Project design document form for CDM project activities

(Version 05.0)

Complete this form in accordance with the Attachment "Instructions for filling out the project design document form for CDM project activities" at the end of this form.

PROJECT DESIGN DOCUMENT (PDD)	
Title of the project activity	El Canadá Hydroelectric Project
Version number of the PDD	12
Completion date of the PDD	28/10/2014
Project participant(s)	**Guatemala**: Generadora de Occidente Ltda. **Finland:** Government of Finland - Ministry of Foreign Affairs of Finland; Fortum Corporation. **Japan:** Chubu Electric Power Co., Inc; The Chugoku Electric Power Co., Inc.; Kyushu Electric Power Co., Inc.; Mitsubishi Corporation; Shikoku Electric Power Co., Inc.; Tohoku Electric Power Co., Inc.; The Tokyo Electric Power Co., Inc.; Japan International Cooperation Agency (JICA); Mitsui & Co., Ltd. **Netherlands:** Netherlands' Ministry of Infrastructure and the Environment (IenM); Electrabel N.V.; Netherlands' Ministry of Economic Affairs, Agriculture and Innovation (EL&I) **Norway:** Government of Norway – Ministry of Foreign Affairs; Norsk Hydro ASA; Statoil ASA. **Sweden:** Government of Sweden - Swedish Energy Agency. **France:** GDF SUEZ **Germany:** RWE Power AG; Deutsche Bank AG; BP Alternative Energy International Ltd. Bilateral and Multilateral Funds - Prototype Carbon Fund (PCF): Managing company – International Bank for Reconstruction and Development (IBRD) as Trustee of the Prototype Carbon Fund (PCF).
Host Party	Guatemala: Generadora de Occidente Ltda. (GdO)
Sectoral scope and selected methodology(ies), and where applicable, selected standardized baseline(s)	Sectoral Scope 1: Energy industries (renewable/non-renewable sources) ACM0002: "Consolidated Baseline Methodology for Grid-connected Electricity Generation from Renewable Sources", version 13.0.0, EB 67.
Estimated amount of annual average GHG emission reductions	96,463 tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

The El Canadá Hydroelectric Project ("the Project") consists of a 48.11 MW[1] peaking run-of-river hydroelectric plant located on the Samalá River on the west coast of Guatemala, near the town of Santa María de Jesus. The western Guatemala region has 350 MW of demand and 31 MW of installed capacity. Construction began in February 2002 and was completed in December 2003. The Project started commercial operation per the Wholesale Market Norms on 23/11/2003. Since its commissioning, it has been producing an average of 194.7 GWh/year of electricity, which is sold (at the moment of writing this document) to Guatemala's largest commercial distributor, COMEGSA, under a 10-year Power Purchase Agreement (PPA).

The Project contributes to the sustainable development of Guatemala in various ways. First, it has increased the supply of power to the local grid, improving stability and helping reduce losses in the distribution system. Second, it is reducing greenhouse gas emissions as well as emissions of local pollutants from power generation by using a cleaner energy source than what typically would have been used in the country. Third, it is one of the first renewable energy projects to be developed after the approval of Guatemala's new General Electricity Law. Its development has provided important knowledge and experience for other project developers that are striving to participate in the competitive national and regional market. Fourth, through the agreements the Project Company has entered into with the neighboring municipalities, the Project is conserving sub-surface water, it has re-forested parts of the land where it was constructed, and it is making annual payments to improve the conditions of the local communities. Finally, it has created 250 jobs, injecting at least US$ 30 million into the Guatemalan economy over the course of the construction period.

A.2. Location of project activity

A.2.1. Host Party

Guatemala

A.2.2. Region/State/Province etc.

Western Guatemala

A.2.3. City/Town/Community etc.

12 miles South of Quetzaltenango Municipality

A.2.4. Physical/Geographical location

The Project is located on the Samalá River, 12 kilometres south of the Quetzaltenango Municipality and 198 kilometres due west from Guatemala City. Quetzaltenango is Guatemala's second largest city and is responsible for a large portion of the 350 MW maximum demand of the western region. The Samalá River is nearly 130 kilometres in length, and has relatively high flows, due to intense rainstorms over the western slopes of the volcanic mountain ranges that act as the river's basin. The slopes around the Project are very steep, with small plateaus. The Project is located immediately downstream from the existing Santa María hydro powerhouse owned by the national utility, Instituto Nacional de Electrificación (INDE), and utilizes some of the existing infrastructure.

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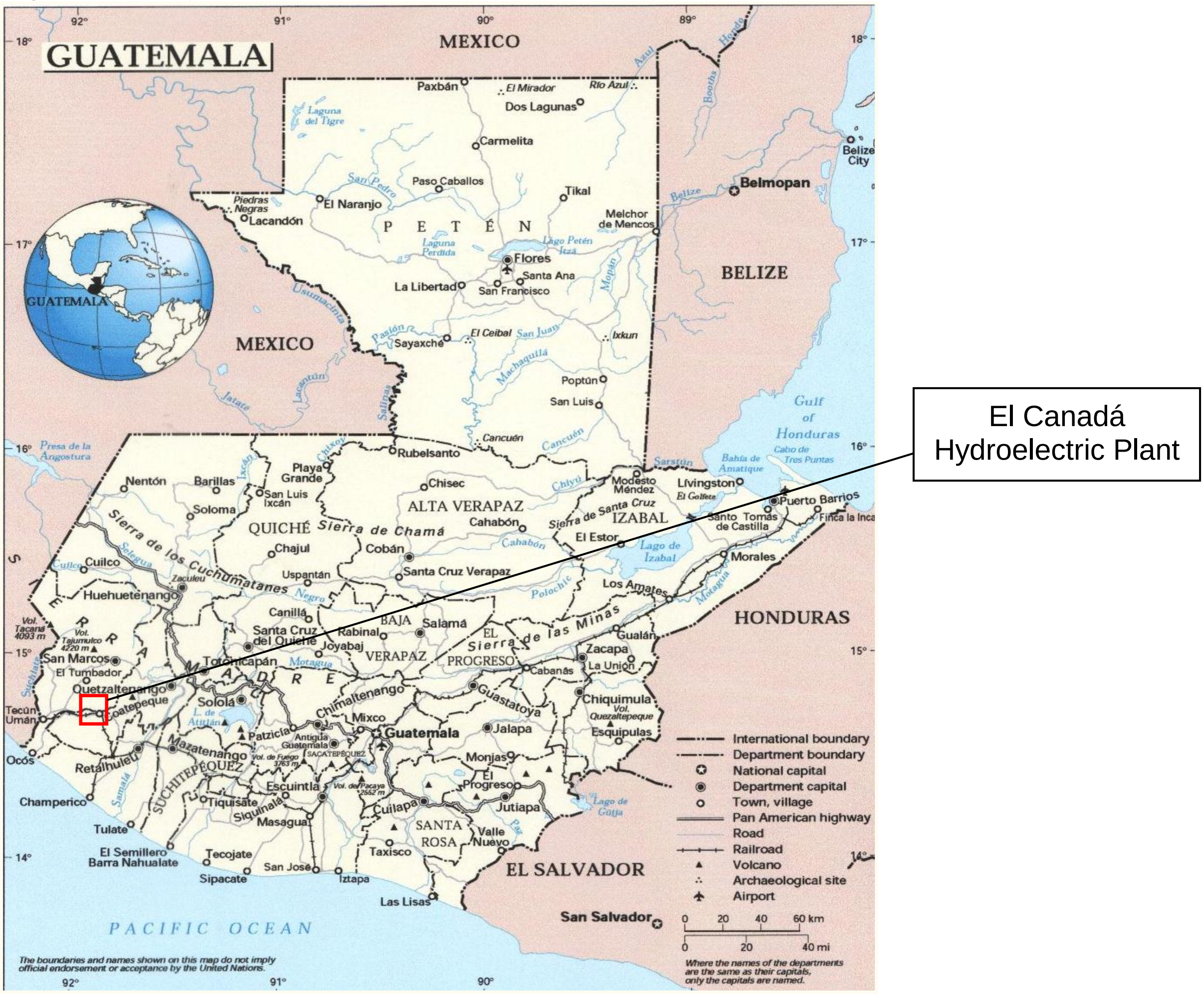
[1] Two turbines with rated capacity of 21.95 MW each, totaling 43.9 MW for the power plant. Each generator has a nameplate capacity of 28.3 MVA with a power factor of 0.85, resulting to generators total maximum output of 48.11 MW.

Figure 1: Project Location



Source: The sponsor.

The geographic coordinates for the El Canadá Power House are north: 14°41´08.80" and East: 91°31´53.35". (Equivalent to Latitude: 14.6857, Longitude: 91.5315)

A.3. Technologies and/or measures

Main Project Characteristics:

Equipment Nameplate Data	Parameter	Unit	Value
Turbine	Type	-	Pelton
	Number of units	-	2
	Rated Head (Net)	m	365
	Rated Flow	m^3/s	13.4
	Rated Rotation Speed	r/min	514.29
	Rated Output	MW	43.9 (21.95 each turbine)
Generator	Number of units	-	2
	Rated Power	MW	48.11 (28.3 MVA each generator)
	Rated Voltage	kV	13.8
	Power factor	%	0.85

Estimated Electricity Generation: 194.7 GWh/year
Powerline: 69 kV

The Project collects water flows from the tailrace of the existing Santa María power plant that is owned by INDE and also collects spillages from the Santa María dam and local inflow from the area between the Santa María dam and the Project diversion dam. All power flows flow through a desander, located immediately downstream of the diversion dam, and are subsequently diverted through a tunnel, 3 m in diameter and approximately 1,200 m long, to a run-of-river reservoir. The run-of-river reservoir is designed to collect water inflows for daily peaking operation, totalling 5 hours.

The run-of-river reservoir volume is 184,000 m^3, occupying a maximum surface are of 28.273 m^2 and using an 8-meter pond fluctuation. The normal operating level of the reservoir is 1,416.90 meters above sea level (masl) and the minimum operating level is 1,409 masl. An intake structure on the run-of-river reservoir is equipped with trash racks and a hydraulically operated gate. The gate is equipped to close during emergency conditions in the event of penstock failure. The penstock is approximately 2,400 m long and conveys the water flows from the run-of-river reservoir to the powerhouse. The penstock is comprised of a low- and a high-pressure section 1,590 and 800 m long, respectively. The penstock is bifurcated into two 1.45-m diameter penstock pipes, approximately 46 m from the powerhouse. The penstock pipe is buried over its total length. The low-pressure penstock diameter is 2.10 m, and the high pressure section diameter 1.85 m.

The El Canadá powerhouse contains two 21.95 MW turbines. Each generating unit has a Pelton turbine and synchronous generator. The powerhouse crane has a capacity at least equal to the heaviest lift during equipment installation of 65 tons. The control room is air conditioned and separate from the equipment area of the powerhouse. The output from the El Canadá facility is stepped up from 13.8 kV to 69 kV, before it is transmitted to Santa María substation about 3.6 km away for delivery to the INDE utility grid. The transmission line poles are steel and the guard and the power cables are 636 MCM ACSR. Each pole of the transmission line is grounded to provide a resistance of not more than 10 ohms.

All equipment utilized in the El Canadá Project is proven technology that has been successfully applied worldwide. The rubber dam used in the diversion dam is a new technology introduced to Guatemala. Rubber dam technology was chosen in order to properly regulate the level at the diversion dam considering the operational restrictions due to being downstream from the Santa Maria powerhouse. This technology also has an added advantage during high volume situations during the wet season, the rubber dam can be deflated in order to avoid diverting mud, rocks, tree trunks, and other garbage into the desander.

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)

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)	Generadora de Occidente, Ltda. ("GdO")	No
Finland	Government of Finland – Ministry of Foreign Affairs of Finland; Fortum Corporation	Yes
Japan	Chubu Electric Power Co., Inc; The Chugoku Electric Power Co., Inc.; Kyushu Electric Power Co., Inc.; Mitsubishi Corporation; Shikoku Electric Power Co., Inc.; Tohoku Electric Power Co., Inc.; The Tokyo Electric Power Co., Inc.; Japan International Cooperation Agency (JICA); Mitsui & Co., Ltd.	No
Netherlands	Netherlands' Ministry of Infrastructure and the Environment (IenM); Electrabel N.V.; Netherlands' Ministry of Economic Affairs, Agriculture and Innovation (EL&I)	Yes

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)
Norway	Government of Norway - Ministry of Foreign Affairs; Norsk Hydro ASA; Statoil ASA	Yes
Sweden	Government of Sweden - Swedish Energy Agency;	Yes
France	GDF Suez	No
Germany	RWE Power AG; Deutsche Bank AG; BP Alternative Energy International Ltd.	No

A.5. Public funding of project activity

The Project has not received and is not seeking any public funding.

SECTION B. Application of selected approved baseline and monitoring methodology and standardized baseline

B.1. Reference of methodology and standardized baseline

ACM0002: "Consolidated Baseline Methodology for Grid-connected Electricity Generation from Renewable Sources" (ACM0002/Version 13.0.0 Sectoral Scope: 1, EB 67).
http://cdm.unfccc.int/methodologies/DB/M0CSBFOF8RQG5I84XU5Y4WX0I5LHS1

According to the "Clean Development Mechanism Project Standard" (version 03.0, EB 70) and the methodological tool for the *"Assessment of the validity of the original/ current baseline and update of the baseline at the renewal of a crediting period"* (version 03.0.1 EB 66, Annex 47), project participants shall update the sections of the PDD relating to the baseline, estimated emission reductions and the monitoring plan using an approved baseline and monitoring methodology.

The following tools have been applied to the project activity:

- *"Tool to calculate the emission factor for an electricity system"*, Version 3.0.0.
- http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v3.0.0.pdf
- *"Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion",* Version 02.
- http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-03-v2.pdf

B.2. Applicability of methodology and standardized baseline

The project activity is a grid-connected run-of-the-river hydropower project and meets all the other conditions stated in ACM0002 (Version 13.0.0) namely:

- grid-connected renewable power generation project activities that install a new power plant at a site where no renewable power plant was operated prior to the implementation of the project activity (greenfield plant);
- the geographic and system boundaries for the relevant electricity grid can be clearly identified and information on the characteristics of grid is publicly available;
- this project does not involve switching from fossil fuels;
- the project activity results in a new single reservoir and the power density of the power plant, as per definitions given in the Project Emissions section, is greater than 4 W/m^2 after the implementation of the project activity.

B.3. Project boundary

Consistent with the definition provided in ACM0002, the spatial extent of the project boundary consists of the El Canadá Project site, (including the tunnel, regulating pond, penstock, powerhouse) and all power plants connected physically to the same electricity system the Project is connected to (the Guatemalan national electricity grid). In determining the BM, the spatial extent of the project boundary was limited to the project electricity system; i.e. the set of power plants that can be dispatched without significant transmission constraints. In determining the OM, the emission factor for imports from the connected electricity system in El Salvador was 0 tCO_2/MWh.

As per ACM0002, electricity exports were not subtracted from electricity generation data used for calculating and monitoring the baseline emissions rate.

Table 1. Sources and Gases in the Project

<table>
<tr><th colspan="2">Source</th><th>GHGs</th><th>Included?</th><th>Justification/Explanation</th></tr>
<tr><td rowspan="3">Baseline scenario</td><td rowspan="3">Power Plants connected to the grid</td><td>CO_2</td><td>Yes</td><td>GHG in the baseline are due to carbon and fuel fired plants</td></tr>
<tr><td>CH_4</td><td>No</td><td>Power plants do not produce CH_4</td></tr>
<tr><td>N_2O</td><td>No</td><td>Power plants do not produce N_2O emissions or are negligible</td></tr>
<tr><td rowspan="6">Project scenario</td><td rowspan="3">Reservoir</td><td>CO_2</td><td>No</td><td>CO_2 emissions are neglected</td></tr>
<tr><td>CH_4</td><td>Yes (equal to 0)</td><td>The project emissions from the run-of-river reservoir are 0 since power density is greater than 10 W/m^2 (Refer Section B.6.3)</td></tr>
<tr><td>N_2O</td><td>No</td><td>The run-of-river reservoir does not produce N_2O</td></tr>
<tr><td rowspan="3">Construction</td><td>CO_2</td><td>No</td><td>The emissions produced during construction for vehicles and machinery are negligible in relation to the emission reductions that the hydroelectric plant will produce</td></tr>
<tr><td>CH_4</td><td>No</td><td>CH_4 is not produced</td></tr>
<tr><td>N_2O</td><td>No</td><td>N_2O is not produced</td></tr>
</table>

B.4. Establishment and description of baseline scenario

According to ACM0002 the changes required for methodology implementation in 2nd and 3rd crediting periods are the following:

At the start of the second and third crediting period project proponents have to address two issues according to the methodological tool for the *"Assessment of the validity of the original/ current*

baseline and update of the baseline at the renewal of a crediting period" (version 03.0.1, EB 66, Annex 47):

- Assess the continued validity of the current baseline for the next crediting period; and
- Update the current baseline and the data and parameters, if the current baseline is not valid any more for the next crediting period.

In assessing the continued validity of the baseline, a change in the relevant national and/or sectoral regulations between two crediting periods has to be examined at the start of the new crediting period. If at the start of the project activity, the project activity was not mandated by regulations, but at the start of the second or third crediting period regulations are in place that enforce the practice or norms or technologies that are used by the project activity, the new regulation (formulated after the registration of the project activity) has to be examined to determine if it applies to existing plants or not. If the new regulation applies to existing CDM project activities, the baseline has to be reviewed and, if the regulation is binding, the baseline for the project activity should take this into account. This assessment will be undertaken by the verifying DOE.

For updating the baseline at the start of the second and third crediting period, new data available will be used to revise the baseline scenario and emissions. Project participants shall assess and incorporate the impact of new regulations on baseline emissions.

Given that the project activity is the installation of a new grid-connected renewable power plant/unit, the baseline scenario is the following:

Electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in the *"Tool to calculate the emission factor for an electricity system"* (EB 70 version 3.0.0). (a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM). As per paragraph 12.9.1 of the "Clean Development Mechanism Project Standard", version 03.0, it does not require a reassessment of the baseline scenario and hence the above mentioned baseline scenario is still applicable for the project activity for the second crediting period.

Validity of the Baseline and its Updating, if not valid

The methodological tool for the "*Assessment of the validity of the original/current baseline and update of the baseline at the renewal of a crediting period*" (version 03.0.1 EB 66, Annex 47) was used and includes the following steps:

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

The "Clean Development Mechanism Project Standard", version 03.0, requires assessing the impact of new relevant national and/or sectoral policies and circumstances on the baseline.

The validity of the current baseline is assessed using the following Sub-steps:

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

The following table mentions the Guatemala's Regulatory framework for the electricity sector:

Law/ Policy	**Key Elements / requirements**	**Does this law/policy exist during initial registration ? Yes/No**	**Are there any changes since then? If yes, explain.**	**Does the project baseline comply ? Yes/No**	**How it complies**
General Electricity Law	-Decentralization of the Guatemalan electricity sector, -All new electricity generation	Yes	No	Yes	The 1996 General Electricity Law prevails, thus the same circumstances apply (in

	should be undertaken by private investors. - Need to create entities that regulate the new electricity market, thus the Wholesale Market Administrator was created (AMM) - Regulates electricity activities pertaining to generation, transport, distribution, and commercialization.				terms of regulation and the project not being business as usual), as when the project was registered.
Renewable Energy Incentives Law (2005)	-Promote the development of renewable energy projects and establish fiscal, economic and administrative incentives to trigger its development. Some of the incentives include: -Imports VAT exemption on equipment to generate energy. - Income tax exemption, - Tax exemption for mercantile and agriculture enterprises	Yes	No	Yes	Article 6 of the Law refers to Certified Emission Reductions. It acknowledges that the CERs will belong to the Project owner and as such will benefit of its commercialization. The objective of this law is to support investors interested in renewables, creating adequate conditions for investment in renewable energy projects. The Law is based on incentives, it is not mandatory to develop renewable energy projects and thus project baseline complies.

Source: General Electricity Law 1996 and Renewable Energy Incentives Law 2005

National and sectoral circumstances: The Electricity Market in Guatemala is ruled by the General Electricity Law (LGE by its abbreviation in Spanish) which was created in 1996 in order to satisfy the needs of the increasing demand in the country. This Law provided for decentralization of the Guatemalan electricity sector, and stipulated that all new electricity generation would be undertaken by private investors.

The LGE also establishes the need of creating the corresponding entities that would be in charge of regulating and administrating this new Electricity Market. By these reasons, it was constituted the Wholesale Market Administrator (AMM by its abbreviation in Spanish) which is in charge of the administration of the market and the National Electric Energy Commission (CNEE by its abbreviation in Spanish) which regulates the market.

AMM is in charge of programming all generating plants to satisfy the daily demand at the lowest cost. This is called the *Load Dispatch,* in order to cover the systems demand, in a specific moment, in such a way that the lowest operation cost is obtained and respecting technical restrictions on liability and quality of the supply according to the criteria, principles and methodologies established in the Coordination Norms.

This dispatch is conformed according to the following criteria:

- The system load is represented by the daily system curve.
- For the dispatch in a certain period of time, it takes into consideration the available capacity of each generating unit, its variable cost and transmission restrictions.
- With the previous information the *Plant Stacking* is formed and it is better known as *merit list.* This merit list is made by organizing all plants according to its variable cost, dispatching first the ones with lower cost. Run of river hydroelectric plants have a natural zero cost because of their inability to store water flows for more than the peak load demand period. Using these principles, the hydroelectric run of river plants are dispatched first.

Since the LGE entered into force, there have been private investments in thermal power generation, but generation from renewable sources including hydropower, has been lagging. Indeed, the share of thermal generation in the energy mix has grown from 40% to 54.5% since the 1996 Law. Dispatch in the Guatemalan National Interconnected System (NIS) is by strict

economic order, considering the need to supply demand, the opportunity cost of water, and the operational cost of the thermal units. These result in older plants with higher fuel and operating costs usually being dispatched last as peaking plants.

It is expected that the power generation through oil derivatives will be substituted in the long run through the addition of thermal plants based on fossil fuels. The interconnection Guatemala–México 400kV is an important resource that contributes in the short run and in the long run will be an additional resource to satisfy demand with competitive prices.

From its analysis it is concluded that the current baseline complies with all relevant mandatory national and/or sectoral policies which have come into effect after the submission of the project activity for registration, and are applicable at the time of requesting renewal of the crediting period, so we go to Step 1.2.

Step 1.2: Assess the impact of circumstances

Assess the impact of circumstances existing at the time of requesting renewal of the crediting period on the current baseline emissions, without reassessing the baseline scenario.

The main challenge for the authorities of the Ministry of Mines and Energy and the CNEE is to attract the trust of investors especially in the current situation of the global economy[2]. Therefore, the efforts of the authorities to give certainty and provide the necessary elements for an adequate business climate are worth mentioning. Some of these efforts include power market development towards competition, eliminate electricity tariff distortions and subsidies giving transparency to the sector, and the design of new policies that encourage investment on renewable energy such as the Expansion Plan of the Generation System 2008-2022.

In 2008, the Electricity National Commission crafted the first Indicative Expansion Plan of the Generation System 2008-2022 whose main objective is to comply with the guidelines, actions and strategies established in the Energy Policy approved by the Ministry of Mines and Energy. These policies foresee the transformation of the energy matrix of the electricity sector from 2008 to 2022. The Plan seeks to increase the power generation with renewable energy from current 45.5% to 64% in 2022, which translates into an increase of the order of 1,600 MW.

This Expansion Plan will be positive to continue the development of the power sector in Guatemala; additionally it will promote a greater participation of hydropower generation. This will allow modifying Guatemala’s energy matrix in the long run and will reduce the use of fossil fuels. It is important to mention that currently less than the 15% of the hydro potential in the country is used. Therefore, it is essential to provide to investors the proper economic signals so that they prefer to invest in renewable energy generation and thus, modify the energy matrix of the country as well as to improve Guatemala’s competitiveness. The Clean Development Mechanism encourages investments and development of projects with renewable sources.

The circumstances related to electricity generation (such as regulation and renewable energy projects not being the business as usual scenario in Guatemala) are similar to when the PDD was first submitted for registration, although a greater share of renewable energy is currently present. Renewable energies represent 45.5% of power generation vs. 54.5% from fossil fuels power generation[3].

The development model of the country has been successful but the availability of finance for project development is scarce. The authorities are making an effort to improve investment conditions in the country; however obtaining credit from regional and international banks has

[2] Memoria de Labores, May 2008 – April 2009, p. 11, Comisión Nacional de Energía Eléctrica de Guatemala.

[3] According to “Informe Estadísticas Energéticas, Subsector Eléctrico, 2001-2008” p.6. Ministry of Energy and Mining, Guatemala.

proved difficult for similar projects. Multilaterals and Commercial Banks have specifically commissioned the development of projects as a CDM activity in order to increase the project's financial attractiveness thereby reducing their overall portfolio risk in the sector. Multilaterals and Commercial banks, believe that CER revenues provide a hard currency revenue stream that is critical to the project development.

Due that similar circumstances prevail as when the last PDD was submitted, the continued validity of the current baseline is plausible.

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

The project activity involves a hydro power plant where in the absence of the project activity, the project participants would not have constructed the plant but where the electricity would have been generated in other existing plants and/or in new plants constructed by third parties elsewhere. As the project activity is a new renewable energy project and equipments have a technical lifetime of 25-30 years, which exceeds the three crediting periods, the continuation of the use of current baseline equipment is thus considered to be technically possible.

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

The data and parameters have been verified and some of them need to be updated, mainly those parameters that were used for calculation of the emission factor for the electricity grid and the corresponding IPCC default values for fuel type. Therefore the baseline needs to be updated for the subsequent crediting period and we go to step 2.

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

Though the project meets requirements under Steps 1.1, 1.2 and 1.3, as per step 1.4, some of the data and parameters that were determined at the start of crediting period and not monitored during the crediting period are not valid, current baseline needs to be updated.

Step 2.1: Update the current baseline

According to Step 1 above, the current baseline is also valid for the 2nd crediting period.

Step 2.2: Update the data and parameters

As some of the data and parameters that were determined at the start of crediting period and not monitored during the crediting period are not valid, it is required to update the data and parameters following the guidance in Step 1.4. To look at the baseline update estimates go to section B.6.3

In accordance with ACM0002, a baseline emission factor (*EFy*) was calculated as a combined margin *(CM),* consisting of the combination of operating margin *(OM)* and build margin *(BM)* factors using the *"Tool to calculate the emission factor for an electricity system"* (Version 3.0.0), following the six steps below:

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

Step 1. Identify the relevant electricity systems

Guatemala's National grid (National Interconnected System NIS) is identified as the relevant electricity system. It is the grid which serves the whole country (except the rural area of Peten).

For determining the electricity emission factors, the project electricity system is the spatial extent of the power plants connected to the National Interconnected system and dispatched without significant transmission constraints. The spatial extent of the project boundary includes the project site and all power plants connected physically to the electricity system.

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

Project participants may choose between two options to calculate the operating margin and build margin emission factor:

Option I is chosen; only grid power plants are included in the calculation.

Step 3. Select a method to determine the Operating Margin (OM)

The calculation of the operating margin emission factor (*EF*) is based on one of the following methods:
(a) Simple OM; or
(b) Simple adjusted OM; or
(c) Dispatch data analysis OM; or
(d) Average OM.

The simple OM method (option a) can only be used if low-cost/must-run resources constitute less than 50% of total grid generation in: 1) average of the five most recent years, or 2) based on long-term averages for hydroelectricity production.

Based on data on the Guatemalan grid's total generation from 2004 to 2008[4], low-cost must-run facilities make up less than 50% of the generation during the last five years, and therefore the choice of option (a) is appropriate for this project activity (see Table 2).

Table 2. Composition of the Total Plants Generation during the five most recent years (2004-2008)

Type	2004	2005	2006	2007	2008
	(GWh)	(GWh)	(GWh)	(GWh)	(GWh)
Hydroelectric	**2,564.5**	**2,938.2**	**3,277.8**	**3,006.9**	**3,651.1**
Geoenergy	**219.1**	**165.8**	**163.2**	**263.1**	**294.2**
Bagasse	**418.2**	**473.7**	**543.9**	**602.2**	**568.0**
Coal	1,116.4	1,064.8	1,102.5	1,128.9	1,138.8
Fuel oil	1,973.3	1,776.4	2,314.3	3,133.8	2,449.7
Diesel oil	5.1	10.6	10.6	17.8	13.8
Orimulsion	947.8	1,017.1	273.2	-	-
Total :	**7,244.4**	**7,446.6**	**7,685.5**	**8,152.7**	**8,115.6**
% Renewable and low cost plants	**44.20%**	**48.04%**	**51.85%**	**47.50%**	**55.61%**
Average of the five most recent years % LC/MR	**49.44%**				

Source: Ministerio de Energía y Minas: "Informe estadísticas Energéticas - Subsector Eléctrico

4 2004-2008 vintage is selected based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation, as per the "Tool to calculate the emission factor for an electricity sector".

For this project **the Simple OM (Option a)** is selected to calculate the operating margin, using the ***ex-ante* option** for the data vintages. As per the *ex-ante* option, the emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emission factor during the crediting period is required.

As per the ***ex-ante* option**, a 3-year generation-weighted average should be used, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation. For this project, generation data from 2006-2008 is chosen.

Step 4. Calculate the operating margin emission factor according to the selected method.
The operating margin is calculated on the basis of "(a) Simple OM" method as low-cost must-run power plants make up less than 50% of the generation during the last five years.

The **simple OM** emission factor (EFgrid,OMsimple,y) is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2/MWh) of all generating power plants serving the system, not including low-cost/must-run power plants/units.

For this project, the simple OM is calculated as per **Option A**: Based on the net electricity generation and a CO2 emission factor of each power unit;

Option A *- Calculation based on average efficiency and electricity generation of each plant*

Under this option, the simple OM emission factor is calculated based on the net electricity generation of each power unit and an emission factor for each power unit, as follows:

$$EF_{grid,OMsimple,y} = \frac{\sum_m EG_{m,y} \cdot EF_{EL,m,y}}{\sum_m EG_{m,y}}$$

Where:
$EF_{grid,OMsimple,y}$ = Simple operating margin CO_2emission 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 = All power units serving the grid in year *y* except low-cost / must-run power units
y = The relevant year as per the data vintage chosen in Step 3

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

Given that for a power unit *m* only data on electricity generation and the fuel types used is available, the emission factor will be determined using **Option A2**, based on the CO_2 emission factor of the fuel type used and the efficiency of the power unit.

As per **Option A2**, the emission factor of each power unit *m* should be determined as follows:

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

Where:
$EF_{EL,m,y}$ = CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)

$EF_{CO2,m,i,y}$ = 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 (ratio)

Other assumptions were as follows:

- Carbon emissions factor for imports from the El Salvador interconnected system were set at zero.
- Exports of electricity were already included in the total generation of each plant, therefore no separate emissions factor was calculated for exports.
- In Guatemala, during the November-May harvest season, cogenerators use 70% bagasse and 30% bunker fuel (Heavy Fuel Oil No. 6). The rest of the year, they use only bunker fuel. The emissions factor for bagasse cogenerations is regarded as zero per IPCC guidance[5]. The emissions factor for the cogenerators is calculated based on 30% bunker fuel used during the harvest season and 100% bunker fuel used the rest of the year.
- During the harvest season cogenerators operate as low-cost/ must-run plants because they have “take or-pay” contracts, which were signed before the 1996 Electricity Law and have been grandfathered.

Considering the above factors, assumptions, and the operation of the Guatemalan power system from 2006 to 2008[6], and applying the Simple OM method, the result is:

Table 3: Calculation of Operating Margin[7]

3 most recent years	**2006**	**2007**	**2008**
Simple Operating Margin* (OM) in t CO_2 / MWh	0.854	0.859	0.805
Generation (*m*) in MWh	3,507,720	4,129,341	3,438,265
Simple OM weighted average of 3 years	0.841		

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

In terms of vintage of data **Option (1)** is chosen, where for the second crediting period the BM emission factor will be calculated ex-ante, 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 subsequent crediting periods, the emission factor will also be calculated ex-ante.

The sample group of power units *m* used to calculate the build margin consists of either:
(a) The set of five power units excluding power units registered as CDM project activities that started to supply electricity to the grid most recently (SET5-units) and determine their annual electricity generation (AEGSET-5-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 AEGtotal (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) (SET >□20%) and determine their annual electricity generation (AEG SET-=20%, in MWh);

(c) From SET5-units and SET-=20%, select the set of power units that comprises the larger annual electricity generation (SET sample);

5 IPCC Guidelines, 2006, Volume 2 Energy.

6 2006-2008 vintage is selected based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation, as per the “Tool to calculate the emission factor for an electricity sector”.

7 Please see EF calculation sheet for detailed calculation.

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

Capacity additions that are applying for CDM registration were excluded, as per the ACM0002. Table 3 below summarizes the results of the BM calculation.

Table 4. BM emission factor for 20% of system generation

A	B	C	D	E	F	H	G	I	J
POWER PLANT	TYPE	FUEL	START	CDM	Generation 2008	5 Most recent Units 2008	20% Gen. 2008 (Excluding CDM)	20% Cum. Gen. 2008 (Excluding	Emission (tCO2)
(AMM)	(AMM)	(AMM)		(MW)	(GWh)	(GWh)	(GWh)	(%)	(CO2 ton)
SANTA ELENA	HYDROELECTRIC	Hydro	Dec-08		0.009	0.009	0.009	0.00%	
GECSA2	INTERNAL COMBUSTION MOTORS	Fuel oil No.6	Oct-08		1.07	1.07	1.08	0.01%	736
ARIZONA VAPOR 1	STEAM TURBINES	Fuel oil No.6	Sep-08		10.57	10.57	11.65	0.16%	7,366
COENESA	INTERNAL COMBUSTION MOTORS	Diesel	Sep-08		0.10	0.10	11.75	0.16%	66
LA LIBERTAD	STEAM TURBINES	Coal	Aug-08		30.93	30.93	42.68	0.57%	19,441
TEXTILES B3	INTERNAL COMBUSTION MOTORS	Fuel oil No.6	Apr-08		2.98		45.66	0.61%	2,700
EL RECREO	HYDROELECTRIC	Hydro	Jul-07		130.43		176.09	2.35%	
ORTITLAN	GEOTHERMAL	GeoThermal	Jul-07	CDM	136.16				
GECSA	INTERNAL COMBUSTION MOTORS	Fuel oil No.6	Feb-07		92.27		268.36	3.59%	63,491
MONTECRISTO	HYDROELECTRIC	Hydro	May-06		57.46		325.82	4.36%	
CANDELARIA	HYDROELECTRIC	Hydro	May-06	CDM	23.71				
MAGDALENA	COGENERATION (STEAM TURBINES)	Bagasse / Fuel oil No.6	2006		178.92		504.74	6.75%	33,516
PALIN II	HYDROELECTRIC	Hydro	Jul-05		0.00		504.74	6.75%	
POZA VERDE	HYDROELECTRIC	Hydro	Jun-05		45.61		550.35	7.36%	
PANTALEON	COGENERATION (STEAM TURBINES)	Bagasse / Fuel oil No.6	Jan-05		167.50		717.85	9.60%	30,633
SAN DIEGO	COGENERATION (STEAM TURBINES)	Bagasse / Fuel oil No.6	Dec-04		3.62		721.47	9.65%	641
EL CANADA	HYDROELECTRIC	HYDRO	Nov-04	CDM	214.68				
RENACE	HYDROELECTRIC	Hydro	Mar-04		318.68		1,040.15	13.91%	
ELECTROGENERA(	INTERNAL COMBUSTION MOTORS	Fuel oil No.6	Nov-03		21.71		1,061.86	14.20%	14,939
ARIZONA	INTERNAL COMBUSTION MOTORS	Fuel oil No.6	May-03		748.61		1,810.47	**24.21%**	515,119
SEIN Annual Generation 2008 (Excluding CDM);					**7,478.87 (GWh)**			(Ton Co2):	**688,650**

Source: AMM Statistical Report 2010
Source: World Bank own Estimates.

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

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

Where:

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

The CO_2 emission factor of each power unit *m* ($EF_{EL,m,y}$) should be determined as per the guidance in Step 4 (a) for the simple OM, using options A1, A2 or A3, using for *y* the most recent historical year for which electricity generation data is available, and using for *m* the power units included in the build margin.

For 2008: EFgrid,BM,y **= 0.380 tCO_2 / MWh**

(Appendix 4 includes the BM estimates)

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

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

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

In this case (a) the weighted average CM is used.

(a) Weighted average CM
The combined margin emissions factor is calculated as follows:

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

Where:
$EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year *y* (tCO_2/MWh)
$EF_{grid,OM,y}$ = Operating margin CO_2 emission factor in year *y* (tCO_2/MWh)
$EF_{grid,CM,y}$ = Combined margin CO_2 emission factor in year *y* (tCO_2/MWh)
w_{OM} = Weighting of operating margin emissions factor (%)
w_{BM} = Weighting of build margin emissions factor (%)

The following default values should be used for w_{OM} and w_{BM}:

Hydro projects: $w_{OM} = 0.25$ and $w_{BM} = 0.75$ for the second and third crediting period, unless otherwise specified in the approved methodology which refers to this tool. Therefore,

$EF_{grid,CM,y} = 0.25 \times EF_{grid,OM,y} + 0.75 \times EF_{grid,BM,y}$ [8]

The CM obtained was:

$EF_{grid,CM,y}$ = 0.25 x 0.841 + 0.75 x 0.380 = **0.495**

B.5. Demonstration of additionality

As prescribed in ACM0002, the additionality of the El Canadá Project was demonstrated and assessed using the latest version of the “Tool for the Demonstration and Assessment of Additionality”. The step-wise approach provided in the Tool was applied as follows:

[8] As per Methodological Tool (version 3.0.0 EB 70) to calculate the emission factor for an electricity system suggestion of percentages for OM and BM for the 2^{nd} crediting period.

Step 0. Preliminary screening based on the starting date of the project activity

(a) The starting date of the El Canadá Project was 23/11/2003, which falls between 1/01/2000 and the date of registration of the first CDM activity. The generation of Emissions Reductions began on this same date.
(b) Documentation exists in the Project files, which provides evidence that the incentives from CDM registration were considered in the decision to invest in the Project. All the information is available to the DOE.

Step 1. Identification of alternatives to the project activity consistent with current laws and regulations

Since the deregulation of the Guatemalan power sector in 1996, of the approximately 690MW of new capacity added to the Guatemalan NIS, 64% has been thermal generation due largely to the lower investment costs and shorter lead times associated with thermal technologies. Given Guatemala's inherent country risk, these conditions are necessary to meet most investor hurdle rates. Based on these past trends, plausible and credible alternatives to the El Canadá Project that could deliver the same level of electricity output, with comparable quality, operating in the same application area, would be thermal generation plants. The Project Company, being a private power developer, would be investing in a capacity expansion in order to maximize return on its investment. Everything else being equal, technologies with the lowest costs per unit of electricity generated are likely to yield the highest returns. At the time of the decision to invest, those technologies that constituted the most economically attractive options for investment in the Guatemalan power sector were coal-fired steam plants and bunker-burning internal combustion motors, as referenced in Appendix 4 and demonstrated under Step 2 below.

Step 2. Investment Analysis

The El Canadá Project is determined to be economically less attractive than thermal alternatives without the revenue from the sale of its emission reductions. This conclusion was reached by following the substeps below:

Sub-step 2a. Determine appropriate analysis method

The investment comparison analysis was chosen (Option II).

Sub-step 2b. Option II. Apply investment comparison analysis

Unit cost of service (levelized cost of electricity production in $/kWh) was identified as the appropriate financial indicator to be used in comparing alternative investments in the power generation sector.

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

As identified above under Step 1, the plausible alternative to the El Canadá Project is thermal power generation given lower generation costs that maximize return on a private power developer's investment.

Table 4 summarizes the results of the investment comparison analysis performed using generation cost as the financial indicator. On the basis of the data presented, it is reasonable to assume that a least-cost base load thermal unit would be selected for capacity expansion. A 150 MW coal-fired steam plant appears to be a reasonably sized generic alternative, given the varied sizes of the existing plants. Since there is no gas available in Guatemala, only coal was considered as fuel. As per Table 4 below, while coal and diesel both provide more attractive alternatives to hydropower, generation costs of coal-fired steam plants are the lowest.
For purposes of further comparison, the generation costs of two other thermal options (a 30 MW gas turbine and a 30 MW diesel motor) are shown, although the least-cost option is the coal-fired steam plant. The calculations show that the generation costs for El Canadá (US$ 49.2/MWh) are

higher than for the least-cost thermal option (US$ 38.8/MWh). Therefore, the El Canadá Project is not the most financially attractive investment option.

Table 5: Calculation of Generation Costs for El Canadá and Thermal Options

	Units	El Canadá Hydro	Coal-Fired Steam	Gas Turbine	Diesel Motor
Capacity	MW	48.11	150	30	50
Cost	US$/kW	1392	1200	350	825
Investment	US$ Million	66.98	180.00	10.50	41.25
Global Efficiency	%		40%	32%	41%
Cost of fuels	US$/MBTU		1.55	5.07	3.46
Annual Costs					
Capital	US$ million	8.31	22.35	1.30	5.12
O&M Fix	US$ million	1.13	4.50	0.30	1.90
Plant factor		0.46	0.80	0.25	0.80
Production	GWh	194.7	1051.2	65.7	350.4
Heat Consumption	b. BTU		8967	701	2916
Cost of fuels	US$ million		13.90	3.55	10.09
Total costs	US$ million	9.44	40.74	5.16	17.11
Generation Cost	**US$/MWH**	**48.5**	**38.8**	**78.5**	**48.8**

Assumptions:
Economic Parameters: Discount Rate: 12% p.a., Useful life of Plants: 30 years
Investment costs of equipment: Costs in US$/kW are net, without financial charges
Efficiency and plant factor of equipment: Based on state-of-the-art of the equipment and reasonable utilization
Price and heat rate of fuels:
Coal: US$ 40/t; heat rate 6500 kcal/kg; Heat cost: US$ 6.15 million Kcal= US$ 1.55 mBTU.
Fuel Oil: US$ 134/t; heat rate: 9700 kCal/Kg, US$ 13.8/mKcal; US$ 3.46/MBTU.
Diesel Oil: US$ 206/t; heat rate 10.200 kCal/Kg; US$ 20.2 mkCal, US$ 5.07/mBTU

The generation costs for each plant were calculated following the EPRI TAG[9] method, as

$$COE = \frac{CRF * I + O \& M}{E}$$

Where,
COE: Levelized Cost of Energy
CRF: Capital Recovery Factor for Discount Rate *i* and Number of Years *n* (equivalent to the useful life of the plant)
I: Plant total investment accumulated by commissioning date
O & M: Annual Operation and Maintenance Costs of the Plant
E : Average Annual Energy[10]

And,

$$CRF = \frac{i * (1+i)^n}{(1+i)^n - 1}$$

[9] EPRI: Edison Power Research Institute.

[10] If costs are expressed in US$ million and Energy in GWh then the levelized generation cost results expressed in US$/MWh.

Sub-step 2d. Sensitivity analysis

The conclusion in Sub-step 2c regarding the financial attractiveness of the El Canadá Project was subjected to three reasonable variations in the critical assumptions. In each of the three sensitivity tests, the conclusion remained robust to the variations that were introduced.

In the first test, the assumption regarding the discount rate was lowered from 12% to 10%, and the useful life of the project also lowered from 30 years to 20 years. The results are summarized in Table 5 below:

Table 6: First Sensitivity Test with Lower Discount Rate and Shorter Useful Life

	Units	El Canadá Hydro	Coal-Fired Steam	Gas Turbine	Diesel Motor
Capacity	MW	48.11	150	30	50
Cost	US$/kW	1392	1200	350	825
Investment	US$ Million	66.98	180.00	10.50	41.25
Global Efficiency	%		40%	32%	41%
Cost of fuels	US$/MBTU		1.55	5.07	3.46
Annual Costs					
Capital	US$ million	7.87	21.14	1.23	4.85
O&M Fix	US$ million	1.13	4.50	0.30	1.90
Plant factor		0.46	0.80	0.25	0.80
Production	GWh	194.7	1051.2	65.7	350.4
Heat Consumption	b. BTU		8967	701	2916
Cost of fuels	US$ million		13.90	3.55	10.09
Total costs	US$ million	8.99	39.54	5.08	16.83
Generation Cost	**US$/MWH**	**46.2**	**37.6**	**77.4**	**48.0**

Assumptions:

Economic Parameters: Discount Rate: 10% p.a., Useful life of Plants: 20 years

Investment costs of equipment: Costs in US$/kW are net, without financial charges

Efficiency and plant factor of equipment: Based on state-of-the-art of the equipment and reasonable utilization

Price and heat rate of fuels:

Coal: US$ 40/t; heat rate 6500 kcal/kg; Heat cost: US$ 6.15 million Kcal= US$ 1.55 mBTU.

Fuel Oil: US$ 134/t; heat rate: 9700 kCal/Kg, US$ 13.8/mKcal; US$ 3.46/MBTU.

Diesel Oil: US$ 206/t; heat rate 10.200 kCal/Kg; US$ 20.2 mkCal, US$ 5.07/mBTU

In the second test, the assumption regarding the investment cost was increased by 10% for the thermal generation options. The results are summarized in Table 6 below:

Table 7: Second Sensitivity Test with Higher Investment Costs for Thermal Generation

	Units	El Canadá Hydro	Coal-Fired Steam	Gas Turbine	Diesel Motor
Capacity	MW	48.11	150	30	50
Cost	US$/kW	1392	1320	385	907.5
Investment	US$ Million	66.98	198.00	11.55	45.38
Global Efficiency	%		40%	32%	41%
Cost of fuels	US$/MBTU		1.55	5.07	3.46
Annual Costs					
Capital	US$ million	8.31	24.58	1.43	5.63
O&M Fix	US$ million	1.13	4.50	0.30	1.90
Plant factor		0.46	0.80	0.25	0.80
Production	GWh	194.7	1051.2	65.7	350.4
Heat Consumption	b. BTU		8967	701	2916

Cost of fuels	US$ million		13.90	3.55	10.09
Total costs	US$ million	9.44	42.98	5.29	17.62
Generation Cost	**US$/MWH**	**48.5**	**40.9**	**80.4**	**50.3**

Assumptions:
Economic Parameters: Discount Rate: 12% p.a., Useful life of Plants: 30 years
Investment costs of equipment: Costs in US$/kW are net, without financial charges
Efficiency and plant factor of equipment: Based on state-of-the-art of the equipment and reasonable utilization
Price and heat rate of fuels:
Coal: US$ 40/t; heat rate 6500 kcal/kg; Heat cost: US$ 6.15 million Kcal= US$ 1.55 mBTU.
Fuel Oil: US$ 134/t; heat rate: 9700 kCal/Kg, US$ 13.8/mKcal; US$ 3.46/MBTU.
Diesel Oil: US$ 206/t; heat rate 10.200 kCal/Kg; US$ 20.2 mkCal, US$ 5.07/mBTU

In the third and final sensitivity test, the assumption regarding the plant capacity factor for El Canadá was lowered from 46% to 40%. The results are summarized in Table 7 below:

Table 8: Third Sensitivity Test with Lower Plant Capacity Factor for El Canada

	Units	El Canadá Hydro	Coal-Fired Steam	Gas Turbine	Diesel Motor
Capacity	MW	48.11	150	30	50
Cost	US$/kW	1392	1200	350	825
Investment	US$ Million	66.98	180.00	10.50	41.25
Global Efficiency	%		40%	32%	41%
Cost of fuels	US$/MBTU		1.55	5.07	3.46
Annual Costs					
Capital	US$ million	8.31	22.35	1.30	5.12
O&M Fix	US$ million	1.13	30	10	38
Plant factor		0.40	0.80	0.25	0.80
Production	GWh	168.6	1051.2	65.7	350.4
Heat Consumption	b. BTU		8967	701	2916
Cost of fuels	US$ million		13.90	3.55	10.09
Total costs	US$ million	9.44	40.74	5.16	17.11
Generation Cost	**US$/MWH**	**56.0**	**38.8**	**78.5**	**48.8**

Assumptions:
Economic Parameters: Discount Rate: 12% p.a., Useful life of Plants: 30 years
Investment costs of equipment: Costs in US$/kW are net, without financial charges
Efficiency and plant factor of equipment: Based on state-of-the-art of the equipment and reasonable utilization
Price and heat rate of fuels:
Coal: US$ 40/t; heat rate 6500 kcal/kg; Heat cost: US$ 6.15 million Kcal= US$ 1.55 mBTU.
Fuel Oil: US$ 134/t; heat rate: 9700 kCal/Kg, US$ 13.8/mKcal; US$ 3.46/MBTU.
Diesel Oil: US$ 206/t; heat rate 10.200 kCal/Kg; US$ 20.2 mkCal, US$ 5.07/mBTU

As a result of the three sensitivity tests above, the sensitivity analysis concluded that the El Canadá Project was unlikely to be the most financially attractive investment option.

Step 3. Barrier Analysis

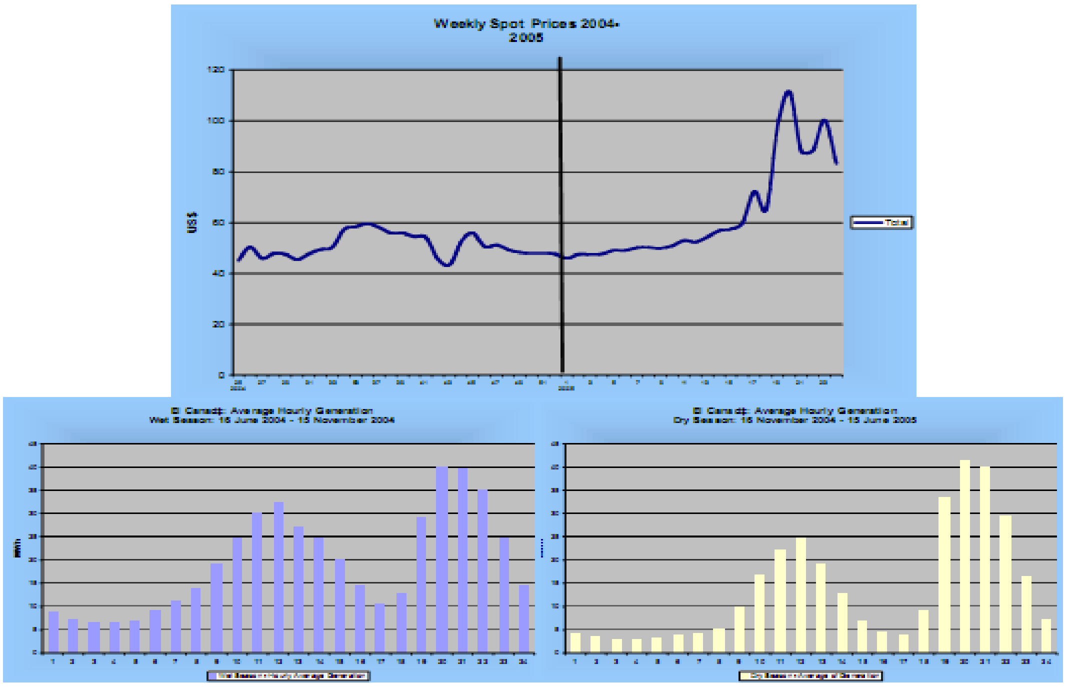
As mentioned in Step 1 and demonstrated in Appendix 4, a large proportion of new capacity additions to the Guatemalan NIS since the deregulation of 1996 has been thermal-based. Many of them burn coal or bunker fuel in medium velocity internal combustion engines for base load, and gas for peaking power generation. Only slightly more than one-third of new additions were renewable-based, which were primarily run-of-the-river hydro peaking facilities. The heavy influx of thermal generation is due largely to the lower investment costs and shorter lead times associated with thermal technologies, which, given Guatemala's inherent country risk, are necessary to meet most investor hurdle rates.

While the generation costs for a diesel motor may seem similar in Table 4 above to the generation costs of the El Canadá hydroelectric plant, again, the risk associated with hydroelectric generation is higher than most thermal generation including diesel motors. This is due to the fact that even though hydroelectric generation bears no fuel costs, unlike thermal generation, availability of fuel is determined by external conditions such as hydrology, which are outside the control of a project developer.

A related factor that has hindered renewable investments is the relation between system pricing and seasonal hydro resource availability. Guatemala has two very pronounced seasons - a wet season ranging from May to November and a dry season from December through April. System pricing is determined by a variable-cost dispatch model that optimizes system operation through the use of available hydro/thermal facilities. System pricing is, therefore, inversely proportional to seasonal hydrology, so that prices are lower during the wet season when more water is available, and prices are higher in the dry season due to a decrease in water flows. The inverse relationship between prices and seasonal hydrology greatly increases the risk profile for hydro facilities because prices are low when the facilities have abundant generation and prices are high when generation is low due to lack of water. This, in turn, limits the competitiveness of hydro facilities in signing long-term contracts as they must assume the added risk of having to purchase highly volatile replacement energy in the spot market during the dry season.

The situation described above can be observed in Figure 2 below, which plots weekly spot prices for each hourly band (Peak, Off-peak, and Shoulder) from June 2004 – 2005. As Figure 2 indicates, during the June-November 2004 wet season electricity prices were lower, whereas during the November-June dry season prices were much higher, particularly from April through June when prices spiked to $220 for several weeks. This demonstrates the point made above, where, as a hydroelectricity generator, the El Canadá Project would have been buying power in the Spot Market to cover its contractual obligations; whereas, thermal units would have simply generated power since all they had to do was to acquire adequate supplies of fuel oil or coal.

Figure 2: Weekly Spot Prices (2004-2005) and Average Hourly Generation



In addition, owners of hydroelectric facilities assume total market/regulatory risk. Thermal plants however, have some flexibility to move facilities if the market/regulatory environment changes. In fact, Duke Energy International recently dismantled and moved its facilities from Guatemala to El Salvador where market conditions were more beneficial. Hydroelectric plants face increased financial barriers. Development of the El Canada Hydroelectric Project began in the last half of 1999. In October of 1999, the special purpose Guatemala company was formed – Generadora de Occidente Limitada ("GdO"), in order to apply for and obtain the necessary rights and permits for the project, including, Environmental Impact Assessment, Water Concession, Land rights, as well as the initial technical feasibility study. At that time, GdO was a subsidiary of Energia Global International ("EGI"), a corporation with mainly US investors. EGI was a small company concentrating on developing and owning environmentally friendly, renewable energy projects in Central America. As a small, early-stage company, EGI had very limited liquidity and carried a large amount of debt from international financial institutions including OPIC and GE Capital. In 1999 the company's consolidated debt was greater than US$60 million. Upon finalizing the feasibility study near the end of 2000, EGI recognized the need to secure 3rd party financing for the project to proceed. At that time, the conditions for project financing in Guatemala were complicated, and the local market lacked the liquidity and experience to lend to projects such as El Canada. Local banks seldom offered terms of more than 5 years and interest rates were close to 10%. Based on the above conditions, EGI realized that for the project to be feasible it would have to secure the required US$37 million loan from international banks, specifically from the multi and bilateral lending institutions. After one year of negotiations and corresponding due diligence, on 31/01/2002, the project signed a letter of intent with the IFC on a best efforts basis, to syndicate the loan. Both IFC and EGI, considered the additional cash flows from the potential sale of emission reductions as part of the review. The parties singed the Loan Agreement one year later on 12/12/2002 and IFC was able to arrange for a loan of US$ 27 million, US$ 15 million directly from IFC and US$ 12 million from FMO.

The first disbursement was on 14/01/2003. In retrospect, the project finalized the development phase in December 2001, and construction was scheduled to begin in February 2002. However, due to the long lead time for securing financing, 24 months, construction was being delayed. As a result, the project was in danger of defaulting on the PPA with COMEGSA. Only the intervention of ENEL through the purchase of EGI, let the project maintain its timetable for completion. In addition, if not for the inclusion of the cash flows from the sale of ERs, the project may not have met ENEL's requirement for a project in Guatemala. Financing for renewable energy projects is still a strong barrier as the process is very slow, expensive and legally complex.

It is also worth mentioning here that the El Canadá Project was evaluated on a merchant basis, taking into account the impact of a deregulated competitive electric market. The power contract the Project has with COMEGSA does not, in any way, offer the "security" associated with traditional PPA's. There is no sovereign guarantee, no take-or-pay provision, nor buy -out clause in the contract. The contract simply provides for a payment and contract compliance guarantee, which, if the contract were rescinded, would provide "make-up" income for the two year period it is estimated, would be necessary in order to rebuild an off-taker portfolio in similar terms to the COMEGSA contract.

Furthermore, under the COMEGSA agreement, El Canadá is still subject to the hydrological risk and must make-up any deficits in on-peak energy through spot market purchases. As explained above, the Project must purchase replacement power when prices are high and has excess energy during the wet season when prices are low. The Contract with COMEGSA also explicitly refers to CDM reductions and requires that the project entity transfer 12.5% of the resulting benefits from such reductions to COMEGSA. This situation confirms El Canada's exposure to technology and pricing barriers.

Step 4. Common Practice Analysis

Sub-step 4a. Analyse other activities similar to the proposed project

As shown in Table 2, activities similar to the El Canadá Project, i.e. privately developed, small, hydroelectric power generation, that are not CDM projects, do not yet prevail in Guatemala.

Sub-step 4.b. Discuss any similar options that are occurring
Most of Guatemala's generation capacity expansion since 1997 has been thermal, as shown in Table A.4.1 of Appendix 4. When the project go-ahead decision was made in 2001, hydro expansion represented only 8% (35MW) of capacity additions in the previous 5 years (1996-2001), whereas thermal-bunker C units represented 87% (378MW) and geothermal 5% (22MW) during this same time period. Given the higher capital costs and associated project and operating risks of hydroelectric power generation, the trend of capacity additions through thermal plants is likely to continue in the foreseeable future.

Step 5. Impact of CDM Registration
As demonstrated in Sub-step 2c and 3 above, the El Canadá Project was not the most financially attractive investment option for the project company unless certain benefits and incentives could be derived from undertaking this particular type of activity: zero-emissions power generation from a renewable energy source.

The financial benefit from the sale of CERs was a crucial factor in the initial decision to invest in this type of, otherwise financially unattractive, activity. The potential CER revenue stream has been factored into the Project's earliest cash flow analyses since conception as shown in step 0. These revenues are of fundamental importance to the Project's viability as they constitute a long term contract, with payments of hard currency made outside Guatemala, thus mitigating country risk. This important leverage provided by the CDM registration was acknowledged by the IFC in its decision-making on the debt financing of the Project.

As all the above steps are satisfied, it is thus demonstrated that the proposed CDM activity is not part of the baseline scenario and, therefore, it is additional.

B.6. Emission reductions

B.6.1. Explanation of methodological choices

Approved Consolidated Monitoring Methodology (ACM0002): "Consolidated Baseline Methodology for Grid-connected Electricity Generation from Renewable Sources" (ACM0002/Version 13.0.0, Sectoral Scope: 1, EB67).

This monitoring methodology is used in conjunction with the Approved Consolidated Baseline Methodology (ACM0002), which is the baseline methodology chosen for the Project. The ACM0002 monitoring methodology is applicable to electricity capacity additions from run-of-river hydroelectric plants such as El Canadá. Moreover, the geographic and system boundaries of the Guatemalan national electricity grid can be clearly identified, and information on the characteristics of the grid is available from the AMM.

B.6.2. Data and parameters fixed ex ante

Data / Parameter	**$EG_{m,y}$ - Electricity by generating units**
Unit	MWh
Description	Annual energy produced by the plants connected to the grid during 2006, 2007 and 2008
Source of data	*Administrador del Mercado Mayorista*, AMM
Value(s) applied	Please see table A.4.1, Appendix 4
Choice of data or Measurement	Electricity generated by the plants data is used to calculate the apparent fuel consumed per plant and Operating Margin and Build Margin.

methods and procedures	Electricity is measured through equipment measurement installed in each plant.
Purpose of data	Calculation of baseline emissions
Additional comment	

Data / Parameter	**NCVi, y - Net Calorific Values**
Unit	$TJ/10^3$ tonnes
Description	Weighted average net calorific value of the fuel type i in year y
Source of data	2006 IPCC Guidelines
Value(s) applied	Default values
Choice of data or Measurement methods and procedures	By means of the net calorific values is calculated the apparent fuel consumed during each year by the generating units.
Purpose of data	Calculation of baseline emissions
Additional comment	

Data / Parameter	$EF_{grid,CM,y}$
Unit	tCO_2/MWh
Description	Combined margin CO_2 emission factor for grid connected power generation in year y calculated using the latest version of the *"Tool to calculate the emission factor for an electricity system".*
Source of data	Calculated. Official statistics from AMM for electricity generation clustered by technology 2006, 2007, and 2008.
Value(s) applied	0.495 tCO_2/MWh
Choice of data or Measurement methods and procedures	This value was calculated according to *"Tool to calculate the emission factor for an electricity system"* (version 3.0.0). Applied value was calculated by referring to Official AMM Statistics for electricity generation (2006, 2007, and 2008).
Purpose of data	Calculation of baseline emissions
Additional comment	The same value will be applied during the second crediting period without updating. Calculated ex-ante and fixed for the second crediting period.

Data / Parameter	$EF_{OM,y}$
Unit	tCO_2/MWh
Description	Operating Margin emission factor for year y
Source of data	Calculated
Value(s) applied	0.841 tCO_2/MWh
Choice of data or Measurement methods and procedures	This value was calculated according to *"Tool to calculate the emission factor for an electricity system"* (version 3.0.0). Applied value was calculated by referring Official AMM Statistics for electricity generation (2006, 2007, 2008).
Purpose of data	Calculation of baseline emissions
Additional comment	This data will be calculated ex-ante at the time of PDD submission and will not be changed during the second crediting period.

Data / Parameter	$EF_{BM,y}$
Unit	tCO_2/MWh
Description	Build Margin emission factor for year y
Source of data	Calculated
Value(s) applied	0.380 tCO_2/MWh
Choice of data or Measurement methods and procedures	This value was calculated according to *"Tool to calculate the emission factor for an electricity system"* (version 3.0.0). Applied value was calculated by referring Official AMM Statistics for electricity generation (2006, 2007, 2008).

Purpose of data	Calculation of baseline emissions
Additional comment	This data will be calculated ex-ante at the time of PDD submission and will not be changed during the second crediting period.

Data / Parameter	$FC_{i,m,y}$
Unit	mass or volume unit
Description	Amount of fossil fuel type i consumed by power plant / unit m in year y
Source of data	Official statistics from AMM for electricity generation clustered by technology 2006, 2007, 2008.
Value(s) applied	See Table 4.3.1 from Appendix 4
Choice of data or Measurement methods and procedures	Applied value was calculated by referring to Official AMM Statistics for electricity generation (2006, 2007, and 2008).
Purpose of data	Calculation of baseline emissions
Additional comment	The same value will be applied during the second crediting period without updating.

Data / Parameter	$EF_{CO2,i,y}$
Unit	tCO_2/TJ
Description	CO_2 emission factor of fossil fuel type i in year y
Source of data	2006 IPCC Guidelines on National GHG Inventories
Value(s) applied	See Appendix 4
Choice of data or Measurement methods and procedures	IPCC default values at the lower limit of the uncertainty at 95% confidence interval as provided in table 1.4 of Chapter1 of Vol.2 (Energy)
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$\eta_{m,y}$
Unit	-
Description	Average net energy conversion efficiency of power unit *m* or *k* in year *y*
Source of data	Appendix 1 of the "Tool to calculate the emission factor for an electricity system" (ver. 3.0.0)
Value(s) applied	See Appendix 4
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

* http://cdm.unfccc.int/UserManagement/FileStorage/AM_CLAR_IF26PUYWE8666VS24I68BM8WBDWJTO

Data / Parameter	Cap_{BL}
Data Unit	W
Description	Installed capacity of the hydro power plant before the implementation of the project activity. For new hydro power plants, this value is zero
Source of data	Project site.
Value(s) applied	0
Choice of data or Measurement methods and procedures	-

Purpose of data	Calculation of project emissions
Additional comment	-

Data / Parameter	**A_{BL}**
Data Unit	m^2
Description	Area of the single or multiple reservoirs measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m^2). For new reservoirs, this value is zero
Source of data	Project site
Value(s) applied	0
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of project emissions
Additional comment	-

The calculation of the OM, BM and CM emission factors were submitted to DOE as an excel file. It includes the following information:

- Information to clearly identify the plant
- The date of commissioning
- The fuel type(s) used
- The quantity of net electricity generation in the relevant year(s)
- The fuel consumption of each fuel type in the relevant year(s)

B.6.3. Ex ante calculation of emission reductions

According to the consolidated approved methodology ACM0002, emission reductions are calculated as follows:

$ER_y = BE_y - PE_y$

No leakage emissions are considered as per the consolidated approved methodology ACM0002.

Baseline Emissions:

The formulae used to estimate the anthropogenic emissions by sources of GHG's in the baseline is based on the project's baseline calculation described in methodology ACM0002. Baseline emissions include only CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity. The methodology assumes that all project electricity generation above baseline levels would have been generated by existing grid-connected power plants and the addition of new grid-connected power plants.

The baseline emissions are to be calculated as follows:

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

Where:
BE_y = Baseline emissions in year *y* (tCO_2/yr)
$EG_{PJ,y}$ = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year *y* (MWh/yr)

$EF_{grid,CM,y}$ = Combined margin CO_2emission factor for grid connected power generation in year *y* calculated using the latest version of the *"Tool to calculate the emission factor for an electricity system"* (tCO_2/MWh)

Calculation of $EG_{PJ,y}$

The project activity is a greenfield renewable energy power plants. According to ACM0002, if the project activity is the installation of a new grid-connected renewable power plant/unit at a site where no renewable power plant was operated prior to the implementation of the project activity, then:

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

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

The grid emission factor was calculated ex-ante in a transparent and conservative manner as 0.25 * $EF_{grid,OM,y}$ and 0.75* $EF_{grid,BM,y}$ Consequently, estimated anthropogenic emissions to be reduced by the project were calculated following a 6-step-process (formulae used were provided for each step):

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

Project Emissions:

According to the consolidated approved methodology ACM0002 version 13.0.0, project emissions for this project are zero since the project is a hydropower plant with a run-of-river reservoir and the power density of the power plant is greater than 10W/m^2..

The project emissions from the run-of-river reservoir are negligible ($PE_{HP,y}$ = 0) since the power density of the project activity is great than 10W/m^2.

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}}$$

Where:
PD = Power density of the project activity (W/m^2)
Cap_{PJ} = Installed capacity of the hydro power plant after the implementation of the project activity (W)
Cap_{BL} = Installed capacity of the hydro power plant before the implementation of the project activity (W). For new hydro power plants, this value is zero
A_{PJ} = Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (m^2)
A_{BL} = Area of the reservoir measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m^2). For new reservoirs, this value is zero.

The run-off river reservoir occupies an area of approximately 2.83 ha[11]. (at maximum capacity) .The power density (PD) is calculated as follows:

PD = 48,110,000 W / 28,273.10 m^2 = 1,701.62 W/m^2

Since power density is greater than 10 W/m^2 the project emissions from the run-off river reservoir are negligible ($PE_{HP,y}$ = 0)[12]

<u>Furthermore, as per methodology ACM0002, version 13.0.0, EB 67, *"The use of fossil fuels for the back-up or emergency purposes (e.g. diesel generators) can be neglected"*.</u>

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

The ERs estimated for the second crediting period add up to 675,241 tCO_2e. This calculation can be seen in the table below:

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
2010 (from 23.11.2010)	10,307	0	0	10,307
2011	96,463	0	0	96,463
2012	96,463	0	0	96,463
2013	96,463	0	0	96,463
2014	96,463	0	0	96,463
2015	96,463	0	0	96,463
2016	96,463	0	0	96,463
2017 (until 22.11.2017)	86,156	0	0	86,156
Total	675,241	0	0	675,241
Total number of crediting years	7			
Annual average over the crediting period	96,463	0	0	96,463

B.7. Monitoring plan

According to ACM0002, all data collected as part of monitoring should be archived electronically and be kept at least for 2 years after the end of the last crediting period. 100% of the data should be monitored if not indicated otherwise in the tables below. All measurements should be conducted with calibrated measurement equipment according to relevant industry standards.

Some key issues in the monitoring plan:

[11] Source: Generadora de Occidente Ldta.- "Surface area of El Canada run-of-river reservoir".

[12] According to EB 23, Annex 5 - *"Thresholds and criteria for the eligibility of hydroelectric power plants with reservoirs as CDM project activities"*.

- At the renewal of each crediting period, confirmation that the Project meets applicability requirements, especially with regards to additionality.
- Correction of emission factors due to electricity imports and exports, as necessary;
- At the renewal of each crediting period, determination of the CM;
- At the renewal of each crediting period, determination of the BM emission factor (weighted average of the most recently built plants that comprise 20% of the grid generation;
- At the renewal of each crediting period, determination of the OM emission factor (weighted average excluding low-cost/must run sources);
- Monitoring of monthly and annual electricity generated by the Project and sold to the grid;

The calculation of the operating margin and build margin emission factors should be documented electronically in a spreadsheet that should be attached to the CDM-PDD. This should include all data used to calculate the emission factors, including:

- For each grid-connected power plant/unit the following information:
    - Information to clearly identify the plant;
    - The date of commissioning;
    - The capacity (MW);
    - The fuel type(s) used;
    - The quantity of net electricity generation in the relevant year(s);
    - If applicable: the fuel consumption of each fuel type in the relevant year(s);
    - In case where the simple OM or the simple adjusted operating margin is used: information whether the plant/unit is a low-cost/must-run plant/unit;
    - Net calorific values used;
    - CO_2 emission factors used;
    - Plant efficiencies used;
    - Identification of the plants included in the build margin and the operating margin during the relevant time year(s);

The data should be presented in a manner that enables reproducing of the calculation of the build margin and operating margin grid emission factor.

B.7.1. Data and parameters to be monitored

Data / Parameter	$EG_{PJ,y}$ (= $EG_{facility,y}$)
Unit	MWh
Description	Net electricity supplied to the grid by the project
Source of data	Calculated (as a difference between 2 measured data) $EG_{PJ,y}$ = E1- E2
Value(s) applied	194,700 kWh/year
Measurement methods and procedures	The electricity supplied to the grid by the El Canadá Hydroelectric Project is calculated by difference of El Canada & Montecristo substation meter readings. Electricity meters at both, El Canada & Montecristo substations, are bi-directional meters designed to measure electricity flow in both directions. Measurement results are cross-checked with records for sold electricity.
Monitoring frequency	Data will be calculated and recorded monthly
QA/QC procedures	- Uncertainty of data is low - QA/QC procedure for this is planned. - The allowable error of data must be within ± 0.5%. - The measurement and calibration of the meters are subject to regular maintenance and testing to ensure accuracy and compliance with AMM Commercial Coordination Norm -14 and Annual Meter Verification Procedure
Purpose of data	Calculation of Baseline Emissions
Additional comment	- Data will be kept for two years after the last issuance of CERs for this project activity. - Data will be aggregated weekly, monthly and yearly - Measured data will be double checked against receipt of sales - This data is electricity generated except electricity consumed in the plant and electricity imported for the project activity

Data / Parameter	**E1**
Unit	MWh
Description	Net electricity supplied to the grid by both El Canada and Montecristo power plants
Source of data	Measured
Value(s) applied	Actual value will be monitored ex-post.
Measurement methods and procedures	Measured – Official metering data sent monthly to the AMM. Invoices to the official COMEGSA, any other third party clients or the Economical Transaction Report submitted by AMM, are compared with the official data to AMM. As established in the NCC-14, the measurement equipment has to comply with Norms: IEC 687 or ANSI/IEEE 12.20. Its exactitude must be of 0.2%.
Monitoring frequency	Hourly measurement and monthly recording
QA/QC procedures	- The measurement and calibration of the meters are subject to regular maintenance and testing to ensure accuracy and compliance with AMM Commercial Coordination Norm -14 and Annual Meter Verification Procedure - Measured data will be double checked against receipt of sales
Purpose of data	Calculation of Baseline Emissions
Additional comment	- Data will be kept for two years after the last issuance of CERs for this project activity. - Data will be aggregated weekly, monthly and yearly

Data / Parameter	E2
Unit	MWh
Description	Net electricity supplied to the grid by Montecristo power Plant
Source of data	Measured
Value(s) applied	Actual value will be monitored ex-post.
Measurement methods and procedures	Measured – Official metering data sent monthly to the AMM. Invoices to the official COMEGSA, any other third party clients or the Economical Transaction Report submitted by AMM, are compared with the official data to AMM. As established in the NCC-14, the measurement equipment has to comply with Norms: IEC 687 or ANSI/IEEE 12.20. Its exactitude must be of 0.2%.
Monitoring frequency	Hourly measurement and monthly recording
QA/QC procedures	- The measurement and calibration of the meters are subject to regular maintenance and testing to ensure accuracy and compliance with AMM Commercial Coordination Norm -14 and Annual Meter Verification Procedure - Measured data will be double checked against receipt of sales
Purpose of data	Calculation of Baseline Emissions
Additional comment	- Data will be kept for two years after the last issuance of CERs for this project activity. - Data will be aggregated weekly, monthly and yearly

Data / Parameter	Cap_{PJ}
Unit	W
Description	Installed capacity of the hydro power plant after the implementation of the project activity.
Source of data	Project site.
Value(s) applied	48,110,000
Measurement methods and procedures	Determine the installed capacity based on recognized standards
Monitoring frequency	Yearly
QA/QC procedures	-
Purpose of data	Calculation of project emissions
Additional comment	-

Data / Parameter	A_{PJ}
Unit	m^2
Description	Area of the single or multiple reservoirs measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (m^2).
Source of data	Project site
Value(s) applied	28,273.10
Measurement methods and procedures	Measured from topographical surveys, maps, satellite pictures, etc
Monitoring frequency	Yearly
QA/QC procedures	-
Purpose of data	Calculation of project emissions
Additional comment	-

B.7.2. Sampling plan

Not applicable.

B.7.3. Other elements of monitoring plan

The monitoring methodology and plan for the project (“the MP”) follows the methodology ACM0002 version 13.0.0 EB 67. All data collected as part of monitoring should be archived electronically and be kept at least for 2 years after the end of the last crediting period. 100% of the data should be monitored if not indicated otherwise in the tables below. All measurements should be conducted with calibrated measurement equipment according to relevant industry standards.

The management and operation of the Project are the responsibility of GdO. For calculating the ERs, GdO relies on data issued by the AMM based on the actual operation of the NIS. Independent verifiers will periodically audit the operational and management systems to ensure credibility and transparency of the reported ERs and other performance indicators of the Project.

Components of the operational and management structure implemented by GdO are:

- A transparent system for the collection, computation and storage of data, including adequate record keeping and data monitoring systems;
- Clear procedures and protocols for collection and entry of data, use of workbooks and spreadsheets and any assumptions made, so that compliance with requirements can be assessed by a third party. Paper-based systems are also used as back-ups in the event of electronic system failures;
- A competent Project Manager who is in charge of, and accountable for, the generation of data, monitoring, record keeping, and computation of ERs, and of audits and verification. He/she officially signs all worksheets;
- Regular reporting to the PCF via copies of completed worksheets, semi-annual ER statements, and brief annual ER reports, as set forth in the Emission Reductions Purchase Agreement (ERPA), while maintaining originals on file;
- Internal training to staff to enable them to undertake the tasks required by the MP.

El Canadá Hydroelectric plant is located 2 km upstream from Montecristo plant. The electricity produced by the Montecristo Hydroelectric plant is transformed from 13.8 kV to 69 kV in an own substation and then is delivered to the 69 kV busbar of El Canadá Substation, through a 69 kV line, whose length is of 2.8 km. The reason of the connection of Montecristo power plant to the grid, through El Canadá substation, was to reduce investment costs using the same line to export the electricity from El Canadá substation to the grid and to reduce the environmental impacts.

El Canadá Electricity Meter (which measures the net electricity supplied by both El Canada and Montrecristo plants) is located in the 69 kV busbar of El Canadá Substation, and the Montecristo Electricity Meter (which measures the electricity supplied by Montecristo plant alone) is located in the 69 kV busbar of Montecristo Substation. The 69 kV busbar of El Canadá Substation was chosen as the sale busbar for both plants, but the net electricity supplied to the grid by each plant is commercialized separately and in different way in the electricity market.

The monthly net electricity supplied to the grid will be collected from the commercial energy meter installed in the El Canada Substation (installed on 19//11/2003),which measures the net electricity supplied by both El Canada Hydroelectric Project and Montecristo Hydroelectric Projects and in the Montecristo Substation in the 69 KV bus which measures net electricity supplied to the grid by the Montecristo Hydroelectric Project alone (installed on 14/05/2006 and started supplying to the grid

from the same month through El Canada substation meter, evidence for the same submitted to DOE), therefore **the net electricity supplied by the El Canadá Hydroelectric Project will be calculated by the difference.**

Figure 3: Localization of El Canadá and Montecristo Power Plants.

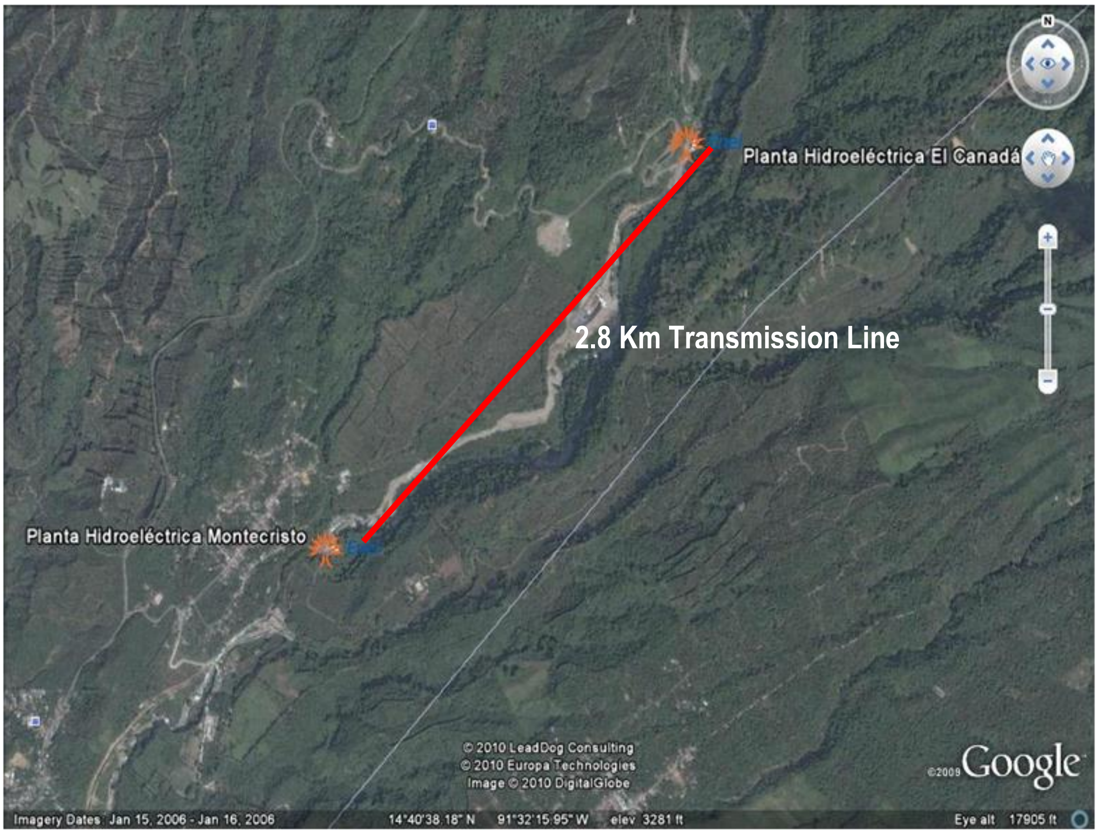
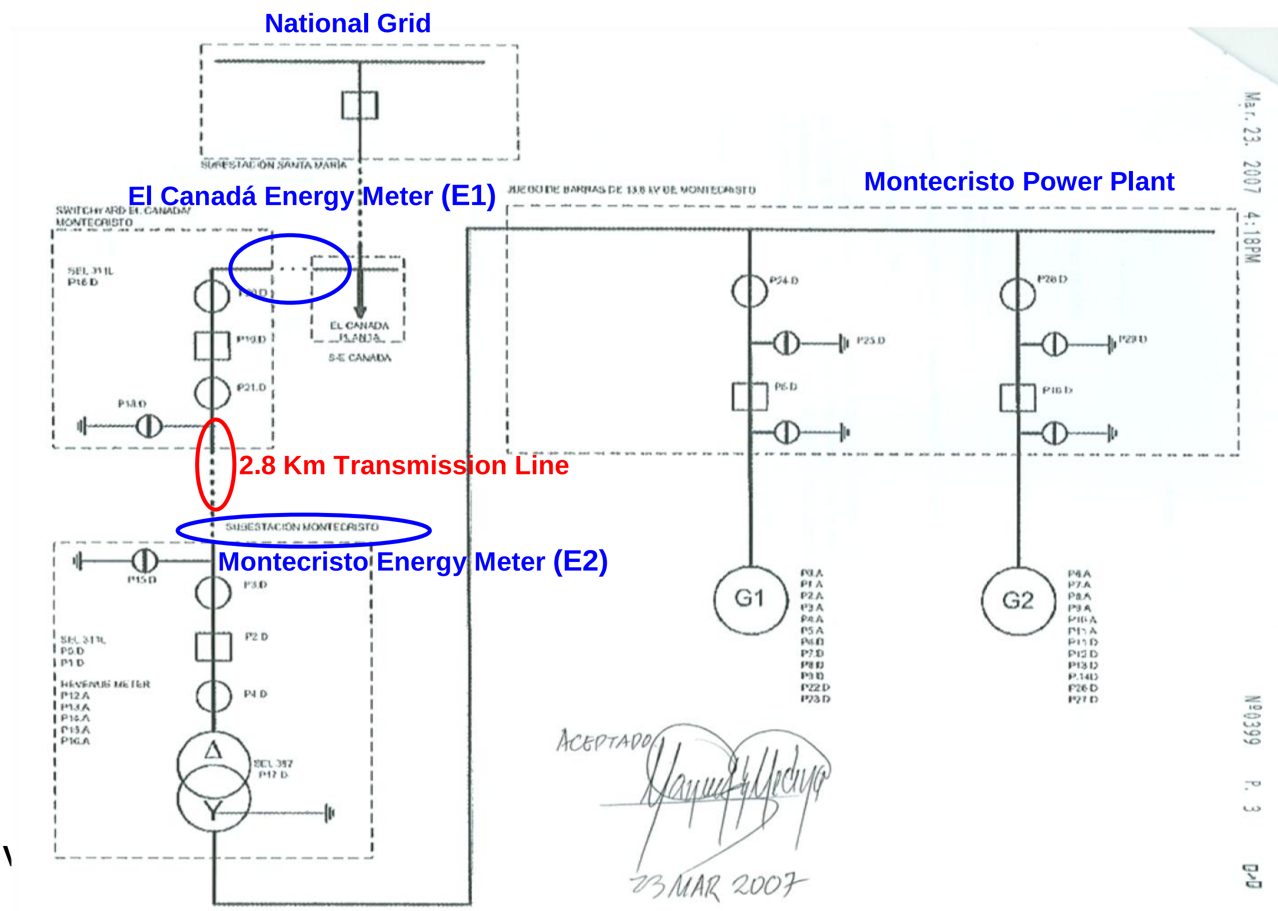


Figure 4: Single Line Diagram



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B.7.4. Date of completion of application of methodology and standardized baseline and contact information of responsible persons/ entities

01/05/2013

Mr. Hector Bracamontes Hinojosa
Enel Green Power Mexico
Tel: +52 55 5083 0310
Email: hector.bracamontes@enel.com
In cooperation with the International Bank for Reconstruction and Development (IBRD) as Trustee of the Prototype Carbon Fund (PCF).
Enel Green Power Mexico is not a project participant.

SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

23/11/2003

C.1.2. Expected operational lifetime of project activity

50 years

C.2. Crediting period of project activity

C.2.1. Type of crediting period

Second renewable crediting period

C.2.2. Start date of crediting period

23/11/2010

C.2.3. Length of crediting period

7 years

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

An Environmental Impact Assessment (EIA) was prepared and approved by the National Environmental Commission (CONAMA), in accordance with Guatemalan law governing new electricity generation projects. The EIA was also reviewed and cleared by the International Finance Corporation (IFC) as fully complying with this financing institution’s environmental and social safeguards policies.

D.2. Environmental impact assessment

The environmental impacts of the Project are considered insignificant.

SECTION E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

IFC carried out and prepared the Project Environmental and Social Review, which was published on the IFC web site and in the local press. This review was also available for public discussion in the El Palmar and Zunil municipalities. If required, the IFC documentation regarding the process is available for DOE review at the ENEL offices in Guatemala City.

E.2. Summary of comments received

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

E.3. Report on consideration of comments received

No concerns about the Project were voiced.

SECTION F. Approval and authorization

The letters of approvals from Parties for the project activity were available at the time of submitting the PDD to the validating DOE.

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Appendix 1. Contact information of project participants and responsible persons/ entities

Project participant and/or responsible person/ entity	☒ Project participant ☐ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	Generadora de Occidente, Ltda
Street/P.O. Box	6 10-65 Zona 10, Centro Gerencial Las Margaritas
Building	Torre 1, Nivel 8, Oficina 801
City	Guatemala City
State/Region	
Postcode	01010
Country	Guatemala
Telephone	502-2327 7018
Fax	
E-mail	oswaldo.smith@enel.com
Website	
Contact person	Oswaldo
Title	Country Manager, Guatemala
Salutation	
Last name	Smith Gonzalez
Middle name	
First name	Rene Oswaldo
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	

Project participant and/or responsible person/ entity	☐ Project participant ☒ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	Enel Green Power Mexico
Street/P.O. Box	Miguel de Cervantes Saavedra 193, Piso 4, Col. Ampliación Granada, Del Miguel Hidalgo
Building	
City	Mexico City
State/Region	Mexico
Postcode	CP 11520
Country	Mexico
Telephone	+52 55 50830310
Fax	+52 55 15219532
E-mail	hector.bracammontes@enel.com
Website	
Contact person	Hector Bracamontes Hinojosa
Title	
Salutation	Mr.
Last name	Bracamontes Hinojosa
Middle name	
First name	Hector
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	

Project participant and/or responsible person/ entity	☐ Project participant ☒ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	International Bank for Reconstruction and Development (IBRD) as Trustee of the Prototype Carbon Fund (PCF)
Street/P.O. Box	1818 H Street
Building	
City	Washington DC
State/Region	Washington DC
Postcode	20433
Country	Unites States of America
Telephone	+1-202-458-5051
Fax	+1-202-522-7432
E-mail	Ibrd-carbonfinance@worldbank.org
Website	www.carbonfinance.org
Contact person	
Title	Operations Team Leader
Salutation	Mr.
Last name	Andreu
Middle name	
First name	Jose
Department	Carbon Finance Unit – Climate Change Group
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	

Project participant and/or responsible person/ entity	☒ Project participant ☐ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	Government of Finland- Ministry for Foreign Affairs
Street/P.O. Box	Katajanokanlaituri 3
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State/Region	
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Country	Finland
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Fax	+358-9-160 56567
E-mail	
Website	
Contact person	Mr. Marko Berglund
Title	Chief Administrator
Salutation	

Last name	Berglund
Middle name	
First name	Marko
Department	Unit for International Environment Policy
Mobile	
Direct fax	358-9-160 56033
Direct tel.	+358 9 1605 5317
Personal e-mail	Marko.berglund@formin.fi

Project participant and/or responsible person/ entity	☒ Project participant ☐ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	Fortum Corporation
Street/P.O. Box	POB 1, 00048 Fortum
Building	
City	Keilaniemi
State/Region	Espoo
Postcode	
Country	Finland
Telephone	358 50 370 0445
Fax	358 10 45 3630
E-mail	heikki.herttuainen@fortum.com
Website	
Contact person	Heikki Herttuainen
Title	Head of Renewable and Carbon Trading
Salutation	Mr.
Last name	Herttuainen
Middle name	
First name	Heikki
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	

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Appendix 2. Affirmation regarding public funding

The Project has not received and is not seeking any public funding.

Appendix 3. Applicability of methodology and standardized baseline

For further details see Section B.2.

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

Table A.4.1 Power Generation by Plant and Fuel Type serving the grid (2006)

Table A.3.1 Power Generation by Plant and Fuel Type serving the grid (2006)						
A	B	C	D	E	F	G
Power plants	Fuel type	2006 Energy produced	Conversion factor	Default efficiency factors ηm	Fuel consumption, Fi2006	Emission co2
		(GWh)	(TJ/MWh)	(%)	(TJ/year)	(co2 ton)
	AMM	AMM	Conversion Factor from International System of Units**	Annex I - "Tool to calculate the emission factor of an electricity system" v. 2.2.1 *	(F = (C *1000 X D)/E)	(G = F * "EF")
STEAM TURBINES	**FUEL**	**1,010.47**			**9,832**	**858,300**
SAN JOSE	**Coal**	**1,010.47**	**0.0036**	**37%**	**9,832**	**858,300.35**
ESC VAPOR 2	**Fuel Oil No.6**	**0.00**	**0.0036**	**39.0%**	**0**	**0**
GAS TURBINES	**FUEL**	**8.46**			**93**	**6,773**
TAMPA	**Diesel**	**6.49**	**0.0036**	**30%**	**78**	**5,652**
STEWART & STEVENSON	**Diesel**	**0.97**	**0.0036**	**46%**	**8**	**549**
ESC.GAS No.3	**Diesel**	**0.00**	**0.0036**	**46%**	**0**	**0**
ESC.GAS No.5	**Diesel**	**1.01**	**0.0036**	**46%**	**8**	**572**
INTERNAL COMBUSTION MOTORS	**FUEL**	**2,219.66**			**23,992**	**1,811,408**
ARIZONA	**Fuel Oil No.6**	**847.47**	**0.0036**	**39.5%**	**7,724**	**583,145**
LA ESPERANZA	**Fuel Oil No.6**	**476.74**	**0.0036**	**30%**	**5,721**	**431,924**
PQPLLC	**Fuel Oil No.6**	**77.76**	**0.0036**	**30%**	**933**	**70,452**
LAS PALMAS 1	**Fuel Oil No.6**	**88.40**	**0.0036**	**30%**	**1,061**	**80,088**
LAS PALMAS 2	**Fuel Oil No.6**	**72.50**	**0.0036**	**30%**	**870**	**65,682**
LAS PALMAS 3	**Fuel Oil No.6**	**75.12**	**0.0036**	**30%**	**901**	**68,062**
LAS PALMAS 4	**Fuel Oil No.6**	**69.40**	**0.0036**	**30%**	**833**	**62,873**
LAS PALMAS 5	**Fuel Oil No.6**	**15.50**	**0.0036**	**30%**	**186**	**14,045**
GENOR	**Fuel Oil No.6**	**178.23**	**0.0036**	**30%**	**2,139**	**161,477**
SIDEGUA	**Fuel Oil No.6**	**74.64**	**0.0036**	**30%**	**896**	**67,623**
ELECTROGENERACIÓN	**Fuel Oil No.6**	**68.56**	**0.0036**	**39.5%**	**625**	**47,176**
GENERADORA PROGRESO	**Fuel Oil No.6**	**50.40**	**0.0036**	**30%**	**605**	**45,662**
LAGOTEX	**Fuel Oil No.6**	**99.09**	**0.0036**	**30%**	**1,189**	**89,771**
AMATEX	**Fuel Oil No.6**	**25.86**	**0.0036**	**30%**	**310**	**23,428**
COGENERATION PLANTS	**FUEL**	**810.04**				**159,021.06**
COGENERATION PLANTS	**Fuel Oil No.6**	**269.13**	**0.0036**	**46%**	**2,106.24**	**159,021.06**
COGENERATION PLANTS	**Bagasse**	**540.90**				
GEOTHERMAL	**FUEL**	**142.53**				
GEOTHERMAL PLANTS	**Steam**	**142.53**				
HYDROELECTRIC	**FUEL**	**3,245.46**				
HYDRO POWER PLANTS	**Hydro**	**3,245.46**				
DISTRIBUTED GENERATION	**FUEL**	**-**	**-**			
POWER PLANTS (< 5 MW)	**Hydro**	**-**				
TOTAL 2006:					**Emissions by Fuel Type:**	
Total Thermal (S.N.I.):		**3,508 (GWh)**			**Diesel (co2 ton) :**	**6,773**
					FuelOil No.6 (co2 ton) :	**1,970,429**
					Coking Coal (co2 ton) :	**858,300**
					Cogeneration (Fuel Oil No.6) (co2 ton) :	**159,021**
Total Thermal Plants (S.N.I.):		**3,508 (GWh)**			**(co2 ton)**	**2,994,523**

* "Tool to calculate the emission factor of an electricity system" - Annex I: Default efficiency factors for power plants.

** The International System of Units (SI) –Conversion Factors for General Use http://ts.nist.gov/WeightsAndMeasures/Metric/upload/SP1038.pdf page 12.

Table A.4.2 Power Generation by Plant and Fuel Type serving the grid (2007)

Table A.3.1 Power Generation by Plant and Fuel Type serving the grid (2007)						
A	B	C	D	E	F	G
Power plants	Fuel type	2007 Energy produced	Conversion factor	Default efficiency factors ηm	Fuel consumption, Fi2007	Emission co2
		(GWh)	(TJ/MWh)	(%)	(TJ/year)	(co2 ton)
	AMM	AMM	Conversion Factor from International System of Units**	Annex I - "Tool to calculate the emission factor of an electricity system" v. 2.2.1 *	(F = (C *1000 X D)/E)	(G = F * "EF")
STEAM TURBINES	**FUEL**	**1,037.61**			**10,096**	**881,338**
SAN JOSE	**Coal**	**1,037.52**	**0.0036**	**37%**	**10,095**	**881,273**
ESC VAPOR 2	**Fuel Oil No.6**	**0.00**	**0.0036**	**39.0%**	**0**	**0**
ARIZONA VAPOR 1	**Fuel Oil No.6**	**0.09**	**0.0036**	**39.0%**	**1**	**65**
GAS TURBINES	**FUEL**	**16.41**			**180**	**13,098**
TAMPA	**Diesel**	**12.46**	**0.0036**	**30%**	**150**	**10,859**
STEWART & STEVENSON	**Diesel**	**1.54**	**0.0036**	**46%**	**12**	**875**
ESC.GAS No. 3	**Diesel**	**0.00**	**0.0036**	**46%**	**0**	**0**
ESC.GAS No. 5	**Diesel**	**1.33**	**0.0036**	**46%**	**10**	**753**
LAGUNA GAS 1	**Diesel**	**0.75**	**0.0036**	**46%**	**6**	**429**
LAGUNA GAS 2	**Diesel**	**0.32**	**0.0036**	**46%**	**3**	**182**
INTERNAL COMBUSTION	**FUEL**	**2,700.75**			**29,287**	**2,211,170**
ARIZONA	**Fuel Oil No.6**	**954.95**	**0.0036**	**39.5%**	**8,703**	**657,103**
LA ESPERANZA	**Fuel Oil No.6**	**595.47**	**0.0036**	**30%**	**7,146**	**539,497**
PQPLLC	**Fuel Oil No.6**	**204.65**	**0.0036**	**30%**	**2,456**	**185,413**
LAS PALMAS 1	**Fuel Oil No.6**	**71.94**	**0.0036**	**30%**	**863**	**65,175**
LAS PALMAS 2	**Fuel Oil No.6**	**76.53**	**0.0036**	**30%**	**918**	**69,340**
LAS PALMAS 3	**Fuel Oil No.6**	**97.01**	**0.0036**	**30%**	**1,164**	**87,894**
LAS PALMAS 4	**Fuel Oil No.6**	**81.62**	**0.0036**	**30%**	**979**	**73,945**
LAS PALMAS 5	**Fuel Oil No.6**	**28.97**	**0.0036**	**30%**	**348**	**26,248**
GENOR	**Fuel Oil No.6**	**191.69**	**0.0036**	**30%**	**2,300**	**173,671**
SIDEGUA	**Fuel Oil No.6**	**70.94**	**0.0036**	**30%**	**851**	**64,274**
ELECTROGENERACIÓN	**Fuel Oil No.6**	**60.75**	**0.0036**	**39.5%**	**554**	**41,802**
GENERADORA PROGRESO	**Fuel Oil No.6**	**66.28**	**0.0036**	**30%**	**795**	**60,045**
GECSA	**Fuel Oil No.6**	**66.05**	**0.0036**	**39.5%**	**602**	**45,452**
GECSA2	**Fuel Oil No.6**	**0.00**	**0.0036**	**39.5%**	**0**	**0**
COENESA	**Diesel**	**0.00**	**0.0036**	**39.5%**	**0**	**0**
AMATEX	**Fuel Oil No.6**	**53.47**	**0.0036**	**30%**	**642**	**48,442**
AMATEX B3	**Fuel Oil No.6**	**0.00**	**0.0036**	**30%**	**0**	**0**
LAGOTEX	**Fuel Oil No.6**	**80.43**	**0.0036**	**30%**	**965**	**72,868**
COGENERATION PLANTS	**FUEL**	**955.01**	**-**			**221,322**
COGENERATION PLANTS	**Fuel Oil No.6**	**374.57**	**0.0036**	**46%**	**2,931**	**221,322**
COGENERATION PLANTS	**Bagasse**	**580.44**				
GEOTHERMAL	**FUEL**	**232.90**	**-**			
GEOTHERMAL PLANTS	**Steam**	**232.90**				
HYDROELECTRIC	**FUEL**	**2,985.60**	**-**			
HYDRO POWER PLANTS	**Hydro**	**2,985.60**				
DISTRIBUTED GENERATION	**FUEL**	**0.00**	**-**			
POWER PLANTS (< 5 MW)	**Hydro**	**0.00**				
TOTAL 2007:					**Emissions by Fuel Type:**	
					Diesel (co2 ton) :	**13,098**
Total Thermal (S.N.I.):		**4,129 (GWh)**			**FuelOil No.6 (co2 ton) :**	**2,432,558**
					Coking Coal (co2 ton) :	**881,273**
					Cogeneration (Fuel Oil No.6) (co2 ton) :	**221,322**
Total Thermal Plants (S.N.I.):		**4,129.34**	**(GWh)**		**(co2 ton)**	**3,548,251.31**

Source: Guatemala National Inter connected System Load Dispatch 2007, Administrador del Mercado Mayorista (AMM).

* "Tool to calculate the emission factor of an electricity system" - Annex I: Default efficiency factors for power plants.

** The International System of Units (SI) –Conversion Factors for General Use http://ts.nist.gov/WeightsAndMeasures/Metric/upload/SP1038.pdf page 12.

Table A.4.3 Power Generation by Plant and Fuel Type serving the grid (2008)

Table A.3.1 Power Generation by Plant and Fuel Type serving the grid (2008)						
A	B	C	D	E	F	G
Power plants	Fuel type	2008 Energy produced	Conversion factor	Default efficiency factors ŋm	Fuel consumption, Fi2008	Emission co2
		(GWh)	(TJ/MWh)	(%)	(TJ/year)	(co2 ton)
	AMM	AMM	Conversion Factor from International System of Units**	Annex I - "Tool to calculate the emission factor of an electricity system" v. 2.2.1 *	(F = (C *1000 X D)/E)	(G = F * "EF")
STEAM TURBINES	**FUEL**	**1,058.13**			**10,212**	**890,339**
SAN JOSE	**Coal**	**1,016.63**	**0.0036**	**37%**	**9,892**	**863,531**
LA LIBERTAD	**Coal**	**30.93**	**0.0036**	**50%**	**223**	**19,441**
ESC VAPOR 2	**FUEL OIL No.6**	**0.00**	**0.0036**	**39.0%**	**0**	**0**
ARIZONA VAPOR 1	**FUEL OIL No.6**	**10.57**	**0.0036**	**39.0%**	**98**	**7,366**
GAS TURBINES	**FUEL**	**15.26**	**-**		**167**	**12,091**
TAMPA	**DIESEL**	**11.29**	**0.0036**	**30%**	**135**	**9,836**
GGG STEWART & STEVENS	**DIESEL**	**1.50**	**0.0036**	**46%**	**12**	**852**
ESC.GAS 3	**DIESEL**	**0.00**	**0.0036**	**46%**	**0**	**0**
ESC.GAS 5	**DIESEL**	**0.79**	**0.0036**	**46%**	**6**	**449**
LAG. GAS	**DIESEL**	**1.68**	**0.0036**	**46%**	**13**	**955**
INTERNAL COMBUSTION MOTORS	**FUEL**	**2,082.89**	**-**		**22,502**	**1,698,883**
ARIZONA	**FUEL OIL No.6**	**748.61**	**0.0036**	**39.5%**	**6,823**	**515,119**
LA ESPERANZA	**FUEL OIL No.6**	**532.69**	**0.0036**	**30%**	**6,392**	**482,617**
PQPLLC	**FUEL OIL No.6**	**107.48**	**0.0036**	**30%**	**1,290**	**97,377**
LAS PALMAS 1	**FUEL OIL No.6**	**30.00**	**0.0036**	**30%**	**360**	**27,180**
LAS PALMAS 2	**FUEL OIL No.6**	**56.09**	**0.0036**	**30%**	**673**	**50,818**
LAS PALMAS 3	**FUEL OIL No.6**	**54.75**	**0.0036**	**30%**	**657**	**49,604**
LAS PALMAS 4	**FUEL OIL No.6**	**56.54**	**0.0036**	**30%**	**678**	**51,225**
LAS PALMAS 5	**FUEL OIL No.6**	**15.73**	**0.0036**	**30%**	**189**	**14,251**
GENOR	**FUEL OIL No.6**	**192.34**	**0.0036**	**30%**	**2,308**	**174,260**
SIDEGUA	**FUEL OIL No.6**	**41.05**	**0.0036**	**30%**	**493**	**37,191**
ELECTROGENERACIÓN	**FUEL OIL No.6**	**21.71**	**0.0036**	**39.5%**	**198**	**14,939**
GENERADORA PROGRESO	**FUEL OIL No.6**	**48.50**	**0.0036**	**30%**	**582**	**43,941**
GECSA	**FUEL OIL No.6**	**92.27**	**0.0036**	**39.5%**	**841**	**63,491**
GECSA2	**FUEL OIL No.6**	**1.07**	**0.0036**	**39.5%**	**10**	**736**
COENESA	**DIESEL**	**0.10**	**0.0036**	**39.5%**	**1**	**66**
LAGOTEX	**FUEL OIL No.6**	**32.92**	**0.0036**	**30%**	**395**	**29,826**
AMATEX	**FUEL OIL No.6**	**48.06**	**0.0036**	**30%**	**577**	**43,542**
AMATEX BLOQUE 3	**FUEL OIL No.6**	**2.98**	**0.0036**	**30%**	**36**	**2,700**
COGENERATION PLANTS	**FUEL**	**864.98**				**166,616**
COGENERATION PLANTS	**FUEL OIL No.6**	**281.98**	**0.0036**	**46%**	**2,207**	**166,616**
COGENERATION PLANTS	**BAGASSE**	**582.99**	**-**	**-**	**-**	**-**
GEOTHERMAL	**FUEL**	**271.65**				**-**
GEOTHERMAL PLANTS	**STEAM**	**271.65**	**-**	**-**	**-**	**-**
HYDROELECTRIC	**FUEL**	**3,624.22**				**-**
HYDRO POWER PLANTS	**HYDRO**	**3,624.22**	**-**	**-**	**-**	**-**
DISTRIBUTED GENERATION	**FUEL**	**0.01**				**-**
POWER PLANTS (< 5 MW)	**HYDRO**	**0.01**	**-**	**-**	**-**	**-**
TOTAL 2010:					**Emissions by Fuel Type:**	
Total Thermal (S.N.I.):		**3,438 (GWh)**			**Diesel (co2 ton) :**	**12,158**
					FuelOil No.6 (co2 ton) :	**1,706,184**
					Coking Coal (co2 ton) :	**882,972**
					Cogeneration (Fuel Oil No.6) (co2 ton) :	**166,616**
Total Thermal Plants (S.N.I.):		**3,438 (GWh)**			**(co2 ton)**	**2,767,930**

Source: Guatemala National Inter connected System Load Dispatch 2008, Administrador del Mercado Mayorista (AMM).

* "Tool to calculate the emission factor of an electricity system" - Annex I: Default efficiency factors for power plants.

** The International System of Units (SI) –Conversion Factors for General Use http://ts.nist.gov/WeightsAndMeasures/Metric/upload/SP1038.pdf page 12.

Table A.4.4 General Values by Fuel Type

General Values according to Fuel Type			
Fuel Type	Source	CO2 Emission Factor *	
		IPCC 2006*	
Diesel:	IPCC 2006	72.6	(tCO2/ TJ)
Fuel Oil No.6:	IPCC 2006	75.5	(tCO2/ TJ)
Coking Coal:	IPCC 2006	87.3	(tCO2/ TJ)

* 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Table 1.4 Chapter 1, Volume 2: Energy, http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_1_Ch1_Introduction.pdf

Table A.4.5 Operating Margin

OPERATING MARGIN	Total Generation (MWh)	OM by year: (tCO2 / MWh)	OM Average (tCO2 / MWh)
2006	3,507,720	0.854	0.841
2007	4,129,341	0.859	
2008	3,438,265	0.805	

Source: World Bank's own estimates based on AMM data.

Table A.4.6 Build Margin

SEIN Annual Generation 2008 GWh :	**7,853.42**	**(GWh)**
SEIN Annual Generation 2008 (Excluding CDM) GWh :	**7,478.87**	**(GWh)**
Build Margin Emission factor for 20% of grid (Excluding CDM) :	**1,495.77**	**(GWh)**
5 Most recent units generation :	**42.68**	**(GWh)**

CDM Registered Projects

Power Plant	Type	Date	Unit.	Gen. 2008
CANDELARIA	HYDRO	2006	(GWh)	23.71
EL CANADA	HYDRO	2004	(GWh)	214.68
ORTITLAN	GEOTHERMAL	2007	(GWh)	136.16
			GWh	374.55

A	B	C	D	E	F	H	G	I	J
POWER PLANT	TYPE	FUEL	START	CDM	Generation 2008	5 Most recent Units 2008	20% Gen. 2008 (Excluding CDM)	20% Cum. Gen. 2008 (Excluding	Emission (tCO2)
(AMM)	(AMM)	(AMM)		(MW)	(GWh)	(GWh)	(GWh)	(%)	(CO2 ton)
SANTA ELENA	HYDROELECTRIC	Hydro	Dec-08		0.009	0.009	0.009	0.00%	
GECSA2	INTERNAL COMBUSTION MOTORS	Fuel oil No.6	Oct-08		1.07	1.07	1.08	0.01%	736
ARIZONA VAPOR 1	STEAM TURBINES	Fuel oil No.6	Sep-08		10.57	10.57	11.65	0.16%	7,366
COENESA	INTERNAL COMBUSTION MOTORS	Diesel	Sep-08		0.10	0.10	11.75	0.16%	66
LA LIBERTAD	STEAM TURBINES	Coal	Aug-08		30.93	30.93	42.68	0.57%	19,441
TEXTILES B3	INTERNAL COMBUSTION MOTORS	Fuel oil No.6	Apr-08		2.98		45.66	0.61%	2,700
EL RECREO	HYDROELECTRIC	Hydro	Jul-07		130.43		176.09	2.35%	
ORTITLAN	GEOTHERMAL	GeoThermal	Jul-07	CDM	136.16				
GECSA	INTERNAL COMBUSTION MOTORS	Fuel oil No.6	Feb-07		92.27		268.36	3.59%	63,491
MONTECRISTO	HYDROELECTRIC	Hydro	May-06		57.46		325.82	4.36%	
CANDELARIA	HYDROELECTRIC	Hydro	May-06	CDM	23.71				
MAGDALENA	COGENERATION (STEAM TURBINES)	Bagasse / Fuel oil No.6	2006		178.92		504.74	6.75%	33,516
PALIN II	HYDROELECTRIC	Hydro	Jul-05		0.00		504.74	6.75%	
POZA VERDE	HYDROELECTRIC	Hydro	Jun-05		45.61		550.35	7.36%	
PANTALEON	COGENERATION (STEAM TURBINES)	Bagasse / Fuel oil No.6	Jan-05		167.50		717.85	9.60%	30,633
SAN DIEGO	COGENERATION (STEAM TURBINES)	Bagasse / Fuel oil No.6	Dec-04		3.62		721.47	9.65%	641
EL CANADA	HYDROELECTRIC	HYDRO	Nov-04	CDM	214.68				
RENACE	HYDROELECTRIC	Hydro	Mar-04		318.68		1,040.15	13.91%	
ELECTROGENERA(	INTERNAL COMBUSTION MOTORS	Fuel oil No.6	Nov-03		21.71		1,061.86	14.20%	14,939
ARIZONA	INTERNAL COMBUSTION MOTORS	Fuel oil No.6	May-03		748.61		1,810.47	**24.21%**	515,119
		SEIN Annual Generation 2008 (Excluding CDM);			**7,478.87 (GWh)**			**(Ton Co2):**	**688,650**

Table A.4.7 Combined Margin (CM)

COMBINED MARGIN (CM)		
Operating margin	Build margin	Emission factor of the grid
OM	BM	(0.25 x OM)+ (0.75 x BM)
tCO2/MWh	tCO2/MWh	tCO2/MWh
0.841	0.380	0.495

Table A.4.8 Information extracted from 2006 IPCC Guidelines for National Greenhouse Gas Inventories

Information extracted from 2006 IPCC Guidelines for National Greenhouse Gas Inventories		
Fossil Fuel	NCV (TJ/Gj)	Carbon Emissions Factors (tC/Tj)
Diesel Oil	43	20,2
Fuel Oil No.6	40,4	21,1
Natural Gas	48	15,3
Coking Coal	28.2	25.8

Appendix 5. Further background information on monitoring plan

The instructions in the approved monitoring methodology ACM0002 will be followed, as described in Section B.7.

Appendix 6. Summary of post registration changes

The following correction has been made: inclusion of parameters Cap_{BL} and $A_{BL.}$

The following permanent changes to the Monitoring Plan have been made: inclusion of parameters Cap_{PJ} and $A_{pj.}$

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Document information

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

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