) in order to obtain a value during the whole accrediting period. The *ex-post* build margin emission factor calculation is based on the more recent information available from the constructed units for sample group *m* at the moment of beginning the validation process.

The build margin emission factor is the generation-weighted average emission factor (tCO_2/MWh) of all power units *m* during the recent year *y* for which electricity generation data is available. The calculation is shown below:

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

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 the year *y* (MWh)
$EF_{EL,m\,y}$	CO_2 emission factor for power unit *m* in the 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

[12] According to the tool, when diverse types of fuels are used in one power plant, the fuel with less CO_2 emission factor is used to determine the $EF_{CO2,m,i,y}$.

The sample of the *m* power units group used for the BM emission factor calculation has been determined according to the tool's criteria, establishing that since $AEG_{SET-\geq 20\%}$ is greater than $AEG_{SET-5-units}$ and part of the power units started to supply electricity to the grid more than 10 years ago, the sample group of *m* power units used for the calculation is $AEG_{SET-\geq 20\%}$. The emission factor of each of the selected power units for the calculation has been obtained applying the previous steps.

Step 6: Calculate the combined margin (CM) emission factor

The calculation of the combined margin (CM) emission factor is based on one of the following methods:

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

For the CM calculation the option a) has been chosen, thus the combined margin emission factor is calculated as a weighted average of the operating margin *(EF_{OM})* and build margin *(EF_{BM})* emission factors.

$$EF_{grid,CM,y} = w_{OM}.EF_{grid,OM,y} + w_{BM}.EF_{grid,BM,y}$$

Where:

$EF_{grid,BM,y}$	Build margin CO_2 emission factor in year *y* (tCO_2/MWh)
$EF_{grid,OM,y}$	Operating margin CO_2 emission factor in one year *y* (tCO_2/MWh)
ω_{OM}	Weighting of operating margin emissions factor (%)
ω_{BM}	Weighting of build margin emissions factor (%)

Generally a weighted coefficient of 50% is considered for both margins (ω_{OM} y ω_{BM}) for the first crediting period. In a second and third crediting period, a ω_{OM}= 0.25 and ω_{BM}= 0.75 would be considered, as mentioned in the tool to calculate the emission factor for an electricity system.

<u>Project emissions</u>

According to the methodology, project emissions for hydro power plant with no reservoir are zero.

<u>Leakage</u>

No leakage emissions are considered.

<u>Emissions reductions</u>

The emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y$$

Where:

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

LE_y Leakage emissions in year *y* (t CO_2/y)

The result of the application of the equations is presented in section B.6.3.

B.6.2. Data and parameters that are available at validation:

Data / Parameter:	***Installed capacity***
Data unit:	MW
Description:	The installed capacity of the project activity.
Source of data used:	Design reports.
Value applied:	11.48
Justification of the choice of data or description of measurement methods and procedures actually applied :	This data refers to the total installed capacity of the project power plants which are defined in the design reports prepared by CGB for each power plant.
Any comment:	No comments.

Data / Parameter:	$EG_{m,y}$
Data unit:	MWh
Description:	Net electricity generated by power units m in year *y*.
Source of data used:	NEON - Compañía de Expertos en Mercados S.A. E.S.P.
Value applied:	Please refer to Annex 3.
Justification of the choice of data or description of measurement methods and procedures actually applied:	EB 61, Meeting report, Annex 12 “Tool to calculate the emission factor for an electricity system”. The national dispatch centre (CND) of Colombia is part of XM (Compañía de Expertos en Mercados S.A. E.S.P.) and is responsible for the operation assuring a reliable performance of the national grid. All information regarding the national interconnected system is handled and stored in the information system NEON. Official data published yearly.
Any comment:	The information is based on the 3-year generation.

Data / Parameter:	$EG,_{k,y}$
Data unit:	MWh
Description:	Net electricity generated by power units k in year *y*.
Source of data used:	NEON - Compañía de Expertos en Mercados S.A. E.S.P
Value applied:	Please refer to Annex 3.
Justification of the choice of data or description of measurement methods and procedures actually applied:	EB 61, Meeting report, Annex 12 “Tool to calculate the emission factor for an electricity system”. The national dispatch centre (CND) of Colombia is part of XM (Compañía de Expertos en Mercados S.A. E.S.P.) and is responsible for the operation assuring a reliable performance of the national grid. All information regarding the national interconnected system is handled and stored in the information system NEON. Official data published yearly.
Any comment:	The information is based on the 3-year generation.

Data / Parameter:	$EF_{EL,m,y}$
Data unit:	tCO_2/MWh
Description:	Emission factor of power units m in year *y*.

Source of data used:	Obtained multiplying the heat rate reported by each thermal power plant to the sectoral authorities and provided by Unidad de Planeación Minero Energética – UPME (official source) with the emission factor of each fossil fuel type consumed in each plant obtained from IPCC 2006 Guidelines for National Greenhouse Gas Inventories (Default values - lower limits of the 95% confidence intervals).
Value applied:	Please refer to Annex 3.
Justification of the choice of data or description of measurement methods and procedures actually applied:	This information is provided by each generation facility connected to the national interconnected system and is compiled by Unidad de Planeación Minero Energética – UPME which is part of the Ministry of Mines and Energy of Colombia.
Any comment:	More calculation details are provided in Annex 3.

Data / Parameter:	$EF_{EL,k,y}$
Data unit:	tCO_2/MWh
Description:	Emission factor of power units k in year *y*.
Source of data used:	Obtained multiplying the heat rate reported by each low-cost/must-run plant, (including cogeneration plants which are part of the low-cost/must-run plants) to the sectoral authorities and provided by Unidad de Planeación Minero Energética – UPME (official source) and the emission factor of each fossil fuel type consumed in each plant obtained from IPCC 2006 Guidelines for National Greenhouse Gas Inventories (Default values - lower limits of the 95% confidence intervals).
Value applied:	Please refer Annex 3.
Justification of the choice of data or description of measurement methods and procedures actually applied:	This information is provided by each generation facility connected to the national interconnected system and is compiled by Unidad de Planeación Minero Energética – UPME which is part of the Ministry of Mines and Energy of Colombia.
Any comment:	More calculation details are provided in Annex 3.

Data / Parameter:	$EF_{grid,OMadj,y}$
Data unit:	tCO_2/MWh
Description:	Simple adjusted operating margin CO_2 emission factor in year *y*.
Source of data used:	Project developer.
Value applied:	Please refer Annex 3.
Justification of the choice of data or description of measurement methods and procedures actually applied:	The Operating Margin was calculated according to the guidelines provided in the EB 61, Meeting report, Annex 12 “Tool to calculate the emission factor for an electricity system” using official and public information. The calculation is based on the 3-year generation-weighted average using the most recent data available.
Any comment:	More calculation details are provided in Annex 3.

Data / Parameter:	$EF_{grid,BM,y}$

Data unit:	tCO_2/MWh
Description:	Build margin CO_2 emission factor in year *y*.
Source of data used:	Project developer.
Value applied:	Please refer Annex 3.
Justification of the choice of data or description of measurement methods and procedures actually applied:	The Operating Margin was calculated according to the guidelines provided in the EB 61, Meeting report, Annex 12 "Tool to calculate the emission factor for an electricity system" using official and public information. The calculation is based on the ex-ante information based on the option 1 by using the most recent data available.
Any comment:	The application details are provided in Annex 3.

Data / Parameter:	$EF_{CO2,i\,y}$
Data unit:	kg CO_2/ TJ
Description:	CO_2 emission factor for each fuel type *i* used.
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (Default values - lower limits of the 95% confidence intervals).
Value applied:	Please refer Annex 3.
Justification of the choice of data or description of measurement methods and procedures actually applied:	Defined according to the EB 61, Meeting report, Annex 12 "Tool to calculate the emission factor for an electricity system".
Any comment:	The application details are provided in Annex 3.

Data / Parameter:	$EF_{grid,y}$ / $EF_{grid,CM,y}$
Data unit:	tCO_2e/MWh
Description:	Combined margin CO_2 emission factor in year *y*.
Source of data used:	Project developer.
Value applied:	Please refer Annex 3.
Justification of the choice of data or description of measurement methods and procedures actually applied:	The emission factor is calculated as the weighted average of the Operating Margin (OM) and the Build Margin (BM) emissions factors according to the procedures described in the "Tool to calculate the emission factor for an electricity system" using official and public information.
Any comment:	According to the tool to calculate the emission factor for an electricity system, the data was calculated ex-ante for the OM and under option 1 for the BM, thus will not need to be revised within crediting period. A single, fixed value is used for the entire crediting period. More calculation details are provided in Annex 3.

B.6.3 Ex-ante calculation of emission reductions:

As prescribed by AMS-I.D, the baseline's emissions are obtained as the product of the net electricity produced and delivered by the renewable generating unit multiplied by an emission coefficient of the grid measured in tCO2e/MWh. According to the design reports prepared by CGB, the energy to be generated by the project power plants is:

Annual electricity generation (MWh/y)	2012*	2013	2014	2015	2016	2017	2018	2019**
Suba	9,982	19,965	19,965	19,965	19,965	19,965	19,965	9,982
Usaquen	6,175	12,350	12,350	12,350	12,350	12,350	12,350	6,175
Ventana	0	0	0	46,506	46,506	46,506	46,506	23,253
Total	16,158	32,315	32,315	78,821	78,821	78,821	78,821	39,410

(*) 6 months operation (**) 6 months of operation

Table: Projected annual electricity generation

As shown in Annex 3 below, the grid emission factor is 0.4749 tCO2e/MWh.

As described in section B.6.1, the anthropogenic emissions of GHG due to the project activity are zero, since the project does not include a reservoir and will not involve the use of other energy sources. In accordance to the methodology, leakage calculation is only required if the renewable energy technology equipment is transferred from another activity or to another activity. This is not the case of the proposed project, so leakage is not to be considered. Therefore the emission reductions resulting from the project are:

Emission reductions calculation - EAAB Hydroelectric Project								
year	**2012***	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019****
Electricity to the grid (MWh/y)	16,158	32,315	32,315	78,821	78,821	78,821	78,821	39,410
EF (tCO_2e/MWh)	0.4749	0.4749	0.4749	0.4749	0.4749	0.4749	0.4749	0.4749
Baseline emissions (tCO_2e/y)	7,673	15,346	15,346	37,432	37,432	37,432	37,432	18,716
Project Emissions (tCO_2e/MWh)	0	0	0	0	0	0	0	0
Leakage (tCO_2e/MWh)	0	0	0	0	0	0	0	0
Net Emission Reductions (tCO_2e/y)	7,673	15,346	15,346	37,432	37,432	37,432	37,432	18,716

(*) 6 months operation (**) 6 months of operation

Table: Emission reduction calculation

B.6.4 Summary of the ex-ante estimation of emission reductions:

Emission reductions calculations taken into the small scale methodology AMS-I.D are:

Year	Estimation of project activity emissions (tonnes of CO_2e)	Estimation of baseline emissions (tonnes of CO_2e)	Estimation of leakage (tonnes of CO_2e)	Estimation of overall emission reductions (tonnes of CO_2e)
2012*	0	7,673	0	7,673
2013	0	15,346	0	15,346
2014	0	15,346	0	15,346
2015	0	37,432	0	37,432
2016	0	37,432	0	37,432
2017	0	37,432	0	37,432
2018	0	37,432	0	37,432
2019**	0	18,716	0	18,716
Total (Tonnes of CO_2e)	0	206,811	0	206,811

(*) 6 months operation (**) 6 months of operation

Table: Summary of project emission reductions

B.7 Application of a monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

Data / Parameter:	***$EG_{BL,y}$***
Data unit:	MWh/year
Description:	Net electricity generated and supplied to the grid by the project activity in the year *y*
Source of data to be used:	Project developer
Value of data	-
Description of measurement methods and procedures to be applied:	Measured continuously and periodically recorded. The records of any energy generated should be recorded since the start of project. Power meters will be installed in the project installations. The measurements will be taken at least hourly. The net electricity supplied to the grid will be determined as the measured quantities of the grid electricity delivered to the grid minus the auxiliary electricity consumption, technical losses and electricity imports from the grid to the project power plant (determined in the commercial border or point used for billing purposes). The values will be monthly recorded and stored in a spreadsheet.
QA/QC procedures to be applied:	Meters will be calibrated periodically according to the national standards and reference points or IEC standards and recalibrated at appropriate intervals according to manufacturer's specifications (at least once every three years). Data collected has some uncertainty levels and to guarantee its accuracy it will be cross checked with the electricity sales receipts obtained from the grid trader/generator. The grid trader/generator will deliver sales receipt separately for each power plant.
Any comment:	Data will be archived at least for two years after the crediting period.

B.7.2 Description of the monitoring plan:

A monitoring plan will be implemented to ensure that the approved monitoring methodology AMS-I.D is correctly implemented in order to enable the accurate and transparent determination of emission reductions. The plan will incorporate the QA/QC procedures which are in line with the quality control system of EAAB. The overall management structure responsible for project monitoring is as follows:

Management monitoring structure: The project's structure for the management plan is as flows:

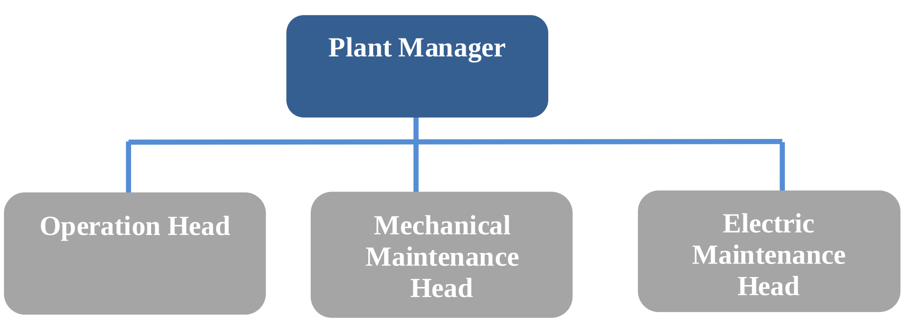

Figure: Monitoring management proposed structure

- **Plant Manager:** will be responsible for the following activities:
  - Supervise and guarantee the quality of the data registered in the spreadsheets.
  - Supervise and guarantee the quality of the annual and monthly final reports.
  - File the data and final reports.
  - Will have knowledge of the activities and calibration and maintenance of the equipment and will file the certificates of the procedure.

- **Operation Head:** will be responsible for the following activities:
  - Supervise and guarantee the quality of the data during their compilation process.
  - Compare the registered data to other available documents (bills, official information, formal communications of the electricity sector and other entities, among others).
  - File the data and final reports.
  - Process the data and generate the final reports.

- **Mechanical Maintenance Head:** will be responsible for performing the periodic revisions of equipment and when required, help with the calibrations and repairs of the equipment.

- **Electric Maintenance Head**: will be responsible for informing the requirements of inspection for calibration and maintenance of the equipment and filing the certificates of the procedure.

On-line monitoring system: All meters required to determine parameters to calculate GHG emission reductions will be monitored from a central control point which will register all the measurement readings in predetermined intervals according to specified standards. These data will be used for the calculation of emission reductions. Parameters to be measured are listed in section B.7.1.

Emission reduction calculation: Data required for the calculation will registered in a spreadsheet according to the formula described in section B.6.1. For security reasons, the access to the spreadsheet will be controlled by security. Process will include a revision such as the comparison of the total energy generated by the power unit and delivered to the grid, against energy supplied to the grid that is indicated in the bills or similar documents obtained from the operator of the grid.

Precision and calibration of the equipment: All meters will be operated and maintained according to the manufacturers' specifications. All key meters will be subjected to a quality control regime that includes maintenance and periodic calibration, as indicated in Resolution CREG 025- Measurement Code[13]. Information on the location and unique identification number of each meter will be registered, the state of calibration (date of the last and next calibration), and the name of the provider of the calibrations service. Calibration certificates will be keep for all meters, for at least two years after the crediting period ends.

Data files: An on-line system will file data automatically in a safe storage format periodically (eg. weekly). Calibration log registries will be filed in an accessible electronic format. This data will be stored for at least two years after the crediting period ends.

[13] This regulation indicates that the owner of the measurement equipment is forced to develop a regular maintenance and calibration program.

Control of documents: A document control system will be implemented to ensure that actual versions of the necessary documents are available on-site. A CDM monitoring guide will be adopted in order to guarantee optimum monitoring practices and results.

Preparation of the monitoring report: Data filed/measured will be used to prepare a monitoring report that will be submitted to the DOE for verification and to the CDM Executive Board for issuance of CERs. A standard format for the monitoring report will be prepared before the presentation of the first monitoring report.

Treatment of lost or damaged data: When data in the on-line system is lost or damaged, it can be estimated taking the smallest average value of this parameter the hour prior to the event, or the hour immediately after the system starts functioning again. If there is evidence that suggest that both values are not representative, the average of the last 24 hours can be used. The error will be registered in the daily registry and the onset of the anomaly will be investigated and corrected as soon as possible. If the on-line system is compromised for a period longer than 24 hours, data will be registered manually for a 48 hours period at most. Any faults in the monitoring data of energy generated and delivered will be corrected by the subsequent verification of energy sold.

Auditing function and management revision: The plant manager will be responsible for auditing the monitoring management system at least once a year. The auditor will not be involved in the daily operation of the power plant. The auditor will evaluate the implementation of the monitoring plan and the preparation of the monitoring report. Findings of the audit and the adopted measures to face the results will be registered and reviewed in a revision meeting by the convened committee at least once a year.

B.8 Date of completion of the application of the baseline and monitoring methodology and the name of the responsible person(s)/entity(ies)

Date of completion of the baseline study and monitoring plan: 02/02/2012

Baseline and monitoring analysis prepared by Consorcio Deuman on behalf of the Inter-American Development Bank (IDB) (not a project participant).

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SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

The contract No.1-01-26300-1063-2009[14], signed between the contractor Consorcio Generación Bogotá and the project participant, establishes as a starting date the signature of the Work Initiation Act. This document was signed on 01/03/2010. The project participant decides to use this date as a starting date for the project activity, since this was the moment in which it acquired contractual obligations to develop the project (point of no return for the project developer).

C.1.2. Expected operational lifetime of the project activity:

50 years

C.2 Choice of the crediting period and related information:

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

01/07/2012

C.2.1.2. Length of the first crediting period:

7 years

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Not applicable

C.2.2.2. Length:

Not applicable

[14] The document "contract No.1-01-26300-1063-2009" was signed on 24/12/2009.

SECTION D. Environmental impacts

D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

The compliance with the environmental regulation must be considered for each hydroelectric power plant separately. According to the national regulation (Ministry of Environment, Housing and Territorial Development, Decree 2820, 05 August 2010[15]) the construction and operation of hydropower plants with a capacity below 100 MW will require environmental license before its installation (this process includes the environmental impacts analysis), however, the normative has an exception for those projects that had contracts in course or were being executed before entry into force of the regulation (August 5, 2010) and were not obliged to have environmental licensing.

Considering the above, the project being developed by EAAB does not require environmental license, since before the date of entry into force of the regulation, the projects had an execution contract and they were being developed by the contractor; therefore, it is not necessary to do a study of environmental impacts. Nevertheless, it is necessary to obtain the water concession (permissions) for the water collection and utilization[16]. These permissions were emitted by the local environmental authorities according to their jurisdiction and correspond to concessions for the use of water from the municipal potable water supply system of Bogota.

Likewise, the contractor received other necessary permissions for the civil works, such as a construction license, a land movement authorization and a land use certification. For this project activity, the project developer has already obtained all the above mentioned permissions.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

An environmental management plan has been prepared in order to determine the environmental impact during construction of the proposed power plants. The plan contains measures to ensure the correct environmental performance during construction and eventually project operation. The environmental aspects identified are:

1. Noise

The major source of noise during the construction stage is related to the use machinery and vehicles. These sources are usually between 80 dB to 85 dB. The major source of noise during the operation stage would be the turbine and generator, which is expected to be between 70 dB to 88 dB. As a mitigation measure, machinery with low noise level has been selected during the construction period. The equipment with high noise level is not operate during the night. The implementation of these measures has reduced effectively the noise level during construction period. For the operation stage, equipment with low noise level will be used. Noise control measures like absorption and insulation will be taken during operation. The power housse will be set in places provided with sound insulation. Evergreen trees would be planted

[15] Decree 1220, 2005 – Ministry of Environment, Housing and Territorial Development.
[16] Resolution 157/2004 UAESPNN, Resolution 158/2004 UAESPNN, Resolution 260/2007 UAESPNN.

around the border of the plant. Noise level for both day and night shall be in compliance with the requirements of national regulations (Resolution 8321 of 1983 from the Ministry of Health).

2. Air Pollution

Dust and suspended solids were the main pollutants created during construction period. Requirements stipulated in national regulations (Decree 948 of 1995, from Ministry of Environment) and other regulations were strictly followed by the constractors. The stone and soil generated from digging activities were reused on the site, and the permit to move and dispose the soil not used was requested. After any construction work, the site has been cleaned without delay, and the exposed land has been covered with vegetation. It is expected that there are not pollutants to be generated during operation period.

3. Wastewater

Industrial wastewater has not been generated during the construction period. The only wastewater to be generated during operation period would be domestic waters. The sewage will be treated according to the local regulations using exiting infrastructure.

4. Solid waste

The solid waste created during construction period has been mainly soil from the digging activity and abandoned construction materials. These residues have been disposed correctly following the regulations. No industrial solid waste will be generated during operation. Domestic garbage will be disposed in the local landfill.

5. Ecological impact

The project is located within the area property of the EAAB (urban and rural area) and no additional land would be necessary. There are no rare plants or animals around the site, therefore this project will cause a small impact to ecological environment. The company has a certification of land use that indicates that the implementation of the projects is not prohibited. The project complies with all the country's regulations in terms of environmental requirements and has been approved by the local authorities.

As a result of the analysis, environmental impacts due to the implementation of the project activity are not considered significant. The measures adopted in this process will result in the improvement of the environmental performance of the entire project activity. In addition, any possible environmental impacts of this project activity will be monitored by the local environment authority.

SECTION E. Stakeholders' comments

E.1. Brief description how comments by local stakeholders have been invited and compiled:

A stakeholder consultation process was developed in order to invite local stakeholders to express their comments regarding the "Ventana, Suba and Usaquen hydroelectric CDM bundled project". According to the Resolution 2734 of 2010 emitted by the Ministry of Environment, Housing and Territorial Development, a CDM project must send to the municipal ombudsman office a document with a description of the project and a letter inviting local stakeholders to participate in a meeting in order to provide information of the project and obtain their comments.

To attend this process, the EAAB considered four consultation sessions to provide adequate consultation opportunities to communities and other stakeholders. The first session was developed with local and national authorities while the other sessions were developed with representatives from local communities in the influence area of each project. The process required by the Resolutión 2734 was followed to invite the participation of the communities.

A project description and the invitation letter were published at the ombudsman office in Bogota and the municipality of Guasca. In order to assure the participation of as many stakeholders as possible, the EAAB organized the meetings with personnel of the city and the municipality. In addition, personal invitations were sent to community leaders, local people, local authorities, committee representatives, media, among others.

The first meeting was held in the auditorium of the Chamber of Commerce of Bogota on July 19, 2011, at 9:00 am and was attended by the project owner representatives, project consultant and the authorities indicated in the attendance list. The second meeting was held in the auditorium of the community of Suba on August 27, 2011, at 8:00 am and was attended by the project owner representatives, project consultant and representatives from the Suba community. The third meeting was held in the installations of EAAB in the neighborhood of Santa Barbara, on August 27, 2011, at 2:00 pm and was attended by the project owner representatives, project consultant and representatives from the Usaquen community. The fourth meeting was held in the municipal council room of Guasca on September 13, 2011, at 9:00 am and was attended by the project owner representatives, project consultant and the stakeholders described in the attendance list. During the meetings several presentations were made by the project owner and by consultants who outlined the planned project activity in a non-technical manner (including environmental, social and technological considerations, climate change and, the role of the CDM). The presentations were followed by questions and answers sessions.

The main objective of the meetings was to clarify and inform the communities about the main characteristics of the project (for each power plant). In addition, the meetings allowed invited stakeholders to understand the basic concepts related to the power plants considering the CDM and the local communities living conditions.

A total of 72 participants attended the meetings. All opinions were collected by means of questionnaires filled out by the participants. All documents regarding the meeting are available for validation.

E.2. Summary of the comments received:

The consultation gave an opportunity for the stakeholders to fully understand the project. The comments received from representatives of the local communities are summarized in the following points:

- Does the project beneficiate people of the surrounding community when it begins operations?
- Who is going to take responsibility for the damage to the roads and urban areas caused by the movement of dump trucks during project construction?
- If the United Nations rejects the project activity as a CDM, all the work already done is going to be lost?
- Does EAAB have all permissions required to use the water to produce energy?
- Will the radiation from the electric substation affect the surrounding communities?
- Is the project activity going to reduce the energy tariff?
- How much money will be invested in the communities in the project area?

In addition, the local stakeholders were asked to complete a survey handed out by the project developer. The results show that stakeholders believe that the proposed CDM project activity will have positive impacts on the local, ecological, environmental, employment, and social life. All stakeholders expressed their support for the proposed project. The complete information of each stakeholder will be provided to the DOE during the validation process.

E.3. Report on how due account was taken of any comments received:

As a result, the comments received by local stakeholders were highly positive about the implementation of the project activity. During the meeting the project owner assured that:

- The construction and operation of the project would be in line with the environmental and health laws of the country and do not affect the surrounding areas.
- The project developer will hire local workers for the unskilled labour and will develop training programs to improve their skills.
- The current water rights allow other uses, such as mechanical use, only if it water conditions are not altered.
- The project developer has an agreement with the authorities to fix the roads and urban areas affected when the construction activities have finished.
- The substation will not generate radiation that can affect the communities.
- The project depends on the incentives generated by the CDM.
- According to the national regulations, the energy generated must be sold to the national grid, thus the tariff for the energy in the region does not depend on the project developer.

In addition, during the meeting EAAB informed of its voluntary commitment to invest a certain percentage of the CER revenues in activities to protect the Chingaza water basin.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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<u>Annex 2</u>

INFORMATION REGARDING PUBLIC FUNDING

No public funding from an Annex I Party has been involved in financing this project activity.

Annex 3

BASELINE INFORMATION

The grid emission factor is determined according to the tool to calculate the emission factor for an electricity system, as a combined margin emission factor, consisting of the combination of the operating margin and the build margin emission factors. The detailed calculation, as well as all the information used for it, is shown in the spreadsheet prepared by the project developer. The following table summarizes the grid emission factor calculation for an ex ante estimation.

Operating Margin Emission Factor	
Year	2010
Electricity generation – low cost/must run (MWh)	40,731,237
CO_2 emissions – low cost/must run (tCO_2)	0
Electricity generation – no low cost/must run (MWh)	16,068,817
CO_2 emissions – no low cost/must run (tCO_2)	10,628,434.4
λ_y	0.0154
Operating Margin Emission factor (tCO_2/MWh)	**0.6512**
Build Margin Emission Factor	
Electricity generation in 2010 (MWh)	56,422,515
20% of electricity generation in 2010 (MWh)	11.284,503
Electricity generation of the power plant capacity additions that comprises 20% of the system generation in 2010, including CDM plants and more than 10 years (MWh)	16,267,711.4
CO_2 emissions of the power plant capacity additions that comprises 20% of the system generation in 2010 (tCO_2)	4,754,185
Build Margin Emission factor (tCO_2/MWh)	**0.2984**
Combined Margin Emission Factor	
Combined Margin Emission Factor, weighted 50% (tCO_2/MWh)	**0.4749**

Table: Summary of emission factor calculation

Annex 4

MONITORING INFORMATION

All relevant information has been presented in Sections B.7.