**PROJECT DESIGN DOCUMENT FORM
FOR SMALL-SCALE CDM PROJECT ACTIVITIES (F-CDM-SSC-PDD)
Version 04.1**

PROJECT DESIGN DOCUMENT (PDD)

Title of the project activity	Candelaria Hydroelectric Project
Version number of the PDD	10
Completion date of the PDD	27/12/2013
Project participant(s)	Hidroeléctrica Candelaria S.A. (private entity) Ecoinvest Carbon S. A. (private entity)
Host Party(ies)	Guatemala
Sectoral scope and selected methodology(ies)	Sectoral Scope 01: Energy industries (renewable / non-renewable sources) Methodology AMS-I.D. "Grid connected renewable electricity generation" (version 17)
Estimated amount of annual average GHG emission reductions	11,800 tCO_2

SECTION A. Description of project activity
A.1. Purpose and general description of project activity

Background

The Candelaria Hydroelectric Project is a small scale, run-of river, hydroelectric project owned and operated by Hidroeléctrica Candelaria S.A. The project was registered as a CDM project activity on 09/11/2006 with the UNFCCC reference number 0604. The first 7-year renewable crediting period started on 01/01/2007 and it will end on 31/12/2013. The project proponent is applying for the renewal of the crediting period from 01/01/2014 to 31/12/2020. Thus, the registered PDD has been updated in accordance with the CDM Project Standard (version 05.0) as given in paragraphs 230 to 234. This PDD contains the necessary adjustments for the second crediting period.

Project Description

The objective of the project activity is to generate renewable electricity using hydroelectric resources and to sell the generated output to the national grid.

The project activity involves a run-of-river hydroelectric plant with an installed capacity of 4.3 MW that utilizes the water of the Trece Aguas River. This watercourse is also used for electricity generation by the Secacao 16.5 MW hydropower plant located upstream of Candelaria. The Secacao plant was developed prior to Candelaria in 1998, and is owned and operated by Candelaria's sponsors.

The total differential altitude (head) between the head pond and the turbine/generator of Candelaria plant is approximately 130 meters. The project involved the installation of a Francis type turbine and the construction of a 430 meter long tunnel and a 770 meter long penstock. Once the water has gone through the Candelaria plant, it is returned to the original river basin downstream.

The construction of Candelaria began in January of 2005. As of early November of 2005, the tunnel, intake structure and transmission line of Candelaria were finalized. From November 2005 through May 2006 the steel penstock of US manufacture was imported, transported and installed, and the remaining tasks required for plant start-up were concluded, including the powerhouse and tailrace channel construction, and the import, transport and installation of electromechanical equipment. Finally, during June 2006, plant testing and final commissioning was successfully accomplished. Candelaria officially began generating electricity for the national market on 01/07/2006.

The Candelaria plant delivers electricity to the Guatemalan Interconnected National System (*Sistema Nacional Interconectado*, SNI) through a 69 kilovolt transmission line that was built to connect the previously existing 16 MW Secacao plant. The Candelaria plant is also connected to a previously existing 13.8 kilovolt distribution line owned by a utility serving the local rural area, thus giving access to electricity to several local communities. The project has delivered an average of 24,415 MWh/year of net electricity during the period 2007-2012.

It is estimated that Guatemala has a hydroelectric potential of at least 4,000 MW. However, due to political and legal instability and the lack of long-term planning and incentives, mainly fossil fuel based power plants have been installed in the country. This is the current practice in the country and it represents the scenario existing prior to the implementation of the project and the baseline scenario. Thus, the electricity delivered to the grid by Candelaria plant would have otherwise been generated by the operation of grid-connected power plants (including fossil fuel power plants) and by the addition of new generation sources into the grid.

As a consequence, the project has the capacity to reduce CO_2 emissions by avoiding electricity generation by the fossil fuel-fired power plants connected to the grid. The project is expected to reduce an average of 11,800 tCO_2/year, totalling 82,600 tCO_2 during the second crediting period.

The project participants consider that the benefits generated by the project activity significantly favour sustainable development. Hydroelectric plants and other renewable technologies would allow Guatemala, in the medium to long-term, to achieve a more sustainable energy matrix.

Specifically, the project provides the following benefits:

- **Economic benefits:** on a national scale, the project provides clean electricity to the power market, thus reducing its dependence on imported fossil fuel.
- **Environmental benefits:** hydroelectricity is a clean generation technology and a renewable energy source. By displacing fossil fuel consumption, Candelaria not only reduces CO_2 emissions, but also mitigates other pollutants, such as SO_2, NO_x, and particulates associated with power generation. In addition, the project developers of the Candelaria, Secacao and Choloma hydroelectric plants have carried out an afforestation and reforestation plan in the areas surrounding the projects, and, with this objective, they have founded Reforestadora Polochic S. A. Moreover, in the long-term, because of its size and general characteristics (i.e., very rural area, local electricity needs), this project has a high probability of being replicated in other parts of Guatemala. This fact magnifies any global and local environmental benefits generated by the project.
- **Social benefits:** the region where the project is located has a serious chronic deficiency in electricity and work opportunities: most inhabitants have no access to either. Petén, Guatemala's largest department (administrative district), is located north of Alta Verapaz, where the project is located. The two departments lack appropriate electricity distribution networks, and large portions of the population have no access to electricity. The project delivers some of its electricity to local inhabitants, improving their quality of life. In addition, the afforestation project established by the Candelaria developers has provided hundreds of jobs for the communities surrounding the project site, and will continue to do so in the long-term.

Additionally, Candelaria directs 10% of the funds generated through the sale of CERs to an organization established by the Candelaria developers (Fundación Trece Aguas) aimed at investing in the local communities to support and strengthen schools, education, health services and infrastructure needs. The long-term aim is to structure it so that it can raise and manage funds from local and/or international aid sources, in order to continue with its mission and extend its local impact.

Revenues from the CERs sales have financed the development of several local support activities, as:

- The "Rural Electrification Project", a Public-Private Partnership carried out by Fundación Trece Aguas and the National Electricity Utility, giving access to electricity for the first time to nine communities with over 400 families, including schools, churches, community centres and small business.
- The construction and continuous operation and maintenance of the first Health Center, benefiting 11 communities and more than 4,000 people. The Health Center has a general clinic area, birthing room, sterilization area, housing for attending personnel and a training center. There are 2 nurses and a doctor working at the clinic, as well as 2 ambulance drivers, hired by Fundación Trece Aguas.
- Opening of access roads, recovery and rehabilitation of existing roads, slope stabilization and storm water management to protect schools, housing and roads from landslides danger, rehabilitation of school-buildings.

A.2. Location of project activity
A.2.1. Host Party(ies)

Guatemala

A.2.2. Region/State/Province etc.

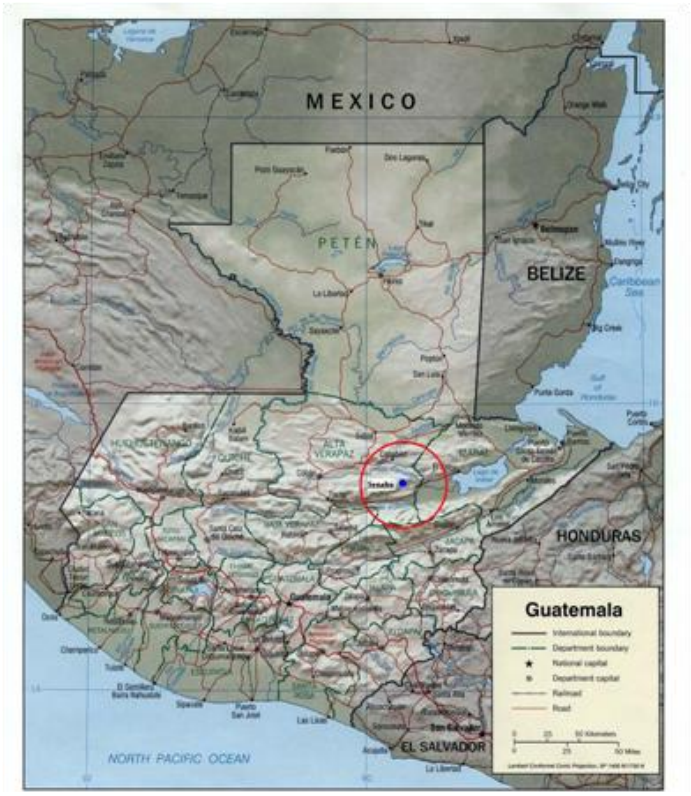
Alta Verapaz Department

A.2.3. City/Town/Community etc.

Senahú (closest town)

A.2.4. Physical/Geographical location

The project is located in the north-central area of Guatemala, on the mountain range called Sierra de Santa Cruz, in the northern area of the Polochic River Valley. The region is an agricultural area and contains large but decreasing areas of rainforest. The following figure shows a map identifying the general location of the project.



Guatemala, Alta Verapaz Department

The geographical coordinates of the power house of Candelaria plant are the following:

Latitude: 15.38695 N
Longitude: -89.75510 W

A.3. Technologies and/or measures

The purpose of the project activity is to generate renewable energy from a hydrological resource. The electricity generated by the project is delivered to the SNI, reducing power generation by thermal plants connected to the grid.

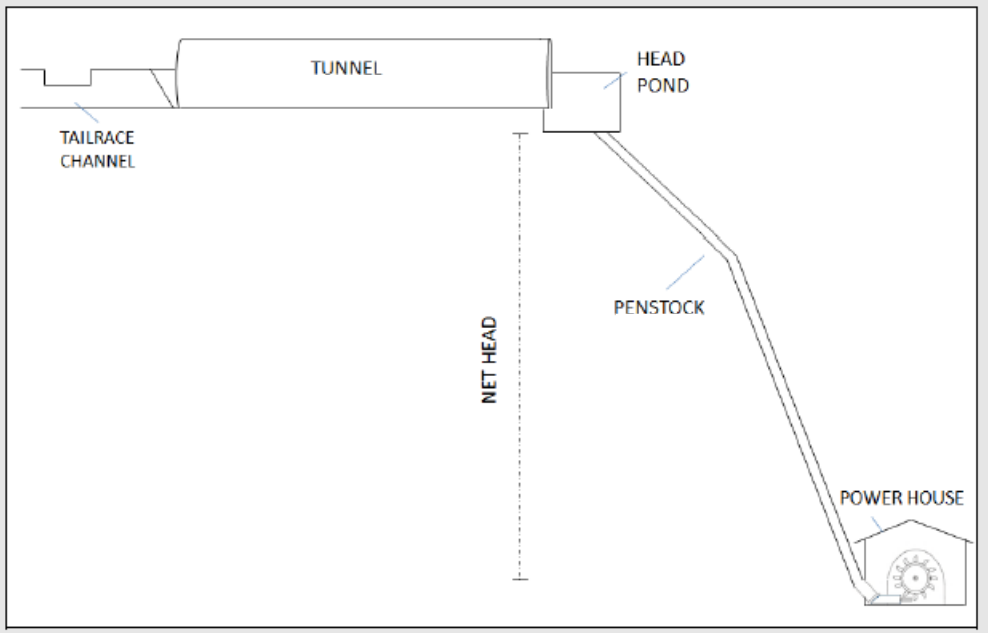
Scenario existing prior to the implementation of the project

No power plant was installed at the project site prior to the implementation of the project activity. The energy generated by the project was previously dispatched by other power plants connected to the national grid, including fossil fuel power plants. This is the scenario existing prior to the implementation of the project and it also represents the scenario that would exist in the absence of the project (i.e.: the baseline scenario).Therefore, the hydropower plant contributes to reducing emissions from those thermal power plants.

Scope of activities implemented within the project activity

Candelaria plant has an installed capacity of 4.3 MW and utilizes water from the Trece Aguas River. The total differential altitude (head) between the head pond and the turbine/generator of Candelaria plant is approximately 130 meters.

As shown in the following figure, the water flows through a tailrace channel into a 430 meter long tunnel. The water then runs through a head pond and into a 770 meters long penstock, and finally propels in a Francis type turbine located at Candelaria power house. The used water is returned to the original river basin downstream.



Candelaria's outline

The plant delivers electricity to the SNI and is connected to a 69 kilovolt transmission line. The plant also delivers part of its output locally through an existing 13.8 kilovolt distribution line, giving access to electricity to several local communities.

The Candelaria plant delivers an average of 24,415 MWh of net electricity per year[1].

The project also involves technology and know-how transfer to the host Party, as follows:

- The turbine installed in the project plant is from UK (Gilbert Gilkes & Gordon Ltd.).
- The generator installed in the project plant is from France (Leroy Sommer).
- The project developer has been supported by specialized consultants from USA (EES Consulting Inc.).

Thus, the Candelaria project involves the importation of environmentally sound technologies to rural Guatemala. Local workers were trained for the operation of these technologies.

Because of its small size (4.3 MW) and location (rural highlands) this project has a high probability of being copied in other parts of the country, thus multiplying the social and environmental benefits, contributing to environmentally safe technology transfer and capacity building.

A.4. Parties and project participants

Party involved (host) indicates a host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Guatemala (host)	Hidroelectrica Candelaria S.A. (private entity)	No
Switzerland	Ecoinvest Carbon S.A. (private entity)	No

A.5. Public funding of project activity

The project does not receive any public funding.

A.6. Debundling for project activity

There is an existing 16.5 MW hydropower plant (Secacao) located upstream Candelaria, also using the water of the Trece Aguas River. The mentioned hydropower plant was developed from 1993 to 1998, began operations in 1998, and is owned and operated by Candelaria's sponsors, but is not part of the project activity. Nor are any other CDM projects to be submitted by the project sponsor in the future on the same river and within the distance limitations of small-scale CDM project activities. Thus, the Candelaria Hydroelectric Project is not part of a larger, debundled CDM activity.

SECTION B. Application of selected approved baseline and monitoring methodology

B.1. Reference of methodology

According to paragraph 230 of the Project Standard, to support the request for renewal of the crediting period of this registered CDM project activity, the sections of the PDD relating to the baseline, estimated GHG emission reductions and the monitoring plan are updated using the latest approved version of the methodology applied in the original PDD.

[1]Historical average of net electricity delivered from 2007 to 2012.

Thus, this updated PDD is developed in accordance with the approved small-scale baseline and monitoring methodology AMS-I.D "Grid connected renewable electricity generation" (version 17)[2].

According to the methodology, the grid emission factor is calculated using the "Tool to calculate the emission factor for an electricity system" (version 04.0)[3].

Additionally, the Tool "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)[4] is used to update the PDD according to the Project Standard.

B.2. Project activity eligibility

The project activity qualifies as Type I (renewable energy project activities with a maximum output capacity of 15 MW) and it is expected to qualify during every year of the crediting period.

The Candelaria Hydroelectric Project involves renewable energy generation by the installation of a new small hydropower plant with an output capacity of 4.3 MW that will supply electricity to the national grid, displacing fossil fuel fired generating units.

As indicated by the manufacturer of the turbine/generator of Candelaria plant (Gilbert Gilkes & Gordon Ltd.) the generator has an apparent power of 5,397 kVA and a power factor of 0.8. The maximum output capacity of the generator is the real power (in kW) and results from multiplying the apparent power (in kVA) by the power factor, as follows: 5,397 kVA × 0.8 = 4,318 kW = 4.3 MW.

As explained in section B.1, the project activity is developed in accordance with the approved small-scale baseline and monitoring methodology AMS-I.D "Grid connected renewable electricity generation" (version 17). The applicability conditions of the methodology are presented below together with an explanation on why each condition is met by the project activity.

1. *This methodology comprises renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal and renewable biomass:*

    a. *Supplying electricity to a national or a regional grid; or*
    b. *Supplying electricity to an identified consumer facility via national/regional grid through a contractual arrangement such as wheeling.*

    The project consists of a hydroelectric power plant that supplies electricity to the national grid in Guatemala. Thus, it complies with this criterion.

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 following table.*

	Project type	***AMS-I.A***	***AMS-I.D***	***AMS-I.F***
1	*Project supplies electricity to a national/regional grid*		√	

[2] http://cdm.unfccc.int/filestorage/V/9/L/V9LRSXKP24Q7YT6HZDUBO3C0ING8AJ.1/EB61_repan17_Revision_AMS-I.D_ver17.pdf?t=bzd8bXhjN2Q5fDCKN2iKxOxpMtCShWjKzlPW
[3] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v4.0.pdf
[4] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-11-v3.0.1.pdf

	Project type	*AMS-I.A*	*AMS-I.D*	*AMS-I.F*
2	*Project displaces grid electricity consumption (e.g. grid import) and/or captive fossil fuel electricity generation at the user end (excess electricity may be supplied to a grid)*			√
3	*Project supplies electricity to an identified consumer facility via national/regional grid (through a contractual arrangement such as wheeling)*		√	
4	*Project supplies electricity to a mini grid system where in the baseline all generators use exclusively fuel oil and/or diesel fuel*			√
5	*Project supplies electricity to household users (included in the project boundary) located in off grid areas*	√		

Since the project consists in a hydroelectric power plant that supplies electricity to the national grid, it is correct to apply AMS-I.D.

3. *This methodology is applicable to project activities that: (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); (b) Involve a capacity addition; (c) Involve a retrofit of (an) existing plant(s); or (d) Involve a replacement of (an) existing plant(s).*

Before the implementation of the project activity, no power plant was installed at the project site. This is a Greenfield power plant and, therefore, complies with this criterion.

4. *Hydro power plants with reservoirs that satisfy at least one of the following conditions are eligible to apply this methodology:*

   a. *The project activity is implemented in an existing reservoir with no change in the volume of reservoir;*
   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;*
   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.*

The project consists of a run-of-river hydroelectric power plant without reservoir. Thus, this condition is not relevant.

5. *If the new unit has both renewable and non-renewable components (e.g. a wind/diesel unit), the eligibility limit of 15 MW 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 project activity has no non-renewable components such as diesel units. Therefore, this condition is not relevant. In any case, the installed capacity of the project is 4.3 MW. Thus, it is below the small-scale limit of 15 MW.

6. *Combined heat and power (co-generation) systems are not eligible under this category.*

The project is not a combined heat and power plant. Thus, this criterion is not relevant.

7. *In the case of project activities that involve the 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 distinct from the existing units.*

   The project consists of a new installed power plant and does not involve the addition of renewable energy generation units at an existing renewable power generation facility. Thus, this criterion is not relevant.

8. *In the case of retrofit or replacement, to qualify as a small-scale project, the total output of the retrofitted or replacement unit shall not exceed the limit of 15 MW.*

   The project consists of a new installed power plant and does not involve any retrofit or replacement of existing units. Thus, this criterion is not relevant.

Since the project activity complies with all relevant criteria, the methodology is applicable to the project activity.

The "Tool to calculate the emission factor for an electricity system" (version 04.0) is also applied to the project activity. The applicability conditions of the Tool are the following:

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 project consists in a hydroelectric power plant that supplies electricity to the national grid in Guatemala. Thus, this criterion is met.

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, the conditions specified in "Appendix 2: 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.*

   In this case, the first option is selected, i.e.: the emission factor is calculated for grid power plants only, excluding off-grid power plants.

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 country.*

   The SNI is located totally in Guatemala, which is not an Annex I country. Thus, this criterion is met.

4. *Under this tool, the value applied to the CO_2 emission factor of biofuels is zero.*

   No biofuels are currently consumed in the power plants connected to the SNI. Should this change during the second crediting period, the CO_2 emission factor of such biofuels would be set at zero.

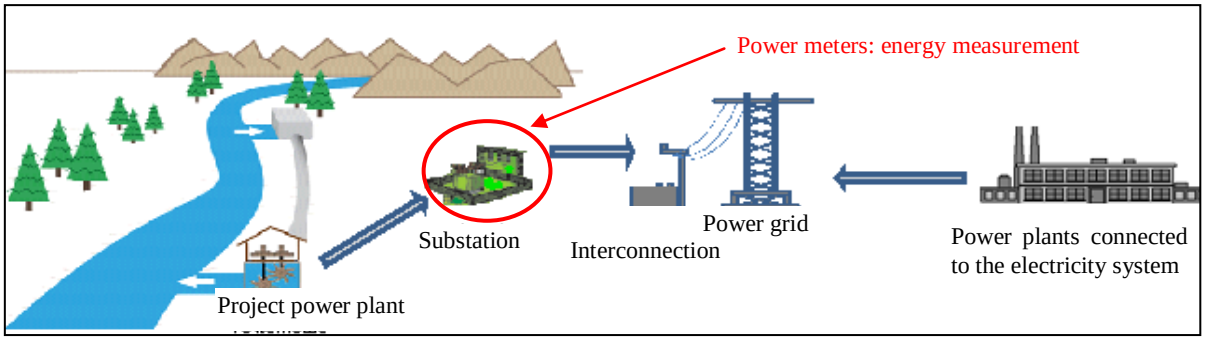
B.3. Project boundary

According to the methodology, the spatial extent of the project boundary includes the project power plant and all power plants connected physically to the electricity system that the CDM project power plant is connected to.

Additionally, according to the Tool, a grid/project electricity system is defined by the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity and that can be dispatched without significant transmission constraints.

In this case, the project activity is connected to the Guatemalan Interconnected National System (*Sistema Nacional Interconectado*, SNI). Thus, the Candelaria power plant and all power plants connected to the SNI are included in the project boundary.

A simplified scheme of the project boundary is shown in the following figure:



Project boundary of the project activity

As shown in the table below, only carbon dioxide emissions from electricity generated by fossil fuel fired power plants displaced by the project activity are taken into account in the baseline scenario. Other potential GHGs such as CH_4 and N_2O are excluded, which is conservative. The project activity, itself, does not produce significant GHG emissions.

Source		Gas	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
Project activity	For geothermal power plants, fugitive emissions of CH_4 and CO_2 from non-condensable gases contained in geothermal steam	CO_2	No	The project activity is a hydroelectric power plant.
		CH_4	No	
		N_2O	No	
	CO_2 emissions from combustion of fossil fuels for electricity generation in solar thermal power plants and geothermal power plants	CO_2	No	The project activity is a hydroelectric power plant.
		CH_4	No	
		N_2O	No	
	For hydro power plants, emissions of CH_4 from the reservoir	CO_2	No	The project activity is a hydroelectric power plant without reservoir.
		CH_4	No	
		N_2O	No	

B.4. Establishment and description of baseline scenario

According to paragraph 231 of the Project Standard, to demonstrate the validity of the original baseline or its update, project participants are not required to re-assess the baseline scenario. Instead, project participants shall assess the GHG emission reductions that would have resulted from that scenario.

The baseline scenario described in the registered PDD is consistent with the definition included in version 17 of the methodology. Thus, the baseline scenario is that the 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 into the grid.

In accordance with the Tool "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), the following stepwise procedure should be usedto update the PDD to support the request for renewal of the crediting period of the registered CDM project activity:

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

The current baseline complies with all relevant mandatory national and/or sectoral policies.

There are no relevant mandatory policies that have come into effect after the submission of the project activity for validation. Thus, the mandatory policies applicable at the time of requesting the renewal of the crediting period are the same than those applicable at the time of the submission of the project for validation.

The legal framework governing the electric power subsector is based on the following policies:

- Constitution of the Republic of Guatemala
- General Electricity Law, Decree 93-96
- Regulations of the General Electricity Law, Government Agreement 256-97 and its modifications
- Regulations of the Wholesale Market Administrator, Government Agreement 299-98 and its modifications
- Regulations of Commercial and Operational Coordination pertaining to the Wholesale Market Administrator

With the passing of the General Electricity Law in 1996, the electricity wholesale market initiated operation administering the energy and power transactions between market agents under free market conditions. The electricity wholesale market allows energy transactions in the opportunity or spot market, and capacity and energy transactions in the contract market, according to mutually agreed contracts between market agents.

The General Electricity Law is the basic law in matters of electricity and is based on the following principles:

- The generation of electric power is free and does not require prior authorization or preconditions from the State, other than those acknowledged by the Political Constitution of the Republic of Guatemala and the national laws. Nonetheless, in order to use State assets for such purposes, the authorization of the Department will be required when the plant power exceeds 5 MW.
- Electric power transmission is free, when the use of public domain assets is not required.

- Electric power transmission implying the use of public domain assets and the final electric power distribution service shall be subject to authorization.
- Electric power buy/sell contracts are freely negotiated among the parties, except for transmission and distribution services, which are subject to authorization. The transfer of power among generators, marketers, importers and exporters resulting from wholesale market operations are subject to regulation as set out by law.

The Wholesale Market Administrator (*Administrador del Mercado Mayorista*, AMM) is the national entity in charge of regulating the commercialization of energy in the national grid. The AMM is responsible for the efficient operation of the wholesale market and manages the economic load dispatch, minimizing the total cost of the generation operation.

Additionally, there is a law that promotes renewable energy sources through fiscal incentives and import exemptions, the Decree 52-2003, regulated by Government Agreement 211-2005. Although this law provides a 10-year income tax and importation tax exemptions to renewable energy projects, which contributes positively to the projects' economics, the impact is relatively low since most projects have long term debt service periods that coincide with this exemption period thus reducing its financial contribution. Therefore, the law only partially contribute to overcome the investment barriers faced by projects like Candelaria, as shown below in Section B.5 of this PDD.

Step 1.2: Assess the impact of circumstances

The circumstances existing at the time of requesting the renewal of the crediting period are the same than those existing at the time of the submission of the project for validation. Thus, the current baseline emissions are not impacted by changes in circumstances.

As mentioned above, it is estimated that Guatemala has a hydroelectric potential of at least 4,000 MW. However, due to political and legal instability and the lack of long-term planning and incentives, mainly fossil fuel based power plants have been installed in the country. This is the current practice in the country and it represents the scenario existing prior to the implementation of the project and the current baseline scenario. Thus, the electricity delivered to the grid by Candelaria plant would have otherwise been generated by the operation of grid-connected power plants (including fossil fuel power plants) and by the addition of new generation sources into the grid.

As a consequence, the project has the capacity to reduce CO_2 emissions by avoiding electricity generation by the fossil fuel-fired power plants connected to the grid. The baseline emissions are the product of quantity of electricity produced by Candelaria plant multiplied by the grid emission factor.

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.

According to the Tool, this sub-step should only be applied if the baseline scenario identified at the validation of the project activity was the continuation of use of the current equipment(s) without any investment and, the projects proponents or third party (or parties) would undertake an investment later due, for example, to the end of the technical lifetime of the equipment(s) before the end of the crediting period or the availability of a new technology.

Thus, this step does not apply to the project activity.

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

There is only one parameter that was determined at the start of the crediting period and not monitored during the first crediting period, the emission factor of the grid, which was determined as a combined margin emission factor, consisting of the combination of an operating margin and a build margin emission factor.

This parameter should be updated for the second crediting period in accordance with the latest version of the "Tool to calculate the emission factor for an electricity system", as required by the latest version of the methodology AMS-I.D.

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

Step 2.1: Update the current baseline

As indicated previously, there are no national and/or sectoral policies or specific circumstances that require an update of the baseline scenario.

Step 2.2: Update the data and parameters

As explained above, the grid emission factor should be updated for the second crediting period. Thus, this PDD includes the calculation of the updated grid emission factor using version 04.0 of the "Tool to calculate the emission factor for an electricity system".

B.5. Demonstration of additionality

Since the additionality of the project does not have to be reassessed for the renewal of the crediting period, the original text of the registered PDD is copied below:

> **Background information on Guatemalan power sector**
>
> During the 1980's, the government of Guatemala, through the state-owned companies such as EEGSA (Empresa Eléctrica de Guatemala) and INDE (Instituto Nacional de Electrificación), controlled all generation, transmission, and distribution of electricity.
>
> The state's largest hydroelectric plant, Chixoy (300 MW), came on line in 1983 while other large government-sponsored hydro projects were also under development. However, after the inauguration of Chixoy, all other investments in the power sector were abandoned and a power crisis took place in the early 1990s. Blackouts were routine, and EEGSA as well as INDE became insolvent. By the end of the decade, there had been no new investment in the energy sector[5].
>
> In an effort to control the power crisis, the Guatemalan government signed the first Power Purchase Agreement (PPA) with private companies that could install generating capacity quickly in the country. The first emergency-style operation was the 110 MW bunker fuel burning barges of Puerto Quetzal Power Company (partial Enron ownership) that began operating in 1993, followed by cogeneration plants installed by several Guatemalan sugar mills[6], and some small hydro projects, all private enterprises.

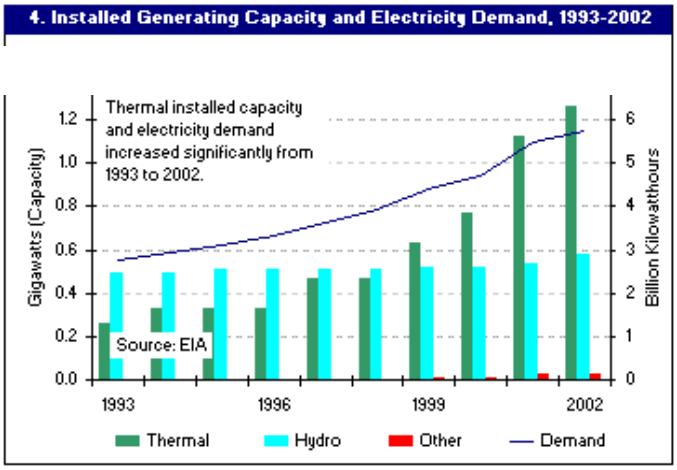
[5] Source: Energy Information Administration (EIA), *Country Analysis Brief*, US Dept. of Energy, 2004, http://www.eia.doe.gov/emeu/cabs/centam.html; IDC, 2001, *Guatemala's Electricity Sector*, National Association of Private Electricity Generators, PowerPoint Presentation.

[6] In Guatemala, cogenerators burn sugarcane bagasse mixed with bunker fuel from November through April, depending on the harvest.

In 2000, Puerto Quetzal Power installed additional barge with capacity of 124 MW. In the same year, TECO (Tampa) began operating the 120 MW San José Power Station using low-grade South American coal.

A dramatic shift in the generation sources used in Guatemala's electricity grid over the past decade can be observed, mainly due to the fact that fossil fuel based plants are cheaper and faster to install when compared with hydropower plants.

From 1993 to 2002, thermal installed generation capacity grew nearly 400%. Along with increased fossil fuel generating capacity, Guatemala added two geothermal powered plants, the 5 MW Calderas in 1998, and the 24 MW Zunil 1 in 1999. During the same period, hydro installed electric generating capacity remained essentially static (see the following figure)[7].



Installed generating capacity and electricity demand (1993-2002)

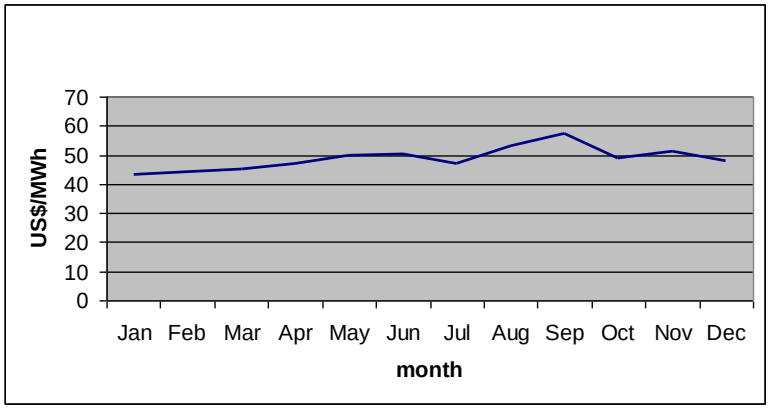
In 1996 the Guatemalan government deregulated the electricity sector by establishing a new General Electricity Law. EEGSA and INDE distribution companies were sold to the private sector following the electricity sector's reform.

The Ministry of Energy and Mines is in charge of developing, implementing, and overseeing the country's energy strategy and the sector's legislation. The General Electricity Law (Decree 93-96, 1996) establishes a free and open market for all electricity activities (generation, distribution, and transmission) and aims to avoid state and private sector monopolies. The National Electricity Commission regulates the Guatemalan power sector, oversees the Spot Market, enforces the law, defines transmission and distribution rates, arbitrates any controversies among agents, and issues technical and operational dispatch rules.

The Spot Market Administrator (AMM) nets out daily (short-term) transactions, thus establishing short-term energy prices (on an hourly basis), and coordinates all power plant generation including international connections. The Guatemalan Spot Market is a cost-based system, and all generation, whether it is renewable resource based or fossil fuel based, must compete under equal terms (this places renewable resource generation at a serious cost disadvantage, especially during debt repayment). All generating plants declare their operating and fuel costs, and the Market Administrator dispatches the system to cover total demand plus reserves at the lowest declared variable cost (US$/MWh). In this manner, geothermal and hydro power plants with no fuel costs

[7] Source: Energy Information Administration, *Country Analysis Brief*, US Department of Energy, 2001 http://www.eia.doe.gov/emeu/cabs/centam.html

are dispatched first, followed by the next least-cost plant and so forth. The most up-to-date spot market prices are available at http://www.amm.org.gt/. The following figure shows the monthly average spot prices in 2004. The annual average was 48.81 US$/MWh, with a maximum of 57.24 US$/MWh registered in September.



Monthly average spot price (2004)

Under Guatemala's current market structure, energy is sold either via power purchase agreements or through the spot market. Capacity, on the other hand, is only sold through short, medium or long-term contracts. Under the Guatemalan Electricity Law, distribution companies must guarantee that they have enough energy and capacity to cover their demand plus a reserve, thus they must contractually purchase energy and capacity from generators.

As informed in the AMM website report, (as of December 2004), the effective installed capacity of Guatemala was 1,785.4 MW (see table below).

Installed capacity connected to the National Grid[8]

Generating Plant	Installed Capacity	
	Installed (MW)	%
Hydro	650.3	36.4
Steam	143.0	8.0
Gas Turbines	184.9	10.4
Internal Combustion	593.0	33.2
Cogenerators	187.8	10.5
Geothermal	26.5	1.5
Total	**1,785.446**	**100**

Price expected for Candelaria's energy and capacity

The combined price to be received from the spot market and a capacity contract for Candelaria's energy and capacity is expected to be 0.0533 US$/kWh. Under this scenario Candelaria would be exposed to the energy price risk of the spot market as a "merchant plant". Although the project is

[8]Source: *Administrador del Mercado Mayorista*, http://www.amm.org.gt/pdfs/informes/2004/InfEst2004_01.pdf.

being developed as a merchant plant under this scenario, the company will continuously evaluate possibilities of negotiating a contract for a fixed energy and capacity price to reduce the market price risk.

Construction of Candelaria began in January of 2005. As of early November of 2005, the tunnel, intake structure and transmission line of Candelaria were finalized. From November 2005 through May 2006 the steel penstock of US manufacture was imported, transported and installed, and the remaining tasks required for plant start-up were concluded, including the powerhouse and tailrace channel construction, and the import, transport and installation of electromechanical equipment. Finally, during June of 2006, plant testing and final commissioning was successfully accomplished. Candelaria officially began generating electricity for the Spot market on July 1, 2006.

Additionality considerations

Following the simplified modalities and procedures for CDM small scale project activities, evidence of barriers to investment is shown to justify the choice of option (a): "Investment Barrier"

Installation costs are lower and construction time is shorter for fossil fuel technologies when compared to renewable energy alternatives. The following table compares costs of the various technologies operating in Guatemala[9].

Cost comparison of various power generation technologies in Guatemala

Technology	Fuel	Installation (US$/kW)	Variable O&M (US$/kWh)	Fixed (US$/kW-mo)
Diesel engines	HFO	900	0.40	5
Gas turbines	Diesel	500	0.10	2.5
Steam turbines	Coal	1,200	0.15	4
Hydroelectric	NA	1,800	0.05	3
Geothermal	NA	2,830	0.06	

Cash Flow Analysis

In 1986, in order to promote private investment in renewable energy projects, the Guatemalan government passed law 20-1986, the "Law for the Development of New and Renewable Energy Sources," which gave tax incentives to renewable energy projects and their investors and has been succeeded in promoting the development and construction of several plants. In 1999 this law was repealed and at present a new law (Decree 52-2003), regulated by Government Agreement 211-2005, is promoting renewable energy sources through fiscal incentives and import exemptions. Although this law provides a 10-year income tax and importation tax exemptions to renewable energy projects, which contributes positively to the projects' economics, the impact is relatively low since most projects have long term debt service periods that coincide with this exemption period thus reducing its financial contribution. Therefore this incentives law does only partially contribute to overcome the investment barrier.

[9]Source: *Asociación Nacional de Generadores*, interviews, 2002

Financial analysis for the Candelaria project was performed with the following assumptions:

- 10 year income tax break
- 0.0533 US$/kWh for capacity and energy (estimated as an average price considering a capacity price of US$ 7 per kW-month, and energy price of 0.048 US$/kWh)
- Discount rate of 12% per year
- Expected life of the project: 30 years
- Debt: 10-year loan (2 year grace period) with an interest rate of 9%

The analysis resulted in a negative net present value of US$ –377,669 and an internal rate of return of 11.00%, without carbon credits. Taking into account income from emission reductions (at US$ 6 per tonne CO_2) the NPV of the project increases to US$ 232,238 and the IRR increases to 12.61%. CDM contributions (with a 21-year crediting period) increase the internal rate of return of the project by 1.61%.

The project cost is estimated at US$ 6.3 million (US$ 6,243,000), close to US$ 1.6 million per installed MW. Hidroeléctrica Candelaria S.A. will provide equity of US$ 375,000 and a local commercial bank will provide a loan of US$ 5.9 million (5,868,000).

A competitive price for energy and capacity for the Guatemalan Electricity Market for the coming 10 years is 0.05 to 0.055 US$/kWh. The price assumed for the Candelaria project is 0.0533US$/kWh, even though the price to make the project "stand on its own" would have needed to be at least 0.06 US$/kWh.

However, the project sponsors decided to develop Candelaria for the following two reasons:

- The long-term attractiveness of a small and efficient hydropower plant at a location already owned, a supplemental cash flow to come from the existing Secacao plant in order to resolve Candelaria's cash flow shortfalls in the early years, and importantly,
- the potential of generating supplemental income from Certified Emission Reductions (CERs).

Candelaria's required price is high relative to the expected future spot market prices mainly due to the fact that a small 4.3 MW plant has difficulties in reducing the investment per MW, as its size does not allow for scale economies to be achieved easily. Due to the market's inability to level costs of renewable energies with fossil fuel burning plants, Candelaria is a marginal project and would not be carried out in the absence of CDM revenues. Income from emission reductions would help the project become more attractive to developers and lenders.

Thus, the project activity is clearly additional.

B.6. Emission reductions
B.6.1. Explanation of methodological choices

Baseline emissions

As per version 17 of the methodology AMS-I.D, the baseline scenario is that the 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 into the grid.

The baseline emissions are the product of electrical energy baseline multiplied by the grid emission factor, as follows:

$$BE_y = EG_{BL,y} \times EF_{CO_2,grid,y} \quad \textbf{(1)}$$

Where:

BE_y	=	Baseline emissions in year *y* (tCO_2)
$EG_{BL,y}$	=	Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year *y* (MWh)
$EF_{CO2,grid,y}$	=	CO_2 emission factor of the grid in year *y* (tCO_2/MWh)

According to the methodology, the emission factor can be calculated in a transparent and conservative manner as follows:

(a) A combined margin, consisting of the combination of operating margin and build margin according to the procedures prescribed in the "Tool to calculate the emission factor for an electricity system", or

(b) The weighted average emissions (in tCO_2/MWh) of the current generation mix. The data of the year in which project generation occurs must be used.

In this case, Option (a) is applied. Thus, the grid emission factor is calculated as a combined margin emission factor using version 04.0 of the "Tool to calculate the emission factor for an electricity system" and according to 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 OM emission factor according to the selected method

STEP 5: calculate the build margin (BM) emission factor

STEP 6: calculate the combined margin (CM) emission factor

Step 1: Identify the relevant electricity systems

For determining the electricity emission factors, a project electricity system is defined by the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity and that can be dispatched without significant transmission constraints. In this case, the project electricity system is the Guatemalan Interconnected National System (*Sistema Nacional Interconectado*, SNI).

For the purpose of determining the OM emission factor, the CO_2 emission factors for net electricity imports from the connected electricity systems are assumed as 0 tCO_2/MWh, according to option (a) given by the Tool. Electricity exports are not subtracted from electricity generation data used for calculating and monitoring the electricity emission factors.

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

Either of the following two options can be used to calculate the OM and the BM emission factor:

- **Option I:** Only grid power plants are included in the calculation.
- **Option II:** Both grid power plants and off-grid power plants are included in the calculation.

In this case, Option I is chosen.

Step 3: Select a method to determine the OM

The calculation of the OM emission factor is based on one of the following methods:

(a) Simple OM
(b) Simple Adjusted OM
(c) Dispatch Data Analysis OM
(d) Average OM

The Tool states that the Simple OM method can only be used where low-cost/must run resources constitute less than 50% of total grid generation (excluding electricity generated by off-grid power plants) in: 1) average of the five most recent years, or 2) based on long-term averages for hydroelectricity production.

In Guatemala, low-cost/must-run resources constitute 61.2% of total grid generation in average of the five most recent years, which is above 50%. Therefore, the Simple Adjusted OM method is applied. See details in Appendix 4 of this PDD.

The Simple Adjusted OM emission factor is calculated using the ex ante option for data vintage. The emission factor is determined once at the validation stage and should be updated at the time of submission of the request for renewal of the crediting period to the DOE. No monitoring and recalculation of the emission factor during the second crediting period is required. A 3-year generation-weighted average is used, based on the most recent data available at the time of submission of the request for renewal of the crediting period to the DOE.

Power plants registered as CDM project activities are included in the sample group that is used to calculate the OM if the criteria for including the power source in the sample group apply.

Step 4: Calculate the OM emission factor according to the selected method

According to the Tool, the Simple Adjusted OM emission factor is a variation of the Simple OM, where the power plants/units (including imports) are separated in low-cost/must-run power sources (*k*) and other power sources (*m*). As under Option A of the Simple OM, it is calculated based on the net electricity generation of each power unit and an emission factor for each power unit, as follows:

$$EF_{grid,OM-adj,y} = (1-\lambda_y) \times \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}} + \lambda_y \frac{\sum_k EG_{k,y} \times EF_{EL,k,y}}{\sum_k EG_{k,y}} \quad \textbf{(2)}$$

Where:

$EF_{grid,OM\text{-}adj,y}$	=	Simple Adjusted OM CO_2 emission factor in year *y* (tCO_2/MWh)
λ_y		Factor expressing the percentage of time when low-cost/must-run power units are on the margin in year *y*
$EG_{m,y}$	=	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
y	=	The relevant year as per the data vintage chosen in Step 3

The CO_2 emission factor of each power unit *m*/*k* is determined according to Option A2 of the Tool, based on the CO_2 emission factor of the fuel type used in the power unit and the efficiency of the power unit.

In accordance with the Tool, where several fuel types are used in the power unit, the fuel type with the lowest CO_2 emission factor is used.

Since the efficiencies are not directly available for the power plants in the SNI, default values from the Appendix 1 of the Tool are applied, which is conservative.

The CO_2 emission factor of each power unit *m*/*k* is calculated as follows:

$$EF_{EL,m/k,y} = \frac{EF_{CO2,m/k,i,y} \times 3.6}{\eta_{m/k,y}} \quad \textbf{(3)}$$

Where:

$EF_{EL,m/k,y}$	=	CO_2 emission factor of power unit *m/k* in year *y* (tCO_2/MWh)
$EF_{CO2,m/k,i,y}$	=	Average CO_2 emission factor of fuel type *i* used in power unit *m/k* in year *y* (tCO_2/GJ)
$\eta_{m/k,y}$	=	Average net energy conversion efficiency of power unit *m/k* in year *y*
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
y	=	The relevant year as per the data vintage chosen in Step 3

According to the Tool, net electricity imports must be considered low-cost/must-run units *k*.

The parameter λ_y (lambda) is defined as follows:

$$\lambda_y = \frac{\text{number of hours low - cost/must - run are on the margin in year y}}{\text{8760 hours per year}} \quad \textbf{(4)}$$

Lambda should be calculated as follows:

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) - 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 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 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.

Step 5: Calculate the BM emission factor

In terms of vintage of data, the project participant has chosen Option 1 of the Tool. For the first crediting period, the BM emission factor is calculated ex ante based on the most recent information available on units already built for sample group *m* at the time of PDD submission to the DOE for validation. For the second crediting period, the BM emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the BM emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.

Capacity additions from retrofits of power plants are not included in the calculation of the BM emission factor.

The sample group of power units *m* used to calculate the BM is determined as per the following procedure, consistent with the data vintage selected above:

a) Identify the set of five power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently ($SET_{5\text{-}units}$) and determine their annual electricity generation ($AEG_{SET\text{-}5\text{-}units}$, in MWh).

b) Determine the annual electricity generation of the project electricity system, excluding power units registered as CDM project activities (AEG_{total}, in MWh). Identify the set of power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently and that comprise 20% of AEG_{total} (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) ($SET_{\geq 20\%}$) and determine their annual electricity generation ($AEG_{SET\text{-}\geq 20\%}$, in MWh).

c) From $SET_{5\text{-}units}$ and $SET_{\geq 20\%}$ select the set of power units that comprises the larger annual electricity generation (SET_{sample}).

   Identify the date when the power units in SET_{sample} started to supply electricity to the grid. If none of the power units in SET_{sample} started to supply electricity to the grid more than 10 years ago, then use SET_{sample} to calculate the BM. In this case, ignore steps (d), (e) and (f).

Otherwise:

d) Exclude from SET_{sample} the power units which started to supply electricity to the grid more than 10 years ago. Include in that set the power units registered as CDM project activity, starting with power units that started to supply electricity to the grid most recently, until the electricity generation of the new set comprises 20% of the annual electricity generation of the project electricity system (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) to the extent is possible. Determine for the resulting set ($SET_{sample-CDM}$) the annual electricity generation ($AEG_{SET-sample-CDM,}$ in MWh).

   If the annual electricity generation of that set is comprises at least 20% of the annual electricity generation of the project electricity system (i.e. $AEG_{SET-sample-CDM} \geq 0.2 \times AEG_{total}$), then use the sample group $SET_{sample-CDM}$ to calculate the BM. In this case, ignore steps (e) and (f).

Otherwise:

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

f) The sample group of power units *m* used to calculate the BM is the resulting set ($SET_{sample-CDM->10yrs}$).

The BM emission factor is the generation-weighted average emission factor of all power units *m* during the most recent year *y* for which power generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}} \quad \textbf{(5)}$$

Where:

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

The CO_2 emission factor of each power unit *m* is determined according to Option A2 of the Tool, based on the CO_2 emission factor of the fuel type used in the power unit and the efficiency of the power unit.

In accordance with the Tool, where several fuel types are used in the power unit, the fuel type with the lowest CO_2 emission factor is used.

Since the efficiencies are not directly available for the power plants in the SNI, default values from the Appendix 1 of the Tool are applied, which is conservative.

The CO_2 emission factor of each power unit *m* is calculated as follows:

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

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* (tCO_2/GJ)
$\eta_{m,y}$	=	Average net energy conversion efficiency of power unit *m* in year *y*
m	=	Power units included in the BM
y	=	Most recent historical year for which electricity generation data is available

Step 6: Calculate the CM emission factor

According to the Tool, the calculation of the CM emission factor is based on one of the following methods:

(a) Weighted average CM
(b) Simplified CM

In this case, Option (a) is chosen. Thus, the CM emission factor is calculated as follows:

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

Where:

$EF_{grid,CM,y}$	=	CM CO_2 emission factor in year *y* (tCO_2/MWh)
$EF_{grid,OM,y}$	=	OM CO_2 emission factor in year *y* (tCO_2/MWh)
$EF_{grid,BM,y}$	=	BM CO_2 emission factor in year *y* (tCO_2/MWh)
w_{OM}	=	Weighting of OM emissions factor
w_{BM}	=	Weighting of BM emissions factor

According to the Tool, for hydroelectric power generation projects the weights applied for the second crediting period are: $w_{OM} = 0.25$ and $w_{BM} = 0.75$.

Project emissions

As per the methodology, project emissions in year *y* (PE_y) for hydroelectric power projects without reservoir are null. Thus, $PE_y = 0$.

Leakage emissions

As per the methodology, as energy generating equipment was not transferred from another activity, the leakage emissions are null. Thus, $LE_y = 0$.

Emission reductions

Emission reductions are calculated as follows:

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

Where:

ER_y = Emission reductions in year y (tCO_2)

BE_y = Baseline emissions in year y (tCO_2)

PE_y = Project emissions in year y (tCO_2)

LE_y = Leakage emissions in year y (tCO_2)

Thus, taking into account all the above explanations, emission reductions are obtained as follows:

$$ER_y = BE_y = EG_{BL,y} \times EF_{CO_2,grid,y} = EG_{BL,y} \times EF_{grid,CM,y} \quad \textbf{(9)}$$

Where:

ER_y = Emission reductions in year y (tCO_2)

BE_y = Baseline emissions in year y (tCO_2)

$EG_{BL,y}$ = Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year y (MWh)

$EF_{CO2,grid,y}$ = CO_2 emission factor of the grid in year y (tCO_2/MWh)

$EF_{grid,CM,y}$ = CM CO_2 emission factor in year y (tCO_2/MWh)

B.6.2. Data and parameters fixed ex ante

Data / Parameter	$EF_{CO2,grid,y}$ / $EF_{grid,CM,y}$
Unit	tCO_2/MWh
Description	CO_2 emission factor of the grid electricity in year y / Combined Margin CO_2 emission factor of the grid electricity in year y
Source of data	Data provided by the Wholesale Market Administrator (official source).
Value(s) applied	0.4833
Choice of data or Measurement methods and procedures	In accordance with paragraph 12 of the methodology, Option (a) has been selected: a combined margin, consisting of the combination of operating margin and build margin is calculated based on the procedures prescribed in version 04.0 of the "Tool to calculate the emission factor for an electricity system".
Purpose of data	Data used to calculate baseline emissions.
Additional comment	Data updated at the time of submission of the request for renewal of the crediting period to the DOE. No monitoring and recalculation of the emission factor during the second crediting period is required.

Data / Parameter	$EF_{CO2,m/k,i,y}$ / $EF_{CO2,m,i,y}$
Unit	tCO_2/GJ
Description	Average CO_2 emission factor of fuel type *i* used in power unit *m* or *k* in year *y*
Source of data	Data from the 2006 IPCC Guidelines on National GHG Inventories, Table 1.4, Chapter 1, Vol. 2 (Energy).
Value(s) applied	See Appendix 4 of this PDD and the attached spreadsheet named "Grid EF and ER_Candelaria_Simple Adjusted OM_27Dec13".
Choice of data or Measurement methods and procedures	According to version 04.0 of the "Tool to calculate the emission factor for an electricity system", if there is no data from fuel supplier of the power plants in invoices or local average default values, IPCC default values at the lower limit of the uncertainty at a 95 per cent confidence interval should be used. In accordance with the Tool, where several fuel types are used in the power unit, the fuel type with the lowest CO_2 emission factor is used.
Purpose of data	Data used to calculate baseline emissions.
Additional comment	For the simple adjusted OM emission factor calculation: data updated once for each crediting period using the most recent three historical years for which data is available at the time of submission of the CDM-PDD to the DOE for validation or request for renewal of the crediting period (ex ante option). For the BM emission factor calculation: for the first crediting period, data determined once ex ante, based on the most recent information available on units already built for sample group *m* at the time of PDD submission to the DOE for validation. For the second and third crediting period, data updated only once ex ante at the start of the second crediting period, based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE.

Data / Parameter	$EG_{m,y}$ / $EG_{k,y}$
Unit	MWh
Description	Net quantity of electricity generated and delivered to the grid by power unit *m* or *k* in year *y*
Source of data	Data provided by the Wholesale Market Administrator (official source).
Value(s) applied	See Appendix 4 of this PDD and the attached spreadsheet named "Grid EF and ER_Candelaria_Simple Adjusted OM_27Dec13".
Choice of data or Measurement methods and procedures	According to version 04.0 of the "Tool to calculate the emission factor for an electricity system", data from utility or government records or official publications should be used.
Purpose of data	Data used to calculate baseline emissions.
Additional comment	For the simple adjusted OM emission factor calculation: data updated once for each crediting period using the most recent three historical years for which data is available at the time of submission of the CDM-PDD to the DOE for validation or request for renewal of the crediting period (ex ante option). For the BM emission factor calculation: for the first crediting period, data determined once ex ante, based on the most recent information available on units already built for sample group *m* at the time of PDD submission to the DOE for validation. For the second and third crediting period, data updated only once ex ante at the start of the second crediting period, based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE.

Data / Parameter	$\eta_{m/k,y}$ / $\eta_{m,y}$
Unit	-
Description	Average net energy conversion efficiency of power unit *m* or *k* in year *y*
Source of data	Data from the Appendix 1 of the "Tool to calculate the emission factor for an electricity system" (version 04.0).
Value(s) applied	See Appendix 4 of this PDD and the attached spreadsheet named "Grid EF and ER_Candelaria_Simple Adjusted OM_27Dec13".
Choice of data or Measurement methods and procedures	According to version 04.0 of the "Tool to calculate the emission factor for an electricity system", if the efficiencies are not directly available for the power plants, default values from the Appendix 1 of the Tool should be used.
Purpose of data	Data used to calculate baseline emissions.
Additional comment	Data determined once for the crediting period.

B.6.3. Ex ante calculation of emission reductions

As explained above in Section B.6.1 of this PDD, emission reductions are calculated as follows:

$$ER_y = EG_{BL,y} \times EF_{grid,CM,y}$$

Where:

ER_y	=	Emission reductions in year y (tCO_2)
$EG_{BL,y}$	=	Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year y (MWh)
$EF_{grid,CM,y}$	=	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 is estimated based on historical data of real electricity delivered by Candelaria plant. The annual average net electricity delivered by the plant from 2007 to 2012 is 24,415 MWh. This is the value of electricity supplied to the grid considered in the ex ante estimation of emissions reductions. However, it is important to note that, since the electricity generation depends on water availability, the values of electricity delivered could be lower or higher than the average historical value. It is expected a fluctuation of about ± 5% of the values of electricity delivered related to the average value.

As shown above in Section B.6.1 of this PDD, the CM emission factor is calculated as follows:

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

Where:

$EF_{grid,CM,y}$	=	CM CO_2 emission factor in year y (tCO_2/MWh)
$EF_{grid,OM,y}$	=	OM CO_2 emission factor in year y (tCO_2/MWh)
$EF_{grid,BM,y}$	=	BM CO_2 emission factor in year y (tCO_2/MWh)
w_{OM}	=	Weighting of OM emissions factor
w_{BM}	=	Weighting of BM emissions factor

According to the Tool, for hydroelectric power generation projects the weights applied for the second crediting period are: w_{OM} = 0.25 and w_{BM} = 0.75.

The OM emission factor is determined as a 3-year generation-weighted average, based on the most recent data available at the time of submission of the request for renewal of the crediting period to the DOE. Specifically, data from years 2010, 2011 and 2012 are used, and the resulting OM emission factor is 0.8085 tCO_2/MWh.

The BM emission factor is determined based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. Specifically, data from year 2012 are used, and the resulting BM emission factor is 0.3750 tCO_2/MWh.

Thus, the resulting CM emission factor is the following:

$\boldsymbol{EF_{grid,CM,y}}$= 0.8085 tCO_2/MWh × 0.25 + 0.3750 tCO_2/MWh × 0.75 = **0.4833 tCO_2/MWh**

As a consequence, the annual value of emission reductions estimated for the project activity is the following:

$\boldsymbol{ER_y}$ = 24,415 MWh × 0.4833 tCO_2/MWh = **11,800 tCO_2**

See more details in Appendix 4 of this PDD and the attached spreadsheet named "Grid EF and ER_Candelaria_Simple Adjusted OM_27Dec13".

As shown in the attached spreadsheet, the value of annual emission reductions estimated for the project activity is rounded down.

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

Year	Baseline emissions (tCO_2e)	Project emissions (tCO_2e)	Leakage (tCO_2e)	Emission reductions (tCO_2e)
2014	11,800	0	0	11,800
2015	11,800	0	0	11,800
2016	11,800	0	0	11,800
2017	11,800	0	0	11,800
2018	11,800	0	0	11,800
2019	11,800	0	0	11,800
2020	11,800	0	0	11,800
Total	**82,600**	**0**	**0**	**82,600**
Total number of crediting years	**7**			
Annual average over the crediting period	**11,800**	**0**	**0**	**11,800**

B.7. Monitoring plan
B.7.1. Data and parameters to be monitored

Data / Parameter	$EG_{BL,y}$
Unit	MWh
Description	Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year *y*
Source of data	Electricity meters onsite
Value(s) applied	24,415 MWh (historical average of net electricity delivered from 2007 to 2012)
Measurement methods and procedures	Data measured using the following commercial electricity meters: **Main electricity meter** Model: KV2c Brand: General Electric Serial number: 28 620 847 Accuracy: 0.2% (according to regulation) **Support electricity meter** Model: KV2c Brand: General Electric Serial number: 28 620 848 Accuracy: 0.2% (according to regulation)
Monitoring frequency	Data monitored continuously, measured hourly and daily, and recorded hourly, daily, monthly and yearly.
QA/QC procedures	According to the Commercial Coordination Norm number 14 (NCC-14), clause 14.12, "Periodic Verifications", issued by the Wholesale Market Administrator (*Administrador del Mercado Mayorista*, AMM), meters and related equipment verifications/audits will be carried out annually at the expense of the AMM, to verify the equipment accuracy. In parallel, in order to satisfy the conditions set forth in the aforementioned norm and to guarantee the precision and quality required, both commercial meters are verified and calibrated once a year (regularly during the annual programmed maintenance) by a recognized calibration company at the expense of Candelaria Hydroelectric Project. Data measured by the meters will be cross checked with the buyer's electricity reports, monthly invoices or through the records saved in the SCADA system, software utilized to control and monitor all the electricity delivered to the national grid.
Purpose of data	Data used to calculate baseline emissions.
Additional comment	All the data monitored will be archived for two years after the end of the crediting period or the last CERs issuance, whichever occurs later.

B.7.2. Sampling plan

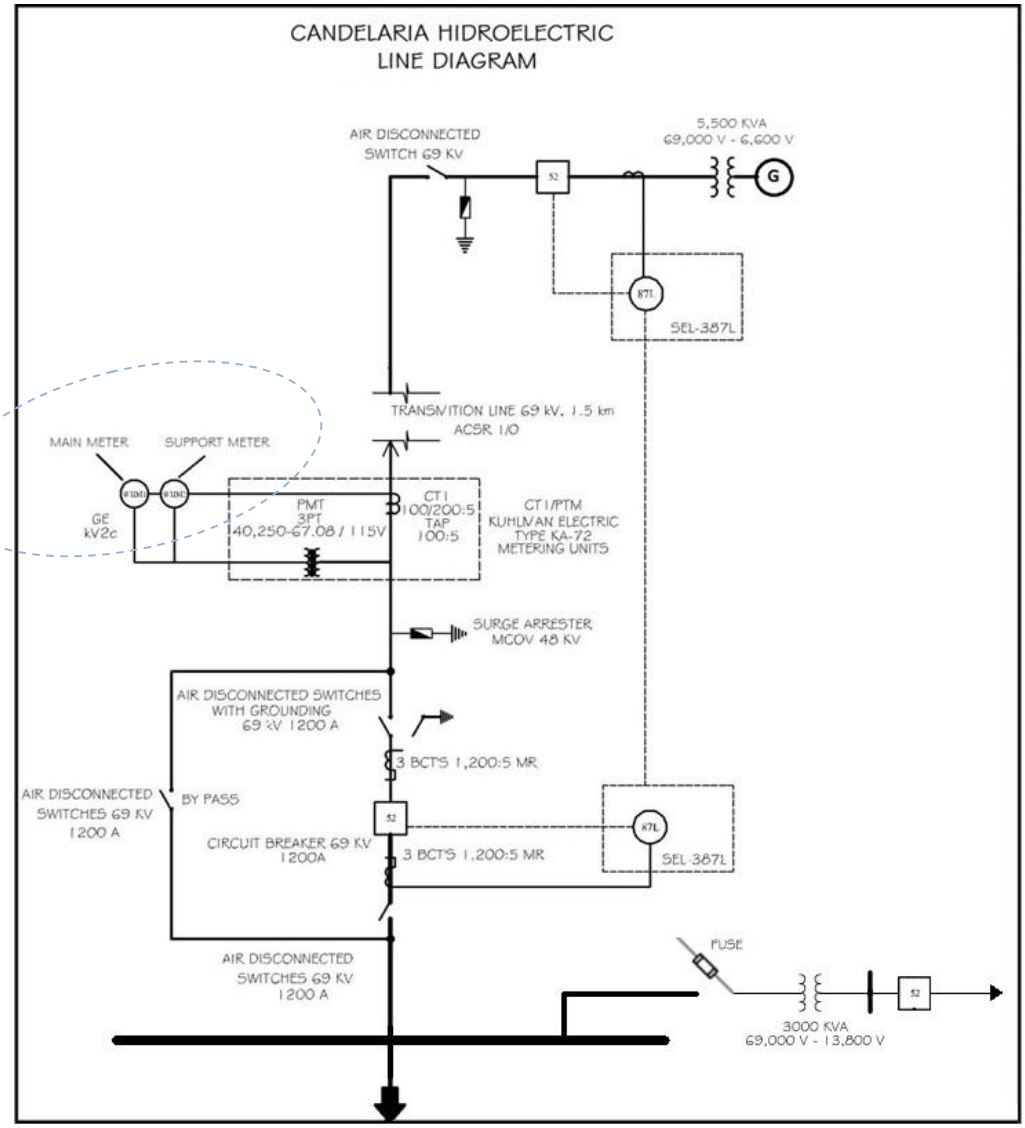
There is no sampling involved in the monitoring of the project activity.

B.7.3. Other elements of monitoring plan

Equipment used for the commercial measuring

The equipment used to measure the energy produced by the Candelaria hydroelectric plant consists in a main and a support meter (electronic General Electric meters). This is in line with the stipulations described in the Commercial Coordination Norm, No. 14, (NCC-14) issued by the Wholesale Market Administrator(*Administrador del Mercado Mayorista*, AMM)[10].

The metering units are shown in the following diagram:



Candelaria plant line diagram

[10] The AMM is the entity in charge of dispatching and programming the operation and coordination of the National Power Grid.

Data quality obtained from the energy meters

According to the Commercial Coordination Norm number 14 (NCC-14), clause 14.12, "Periodic Verifications", issued by the AMM, meters and related equipment verifications/audits will be carried out annually at the expense of the AMM, to verify the equipment accuracy.

In parallel, in order to satisfy the conditions set forth in the aforementioned norm and to guarantee the precision and quality required, both commercial meters are verified and calibrated once a year (regularly during the annual programmed maintenance) by a recognized calibration company at the expense of Candelaria Hydroelectric Project.

Data collection procedures

The energy data of the Candelaria hydroelectric project are captured and recorded by the following procedures. Each procedure and the data collected are also verified by different persons to ensure the accuracy of the measured data. The procedures used to collect, monitor and register the data of the produced energy are described below:

1. Hourly and daily readings procedure

Source of data:	SCADA system / Main and Support commercial meters
Responsible to collect data:	Operator
Responsible of quality data:	Operations Supervisor

Procedure:

The SCADA system reports hourly the instantaneous power and other generation conditions. This system works using a computer with SCADA (Supervisory Control and Data Acquisition) software, connected to a PLC (Programmable Logic Controller) device that automatically captures the information and converts it to data. This hourly generation data is available to the operator continuously, 24 hours a day, on the computer screen. The operator is responsible for transcribing the hourly data to the "Operation Control Sheets", which are kept in the Control Room of the plant.

Besides this, at 00:00 hrs, the Operator directly takes visual meter readings (from the main commercial meter). The difference from the previous day's reading and the current reading corresponds to the energy produced over that day (data read in kilowatts).

In addition, an internal daily report is generated by an automatic Data Monitoring System (*Sistema de Monitoreo de Información*, SIMON), which is fed by the Operator with the SCADA and the commercial meter data. This program allows the access to updated data and graphics of the daily, weekly, monthly and yearly power and energy produced by Candelaria hydroelectric plant.

2. Monthly readings procedure

Source of data:	Main and Support commercial meters
Responsible to collect data:	Operations Supervisor
Responsible of quality data:	Operations Manager

Procedure:

Once a month, the Operations Supervisor uses the automated reading system to summarize, for billing purposes, the total energy produced by Candelaria hydroelectric plant. On the first day of the month, the Operations Supervisor uses an optical reader connected to a portable computer in which the Meter Mate Software (meter-reading software provided by General Electric) has been installed. This software allows for hourly automatic reading: the optical reader is positioned on the meter control panel lens and an hhf format file with all the updated hourly energy production reading is automatically created. The hhf format files of both electricity meters are sent by email to the Operations Manager, who exports it to an Excel file, reviews it and generates a monthly report, allowing the total calculation of generated energy. Both reports are sent to the Financial Manager, General Manager Assistant, the buyer's representative and to the AMM's Measuring Coordinator, for their revision or reference.

Both entities (AMM and the buyer) compare the measurements taken by Candelaria hydroelectric plant with those taken through the external meters owned by the AMM. Once AMM and the buyer confirm their approval of the report, commercial invoice is issued by Candelaria hydroelectric plant for the energy provided to the national grid.

3. Yearly data collection procedure

Source of data:	Monthly commercial invoice reports
Responsible to collect data:	CDM Coordinator
Responsible of quality data:	General Manager

Procedure:

In order to prepare the monitoring report to calculate the total energy produced by the Candelaria hydroelectric plant and estimate emission reductions, the General Management and Financial Division collect in a single report all the monthly reports used for billing purposes in an Excel spreadsheet, calculating the annual emission reductions. This report is reviewed and approved by the General Manager.

SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

01/01/2005

The start date of the project activity is determined as the construction start date of Candelaria plant.

C.1.2. Expected operational lifetime of project activity

30 years

C.2. Crediting period of project activity

C.2.1. Type of crediting period

Renewable crediting period (This PDD corresponds to the second crediting period.)

C.2.2. Start date of crediting period

01/01/2014

C.2.3. Length of crediting period

7 years

SECTION D. Environmental impacts
D.1. Analysis of environmental impacts

The following documents have been developed:

- Plant Design Blueprints
- Environmental Impact Assessment (EIA)
- Water Quality Study
- Geological Study
- Topographical Study

No significant negative impacts are reported in any of the aforementioned documents.

The project does not have any significant impact on local bio systems or water supply to residents in the region. The EIA was performed for the project in connection with the EIA of the upstream power plant[11], and the EIA has been approved by the relevant Guatemalan authorities.

SECTION E. Local stakeholder consultation
E.1. Solicitation of comments from local stakeholders

Candelaria hydroelectric project conducted two stakeholders' consultation processes in order to obtain comments from all the stakeholders.

The first stakeholder consultation was carried out by means of a survey. The following questionnaire was sent to stakeholders in June 2003:

1. Do you think Candelaria hydroelectric project will contribute to the sustainable development of Guatemala?
2. Do you believe that the socio-economic situation of the region will improve due to the implementation of Candelaria hydroelectric project?
3. Could the implementation of project improve the environmental situation in the region?
4. How does the development of the project (positively or negatively) affect you and/or your environment?
5. Would you recommend that private companies or authorities develop projects of this nature?
6. Any additional comments you would like to make.

[11] EIA: *"Estudio de Evaluación del Impacto Ambiental Significativo del Proyecto Hidroeléctrica Secacao –16 MW– , de Hidroeléctrica Secacao S.A., Municipio Senahú, Departamento de Alta Verapaz, Guatemala"* by Miguel Ángel Carballo Hernández (Geology, Oil and Environment advisor), April 1995. The Guatemalan authorities approved the study. Hidroeléctrica Secacao is linked with the Candelaria Project since both power plants share the water the same river and are operated by the same sponsors.

The questionnaire was sent to the following persons:

First Stakeholders Consultation

Name	Position	Company/Institution
Ing. Rudy Haroldo Najera Sagastume	General Director	General Direction of Energy – Ministry of Energy and Mines (*Dirección General de Energía – Ministerio de Energía y Minas*)
Ing. Jorge Juárez Pedroza	General Manager	National Institute of Electrification (*Instituto Nacional de Electrificación*)
Ing. Luis E. García Pinot	President	National Commission of Electric Energy (*Comisión Nacional de Energía Eléctrica*)
Lic. Carlos Roberto Morales Monzón	General Director	General Direction of Environmental Management and Natural Resources – Ministry of Environment and Natural Resources (*Dirección General de Gestión Ambiental y Recursos Naturales – Ministerio de Ambiente y Recursos Naturales*)
Mr. Roberto Barrera		AMM (*Administrador del Mercado Mayorista*)

The second stakeholder consultation intended to collect comments from local communities.

On 21/07/2006 Hidroeléctrica Candelaria S.A. presented the project at a meeting to which stakeholders from the local communities were invited.

In this event, 38 representatives (stakeholders) from four neighbouring communities participated, as documented in the attendance sheet. Ing. Raúl Castañeda from the local DNA Office (*Oficina Nacional de Desarrollo Limpio del Ministerio de Ambiente y Recursos Naturales*) also participated in the event as an observer.

The following table lists the stakeholder attendees:

Second Stakeholders Consultation

Name	Position	Company/Institution
Domingo Coy Cuz	Teacher	La Montanesa
Enrique Coal	Teacher	La Montanesa
Hermenegildo Xol Tul	Teacher	Santa Lucía
Elmer Chiqui Turcios	Teacher	Santa Lucía
Manuel Cucul Mo	Teacher	San Carlos
Juan Cucul Tox	Secretary	Santa Lucía
Mario Cac Coc	Secretary	San Carlos
Lorenzo Cac	Treasurer	San Carlos
David Che	Member I	San Carlos
Cesario Bac Chub	Auxiliary Mayor	San Carlos
Alfonso Cholon	Member III	San Carlos
Juan Rax	President	Santa Lucia Secacao
David Tox	Vicepresident	Santa Lucia Secacao

Santiago Coc	Treasurer	Santa Lucia Secacao
Vicente Cucul	Member I	Santa Lucia Secacao
Mateo Caal	Auxiliary Mayor	Santa Lucia Secacao
Santiago Maquin	Member II	Santa Lucia Secacao
Jose Choc	President	La Montañesa
Felipe Ich	Vicepresident	La Montañesa
Emilio Chic Jalal	Secretary	La Montañesa
Pedro Ich Choc	Treasurer	La Montañesa
Francisco Choc	Member I	La Montañesa
Alejandro Chub Col	Auxiliary Mayor	La Montañesa
Juan Daniel Caal	Member II	La Montañesa
Ramiro Choc Choc	Vicepresident	San Carlos
Martin Choc	President	San Carlos
Santiago Choc	Member II	San Carlos
Felipe Tzi Mo	Teacher	Santa Lucia
Javier Choc	Legal Representative	Las Margaritas Semococh
Fancisco Chub Choc	Secretary	Las Margaritas Semococh
Augusto Chub	Vicepresident	Las Margaritas Semococh
Adrian Sub	Treasurer	Las Margaritas Semococh
Jose Ba Coal	Under-Treasurer	Las Margaritas Semococh
Alberto Choc	Member I	Las Margaritas Semococh
Carlos Villela	Advisor	Las Margaritas Semococh
Rodrigo J. Tormo A.	Manager	Hidroelectrica Candelaria
Ricardo A. Vasquez	Operations Manager	Hidroelectrica Candelaria
Hugo R. Alvarado Chavez	Notary Public	Hidroelectrica Candelaria
Raul Castañeda	Observer	National Clean Development Department

The presentation was coordinated by Ing. Ricardo Vasquez, Operation Manager of Hidroeléctrica Candelaria S. A. at that time. The event included a presentation by Mr. Rodrigo Tormo, General Manager of Hidroeléctrica Candelaria and a tour visit to project installations. Mr. Mario Cruz Pop participated as a translator (many participants only speak a Mayan dialect) and Lic. Hugo Ricardo Alvarado (Notary Public) documented a transcript of the meeting.

After the meeting and the visit were concluded, local stakeholders had the opportunity to express their comments through the following questionnaire:

1. Based on the available information and your knowledge regarding Environment, Climate Change, Clean Development Mechanism (CDM) and Global Carbon Market related issues, briefly express your opinion about the Candelaria hydroelectric project.
2. Would you recommend private companies, governmental authorities or other organizations to develop projects of this kind: electricity generation from renewable resources as contribution to the mitigation of climate change?
3. Do you believe that Candelaria hydroelectric project will contribute to the environmental, social and economic development (sustainable development) of the region and of Guatemala?
4. Express any additional comments

E.2. Summary of comments received

The following table shows a synthesis of the comments received during the first stakeholder consultation process:

Stakeholders comments received during the First Stakeholder Consultation

No	Ing. Rudy Haroldo Najera Sagastume	Ing. Jorge Juárez Pedroza	Ing. Luis E. García Pinot	Lic. Carlos Roberto Morales Monzón	Mr. Roberto Barrera
1	Yes. The project will contribute to reduce the electricity tariff dependency on international petroleum price and to reduce pollutant emissions due to fossil fuel combustion.	Yes. The project characteristics are compatible with the guidelines for sustainable development, e.g. private participation, internal development, clean energy utilization, and national energy sources development.	Yes. The project, using renewable resources to generate electricity, reduces the country vulnerability to changes in international fossil fuel price and contributes to tariff stabilization. It also contributes to balance the type of electricity generation in Guatemala.	Candelaria project would contribute to the regional development. However, we cannot give an opinion since we do not know EIA results for Candelaria project.	Yes. Definitely.
2	Project implementation will impact positively in rural development and the reduction of poverty, producing new jobs, agro industrial development and attracting investment.	Yes, the local community will be favoured by the electricity supply, but also in new jobs generation and improvement of the local electricity market.	Yes. The project contributes to create new jobs during the construction phase and introduces capacity and specialization in local people. During the project operation new technical and specialized jobs will be created.	The economic situation of the local inhabitants would improve considerably. The social situation could improve life quality for local people. This situation should be proven in the Candelaria EIA. Nevertheless, the opinion of the inhabitants who live close to the SECACAO hydro central (which is upstream from the Candelaria project), Mr. Von Quednow Cruz`s leagal appeal to the EIA in reference to regularization of the SECACAO reservoir, and the results of the social monitoring of environmental components through 30 surveys; should be considered as well.	Yes. There is an important percent of Guatemala inhabitants without electricity supply. Investment in power generation contributes to economic development since it represents production opportunities.

No	Ing. Rudy Haroldo Najera Sagastume	Ing. Jorge Juárez Pedroza	Ing. Luis E. García Pinot	Lic. Carlos Roberto Morales Monzón	Mr. Roberto Barrera
3	Yes. The environment will be favoured with construction of hydroelectric projects instead of conventional power plants, provided mitigation measures are included in the environmental impact assessment.	Yes, but very low. If we consider that more hydroelectric electricity will be used instead of another source consuming fossil fuels, local impact will be reduced.	Yes. The project sponsor will protect the river and its environment: fauna, flora, archaeology, etc., and today are careless. This improvement has positive effects at a regional and national level. In this point it is important to ensure that the environmental impact assessment recommendation will be enforced, taking into consideration the minimum water level that is ecologic.	In general, if renewable electricity supply increases, lower electricity consumption is expected from other electricity sources. But without the project EIA we cannot confirm that part of the electricity generated by the project will meet the energy demand of the local community. Candelaria EIA should consider the situation of project lifetime, and mitigation measures in the construction, operation and closure.	Yes. In 2002 the 64 % of the electricity generation was based on fossil fuel consumption (bunker fuel oil and coal) and this generates environmental pollution.
4	Project implementation is positive since the National Interconnected System will improve the offer of the power generation, making the electricity tariff more stable.	A better clime and atmosphere. The national economy will be improved since exports will be reduced. There will be new job opportunities. Enjoying a better environment through forest conservation.	Projects based in renewable electricity generation are very important for the National Committee of Electric Energy, since the electricity supply is increased, which is essential to the country development, reducing the country vulnerability and contributing to the electricity price stabilization.	I cannot give an opinion because I have not seen the EIA.	Hydroelectric projects are beneficial because they improve the electric inertia of the Interconnected System. I receive the benefits of the no environmental contamination.
5	Yes.	Yes, if more hydroelectric energy is used positive effects will occur in the environment, new jobs opportunities will appear and its contribution to increase social life quality and national and regional demand.	Yes. The National Committee of Electric Energy not only recommends this kind of projects but also has submitted to the National Congress a project of law named “Incentives for the Development of Renewable Energy Projects”.	Yes, if project EIA can demonstrate that the construction and operation are compatible with the environment and mitigation measures are taken.	Yes. A balance of the generation system is needed. Most plants installed are thermal plants so the electricity price is dependent on the international price of fossil fuels and this is not an advantage for the country.

No	Ing. Rudy Haroldo Najera Sagastume	Ing. Jorge Juárez Pedroza	Ing. Luis E. García Pinot	Lic. Carlos Roberto Morales Monzón	Mr. Roberto Barrera
6	National policies are intended to encourage renewable resources development, which allow promoting investment in the renewable energy sector and benefit environmental quality in the energy sector. In this way the Ministry of Energy and Mines has created the Centre for Information and Promotion of Renewable Energy and has developed a project of law named "Incentives for the Development of Renewable Energy Projects".		It is recommended the study of a third project located in the same river downstream due to the topographic conditions could permit the construction. Commercialization that benefits local communities should be legally and economically studied.	Project EIA should consider local community opinion in detail. SECACAO local inhabitant requirements should be solved because Candelaria is located downstream SECACAO. Project Sponsor could register the project as CDM to increase cash-flow benefits.	The development of electricity generation facilities using renewable sources has social and economic benefits for the country.

The comments received from local stakeholders during the consultation process on 21/07/2006 are mainly very positive. Local stakeholders expressed that Candelaria hydroelectric project will bring benefits to their communities, generating new jobs and increasing electricity generation from a non-polluting source. Provided the project activity is implemented, clean electricity will reach their houses and fossil fuels consumption will be reduced.

Local stakeholders also stated that Candelaria hydroelectric project will not only generate clean electricity but also will improve the labour and health conditions of the area through reforestation, providing better environmental conditions for the local communities.

The transcription of the comments received is included in the following table:

Stakeholders comments received during the Second Stakeholder Consultation

Question	1	2	3	4
Hermenegildo Xal Tiul	Hidroeléctrica Candelaria is not contaminating our environment, as it is searching for techniques for reducing contamination.	Yes, because it does not generate contamination, by using renewable resources.	These projects are significantly important, since they provide a percentage of daily incomes.	Job opportunities for the young people in our community.
Mario Cac Coc	Hidroeléctrica Candelaria represents a huge benefit for all, as it allows us to breathe clean air and does not contaminate the environment at all.	Of course, I recommend this project to the private companies so that stop damaging our lives.	Yes, it benefits us by providing us electric energy, employment and protection of the flora and fauna of our country.	I believe that more projects should be implemented and more employment should be generated for the community.

Question	1	2	3	4
Martin Choc	I believe it is very good, because it does not contaminate and the water returns to its natural state.	I recommend the execution of projects involving renewable resources.	Now that the project is being developed, I believe that it will benefit us with a greater development.	It protects and preserves nature so that the rivers do not dry.
Lorenzo Cac	The project is excellent, as it helps to avoid an increase in the Earth's temperature.	Yes, the implementation of this type of projects helps to avoid contamination.	Yes, I believe it is a help regarding the financial development of the community.	Hidroeléctrica Candelaria is protecting our environment, unlike other companies that contaminate.
Manuel Cucul Mo	The project is not contaminating, everything is clean, and reforestation is being carried out in order to recover our natural wealth.	Yes, because it does not contaminate the environment at all.	Without the projects there are no incomes or employment. The implementation of the project in our country is worth it.	That employment opportunity should be provided to the community.
Alfonso Cholom	It is a very good work and helps us to preserve the environment.	I recommend them not to do it as it really affects nature.	Of course, because it can involve a better development for our community.	No
Cesario Bac Chub	Hidroeléctrica Candelaria does not contaminate because it involves a generation with no contamination.	This project is good for us, the construction of the Candelaria project must continue.	The projects involve improvements for the economy and social development of our community.	As Hidroeléctrica Candelaria is protecting the environment we expect more projects of this type to be developed.
David Che	I believe that the hydroelectric plant is working better with no type of contamination, everything is ok.	Yes, it is very good because this service is needed in our communities.	Yes, we need the employment sources that this company could generate.	Hidroeléctrica Candelaria works wells without contaminating. Besides, it is helping to the reforestation of the environment.
Ramiro Choc Choc	For us, Hidroeléctrica Candelaria does not involve any contamination and helps to improve the environment.	What we want is to continue with the same equipment of Candelaria, unlike of those that produce gases that contaminate.	A project like Hidroeléctrica Candelaria is very important, as they provide a percentage of daily incomes.	Job opportunities for our community.
Santiago Choc	With the Hidroeléctrica Candelaria project there will not be diseases, it will bring development to our community.	Yes, because it does not contaminate the environment by using the same hydraulic technology.	It is contributing to the development of our community.	We would like to ask more projects like this in order to generate jobs.
Emilio Chub	It is very important because it protects the environment.	I agree because we want this project to benefit our community.	The reforestation of our community is necessary in order to protect water.	We would like the project to reach our community.

Question	1	2	3	4
Pedro Ich	For us it is very important because it helps us with the environmental contamination problem.	It is very important for our community because it protects water.	I agree because it will help our community.	It is a help for us.
José Choc	It is very beneficial for the community, involving the planting of more trees so as to have enough natural resources.	To improve the condition of not contaminating the environment, to have a project like Candelaria	Yes, I agree.	We need the energy for our community.
Juan Daniel Caal	It is very important to know the rural situation.	Yes, I agree.	We would need this energy to reach the community.	I would like to thank everybody ad I hope you can continue working in this project.
Francisco Choc	It is very important how the project functions because it does not contaminate the environment.	Yes.	It is very useful for the community	We need to have energy in order to improve our situation.
Alejandro Chub	The project does not contaminate the environment; it benefits and helps us satisfy our needs.	I recommend the authorities of the project to keep on working.	Yes, I agree, and I hope the activities will continue in order to achieve a clean environment.	I would like our community to receive the energy produced.
Domingo Coy	It involves a benefit that will allow improving our situation and not contaminating the environment.	Yes, it is very important to not contaminate the environment.	It is a general benefit, because it benefits the whole community and satisfies its needs.	It is a pleasure to attend this lecture because it provides a lot of information.
Tiul Cal	For me, Hidroeléctrica Candelaria is very beneficial for the rural community.	It is very important because it covers the needs of the community.	I consider that Hidroeléctrica Secacao will help us with the reforestation in our community.	As teachers we need to be helped in the educative process, so as to have a better education.
Felipe Ich	This project will be a significant help for our community.	I recommend the project to help us in the reforestation of our environment.	I would like this project to be developed in our community.	I think the project will provide a help for us in the energy and drinkable water sector.
Santiago Coc	I liked the Candelaria Hydroelectric Project because it is very clean.	I would like the authorities to develop more projects like Candelaria.	Yes, it generates jobs	Hidroeléctrica Secacao should continue generating a clean development.
Felix Tzi Mó	It is a project that economically contributes to the local and national community, as it avoids contamination.	In my opinion, it is advisable for other entities or companies to promote projects like the Candelaria project.	Of course, this project is a contribution to the social and environmental development.	It is necessary to promote the generation of electric energy of Candelaria in rural areas and thus the use of fuels will be avoided.

Question	1	2	3	4
Juan Rax	Yes, I think it is convenient to carry out this kind of projects.	Yes, I recommend other companies to develop a project like this.	I consider that Hidroeléctrica Candelaria is contributing to the development of the country.	It is good for our development that the company keeps on generating electricity.
David Tox	I think that the electricity generation in Hidroeléctrica Candelaria is very good, because of the proper use of natural resources.	Yes, I recommend it because it does not involve the cutting down of trees or burning of fossil remains.	Of course. Hidroeléctrica Candelaria is contributing to the development of the country.	Besides the hydroelectric project, the area is also being afforested and this sets an example for other companies.
Mateo Caal	Hidroeléctrica Candelaria is a clean development project for it does not contaminate.	Yes because it constitutes a form of clean development without contamination.	Yes, it generates jobs	Hidroeléctrica Candelaria promotes the development of our community.
Santiago Maquín	HidroeléctricaSecacaco does not damage our environment.	Yes, because it does no contaminate the environment.	Yes, it generates jobs	No
Abner Chiquin	Hidroeléctrica Candelaria is beneficial for our development and does not damage the community because it does not contaminate.	Yes, because the generation of electricity from renewable resource does not generate contamination.	Yes, it generates jobs	Hidroeléctrica Candelaria helps the development of our region.
Juan Cucul	I like Hidroeléctrica Candelaria, because it involves clean development and benefit our environment as it does not generate contamination; I hope it will continue that way.	Yes, I recommend the companies to develop projects like this.	Yes, it generates jobs	Hidroeléctrica Candelaria implies development for our region.
Vicente Cucul	Hidroeléctrica Candelaria does not destroy our environment	Yes, because it does not contaminate the environment	Yes, because it generates employment and social development.	We would like to ask more projects like this in order to generate jobs.
Juan Carlos Villela	I totally agree with the project implementation - The use of clean energy must be stimulated in order to avoid environmental contamination	Yes, I would recommend it, as it encourages the creation of laws for limiting the use of any type of contaminants.	Yes, I consider that the project involves a direct and indirect benefit for all.	I congratulate Hidroeléctrica Candelaria for participating in the development of Guatemala and for all the direct and indirect benefits it will generate.
José Bacaal	The projects that generate fumes is what there was before and it was bad, but this project is clean and protects the environment. I hope there are more projects like this.	Yes, I recommend it	Yes, I'm happy and I know that it will soon help the community.	I just want to thank for the invitation and for the project

Question	1	2	3	4
Augusto Chub	The project is very good, since everything that generates fumes contaminates and it has to be removed. The project must continue.	Yes, I recommend it	Yes, I'm happy that the project is being developed and that it will involve more development for the community, you are doing a good job, keep on doing it.	I thank Hidroeléctrica Candelaria for giving us the opportunity to know the project that so much benefit will bring to the community.
Adrian Sub	The project is very good and it is an excellent thing for the environment.	Yes, I recommend it	Yes, the project brings hope of a better future, as it will involve the generation of energy, employment and improvement of health for the community.	Thanks!
Alberto Choc	I like the project because it protects the environment. Continue with the project so that contamination ends.	Yes, I recommend it	Yes, the entire project is good and it will benefit the community and the children living in it.	I thank for the invitation as it helped me to know the project and I'm sure it will help the development of the community.
Francisco Chub	I liked the explanation regarding the greenhouse effect and I hope more projects similar to this are developed.	Yes, I recommend it	Yes, because we want to see improvements, such as light, development and the social benefits that the project involves.	I thank you for the work you are doing.
Javier Choc	I'm glad to know that the project is good, continue with the project.	Yes, I recommend it.	Yes	Yes, and I believe it will involve benefits regarding development, light, education and health.

E.3. Report on consideration of comments received

Reforestation and afforestation projects

Hidroeléctrica Candelaria S.A. began implementing reforestation and afforestation projects in 2003, by starting with a development of 231 hectares. Later on, other projects involving 159 hectares and 53 hectares were carried out in 2005 and 2007, respectively. Finally, 417 hectares were developed during the 2008-2012 period.

For 2013, the project sponsors have planned the reforestation/afforestation of another 45 hectares.

It is estimated that about 3,500 employees are hired for the sowing/planting process involved in a project of 50 hectares, depending on the type of plantation.

Additionally, 13,000 workers are expected to be hired for the maintenance of the existing plantations up to 2013.

All workers come from the local communities and, during all this time, they have had the opportunity of being trained for the type of work they perform. An agricultural engineer is responsible for the management and maintenance of the plantations.

All of these activities yield significant benefits to the communities, not only by providing them with employment, but also through what they learn and put into practice in their own plantations, allowing them to achieve higher productivity in their personal crop plantation yields.

Mitigation Measures

The Environmental Impact Assessment of the project activity includes a list of mitigation measures that have to be implemented by the Candelaria project sponsors. In order to control the achievement of these commitments and to continue evaluating the project impacts, an environmental monitoring plan was implemented by Candelaria project sponsors since August 2006. Additionally, an environmental audits company is hired periodically by Candelaria project sponsors to bring support during the monitoring activities.

The results of the monitoring are presented periodically to the Environment and Natural Resources Ministry (*Ministerio de Ambiente y Recursos Naturales*, MARN) for its review and approval.

During the first years of operation of Candelaria plant, the reports showing the results of the monitoring were carried out every 6 months. However, due to the stability of the results, the reports started to be developed once a year.

SECTION F. Approval and authorization

The letters of approval from Guatemala (23/08/2006) and Switzerland (23/10/2009) are available and can be accessed at the UNFCCC website:

http://cdm.unfccc.int/Projects/DB/DNV-CUK1158743330.88/view

Appendix 1: Contact information of project participants

Organization name	Hidroeléctrica Candelaria S.A.
Street/P.O. Box	16 Calle 0-26 Zona 14
Building	
City	Guatemala City
State/Region	Central America (Latin American / Caribbean Region)
Postcode	01014
Country	Guatemala
Telephone	(502) 2313-8383
Fax	(502) 2313-8383
E-mail	rtormo@gruposecacao.com
Website	
Contact person	
Title	General Manager
Salutation	
Last name	Tormo
Middle name	José
First name	Rodrigo
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	rtormo@gruposecacao.com

Organization name	Ecoinvest Carbon S.A.
Street/P.O. Box	Route de Florissant , P.O. Box 518
Building	13
City	Geneva
State/Region	Geneva
Postcode	1211
Country	Switzerland
Telephone	+41 22 592 9765
Fax	+41 22 580 3360
E-mail	emissions@bunge.com
Website	
Contact person	
Title	CEO
Salutation	Mr.
Last name	Evans
Middle name	
First name	Alfred
Department	
Mobile	
Direct fax	+41 22 580 3360
Direct tel.	+41 22 580 3360
Personal e-mail	alfred.evans@bunge.com

Appendix 2: Affirmation regarding public funding

See Section A.5 of this PDD.

Appendix 3: Applicability of selected methodology

See Section B.2 of this PDD.

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

Candelaria Net Electricity Supplied to the Grid

Average net electricity delivered (MWh)

	2007	2008	2009	2010	2011	2012
January	2,141	1,600	1,416	1,601	1,565	1,912
February	1,514	1,266	1,372	1,243	1,219	1,698
March	1,560	1,133	1,204	1,186	1,234	1,427
April	1,451	863	999	863	1,130	775
May	1,199	932	462	1,635	1,062	1,374
June	1,609	2,020	1,219	1,845	1,760	2,000
July	2,432	2,995	2,779	2,524	2,868	2,697
August	2,852	3,045	3,109	2,869	2,596	3,076
September	3,031	2,980	2,968	2,844	2,911	3,031
October	3,122	3,094	3,090	2,901	2,924	3,076
November	2,451	2,648	2,558	2,305	2,730	2,398
December	2,052	2,161	1,962	1,893	2,103	1,930
Total	**25,414**	**24,738**	**23,137**	**23,708**	**24,101**	**25,394**
Average	**24,415**					

Grid OM Emission Factor

Average LC/MR generation

	2008	2009	2010	2011	2012
LC/MR generation (GWh)	4,761	4,243	5,005	5,229	5,691
Total generation without imports (GWh)	7,917	7,979	7,914	8,147	8,704
Share of LC/MR generation	60.1%	53.2%	63.2%	64.2%	65.4%
Average share of LC/MR generation	**61.2%**				

2012 OM emission factor

No LC/MR plants	Operation start date	Generation (GWh)	Generation type	Fuel type	Efficiency	Emission factor (tCO_2/MWh)	Emissions (tCO_2)
SAN JOSE	2000	863.53	Steam turbine	Coal	0.370	0.8708	751,968
LA LIBERTAD	2008	89.96	Steam turbine	Coal	0.500	0.6444	57,973
PALMAS 2	2012	284.42	Steam turbine	Coal	0.500	0.6444	183,283
ARIZONA VAPOR 1	2008	11.92	Steam turbine	Fuel oil	0.390	0.6969	8,304
ARIZONA	2003	673.11	Internal combustion	Fuel oil	0.395	0.6881	463,170
LA ESPERANZA (POLIWATT)	2000	455.31	Internal combustion	Fuel oil	0.300	0.9060	412,515

No LC/MR plants	Operation start date	Generation (GWh)	Generation type	Fuel type	Efficiency	Emission factor (tCO_2/MWh)	Emissions (tCO_2)
PQPLLC (PUERTO QUETZAL POWER)	1993	112.73	Internal combustion	Fuel oil	0.300	0.9060	102,132
LAS PALMAS 1	1998	27.01	Internal combustion	Fuel oil	0.300	0.9060	24,471
LAS PALMAS 2	1998	35.97	Internal combustion	Fuel oil	0.300	0.9060	32,587
LAS PALMAS 3	1998	23.93	Internal combustion	Fuel oil	0.300	0.9060	21,676
LAS PALMAS 4	1998	26.73	Internal combustion	Fuel oil	0.300	0.9060	24,219
LAS PALMAS 5	1998	7.26	Internal combustion	Fuel oil	0.300	0.9060	6,579
GENOR	1998	265.90	Internal combustion	Fuel oil	0.300	0.9060	240,902
SIDEGUA	1995	27.24	Internal combustion	Fuel oil	0.300	0.9060	24,680
TEXTILES B1	1996	16.17	Internal combustion	Fuel oil	0.300	0.9060	14,654
TEXTILES B2	1996	28.11	Internal combustion	Fuel oil	0.300	0.9060	25,468
TEXTILES B3	1996	27.28	Internal combustion	Fuel oil	0.300	0.9060	24,718
ELECTROGENERACIÓN	2003	11.22	Internal combustion	Fuel oil	0.395	0.6881	7,723
GENERADORA PROGRESO	1993	14.49	Internal combustion	Fuel oil	0.300	0.9060	13,131
GECSA	2007	0.00	Internal combustion	Fuel oil	0.395	0.6881	0
GECSA2	2008	0.00	Internal combustion	Fuel oil	0.395	0.6881	0
COENESA	2008	0.64	Internal combustion	Diesel	0.395	0.6617	422
INTECSA	1994	0.35	Internal combustion	Fuel oil/diesel	0.300	0.8712[12]	301
TAMPA	1995	7.12	Gas turbine	Diesel	0.300	0.8712	6,201
STEWART & STEVENSON	1995	0.32	Gas turbine	Diesel	0.300	0.8712	280
ESC.GAS No. 3	1976	0.00	Gas turbine	Diesel	0.300	0.8712	0
ESC.GAS No. 5	1985	1.19	Gas turbine	Diesel	0.300	0.8712	1,033
LAGUNA GAS 2	1978	0.29	Gas turbine	Diesel	0.300	0.8712	254
Total		**3,012**					**2,448,644**

LC/MR plants	Generation (GWh)	Generation type	Fuel type	Emission factor (tCO_2/MWh)	Emissions (tCO_2)
CHIXOY	1,798.38	Hydroelectric		0.0000	0
AGUACAPA	312.04	Hydroelectric		0.0000	0
JURUN	294.02	Hydroelectric		0.0000	0
ESCLAVOS	63.03	Hydroelectric		0.0000	0
PEQUEÑAS HIDRO	53.49	Hydroelectric		0.0000	0
RIO BOBOS	51.10	Hydroelectric		0.0000	0
SECACAO	101.10	Hydroelectric		0.0000	0
PASABIEN	57.60	Hydroelectric		0.0000	0
POZA VERDE	49.34	Hydroelectric		0.0000	0
LAS VACAS	86.91	Hydroelectric		0.0000	0
EL CANADÁ	215.28	Hydroelectric		0.0000	0
MATANZAS + SAN ISIDRO	67.25	Hydroelectric		0.0000	0
RENACE	264.12	Hydroelectric		0.0000	0
PALIN II	1.72	Hydroelectric		0.0000	0

[12] In accordance with the Tool, where several fuel types are used in the power unit, the fuel type with the lowest CO_2 emission factor is used. Thus, for the power unit that use fuel oil and diesel, the CO_2 emission factor of diesel is used.

LC/MR plants	Generation (GWh)	Generation type	Fuel type	Emission factor (tCO_2/MWh)	Emissions (tCO_2)
MONTECRISTO	59.85	Hydroelectric		0.0000	0
CANDELARIA	25.42	Hydroelectric		0.0000	0
EL RECREO	145.82	Hydroelectric		0.0000	0
HIDROXACBAL	360.21	Hydroelectric		0.0000	0
PANAN	34.79	Hydroelectric		0.0000	0
SANTA TERESA	44.06	Hydroelectric		0.0000	0
CHOLOMA	31.45	Hydroelectric		0.0000	0
PALO VIEJO	239.53	Hydroelectric		0.0000	0
ORZUNIL	104.46	Geothermal		0.0000	0
ORTITLAN	141.16	Geothermal		0.0000	0
CONCEPCION	61.76	Cogeneration	Biomass/Fuel oil	0.0000[13]	0
PANTALEON	205.16	Cogeneration	Biomass/Fuel oil	0.0000	0
SANTA ANA	124.95	Cogeneration	Biomass/Fuel oil	0.0000	0
MAGDALENA	306.87	Cogeneration	Biomass/Fuel oil	0.0000	0
LA UNION	141.93	Cogeneration	Biomass/Fuel oil	0.0000	0
MADRE TIERRA	81.74	Cogeneration	Biomass/Fuel oil	0.0000	0
TULULA	13.62	Cogeneration	Biomass/Fuel oil	0.0000	0
TRINIDAD	67.25	Cogeneration	Biomass	0.0000	0
EL PILAR	4.22	Cogeneration	Biomass	0.0000	0
SANTA ELENA	2.17	Hydroelectric		0.0000	0
KAPLAN CHAPINA	1.99	Hydroelectric		0.0000	0
CUEVAMARIA	26.88	Hydroelectric		0.0000	0
LOS CERROS	4.49	Hydroelectric		0.0000	0
COVADONGA	3.75	Hydroelectric		0.0000	0
JESBON MARAVILLAS	1.44	Hydroelectric		0.0000	0
EL PRADO	1.52	Hydroelectric		0.0000	0
OSCANA	0.33	Hydroelectric		0.0000	0
HIDRO SDMM	12.05	Hydroelectric		0.0000	0
HIDRO LA PERLA	9.98	Hydroelectric		0.0000	0
HIDROELECTRICA SAC-JA	5.75	Hydroelectric		0.0000	0
INGENIO PALO GORDO	3.31	Cogeneration	Biomass	0.0000	0
SAN JOAQUIN 2	4.60	Hydroelectric		0.0000	0
LUARCA	0.52	Hydroelectric		0.0000	0
CERRO VIVO	2.96	Hydroelectric		0.0000	0
Total	**5,691**				**0**

[13] In accordance with the Tool, where several fuel types are used in the power unit, the fuel type with the lowest CO_2 emission factor is used. Thus, for the cogenerators that use fuel oil and biomass, the CO_2 emission factor of biomass is used.

no LC/MR generation (GWh)	3,012
LC/MR generation (GWh)	5,691
Net imports (GWh)	26
LC/MR generation + net imports (GWh)	5,717
no LC/MR emissions (tCO_2)	2,448,644
LC/MR emissions (tCO_2)	0
Lambda	0.0312
2012 OM emission factor (tCO_2/MWh)	**0.7876**

2011 OM emission factor

No LC/MR plants	Operation start date	Generation (GWh)	Generation type	Fuel type	Efficiency	Emission factor (tCO_2/MWh)	Emissions (tCO_2)
SAN JOSE	2000	961.94	Steam turbine	Coal	0.370	0.8708	837,664
LA LIBERTAD	2008	92.26	Steam turbine	Coal	0.500	0.6444	59,454
PALMAS 2	2012*	30.59	Steam turbine	Coal	0.500	0.6444	19,713
ARIZONA VAPOR 1	2008	9.49	Steam turbine	Fuel oil	0.390	0.6969	6,611
ARIZONA	2003	634.33	Internal combustion	Fuel oil	0.395	0.6881	436,482
LA ESPERANZA (POLIWATT)	2000	330.20	Internal combustion	Fuel oil	0.300	0.9060	299,162
PQPLLC (PUERTO QUETZAL POWER)	1993	94.63	Internal combustion	Fuel oil	0.300	0.9060	85,733
LAS PALMAS 1	1998	38.70	Internal combustion	Fuel oil	0.300	0.9060	35,060
LAS PALMAS 2	1998	55.47	Internal combustion	Fuel oil	0.300	0.9060	50,252
LAS PALMAS 3	1998	50.01	Internal combustion	Fuel oil	0.300	0.9060	45,307
LAS PALMAS 4	1998	37.87	Internal combustion	Fuel oil	0.300	0.9060	34,309
LAS PALMAS 5	1998	13.81	Internal combustion	Fuel oil	0.300	0.9060	12,509
GENOR	1998	236.25	Internal combustion	Fuel oil	0.300	0.9060	214,047
SIDEGUA	1995	65.00	Internal combustion	Fuel oil	0.300	0.9060	58,888
TEXTILES B1	1996	31.15	Internal combustion	Fuel oil	0.300	0.9060	28,218
TEXTILES B2	1996	56.48	Internal combustion	Fuel oil	0.300	0.9060	51,167
TEXTILES B3	1996	79.66	Internal combustion	Fuel oil	0.300	0.9060	72,170
ELECTROGENERACIÓN	2003	31.36	Internal combustion	Fuel oil	0.395	0.6881	21,581
GENERADORA PROGRESO	1993	38.70	Internal combustion	Fuel oil	0.300	0.9060	35,066
GECSA	2007	0.00	Internal combustion	Fuel oil	0.395	0.6881	0
GECSA2	2008	0.00	Internal combustion	Fuel oil	0.395	0.6881	0
COENESA	2008	0.22	Internal combustion	Diesel	0.395	0.6617	142
TAMPA	1995	26.81	Gas turbine	Diesel	0.300	0.8712	23,353
STEWART & STEVENSON	1995	1.08	Gas turbine	Diesel	0.300	0.8712	939
ESC.GAS No. 3	1976	0.00	Gas turbine	Diesel	0.300	0.8712	0
ESC.GAS No. 5	1985	0.24	Gas turbine	Diesel	0.300	0.8712	205
LAGUNA GAS 2	1978	1.25	Gas turbine	Diesel	0.300	0.8712	1,090
Total		**2,917**					**2,429,123**

* Start date of commercial operation

LC/MR plants	Generation (GWh)	Generation type	Fuel type	Emission factor (tCO_2/MWh)	Emissions (tCO_2)
CHIXOY	1794.11	Hydroelectric		0.0000	0
AGUACAPA	312.77	Hydroelectric		0.0000	0
JURUN	318.74	Hydroelectric		0.0000	0
ESCLAVOS	50.81	Hydroelectric		0.0000	0
PEQUEÑAS HIDRO	57.44	Hydroelectric		0.0000	0
RIO BOBOS	48.94	Hydroelectric		0.0000	0
SECACAO	95.61	Hydroelectric		0.0000	0
PASABIEN	62.53	Hydroelectric		0.0000	0
POZA VERDE	47.99	Hydroelectric		0.0000	0
LAS VACAS	97.82	Hydroelectric		0.0000	0
EL CANADÁ	222.30	Hydroelectric		0.0000	0
MATANZAS + SAN ISIDRO	71.84	Hydroelectric		0.0000	0
RENACE	276.61	Hydroelectric		0.0000	0
PALIN II	0.00	Hydroelectric		0.0000	0
MONTECRISTO	61.54	Hydroelectric		0.0000	0
CANDELARIA	24.11	Hydroelectric		0.0000	0
EL RECREO	61.35	Hydroelectric		0.0000	0
HIDROXACBAL	394.19	Hydroelectric		0.0000	0
PANAN	33.29	Hydroelectric		0.0000	0
SANTA TERESA	21.26	Hydroelectric		0.0000	0
CHOLOMA	3.73	Hydroelectric		0.0000	0
ORZUNIL	87.37	Geothermal		0.0000	0
ORTITLAN	149.71	Geothermal		0.0000	0
CONCEPCION	70.03	Cogeneration	Biomass/Fuel oil	0.0000[14]	0
PANTALEON	204.93	Cogeneration	Biomass/Fuel oil	0.0000	0
SANTA ANA	92.42	Cogeneration	Biomass/Fuel oil	0.0000	0
MAGDALENA	258.21	Cogeneration	Biomass/Fuel oil	0.0000	0
LA UNION	133.50	Cogeneration	Biomass/Fuel oil	0.0000	0
MADRE TIERRA	80.08	Cogeneration	Biomass/Fuel oil	0.0000	0
TULULA	11.20	Cogeneration	Biomass/Fuel oil	0.0000	0
SAN DIEGO	0.00	Cogeneration	Biomass	0.0000	0
TRINIDAD	47.24	Cogeneration	Biomass	0.0000	0
SANTA ELENA	2.40	Hydroelectric		0.0000	0
KAPLAN CHAPINA	1.36	Hydroelectric		0.0000	0
CUEVAMARIA	13.58	Hydroelectric		0.0000	0
LOS CERROS	4.46	Hydroelectric		0.0000	0
COVADONGA	3.72	Hydroelectric		0.0000	0
JESBON MARAVILLAS	0.78	Hydroelectric		0.0000	0
EL PRADO	1.08	Hydroelectric		0.0000	0
OSCANA	0.54	Hydroelectric		0.0000	0
HIDRO SDMM	6.84	Hydroelectric		0.0000	0
HIDRO LA PERLA	1.44	Hydroelectric		0.0000	0

[14] In accordance with the Tool, where several fuel types are used in the power unit, the fuel type with the lowest CO_2 emission factor is used. Thus, for the cogenerators that use fuel oil and biomass, the CO_2 emission factor of biomass is used.

LC/MR plants	Generation (GWh)	Generation type	Fuel type	Emission factor (tCO_2/MWh)	Emissions (tCO_2)
HIDROELECTRICA SAC-JA	0.97	Hydroelectric		0.0000	0
INGENIO PALO GORDO	0.25	Cogeneration	Biomass	0.0000	0
Total	**5,229**				**0**

no LC/MR generation (GWh)	2,917
LC/MR generation (GWh)	5,229
Net imports (GWh)	327
LC/MR generation + net imports (GWh)	5,556
no LC/MR emissions (tCO_2)	2,429,123
LC/MR emissions (tCO_2)	0
Lambda	0.0151
2011 OM emission factor (tCO_2/MWh)	**0.8201**

2010 OM emission factor

No LC/MR plants	Operation start date	Generation (GWh)	Generation type	Fuel type	Efficiency	Emission factor (tCO_2/MWh)	Emissions (tCO_2)
SAN JOSE	2000	942.54	Steam turbine	Coal	0.370	0.8708	820,773
LA LIBERTAD	2008	93.08	Steam turbine	Coal	0.500	0.6444	59,980
ARIZONA VAPOR 1	2008	7.80	Steam turbine	Fuel oil	0.390	0.6969	5,434
ARIZONA	2003	643.01	Internal combustion	Fuel oil	0.395	0.6881	442,459
LA ESPERANZA (POLIWATT)	2000	454.75	Internal combustion	Fuel oil	0.300	0.9060	412,002
PQPLLC (PUERTO QUETZAL POWER)	1993	40.22	Internal combustion	Fuel oil	0.300	0.9060	36,442
LAS PALMAS 1	1998	63.99	Internal combustion	Fuel oil	0.300	0.9060	57,979
LAS PALMAS 2	1998	67.84	Internal combustion	Fuel oil	0.300	0.9060	61,466
LAS PALMAS 3	1998	41.13	Internal combustion	Fuel oil	0.300	0.9060	37,268
LAS PALMAS 4	1998	24.72	Internal combustion	Fuel oil	0.300	0.9060	22,399
LAS PALMAS 5	1998	14.29	Internal combustion	Fuel oil	0.300	0.9060	12,944
GENOR	1998	215.69	Internal combustion	Fuel oil	0.300	0.9060	195,415
SIDEGUA	1995	22.69	Internal combustion	Fuel oil	0.300	0.9060	20,559
TEXTILES B1	1996	23.40	Internal combustion	Fuel oil	0.300	0.9060	21,200
TEXTILES B2	1996	63.97	Internal combustion	Fuel oil	0.300	0.9060	57,954
TEXTILES B3	1996	42.80	Internal combustion	Fuel oil	0.300	0.9060	38,777
ELECTROGENERACIÓN	2003	32.38	Internal combustion	Fuel oil	0.395	0.6881	22,283
GENERADORA PROGRESO	1993	27.11	Internal combustion	Fuel oil	0.300	0.9060	24,560
GECSA	2007	8.91	Internal combustion	Fuel oil	0.395	0.6881	6,129
GECSA2	2008	48.85	Internal combustion	Fuel oil	0.395	0.6881	33,612
COENESA	2008	0.14	Internal combustion	Diesel	0.395	0.6617	90
ELECTROCRISTAL BUNKER	2005	25.98	Internal combustion	Fuel oil	0.395	0.6881	17,879
TAMPA	1995	2.03	Gas turbine	Diesel	0.300	0.8712	1,765
STEWART & STEVENSON	1995	0.84	Gas turbine	Diesel	0.300	0.8712	736
ESC.GAS No. 3	1976	0.12	Gas turbine	Diesel	0.300	0.8712	104

No LC/MR plants	Operation start date	Generation (GWh)	Generation type	Fuel type	Efficiency	Emission factor (tCO_2/MWh)	Emissions (tCO_2)
ESC.GAS No. 5	1985	0.15	Gas turbine	Diesel	0.300	0.8712	135
LAGUNA GAS 2	1978	0.39	Gas turbine	Diesel	0.300	0.8712	338
Total		**2,909**					**2,410,683**

LC/MR plants	Generation (GWh)	Generation type	Fuel type	Emission factor (tCO_2/MWh)	Emissions (tCO_2)
CHIXOY	1691.83	Hydroelectric		0.0000	0
AGUACAPA	317.02	Hydroelectric		0.0000	0
JURUN	276.29	Hydroelectric		0.0000	0
ESCLAVOS	44.34	Hydroelectric		0.0000	0
PEQUEÑAS HIDRO	55.62	Hydroelectric		0.0000	0
RIO BOBOS	52.02	Hydroelectric		0.0000	0
SECACAO	94.40	Hydroelectric		0.0000	0
PASABIEN	53.80	Hydroelectric		0.0000	0
POZA VERDE	35.21	Hydroelectric		0.0000	0
LAS VACAS	42.32	Hydroelectric		0.0000	0
EL CANADÁ	233.37	Hydroelectric		0.0000	0
MATANZAS + SAN ISIDRO	63.73	Hydroelectric		0.0000	0
RENACE	310.54	Hydroelectric		0.0000	0
PALIN II	0.00	Hydroelectric		0.0000	0
MONTECRISTO	57.31	Hydroelectric		0.0000	0
CANDELARIA	23.71	Hydroelectric		0.0000	0
EL RECREO	140.82	Hydroelectric		0.0000	0
HIDROXACBAL	259.56	Hydroelectric		0.0000	0
PANAN	0.03	Hydroelectric		0.0000	0
ORZUNIL	114.43	Geothermal		0.0000	0
ORTITLAN	144.88	Geothermal		0.0000	0
CONCEPCION	68.54	Cogeneration	Biomass/Fuel oil	0.0000[15]	0
PANTALEON	181.03	Cogeneration	Biomass/Fuel oil	0.0000	0
SANTA ANA	122.51	Cogeneration	Biomass/Fuel oil	0.0000	0
MAGDALENA	316.56	Cogeneration	Biomass/Fuel oil	0.0000	0
LA UNION	151.40	Cogeneration	Biomass/Fuel oil	0.0000	0
MADRE TIERRA	87.93	Cogeneration	Biomass/Fuel oil	0.0000	0
TULULA	11.26	Cogeneration	Biomass/Fuel oil	0.0000	0
SAN DIEGO	1.39	Cogeneration	Biomass	0.0000	0
TRINIDAD	38.30	Cogeneration	Biomass	0.0000	0
SANTA ELENA	0.77	Hydroelectric		0.0000	0
KAPLAN CHAPINA	0.57	Hydroelectric		0.0000	0
CUEVAMARIA	8.70	Hydroelectric		0.0000	0
LOS CERROS	2.79	Hydroelectric		0.0000	0
COVADONGA	1.27	Hydroelectric		0.0000	0

[15] In accordance with the Tool, where several fuel types are used in the power unit, the fuel type with the lowest CO_2 emission factor is used. Thus, for the cogenerators that use fuel oil and biomass, the CO_2 emission factor of biomass is used.

LC/MR plants	Generation (GWh)	Generation type	Fuel type	Emission factor (tCO_2/MWh)	Emissions (tCO_2)
JESBON MARAVILLAS	0.95	Hydroelectric		0.0000	0
EL PRADO	0.06	Hydroelectric		0.0000	0
OSCANA	0.01	Hydroelectric		0.0000	0
Total	**5,005**				**0**

no LC/MR generation (GWh)	2,909
LC/MR generation (GWh)	5,005
Net imports (GWh)	220
LC/MR generation + net imports (GWh)	5,225
no LC/MR emissions (tCO_2)	2,410,683
LC/MR emissions (tCO_2)	0
Lambda	0.0110
2010 OM emission factor (tCO_2/MWh)	**0.8197**

Average OM emission factor

	2010	2011	2012
Total generation (GWh)	7,914	8,147	8,704
OM emission factor (tCO_2/MWh)	0.8197	0.8201	0.7876
Average OM emission factor (tCO_2/MWh)	**0.8085**		

Grid BM Emission Factor

2012 BM emission factor

Plant	Operation start date	Generation (GWh)	Cumulative generation (GWh)	Generation type	Fuel type	Efficiency	Emission factor (tCO_2/MWh)	Emissions (tCO_2)	Cumulative emissions (tCO_2)
HIDROELECTRICA CERRO VIVO	12Aug12	2.96	2.96	Hydroelectric			0.0000	0	0
HIDROELECTRICA LUARCA	16Jun12	0.52	3.47	Hydroelectric			0.0000	0	0
PALO VIEJO (CDM)	31May12		3.47	Hydroelectric					0
LAS PALMAS II	13May12	284.42	287.90	Steam turbine	Coal	0.500	0.6444	183,283	183,283
EL PILAR	18Mar12	4.22	292.11	Cogeneration	Biomass		0.0000	0	183,283
HIDROELECTRICA SAN JOAQUIN	1Jan12	4.60	296.72	Hydroelectric			0.0000	0	183,283
CHOLOMA (CDM)	11Dec11		296.72	Hydroelectric					183,283
PALO GORDO	1Dec11	3.31	300.03	Cogeneration	Biomass		0.0000	0	183,283
SANTA TERESA	9Oct11	44.06	344.09	Hydroelectric			0.0000	0	183,283
HIDROELECTRICA SAC-JA	1Oct11	5.75	349.84	Hydroelectric			0.0000	0	183,283
HIDROELECTRICA LA PERLA	1Oct11	9.98	359.82	Hydroelectric			0.0000	0	183,283
PANAN	18Sep11	34.79	394.61	Hydroelectric			0.0000	0	183,283
HIDROPOWER SDMM	1Apr11	12.05	406.66	Hydroelectric			0.0000	0	183,283
HIDROELECTRICA FINCA LAS MARGARITAS (OSCANA)	1Dec10	0.33	406.99	Hydroelectric			0.0000	0	183,283
CENTRAL GENERADORA EL PRADO (Sn Ant Morazán)	1Dec10	1.52	408.51	Hydroelectric			0.0000	0	183,283
HIDRO XACBAL (CDM)	8Aug10		408.51	Hydroelectric					183,283
HIDROELECTRICA JESBON MARAVILLAS	1Aug10	1.44	409.95	Hydroelectric			0.0000	0	183,283
HIDROELECTRICA COVADONGA	1Jul10	3.75	413.69	Hydroelectric			0.0000	0	183,283

Plant	Operation start date	Generation (GWh)	Cumulative generation (GWh)	Generation type	Fuel type	Efficiency	Emission factor (tCO_2/MWh)	Emissions (tCO_2)	Cumulative emissions (tCO_2)
HIDROELECTRICA LOS CERROS	1Feb10	4.49	418.18	Hydroelectric			0.0000	0	183,283
LA UNION EXCEDENTES	2009	0.00	418.18	Cogeneration	Biomass		0.0000	0	183,283
HIDROELECTRICA CUEVA MARIA	1Oct09	26.88	445.06	Hydroelectric			0.0000	0	183,283
KAPLAN CHAPINA	1Jun09	1.99	447.05	Hydroelectric			0.0000	0	183,283
TRINIDAD	Feb09	67.25	514.30	Cogeneration	Biomass		0.0000	0	183,283
HIDROELECTRICA SANTA ELENA	1Dec08	2.17	516.47	Hydroelectric			0.0000	0	183,283
GECSA 2	12Oct08	0.00	516.47	Internal combustion	Fuel oil	0.395	0.6881	0	183,283
COENESA	Sep08	0.64	517.10	Internal combustion	Diesel	0.395	0.6617	422	183,705
ARIZONA VAPOR	29Sep08	11.92	529.02	Steam turbine	Fuel oil	0.390	0.6969	8,304	192,009
LA LIBERTAD	17Aug08	89.96	618.98	Steam turbine	Coal	0.500	0.6444	57,973	249,982
EL RECREO	Jul07	145.82	764.80	Hydroelectric			0.0000	0	249,982
ORTITLAN (CDM)	1Jul07		764.80	Geothermal					249,982
GECSA	25Feb07	0.00	764.80	Internal combustion	Fuel oil	0.395	0.6881	0	249,982
CANDELARIA (CDM)	May06		764.80	Hydroelectric					249,982
MONTECRISTO (CDM)	May06		764.80	Hydroelectric					249,982
PANTALEÓN EXCEDENTES	2005	55.80	820.60	Cogeneration	Biomass		0.0000	0	249,982
MAGDALENA EXCEDENTES (B1 and B4)	2005	102.39	923.00	Cogeneration	Biomass		0.0000	0	249,982
PALÍN 2	Jul05	1.72	924.72	Hydroelectric			0.0000	0	249,982
POZA VERDE	22Jun05	49.34	974.06	Hydroelectric			0.0000	0	249,982
ELECTRO GENERACIÓN CRISTAL BUNKER	2005	0.00	974.06	Internal combustion	Fuel oil	0.395	0.6881	0	249,982
DARSA	2004	0.00	974.06	Steam turbine			0.0000	0	249,982
SAN DIEGO	Dec04	0.00	974.06	Cogeneration	Biomass		0.0000	0	249,982

Plant	Operation start date	Generation (GWh)	Cumulative generation (GWh)	Generation type	Fuel type	Efficiency	Emission factor (tCO_2/MWh)	Emissions (tCO_2)	Cumulative emissions (tCO_2)
RENACE	Mar04	264.12	1238.17	Hydroelectric			0.0000	0	249,982
EL CANADA (CDM)	Nov03		1238.17	Hydroelectric					249,982
ELECTRO GENERACIÓN	Nov03	11.22	1249.40	Internal combustion	Fuel oil	0.395	0.6881	7,723	257,705
ARIZONA	Apr03	673.11	**1922.51**	Internal combustion	Fuel oil	0.395	0.6881	463,170	**720,875**

2012 total generation (GWh)	8,704
2012 CDM total generation (GWh)	1,227
AEG_{total}(MWh)	7,476,490
20% of AEG_{total}(MWh)	1,495,298
BM generation (MWh)	1,922,510
BM emissions (tCO_2)	720,875
2012 BM emission factor (tCO_2/MWh)	**0.3750**

Appendix 5: Further background information on monitoring plan

See Section B.7 of this PDD.

Appendix 6: Summary of post registration changes

There have been no post registration changes for this project activity.

- - - - -

History of the document

Version	Date	Nature of revision
04.1	11 April 2012	Editorial revision to change history box by adding EB meeting and annex numbers in the Date column.
04.0	EB 66 13 March 2012	Revision requiredto ensure consistency with the "Guidelines for completing the project design document form for small-scale CDM project activities" (EB 66, Annex 9).
03	EB 28, Annex 34 15 December 2006	• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.
02	EB 20, Annex 14 08 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
01	EB 07, Annex 05 21 January 2003	Initial adoption.
Decision Class: Regulatory **Document Type:** Form **Business Function:** Registration		