



**Monitoring report form for CDM project activity**  
**(Version 07.0)**

**MONITORING REPORT**

<b>Title of the project activity</b>	Rio Amoyá Run-of-River Hydro Project	
<b>UNFCCC reference number of the project activity</b>	3461	
<b>Version number of the PDD applicable to this monitoring report</b>	6	
<b>Version number of this monitoring report</b>	Version 2	
<b>Completion date of this monitoring report</b>	24/09/2019	
<b>Monitoring period number</b>	Third Monitoring Period	
<b>Duration of this monitoring period</b>	01/06/2017 – 30/06/2019	
<b>Monitoring report number for this monitoring period</b>	N/A	
<b>Project participants</b>	ISAGEN S.A. E.S.P.	
<b>Host Party</b>	Colombia	
<b>Applied methodologies and standardized baselines</b>	ACM0002-version 12.1.0 “Consolidated baseline methodology for grid-connected electricity generation from renewable sources”	
<b>Sectoral scopes</b>	Sectoral Scope 1: Energy industries (renewable - /non-renewable sources)	
<b>Amount of GHG emission reductions or net anthropogenic GHG removals achieved by the project activity in this monitoring period</b>	<b>Amount achieved before 1 January 2013</b>	<b>Amount achieved from 1 January 2013</b>
	0	326,030 tCO <sub>2</sub> e
<b>Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the PDD</b>	368,006 tCO <sub>2</sub> e	

## SECTION A. Description of project activity

### A.1. General description of project activity

The Rio Amoyá Run-of-River Hydro Project ( "Project"), consists of a greenfield run-of-river power plant with a nominal capacity of 80 MW and an anticipated generation of approximately 513.6 GWh/year, based on the projected generation resulting from engineering studies contracted by ISAGEN S.A. E.S.P. ("ISAGEN") in 1998 and 2005. The power plant is connected to the national grid through an 18.6 km transmission line.

The Project is considered not only as a power plant, but also as an "Environmental Services Project". It contributes to decrease the global emissions of carbon through the substitution of polluting fuels as a source of electric power generation; and with its multiple benefits and capacity to yield and consolidate economic resources, it will contribute to the conservation and protection of the Amoyá River's basin and to the conservation of the *Las Hermosas Páramo* ecosystem. About the environmental effects, the plant, thanks to its characteristics of being a run-of-river-intake hydroelectric with no dam, and the simplicity involving the civil works, had a minimum environmental impact, since it involved no settlement relocation or displacement whatsoever, it had a low effect on the ecosystems in the area of influence and its land requirements were minimal.

The Project was expected to start its operation in 2011 and to reduce about 1.2 million tCO<sub>2</sub>e by 2018. However, the construction spent more time because of different circumstances and the plant started commercial operation on May 30th 2013.

### A.2. Location of project activity

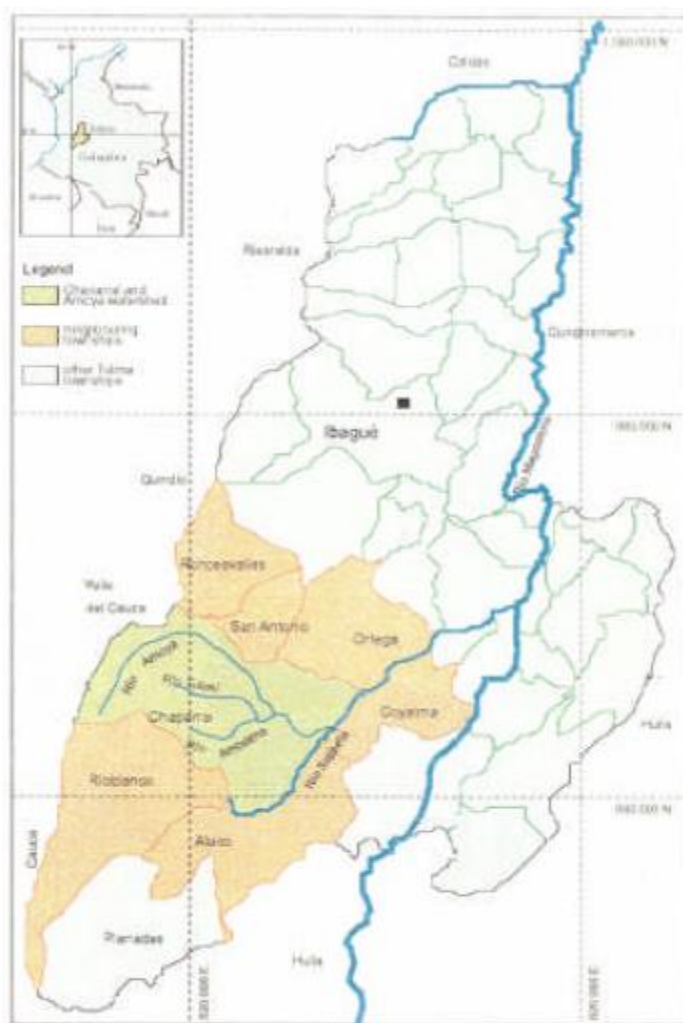
The Project is located in the middle section of the Amoyá River Basin in the municipality of Chaparral, Tolima province, Colombia. Chaparral is 262 Km from Colombia's capital, Bogota. The Amoyá River receives waters from Las Hermosas Páramo ecosystem.

The upper reaches of the Amoyá River basin are conformed by a Páramo ecosystem. This high altitude ecosystem is considered of major importance given its great ecological value and the multiple environmental services it provides. Both reasons make the relation with the Project of particular relevance. Páramos in the Amoyá area form the largest patch in the Central Cordillera. Out of the Páramo total area; there are 650 km<sup>2</sup> under protection status in the Páramo de las Hermosas National Park; 27% of this area is in the Amoyá River basin.

**Project's Coordinates**

	Y	X	Latitude	Longitude
Bogotá	N 1'000,000.000	E 1'000,000.000		
Power house	N 912,781.836	E 831,653.566	3° 48' 22"	-75° 35' 35"
Intake	N 917,584.603	E 824,852.432	3° 50' 58"	-75° 39' 15"

Civil works and generation equipment are located around the geographical coordinates 75° 40' W and 3° 50' N along the Amoyá River, at elevations between 1,486 and 939 meters above mean sea level, downstream from where the Davis River joins the Amoyá River.



Map 1. Location of project area: Chaparral and Amoyá river watershed in Tolima province

**Figure 1:** Geographical localization of the project activity

### A.3. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Republic of Colombia (host Party)	ISAGEN S.A. E.S.P. - Private entity	No

### A.4. References to applied methodologies and standardized baselines

The ACM0002-version 12.1.0 “Consolidated baseline methodology for grid-connected electricity generation from renewable sources” is chosen as the most relevant to the project activity. This methodology, as applied in this project activity, also refers to the latest approved version of the following Tools: (i) the tool to calculate the emission factor for an electricity system (version 02 - <https://cdm.unfccc.int/methodologies/PAMethodologies/tools/am-tool-07-v2.pdf>), and (ii) the tool for the demonstration and assessment of additionality (version 05.2 - <https://cdm.unfccc.int/methodologies/PAMethodologies/tools/am-tool-01-v5.2.pdf>).

### A.5. Crediting period type and duration

The crediting period is a Renewable period for 7 years; from 01/07/2012 to 30/06/2019, (first and last days included).

This third monitoring period is for two operational years and one month: from 01/06/2017 to 30/06/2019 (first and last days included).

## SECTION B. Implementation of project activity

### B.1. Description of implemented project activity

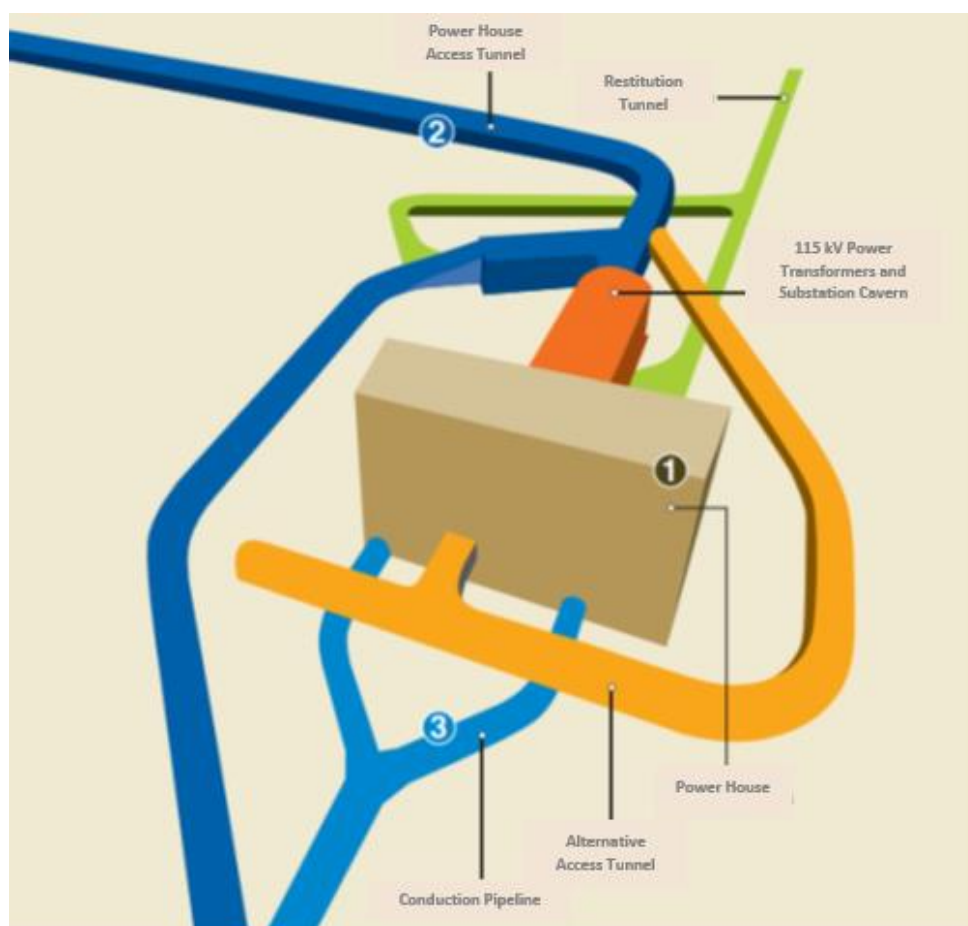
The Rio Amoyá Run-of-River Hydro Project began operations at cero (0:00) hours of May 30 2013, and it was implemented according to the PDD approved by UNFCCC.

The underground powerhouse takes advantage of maximum flow 18.4 m<sup>3</sup>/s. The powerhouse has two Pelton turbines with a capacity of 40 MW each and two generators with a rated capacity 45.7 MVA each. The net generation of the project was 948.038 GWh during the period to be verified.

The run-of-river power plant was built as stated in the PDD. It uses the water flow of the Amoyá and Davis rivers (See Figure 2).

The main components of the plant are:

- 1- Powerhouse: It has two generators with a capacity of 40 MW each.
- 2- Penstock: Access to tunnel Powerhouse.
- 3- Inflow: Conduction Pipeline



**Figure 2.** Amoyá hydroelectric power plant diagram

The key technical data of the hydro turbines and the generators of the project is listed in Table 1.

**Table 1.** Technical data of the hydro turbines, generators and energy measurement equipment

Element	Value/description	Unit	Brand/Serial
Pelton Turbines (2)			

Element	Value/description	Unit	Brand/Serial
Vertical axis (2)	40	MW	VOITH and ANDRITZ <sup>1</sup>
Valves (2)	1.10 m D	Meters	
Synchronic generator (2)	45.7	M V A	VOITH / 1DH5949-3WF07-Z Built numbers: SP.08.003438.02 and SP.08.003438.01
	13.8 nominal	kV	
Load Bridge	800	kN	MOCOM/120T/16T
Transformers (2)	13.8/115	kV	SIEMENS
Sub-station GIS	115	kV	SIEMENS/ION 9610
Sub-station Tuluní	115	kV	POWER LOGIC: ION8650

## B.2. Post-registration changes

### B.2.1. Temporary deviations from the registered monitoring plan, applied methodologies, standardized baselines or other methodological regulatory documents

N/A

### B.2.2. Corrections

N/A

### B.2.3. Changes to the start date of the crediting period

The new start date of the crediting period is 1 of July 2012. This change was approved by UNFCCC by PRC-3461-001 on September 21<sup>st</sup>, 2016.

### B.2.4. Inclusion of monitoring plan

N/A

### B.2.5. Permanent changes to the registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other methodological regulatory documents

Two permanent changes to the monitoring plan were approved (PRC-3461-001 of September 21<sup>st</sup>, 2016) by the EB in the revised PDD (version 06, 20/04/2016). Both changes are:

- A correction to modify in the PDD the name of the Colombian National Dispatch Center (CND) as XM, which is the Company in charge of planning, supervision and control of generation and transmission of the national electricity system.
- Section B.7.1. of the PDD titled *Data and parameters to be monitored*, was modified to clarify the procedure for cross-checking the energy delivered to the national grid adding the text: *"To cross-check the electricity delivered by the Amoyá Hydroelectric Power Plant to the grid, the hourly energy measured per day in the commercial frontier in Tuluní Substation, must be compared with the last XM report published."*

### B.2.6. Changes to project design

N/A

### B.2.7. Changes specific to afforestation or reforestation project activity

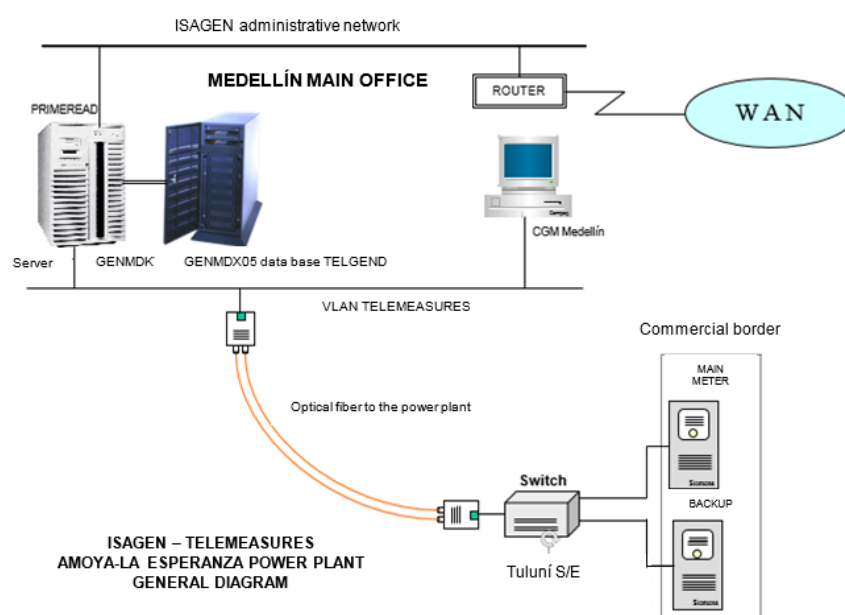
N/A

## SECTION C. Description of monitoring system

The Monitoring Plan (MP) defines a baseline against which it is possible to measure the Rio Amoyá Run-of-River Hydro Project performance in terms of its greenhouse gas (GHG) emissions and

<sup>1</sup> Two backup Vertical Axis of 40 MW each were purchased by ISAGEN to ANDRITZ, which are operating on the time of this Report.

emission reductions that can be monitored and verified in conformity with the modalities and procedures of the Clean Development Mechanism.



**Figure 3.** Operational and Management Structure

ISAGEN has incorporated explicitly into its internal procedures a detailed description of the activities regarding to the adequate management of the CDM monitoring system, including the roles and responsibilities associated with those activities (Eg. Internal procedure number 0029).

ISAGEN has formed a multidisciplinary team, coordinated by the Production Department (*Gerencia de Producción*) which is responsible to monitor the parameters, to record them and to analyse the data. Since the project will be using an Ex-Ante option for the grid emission factor, the only parameter to monitor for upcoming verifications is the actual electricity dispatched to the grid. This is relatively simple process, as the Colombian interconnected system relies on a highly regulated metering setup, which is required for the electricity accountability and payments.

As per the metering, the Amoyá hydroelectric power plant is equipped with multi-function electronic metering devices, which register all information that needs to be monitored, such as exported energy, imported energy, power factor, electric tension, electric flow, etc. It is mandatory to install a backup equipment in addition to the main meter. The metering devices are located at the commercial frontier at the Tuluní substation, located 18.6 km away from the power plant. Before the starting of commercial energy exchanges in the wholesale market system, the equipment needs to be duly certified by authorized entities<sup>2</sup>.

Information recorded by the metering equipment is sent every 24 hours to the Commercial Exchange System, operated by the National Dispatch Center (XM). All energy transactions are registered every hour. ISAGEN sends every day, before 8:00 am, the recorded values of the day before. According to that information, the National Dispatch Center (XM) processes the bills and payments for all transactions performed in the wholesale market. All this information is available to the market agents and to the system control authorities.

The Production Management Unit keeps a periodical maintenance and calibration program according to the codes approved by law, and following recommendations by the equipment providers.

<sup>2</sup> Following Decree 2269 of 1993.

ISAGEN saves the data in the internal software ZSIGEN. The data system is composed by software and hardware that allow recording the data collected at the meters automatically. Using a system called PRIMEREAD, all data for outgoing and incoming energy are measured so that net electricity records are kept in files.

For verification purposes, the data will be easily available at ISAGEN. In addition, historic records of actual energy supplied to the grid are publicly available at the XM website [www.xm.com.co](http://www.xm.com.co).

## SECTION D. Data and parameters

### D.1. Data and parameters fixed ex ante

Data/Parameter	$EF_{grid,CM,y}$
Unit	tCO <sub>2</sub> /MWh
Description	Combined margin CO <sub>2</sub> 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"
Source of data	Ex-ante calculations
Value(s) applied	0.3439
Choice of data or measurement methods and procedures	As per the "Tool to calculate the emission factor for an electricity system".
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	As per the "Tool to calculate the emission factor for an electricity system". This value is calculated ex-ante and will be used throughout the crediting period.

### D.2. Data and parameters monitored

Data/Parameter	$EG_{PJ,y}$
Unit	MWh
Description	Net electricity displaced by the project activity during year y
Measured/calculated/default	Measured. Hourly values. XM monitors the value of this variable. It also keeps records for its customers.
Source of data	Data supplied by ISAGEN for ex-ante calculation, and later by XM for verification purposes. Data supplied by ISAGEN used for ex-ante calculations.
Value(s) of monitored parameter	948,038 MWh

Monitoring equipment	<p>According to Colombian regulations, the electricity generated by each power plant connected to the grid will be monitored using metering equipment located at the commercial frontier of every plant. For Amoyá, this equipment is located at the Tuluní substation (Chaparral Municipality) and the commercial frontier is identify with the XM code Frt19972. An 18.6 km - 115 kV transmission line connects the plant and the Tuluní substation. This substation links the plant with the regional interconnected system. In Colombia, The Measurement Code “Código de Medida” establishes mandatory high technical standards, procedures for reading, registering and recording activities of electricity transactions performed in the Colombian energy market, according to the resolution CREG 038 of 2014 (Measurement Code).</p> <p>The measuring equipment located at Tuluni has the following characteristics:</p> <p style="text-align: center;"><b>Principal Measurement Equipment</b></p> <table border="1" data-bbox="675 674 1291 994"> <tr><td>Type/Brand</td><td>POWER LOGIC: ION8650</td></tr> <tr><td>Accuracy class</td><td>CL active accuracy:0.2S CI reactive accuracy: 2</td></tr> <tr><td>Serial number</td><td>MW-1511A832-02</td></tr> <tr><td>Calibration frequency</td><td>2 years</td></tr> <tr><td>First Calibration date</td><td>25/01/2016</td></tr> <tr><td>Validity Period</td><td>2016-2018</td></tr> <tr><td>Calibration Certificate</td><td>19919742-1-1</td></tr> <tr><td>Last Calibration date</td><td>23/01/2018</td></tr> <tr><td>Validity Period</td><td>2018-2020</td></tr> <tr><td>Calibration Certificate</td><td>180123-64574</td></tr> </table> <p style="text-align: center;"><b>Backup Measurement Equipment</b></p> <table border="1" data-bbox="675 1084 1291 1404"> <tr><td>Type/Brand</td><td>POWER LOGIC: ION8650</td></tr> <tr><td>Accuracy class</td><td>CL active accuracy:0.2S CI reactive accuracy: 2</td></tr> <tr><td>Serial number</td><td>MW-1511A833-02</td></tr> <tr><td>Calibration frequency</td><td>2 years</td></tr> <tr><td>First Calibration date</td><td>25/01/2016</td></tr> <tr><td>Validity Period</td><td>2016-2018</td></tr> <tr><td>Calibration Certificate</td><td>19919742-2-1</td></tr> <tr><td>Last Calibration date</td><td>24/01/2018</td></tr> <tr><td>Validity Period</td><td>2018-2020</td></tr> <tr><td>Calibration Certificate</td><td>180123-64575</td></tr> </table> <p>Additional to the Measurement Code, ISAGEN has implemented an administrative document (reference 0545) that defines the internal policy regarding to the technical characteristics, calibration conditions, maintenance of measurement equipment, etc.</p>	Type/Brand	POWER LOGIC: ION8650	Accuracy class	CL active accuracy:0.2S CI reactive accuracy: 2	Serial number	MW-1511A832-02	Calibration frequency	2 years	First Calibration date	25/01/2016	Validity Period	2016-2018	Calibration Certificate	19919742-1-1	Last Calibration date	23/01/2018	Validity Period	2018-2020	Calibration Certificate	180123-64574	Type/Brand	POWER LOGIC: ION8650	Accuracy class	CL active accuracy:0.2S CI reactive accuracy: 2	Serial number	MW-1511A833-02	Calibration frequency	2 years	First Calibration date	25/01/2016	Validity Period	2016-2018	Calibration Certificate	19919742-2-1	Last Calibration date	24/01/2018	Validity Period	2018-2020	Calibration Certificate	180123-64575
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Last Calibration date	24/01/2018																																								
Validity Period	2018-2020																																								
Calibration Certificate	180123-64575																																								
Measuring/reading/recording frequency	Hourly measurement and monthly recording.																																								
Calculation method (if applicable)	N/A																																								
QA/QC procedures	All metering devices used to monitor and measure data follow rules that have been summarized in resolution CREG 038 of 2014. This resolution specifies the technical measurement, telecommunications and back-up equipment characteristics to meet installation, testing, certification, operation and maintenance procedures.																																								
Purpose of data/parameter	This information is required to calculate baseline emissions																																								
Additional comments	N/A																																								

**D.3. Implementation of sampling plan**

N/A

## SECTION E. Calculation of emission reductions or net anthropogenic removals

### E.1. Calculation of baseline emissions or baseline net removals

The Baseline emissions are calculated as follows, according to the Consolidated Baseline Methodology ACM0002 version 12.1.0:

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

$BE_y$  = Baseline emissions in year  $y$  (tCO<sub>2</sub>e)

$EG_{PJ,y}$  = 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<sub>2</sub> 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 v.02"* (tCO<sub>2</sub>e/MWh) in year  $y$

THIRD MONITORING PERIOD (June 1 2017 - June 30 2019)		
Year	Month	Net electricity supply to the Grid (MWh)
2017	June	47,224
	July	50,232
	August	50,847
	September	39,948
	October	38,717
	November	42,220
	December	33,307
2018	January	34,850
	February	4,106
	March	14,457
	April	44,866
	May	48,595
	June	41,250
	July	53,969
	August	52,365
	September	43,236
	October	38,309
	November	42,878
	December	26,687
2019	January	19,399
	February	17,557
	March	27,942
	April	36,474
	May	46,772
	June	51,829
TOTAL		948,038

**E.2. Calculation of project emissions or actual net removals****Methodology:**

Determine the net annual project electricity output for the period under verification from the XM (the official database of the National Dispatch Center), which can be accessed from the website, <http://informacioninteligente10.xm.com.co>. The output is available in kWh.

- Use the ex-ante combined emission factor calculated in the PDD.
- Multiply the project actual electricity supply to the Grid by the combined emission factor for the Colombian interconnected electricity grid.
- *Total CERs generated by the project for the period are calculated as:*

$$ER_y = BE_y - PE_y - L_y$$

Where:

$ER_y$  = Emission reductions in year  $y$  (tCO<sub>2</sub>e/yr.)

$BE_y$  = Baseline emissions in year  $y$  (tCO<sub>2</sub>/yr.)

$PE_y$  = Project emissions in year  $y$  (tCO<sub>2</sub>e/yr.)

$PE_y$  is the project emissions in year  $y$  and

$L_y$  refers to leakage in year  $y$  as defined in the methodology ACM0002 (ver. 12.1.0 -“Consolidated baseline methodology for grid-connected electricity generation from renewable sources”).

According to the PDD,  $PE_y = 0$  and  $LE_y = 0$

**E.3. Calculation of leakage emissions**

According to the PDD, 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 transport). These emissions sources are neglected.

**E.4. Calculation of emission reductions or net anthropogenic removals**

	Baseline GHG emissions or baseline net GHG removals (tCO <sub>2</sub> e)	Project GHG emissions or actual net GHG removals (tCO <sub>2</sub> e)	Leakage GHG emissions (tCO <sub>2</sub> e)	GHG emission reductions or net anthropogenic GHG removals (tCO <sub>2</sub> e)		
				Before 01/01/2013	From 01/01/2013	Total amount
<b>Total</b>	326,030	0	0	0	326,030	326,030

**E.5. Comparison of emission reductions or net anthropogenic removals achieved with estimates in the registered PDD**

Amount achieved during this monitoring period (tCO <sub>2</sub> e)	Amount estimated ex ante for this monitoring period in the PDD (tCO <sub>2</sub> e)
326,030	368,006

**E.5.1. Explanation of calculation of “amount estimated ex ante for this monitoring period in the PDD”**

The amount estimated ex ante for this monitoring period, corresponds to two years and one month of operation of the Project.

Taking into account that the estimated annual Project generation is 513,6 GWh, resulting in an emissions reductions of 176,643 tCO<sub>2</sub>, and a monthly emissions reductions of 14,720.25 tCO<sub>2</sub>. For the period under evaluation, two years and one month, the amount estimated ex ante would be 368,006 tCO<sub>2</sub>.

**E.6. Remarks on increase in achieved emission reductions**

N/A.

**E.7. Remarks on scale of small-scale project activity**

N/A

## Document information

<i>Version</i>	<i>Date</i>	<i>Description</i>
07.0	31 May 2019	Revision to: <ul style="list-style-type: none"> <li>• Ensure consistency with version 02.0 of the “CDM project standard for project activities” (CDM-EB93-A04-STAN);</li> <li>• Add a section on remarks on the observance of the scale limit of small-scale project activity during the crediting period;</li> <li>• Add "changes specific to afforestation or reforestation project activity" as a possible post-registration changes;</li> <li>• Clarify the reporting of net anthropogenic GHG removals for A/R project activities between two commitment periods;</li> <li>• Make editorial improvements.</li> </ul>
06.0	7 June 2017	Revision to: <ul style="list-style-type: none"> <li>• Ensure consistency with version 01.0 of the “CDM project standard for project activities” (CDM-EB93-A04-STAN);</li> <li>• Make editorial improvements.</li> </ul>
05.1	4 May 2015	Editorial revision to correct version numbering.
05.0	1 April 2015	Revisions to: <ul style="list-style-type: none"> <li>• Include provisions related to delayed submission of a monitoring plan;</li> <li>• Provisions related to the Host Party;</li> <li>• Remove reference to programme of activities;</li> <li>• Overall editorial improvement.</li> </ul>
04.0	25 June 2014	Revisions to: <ul style="list-style-type: none"> <li>• Include the Attachment: Instructions for filling out the monitoring report form (these instructions supersede the "Guideline: Completing the monitoring report form" (Version 04.0));</li> <li>• Include provisions related to standardized baselines;</li> <li>• Add contact information on a responsible person(s)/ entity(ies) for completing the CDM-MR-FORM in A.6 and Appendix 1;</li> <li>• Change the reference number from <i>F-CDM-MR</i> to <i>CDM-MR-FORM</i>;</li> <li>• Editorial improvement.</li> </ul>
03.2	5 November 2013	Editorial revision to correct table in page 1.
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB 70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01.0	28 May 2010	EB 54, Annex 34. Initial adoption.

<i>Version</i>	<i>Date</i>	<i>Description</i>
Decision Class: Regulatory Document Type: Form Business Function: Issuance Keywords: monitoring report		