# Project design document form
## (Version 11.0)

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

| BASIC INFORMATION | |
|---|---|
| **Title of the project activity** | Project 0122: Agua Fresca Multipurpose and environmental services project |
| **Scale of the project activity** | ☐ Large-scale<br>☒ Small-scale |
| **Version number of the PDD** | 6 |
| **Completion date of the PDD** | 12/08/2020 |
| **Project participants** | Energía del Río Piedras S.A. E.S.P. |
| **Host Party** | Colombia |
| **Applied methodologies and standardized baselines** | AMS-I.D. Grid connected renewable electricity generation, version 18. |
| **Sectoral scopes** | 01: Energy industries - Renewable sources |
| **Estimated amount of annual average GHG emission reductions** | 11,577 $tCO_2e$ |

## SECTION A. Description of project activity

### A.1. Purpose and general description of project activity

Agua Fresca Project in its first stage, it is a hydroelectric run-of river power generation project, with a design flow of 2.7 $m^3/s$, an installed capacity of 7.49 MW and an annual production of 63.3 GWh.

The connection of the Project to the National Electrical Grid is done in the Municipality of Fredonia, in the Fredonia Substation of Empresas Públicas de Medellín - EPM. For this, a 44 kV transmission line with a length of 15 km was built. It is estimated that the project will displace yearly in the third crediting period 11,577 $tCO_2e$, by displacing the power generation of the thermal plants in the Colombian Electric Sector.

The project reuses the water from the discharge of Rio Piedras Hydroelectric Plant. In case this plant is not operating or operating with a flow less than 2.7 $m^3/s$, Agua Fresca Power Plant counts with a secondary intake structure that takes water directly from the river. In this way, Agua Fresca project is independent and has an increased reliance in its operation.

The Administration, Operation and Maintenance of the Plant is performed by Generadora Unión S.A.S.

The second stage of the project comprehends the construction of a regional aqueduct to provide water for human consumption as for irrigation to the lands and settlements located in the Cauca River canyon between La Pintada and Bolombolo, harnessing the hydrological resource contributed by the Piedras River. This is still in financial evaluation.

The construction of the regional aqueduct is expected to develop according to the area real demand warrants. The current state of the second stage of Agua Fresca Multipurpose Project has no impact on it as Project Clean Development Mechanism.

The project has environmental license granted by the Environmental Authority – Corantioquia. Also, the project is in line with the national policies and programs by promoting the use of renewable energy sources - Law 697 of 2001 and Law 1715 of 2014 which controls the integration of non-conventional renewable energies into the National Energy System.

The Agua Fresca Project is considered not only as a project of electric power generation and aqueduct, but also as an "Environmental Services Project", since 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 Piedras River's basin.

It is estimated that the project will displace yearly from the beginning of the third crediting period 11,577 $tCO_2e$, based on a combined emission factor of 0.1829 $tCO_2e/MWh$. To calculate the emission factor was applied la Methodological tool: "Tool to calculate the emission factor for an electricity system", version 07.0.0.

About the environmental effects, Agua Fresca Project, thanks to its characteristics of being a run of-river-intake project with no dam, and the simplicity involving the civil works, has a minimum environmental impact, since it involves no settlement relocation or displacement whatsoever, it has a low effect on the ecosystems in the area of influence and its land requirements are minimal.

Additionally, the reduction of 2.7 $m^3/s$ of the Piedras River's flow in the section of the river located between the discharge of the Río Piedras Power Plant and its mouth to the Cauca River will help to control the erosion of the shores in this section, which have been qualified by experts as geologically unstable.

Agua Fresca Multipurpose and Environmental Services Project contributes to local sustainable development with the investment of 20% of the revenue generated by the sale of carbon certificates, which is intended for the administration and maintenance of Jerico's Botanical Garden and its articulation with Las Nubes Natural Reserve, and also financial support to the Historical Center of Jerico's Municipality.

Agua Fresca Multipurpose and Environmental Services Project contribute to sustainable development in different ways:

- Shows the potential of run-of-river power plants as alternative to conventional hydropower or thermo power plants, encouraging the construction of run-of-river plants in the Country. These plants produce sustainable development mechanisms using small resources in different places in the Country.

- Plants of this type contribute to the reduction of polluting particles in the Country, which can else be discharged by thermo power plants.

- Developed great knowledge and nationwide experience in the construction of run-of river power plants; also strengthen the national institutional capacities focused to the consolidation of competitive advantages to participate in the international carbon market.

- Demonstrates the potential value of the environmental services in the region, through the recognition of the role of the natural forest ecosystems in the generation of electric power and in the production and acquisition of the resources destined to their conservation and protection.

- The local community has obtained benefits with short term social programs, becoming a key element to assure the approval, backup, and participation of the community in the project and its complementary activities.

## A.2. Location of project activity

Agua Fresca Multipurpose and Environmental Services Project is located in the Republic of Colombia at the municipality of Jericó (Department of Antioquia) within the area of influence of the Río Piedras Basin (Piedras River Basin).

Jericó is at the south west of the department of Antioquia, in the Colombian Andes, with an altitude ranging from 600 m to 3,000 m. The project is located in the lower part of Piedras River Basin, near the Cauca River and the sector of Puente Iglesias. Whit geographic coordinates 5°49'53.66'' North and 75°43'34,38'' West (Powerhouse location).

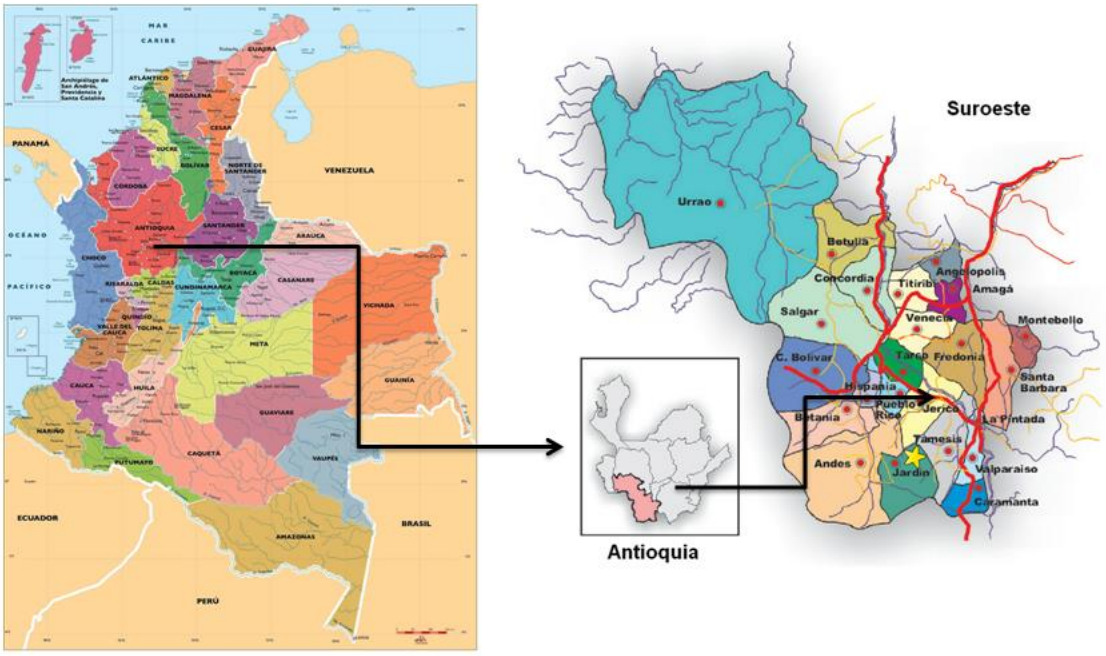


**Figure 1. Project location**

## A.3. Technologies/measures

Agua Fresca Project in its first stage, it is a hydroelectric run-of river power generation project, with a design flow of 2.7 $m^3/s$, an installed capacity of 7.49 MW and an average annual production of 63.3 GWh.

The connection of the Project to the National Electrical Grid is done in the Municipality of Fredonia, in the Fredonia Substation of EPM. For this, a 44 kV transmission line with a length of 15 km was built. It is estimated that the project will displace yearly 11,577 $tCO_2e$ for its third crediting period, by displacing the power generation of the thermal plants in the Colombian Electric Sector.

Essential technical aspects:

- Run-of-the river facility. The project does not imply the construction of dam of reservoir.
- Installed Capacity: 7.49 MW
- Power Factor (cosine ø): 0.925
- Design Flow: 2.7 $m^3/s$
- Total Head: 327 m
- Power generation: 63.3 GWh / year
- Basin: Río Piedras. The project reuses the waters of Rio Piedras Hydroelectric Plant.
- Secondary intake structure
- Water inlet to back.
- Powerhouse at surface.
- For electricity generation, technologies are employed: One Pelton turbine with vertical axis of 7.49 MW, 720 rpm, and five jets, with 327 m of total head. One synchronic generator of 8.08 MVA and 4.16 kV of nominal tension.
- Connection to the grid: transmission line (44 kV) 15 km length.
- Emission reduction: 11,577 $tCO_2e$ per year (for third crediting period).
- Administration, Operation and Maintenance of the Plant by Generadora Unión S.A.S.
- Monitoring equipment: bidirectional main and backup meters class 0.2S, are installed in Fredonia Substation, measuring the power delivered to the national grid (see Figure 2).

- Phase II of the project: Aqueduct (this issue it's not included into the budget of the project and its financial evaluation).

A Pelton turbine with vertical axis and a rated capacity of 7.49 MW is used to generate power making use of the kinetic energy carried by the fast-flowing stream and the potential energy between the entry and exit points of the project. This obviate the need for water storage and the use of reservoirs, therefore avoiding potential environmental and social impacts in the area. Pelton turbines have been extensively utilized in hydroelectric projects around the world and in Colombia.

Since the start of operations Agua Fresca Power Plant operates continuously every day of the year, 24 hours a day, optimally and efficiently, except on days that are performed maintenance.

These maintenances are classified into three groups:

1. *Minor preventive and corrective* are in charge of the plant operators.

2. *Preventive, predictive and corrective elderly* are made by the maintenance team and are scheduled repeatedly according to the traceability of equipment.

3. The major corrective Emergency: become immediately due to no time for any type of programming and will be attended by staff of the maintenance team.

There is an annual program of preventive and predictive maintenance for Agua Fresca Power Plant. The general maintenance of the power plant is performed once a year.

### A.4. Parties and project participants

| Parties involved | Project participants | Indicate if the Party involved wishes to be considered as project participant (Yes/No) |
|---|---|---|
| Colombia | Energía del Río Piedras S.A. E.S.P. | No |

### A.5. Public funding of project activity

Energía del Río Piedras S.A. E.S.P. is a Private Society. There is not public funding in the Agua Fresca Multipurpose and Environmental Services Project. For this reason, Appendix 2 is not applicable.

### A.6. History of project activity

1**.** Project Participant - PP hereby confirms that: The proposed CDM project activity is neither registered as a CDM project activity nor included as a component project activity (CPA) in a registered CDM programme of activities (PoA); The proposed CDM project activity is not a project activity that has been deregistered.

2. PP further declares that: The proposed CDM project activity was not a CPA that has been excluded from a registered CDM PoA; No registered CDM project activity or a CPA under a registered CDM PoA whose crediting period has or has not expired (hereinafter referred to as former project) exists in the same geographical location as the proposed CDM project activity.

### A.7. Debundling

Agua Fresca Power Plant is a product of an initiative from Aguas de la Cabaña (now called Energía del Río Piedras), who saw the opportunity for the optimal utilization of water resource of

the Piedras River. This resource was seized by constructing an independent power plant. In turn, this plant not only takes advantage of the Piedras River, but also uses the water discharged by the Río Piedras Power Plant, located upstream of the Agua Fresca Power Plant.

Project 0122: Agua Fresca Multipurpose and environmental services project is an independent project and is not tied to any large-scale project. It was validated and registered by Aguas de la Cabaña (now called Energía del Río Piedras) in January 7th, 2006 as small-scale project and is in commercial operation since April 2008.

Project participants report that there is not another project with the characteristics specified regarding modalities and procedures for small-scale project under the CDM:

a. With the same project participants;
b. In the same project category and technology/measure; and
c. Registered within the previous 2 years; and
d. Whose project boundary is within 1 km of the project boundary of the proposed small- scale activity at the closest point.

## SECTION B. Application of methodologies and standardized baselines

### B.1. References to methodologies and standardized baselines

The project activity is developed under the approved consolidated baseline and monitoring Small Scale Methodology AMS-I.D. "*Grid-connected renewable electricity generation"* (version 18.0)[1].

Also, following the AMS-I.D., version 18.0 guidelines, it is applied for the renewable of the crediting period:

a. TOOL07 "Tool to calculate the emission factor for an electricity system" (version 07.0)[2]
b. TOOL11 "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period" (Version 03.0.1)[3] is also applied.

### B.2. Applicability of methodologies and standardized baselines

Category I.D – Grid connected renewable electricity generation from AMS-I.D (version 18.0) - this methodologies comprises renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal, and renewable biomass, that supply electricity to a national or a regional grid:

| Item | Applicability conditions - AMS-I.D version 18.0 | Project Activity |
|---|---|---|
| 1 | This methodology comprises renewable energy generation units, such as photovoltaic, ***hydro***, tidal/wave, wind, geothermal and renewable biomass:<br>**a. Supplying electricity to a national or a regional grid**; or<br>b. Supplying electricity to an identified consumer facility via national/regional grid through a contractual arrangement such as wheeling. | Agua Fresca Project is a hydroelectric renewable energy generation project with an installed capacity lower than 15 MW (7.49 MW) that will be connected to the national grid by a 44 kV transmission line, 15 km length. |

[1] See document: https://cdm.unfccc.int/methodologies/DB/W3TINZ7KKWCK7L8WTXFQQOFQQH4SBK
[2] See document: https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v7.0.pdf
[3] See document: https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-11-v3.0.1.pdf

| Item | Applicability conditions - AMS-I.D version 18.0 | Project Activity |
|---|---|---|
| **2** | Illustration of respective situations under which each of the methodology (i.e. AMS-I.D, AMS-I.F and AMS-I.A) applies is included in the appendix-Table 1. | Project supplies electricity to the Colombian National Grid. Therefore, as described in Table 1 of the methodology, AMS-I.D. is suitable to the proposed project activity. |
| **3** | This methodology is applicable to project activities that:<br>**a. Install a new power plant at a site where there was no renewable energy power plant operating prior to the implementation of the project activity (Greenfield plant);**<br>b. Involve a capacity addition;<br>c. Involve a retrofit of (an) existing plant(s); or<br>d. Involve a replacement of (an) existing plant(s). | The project activity applied to:<br>a. Install a new power plant at a site where there was no renewable energy power plant operating prior to the implementation of the project activity (Greenfield plant); |
| **4** | Hydro power plants with reservoirs that satisfy at least one of the following conditions are eligible to apply this methodology:<br>a. The project activity is implemented in an existing reservoir with no change in the volume of reservoir;<br>b. The project activity is implemented in an existing reservoir, where the volume of reservoir is increased and the power density of the project activity, as per definitions given in the Project Emissions section, is greater than 4 $W/m^2$;<br>c. The project activity results in new reservoirs and the power density of the power plant, as per definitions given in the Project Emissions section, is greater than 4$W/m^2$. | Agua Fresca hydroelectric project involves renewable energy power generation through the installation of a run-of-river Small Hydroelectric Plant without reservoir. Thus, this condition does not apply. |
| **5** | If the new unit has both renewable and nonrenewable components (e.g., a wind/diesel unit), the eligibility limit of 15MW for a small scale CDM project activity applies only to the renewable component. If the new unit co-fires fossil fuel, the capacity of the entire unit shall not exceed the limit of 15 MW. | The proposed project activity has not non-renewable components. Hence, it does not co-fire fossil fuels. The maximum output capacity of Agua Fresca hydroelectric project is 7.49 MW, and which will not increase beyond 15 MW. |
| **6** | Combined heat and power (co-generation) systems are not eligible under this category | Not applicable. The proposed project activity does not correspond to a combined heat and power system. |
| **7** | In the case of project activities that involve the capacity addition of renewable energy generation units at an existing renewable power generation facility, the added capacity of the units added by the project should be lower than 15 MW and should be physically distinct1 from the existing units. | Not applicable. As discussed above, the proposed project activity corresponds to a Greenfield plant. |
| **8** | In the case of retrofit, rehabilitation or replacement, to qualify as a small-scale project, the total output of the retrofitted, rehabilitated or replacement power plant/unit shall not exceed the limit of 15 MW. | Not applicable. As discussed above, the proposed project activity corresponds to a Greenfield plant with a capacity of less than 15 MW. |

| Item | Applicability conditions - AMS-I.D version 18.0 | Project Activity |
|---|---|---|
| 9 | In the case of landfill gas, waste gas, wastewater treatment and agro-industries projects, recovered methane emissions are eligible under a relevant Type III category. If the recovered methane is used for electricity generation for supply to a grid, then the baseline for the electricity component shall be in accordance with procedure prescribed under this methodology. If the recovered methane is used for heat generation or cogeneration other applicable Type-I methodologies such as "AMS-I.C.: Thermal energy production with or without electricity" shall be explored. | The proposed project activity involves the installation of a Greenfield Hydroelectric power plant. Thus, this condition is not applicable. |
| 10 | In case biomass is sourced from dedicated plantations, the applicability criteria in the tool "Project emissions from cultivation of biomass" shall apply | The proposed project activity involves the installation of a Greenfield Hydroelectric power plant. Thus, this condition is not applicable. |

Also, the project activity complies with the applicability conditions of Tool to calculate the emission factor for an electricity system, version 07.0[4], as presented below:

| Item | Applicability of the TOOL07 | Project activity |
|---|---|---|
| 1 | This tool may be applied to estimate the OM, BM and/or CM when calculating baseline emissions for a project activity that substitutes grid electricity that is where a project activity supplies electricity to a grid or a project activity that results in savings of electricity that would have been provided by the grid (e.g. demand-side energy efficiency projects). | The proposed project activity substitutes grid electricity that is where a project activity supplies electricity to a grid or a project activity that results in savings of electricity that would have been provided by the grid. Therefore, use the TOOL07 to estimate the OM, BM and/or CM to calculate its baseline emissions. Please refer to section B.6. of current PDD. |
| 2 | Under this tool, the emission factor for the project electricity system can be calculated either for grid power plants only or, as an option, can include off-grid power plants. In the latter case, two sub-options under the step 2 of the tool are available to the project participants, i.e. option IIa and option IIb. If option IIa is chosen, the conditions specified in "Appendix 1: Procedures related to off-grid power generation" should be met. Namely, the total capacity of off-grid power plants (in MW) should be at least 10 per cent of the total capacity of grid power plants in the electricity system; or the total electricity generation by off-grid power plants (in MWh) should be at least 10 per cent of the total electricity generation by grid power plants in the electricity system; and that factors which negatively affect the reliability and stability of the grid are primarily due to constraints in generation and not to other aspects such as transmission capacity. | The proposed project activity calculates the emission factor for the project electricity system including only grid power plants, as an option given by the TOOL07. See section B.6. for the Emission Factor calculation explanation. |
| 3 | In case of CDM projects the tool is not applicable if the project electricity system is located partially or totally in an Annex I | The proposed CDM project activity is located in Colombia, a non-Annex I country. Thus, this condition is not applicable. |

[4] See TOOL07 v7: https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v7.0.pdf

| | | |
|---|---|---|
| | country. | |
| **4** | Under this tool, the value applied to the $CO_2$ emission factor of biofuels is zero | The proposed project activity applied zero to the $CO_2$ emission factor of biofuels, for its emission factor calculation. |

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

According to the methodology AMS-ID: Grid connected renewable electricity generation, Version 18.0. The spatial extent of the project boundary includes the project power plant connected physically to the electricity system. Thus, the project boundary is the spatial extent of the project includes the power plant and all power plants connected physically to the National Electric Grid.

This is shown in the following scheme:

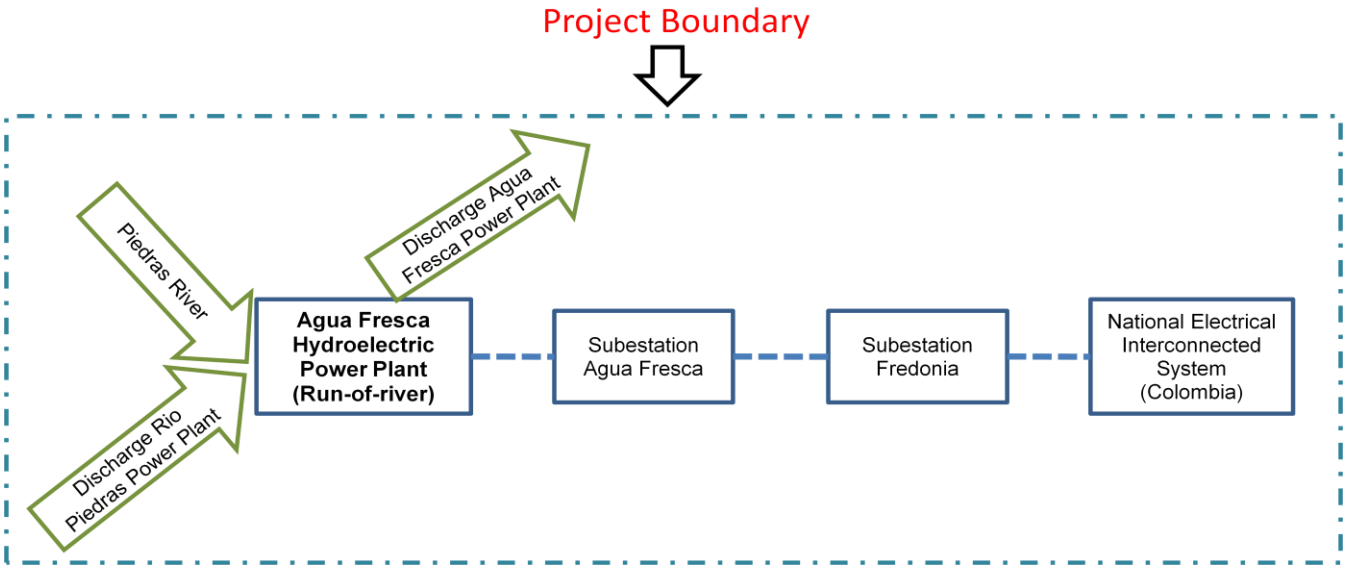


**Figure 2. Project Boundary**

The spatial extension of the limits of the project includes the physical location of the project (Agua Fresca Hydroelectric Power Plant) and all plants connected to the National electricity System (National Interconnected System of Colombia -SIN[5]), which will be connected to the Hydroelectric Power Plant. The power plants of this grid are all connected and can be dispatched without significant transmission constraints.

[5] In Spanish: *Sistema Interconectado Nacional - SIN*

| Source | | GHG | Included? | Justification/Explanation |
|---|---|---|---|---|
| Baseline | $CO_2$ emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity | $CO_2$ | Yes | Main emission source |
| | | $CH_4$ | No | Minor emission source |
| | | $N_2O$ | No | Minor emission source |
| | | --- | No | No other emission sources |
| Project activity | For hydro power plants, emissions of $CH_4$ from the reservoir | $CO_2$ | No | The project has no reservoir |
| | | $CH_4$ | No | The project has no reservoir |
| | | $N_2O$ | No | The project has no reservoir |
| | | --- | No | The project has no reservoir |

## B.4. Establishment and description of baseline scenario

The hydroelectric power plant project of Agua Fresca is based on the construction of a new plant that will be integrated in the National Interconnected System of Colombia. The system is composed of a combination of power plants that consume fossil fuels and plants that use renewable energy sources.

As stated in the approved Small-scale methodology AMS-I.D. Grid connected renewable electricity generation, version 18: If the project activity is the installation of a Greenfield power plant, the baseline scenario is the following:

Electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in the "Tool to calculate the emission factor for an electricity system – version 7.0".

Therefore, the baseline scenario consists of the electricity that would have been generated and delivered to the grid in the absence of the proposed project activity by:

- Other plants currently connected to the SIN; and
- New capacity additions to the SIN.

Hence, the baseline scenario is identified as the continuation of the common practice of power generation, i.e. mainly large hydro power plants with reservoirs and thermal power stations (Fuel oil, natural gas and coal), that emit large quantities of carbon dioxide ($CO_2$) to the atmosphere.

For the third crediting period, the continued validity of the original baseline has been assessed, following the stepwise procedure, according to the TOOL11 "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period" (version 03.0.1),

***Step 1: Assess the validity of the current baseline for the next crediting period***

***Step 1.1: Assess compliance of the current baseline with relevant mandatory national and/or sectoral policies***

For the third crediting period of the project, the baseline complies with existing rules and policies established from the Colombian Ministry of Environment and Sustainable Development, the Ministry of Mines and Energy, and UPME (Mining and Energy Planning Unit).

The Ministry of Mines and Energy and Energy Mining Planning Unit (UPME) is in charge of development the National Electricity Sector Expansion Plan which is a reference or indicative plan

based on the criteria established in both the PND (National Development Plan)[6] and the PEN (National Energy Plan)[7].

The national strategic elements related to the electricity sector are summarized below:

- Attend the electricity demand with a reliability higher than 95% in the long term.

- Enhance the availability of firm capacity through the addition of thermal based capacity.

- Improve system's efficiency through the installation of clean efficient technology.

- Diversify the sources of electricity generation in the system, in the context of the availability of domestic energy resources.

Increased reliance on thermal-based generation capacity. After severe droughts, registered during the 1990s (i.e. 1992, 1997), that caused power shortages with associated forced rationing, the system has encouraged the development of more thermal generation capacity, specifically with the intention of increasing the share of firm capacity and enhancing the system's reliability of supply. The increase in thermal share of the SIN (National Interconnected System) has also been the indirect result of the withdrawal of the public sector in large investments and the reluctance of private generators to enter the hydroelectric generation and associated environmental and social requirements. Therefore, future additions to the power mix to attend the projected growth in demand are anticipated to be thermal based. While this responds to the need for flexibility and robustness of the system, the increase in thermal share contributes to the gradual increase of GHG emissions by the sector and the release of local criteria pollutants (such as NOx and, SOx particulates and volatile hydrocarbons, which have been linked to health of exposed populations).

The fuel conversion (from coal, oil to gas) as a source of energy is harmful to the environment and clearly increases local air pollution and GHG emission releases. Actually, natural gas-based power plants are being rapidly built in Latin America to the detriment of non-GHG emitting technologies. Indeed, there is a general tendency to an increase in the regional thermal generation share and a decrease in non-fossil fuel-based generation such as hydropower.

Run-of-the river power plants provide a good example of non-GHG emitting power generation projects that address both local environment needs and global environmental problems such as climate changes. In these terms, the project fulfils national and environmental priorities:

- It is consistent with national ratification of the Kyoto Protocol and associated voluntary commitments regarding global climate change mitigation.

- It is consistent with regional and local needs in terms of supplying sustainable electricity.

- It is consistent with the power sector development plans since a run-of the-river power plant uses a renewable source of energy for electricity generation that produces minimum local impacts.

- From the social viewpoint the project generates employment during the administration, operation and maintenance of power plant. The company also supports the creation of community organizations for the development of the region and promotion of sustainable human development.

[6] National Development Plan – 2010-2014 – Prosperity for all. National Planning Department. Bogotá D.C., 2011.

[7] National Energy Plan – 2006 – 2025 – Context and Strategies. Mining and Energy Planning Unit – UPME -. Bogotá D.C. April de 2007.

- Additionally, the project contributes not only to the growth of the national economy through private investment but also boosts the energy sector in the country through the development of this type of renewable power generation projects.

The structure of the Colombian energy market is based on Laws 142 (Public Services Law) and 143 (Electricity Law) of 1994[8], which represent the last major reform of the power sector and establish the current regulatory framework. Since their enactment, Colombia has had a liberalized energy market, which is characterized by an unbundled generation, transmission, distribution, and commercialization scheme in order to separate the power activities and the markets. An electricity spot market and the development of a long-term contract market for electricity sales are the core of new structure to introduce a more effective framework for competition and an independent regulatory system supervised by the CREG (Regulatory Commission for Energy and Gas), created by the Law 143. This Electricity Law specifically introduced rules regarding: (i) Power sector planning; (ii) power generation; (iii) transmission and distribution; (iv) grid operation; (v) grid access fees; (vi) regime for electricity sales; (vii) concessions and contracts; and (viii) environmental issues, among others.

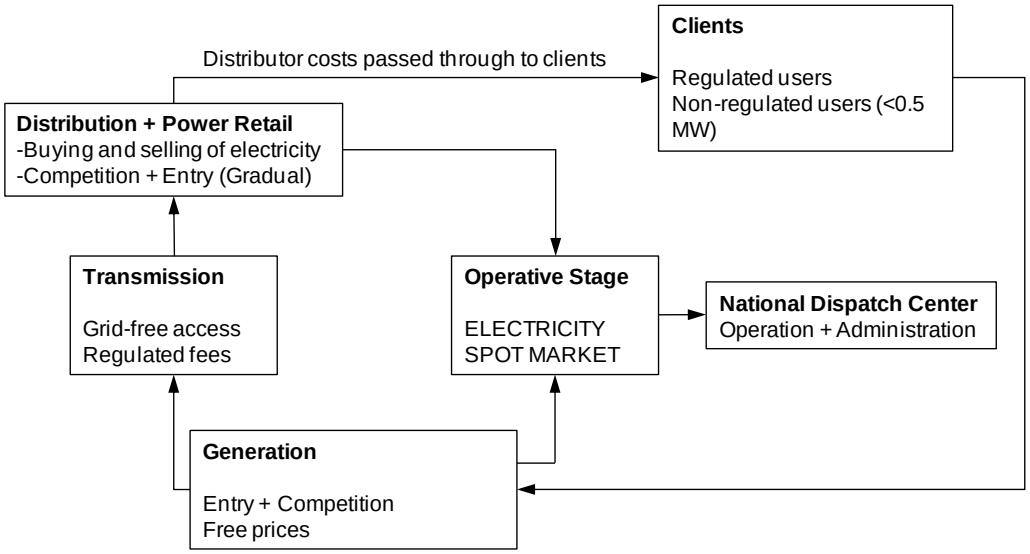


**Figure 3. Simplified Scheme of the Colombian Power Market based on Electricity Law from 1994 (Law 143).**

It can be said that the project complies with the current regulations dealing with renewable sources of power generation. Specifically, the project activity is not affected by the body of actual main regulations (see Table 1).

**Table 1. Policy compliance for the third crediting period (yes √ – not X)**

| Policy | Impact on baseline | Validity during third crediting period | Outstanding changes since issuance |
|---|---|---|---|
| Laws 142/143 of 1994 Set the norms and procedures for the generation, interconnection, transmission, distribution, and electricity commercialization | X | √ | X |

[8] Laws can be accessed on the website: http://www.creg.gov.co/cxc/secciones/documentos/leyes.htm (accessed: 12/03/2019)

| Policy | Impact on baseline | Validity during third crediting period | Outstanding changes since issuance |
|---|---|---|---|
| Resolution 055 of 1994 - Electricity market conditions | X | √ | X |
| Resolution 086 of 1996 - Power generation activities regulation | X | √ | X |
| Resolution 039 of 2001 - Establish complementary conditions | X | √ | X |
| Law 697 of 2001 - Promotes the development and use of rational and efficient sources of energy | X | √ | X |
| Law 1715 of 2014 Controls the integration of non-conventional renewable energies into the National Energy System. | X | √ | X |

Since the project was constructed and operated in a highly regulated market that is controlled by a series of public and private actors, compliance with all applicable laws and regulatory requirements is supervised and can be guaranteed.

Therefore, it can be concluded that the fundamental elements of the baseline have not changed since the project was first registered, and the market structure, regulatory framework, and functioning remains the same.

According to the above, the project activity is consistent with the Colombian National legislation and policies established in the Energy Sector of the country, therefore complies with the step 1.1.

***Step 1.2: Assess the impact of circumstances***

At the time of requesting renewal of the crediting period on the current baseline emissions, no impact of circumstances prevail. It can be concluded that the conditions used to determine the baseline emissions in the previous crediting period are still valid.
Law 1715 which promotes renewable energy has not modified prices or electricity availability. The enactment of that law has not enhanced the continuation of the baseline scenario at the time of validation.

***Step 1.3: Assess whether the continuation of use of current baseline equipment(s) or an investment is the most likely scenario for the crediting period for which renewal is requested***

Since the baseline scenario identified at the validation is the continuation of the current practice, i.e. the electricity would be supplied by the power grid in the absence of the project activity, and the baseline did not consider the use of any existing equipment by the project, because in the absence of the project activity the energy generated would have been generated by the operation of grid-connected power plants and by the addition of new generation sources to the grid, this step is not applicable.

***Step 1.4: Assessment of the validity of the data and parameters***

Relevant data and parameters, for the operating margin emission factor calculation to obtain the final combined margin emission factor, were updated for the third crediting period according to the TOOL07 - Tool to calculate the emission factor for an electricity system - version 7.0. (Build Margin emission factor remains the same for the third crediting period). This update includes the recalculation of the operating margin Emission Factor involving all values and parameters used in its calculation (fossil fuel emission factors, most recent three historical years for which Colombian grid national generation data is available, among other), see section B.6. Application of Steps 1.1, 1.2, 1.3 and 1.4 above confirmed that the current baseline remains valid for the third crediting period; even though, some data and fixed parameters needed to be updated due to changes presented above. In this context step 2 is assessed below.

***Step 2: Update the current baseline and the data and parameters***

***Step 2.1: Update the current baseline***

Baseline emissions for the third crediting period have been updated in accordance with the stated above in step 1.4., without reassessing the current baseline, based on the latest approved version of the methodology AMS-I.D.- Grid connected renewable electricity generation (version 18.0). This update was applied in the context of the sectoral policies and circumstances that are applicable at the time of requesting for renewal of the crediting period, which have not changed as to affect the project dispatch.

***Step 2.2: Update the data and parameters***

As said in step 1.4, the parameters regarding the grid emission factor calculation have been updated for this third crediting period using TOOL07 - Tool to calculate the emission factor for an electricity system - version 7.0. The build margin emission factor stablished for the second crediting period remains for the third crediting period applying the ex-ante option, in the contrary, the operating margin emission factor was reevaluated applying the ex-ante option. More details can be seen in section B.6 and B.7 (updated monitoring parameters).

## B.5. Demonstration of additionality

Not applicable, remains additionality demonstration for the first crediting period. SSC-PDD-FORM[9] Version 01 (21 January 2003).

## B.6. Estimation of emission reductions

### B.6.1. Explanation of methodological choices

As per the application of the Procedure for Renewal of the Crediting Period of a Registered CDM Project Activity Version – TOOL 11, for the project the baseline remains the same and is updated only the calculation of the project emissions reductions with recent emission factor and methodology of monitoring.

In accordance with this, the Agua Fresca Power Plant, is governed by the following existing methodology and tools:

[9] See document - https://cdm.unfccc.int/Projects/DB/DNV-CUK1132831273.89/view?cp=1

- Methodology:
  - *Category*: AMS-I.D.- Grid connected renewable electricity generation.
  - *Name*: Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories.
  - Version: 18.0

- Tool:
  - *Name:* Tool to calculate the emission factor for an electricity system,
  - Version: 07.0.0, TOOL07.

In accordance with this methodology, the reduction of emissions is the difference between the baseline emissions (characterised by their absence from the project) and the emissions of the project. In this type of renewable energy projects, the direct emissions are non-significant. Likewise, since there is no reservoir, leakages can also be considered as very low. Therefore, the calculation for the reduction of emissions associated to the operation of the project activity only considers the baseline emissions. Their calculation is carried out with a combined margin factor, resulting from the weighting of the two factors calculated before:

- Operating margin emission factor shows the emissions avoided as a consequence of the electrical energy previously transferred to the system by thermal power plants and which is shifted after the commissioning of the new plant.

- Build margin emission factor introduces the calculation of GHG emissions avoided as a result of the effects of increasing the capacity by adding plants to the system (for the third crediting period the same BM of the second period applies).

The National Dispatch Centre, which coordinates the electricity market trade and the operations of the National Interconnected Electricity System of Colombia, and the Mining-Energy Approach Unit of the Ministry of Mines and Energy provides the data required for the calculation of these two emission factors. With these and other sources, the following information has been gathered:

**Table 2. Basic information for baseline calculation**

| **BASIC INFORMATION FOR THE CALCULATION OF THE BASELINE** | |
|---|---|
| **Data** | **Source** |
| Fuel emission factor | Fuel Emissions Factor database of Colombia published by UPME (FECOCupme.xls) |
| Heat Rate | XM - Associated Services Management, C*ompañía de Expertos en Mercados S.A. E.S.P. Source: http://paratec.xm.com.co/paratec/SitePages/generacion.aspx?q=capacidad CREG Resolution 005 of 2010* |
| Total electricity generated by all power plants connected to the National Interconnected System of Colombia | XM - Associated Services Management, C*ompañía de Expertos en Mercados* |
| Total hourly generation of the System | XM - Associated Services Management, C*ompañía de Expertos en Mercados* |
| Type of fuel used in each plant | UPME / XM |

**Baseline emissions**

The baseline scenario and the emission rate calculation are based on the electricity that otherwise would have been generated by the plants connected to the grid and by addition of future plants.

Baseline emissions are calculated by multiplying the combined margin emission factor ($EF_{grid,CM,y}$, in $tCO_2e/MWh$) by the electricity generated for the project activity during the year y ($EG_{PJ,y}$, in MWh).

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

The relevant methodological approaches and formulas are presented below.

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

Where:

$BE_y$ = Baseline emissions in year *y* ($tCO_2/yr$)

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

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

Since it is a green-field project, according to Eq. (2) of AMS-I.D (version 18.0),

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

**Calculation of Combined Margin Emission Factor - $EF_{grid,CM,y}$**

The combined margin emission factor ($EF_{grid,CM,y}$) is calculated following the methodological tool "Tool to calculate the emission factor for an electricity system" (version 07.0) by applying the following steps:

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

In the following it is explained how each step is applied.

STEP 1. Identify the relevant electricity systems.

For determining the electricity emission factors, the project electricity system is defined by the spatial extent of the power plants that are physically connected through transmission and distribution lines to the run of river hydro power plant and that can be dispatched without significant transmission constraints. In this case, the project electricity system is given as the National Interconnected System (SIN).

For the purpose of determining the operating margin emission factor, the $CO_2$ emission factor(s) for net electricity imports is chosen as 0 t $CO_2$/MWh.

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

In accordance with the tool, this step is optional. For the proposed project activity, off-grid power plants are not included in the project electricity system (Option 1).

STEP 3. Select a method to determine the operating margin (OM).

In accordance with the tool, the calculation of the operating margin emission factor ($EF_{grid,OM,y}$) is based on one of the following methods:

(a) Simple OM; or
(b) Simple adjusted OM; or
(c) Dispatch data analysis OM; or
(d) Average OM.

For the project activity, the simple adjusted OM is applied, using the *ex-ante* option:

*Ex ante option: if the ex-ante option is chosen, the emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emissions factor during the crediting period is required. For grid power plants, use a 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation. For off-grid power plants, use a single calendar year within the five most recent calendar years prior to the time of submission of the CDM-PDD for validation.*

*Therefore, the years 2017-2018-2019 have been chosen based on the most recent data available at the time of submission of the CDM-PD for validation.*

All power plants connected to the SIN are included. Power plants registered as CDM project activities are also included as suggested by the tool. Historical data of the three most recent years is available from XM (grid operator and administrator[10]).

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

The simple adjusted operating margin emission factor $EF_{grid,OM-adj,y}$ ($tCO_2e/MWh$) is a variation of the simple operating margin emission factor , where the power sources (including imports) are separated in low-cost/must-run power sources (k) and other power sources (j), as follows:

$$EF_{grid,OM-adj,y} = (1 - \lambda_y) \cdot \frac{\sum_m EG_{m,y} \cdot EF_{EL,m,y}}{\sum_m EG_{m,y}} + \lambda_y \cdot \frac{\sum_k EG_{k,y} \cdot EF_{EL,k,y}}{\sum_k EG_{k,y}} \quad \textbf{(3)}$$

Where:

| | | |
|---|---|---|
| $\lambda_y$ | = | Factor expressing the percentage of time when low-cost/must-run power units are on the margin in year y |
| $EG_{m,y}$ | = | 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) |
| $EF_{EL,m,y}$ | = | $CO_2$ 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 ($tCO_2/MWh$) |
| 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 |

The lambda factor (λ) is determined as:

$$\lambda = \frac{Number\ of\ hours\ per\ year\ low-\text{cost}/must\ -run\ sources\ are\ on\ the\ margin}{8760\ hours\ per\ year} \quad \textbf{(4)}$$

[10] www.xm.com.co

According to the methodology, the number of hours low-cost/must-run sources are on the margin is obtained through the following procedure (see Figure 4 below):

Step i) Plot a Load Duration Curve

Collect chronological load data (typically in MW) for each hour of the year y and sort the load data from the highest to the lowest MW level. Plot MW against 8760 hours in the year in descending order.

Step ii) Organize Data by Generating Sources

Collect electricity generation data from each power plant/unit. Calculate the total annual generation (in MWh) from low-cost/must-run power plants/units.

Step iii) Fill Load Duration Curve

Fill the load duration curve. Plot a horizontal line across the load duration curve such that the area under horizontal line and the curve right from the intersection point (MW times hours) equals the total generation (in MWh) from low-cost/must-run power plants/units

Step iv) Determine the "Number of hours per year low-cost/must-run sources are on the margin"

Determine the "Number of hours for which low-cost/must-run sources are on the margin in year y. First, locate the intersection of the horizontal line plotted in Step (iii) and the load duration curve plotted in Step (i). The number of hours (out of the total of 8760 hours) to the right of the intersection is the number of hours for which low-cost/must-run sources are on the margin. If the lines do not intersect, then one may conclude that low-cost/must-run sources do not appear on the margin and lambda is equal to zero.

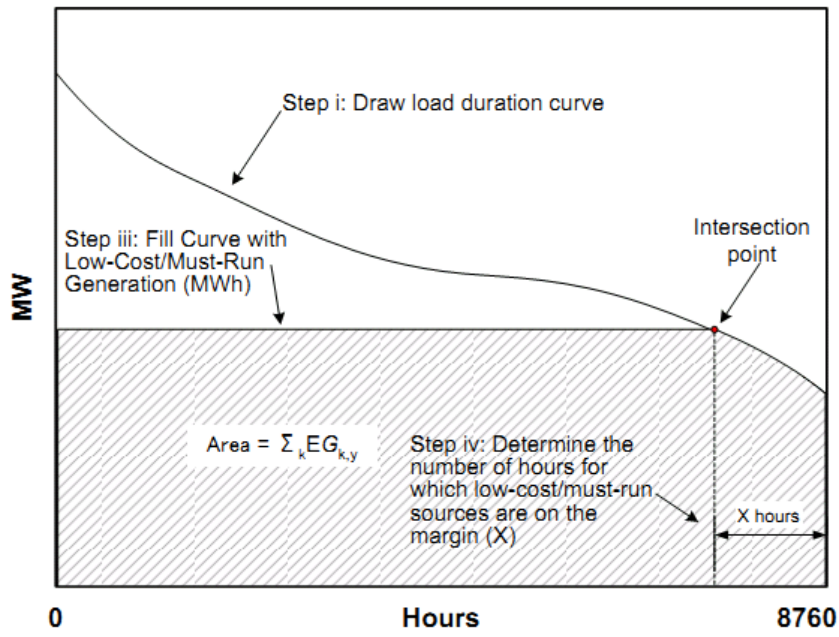


**Figure 4. Illustration of Lambda calculation for simple adjusted OM method.**

(Note: Step (ii) is not shown in the figure; it deals with organizing data by source.)

The detailed calculations of lambda are provided in the Excel file "EF Agua_Fresca 2017-2019_v2.xls". The following figures show the load duration curves and the area given by low cost/must run units, and the resulting lambda.

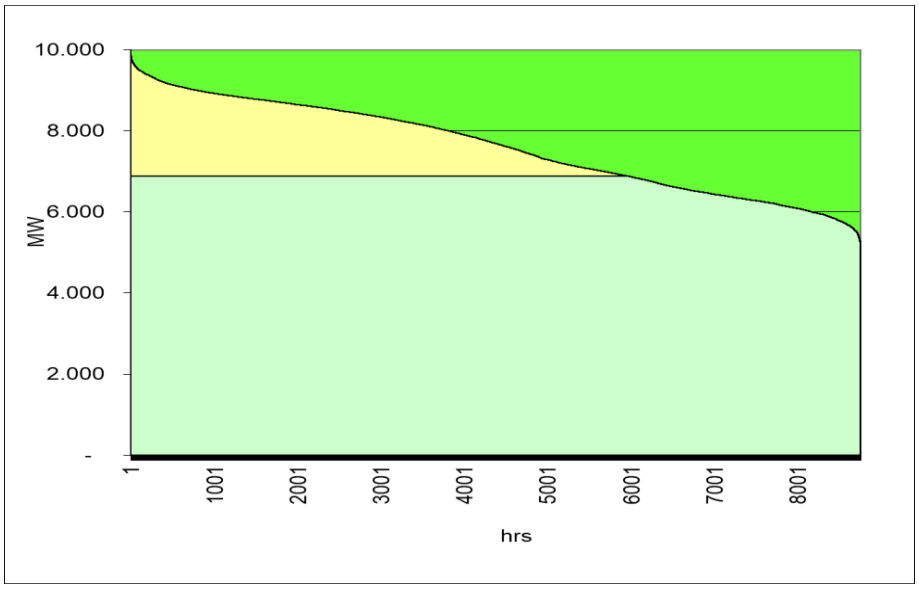


**Figure 5. Load duration curve and area given by low-cost/must-run units, and the resulting lambda in year 2017.**

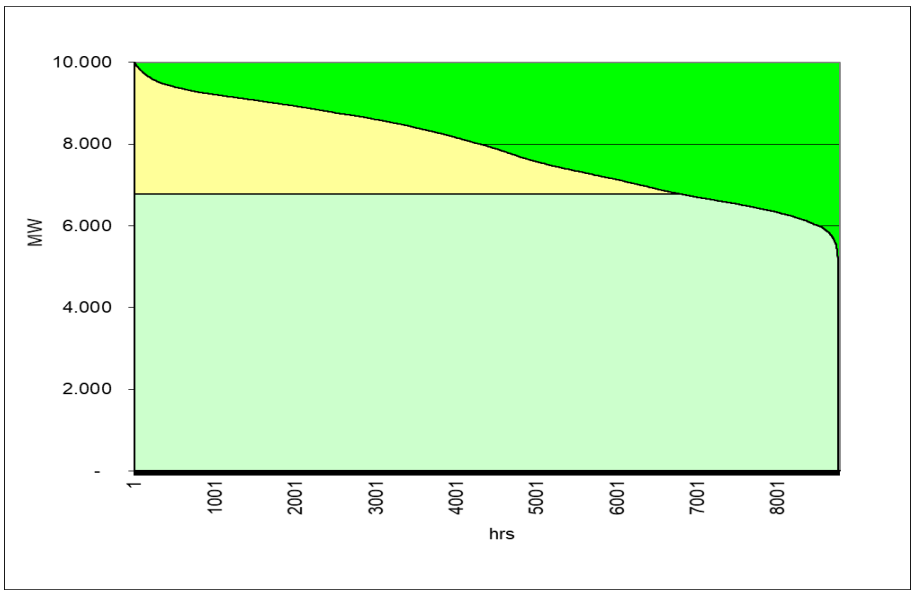


**Figure 6. Load duration curve and area given by low-cost/must-run units, and the resulting lambda in year 2018.**

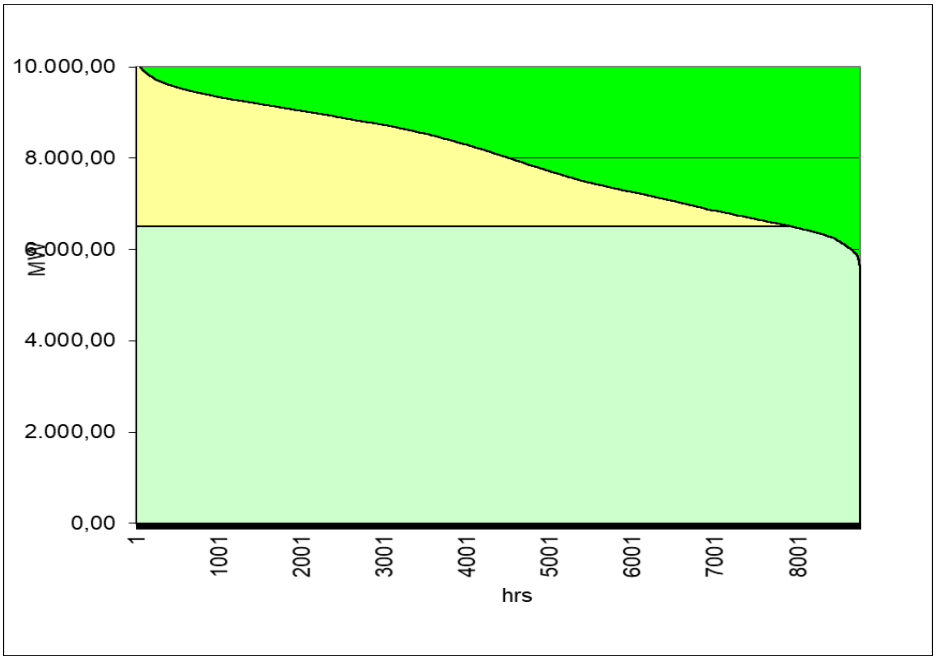


**Figure 7. Load duration curve and area given by low-cost/must-run units, and the resulting lambda in year 2019.**

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

The emission factor of each power unit *m* is determined using two options as follows:

$$EF_{EL,m,y} = \frac{\sum_i FC_{i,m,y} \times NCV_{i,y} \times EF_{CO2,i,y}}{EG_{m,y}} \quad \textbf{(5)}$$

| | | |
|---|---|---|
| $EF_{EL.m,y}$ | = | $CO_2$ emission factor of power unit m in year y ($tCO_2/MWh$) |
| $FC_{i,m,y}$ | = | Amount of fuel type I consumed by power unit m in year y (Mass or volume unit) |
| $NCV_{i,y}$ | = | Net calorific value (energy content) of fuel type I in year y (GJ/mass or volume unit) |
| $EF_{CO2,m,i,y}$ | = | $CO_2$ emission factor of fuel type i used in power unit m in year y ($t CO_2/GJ$) |
| $EG_{m,y}$ | = | 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 |
| i | = | All fuel types combusted in power unit m in year y |

For the simple adjusted OM, Option A1 y A2 are used:

Option A1 is used in the power units that the fuel consumption and electricity generation is available. Colombian power units report the fuel consumption as combustion energy (MBTU)[11], so the equation 6 is modified and the amount of fuel type in mass and net calorific value is not used.

[11] Available at: http://portalbissrs.xm.com.co/oferta/Paginas/Historicos/Historicos.aspx "Consumo de Combustible"

Option A2 based on average efficiency and electricity generation of each plant is chosen as the most appropriate approach in which fuel consumption is not available, this option is the appropriate method due to the availability of heat rates (efficiencies) of the other plants:

$$EF_{EL,m,y} = \frac{EF_{CO2,m,i,y} \times 3.6}{\eta_{m,y}} \quad (6)$$

Where:

| | | |
|---|---|---|
| $EF_{EL.m,y}$ | = | $CO_2$ emission factor of 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 ($t\ CO_2/GJ$) |
| $\eta_{m,y}$ | = | Average net energy conversion efficiency of power unit m in year y (ratio) |

By applying formulae (5) and (6) to determine the emission factor of each power plant, the results from the lambda calculation and the main equation (3) for the OM emission factor, and the corresponding generation weight for each year, the simple OM emission factor is determined as shown in Table 3.

**Table 3. Simple adjusted operating margin emission factor for the years 2017-2018-2109.**

| Parameter | 2017 | 2018 | 2019 |
|---|---|---|---|
| EF No LC/MR | 0.7278 | 0.7496 | 0.8280 |
| EF LC/MR | 0.0217 | 0.0240 | 0.0283 |
| Lambda | 0.3217 | 0.2250 | 0.0963 |
| EF OM [$tCO_2/MWh$] | **0.5006** | **0.5864** | **0.7510** |
| Generation [MWh] | **66,667,097** | **68,948,232** | **70,114,598** |
| **EF $_{OM\ Simple\ adjusted\ 2017-2018-2019}$($tCO_2/MWh$)** | | **0.6146** | |

STEP 5. Calculate the build margin (BM) emission factor

In terms of vintage of data, option 2 of the tool is chosen, i.e. the *ex-ante* approach:

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

Regarding this option chosen for the second crediting period, for the third crediting period the build margin emission factor is the same as established for second crediting period.

The BM emission factor is **0.0390 $tCO_2/MWh$**. (rounded down).[12]

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

Combined margin emissions factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM} \quad (7)$$

[12] See. Agua Fresca Multipurpose and environmental services project. V 3.1

Where:

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

The weighting of operating and build margin is done as indicated in the tool for the third crediting period, i.e. $W_{OM}$ = 0.25 and $W_{BM}$ = 0.75.

The combined margin emission factor is calculated as **$EF_{grid,CM,y}$ = 0.1829** $tCO_2$/MWh (rounded down).

### B.6.2. Data and parameters fixed ex ante

*(Copy this table for each piece of data or parameter.)*

| **Data/Parameter** | ***$EF_{grid, BM,y}$*** |
|---|---|
| Data unit | $tCO_2e$/MWh |
| Description | Build margin $CO_2$ emission factor for grid connected power generation in year *y* calculated using version 3.0 of the "Tool to calculate the emission factor for an electricity system". |
| Source of data | Calculated as per the "*Tool to calculate the emission factor for an electricity system*" version 3.0. |
| Value(s) applied | 0.0390 |
| Choice of data or measurement methods and procedures | For being the third crediting period, the build emission factor calculated for the second crediting period should be used; so that is the value applied. |
| Purpose of data | Baseline Emissions calculation |
| Additional comment | |

| **Data/Parameter** | ***$EF_{grid, OM,y}$*** |
|---|---|
| Data unit | $tCO_2e$/MWh |
| Description | Operating Margin $CO_2$ emission factor for grid connected power generation in year *y* calculated using version 7.0 of the "Tool to calculate the emission factor for an electricity system". |
| Source of data | Calculated as per the "*Tool to calculate the emission factor for an electricity system*" version 7.0. |
| Value(s) applied | 0.6146 |
| Choice of data or measurement methods and procedures | Calculated as per "Tool to calculate the emission factor for an electricity system, version 07.0" applying option ex-ante using the generation-weighted average of years 2017-2018-2019, based on the most recent data. The data is obtained from "XM System" Colombian grid operator.<br>Please check section B.6.1 of the document<br>See support document - Excel file "EF Agua_Fresca 2017-2019_v2.xls" |
| Purpose of data | Baseline Emissions calculation |
| Additional comment | |

| Data/Parameter | $EF_{grid, CM,y}$ |
|---|---|
| Data unit | $tCO_2e/MWh$ |
| Description | Combined margin $CO_2$ emission factor for grid connected power generation in year *y* calculated using version 7.0 of the "Tool to calculate the emission factor for an electricity system". |
| Source of data | Calculated as per the "*Tool to calculate the emission factor for an electricity system*" version 7.0. |
| Value(s) applied | 0.1829 |
| Choice of data or measurement methods and procedures | Calculated as per "Tool to calculate the emission factor for an electricity system, version 07.0" applying option ex-ante using the generation-weighted average of years 2017-2018-2019, based on the most recent data. The data is obtained from "XM System" Colombian grid operator.<br>Please check section B.6.1 of the document<br>See support document - Excel file "EF Agua_Fresca 2017-2019_v2.xls". |
| Purpose of data | Baseline Emissions calculation |
| Additional comment | |

### B.6.3. Ex ante calculation of emission reductions

The ex-ante calculations for the reduction of emissions are the following:

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

Where:
- *ERy* is the reduction of emissions ($tCO_{2e}$) during year y
- *BEy* are the baseline emissions during year y
- *PEy* are the project emissions during year y
- *LEy* represents the emissions due to leakages during year y

**Project emissions**

According to the applied methodology, the project emissions are calculated using the following equation:

$$PE_y = PE_{FF,y} - PE_{PG,y} - PE_{HP,y} \quad (9)$$

Where:

$PE_y$ = Project emissions in year y ($tCO_2e$)
$PE_{FF,y}$ = Project emissions from fossil fuel consumption in year y ($tCO_2$)
$PE_{GP,y}$ = Project emissions from the operation of geothermal power plants due to the release of non-condensable gases n year y ($tCO_2e$)
$PE_{HP,y}$ = Project emissions from reservoirs of hydro power plants in year y ($tCO_2e$)

The proposed project is a run of river hydro power plant that neither uses fossil fuel nor operates geothermal power. Furthermore, since the project activity has no reservoir, this step is not required, and the project emissions are zero:

$PE_y = 0$

**Leakage emissions – LEy**

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, $LE_y = 0$.

Therefore, it can be concluded that the calculation of the emission reductions only takes into account the baseline emissions:

$$ER_y = BE_y$$

As explained above in Section B.6.1, emission reductions are calculated as follows using equation (1):

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

Where:

| | | |
|---|---|---|
| $BEy = ERy$ | = | Emission reductions in year *y* ($tCO_2$) |
| $EG_{PJ,y}$ | = | Quantity of net electricity generation supplied by the project plant/unit to the grid in year *y* (MWh) |
| $EF_{grid,CM,y}$ | = | CM $CO_2$ emission factor in year *y* ($tCO_2$/MWh) |

For the ex-ante calculation of emission reductions, the quantity of net electricity supplied to the grid by the project is estimated based on the expected project average generation per year to the grid which is 63,300 MWh.

As shown above in Section B.6.1, the CM emission factor is calculated as follows using equation (7):

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

According to the Tool, for Hydro power generation projects in their third crediting period, the weights to be applied are: $w_{OM} = 0.25$ and $w_{BM} = 0.75$.

The OM emission factor is determined as 3-year generation-weighted, based on the most recent data available at the time of submission of the project documentation to the DOE for validation. Specifically, data for years 2017-2018-2019 is used, and the resulting OM emission factor is 0.6146 $tCO_2$/MWh.

The BM emission factor for the third crediting period remains the same as in the previous period, then, the applied BM emission factor is 0.0390 $tCO_2$/MWh.

Thus, the resulting CM emission factor is the following:

$EF_{grid,CM,y}$= 0.6146 $tCO_2$/MWh × 0.25 + 0.0390 $tCO_2$/MWh × 0.75 = **0.1829 $tCO_2$/MWh**

Consequently, the annual value of emission reductions estimated for the project activity is the following:

$ER_y$ = 63,300 MWh × 0.1829 $tCO_2$/MWh = **11,577 $tCO_2$**

Thus: **$ER_y$ = 11,577 $tCO_2$/y**

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

| Year | Baseline emissions (t $CO_2e$) | Project emissions (t $CO_2e$) | Leakage (t $CO_2e$) | Emission reductions (t $CO_2e$) |
|---|---|---|---|---|
| 2020 | 11,577 | 0 | 0 | 11, 577 |

| Year | Baseline emissions (t $CO_2e$) | Project emissions (t $CO_2e$) | Leakage (t $CO_2e$) | Emission reductions (t $CO_2e$) |
|---|---|---|---|---|
| 2021 | 11, 577 | 0 | 0 | 11, 577 |
| 2022 | 11, 577 | 0 | 0 | 11, 577 |
| 2023 | 11, 577 | 0 | 0 | 11, 577 |
| 2024 | 11, 577 | 0 | 0 | 11, 577 |
| 2025 | 11, 577 | 0 | 0 | 11, 577 |
| 2026 | 11, 577 | 0 | 0 | 11, 577 |
| **Total** | 81,039 | | | 81,039 |
| **Total number of crediting years** | 7 | | | |
| **Annual average over the crediting period** | 11, 577 | 0 | 0 | 11, 577 |

## B.7. Monitoring plan

### B.7.1. Data and parameters to be monitored

| Data/Parameter | $EG_{facility, y}$ |
|---|---|
| Data unit | MWh/y |
| Description | Electricity generated and delivered to the grid by the project activity |
| Source of data | GU (Generadora Unión SAS) - XM Expertos en Mercados (Colombia's Power Whole sale Market Administrator) |
| Value(s) applied | 63,300 |
| Measurement methods and procedures | Electricity meters installed complying with country regulations, records double-checked with receipt of sales. |
| Monitoring frequency | Hourly measurements |

<table>
<tr><td>QA/QC procedures</td><td>The energy meters of the Hydroelectric Power Plant located in Fredonia substation are latest generation equipment. They are calibrated for Empresas Públicas de Medellin – EPM, who is in charge to operate and maintain the substation. From July 10, 2017 the project measurement manager, who reads and transmits data from the energy meters to the National Dispatch Center through XM - Expertos en Mercado, is Gestión de Energía Consultores – CGM.<br><br>The registration information of the energy generated by the central is performed through two (2) energy meters, one is the main meter and the other is the backup meter, which are located at the Fredonia Substation. The energy meters are bidirectional. Cross check measurement results with records for sold electricity.<br><br>In 2014 after the project second crediting period renewal, in Colombia was issued a new regulatory electrical measurement code (CREG Resolution 038/2014), which enters into force by 2016. Therefore, measurement units of the energy transferred from the plant to the network will be calibrated periodically in accordance with the standards established by the national authorities or at least every 4 years according to Resolution CREG 038-2014.<br><br>
<table>
<tr><th>Measurement point type</th><th>Consumption or energy transfer (MWh-month)</th><th>Installed capacity (MW)</th></tr>
<tr><td>1</td><td>C ≥ 15.000</td><td>CI ≥ 30</td></tr>
<tr><td>2</td><td>15.000 > C ≥ 500</td><td>30 > CI ≥ 1</td></tr>
<tr><td>3</td><td>500 > C ≥ 50</td><td>1 > CI ≥ 0,1</td></tr>
<tr><td>4</td><td>50 > C ≥ 5</td><td>0,1 > CI ≥ 0,01</td></tr>
<tr><td>5</td><td>C < 5</td><td>CI < 0,01</td></tr>
</table>
<br>
<table>
<tr><th>Measurement point type</th><th>Calibration frequency (years)</th></tr>
<tr><td>1</td><td>2</td></tr>
<tr><td>2 y 3</td><td>4</td></tr>
<tr><td>4 y 5</td><td>10</td></tr>
</table>
<br>
<table>
<tr><th>Project activity</th><th>Installed capacity (MW)</th><th>Calibration frequency (years)</th></tr>
<tr><td>Agua Fresca</td><td>7.49</td><td>4</td></tr>
</table>
<br>The meters have an accuracy class of 0.2S or grater.</td></tr>
<tr><td>Purpose of data</td><td>Baseline Emissions calculation</td></tr>
<tr><td>Additional comment</td><td></td></tr>
</table>

### B.7.2. Sampling plan

Not Applicable.

### B.7.3. Other elements of monitoring plan

The Monitoring Plan is based on i) recording electricity generation of Agua Fresca Hydro Power Plant and ii) obtaining the data required to calculate the grid emission factor, electricity generation and fuel consumption of all power plants serving the interconnected national system.

Considering the project boundary and that the emission factor is determined ex-ante, the electricity generation is the only parameter to be monitored in order to calculate emissions reduction.

**Electricity Generation**

Accordingly, with the AMS I.D. – Renewable electricity generation for a grid - shall consist of metering the electricity generated by the renewable technology.

All the power generation plants in Colombia have records of their hourly generation and these records are public because of the market condition. All this information is gathered by XM Expertos en Mercados, a Colombian company that provides the integral services of operation, administration, and development for the Colombian wholesale power market. More information on this company is available in the webpage http://www.xm.com.co. The hourly generation per year of Agua Fresca project is always available at http://portalbissrs.xm.com.co/oferta[13] (go to link supply - oferta, and then to historical supply - oferta historica).

There are main and back-up meters that measure the power delivered to the national grid. These meters are maintained and calibrated by Empresas Públicas de Medellín.

The energy meters of the Power Plant located in Fredonia substation are latest generation equipment. They are calibrated for Empresas Públicas de Medellin – EPM -, who is in charge to operate and maintain the substation. From July 10, 2017 the project measurement manager, who reads and transmits data from the energy meters to the National Dispatch Centre through XM - Expertos en Mercado, is Gestión de Energía Consultores – CGM (https://gestionenergia.com.co/).

The registration information of the energy generated by the central performed through the two (2) energy meters is achieved at the Fredonia Substation - interconnection point of the project with the SIN (which is where the commercial frontier registered with the Administrator of the electrical interconnected system - XM- is be established).

**Electronic Electricity Meters**

**Table 4. Monitoring Equipment and calibration frequency**

| Meter ID/Description | Energy Meter Type | Location | Calibration fequency |
|---|---|---|---|
| SMC TR 01: Commercial Measurement System (SMC) Agua Fresca TR 01: Main Meter | Class: 0.2S | Subestation Fredonia (EPM) | Every four (4) years according to CREG Measurement Code - 038 of 2014 |
| SMC TR 02: Commercial Measurement System (SMC) Agua Fresca TR 02: Backup meter | Class: 0.2S | Subestation Fredonia (EPM) | |

**QA/QC measures**

All meters must comply with the standards established by the CREG, in terms of its specifications and calibrations. According to Resolution CREG 038 of 2014[14], article 11 and 28, it is established that by the installed capacity of the Hydroelectric Power Plant Agua Fresca (30>CI>1 MW) the measurement point is recognised as type 2 of the commercial boundary. According to this, the calibration of the equipment should be done at least every four years and must be certified by a body endorsed by XM.

[13] See web page: http://portalbissrs.xm.com.co/oferta/Paginas/Historicos/Historicos.aspx?RootFolder=%2Foferta%2FHistricos%2FGeneraci%C3%B3n&FolderCTID=0x012000B3FC86CB37661147B52CAE93637C1249&View=%7B946210C0%2D4071%2D4173%2D964C%2DED5BCCE4E66C%7D

[14] See document *9 - Resolucion-CREG-038-de-2014-codigo-de-medida.pdf*

The same resolution indicates that the system measurement elements must have a valid calibration certificate, issued by a certifying body approved by ONAC[15] (National Accreditation Body of Colombia).

Calibration tasks also follow national standards and are in accordance with the calibration instructive specified in Colombian standard NTC 4856 for electricity metering devices. In case both meters fail, no emission reductions will be claimed during that period until having again data from the main or backup meter.

It is important to remark that XM according to resolution 038 of 2014, must perform a commercial boundary verification every 5 year to the meters located at Fredonia Substation[16].

## SECTION C. Start date, crediting period type and duration

### C.1. Start date of project activity

On July 16, 2006 (16/07/2006) the contract of the Project Construction Management was signed between Aguas de la Cabaña S.A. E.S.P. (now Energía del Río Piedras S.A. E.S.P.) and Generadora Unión S.A E.S.P., date on which the process of contracting Electromechanical Equipment, Civil Works, Supervision, etc. began.

### C.2. Expected operational lifetime of project activity

50 years and 0 months

### C.3. Crediting period of project activity

#### C.3.1. Type of crediting period

Renewal crediting period, so:

- First Crediting period: 1st January 2007 – 31st December 2012
- Second Crediting period: 1st January 2013 – 31st December 2019
- Third Crediting period: 1st January 2020 – 31st December 2026

#### C.3.2. Start date of crediting period

01/01/2020

#### C.3.3. Duration of crediting period

Seven years and 0 months

## SECTION D. Environmental impacts

### D.1. Analysis of environmental impacts

The Project counts with Environmental License granted by Corantioquia.

[15] In Spanish – Organismo Nacional de Acreditación - ONAC

[16] The generation frontier and own consumption complied with the Five-Year Verification required by RES. CREG 038/2014: Generation Border: Frt00002 (05/22/2018) and Own Consumption Border: Frt10275 (06/24/2018)

About the environmental effects, Agua Fresca Multipurpose Project, thanks to its characteristics of being a run-of-river-intake project with no dam, and the simplicity involving the civil works, has a minimum environmental impact, since it involves no settlement relocation or displacement whatsoever, it has a low effect on the ecosystems in the area of influence and its land requirements are minimal. The project will not generate adverse impacts.

Additionally, the reduction of 2.7 m3/s of the Piedras River's flow in the section of the river located between the discharge of the Piedras River Power Plant and its mouth to the Cauca River, will help to control the erosion of the shores in this section, which have been qualified by experts as geologically unstable.

Since the Power Plant enters in commercial operation, approximately 20% of the annual income from the sale of the carbon emission reduction certificates is destined to sustaining during the useful life of the project the environmental investment programs structured during construction stage; which were agreed with the Municipality of Jericó and CORANTIOQUIA, the main program is the conformation and adjustment of Las Nubes Botanical Garden[17]and the contribution of a minimum monthly salary to Jerico's Historical Center.

### D.2. Environmental impact assessment

Not applicable

## SECTION E. Local stakeholder consultation

### E.1. Modalities for local stakeholder consultation

Energía del Río Piedras S.A. E.S.P. developed a consultation process with the community and local and environmental authorities during the studies stage of the project. Additionally, Energía del Río Piedras S.A. E.S.P. has met with the people of the region and the local authorities in order to inform them periodically about the development and advance of the project.

Several meetings have been made in the Municipality of Jericó with public officials from the Municipal Administration, the Counsel and the community in general where the project has been presented and the inquires of the community regarding it have been attended.

### E.2. Summary of comments received

No concerns about the project were voiced by the local stakeholders during process described above.

### E.3. Consideration of comments received

Not applicable

## SECTION F. Approval and authorization

The National Approval granted by the Ministry of Environment and Sustainable Development - MADS, who is the Designated National Authority in Colombia, of 26th November, 2004, and

[17] Support documents - See Environmental Management Plan and Attachment Environmental Investment Plan.

according to Colombian legislation in this area, does not require to be renewed, since it is given once for the entire duration of the project.

It is important to remark that National Approval granted by the Ministry of Environment and Sustainable Development was updated on August 16th, 2018 after requesting a modification of the Letter of Approval of the "Agua Fresca Multipurpose and Environmental Services Project" as a Clean Development Mechanism (CDM) activity, given that Project Participant "Aguas de la Cabaña S.A. E.S.P." changed to "Energía del Río Piedras S.A. E.S.P." [18].

[18] See document – https://cdm.unfccc.int/filestorage/Q/2/H/Q2HPWTXCM9L46E0JGZSNY5A1BIV8RK/0122_LoA%20Colombia_merged.pdf?t=M3d8cWF6MXN2fDAaOK8dppPByU2cjQXWLJdd

# Appendix 1. Contact information of project participants

| | |
|---|---|
| **Organization name** | Energía del Río Piedras S.A. E.S.P. |
| **Country** | Colombia |
| **Address** | Cra 35 # 7 - 99 Piso 2. Medellín |
| **Telephone** | (574) 312 4084 |
| **Fax** | |
| **E-mail** | sortega@gunion.com |
| **Website** | http:www.gunion.com/ |
| **Contact person** | Sergio Ortega |

# Appendix 2. Affirmation regarding public funding

Not applicable

# Appendix 3. Applicability of methodologies and standardized baselines

Not applicable

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

Not applicable

# Appendix 5. Further background information on monitoring plan

Not applicable

# Appendix 6. Summary report of comments received from local stakeholders

Not applicable

# Appendix 7. Summary of post-registration changes

As considered for the second crediting period

| Version | Date | Nature of revision |
|---|---|---|
| 02 | May 25th, 2012 | • It implemented the current format of the PDD for project activities (F-CDM-PDD) Version 04.1.<br>• It implemented Methodological Tool: "Validity of the original/current Baseline and the update the baseline at the Renewal of a crediting period". Version 03.0.1, EB 66, Annex 47, 2th March 2012.<br>• It implemented "Procedure for renewal of the crediting period of a registered CDM Project Activity", Version 06.0, EB63, Annex 29. 29th September 2011.<br>• Updated the monitoring methodology, based on the methodology for small scale projects effect on the date (Grid connected renewable electricity generation --- Version 17.0)<br>• Updated the "Tool to calculate the emission factor for an electricity system". Version 03.0.0., TOOL07. |
| 01 | January 7th, 2006 | Initial adoption. |
| | | |

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## Document information

| *Version* | *Date* | *Description* |
|---|---|---|
| 11.0 | 31 May 2019 | Revision to:<br>• Ensure consistency with version 02.0 of the "CDM project standard for project activities" (CDM-EB93-A04-STAN);<br>• Make editorial improvements. |
| 10.1 | 28 June 2017 | Revision to make editorial improvement. |
| 10.0 | 7 June 2017 | Revision to:<br>• Improve consistency with the "CDM project standard for project activities" and with the PoA-DD and CPA-DD forms;<br>• Make editorial improvement. |
| 09.0 | 24 May 2017 | Revision to:<br>• Ensure consistency with the "CDM project standard for project activities" (CDM-EB93-A04-STAN) (version 01.0);<br>• Incorporate the "Project design document form for small-scale CDM project activities" (CDM-SSC-PDD-FORM);<br>• Make editorial improvement. |
| 08.0 | 22 July 2016 | EB 90, Annex 1<br>Revision to include provisions related to automatically additional project activities. |
| 07.0 | 15 April 2016 | Revision to ensure consistency with the "Standard: Applicability of sectoral scopes" (CDM-EB88-A04-STAN) (version 01.0). |

| *Version* | *Date* | *Description* |
|---|---|---|
| 06.0 | 9 March 2015 | Revision to:<br>• Include provisions related to statement on erroneous inclusion of a CPA;<br>• Include provisions related to delayed submission of a monitoring plan;<br>• Provisions related to local stakeholder consultation;<br>• Provisions related to the Host Party;<br>• Make editorial improvement. |
| 05.0 | 25 June 2014 | Revision to:<br>• Include the Attachment: Instructions for filling out the project design document form for CDM project activities (these instructions supersede the "Guidelines for completing the project design document form" (Version 01.0));<br>• Include provisions related to standardized baselines;<br>• Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and Appendix 1;<br>• Change the reference number from F-CDM-PDD to CDM-PDD-FORM;<br>• Make editorial improvement. |
| 04.1 | 11 April 2012 | Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b. |
| 04.0 | 13 March 2012 | Revision required to ensure consistency with the “Guidelines for completing the project design document form for CDM project activities” (EB 66, Annex 8). |
| 03.0 | 26 July 2006 | EB 25, Annex 15 |
| 02.0 | 14 June 2004 | EB 14, Annex 06b |
| 01.0 | 03 August 2002 | EB 05, Paragraph 12<br>Initial adoption. |

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