CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006

CONTENTS

SECTION A. General description of project activity

A.1. Title of the project activity:

Title: "Construction and operation of the Hydraulic Power Plant Chicoasén II"
Version: 3.0
Date: 20/03/2013

A.2. Description of the project activity:

The project activity consists in the construction of one hydroelectric facility in the bed of the Grijalva River. This hydroelectric facility will be located in the Chicoasén municipality, State of Chiapas, in southern Mexico. It is projected that the construction of this facility will include:

- Access Roads.
- Warehouses, storages, offices.
- Water deviation and spillway civil works.
- Entrance and exit canals.
- Upstream and downstream cofferdams.

The facility will operate with the water volume released from the upstream hydroelectric facility Chicoasén I, also known as Ing. Manuel Moreno Torres and the Grijalva river flow[1]. The construction of this facility includes the installation of 3 - 80.4 MW Kaplan turbines, giving a total nominal[2] capacity of 241.2MW. The net capacity generation of the facility will be of 240 MW. As the water enters the Kaplan turbines, it will use its kinetic energy to move the turbines in order to produce electricity. The energy generated by the use of this technology does not produce GHG emissions, thus providing a great alternative to usual energy generation methods in Mexico.

Prior to the start of the implementation of the project activity, no other facilities other than the river exist in the area where the hydropower project is going to be installed.

The proposed project activity is the installation of a new grid-connected renewable power plant/unit, according to the methodology ACM002 on its 12.3.0 version, the baseline scenario is the following:

Electricity delivered to the grid[3] by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in the "Tool to calculate the emission factor for an electricity system" Version 02.2.1.

Mexico, which is the country where this project will be developed, has a great availability of water bodies to provide the National Interconnected System, SIN with clean and renewable energy that would

[1] Feasibility study. "CH Chicoasén II y LT Red de transmisión asociada a la CH Chicoasén II".Comisión Federal de Electricidad ,CFE. Page 105 of the PDF

[2] Feasibility study. "CH Chicoasén II y LT Red de transmisión asociada a la CH Chicoasén II" Comisión Federal de Electricidad, CFE. Page 64.

[3] In this case the grid is the National Interconnected System (as in Spanish Sistema Interconectado Nacional SIN).

otherwise be generated using an emission producing technology. Without the implementation of the project the 240 MW would still be generated by CO_2 producing technologies; this will be considered as the baseline scenario. The baseline scenario is the same as the one prior to the start of the implementation of the project activity.

The project activity will reduce greenhouse gas (GHG) emissions by replacing fossil fuel based technologies to produce electricity. If this activity is not carried out, the first scenario mentioned, Mexico producing electricity using non environmental friendly technologies, would persevere and GHG would be emitted , especially CO_2 which is the main gas emitted by fossil fuel based technologies; the proposed technology uses kinetic energy to move a power generator to produce electricity, this technology does not emit GHG gases. No emissions of methane were taken into consideration in the project emission calculation because the power density of the project is greater than 10 W/m^2, as shown later in this document.

The project complies with all country regulations and permits and contributes to sustainable development at the local, regional and global levels in the following ways:

Environmental sustainability:

- Use of renewable energy resources for electricity generation which otherwise would have been generated through fossil fuel power plants, contributing with a reduction in GHG emissions.
- Impulse of the environmental sustainability, diminishing exploitation and exhaustion of natural, finite and non-renewable resources, like oil/natural gas.
- Non generation of any significant negative environmental impact during the construction and implementation of the project.

Economic and social sustainability:

- Creation of new employment opportunities in the area: mainly during the construction phase but also along the lifetime of the hydropower plant because of maintenance and operation stages.
- Some regions in the country do not have energy generation infrastructure; the project activity will contribute to the improvement of the current situation satisfying the growing demand for electricity and making possible the distribution of energy to more isolated zones.

The electricity grid that is relevant for the determination of baseline emissions was identified as the National Interconnected System, SIN.

A.3. Project participants:

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Mexico (Host)	Comisión Federal de Electricidad. (Public)	No
Mexico (Host)	Carbon Solutions de México S.A. de C.V. (Private)	No

Table 1. Project Participants of the project activity.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Mexico

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

Chiapas

A.4.1.3. City/Town/Community etc.:

Chicoasén municipality

A.4.1.4. Details of physical location, including information allowing the unique identification of this project activity (maximum one page):

The project will be located in the municipality of Chicoasén, Chiapas State. The dam will be located in the following coordinates[4]:

CH1.- 16°59'6.65"N, 93° 9'54.49"W X: 482,421.043 Y:1,877,922.963 Lat[5]: 16.98518, Lon: -93.16514
CH2.- 16°59'9.57"N, 93° 9'54.16"W X: 482,430.755 Y:1,878,012,743 Lat: 16.98599, Lon: -93.16504

The location at a global scale and of the dam's curtain comprising the projected hydroelectric facility can be seen in the next figure.

[4] General area distribution blueprint. Comisión Federal de Electricidad

[5] To convert coordinates from deg-min-sec to decimal format the following page was used: http://andrew.hedges.name/experiments/convert_lat_long/

Figure 1. Map of the project activity

A.4.2. Category(ies) of project activity:

This project is categorized under:

- Sectoral Scope 1. Energy Industries (renewable - / non-renewable sources).

A.4.3. Technology to be employed by the project activity:

In the current scenario in the National Interconnected System, SIN, the electricity is generated mainly from the burning of fossil fuels. This scenario is considered as the baseline and is considered the same scenario prior the start of the project activity.

In the current scenario the main source of the GHG emissions are the power fuel based plants, which consume fossil fuels for electricity production, and due to the growing energy demand in the Mexico, these fossil fuel based plants will continue to operate, making the fossil fuel demand and GHG emissions to the environment even larger.

In order to mitigate GHG emissions it is necessary to develop new projects that generate electricity without producing GHG emissions, such as the projects that involve the use of renewable resources (project activity).

The project activity described in this document reduces the emissions of greenhouse gases (CO_2, please refer to section B.3) due to the substitution of power generation using fossil fuels (the main producers of greenhouse gases) by renewable energy sources (which most are considered to have an emission factor of 0 tCO_2/MWh). The project activity will generate "clean energy", which would replace the energy generated by fossil fuels.

The scenario prior to the project activity is the electricity generation through the use of carbon intensive GHG producing technologies; considered as the baseline scenario. As of today there are no other facilities other than the river in the area where the project is going to be developed.

The project activity consists in the installation of a hydropower facility with a net generation capacity of 240 MW, which is expected to produce 571,852.8 MWh/year with an average plant load factor of 27.2%. The minimum expected operational lifetime is 50 years[6].

The technology to be employed in this project activity is the use of three turbines to produce electricity without emitting GHG. As nominal capacity three 80.4 MW Kaplan turbines, will be installed, giving 241.2 MW as the total capacity of the facility, which gives a net generation capacity of 240 MW, this due to the losses between the process stages, generator, efficiencies and water and electricity transmission. The turbines were selected taking into consideration the waterfall, as well as on a maintenance and operation criterion. Water runs through the blades at a feeding rate[7] of 497.87 m^3/s per unit, and the

[6] Feasibility Study. "CH Chicoasén II y LT Red de transmisión asociada a la CH Chicoasén II".Comisión Federal de Electricidad, CFE. Page 9 of the PDF.

[7] Feasibility Study. "CH Chicoasén II y LT Red de transmisión asociada a la CH Chicoasén II". Comisión Federal de Electricidad, CFE. Page 60 of the PDF.

kinetic energy in it will move the blades which are connected to a mechanical axis. This axis is connected to a generator that transforms mechanical energy into electricity. The system will have the following characteristics:

Net Generation per Turbine	80	MW
Net total Generation Capacity	240	MW
No. Of turbines	3	-
Design flow	497.87	m^3/s per unit
Generation per year	571,852.8	MWh/year
Transmission line length[8]	9.3	Km
Transmission line Voltage[9]	400	kV
Plant Load factor	27.2%	
Equivalent annual operating hours	2,383	
Life span	50	Years

Table 2. Characteristics of the technology to be applied.

The project will be interconnected to the Chicoasén II Substation[10]. The voltage and length of the transmission line is 400 kV and 9.3 km, respectively. The Sub Direction of Programming consideres the construction of the substation Chicoasén II with two 115 kV feeders, from which two will be connected to the transmission line Manuel Moreno Torres-Ocozocuautla and two will be connected to the transmission line Manuel Moreno Torres-Tuxtla Sur (both lines are 115 kV).

The project´s implementation through training for operation and maintenance sessions, besides the individual benefits of the hydropower facility (clean electricity production) will represent a knowledge and technological transfer to the host country. It is to be expected that when built, the project will awaken the interest of the Mexican folk for this kind of technologies, spreading the technology and knowledge throughout Mexico.

A.4.4. Estimated amount of emission reductions over the chosen crediting period:

The crediting period commences on 01/07/2017, with total emissions reductions of 2,994,360 tons of CO_2.

Years	Annual estimation of emission reductions in tonnes of CO2 e
2017 (6 months July-December)	149,718
2018	299,436
2019	299,436
2020	299,436
2021	299,436

[8] Feasibility Study. "CH Chicoasén II y LT Red de transmisión asociada a la CH Chicoasén II". Comisión Federal de Electricidad, CFE. Page 61 of the PDF.

[9] Feasibility Study. "CH Chicoasén II y LT Red de transmisión asociada a la CH Chicoasén II". Comisión Federal de Electricidad, CFE. Page 61 of the PDF.

[10] Environmental Impact Assessment. University of Sciences and Arts of Chiapas. Second Chapter. Page 25

Years	Annual estimation of emission reductions in tonnes of CO_2 e
2022	299,436
2023	299,436
2024	299,436
2025	299,436
2026	299,436
2027 (6 months January – June)	149,718
Total estimated reductions (tonnes of CO_2 e)	2,994,360
Total number of crediting years	10 Years
Annual average over the crediting period of estimated reductions (tonnes of CO_2 e)	299,436

Table 3. Emissions reductions during the crediting period.

A.4.5. Public funding of the project activity:

No public funding from Parties included in Annex 1.

SECTION B. Application of a baseline and monitoring methodology

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

For the project activity, the approved baseline methodology used is ACM0002 Version 12.3.0, *"Consolidated baseline methodology for grid-connected electricity generation from renewable sources"*.

This methodology draws upon the following tools:

- Tool to calculate the emission factor for an electricity system Version. 02.2.1.
- Tool for the demonstration and assessment of additionality Version 06.0.0
- Combined tool to identify the baseline scenario and demonstrate additionality Version 4.0.0.
- Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion Version 02.

B.2. Justification of the choice of the methodology and why it is applicable to the project activity:

The methodology ACM0002 is applicable to:

Grid-connected renewable power generation project activities that (a) 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); (b) involve a capacity addition; (c) involve a retrofit of (an) existing plant(s); or (d) involve a replacement of (an) existing plant(s).

The project activity consists in the installation of a new power plant for renewable electricity generation that will be connected to the National Interconnected System, SIN.

The project activity is the installation, capacity addition, retrofit or replacement of a power plant/unit of one of the following types: hydro power/unit (either with a run-of-river reservoir or an accumulation reservoir), wind power plant/unit, geothermal power plant/unit, solar power plant/unit, wave power plant/unit or tidal power plant/unit.

The project activity is applicable as it fits in one of the types of power plants included in the methodology, which is the installation of a new hydropower plant.

"In the case of capacity additions, retrofits or replacements (except for capacity addition projects for which the electricity generation of the existing power plant(s) or unit(s) is not affected): the existing plant started commercial operation prior to the start of a minimum historical reference period of five years, used for the calculation of baseline emissions and defined in the baseline emission section, and no capacity addition or retrofit of the plant has been undertaken between the start of this minimum historical reference period and the implementation of the project activity"

The project activity consists in the installation of a new hydroelectric facility; therefore, the last condition of applicability does not apply because the project activity doesn't consist in a capacity addition, retrofit or replacement.

"In case of hydro power plants:

- *At least one of the following conditions must apply:*
  - *The project activity is implemented in an existing single or multiple reservoirs, with no change in the volume of any of the reservoirs; or.*
  - *The project activity is implemented in an existing single or multiple reservoirs, where the volume of any reservoirs is increased and the power density of each reservoir, as per definitions given in the Project Emissions section, is greater than 4 W/m2 after the implementation of the project activity; or*
  - *The project activity results in new single or multiple reservoirs and the power density of each reservoir, as per definitions given in the Project Emissions section, is greater than 4 W/m^2 after the implementation of the project activity."*

The project activity is applicable because a new water reservoir will be constructed and the power density of the power plant is greater than 4 W/m^2, as shown in the next calculation:

Projected Hydroelectric Capacity[11]: 240,000,000 W
Planned Water Surface[12]: 1,886,000 m^2

$$\text{Power density} = 240{,}000{,}000\ W / (1{,}886{,}000\ m^2) = 127.25\ W/m^2$$

Equation 1. Power Density.

[11] Environmental Impact Assessment. University of Sciences and Arts of Chiapas. Second Chapter. Page 7. Subsection 2.2.1.

[12] Environmental Impact Assessment. University of Sciences and Arts of Chiapas. Second Chapter. Page 11. Table 2.3

In case of hydro power plants using multiple reservoirs where the power density of any of the reservoirs is lower than 4 W/m^2 after the implementation of the project activity all of the following conditions must apply:

- *The power density calculated for the entire project activity using equation 5 is greater than 4 W/m^2.*
- *All reservoirs and hydro power plants are located at the same river and where are designed together to function as an integrated project1 that collectively constitutes the generation capacity of the combined power plant.*
- *The water flow between the multiple reservoirs is not used by any other hydropower unit which is not a part of the project activity.*
- *The total installed capacity of the power units, which are driven using water from the reservoirs with a power density lower than 4 W/m2, is lower than 15MW.*
- *The total installed capacity of the power units, which are driven using water from reservoirs with power density lower than 4 W/m^2, is less that 10% of the total installed capacity of the project activity from multiple reservoirs*

As the density of the project activity is greater than 4 W/m^2 this applicability condition does not apply.

The methodology is not applicable to the following:

- *Project activities that involve switching from fossil fuels to renewable energy sources at the site of the project activity, since in this case the baseline may be the continued use of fossil fuels at the site;*
- *Biomass fired power plants;*
- *A hydro power plant that results in the creation of a new single reservoir or in the increase in an existing single reservoir where the power density of the power plant is less than 4 W/m^2.*

This methodology is applicable because the project activity consists on a hydropower plant, non-fuel switching is foreseen in this project activity, no biomass plant will be developed and the hydroelectric facility has over 4 W/m^2 as power density, for calculation please refer to page 9.

The geographic and system boundaries for the relevant electricity grid are clearly marked, and information on the National Interconnected System, SIN characteristics is given in the Energy Sector Outlook, prepared by Mexican Energy Ministry, SENER. These boundaries include all the geographic areas and infrastructures within the entire Mexican territory, as well as energy exports and imports outside the National Interconnected System, SIN.

Additionally, the applicability conditions of the tools referred in this methodology have been taken into account. As per the "Tool to calculate the emission factor for an electricity system" version 02.2.1[13]:

In case of CDM projects the tool is not applicable if the project electricity system is located partially or totally in an Annex I country.[14]

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[13] UNFCCC-CDM. Tool to calculate the emission factor of an electricity system. Version 02.2.1.

Available at: http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v2.2.1.pdf

[14] National Interconnected System (SIN).

Available at: http://www.sener.gob.mx/res/1452/mapa.html

This project activity will not be conducted in an Annex I country, then this tool does apply to the Mexican electricity system.

Finally, the "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion" version 02 states the following[15]:

This tool provides procedures to calculate project and/or leakage CO2 emissions from the combustion of fossil fuels. It can be used in cases where CO2 emissions from fossil fuel combustion are calculated based on the quantity of fuel combusted and its properties. Methodologies using this tool should specify to which combustion process j this tool is being applied.

Methodology ACM0002 version 12.3.0 specifies that the project emissions from fossil fuel combustion in the year *y* ($PE_{FF,y}$) should be calculated as part of the project emissions (PE_y), then the applicability condition is also met.

In summary, the project activity complies all the applicability conditions (that apply to the project) of the methodology ACM0002 version 12.3.0 and the tools of the same methodology

B.3. Description of the sources and gases included in the project boundary:

As indicated in the methodology ACM0002 Version 12.3.0, the project boundary will cover any CO_2 emissions from electricity generation in fossil fuel fired power plants that is displaced by the project activity, being this all the plants that are connected to the National Interconnected System, SIN.

[15] UNFCCC-CDM. Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion- Version 02. Available at: http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-03-v2.pdf

	Source	Gas	Included?	Justification / Explanation
Baseline	CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity	CO_2	Yes	Main emission source
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source
Project activity	For geothermal power plants, fugitive emissions of CH_4 and CO_2 from non-condensable gases contained in geothermal steam	CO_2	No	Not applicable to project activity.
		CH_4	No	Not applicable to project activity.
		N_2O	No	Not applicable to project activity.
	CO_2 emissions from combustion of fossil fuels for electricity generation in solar thermal power plants and geothermal power plants	CO_2	No	Not applicable to project activity.
		CH_4	No	Not applicable to project activity.
		N_2O	No	Not applicable to project activity.
	For hydro power plants, emissions of CH_4 from the reservoir	CO_2	No	Minor emission source
		CH_4	No	Main emission source
		N_2O	No	Minor emission source

Table 4. Emission reductions

As it's described in the methodology ACM0002 version 12.3.0 the project boundary consists in the spatial extent of the project boundary and includes the project power plant and all power plants connected physically to the electricity system that the CDM project power plant is connected to. Therefore the project boundary will consist of the "Construction and operation of the Hydraulic Power Plant Chicoasén II" and the National Interconnected System, SIN.

This could be demonstrated with the following flow diagram:

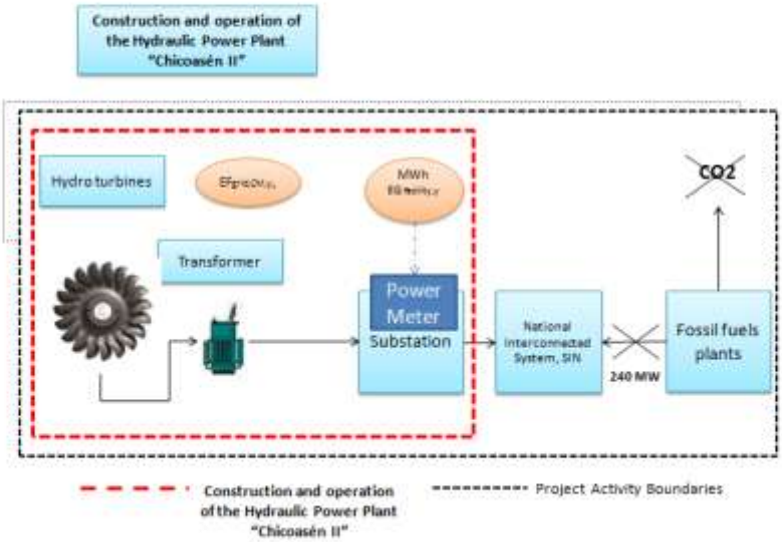

Figure 2. Diagram of the project activity.

B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

In the absence of the project, electricity would continue to be generated by the existing generation mix, operating in the National Interconnected System, SIN.

The project activity is the *"installation of a new grid-connected renewable power plant"*. Hence, as per the methodology ACM0002/ Version 12.3.0 the baseline scenario is the electricity delivered to the grid by the project activity that would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in the "Tool to calculate the emission factor for an electricity system" version 02.2.1.

The baseline is the electricity that would have otherwise been generated by the operating plants connected to the National Interconnected System, SIN.

According to the projection elaborated by the Mexican Energy Ministry, SENER in its Energy Sector Outlook 2011 - 2025 for the electricity generation in Mexico organized by type of technology used, the use of fossil fuels prevails in the next ten years. The production percentages for 2017 and the forecasts for 2025 are shown in the next table[16]:

	2017	2025
Fossil Fuel	79.42%	83.53%
Nuclear	3.68%	2.84%
Geothermal & wind	4.99%	3.54%
Hydropower	11.65%	10.09%
Free	0.0%	0.0%

[16] Energy Sector Outlook 2011-2025. Mexican Energy Ministry, SENER. Page 197. Table 6

Total	308,646 GWh	414,604 GWh

Total % low/cost must run	
2017	2025
20.32%	16.47%

Table 5. % Electricity generation per technology

The forecast for power installed in Mexico[17] in 2017 is 60,290 MW, which is the year when the project will start activities, so the impact of 240 MW would not account for more than 0.398% of the system's generation mix of electricity in that year.

From the above, and in consistence with the version ACM0002 ver. 12.3.0 for the cases of *"installation of a new grid-connected renewable power plant/unit"*, the baseline scenario is defined as the "*Electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in the Tool to calculate the emission factor for an electricity system"*.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality):

Timeline of events of the project activity

Comisión Federal de Electricidad, CFE has been working in the analysis of the CDM project feasibility, next is described how the project was conceived and the different events that have occurred to decide the development of the project under the Clean Development Mechanism:

Date	Event	Support/Reference
2006	The Energy Ministry's Electricity Sector Outlook 2005-2014[18] considers the additional income from the carbon market for those projects reducing GHG in order to make them economically feasible.	A copy of this document can be found at: http://www.sener.gob.mx/portal/publicaciones.html

[17]Energy Sector Outlook 2011-2025. Mexican Energy Ministry, SENER. Graph 62. Page 153

[18] Energy Sector Outlook 2005-2014. Mexican Energy Ministry, SENER. Page 74

Date	Event	Support/Reference
07/2011	The feasibility study of the project activity was carried out by CFE. In order to verify all the particular inputs of the project.	A copy of this study will be handed to the DOE.
08/09/2011	Date that the project obtained the environmental approval from Ministry of Environment and Natural Resources, SEMARNAT.	As evidence the EIA and the resolutions from Ministry of Environment and Natural Resources, SEMARNAT will be presented.
31/01/2012	Date that the Prior CDM Consideration was sent to UNFCCC and the Mexican DNA.	Copies of the e-mails, in these emails Comisión Federal de Electricidad, CFE sent the Prior CDM Consideration to the UNFCC and the Mexican DNA.
31/01/2012	Date when the intention letter between Comisión Federal de Electricidad and Carbon Solutions de México S.A. de C.V. was signed.	The intention letter was provided to the DOE as evidence.
31/01/2012	Date that the UNFCCC Secretariat confirms the reception of the Prior CDM Consideration.	Copies of the e-mail sent by the UNFCCC Secretariat to Comisión Federal de Electricidad, CFE confirming the reception of the document.
15/06/2012	Date when the Letter of Approval was processed by SEMARNAT	The LOA was provided as evidence to the DOE.
26/06/2012 - 28/06/2012	Dates when the site validation took place at Chicoasén, Chipas State, Mexico.	The validation plan made by the DOE was presented as evidence.
31/10/2012	Date that Comisión Federal de Electricidad, CFE estimates to sign the tender contract of the construction of the “Construction and operation of the Hydraulic Power Plant Chicoasén II”	This event doesn’t have evidence because it hasn’t occur yet.

Table 6. Timeline of events of the project activity

Analysis of the additionality of the project

The next table shows the official forecast of the Mexican electricity generation mix; the electric generation in the next years will be based mainly in fossil fuels; this is why the project activity will reduce GHG emissions because in absence of the project the 240 MW would be consumed from the

National Interconnected System, SIN. The project is expected to reduce 2,994,360 tCO2 during the 10 years of the first crediting period. The predominant electricity production technologies by 2025 are shown in the next table[19]:

Type	**2017**	**2020**	**2025**
Hydropower	34,785	37,247	41,854
Combined cycle	157,993	201,171	239,750
Turbogas	4,079	4,092	4,103
Internal combustion	2,553	3,202	2,967
Windpower	7,563	7,588	7,576
Thermoelectric	25,131	15,682	8,671
Coal	42,244	42,362	42,288
Nuclear	11,807	11,807	11,807
Geothermoelectric	7,380	7,011	7,114
New clean generation	0	0	36,167
Others	2,854	4,241	12,317
TOTAL	**296,389**	**334,403**	**414,604**

Table 7. Forecast of electricity production in Mexico.

Hydropower installations will involve 10.09 % (not including the power capacity of the proposed project activity) within the National Interconnected System, SIN in 2025 and 11.73 % in 2017 year of the first operation stage according to long-term forecasting. Thus, power produced from this project will have no impact on baseline calculations.

It is important to remark that it is very unlikely that the hydro power facility projected in this forecast operate if it doesn't any kind of incentive such as the CERs for CDM projects.

To demonstrate its additionality, the "Tool for demonstration and assessment of additionality" ver. 06.0.0 was applied, following all steps defined. These steps will demonstrate that the proposed project activity is not the baseline scenario.

Step 0: Demonstration whether the proposed project activity is the First-of-its-kind

"This step is optional. If it is not applied it shall be considered that the proposed project activity is not the First-of-its-kind"

The project activity is not a first of a kind as it will be demonstrated in this document.

OUTCOME OF STEP 0.- Conclusion II, the proposed project activity is not the first of a its kind.

Step 1: Identification of alternative scenarios

Step 1a: Define alternative scenarios to the proposed CDM project activity

[19]Energy Sector Outlook 2011-2025. Mexican Energy Ministry, SENER. Table 6. Page 197

The project activity consists in clean energy generation that will supply the National Interconnected System, SIN.

Definition of alternative scenarios to the project activity that otherwise could be implemented in absence of the project activity

Alternative 1

- The construction and operation of fossil fuel power plant(s). Conventional power generation systems using fossil fuels such as natural gas or coal are the common practice in the country and, as explained in step 3, are the most cost – effective ways to comply with the country's power needs.

The implementation of a natural gas combined cycle power plant or a coal based power plant would easily achieve the requested social discount rate[20] of 12% without CDM incomes due to significantly lower investment costs.

Alternative 2

- Continuation of the current situation: Comisión Federal de Electricidad, CFE does not implement the project; its designated customers will continue purchasing the electricity from the Mexican Grid, and more fossil fuels will be consumed, causing more GHG emission to the environment.
  This scenario consists in the continuation of the current practices, which is the use of carbon intensive electricity sources in the National Interconnected System, SIN, and the non-implementation of the Proposed Project Activity as reflected in the combined margin calculations. This alternative is considered as the baseline scenario, with the addition of fossil fuel based generation sources.

The project activity consists in the "installation of a new grid-connected renewable power plant". Hence, as per the methodology ACM0002/ Version 12.3.0 the baseline scenario is the electricity delivered to the grid by the project activity that would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in the "Tool to calculate the emission factor for an electricity system" version 02.2.1.

OUTCOME OF STEP 1A.- The alternative scenarios to the project activity are described above in this document, in short these are:
1.- The construction and operation of a gas combined cycle power plant or a coal based power plant.
2.- Continuation of the current situation: the electricity delivered to the grid by the project activity is generated by the existing grid-connected power plants and by the addition of new generation sources.

Step 1b. Consistency with mandatory laws and regulations.

The alternatives identified in sub-step 1a are in compliance with mandatory laws, Electric Public Service Law – EPSL[21] and regulations. Articles 1, 2, 3, 4 and 7 of Mexico's EPSL confirm that the alternatives are a real possibility available to the project developer, as follow:

[20] Costs and Parameters for the Formulation of Investment Projects in the Electricity Sector, COPAR. Comisión Federal de Electricidad, CFE. Page 21

- Article 1 of Mexico's EPSL confirms that it is the exclusive right of the Mexican nation to generate, conduct, transform, distribute, and provide electricity as a public service. Therefore, there will not be granted concessions to privates and the nation will make good use of the goods and natural resources that are required to perform this right through the Comisión Federal de Electricidad, CFE.
- Article 2 of Mexico's EPSL confirms that every act related with the electricity public service is of public character.
- Article 3 of Mexico's EPSL confirms that the following are not considered as public services:
  - Electricity generation for self-consumption, cogeneration or small production.
  - Electricity generation developed by private producers to be sold to the Comisión Federal de Electricidad, CFE.
  - Electricity generation to be exported derived from cogeneration, private production and small production.
  - Electricity imported from persons exclusively for self-consumption.
  - Electricity generation for emergencies because of electricity public service interruptions.
- Article 4 of Mexico's EPSL confirms that electricity public service involved the following:
  - The planning of the National Interconnected System, SIN.
  - The generation, conduction, transformation, distribution and selling of electricity.
  - The developing of all constructions, installations and works that require planning, execution, operation and maintenance of the National Interconnected System, SIN.
- Article 7 of Mexico's EPSL confirms that the only entity in charged to carry out the tasks mentioned in Article 4 is the Comisión Federal de Electricidad, CFE.

(a) The proposed project activity complies with all mandatory laws and regulations.
(b) The construction and operation of fossil fuel power plants complies with all mandatory laws and regulations.
(c) The continuation of the current situation complies with all mandatory laws and regulations: despite Comisión Federal de Electricidad, CFE has to secure the power generation and meet the increasing electricity demand in Mexico, it is also important to say there are no legal bindings for the construction of this specific project.

It is also important to mention that this project obtained already (approval date: 08/10/2011) the no objection vote and approval by the Environmental and Natural Resource Ministry, SEMARNAT. The project has already processed the water concession by the National Water Commission, CNA, this permit is still in process. With the aforementioned said, it is concluded that the project fulfills and is in consistency with all Mexican laws and regulations.

OUTCOME OF SUB-STEP 1B.- The project activity complies with all regulations and laws in the host country, because:
1.- The project activity complies with the statements of the Electric Public Service Law, being this with the Articles 1, 2, 3, 4 and 7.
2.- The proposed alternative to the project activity also complies with the statements of the Electric Public Service Law, being this the Articles 1 and 4. The development of a fossil fuel based power plant by the Comisión Federal de Electricidad, CFE complies with the statements of Article 7.
3.- The project obtained on the 08/10/2011 the approval of the Ministry of Environment and Natural Resources, SEMARNAT will be presented.

[21] Electric Public Service Law. Deputies Chamber of the Mexican Union Congress. Pages 1 -2

4.- The project has also started to process the water concession permit by the National Water Commission, CNA.

Step 2: Barrier analysis

N/A

Step 3: Investment analysis

Sub-Step 3a. Determinate appropriate analysis method

Considering that the Comisión Federal de Electricidad, CFE can develop projects other than the "Construction and operation of the Hydraulic Power Plant Chicoasén II" in order to satisfy the Mexican electricity demand, and that the project activity will generate additional income other than the CDM incentive with the objective to improve the financial indicators, the analysis method to be used is the Investment Comparison Analysis (Option II).

Sub-step 3b. Option II. Investment Comparison Analysis

The financial indicator most suitable for the project type and decision-making context is the levelized cost of electricity production in $/kWh, as stated in the document Referential Costs and Parameters for the Formulation of Investment Projects in the Electricity Sector, COPAR[22]. This indicator is especially useful to compare two or more projects giving the same product and it is used by the Mexican government when comparing two electricity generation projects.

Sub-step 3c. Calculation and comparison of financial indicators

The total levelized cost of electricity production corresponds to the sum of the investment levelized cost, the fuel levelized cost and the operation & maintenance levelized cost. As stated in the document Costs and Parameters for the Formulation of Investment Projects in the Electricity Sector, COPAR. This cost is calculated as follows:

$$\overline{CI} = \left[\frac{I}{C}\right]\left[\frac{1}{GNA}\right]\left[\frac{frc(i,n)}{(1+i)}\right]\left[\sum_{t=-N}^{-1} W_t (1+i)^{-t}\right]$$

Equation 2. Levelized Energy Cost

Where:

I	Investment (or fuel or operation & maintenance), US$
C	Capacity, MW
n	Lifetime, years
i	Discount rate, %

[22] Costs and Parameters for the Formulation of Investment Projects in the Electricity Sector, COPAR. Comisión Federal de Electricidad, CFE. Pages 183-186

up	Self consumption, %
fp	Load factor, %
N	Construction period, years
W	Percentage of the investment (or fuel or operation & maintenance) in the year t, %
CU	Unit cost (investment, fuel or operation & maintenance), US$/MW
frc (i,n)	Capital recovery factor
fvp (i,w)	Present value factor
GNA Net	Generation in the year t, MWh/MW

Table A.1 of COPAR 2011 (Page 166, Table A.1) clearly show that conventional power generation systems using fossil fuels such as natural gas or coal are considerably more attractive than the proposed project activity (55 to 83 USD/MWh). These options were chosen because are the most efficient way to produce energy.

First the Unit Cost was calculated according to the next equation:

$$CU = \frac{I}{C}$$

Equation 3. Unit Cost

Then it was proceeded to calculate the Capital Recovery Factor. For this calculation there were two equations used, which are the following:

$$frc = \frac{frc(i,n)}{(1+i)} = \frac{\frac{i(1+i)^n}{(1+i)^n - 1}}{(1+i)}$$

Equation 4. Capital Recovery Factor

Where:

$$frc(i,n) = \frac{i(1+i)^n}{(1+i)^n - 1}$$

Equation 5. First term of Capital Recovery Factor calculation

Next, the Present Value Factor was calculated according to the next equation:

$$\sum_{t=-N}^{-1} W_t (1+i)^{-t}$$

Equation 6. Present Value Factor

To conclude, the Annual Net Generation Power per MW Installed was obtained with this equation:

$$GNA=(1-up)*fp*8{,}760$$

Equation 7. Annual Net Generation Power per MW Installed

Finally the Levelized Energy Cost was calculated as follows:

$$\overline{CI}=\left[\frac{I}{C}\right]\left[\frac{1}{GNA}\right]\left[\frac{frc(i,n)}{(1+i)}\right]\left[\sum_{t=-N}^{-1}W_t(1+i)^{-t}\right]$$

Equation 8. Levelized Energy Cost final calculation

The results of the levelized energy cost for the investment, operation and maintenance and fuel (in this case water) are summarized in the next table, for more information please refer to the spreadsheet:

Concept	Result	Units
Levelized energy cost Investment:	94.59	$USD/MW
Levelized energy cost O&M:	7.58	$USD/MW
Levelized energy cost fuel:	29.00	$USD/MW
Total levelized energy cost	131.17	$USD/MW

Table 8. Results for the calculation of the Levelized Energy Cost

Sub-step 3d. Sensitivity Analysis

The following variables will undergo a sensitivity analysis to prove the robustness of the conclusion given in sub-step 2c:

a) Investment ± 10%
b) Plant Load Factor ± 10%

The net levelized energy cost varying the scenarios according to the next table are presented next:

	-10%	**-5%**	**0%**	**5%**	**10%**
Investment	121.72	126.44	131.17	135.90	140.63
	-10%	**-5%**	**0%**	**5%**	**10%**
Plant Load Factor	141.68	136.15	131.17	126.67	122.58

Table 9. Sensitivity analysis results

Analyzing the results above, it can be concluded that the project is not the most economically attractive alternative, even considering a 10% decrease in the investment or a 10% increase in the load factor the project does not reach the levelized energy cost of conventional power generation systems using fossil fuels such as natural gas or coal, which are considerably more attractive than the proposed project activity (55 to 83 USD/MWh)[23]. The results in sub-step 2d are robust considering reasonable variations in the

[23] Costs and Parameters for the Formulation of Investment Projects in the Electricity Sector, COPAR. Comisión Federal de Electricidad, CFE. Page 166. Table A.1

critical assumption. The comparison was made against all levelized energy costs for gas combined cycle electricity generation options and coal based plants, this in order to be conservative.

Then, it can be concluded that the project activity is not the most economically attractive alternative in Mexico and then needs CDM incentives in order to compete with other energetic technologies. The Mexican electric market is dominated by thermal power plants due to their better implementation conditions.

OUTCOME OF STEP 2.- As shown in the comparison tables above in the document, the project activity is not economically/financially attractive. The levelized energy cost of the project is much higher than conventional power generation systems using fossil fuels such as natural gas or coal, which demonstrates that the project needs the CDM incentive in order to compete with other energetic technologies in Mexico that have better implementation conditions.

Step 4. Common practice analysis

The common practice analysis was made according the Guidelines on Common Practice version 01.0

The steps of the common practice analysis are the following:

Step 4a: The proposed CDM project activity(s) applies measure(s) that are listed in the definitions section above

Sub-Step 4a(1): Calculate applicable output range as +/-50% of the design output or capacity of the proposed project activity.

The capacity of the project activity is 240 MW. Therefore the applicable output range is 120-360 MW. This range will be applied for the following steps.

Sub-Step 4a(2): In the applicable geographical area, identify all plants that deliver the same output or capacity, within the applicable output range calculated in Step 1, as the proposed project activity and have started commercial operation before the start date of the project. Note their number N_{all}. Registered CDM project activities and project activities undergoing validation shall not be included in this step.

The following table shows the power plants of the National Interconnected System, SIN that have an output capacity within the range[24] of 120-360 MW:

ID	*Plant*	*Capacity*	*Type*	*Registred*
APR	C.H. VALENTIN GOMEZ FARIAS	240	Hydropower	NO
AZF	C. G LOS AZUFRES	194.5	Geothermal	NO
CNC	C. TURBOGAS CANCUN	121	Turbogas	NO
CPC	C. GEOTERMICA CERRO PRIETO	320	Geothermal	NO
CPD	C. GEOTERMICA CERRO PRIETO	220	Geothermal	NO
CPU	C. GEOTERMICA CERRO PRIETO	180	Geothermal	NO

[24] CFE as National Regulation provides a list of all the plants that are in operation in the National Interconnected System. A copy of this information is provided to the DOE.

FVL	C.T. FRANCISCO VILLA	316	Conventional Steam	NO
GCP	C. GEOTERMICA CERRO PRIETO	220	Geothermal	NO
GPP	C.C GOMEZ PALACIO	240	CC	NO
LED	C.T. GUADALUPE VICTORIA	320	Conventional Steam	NO
HLI	C. CC HERMOSILLO	243.506	CC	NO
LRA	C. TERMOELECTRICA LERMA	150	Conventional Steam	NO
LRP	C. SAN LORENZO POTENCIA	300	Turbogas	NO
MDA	C. TERMOELECTRICA MERIDA II	168	Conventional Steam	NO
MZT	C.H. MAZATEPEC	208.8	Hydropower	NO
NIZ	C. TURBOGAS NIZUC	126	Turbogas	NO
NVL	C.H. PLUTARCO ELIAS CALLES	135	Hydropower	NO
PJZ	C.T. PRESIDENTE JUAREZ	320	Conventional Steam	NO
RIC	C.C. EMILIO PORTES GIL	225	CC	NO
RIB	C.T. EMILIO PORTES GIL	300	Conventional Steam	NO
SYC	C.T. SAMALAYUCA (BENITO JUÁREZ)	316	Conventional Steam	NO
TMU	C.H. TEMASCAL	354.08	Hydropower	NO
TPO	C. T. JUAN DE DIOS BATIZ PAREDES	320	Conventional Steam	NO
TIJ	C. TURBOGAS TIJUANA	213.22	Turbogas	NO
TUT	C.T. PDTE. ADOLFO LOPEZ MATEOS	163	Turbogas	NO
VAD	C. TERMOELECTRICA FELIPE CARRILO PUERTO	295	Conventional Steam	NO
VIL	C.H. VILLITA	312	Hydropower	NO
ZMN	C.H. ING. FERNANDO HIRIART B.	292	Hydropower	NO
PLM	T 25000 1	154.75	Turbogas	NO
FEH	Hermosillo (C.C.C. Fuerza y Energia de Hermosillo)	250	CC	NO
CSO	Saltillo	247.5	CC	NO
CPC	Campeche (energía campeche)	252.4	CC	NO
FEN	Naco Nogales (Fuerza y Energía de Naco-Nogales)	258	CC	NO
PTC	Chihuahua III (Energía Chihuahua)	259	CC	NO

Table 10. Power plants within the range of the common practice analysis

Therefore, $\mathbf{N_{all} = 34}$

Sub-Step 4a(3): Within plants identified in Step 2, identify those that apply technologies different that the technology applied in the proposed project activity. Note their number $\mathbf{N_{diff}}$.

As it can be observed most of the power plants have a different technology that the technology applied in the proposed project activity (hydroelectric power project). Therefore, $\mathbf{N_{diff}= 28}$

Sub-Step 4a(4): Calculate factor $\mathbf{F=1-N_{diff}/N_{all}}$ representing the share of plants using technology similar to the technology used in the proposed project activity in all plants that deliver the same output or capacity as the proposed project activity.

According to the last steps, the calculation of the Factor F is the following:
$F = 1 – N_{diff}/N_{all}$

Where:
$N_{all} = 34$

N_{diff} = 28

Therefore, F = 1- (28/34) = 0.17

According to the “Guidelines on Common Practice” version 01.0 if the value of the F factor is more than 0.2 and the difference between N_{all} and N_{diff} is more than 3, the project activity is a common practice.

For this project activity the value calculated of the F factor is 0.17 and the difference between N_{all} and N_{diff} is 6. Therefore, the project activity is not a common practice.

It was already shown that the proposed project activity is not a first of its kind, because of its capacity of technology used. None the less, in the next paragraphs it is given an explanation of how the proposed project activity is a first of its kind in the investment environment timing and matters.

This table shows the other hydroelectric activities of similar capacity.

Power Plant	Capacity (MW)	Construction Date	Location
C.H. VALENTIN GOMEZ FARIAS	240	15/09/1993	Zapopan, Jalisco
C.H. MAZATEPEC	208.8	06/07/1962	Tlatlauquitepec, Puebla
C.H. PLUTARCO ELIAS CALLES	135	12/11/1964	Soyopa, Sonora
C.H. TEMASCAL	354.08	18/06/1959	San Miguel Soyaltepec, Oaxaca
C.H. VILLITA	312	01/09/1973	Lázaro Cárdenas, Michoacán
C.H. ING. FERNANDO HIRIART B.	292	27/09/1996	Zimapán, Hidalgo

Table 11. Other hydroelectric projects in Mexico

Despite there are several hydroelectric power plants with similar capacity operating at Mexico, as shown in the previous table, in the following paragraphs it will be demonstrated that none of them were constructed under similar conditions as “Construction and operation of the Hydraulic Power Plant Chicoasén II”, taking into account the important changes faced by the electricity sector over time.

The following description of the evolution of the electricity sector is based on the document "The Mexican Electricity Sector: Economic, Legal and Political Issues"[25]:

Late 19th century - 1960:

In the beginnings in the late 19th century, the Mexican power system grew as a series of privately owned, vertically integrated regional monopolies. Investors, mainly from firms based in foreign countries, built power systems in areas where they thought they could earn a profit -mainly mining and textile industrial

[25] Victor G. Carreón-Rodriguez, Armando Jiménez San Vicente and Juan Rosellón. Program on Energy and Sustainable Development at the Center for Environmental Science and Policy Stanford Institute for International Studies, Working Paper # 5. November 2003. (Pages 1-3). Available at http://iis-db.stanford.edu/pubs/20311/WP5,_10_May_2004.pdf

areas as well as the largest cities- while leaving aside most rural areas. By the late 1920's, private investment in the sector was declining and electricity demand was rising. Therefore, there was an urge for the government to step in and assume control of the power system. During the 1930s the far-flung Mexican states were integrated in a federal country. As a result of this consolidation, Mexico had the National Electric Code, and a newly created state-owned and state-financed enterprise - Comisión Federal de Electricidad, CFE - which came to dominate all investment in new capacity.

Through the 1940s and 1950s installed power-generating capacity continued to rise as the government and a few private generators invested heavily in the sector.

In 1960, a constitutional amendment to Article 27 nationalized the electricity industry, formally giving the government "exclusive responsibility" for generating, transmitting, transforming, and distributing electricity. Considering that before this amendment both the government and private investors participated in the electricity industry, it represents an essential distinction in the regulatory framework and investment climate. **Then, power plants constructed before 1960 can be excluded from the analysis.**

1960 - Early 1980s

Power plants constructed before the early 1980s are not similar to the project activity because they where beneficiated with subsides: the surges in oil prices at that time delivered a windfall to oil-rich Mexico, much of which was directed to subsidies for electricity generation. When oil prices crashed in the early 1980s, a deep financial problem created both the urgent need and a political opportunity for reforms that would make the power sector more efficient while reducing the burden on the state to supply all new capacity.

Late 1980s-1995

In the late 1980s and early 1990s, the Mexican government implemented swift market reforms in various economic sectors (like banking and pension systems) and started to open its markets to international free trade. These included foreign investment agreements allowing participation in several sectors (including electricity) and the creation of new economic institutions that were required to implement those reforms. The Antitrust Federal Commission, CFC, and the Energy Regulatory Commission, CRE were created to regulate markets in order to get the desired social outcomes. More specifically, the CRE was created in 1993 to help build an electricity market.

The Congress of the Union enacted the Energy Regulatory Commission Law in 10/1995. After that date, the CRE was established as a regulatory authority in the matter and initiated a process of definition, organization and institutional development according to its functions, powers and responsibilities granted by Congress[26]. **Then, all power plants constructed before 1995 cannot be considered similar to the project activity.**

1995-2003

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[26] Congress of the Union. Energy Regulatory Commission, CRE. Please refer to pages 1-4. Available at: http://www.diputados.gob.mx/LeyesBiblio/pdf/48.pdf

In July 2003 the Ministry of Finance and Public Credit issued the Guidelines for the Preparation and Presentation of Cost-Benefit Analysis of Programs and Investment Projects. Article number 26 of these Guidelines established a discount rate for the cost-benefit analysis of 12% instead of 10% used by CFE until then (since this moment, projects need to present benefits above this 12% indicator to obtain financial resources). For this reason, **power plants constructed before July 2003 are excluded of the common practice analysis (since they were evaluated with a lower discount rate)**. It must be noted that **El Cajón** is operating since 2007, but it has been considered in this group because its construction was approved before 2003.

Taking into account all the previous criteria and that Leonardo Rodríguez Alcaine (El Cajón) power plant started construction on June[27] 6th 2003 and was evaluated with the previous regulatory framework for the electric market, and then did not faced the same investment conditions as "Construction and operation of the Hydraulic Power Plant Chicoasén II". It can be concluded that there is no similar hydroelectric power plant operating in Mexico.

Sub-step 4b. Discuss any similar options that are occurring.

After the previous analysis it can be seen that there are no similar hydroelectric power plants operating in Mexico. As Sub-steps 4b is satisfied, then the proposed project activity is additional.

OUTCOME OF STEP 4.- There are other electricity generating projects observed, but as they were built and/or approved in periods with different political, economical and technical circumstances, they can't be compared with the project activity of this document. Therefore there are not similar options occurring and there are not similar activities to the proposed project activity.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

Emission reductions:

According to the methodology ACM002 v.12.3.0 the emission reductions are:

$$ER_y = BE_y - PE_y$$

Equation 9. Emission reductions

Where:

ER_y	Emissions reductions in year *y* (tCO2e)
BE_y	Baseline emissions in year *y* (tCO2)
PE_y	Project emissions in year *y* (tCO2e)

Project emissions

The project emissions are calculated as follows

$$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y}$$

[27] Business News Americas. Online Newspaper. Available at: http://www.bnamericas.com/news/aguasyresiduos/Construccion_de_presa_El_Cajon_comenzara_el_jueves

Equation 10. Project emissions

Where:

PE_y	Project emissions in year *y* (tCO2e)
$PE_{FF,y}$	Project emissions from fossil fuel consumption in year *y* (tCO2)
$PE_{GP,y}$	Project emissions from the operation of geothermal power plants due to the release of non-condensable gases in year *y* (tCO2e)
$PE_{HP,y}$	Project emissions from water reservoirs of hydro power plants in year *y* (tCO2e)

The procedure to calculate the project emissions from each of these sources is presented next.

Fossil Fuel Combustion ($PE_{FF,y}$)

For geothermal and solar thermal projects, which also use fossil fuels for electricity generation, CO_2 emissions from the combustion of fossil fuels shall be accounted for as project emissions ($PE_{FF,y}$).

$PE_{FF,y}$ shall be calculated as per the latest version of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion".

This emission source does not apply to this project activity due that there will not be any use of fossil fuels for electricity generation.

Emissions of non-condensable gases from the operation of geothermal power plants ($PE_{GP,y}$)

For geothermal project activities, project participants shall account fugitive emissions of carbon dioxide and methane due to release of non-condensable gases from produced steam. Non-condensable gases in geothermal reservoirs usually consist mainly of CO_2 and H_2S. They also contain a small quantity of hydrocarbons, including predominantly CH_4. In geothermal power projects, non-condensable gases flow with the steam into the power plant. A small proportion of the CO_2 is converted to carbonate/bicarbonate in the cooling water circuit. In addition, parts of the non-condensable gases are reinjected into the geothermal reservoir. However, as a conservative approach, this methodology assumes that all non-condensable gases entering the power plant are discharged to atmosphere via the cooling tower. Fugitive carbon dioxide and methane emissions due to well testing and well bleeding are not considered, as they are negligible.

$PE_{GP,y}$ is calculated as follows:

$$PE_{GP,y} = (w_{steam,CO2,y} + w_{steam,CH4,y} \cdot GWP_{CH4}) \cdot M_{steam,y}$$

Equation 11. Emission from geothermal power plants

Where:

$PE_{GP,y}$	=	Project emissions from the operation of geothermal power plants due to the release of non-condensable gases in year *y* (tCO_2e)
$w_{steam,CO2,y}$	=	Average mass fraction of carbon dioxide in the produced steam in year *y* (tCO_2/t steam)
$w_{steam,CH4,y}$	=	Average mass fraction of methane in the produced steam in year *y* (tCH_4/t steam)
GWP_{CH4}	=	Global warming potential of methane valid for the relevant commitment period (tCO_2e/tCH_4)

$M_{steam,y}$ = Quantity of steam produced in year *y* (t steam)

As the project activity does not involve the development of a geothermal electric facility, these emissions were not taken into consideration.

Emissions from water reservoirs of hydro power plants ($PE_{HP,y}$)

For hydro power project activities that result in new single or multiple reservoirs and hydro power project activities that result in the increase of single or multiple existing reservoirs, project proponents shall account for CH_4 and CO_2 emissions from the reservoirs, estimated as follows:

(a) If the power density of the single or multiple reservoirs (PD) is greater than 4 W/m^2 and less than or equal to 10 W/m^2:

$$PE_{HP,y} = \frac{EF_{Res} \cdot TEG_y}{1000}$$

Equation 12. Emissions from water reservoirs if power density greater than 4 W/m^2 and less than 10 W/m^2

Where:

$PE_{HP,y}$	=	*Project emissions from water reservoirs (tCO_2e/yr)*
EF_{Res}	=	*Default emission factor for emissions from reservoirs of hydro power plants in year y ($kgCO_2e/MWh$)*
TEG_y	=	*Total electricity produced by the project activity, including the electricity supplied to the grid and the electricity supplied to internal loads, in year y (MWh)*

(b) If the power density of the project activity (PD) is greater than 10 W/m^2:

$$PE_{HP,y} = 0$$

Equation 13. Emissions from water reservoirs if power density greater than 10 W/m^2

In order to determine if some of the above mentioned emissions from water reservoirs must be taken into consideration, the power density of the project “Construction and operation of the Hydraulic Power Plant Chicoasén II” will be calculated as follows:

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

Equation 14. Power density of the project activity

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 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)
A_{BL} = 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

The power density of the proposed project activity is then:

$$PD = \frac{(240{,}000{,}000 - 0)W}{(1{,}886{,}000 - 0)m^2} = 127.27\frac{W}{m^2}$$

Equation 15. Calculation of the project's power density

From this last calculation it can be then concluded that the emissions from water reservoirs will be considered zero. This is

$$\mathrm{PE}_{\mathrm{HP,y}} = 0$$

Equation 16. Emissions from water reservoir for the "Construction and operation of the Hydraulic Power Plant Chicoasén II"

Based on the following sentence taken from the ACM0002 / version 12.3.0 methodology description the value of PE_y was considered zero:

For most renewable power generation project activities, PE_y=0

As the project is not related with the development of a geothermic power plant, and the emissions from water reservoirs will be considered zero, because of the power density it is then concluded that the emissions of the project are considered zero.

Leakage

Based on the next quote taken from the methodology ACM002 ver.12.3.0, the leakage emissions are considered zero:

"No leakage emissions are considered. The main emission potentially giving rise to leakage in the context of electric sector projects are emissions arising due to activities such as power plant construction and upstream emission from fossil fuel use (e.g. extraction, procession, transport). These emissions sources are neglected"

In conclusion the leakage emissions are considered zero.

Baseline emissions.

Baseline emissions include only CO2 emissions generated by the electricity generation of the grid-connected power plants and by the addition of new generation sources that will be displaced due to the project activity.

The baseline emissions are calculated as follows:

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

Equation 17. Baseline emissions

Where:

BE_y	Baseline emission in year *y* (tCO2)
$EG_{PJ,y}$	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)
$EF_{grid,CM,y}$	Combined margin CO2 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” (tCO2/MWh)

It is important to mention that the $EF_{grid,CM,y}$ will be calculated according the latest version of the ”*Tool to calculate the emission factor for an electricity system”* version 02.2.1and will be ex-ante.

As the project activity is being developed in a site where no renewable power plant was operated prior to the implementation, then according to the methodology ACM0002/version 12.3.0:

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

Equation 18. Electricity generation

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)
$EG_{facility,y}$	Quantity of net electricity generation supplied by the project plant/unit to the grid in year *y* (MWh)

Therefore, the quantity of net energy generation that is produced and fed into the grid for the project activity is 571,852.8 MWh.

For the calculation of the emission factor, which will yield the total equivalent CO2 emission reduction for the whole crediting period, a Combined Margin (CM) will be used, in accordance with the “Tool to calculate the emission factor for an electricity system ver 02.2.1”.

The steps to calculate the emission factor are:

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

1. Identify the relevant electricity systems.

The regions in the National Interconnected System, SIN are interconnected; for this, the relevant electric power system is the entire National Interconnected System, SIN. Moreover the public information of the

Mexican Energy Ministry, SENER, is for type of fuel for consumption and fuel share and technology for gross generation and power share, not for regions.

For determining the Operating Margin (OM) emission factor, it is necessary to determine the net electricity imports. There are no imports from other systems inside Mexico. The Mexican electricity imports and exports with other electric systems in other countries (imports from USA and exports to Belize) are[28]:

	2008	2009	2010
Imports (GWh)	351	346	397
Exports (GWh)	1,452	1,249	1,349
Net Exchange (GWh)	1,101	903	952
% of total generation	0.46%	0.38%	0.39%

Table 12. National statistics (Imports- Exports) of the Mexican grid

For imports from an on-line electricity system located in another country, the emission factor is 0 tCO2/MWh in order to ensure a conservative approach. Electricity exports will not be subtracted from electricity generation data used for calculating the baseline emission factor.

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

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

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

Comisión Federal de Electricidad, CFE has chosen Option I and only grid power plants are included in the calculation. Option I corresponds to the calculation procedure contained in earlier versions of the "Tool to calculate the emission factor for an electricity system".

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

The Operating Margin refers to the current energy generation mix installed in Mexico. The total fuel consumption for generation is divided into the different types of power plants, in order to determine the weighted average of the actual CO2 emissions in Mexico.

For its calculations, the simple OM method has been selected from the four options options proposed in the "Tool to calculate the emission factor for an electricity system ver.02.2.1".

The reason for selecting the simple OM method over the other two methods (simple adjusted OM or Average OM) is that the low-cost/must-run resources in Mexico are well below 50% of total grid

[28]Energy Sector Outlook 2011-2025. Mexican Energy Ministry, SENER. Table 20. Page 115

generation in both the average of the five most recent years and in the long-term normal for hydroelectricity production[29].

	2006		2007		2008		2009		2010	
Thermoelectric	51,931	23.0723%	49,482	21.2778%	43,325	18.3682%	43,112	18.3371%	40,570	17.2559%
Dual	13,875	6.1645%	13,375	5.7514%	6,883	2.9181%	12,299	5.2312%	15,578	6.6259%
CC	91,064	40.4587%	102,674	44.1510%	107,830	45.7159%	113,900	48.4458%	115,865	49.2816%
Turbogas	1,523	0.6767%	2,666	1.1464%	2,802	1.1879%	3,735	1.5886%	3,396	1.4444%
IC	854	0.3794%	1,139	0.4898%	1,234	0.5232%	1,241	0.5278%	1,242	0.5283%
Hydro	30,305	13.4642%	27,042	11.6284%	38,892	16.4887%	26,445	11.2480%	36,738	15.6260%
Carbon	17,931	7.9665%	18,101	7.7836%	17,789	7.5419%	16,886	7.1822%	16,485	7.0117%
Nuclear	10,866	4.8276%	10,421	4.4811%	9,804	4.1565%	10,501	4.4665%	5,879	2.5006%
Geothermal	6,685	2.9701%	7,404	3.1838%	7,056	2.9915%	6,740	2.8668%	6,618	2.8149%
Wind	45	0.0200%	248	0.1066%	255	0.1081%	249	0.1059%	166	0.0706%
TOTAL	225,079	100.0000%	232,552	100.0000%	235,870	100.0000%	235,108	100%	242,537	103%
% Low cost /must run of total generation		**21.2619%**		**19.2933%**		**23.6367%**		**18.687%**		**21.012%**

Table 13. % Electricity Generation per technology (2006-2010)

Average Low Cost-Must Run (2006-2010)	20.7782%

The average low-cost/must-run generation resource in the last five years is 20.7782%, well below the 50% threshold defined by the baseline methodology.

Coal is not included under the low-cost/must-run category, because the Mexican coal-fired power plants cannot be considered must-run plants. Therefore the Simple OM method can be used to calculate the baseline emissions.

In addition, data for calculating the emission factor using the simple OM method are very robust and reliable. In accordance with the approved methodology chosen, the simple OM method has been finally chosen to determine the relevant operating margin.

For the simple OM, the simple adjusted OM and the average OM, the emissions factor can be calculated using either of the two following data vintages:

- *Ex ante* option: If the ex ante option is chosen, the emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emissions factor during the crediting period is required. For grid power plants, use a 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation. For off-grid power plants, use a single calendar year within the 5 most recent calendar years prior to the time of submission of the CDM-PDD for validation.

[29]Energy Sector Outlook 2011-2025. Mexican Energy Ministry, SENER. Table 20. Page. 115

- *Ex post* option: If the ex post option is chosen, the emission factor is determined for the year in which the project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring. If the data required to calculate the emission factor for year y is usually only available later than six months after the end of year y, alternatively the emission factor of the previous year y-1 may be used. If the data is usually only available 18 months after the end of year y, the emission factor of the year proceeding the previous year y-2 may be used. The same data vintage (y, y-1 or y-2) should be used throughout all crediting periods.

We have chosen the first option because the yearly statistics provided by the Mexican Energy Ministry, SENER that are necessary to calculate the OM *ex-post* are published normally at the end of the year after the end of the reporting year, leading to large delays between emission reduction on one hand and monitoring, verification and issuance of CERs on the other. Another reason to choose this option is that *ex-ante* monitoring is simpler for the project development and also for the emission reduction verification.

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

For calculating the Simple OM, the generation-weights average emission per electricity unit (tCO2/MWh) of all generating sources serving the system excluding the low-cost/must-run generation units is used. It may be calculated:

- Option A: Based on the net electricity generation and a CO2 emission factor of each power unit; or
- Option B: Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system. Option B can only be used if:

  a) The necessary data for Option A is not available; and
  b) Only nuclear and renewable power generation are considered as low-cost/must-run power sources and the quantity of electricity supplied to the grid by these sources is known; and
  c) Off-grid power plants are not included in the calculation (i.e., if Option I has been chosen in Step 2).

Option B is used because total net electricity generation of all power plants serving the system as well as the fuel types and total fuel consumption of the project electricity system are available. Information needed for the Option A is not available.

$$EF_{grid,OM,simple,y} = \frac{\sum_i FC_{i,y} \cdot NCV_{i,y} \cdot EF_{CO2,i,y}}{EG_y}$$

Equation 19. Simple Operating Margin equation

Where:

$EF_{grid,OM,simple,y}$ Simple operating margin CO_2 emission factor in year *y* (tCO_2/MWh).
$FC_{i,y}$ Amount of fossil fuel type *i* consumed in the project electricity system in year *y* (mass or volume unit).

$NCV_{i,y}$	Net calorific value (energy content) of fossil fuel type *i* in year *y* (GJ/mass or volume unit).
$EF_{CO2,i,y}$	CO2 emission factor of fossil fuel type *i* in year *y* (tCO2/GJ).
EG_y	Net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost / must-run power plants / units, in year *y* (MWh).
i	All fossil fuel types combusted in power sources in the project electricity system in year *y*.
y	The relevant year as per the data vintage chosen in Step 3.

The years for calculating the Simple OM are 2008, 2009 and 2010 (based on the most recent data available at time of submission of the CDM-PDD to the DOE for validation).

$EF_{CO2,i,y}$ (in tC/TJ) can be found in the Reviewed 2006 IPCC Guidelines for Greenhouse Gas Inventories: Workbook. Data for $FC_{i,y}$ can be found in TJ/day in the three Energy Sector Outlooks (*Prospectivas)* so total annual consumption per fuel source can be calculated multiplying by 365.

5. Calculate the build margin (BM) emissions factor.

In terms of vintage of data, project participants can choose between one of the following two options:

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

Option 2: For the first crediting period, the build margin emission factor shall be updated annually, *ex post*, including those units built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available. For the second crediting period, the build margin emissions factor shall be calculated *ex ante*, as described in Option 1 above. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used.

As shown in the spreadsheet, the first option was chosen for this project.

According the “Tool to calculate the emission factor of an electricity system” version 02.2.1, the sample group of power units *m* used to calculate the build margin should be determined as per the following procedure, consistent with the data vintage selected above:

a) Identify the set of five power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently ($SET_{5\text{-}units}$) and determine their annual electricity generation ($AEG_{SET\text{-}5\text{-}units}$, in MWh).
b) Determine the annual electricity generation of the project electricity system, excluding power units registered as CDM project activities (AEG_{total}, in MWh). Identify the set of power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently and that comprise 20% of AEG_{total} (if 20% falls on part of the generation of a

unit, the generation of that unit is fully included in the calculation) ($SET \geq 20\%$) and determine their annual electricity generation ($AEG_{SET-\geq 20\%}$, in MWh).

c) From SET5-units and $SET \geq 20\%$ select the set of power units that comprises the larger annual electricity generation (SET_{sample}).

In the case of Mexico the $SET_{>20\%}$ comprises a larger annual electricity generation. Therefore, this is considered the sample group used to calculate the build margin (SET_{sample}).

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 power generation data is available, calculated as follows:

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

Equation 20. Build Margin equation

Where:

$EF_{grid,BM,y}$	Build margin CO2 emission factor in year y (tCO2/MWh)
$EG_{m,y}$	Net quantity of electricity generated and delivered to the grid by power unit m in year y (GWh)
$EF_{EL,m,y}$	CO2 emission factor of power unit m in year y (tCO2/MWh)
m	Power units included in the build margin
y	Most recent historical year for which power generation data is available

6. Calculate the combined margin (CM) emission 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.

The weighted average CM method (option A) should be used as the preferred option.

The simplified CM method (option b) can only be used if:
• The project activity is located in a Least Developed Country (LDC) or in a country with less than 10 registered CDM projects at the starting date of validation; and
• The data requirements for the application of step 5 above cannot be met.

For this project, the weighted average CM (option a) was chosen due that in Mexico there are more than 10 registered projects, the combined margin emissions factor is then calculated as follows:

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

Equation 21. Combined Margin equation

Where:

$EF_{grid,OM,y}$	Operating margin CO2 emission factor in year y (tCO2/MWh).
$EF_{grid,BM,y}$	Build margin CO2 emission factor in year y (tCO2/MWh).
w_{OM}	Weighting of operating margin emissions factor (%).
w_{BM}	Weighting of build margin emissions factor (%).

For hydropower projects, the default weights are as follows: WOM = 0.5 and WBM = 0.5.

For the calculation of these two terms ($EF_{grid,OM,y}$, $EF_{grid,BM,y}$) the information used can be found in the Energy Sector Outlooks 2009-2024; 2010-2025; 2011-2025 prepared by the Mexican Energy Ministry, SENER. These documents can be accessed at http://www.energia.gob.mx/portal/Default.aspx?id=1433.

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

Data / Parameter:	**$EF_{grid,CM,y}$**
Data unit:	tCO_2/MWh
Description:	Combined margin CO2 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 used:	Revised 2006 IPCC Comisión Federal de Electricidad, CFE Mexican Energy Ministry, SENER: Energy Sector Outlook 2009-2024 Energy Sector Outlook 2010-2025 Energy Sector Outlook 2011-2025
Value applied:	0.524 tCO2/MWh
Justification of the choice of data or description of measurement methods and procedures actually applied:	Once for each crediting period using the most recent three historical years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex ante option).
Any comment:	-

Data / Parameter:	**$EF_{CO2,i,y}$**
Data unit:	tCO_2/GJ
Description:	CO2 emission factor of fossil fuel type *i* in year *y*
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories. Chapter 1 “Stationary Combustion”. Table 1.4 Page 123
Value applied:	Fuel Oil 75,500 kg/TJ Natural Gas 54,300 kg/TJ Diesel 72,600 kg/TJ Coal 89,500 kg/TJ
Justification of the choice of data or description of	Once for each crediting period using the most recent three historical years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex ante option).

measurement methods and procedures actually applied:	
Any comment:	-

Data / Parameter:	$\mathbf{A_{BL}}$
Data unit:	m^2
Description:	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 the value is zero.
Source of data used:	Project site
Value applied:	0 (zero) m^2
Justification of the choice of data or description of measurement methods and procedures actually applied:	Once for each crediting period as the OM and BM are calculated ex-ante.
Any comment:	-

Data / Parameter:	$\mathbf{Cap_{BL}}$
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 used:	Project site
Value applied:	0 (zero) W
Justification of the choice of data or description of measurement methods and procedures actually applied:	Once for each crediting period as the OM and BM are calculated ex-ante.
Any comment:	-

Data / Parameter:	$\eta_{m,y}$
Data unit:	%
Description:	Average net energy conversion efficiency of power unit *m* in year *y*
Source of data used:	Energy Sector Outlook 2011-2025. Mexican Energy Ministry, SENER. Chart 49. Page.176
Value applied:	TG (Gas Turbine): 40.67% CC (Combined Cycle): 52.86% GEO (Geothermal): 100% HID (Hydropower):100% CI (Internal Combustion): 45.07%
Justification of the choice of data or description of	Once for each crediting period using the most recent three historical years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex ante option).

measurement methods and procedures actually applied:	
Any comment:	-

Data / Parameter:	**Cap_{PJ}**
Data unit:	W
Description:	Installed capacity of the hydro power plant after the implementation of the project activity
Source of data used:	Environmental Impact Assessment. University of Sciences and Arts of Chiapas. Second Chapter. Page 7. Subsection 2.2.1. Project Site.
Value applied:	240,000,000
Justification of the choice of data or description of measurement methods and procedures actually applied:	Once for each crediting period as the OM and BM are calculated ex-ante.
Any comment:	-

Data / Parameter:	**A_{PJ}**
Data unit:	m^2
Description:	Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full.
Source of data used:	Environmental Impact Assessment. University of Sciences and Arts of Chiapas. Second Chapter. Page 11. Table 2.3. Project Site.
Value applied:	1,886,000
Justification of the choice of data or description of measurement methods and procedures actually applied:	Once for each crediting period as the OM and BM are calculated ex-ante.
Any comment:	-

Data / Parameter:	**$FC_{i,y}$**
Data unit:	Mass or volume unit
Description:	Amount of fossil fuel type *i* consumed in year *y*
Source of data used:	Mexican Energy Ministry, SENER Electricity Sector Outlook 2009-2024. Page 144. Chart 38 Electricity Sector Outlook 2010-2025. Page 164. Chart 41 Electricity Sector Outlook 2011-2025. Page 158. Chart 38
Value applied:	2008: Fuel Oil: 29,900 m3/day

	Natural Gas: 71,900,000 m3/day Diesel: 700 m3/day Coal national: 9,100,000 m3/day Coal imported: 1,700,000 m3/day 2009 Fuel Oil: 26,500 m3/day Natural Gas: 76,600,000 m3/day Diesel: 1,100 m3/day Coal national: 8,500,000 m3/day Coal imported: 5,200,000 m3/day 2010 Fuel Oil: 23,600 m3/day Natural Gas: 74,300,000 m3/day Diesel: 9,00 m3/day Coal national: 9,100,000 m3/day Coal imported: 6,800,000 m3/day
Justification of the choice of data or description of measurement methods and procedures actually applied:	Once for each crediting period as the OM and BM are calculated ex-ante.
Any comment:	-

Data / Parameter:	**$NCV_{i,y}$**
Data unit:	GJ/Mass or volume unit
Description:	Net calorific value (energy content) of fossil fuel type *i* in year *y*
Source of data used:	National Energy Balance, 2010. Mexican Energy Ministry, SENER. Table 33. Page 92
Value applied:	2008: Fuel Oil: 0.04044 TJ/ton Natural Gas: 0.00004 TJ/ton Diesel: 0.03744 TJ/ton Coal national: 0.01941 TJ/ton Coal imported: 0.02528 TJ/ton 2009 Fuel Oil: 0.04112 TJ/ton Natural Gas: 0.00004 TJ/ton Diesel: 0.03580 TJ/ton Coal national: 0.01941 TJ/ton Coal imported: 0.02528 TJ/ton 2010 Fuel Oil: 0.04003 TJ/ton Natural Gas: 0.00004 TJ/ton

	Diesel: 0.03573 TJ/ton Coal national: 0.01941 TJ/ton Coal imported: 0.02528 TJ/ton
Justification of the choice of data or description of measurement methods and procedures actually applied:	Once for each crediting period as the OM and BM are calculated ex-ante.
Any comment:	-

B.6.3. Ex-ante calculation of emission reductions:

Project emissions

The project emissions are calculated as follows

$$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y}$$

Equation 22. Project emissions

Where:

PE_y Project emissions in year *y* (tCO2e)

$PE_{FF,y}$ Project emissions from fossil fuel consumption in year *y* (tCO2)

$PE_{GP,y}$ Project emissions from the operation of geothermal power plants due to the release of non-condensable gases in year *y* (tCO2e)

$PE_{HP,y}$ Project emissions from water reservoirs of hydro power plants in year *y* (tCO2e)

The procedure to calculate the project emissions from each of these sources is presented next.

Fossil Fuel Combustion ($PE_{FF,y}$)

For geothermal and solar thermal projects, which also use fossil fuels for electricity generation, CO_2 emissions from the combustion of fossil fuels shall be accounted for as project emissions ($PE_{FF,y}$).

$PE_{FF,y}$ shall be calculated as per the latest version of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion".

This emission source does not apply to this project activity due that there will not be any use of fossil fuels for electricity generation.

Emissions of non-condensable gases from the operation of geothermal power plants ($PE_{GP,y}$)

For geothermal project activities, project participants shall account fugitive emissions of carbon dioxide and methane due to release of non-condensable gases from produced steam. Non-condensable gases in geothermal reservoirs usually consist mainly of CO_2 and H_2S. They also contain a small quantity of hydrocarbons, including predominantly CH_4. In geothermal power projects, non-condensable gases flow with the steam into the power plant. A small proportion of the CO_2 is converted to carbonate/bicarbonate in the cooling water circuit. In addition, parts of the non-condensable gases are reinjected into the geothermal reservoir. However, as a conservative approach, this methodology assumes that all non-condensable gases entering the power plant are discharged to atmosphere via the cooling tower.

Fugitive carbon dioxide and methane emissions due to well testing and well bleeding are not considered, as they are negligible.

$PE_{GP,y}$ *is calculated as follows:*

$$PE_{GP,y} = (w_{steam,CO2,y} + w_{steam,CH4,y} \cdot GWP_{CH4}) \cdot M_{steam,y}$$

Equation 23. Emission from geothermal power plants

Where:

$PE_{GP,y}$	=	Project emissions from the operation of geothermal power plants due to the release of non-condensable gases in year *y* (tCO_2e)
$w_{steam,CO2,y}$	=	Average mass fraction of carbon dioxide in the produced steam in year *y* (tCO_2/t steam)
$w_{steam,CH4,y}$	=	Average mass fraction of methane in the produced steam in year *y* (tCH_4/t steam)
GWP_{CH4}	=	Global warming potential of methane valid for the relevant commitment period (tCO_2e/tCH_4)
$M_{steam,y}$	=	Quantity of steam produced in year *y* (t steam)

This emission source does not apply to the "Construction and operation of the Hydraulic Power Plant Chicoasén II", because there aren't any geothermal facilities planned, these emissions were not considered.

Emissions from water reservoirs of hydro power plants ($PE_{HP,y}$)

For hydro power project activities that result in new single or multiple reservoirs and hydro power project activities that result in the increase of single or multiple existing reservoirs, project proponents shall account for CH_4 and CO_2 emissions from the reservoirs, estimated as follows:

(a) If the power density of the single or multiple reservoirs (PD) is greater than 4 W/m^2 and less than or equal to 10 W/m^2:

$$PE_{HP,y} = \frac{EF_{Res} \cdot TEG_y}{1000}$$

Equation 24. Emissions from water reservoirs if power density greater than 4 W/m^2 and less than 10 W/m^2

Where:

$PE_{HP,y}$	=	*Project emissions from water reservoirs (tCO_2e)*
EF_{Res}	=	*Default emission factor for emissions from reservoirs of hydro power plants in year y ($kgCO_2e/MWh$)*
TEG_y	=	*Total electricity produced by the project activity, including the electricity supplied to the grid and the electricity supplied to internal loads, in year y (MWh)*

(b) If the power density of the project activity (PD) is greater than 10 W/m^2:

$$PE_{HP,y} = 0$$

Equation 25. Emissions from water reservoirs if power density greater than 10 W/m²

In order to determine if some of the above mentioned emissions from water reservoirs must be taken into consideration, the power density of the project "Construction and operation of the Hydraulic Power Plant Chicoasén II" will be calculated as follows:

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

Equation 26. Power density of the project activity

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 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)
A_{BL}	=	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

The power density of the proposed project activity is then:

$$PD = \frac{(240{,}000{,}000 - 0)W}{(1{,}886{,}000 - 0)m^2} = 127.27\frac{W}{m^2}$$

Equation 27. Calculation of the project's power density

From this last calculation it can be then concluded that the emissions from water reservoirs will be considered zero. This is

$$PE_{HP,y} = 0$$

Equation 28. Emissions from water reservoir for the "Construction and operation of the Hydraulic Power Plant Chicoasén II"

Based on the following sentence taken from the ACM0002 / version 12.3.0 methodology description the value of PE_y was considered zero:

For most renewable power generation project activities, PE_y=0

As the project is not related with the development of a geothermic power plant, and the emissions from water reservoirs will be considered zero, because of the power density it is then concluded that the emissions of the project are considered zero.

Leakage

Based on the next quote taken from the methodology ACM002 ver.12.3.0, the leakage emissions are considered zero:

"No leakage emissions are considered. The main emission potentially giving rise to leakage in the context of electric sector projects are emissions arising due to activities such as power plant construction and upstream emission from fossil fuel use (e.g. extraction, procession, transport). These emissions sources are neglected"

In conclusion the leakage emissions are considered zero.

Baseline emissions

In order to calculate the baseline emissions it is necessary to obtain the emission factor of the National Interconnected System, SIN. Such factor is composed of two parts: Operating Margin ($EF_{grid,OM,y}$) and Build Margin ($EF_{grid,BM,y}$).

- The Operating Margin emission factor calculation for 2010 is 0.6027 tCO2/MWh (see details in Annex 3)
- The Build Margin emission factor calculation for 2010 is 0.4446 tCO2/MWh (see details in Annex 3)

The baseline emission factor is calculated as the weighted average of the Operating Margin emission factor and the Building Margin emission factor. For hydroelectric power projects, the default weights are as follows: W_{OM} = 0.5 and W_{BM} = 0.5 (because of their intermittent and non-dispatchable nature).

Thus, the *ex-ante* baseline emission factor will be: 0.5*0.6027+ 0.5* 0.4446= **0.524** tCO2/MWh

Emission Reductions:

The emission reductions by the project activity are the difference between the baseline emissions, project emissions and emissions due to leakage. Since there are no project emissions and leakage emissions are neglected, the emission reduction will be the baseline emission. This baseline emission is the baseline emission factor multiplied by the energy generation.

Baseline emission factor: **0.524** tCO2/MWh
Annual generation: 571,852.8 MWh
Baseline Emissions: 299,436 tCO2
Emission Reductions: 299,436 – 0 = 299,436

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

Year	Estimation of project activity emissions (tonnes of CO_2 e)	Estimation of baseline emissions (tonnes of CO_2 e)	Estimation of leakage (tonnes of CO_2e)	Estimation of overall emission reductions (tonnes of CO_2 e)
2017(6	0	149,718	0	

Year	Estimation of project activity emissions (tonnes of CO_2 e)	Estimation of baseline emissions (tonnes of CO_2 e)	Estimation of leakage (tonnes of CO_2e)	Estimation of overall emission reductions (tonnes of CO_2 e)
months July-December)				149,718
2018	0	299,436	0	299,436
2019	0	299,436	0	299,436
2020	0	299,436	0	299,436
2021	0	299,436	0	299,436
2022	0	299,436	0	299,436
2023	0	299,436	0	299,436
2024	0	299,436	0	299,436
2025	0	299,436	0	299,436
2026	0	299,436	0	299,436
2027 (6 months January-June)	0	149,718	0	149,718
Total (tonnes of CO_2e)	0	2,994,360	0	2,994,360

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

B.7.1 Data and parameters monitored:

Data / Parameter:	**$EG_{facility,y}$**
Data unit:	MWh
Description:	Quantity of net electricity generation supplied by the project plant to the grid in year *y*.
Source of data to be used:	Project activity site.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	571,852.8 MWh. This value is an estimation according the plant load factor of the project activity.
Description of measurement methods and procedures to be applied:	Continuous measurement and at least monthly recording. Extra information of the meters: • Number of meters: 2 meters at the Comisión Federal de Electricidad, CFE substation for the net energy (1 main, 1 backup). The calibration period of such measures would at least every two years.

QA/QC procedures to be applied:	Cross check measurement results with records for sold electricity.
Any comment:	-

B.7.2. Description of the monitoring plan:

Methodology applicable to this project is the approved ACM0002 Version 12.3.0 The Monitoring Plan describes the procedures for data collection and auditing required for the project, in order to determine and verify emission reductions achieved by the project. This project will require only very straightforward collection of data, described in this PDD, which will be collected routinely. The purpose of the monitoring plan is to ensure that the required data is accurately monitored and recorded to enable the calculation of the emission reductions achieved by the project, then before the start of the crediting period of the project activity the following procedures and activities will be implemented or adjusted or clearly defined in order to meet the CDM requirements:

To establish and maintain data collection and recording systems.

- Procedure for quality assurance for internal and external data acquisition (considers equipment calibration and maintenance schedules).
- Procedure for project performance review before submitted for verification.
- Procedure for storing and maintain records (paper and electronic information).
- Identification of training needs to enable operational staff to meet the needs of the project and this monitoring plan during the operation stage.
- Procedure for corrective actions to improve future monitoring and reporting.

In addition, before the start of the first crediting period a CDM manager will be designated (or Project Developer's Head Office). This CDM manager will be responsible of the CDM monitoring and verification processes: he will verify the parameters monitored and the data recording, will perform emission reduction calculations and sign every monitoring report, among others. Data monitored and required for verification and issuance will be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later. For more details, see Annex 4

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

Date of completion: 23/04/2012

Alfonso Lanseros Valdés
Partner consultant
infocdm@co2-solutions.com
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This entity is a project participant (private).

SECTION C. Duration of the project activity / crediting period

C.1. Duration of the project activity:

C.1.1. Starting date of the project activity:

31/10/2012

This is the date when Comisión Federal de Electricidad, CFE estimates to sign the tender contract of the construction of the "Construction and operation of the Hydraulic Power Plant Chicoasén II"

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

50 years 0 months

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

The crediting period choice is 10 years 0 months, not renewable.

C.2.1. Renewable crediting period:

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

NA

C.2.1.2. Length of the first crediting period:

NA

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

01/07/2017

C.2.2.2. Length:

The project participant selects a crediting period of 10 years 0 months.

SECTION D. Environmental impacts

D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

To identify the environmental impacts that the project will bring to the site, an Environmental Impact Assessment was carried out. The project participant, Comisión Federal de Electricidad, CFE in charged the University of Sciences and Arts of Chiapas to carry out this task. On the study all the civil works and changes in the environment as consequence of the development of the project were considered. The main assessed concepts are described below and their impact to the flora, fauna and project site is mentioned. This assessment has a classification range composed by low, moderate, high and very high.

The lost of species included in the[30] NOM-059-SEMARNAT-2010 was assessed as a moderate almost negligible impact, it is foreseen that with the mitigation, follow, and control programs[31] the succession processes will be strengthen, which will propitiate an increment in the diversity of the zone.

The landscape modifications due to the development of the "Construction and operation of the Hydraulic Power Plant Chicoasén II" are also classified as moderate, and it is thought that this modifications will be compensated by the restoration, reforestation, soil control and erosion control programs.

The loss of fishing sites is assessed as a moderate impact, and it is thought to be highly alleviated by including the fishermen in the Regional Development Support Program, foreseen in the 6th chapter of the Environmental Impact Assessment.

As the spillway of the "Construction and operation of the Hydraulic Power Plant Chicoasén II" is relative superficial and is not thought that it will storage great amounts of water, the development of algae will not form. This will avoid any changes in the water composition at the project site.

Due that in the project site there have been modifications of the system because of the construction and operations of other hydropower facilities of great capacity, it is considered that the possible changes or alterations in the ecosystem and natural resources will not obstruct the continuity of the natural processes, and that the development of the project respects the functional integrity absorption capacity of the involved ecosystems.

The impact on the ecosystem downstream the project is also considered as moderate due to the ecologic current/flux that will be hydrating the bed of the Grijalva river. This impact will be monitored through the Aqueous Ecosystem Monitoring Plan.

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

[30] Environmental – Native Flora and Fauna Species Protection Law. SEMARNAT. Page 20-77

[31] Environmental Impact Assessment. University of Sciences and Arts of Chiapas. Sixth Chapter. Conservation and handlich program for terrestrial fauna.

The environmental impact study done for "Construction and operation of the Hydraulic Power Plant Chicoasén II", states that impacts caused by the project are minor.

Some of the mitigation measurements that will be enforced in order to reduce the environmental impact are the following:

1. Integral solid residues handling program
    a. Aims
        i. Soil contamination
        ii. Water quality modifications
        iii. Lost and perturbation of habitat
        iv. Landscape loss
        v. Etc.
            - Objectives: Give proper treatment of waste from the environmental standpoint according to characteristics like volume, origin, treatment costs, chances of recovery and disposal.
2. Dangerous material/substances handling program
    a. Aims
        i. Handling and use of explosives
        ii. Handling and use of fuels
            - Objectives: Develop strategies for proper management of fuels and explosives to prevent soil contamination and accidents by improper handling.
3. Sewage water handling program
    a. Aims:
        i. Generation and disposition of sewage waters
            - Objectives. Manage and control the discharge of wastewater generated during the project construction.
4. Environmental information and training program
    a. Aims

        i. Soil contamination
        ii. Water quality modifications
        iii. Loss of individuals of species included in the NOM 059
        iv. Accidental death and hunting of species
        v. Loss and perturbation of habitat
        vi. Landscape modification
            - Objectives: Educate and train staff working in the project on causal relations links between the performance of activities of each profession and environmental conservation.
            - Objectives: Strengthen or promote the culture of prevention as an integral part staff behavior in order to preserve their physical integrity and conservation of natural resources.
5. Batter protection program
    a. Aims:
        i. Cuts, levelling and excavations
        ii. Modification and stability of batters
        iii. Alterations of surface sewage

iv. Landscape modification
- Objectives: Prevent, avoid and control geomorfodinyamic processes such as landslides and andslides caused by improper handling or exposure of slopes during excavation activities, cuts and grading.

6. Program for erosion and sediment drag
   - Objectives: Prevent and compensate for the deterioration of soil resources in the area of influence project as a result of construction activities.
7. Handling and conservation of vegetal communities program.
   - Objectives: Reduce the impact that the project will have on the ecosystems through the implementation of concrete actions which influence the recovery of areas that provide shelter for flora and fauna communities.
8. Others.

SECTION E. Stakeholders' comments

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

Local stakeholders refer to the communities that will be directly affected by the development of the project. In this case, people from communities close to the project were invited to express their comments about the project activity.

The stakeholders consultation consisted in a presentation were the members of Comisión Federal de Electricidad, CFE presented the project to the community and showed the advantages and the benefits that the project will bring to the community. In order to confirm this stakeholder's consultation the PP will give the copies of the surveys and pictures of the stakeholders consult. The stakeholders were invited and a presentation of the project was shown, also the project was explained in detail. It was explained to them the environmental, economical and ecological advantages of the project. A moment was given to the stakeholders to fill out the interviews and to express their ideas among them. Some photographs were made as evidence that the consultation was made.

E.2. Summary of the comments received:

- The project is an opportunity for spreading the importance of environmental care
- It is expected that the project will bring benefits for the community, as new job opportunities and development of services for the community.
- The project will have a huge impact for the society, the local economy and the environment
- This kind of projects brings more jobs to the community
- With the project, it is expected that new business opportunities for the community will be created
- In general, the people consider important the development of this kind of projects because they think that the project will improve the environment and it is a clean manner of generate energy

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

Most of the people see as a positive and optimistic way the development of the project activity. The main comments are involved to the economic benefits that the project activity will bring to the region (due to the generation of jobs) and the environmental benefits (due the generation of clean energy). The community expresses the approval of the project activity.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

THERE WILL BE NO PUBLIC FUNDING FROM PARTIES INCLUDED IN ANNEX 1**.**

Annex 3

BASELINE INFORMATION

Total Fuel consumption:

Total Fuel Consumption (TJ)	
2008	81,594,982.40
2009	109,727,110.92
2010	128,601,856.21

Table 14. Total fuel consumption per year

	2008		
	Fuel consumption (m3/day or tonne/year) {2}	**CO2 Emission Factor (tCO2/TJ) {1}**	**Emissions CO2 (tCO2)**
Fuel Oil	29,000	75.5	32,315,541
Natural Gas	71,900,000	54.3	55,112,728
Diesel	700	72.6	694,428
Coal (national)	9,100,000	89.5	15,804,402
Coal (imported)	1,700,000		3,846,961
Total	-		**107,774,060**

Table 15. Emissions year 2008

	2009		
	Fuel consumption (m3/day or tonne/year) {3}	**CO2 Emission Factor (tCO2/TJ)**	**Emissions CO2 (tCO2)**
Fuel Oil	26,500	75.5	30,030,378
Natural Gas	76,600,000	54.3	60,921,274
Diesel	1,100	72.6	1,043,576
Coal (national)	8,500,000	89.5	14,762,354
Coal (imported)	5,200,000		11,767,174
Total	-		**118,524,755**

Table 16. Emissions year 2009

	2010		
	Fuel consumption (m3/day or tonne/year) {4}	**CO2 Emission Factor (tCO2/TJ)**	**Emissions CO2 (tCO2)**
Fuel Oil	23,600	75.5	26,032,278
Natural Gas	74,300,000	54.3	56,294,127
Diesel	900	72.6	852,184
Coal (national)	9,100,000	89.5	15,804,402
Coal (imported)	6,800,000		15,387,842
Total	-		**114,370,834**

Table 17. Emissions year 2010

- **{1}** Source from values at the lower limit of the uncertainty at a 95% confidence interval of Table 1.4, Chapter 1 of Volume 2 of the 2006 IPCC Guidelines for National GHG Inventories. [p.1.23]
- **{2}**Source from Chart 38 of the Electricity Sector Outlook 2009-2024 [p.144].
- **{3}**Source from Chart 41 of the Electricity Sector Outlook 2010-2025 [p.164].
- **{4}**Source from Chart 38 of the Electricity Sector Outlook 2011-2025 [p.158].

Fuel	2008		2009		2010	
	Net Calorific Value (TJ/m^3 or TJ/tonne)	**Net Calorific Value (GJ/m^3 or GJ/tonne)**	**Net Calorific Value (TJ/m^3 or TJ/tonne)**	**Net Calorific Value (GJ/m^3 or GJ/tonne)**	**Net Calorific Value (TJ/m^3 or TJ/tonne)**	**Net Calorific Value (GJ/m^3 or GJ/tonne)**
Fuel Oil	0.04044	40.43651	0.04112	41.12208	0.04003	40.02767
Natural gas	0.00004	0.03868	0.00004	0.04013	0.00004	0.03823
Diesel	0.03744	37.43689	0.03580	35.80154	0.03573	35.73235
Coal (national)	0.01941	19.40500	0.01941	19.40500	0.01941	19.40500
Coal (imported)	0.02528	25.28400	0.02528	25.28400	0.02528	25.28400

Table 18. Net calorific values used

Generation by sources:

	2008		2009		2010	
	Power share	**MWh**	**Power share**	**MWh**	**Power share**	**MWh**
Dual	2.92%	6,883,000	5.23%	12,299,000	6.42%	15,578,000
Combined cycle	45.72%	107,830,000	48.45%	113,900,000	47.77%	115,865,000

Gas turbine	1.19%	2,802,000	1.59%	3,735,000	1.40%	3,396,000
Coal	7.54%	17,789,000	7.18%	16,886,000	6.80%	16,485,000
Internal	0.52%	1,234,000	0.53%	1,241,000	0.51%	1,242,000
Nuclear	4.16%	9,804,000	4.47%	10,501,000	2.42%	5,879,000
Standard Thermoelectric	18.37%	43,325,000	18.34%	43,112,000	16.73%	40,570,000
Renewables (Hydro, Geo, Wind …)	19.59%	46,203,000	14.22%	33,434,000	17.94%	43,522,000
Total Generation (MWh)		235,871,000		235,107,000		242,537,000
Self-consumption (MWh)		20,595,000		20,619,000		22,987,000
Net Electricity Generation	**100%**	**215,276,000**	**100%**	**214,488,000**	**100%**	**219,550,000**

Table 19. Net calorific values years 2008,2009,2010

Source: National Energy Balance 2010. Mexican Energy Ministry. Page 92.Chart 33.
1 m3 equal to 6.2898 barrels

Total % under methodology

	2008	**2009**	**2010**
Exports (MWh)	1,452,000	1,249,000	1,349,000
Imports (MWh)	351,000	346,000	397,000
Net Exchange (MWh)	1,101,000	903,000	952,000

Table 20. Exports and imports of electricity

Total generation in baseline

	2008	**2009**	**2010**
Baseline	179,863,000	191,173,000	193,136,000
Baseline + Imports	180,214,000	191,519,000	193,533,000

Table 21. Baseline plus imports

	2008	**2009**	**2010**
OM (tCO_2/MWh)	0.598	0.619	0.591

Table 22. Operating Margin for the period

Weighted OM (tCO_2/MWh)
0.6027

Table 23. Weighted O&M

Baseline calculations:

- Operating Margin:

Operating Margin = total CO_2 emission / (total generation under baseline + imports)

Operating Margin 2008 = 107,774,060/ (180,214,000) = 0.598 tCO_2/MWh
Equation 29. OM year 2008

Operating Margin 2009 = 118,524,755/ (191,519,000) = 0.619 tCO_2/MWh
Equation 30. OM year 2009

Operating Margin 2010= 114,370,834/ (193,533,000) = 0.591 tCO_2/MWh
Equation 31. OM year 2010

OM = 0.598* (180,214,000) + 0.619* (191,519,000) + 0.591*((193,533,000)) / ((180,214,000) + (191,519,000)+ (193,533,000)) = **0.6027 tCO_2/MWh**
Equation 32. Weighted OM

- Build Margin:

Calculation of Build Margin:

Build Margin = (Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh) * CO2 emission factor of power unit *m* in year *y* (tCO2/MWh)) / Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)

CO2 emission factor of power unit = 3.6 * Average CO2 emission factor of fuel type *i* used in power unit *m* in year *y* (tCO2/GJ) / Average net energy conversion efficiency of power unit *m* in year *y* (%)

No.	Name	Capacity MW	Technology	Net Generation (MWh)	Accumulate Percentaje	Fuel	Emission Factor of Fuel	Efficiency
		MW			%		tCO2/GJ	%
Additions 2010								
	Aragón	32	TG	0	0.00%	N.A.	0.000	40.67%
44	Petacalco (Plutarco Elías Calles)	678.4	CAR	14,456,384	5.96%	K	0.0682	37.87%
92	Norte Durango	450	CC	1,446,962	6.56%	GAS	0.0543	52.86%
Additions 2009								
	Iztapalapa	32	TG	0	6.56%	N.A	0.000	40.67%
	Coapa	32	TG	0	6.56%	N.A	0.000	40.67%
	Santa Cruz	32	TG	0	6.56%	N.A	0.000	40.67%
	Magdalena	32	TG	0	6.56%	N.A	0.000	40.67%
91	San Lorenzo Potencia	133	CC	230,065	6.65%	GAS	0.0543	52.86%
91	San Lorenzo Potencia	133	CC	0	6.65%	GAS	0.0543	52.86%
91	San Lorenzo Potencia	116.1	CC	0	6.65%	GAS	0.0543	52.86%
Adiciones 2008								

59	Humeros	5	GEO	325,000	6.79%	N.A	0.000	100.00%
	Ciudad del Carmen	16	TG	0	6.79%	GAS	0.0543	40.67%
	Ciudad del Carmen	17	TG	0	6.79%	GAS	0.0543	40.67%
Additions 2007								
	La Venta II	83.3	Wind	0	6.79%	N.A	0.000	100.00%
90	El Cajón (Leonardo Rodríguez Alcaine)	375	HID	569,000	7.02%	N.A	0.000	100.00%
	El Cajón (Leonardo Rodríguez Alcaine)	375	HID	0	7.02%	N.A	0.000	100.00%
89	Tamazunchale (PIE)	1135	CC	7,916,194	10.28%	GAS	0.0543	52.86%
	Río Bravo (Emilio Portes Gil)	33	CC	0	10.28%	GAS	0.0543	52.86%
	Río Bravo (Emilio Portes Gil)	33	CC	0	10.28%	GAS	0.0543	52.86%
26	Río Bravo (Emilio Portes Gil)	145.1	CC	258,456	10.39%	COM & GAS	0.0543	52.86%
	Ecatepec (LFC)	32	TG	0	10.39%	GAS	0.0543	40.67%
	Remedios (LFC)	32	TG	0	10.39%	GAS	0.0543	40.67%
	Victoria (LFC)	32	TG	0	10.39%	GAS	0.0543	40.67%
	Villa de Flores (LFC)	32	TG	0	10.39%	GAS	0.0543	40.67%
	Cuautitlán (LFC)	32	TG	0	10.39%	GAS	0.0543	40.67%
	Coyotepec (LFC)	32	TG	0	10.39%	GAS	0.0543	40.67%
	Coyotepec (LFC)	32	TG	0	10.39%	GAS	0.0543	40.67%
	Vallejo (LFC)	32	TG	0	10.39%	GAS	0.0543	40.67%
	Holbox	0.8	CI	0	10.39%	DI	0.0726	45.07%
	Holbox	0.8	CI	0	10.39%	DI	0.0726	45.07%
Additions 2006								
86	Tuxpan V (PIE)	495	CC	3,877,819	11.99%	GAS	0.0543	52.86%
87	Valladolid III (PIE)	525	CC	3,658,523	13.50%	GAS	0.0543	52.86%
85	Altamira V (PIE)	1121	CC	8,041,506	16.81%	GAS	0.0543	52.86%
69	Chihuahua II (El Encino)	65.3	CC	4,445,639	18.65%	GAS	0.0543	52.86%
	Atenco (LFC)	32.0	TG	0	18.65%	GAS	0.0543	40.67%
Additions 2005								
	Ixtaczoquitlán	1.6	HID	0	18.65%	N.A	0.000	100.00%
	Botello	9	HID	0	18.65%	N.A	0.000	100.00%
66	Hermosillo	93.3	CC	1,534,093	19.28%	GAS	0.0543	52.86%
77	Rio Bravo IV	500	CC	2,667,775	20.38%	GAS	0.0543	52.86%
73	La Laguna II	498	CC	3,687,893	21.90%	GAS	0.0543	52.86%
	Yécora	.7	CI	0	21.90%	DI	0.0726	45.07%
	Hol Box	.8	CI	0	21.90%	DI	0.0726	45.07%

New power plants installed. Source: Mexican Energy Ministry, SENER. *Energy Sector Outlook 2011-2025 Chart 12 p.90; Energy Sector Outlook 2010-2025 Chart 17 p.103; Energy Sector Outlook 2009-2024 Chart 18 p.96; Energy Sector Outlook 2008-2017 Chart 19 p.101; Energy Sector Outlook 2007-2016 Chart 19 p.77; Energy Sector Outlook 2006-2015 Chart 13 p.57;* Abbreviations: Hydro: Hydropower plant; Geo: Geothermal plant, CC: Combined cycle plant, fuelled with natural gas, GT: Gas turbine, fuelled with natural gas. IC: Internal combustion.

BM factor: **0.4446** tCO2/MWh

Emission factor ex-ante = 0.5*OM+ 0.5*BM = **0.524** tCO_2/MWh

Annex 4

MONITORING INFORMATION

The CDM manager, will have final responsibility for all aspects related to data measurements, monitoring of data recording and emissions and will sign off all reports on monitoring.

Data will be collected and consolidated in monthly and annual emission reduction internal reports.

The bulk of data required for the monitoring of the emission reductions will come from data already collected as part of the plant’ s operations or officially reported by the competent governmental entity (CENACE).

The actual monitored data will be entered into an “ER Spreadsheet”, informatics program or other registry system to calculate the emission reductions for the period.

All physic documentation will be collected in a central place, together with this monitoring plan or CDM - PDD. In order to facilitate auditor’s reference, monitoring results should be indexed. All paper-based information will be stored and at least one copy (paper or electronic) will be kept. All the reports will also have an electronic copy in order to be sent to the any audit team or consultant requirement.

The data monitored which is required for verification and issuance will be kept at least for two years after the end of the crediting period or the last issuance of CERs for this proposed project activity, whatever occurs later.

The CDM manager will be in permanent contact with the persons in charge of the Coordination of Hydroelectric Projects of CFE (Coordinación de Proyectos Hidroeléctricos, CPH), Sub-Directorate of Projects and Construction (Subdirecciones de Proyectos y Construcción), Project Development and Operation, Environmental Protection Management, among others, for any specific requirement.

Training of Monitoring Personnel

All people that participated in the monitoring process for the CDM project will be suitably qualified and trained in the operation and maintenance of the plant. The training for operating and maintaining the plant may be provided by the supplier of electro-mechanical and hydro-mechanical equipment as part of the contract terms with the equipment suppliers or have especial training under the guidance of the project developer. They will also receive appropriate training in the CDM monitoring requirements, which will include an overview of the CDM and all elements of the monitoring plan in detail. A copy of the project monitoring plan and/or registered CDM - PDD will be distributed to all the people involved and an additional copy will be easily accessible at appropriate locations on site.

The CDM manager will be responsible that all the personal participating in the monitoring process is properly trained in the CDM monitoring requirements.

Calibration of monitoring equipment

The metering equipment used to record the net electricity sold to the grid will be calibrated at least every two years.

Monitoring data adjustment procedures

Monitored parameters ($EG_{facility}$) and emission reduction calculations will be consolidated into monthly reports by the CDM manager, who will examine it for possible anomalies by comparing it with previous reports to verify consistency. The monitored parameter will be checked with records for sold electricity by the CDM manager; if there are discrepancies in data, the source of the error will be identified and corrected.

Data will be consolidated on a monthly basis and every discrepancies and corrective actions will be recorded in an appendix to the relevant report. If the corrective actions result in any adjustments to monitoring data then the relevant report will be revised.

Emission Reductions

Emission reductions will be calculated on a monthly and yearly basis, as well as part of the monitoring reports at every verification process. Emission reductions occurring as a result of the project activity will be summarized in a report that will be prepared by the CDM manager.

Updating the Baseline Emission Factor

The baseline emission factor will be updated at the end of each crediting period. The baseline emission factor will be calculated in accordance with the Tool to calculate the emission factor for an electricity system. The information used for updates will be summarized every time the emission factor is calculated. The update process will be made or revised by the CDM manager.

Environmental and Social Monitoring

The project manager will have ready at hand at every verification process all the environmental and social reports of the project (PROFEPA), and the formal documentation for every commitment, agreement or similar made in the context of the environmental and social processes of the project activity.

In addition the project manager will request an annual internal summary report of the progress in social commitments of the project.

Data and reports review procedures

Data will be reviewed by the Operation Manager and signed semiannually.

Internal GHG audit procedures

There are no requirements for internal audits of GHG project compliance with the plants operational requirement Operational procedures and responsibilities for monitoring and quality assurance of emissions reductions from the project activity are presented in the next table:

Responsible and responsibilities

Task	Technician	Operation Manager	CDM Manager
Collect data	E	-	E/R
Enter data into Spreadsheet/system	E	-	R
Make monthly and annual reports	-	R	E/R
Archive data & reports	E	-	E/R
Updating the Baseline emission Factor	-	R	E/R

(E = responsible for executing the task, R = responsible for overseeing and assuring quality, I = to be informed)

MONITORING INFORMATION

The following table contains the basic information to be managed by the project.

Data	The project generation data The project net generation measured data Invoices of net generation supplied to the grid
Quality of collection	Calibration of electricity meteres Which data comes? The above By what means does it come? e.g. by e-mail / CD How does it come? e.g In Excel How frequently does it come? e.g. yearly From whom does it come? e.g. from Centro Nacional de Control de Energía, CENACE
Quality of Data Processing	To whom does it come? e.g. technician Original data Organized data Entered data Processed data
Quality of Data Storage	Result **Office:** Prevention of Excel, or other document type, versioning problem. Data will be kept for two years after the end of the crediting period or the last issuance of CER's for this project activity, whatever occurs later. Acces of only authorized personnel. **Special programs:** Use of data protection programs. **Written documentation:** Use of official versions and control of number, date and final distribution locations.
Quality of Data Delivery	Keep all written documentation also in electronic version.

	Have special location for document storage. Provide to the audit team the original version of the information (internal and external).

I.