CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)
Version 03 - in effect as of: 22 December 2006

CONTENTS

Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
03	22 December 2006	• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.

SECTION A. General description of small-scale project activity

A.1 Title of the small-scale project activity:

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Small-scale project of the Hydroelectric Power Plant of Cañazas.
Version 01
14th of January, 2008

A.2. Description of the small-scale project activity:

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The project involves the construction of a hydroelectric power plant with an installed capacity of 5.94 MW in the Cañazas river, and a mean annual generation of 27.17 GWh. The purpose of the project is to cover the forecasted increase of demand for electricity, in accordance with the Expansion Plan of the Interconnected National System of Panama. In addition, the efficiency of the electrical system of Panama will be increased, thus facilitating the transport of electricity to all provinces in the country. Likewise, the progress of this project shall contribute to the local and global sustainable development, since the CO_2 emissions of the electricity system of Panama will be reduced.

The hydrological project of Cañazas will be executed with a run-of-river plant that will make use of the instantaneous flow of the river. The plant will not have a reservoir, since the water will be obtained from the left bank, being bypassed by the conduction channel to the loading chamber and, once it has been driven through a turbine, the water will be returned to the bed through the discharge channel.

The hydroelectric power plant of Cañazas is located in the province of Veraguas (Panama), in the district of Cañazas. The plant will process a mean flow of 6.65 m^3/s, 323 m over sea level. From this load point, the pressurised water will be driven to a loading chamber, where the pressure pipe connects to the engine house, which is where the electromechanical equipment is hosted. The pressure pipe is composed of an overhead pipe supported on concrete anchoring and seating elements, as a result of the characteristics of the terrain. Likewise, the electromechanical equipment is composed of two Francis turbines, rated at 2970 kW each, as well as two generators, in addition to the rest of remaining auxiliary units, such as the protection, measurement, control, etc. units. A 48 km long line will be built from the engine house to the connection substation of Barbera in Santiago.

PLANT DATA	
Installed capacity (MW)	**5.94**
Mean annual generation (GWh per year)	**27.17**
Usage hours at full load per year	**4,573**
Drainage area (Km^2)	**83.06**
Average flow (m^3/s)	**6.65**
Design flow (m^3/s)	**6.35**
Forecasted ecological flow (m^3/s)	**0.665**
Minimum technical flow (m^3/s)	**1.27**
Dam	**Conventional Concrete**
Type of connection	**Tyrolean**

Length of the conduction channel (m)	**1,900**
Length of the pressure pipe (m)	**600**
Diameter of the pressure pipe (m)	**1,55**
Operating level (m above sea level)	**323**
Turbine discharge level (m above sea level)	**200**
Gross drop (m)	**123**
Net operating drop (m)	**114**
Number of turbines x Unit Capacity	**2x2970 kW Francis type**
Length of the transmission line at 34.5 kv (km)	**48**

The hydroelectric energy is produced as the result of the expansion in the electrical generation capacity of renewable energy sources, shifting the use of energy sources that, in the absence of plants, would be partially generated by fossil fuel consuming plants (mainly bunker or diesel), which emit greenhouse gases. Therefore, the growing demand for electricity in the country can be catered for, with an approach that is compatible with the sustainable development principles and commitments acquired by Panama in the Electricity Sector's Energy Policy. The main purpose of this state policy is to facilitate the supply of the energy needs of the country with criteria focused on economic efficiency, quality and reliability, increased coverage of services, development of the sustainable exploitation of natural resources and promotion of the rational and efficient use of energy, while respecting the environment.

Likewise, it is aimed at the promotion of renewable and clean energies, with the purpose of stabilising the price of energy, by means of decreasing the amount of electricity generated by fuels and, therefore, mitigating the environmental impact caused by associated emissions. Therefore, this policy goes hand in hand with the Kyoto Protocol, of which Panama is a signatory, having access to the carbon credits that will contribute towards the development of renewable and clean energy projects with the clean development mechanism.

The guidelines of the Energy Policy of Panama as regards the electricity sector are established in article 2 of Act 6, February 3rd, 1997, with the purpose of:

- Meeting the demand of electrical energy services and making the community's access to them possible, based on economic efficiency, financial viability, quality and reliability of the service, within a framework of rational and efficient use of the different energetic resources of the country by, for example, optimising the water resources of the country or adding renewable systems.
- Establish the legal framework to motivate the attainment of economic efficiency in the development of the activities related to the generation, transmission, distribution and use of electrical energy.
- Promote competitiveness and the participation of the private sector as basic instruments to increase the efficiency in the delivery of services, with the methods deemed as most convenient for such purposes.

A.3. Project participants:

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Name of the party involved	Public or Private Entity(ies) participating in the project	Indicate whether the party involved wishes to be considered as a project participant or not (Yes/No)
Panama	NATURAL POWER AND RESOURCES, S.A. SECCI – Initiative for Sustainable Energy and Climate Change of the Inter-American Development Bank	No

A.4. Technical description of the small-scale project activity:

A.4.1. Location of the small-scale project activity:

A.4.1.1. Host Party(ies):

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Panama

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

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Province of Veraguas

A.4.1.3. City/Town/Community etc:

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District of Cañazas

A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale project activity :

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The project of the Hydroelectric Power Plant of Cañazas is located in the Cañazas River, province of Veraguas. The level of operation is 323 m over sea level and the level of discharge of the turbine is 200 m over sea level, so that the gross drop is 123 m.

The UTM coordinates of the site are:

- Dam location: 9240950 m N- 476 950 m E
- Charge chamber: 923 500 m N- 476 150 m E
- Engine house: 923 550 m N- 475 550 m E

A.4.2. Type and category(ies) and technology/measure of the small-scale project activity:

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In accordance with the appendix B of the "Simplified modalities and procedures for small-scale CDM project activities", published by the UNFCCC, the category of project activities corresponds to type I, "Renewable energy projects, Category" and category .D.- "Electricity generation for a system".

This project is included in this category as a result of the following:

- The generation source is a renewable source, as is the case of hydroelectric energy.
- The project's nominal power rating does not exceed the 15 MW capacity limit imposed by the UNFCCC.
- The electricity generated by the Hydroelectric Power Plant of Cañazas will be wholly transferred to the electrical distribution system of Panama.

This project produces a reduction in the emission of greenhouse gases (GHG) in the energy sector of Panama and, in particular, leads to the reduction of these gases, which are derived from the combustion of fossil fuels in thermal power plants.

The technology used in the project's equipment is relatively modern, although simple, in order to guarantee the energetic performance that can cover the electrical generation requirements. The characteristics of the infrastructures used are the following:

- Water collection: water intake or water bypass point, located at 323 m over sea level.
- Pressure pipe: overhead pipe, supported on concrete anchoring and seating elements, with a length of 600 m and a diameter of 1.55 m.
- Engine house: This building integrates the spaces required to host two Francis turbines with their generators and respective auxiliary equipment (protection, measurement, control, instrumentation, etc.). The capacity of each turbine is the same and equivalent to 2,970 kW. The performance of the turbines is 88% and that of the generators is 95%.
- Substation and transmission line: there are no large consumption points near the plant, so that a line will be built from the engine house to the connection substation. The 4.16 kV generation of the equipment must be converted to the transmission voltage (34.5 kV). The length of the line will be 48 kilometres, connected to the Barbarena substation in Santiago.

A.4.3 Estimated amount of emission reductions over the chosen crediting period:

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The project's activity is based on the generation of hydroelectric energy and, therefore, obtaining a "zero" emission factor in terms of greenhouse gas emissions. Said generation will shift part of the production of electricity coming from thermal power plants, which use bunker C or diesel to generate energy and, therefore, it will reduce the emissions of CO_2 associated to the production of electricity in Panama's energy system.

The forecasted reduction of emissions derived from the operation of the Hydroelectric Power Plant of Cañazas is shown on the following table, with an estimated mean annual production of 27.17 GWh, and with the application of the simplified baseline methodology set forth by the UNFCCC for small-scale electricity generation projects from renewable sources:

		Estimation of the reduction of emissions in tonnes of CO_2
Year	2010	17.289
	2011	17.289
	2012	17.289
	2013	17.289
	2014	17.289
	2015	17.289
	2016	17.289
Total forecasted reductions during the first crediting period		121,023
Total number of crediting years		7 (Renewable twice until 21 years are completed)
Mean forecasted annual reductions during the crediting period (tonnes of CO_2 per year)		17.289
Total reduction of emissions, considering three periods of 7 years each		363.069

A.4.4. Public funding of the small-scale project activity:

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This project does not include Public finance sources.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large scale project activity:

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In accordance with the information stated in Annex C, " Simplified modalities and procedures for small-scale CDM project activities", this project is not a separate component of a greater project activity, provided that the project participants have not registered or are in the process of registering or executing a different project within the surrounding region to that of the hydroelectric project of Cañazas.

SECTION B. Application of a baseline and monitoring methodology

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

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Simplified methodologies of the baseline for small-scale CDM projects.
I.D Project activity, (AMS-I.D.), version 13, December 14th, 2007 – "Generation of electrical energy with renewable sources connected to the grid".

The application of this methodology has been supplemented on the basis of version 01 of the Document entitled "Tool to calculate the emission factor of an electricity system". Furthermore, the additionality of the project has been analysed, in accordance with version 04 of the Document entitled "Tool for the demonstration and assessment of additionality".

B.2 Justification of the choice of the project category:

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According to appendix B of the document "Simplified modalities and procedures for smalll-scale CDM project activities", project activity is included in type I, "Renewable energy projects, Category" and category .D.- "Electricity generation for a system". The project activity proposed complies with all conditions required for its application, since:

- The nominal power rating of the project does not exceed the 15 MW capacity limit imposed by the UNFCCC since it is considered as small-scale project.
- The electricity generated by the Hydroelectric Power Plant of Cañazas will be wholly transferred to Panama's electrical distribution system.

B.3. Description of the project boundary:

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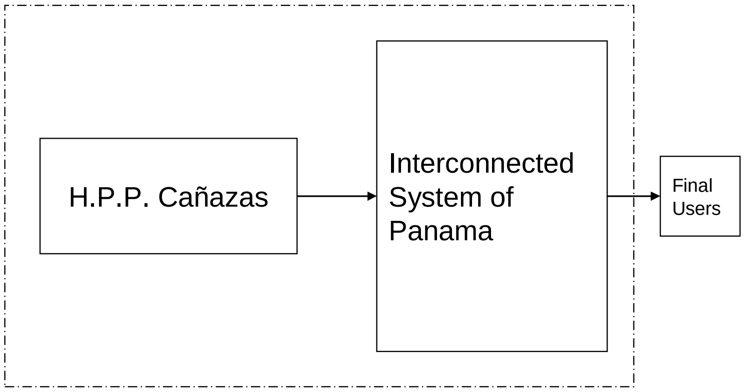
The scope of the project is defined as the surrounding project boundary, in which the impacts of the project will be calculated in terms of CO_2 emissions. As stated in Appendix B "Simplified modalities and procedures for small-scale CDM project activities", the scope of the project for small-scale hydroelectric plants that supply energy to the grid includes the physical and geographic location of the source of generation of renewable energy.

The scope of the system for the project is defined as the national interconnected system of Panama. Therefore, the scope of the system shall include the calculation of the baseline of all direct emissions in the production of electricity in the plants where there is combustion of fossil fuels that are shifted by the activity of the CDM project.

In accordance with the modes and procedures of small-scale activities, the emissions related to the production, transport and distribution of fuels used in baseline plants shall not be included in the scope of the project, since they do not take place in the same physical and geographic location of the project. Likewise, the emissions coming from transport activities have also been excluded from the scope of the project.

The spatial extension of the limits of the project includes the physical location of the project (Hydroelectric Power Plant of Cañazas) and all plants connected to the electrical system, which will be connected to the plant (Interconnected System of Panama), as shown on the following figure:



Operation of the Electricity Market in Panama.

The electricity market of Panama is a traditional supply and demand-based market, where generators must compete to close energy and/or power acquisition/sale contracts in public tenders or sell energy to large consumers or the occasional market. The electricity generation market is composed of hydroelectric and thermoelectric energy generators or the generators of other sources of energy that are interconnected through the ETESA transmission system, transferring energy in kWh and power in kW. Energy is transferred by ETESA to the distribution companies, who carry it to companies, homes and other users of the electricity sector.

There are two markets: the contracts market and the occasional market. The contracts market is based on the acquisition or sale of energy and/or power between generators, distributors and large clients. Distributors must submit a tender for the coverage of 100% of the demand of its clients regulated with a firm power rating, in the form of a public tender. The occasional market is the market of energy where the difference between what is established in the contracts and the real generation of each plant is balanced.

B.4. Description of baseline and its development:

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The project's activity is based on the construction of a new plant that will be integrated in the National Interconnected System of Panama. Said System is composed of a series of plants that consume fossil fuels and hydroelectric power plants. Given the increase in demand for electricity, new plants will be added to the system. Therefore, the baseline scenario can be described as one where electricity that will be carried by the project to the grid will be generated by the plants currently in operation, as well as those added to the System. These two aspects have been considered in the calculated Combined Margin for the baseline, as explained later on.

In accordance with the specifications of the simplified baseline methodology approved by the UNFCCC for I.D. projects – "Generation of electrical energy with renewable sources connected to the grid", the use of a combined margin has been selected for the calculation of the baseline, in accordance with the "Tool to calculate the emission factor for an electricity system".

The baseline study was carried out in 14/01/08 by:
Novotec Consultores, S.A., Tel.: +34 91 210 79 00 (contact: David Llorente Ónega, dllorente@novotec.es; Raquel García Alonso, rgarciaa@novotec.es)

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 small-scale CDM project activity:

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The additionality of the project's activity has been analysed applying the Attachment A to Appendix B of the "Simplified modalities and procedures for small-scale CDM project activities", using the "Tool for the demonstration and assessment of additionality" (Version 4). In accordance with the tool, the steps that must be followed are:

Step 1. Identification of the alternatives of the project's activity in compliance with the current legislation and regulations.

Sub-step 1a. Define the alternatives to the project's activity:

The alternatives defined are the following:

- Continuation of the current trend to add capacity to the system (baseline scenario)
- Execution of the project without its registration as CDM

Sub-step 1b. Compliance with the current legislation and regulations

The aforesaid alternatives and the project's activity comply with the applicable regulatory and planning requirements. The planning of the Panamanian electricity sector is established in the 2006-2020 Expansion Plan, which establishes the guidelines for the evolution of the Panamanian generation park, with a study of the four potential scenarios, in accordance with the provision of energy sources used. The following table shows the short and medium-term actions described in the document. The analysis of the base generation scenario has taken into account the projects which will definitely start to operate during the 2007-2014 period. In the case of thermal power plants, only the thermoelectric projects that use traditional fuels, such as bunker or diesel, have been taken into account. However, the Expansion Plan has analysed scenarios with other fuels, such as natural gas and carbon.

Projects included in the Panamanian Generation Expansion Plan in the short and medium-term				
Project	**Description**	**MW**	**Forecasted date of commissioning**	**CDM**
Concepción	Hydroelectric Power Plant Run-of-River Plant	10	2007	YES
Paso Ancho	Hydroelectric Power Plant Run-of-River Plant	5	2008	YES

Projects included in the Panamanian Generation Expansion Plan in the short and medium-term				
Project	**Description**	**MW**	**Forecasted date of commissioning**	**CDM**
Bajo de Mina	Hydroelectric Power Plant Run-of-River Plant	51	2009	[I]
Gualaca	Hydroelectric Power Plant Run-of-River Plant	20	2009	[I]
Los Algarrobos	Hydroelectric Power Plant Run-of-River Plant	10	2009	YES
El Sindigo	Hydroelectric Power Plant Run-of-River Plant	10	2009	[I]
Bonyic de Mina	Hydroelectric Power Plant	30	2009	[I]
CCBLM_ Gas	Combined Cycle Transformation of Marine Diesel to natural gas in Bahía las Minas	160	2010	NO
El Alto	Hydroelectric Power Plant Run-of-River Plant	60	2010	[I]
Chang 75	Hydroelectric Power Plant Run-of-River Plant	135	2010	NO
Pando	Hydroelectric Power Plant Run-of-River Plant	32.6	2011	[I]
Medium speed engines	Medium speed engines	100	2011	NO
Medium speed engines	Medium speed engines	100	2012	NO
Monte Lirio	Hydroelectric Power Plant Run-of-River Plant	52	2013	[I]
Mendre	Hydroelectric Power Plant Run-of-River Plant	16.4	2013	[I]
Chang 140	Hydroelectric Power Plant Run-of-River Plant	132	2014	[I]

Source: 2006-2020 SIN Expansion Plan

[I] Project included in the CDM project portfolio of Panama

Step 3. Analysis of barriers

This section includes the analysis of the barriers to the project's activity, which hinder its execution and, therefore, make the baseline scenario more attractive. Based on this information, the project can be considered as additional.

Sub-step 3a. Identification of the barriers that could prevent the implementation of the project activity proposed

The barriers identified are the following:

- **Barriers in the common practice**: In Panama, the electricity generation scenario has been mainly composed of electricity generation installations that use thermal sources and large hydroelectric power plants. As regards the small-scale hydroelectric power plants, four installations are currently in operation (Hidro Panamá, Dolega, Macho Montes and Hidro Candela), which represented approximately 0.25% of the total electricity generated in the country in 2006. Therefore, the project's activity should not be considered as a common practice.
- **Sector barriers**: There are also a series of uncertainties surrounding the value of sale of electricity generated and the values charged by capacity, which are also related to the availability of fuels and the reliability of the Interconnected System, since it can not be mainly based on hydroelectric energy because of hydro-geologic uncertainties.
- **Social and institutional barriers:** Given their dependence on hydrologic and topographic conditions, run-of-river plants must be located in specific areas that can affect local populations.
- **Political and investment barriers:** Since there is no reservoir, the generation of electricity of run-of-river hydroelectric power plants depends on the instantaneous availability of water in the intake point. Therefore, this point adds uncertainty to the profitability of the project, which can be modified as a consequence of the local impacts of the climatic change as regards the water resources. All in all, the profitability of the investment required for the execution of the project is conditioned by the weather conditions.

Sub-step 3b. Justification of the fact that the barriers identified can not prevent the implementation of at least one of the alternatives (except the project activity proposed)

The current trend of adding capacity to the system is characterised by the construction of thermal power plants that use diesel or bunker fuels, as well as the construction of hydroelectric power plants associated to reservoirs or large run-of-river plants. These alternatives can benefit from major advantages, since they must not face the following barriers when adding capacity to the system:

- **Barriers in the common practice**: The mean growth rate of the demand for energy in Panama is 4.2%, so that the system must find generation sources that can guarantee a constant supply of energy. Therefore, and despite the negative weather and social consequences associated to the use of fossil fuels to obtain energy, the Panamanian thermal power plants that use traditional fuels (diesel or bunker) and other fuels, such as carbon and natural gas, will continue to be the main options for the expansion of the energy generation system.
- **Sector barriers**: Thermal power plants do not depend on weather conditions, so that their participation in the distribution system will only depend on their efficacy and price, provided that fuel is available. In the case of hydroelectric power plants with a reservoir, they can administrate water resources with said reservoir, which makes them more reliable in the generation of energy

when compared to run-of-river plants. Therefore, these two types of plants have a lower degree of uncertainty than in the case of the project's activity, making their investment more attractive and safe.

- **Social and institutional barriers:** Thermal power plants do not depend on the hydrologic or topographic conditions, so that they can be located in specific areas with a lower social impact. In the case of the main plants with a reservoir or run-of-river plants, their location does depend on said conditions.
- **Political and investment barriers:** Conventional thermal and hydroelectric power plants are more attractive investments than small-scale run-of-river hydroelectric power plants, since they do not depend on the weather conditions and water reserves, while the latter have a reservoir, so that they have a lower degree of dependence when compared to run-of-river hydroelectric power plants.

In conclusion, the hydroelectric project of Cañazas must face a series of barriers, mainly those derived from aspects that are based on the common practices in the country, so that, in the absence of the incentive created by the Clean Development Mechanism, it would not be the most attractive scenario and we are therefore facing an additional project when we take into account the barriers in the execution of the project.

Step 4. Analysis of common practices.

Sub-step 4a. Analysis of other activities similar to those of the project

As we have stated above, the electricity sector in Panama is mainly composed of thermal power plants that use bunker or diesel fuels, as well as large hydroelectric power plants. In the case of hydroelectric power plants, we must differentiate between the large plants and small-scale hydroelectric power plants (small-scale) with a power rating that does not exceed 10 MW. Both types of plants can be classified in plants with a reservoir or run-of-river plants. The investment in the latter has a greater risk associated to them, since the availability of water resources that can guarantee the level of production can not be regulated, despite the fact that they have a lower environmental impact. In fact, in 2006 only 4 small-scale run-of-river hydroelectric power plants supplied electricity to the grid (Dolega, Macho Montes, Hidro Panamá and Hidro Candela). During this year, the plants generated 0.25% of the total energy generated by the system and they represented 0.58% of the total installed capacity for the whole Interconnected System of Panama, so that we can guarantee that the project activity proposed is not a common practice in Panama and it does not correspond to the baseline scenario.

SMALL-SCALE RUN-OF-RIVER HYDROELECTRIC POWER PLANTS			
Name of the plant	**Situation**	**Date of commissioning**	**Installed capacity (MW)**
Dolega	In operation	2006	3.12
Macho Montes	In operation	2006	2.40
Hidro Panamá	In operation	2006	2.80
Hidro Candela	In operation	2006	0.53

ANALYSIS OF THE IMPORTANCE OF SMALL-SCALE RUN-OF-RIVER HYDROELECTRIC POWER PLANTS DURING 2006		
Total capacity of the SIN	1,528,050	kW
Capacity of small-scale run-of-river hydroelectric power plants	8,850	kW
% small-scale run-of-river hydroelectric power plants	0.58	%
Total generation of the IS	5,737,580,980	kWh
Generation of small-scale run-of-river hydroelectric power plants	14,314,010	kWh
% small-scale run-of-river hydroelectric power plants	0.25	%

Sub-step 4b. Discussion about other similar options used

The operations of large capacity hydroelectric power plants, and even the repotentiation of some of these plants to add capacity, has been and continues to be a common practice in Panama, as is the case of the expansion of the plants of Bayano I and II.

Likewise, the construction of new large capacity hydroelectric power plants has taken place during the past few years, as is the case of the plants of Estí, and the Panamanian Expansion of Generation projects, as is the case of Bajo de Mina, Bonyic de Mina, etc. Therefore, the construction of this type of plants can be considered as a common practice.

In the case of the project's activity, the Clean Development Mechanism has increased the feasibility of the scheme for small-scale run-of-river plants as a valid option. In fact, two of the latest small-scale run-of-river plants have been registered by the executive board[II]. Likewise, there are another two projects registered as CDMs, Paso Ancho and los Algarrobos, which will be commissioned in 2008 and 2009, respectively. Therefore, we can see how the project's activity can hardly be developed without this mechanism. We must state that, with the coming into force of Act no. 45, August 2004, the installation of new hydroelectric generation systems has been encouraged, since there is an incentives regime for the promotion of new hydroelectric generation systems and other renewable and clean sources of energy.

Therefore, the application of the additionality tool shows that:

- the project's activity can not be compared to the baseline scenario, characterised by the construction of major hydroelectric and thermal power plants.
- the project's activity is not a common practice in the electricity sector of Panama, which uses this technology in a much reduced percentage.
- the project's activity has important barriers that are not present in the baseline scenario or which are not as important.
- these barriers can be partially overcome with the registration of the project as a CDM.

[II] Plants of Dolega and Macho Montes, both commissioned in 2006.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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The project of the small-scale hydroelectric power plant of Cañazas will be integrated in the National Interconnected System of Panama. It is characterised by the generation of hydroelectric and thermal energy from diesel and bunker fuels, 59% and 41%, respectively. Small-scale plants based on renewable energies play a very small part and represent less than 0.5% of the energy generated and they produce less than 1% of the installed capacity.

GENERATION DATA OF THE NATIONAL INTERCONNECTED SYSTEM DURING THE YEAR 2006					
Type of resource		**Generation**		**Capacity**	
		GWh	**%**	**MW**	**%**
Hydroelectric		**3,376.03**	**58.8%**	**830.2**	**54.7%**
Thermal		**2,347.10**	**40.9%**	**689**	**45.4%**
	Bunker	1918.3	33.4%	327.5	21.6%
	Light Diesel	281.0	4.9%	135.5	8.9%
	Marine Diesel	147.8	2.6%	226	14.9%
Small-scale		**14.45**	**0.25%**	**8.85**	**0.58%**
	Hydroelectric	14.456	0.25%	8.85	0.58%
Total		**5,737.58**	**100.0%**	**1,528.05**	**100.0%**

Source: Own source, with the data provided by the National Dispatch Centre

The electricity generated by the Hydroelectric Power Plant of Cañazas will shift electricity from the grid that would be generated by conventional plants. As we can see in the previous table, these plants include thermal energy plants, which produce greenhouse gases. Therefore, the start of the project's activity would lead to a reduction in the total CO_2 emissions of the National Interconnected System of Panama.

To calculate the reduction of emissions generated by the project's activity, the AMS-I.D. methodology is going to be used, version 13, for small-scale projects. In accordance with this methodology, the calculation of the emission factor must be carried out with the "Tool used to calculate the emission factor of an electricity system", version 01. Therefore, the reduction of emissions will be calculated with the baseline emissions obtained from the calculation of a combined margin factor, resulting from the weighting of two factors:

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

- *build margin emission factor:* introduces the calculation of GHG emissions avoided as a result of the effects of increasing the capacity by adding plants to the system.

The calculation of this combined factor uses the total hourly generation data available on the web page of the National Dispatch Centre of Panama, a non-profit subsidiary of Empresa de Transmisión Eléctrica, S. A. (ETESA), which will coordinate the operations and transactions between the participants of the Wholesale Power Market. The following information has been gathered from this source and other additional sources:

BASIC INFORMATION FOR THE CALCULATION OF THE BASELINE	
Data	**Source**
Fuel emission factor	2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2.
Performance	2006 SIN Expansion Plan, drafted by ETESA.
Hourly electricity generated by the whole system during the year 2006	National Dispatch Centre (NDC)
2006 Exports (hourly data)	NDC
Type of fuel used in each plant	NDC

Since the hourly generation data could not be obtained for all plants, the dispatch analysis method (option c) could not be selected for the calculation of the **operating margin emission factor**. One of the restrictions on the use of the simple method for the calculation of the operating margin factor is that it can only be used when low-cost/must-run plants represent less than 50% of the total generation of the system, using the average of the last five years. In the case of Panama, this method can not be used, since this type of plants has represented more than 50% (data from the National Dispatch Centre), as shown on the following table:

Year	% Low-cost/ Must-run
2002	**61.6**
2003	**48.8**
2004	**63.6**
2005	**63.4**
2006	**59.1**
Average	**59.3**

Therefore, the method selected for the calculation of the operating margin factor has been the simple adjusted method (option b) of the abovementioned tool. This method is a variation of the simple method, where low-cost/must-run plants are separated from all other plants for the calculation of the factor.

These options include the tool for the calculation of the operating margin factor with the method selected, choosing the ex-post option, which will be updated each year during the crediting period in the monitoring plan.

"Option 2" has been chosen in the **build margin emission factor** as the tool. Therefore, during the first crediting period, the factor must be updated each year with an ex-post approach, while, during the second period, the factor must be updated with the latest information available and this value must be used for the third crediting period.

In accordance with the "Tool used to calculate the emission factor of an electricity system", the **baseline emission factor** (EF_y) is calculated with the weighted mean of the operating margin emission factor ($EF_{OM,y}$) and the build margin emission factor ($EF_{BM,y}$). The weighting factors selected are identical for both factors ($w_{OM}=w_{BM}=0.5$).

A detailed description of the methodological options selected for the calculation of these factors is shown below.

a) Calculation of the operating margin emission factor ($EF_{OM,y}$): simple adjusted method

The option of the "Tool used to calculate the emission factor of an electricity system" is applicable to electrical systems, where % of the mean generation during a period of five years for low-cost/must-run plants exceeds the 50% value, as is the case of the Panamanian System. The main difference with the simple method lies in that this method takes into account this type of plants, differentiating them in the calculation of the emission factor from the rest of plants.

The plants registered as CDM project activities have been taken into account for the calculation of the operating margin emission factor, as established in the Tool. The option selected for the calculation of the emission factor for each plant is based on performance (option B1) of the different plants of the National Interconnected System of Panama. The procedure followed for the calculation of the operating margin includes the following stages:

1. The emission factor was calculated for each plant of the Panamanian electricity system, with the following expression:

$$EF_{EL,m,y} = Performance_m \times NCV_{i,y} \times \frac{1\,KJ}{0.24\,Kcal} \times FE_{i,m} \times \frac{1TJ}{10^9\,KJ} \times \frac{1t}{1000\,kg}$$

[Equation 1]

Where:

- $EF_{EL,m,y}$ is the emission factor of plant m, during year y in t CO_2/MWh.
- Performance is the performance (efficiency) of plant m (gal/MWh)[III]

[III] The values of all operating plants have been obtained from the 2006 SIN Expansion Plan of ETESA.

- NCV $_{i,y}$ is the net calorific value of fuel i during year y (Kcal/gal)[IV].
- $FE_{i,m}$ (kgCO_2/TJ) provides the quantity of CO_2 emitted by plant m for every TJ of fuel i used[V].

2. Value λ_y must be calculated before the calculation of the operating margin emission factor, using the following expression:

$$\lambda_y(\%) = \frac{\text{N° hours low-cost/must-run sources are on the margin during the year } y}{8760\, hours..per..year}$$

[Equation 2]

The steps required to calculate λ_y are:

- Step i: The total hourly generation data of the year are presented, from high to low, in comparison to the total 8760 hours of the year.
- Step ii: Calculate the total annual generation of low-cost/must-run plants ($\sum_k EG_{k,y}$).
- Step iii: Draw a horizontal line that crosses the line represented, so that the area under the curve represents the total generation of low-cost/must-run plants ($\sum_k EG_{k,y}$).
- Step iv: Determine value λ_y, taking into account that λ_y is calculated as X/8760, where X represents the hours on the right of the point of intersection.

3. The next step involves the calculation of the quantity of carbon dioxide emissions produced by energy unit generated by the system. The said emission factor ($EF_{DD,h}$) is obtained with the following expression:

$$EF_{grid,OM-adj,y} = (1-\lambda_y)\times\frac{\sum_j EG_{j,y}EF_{EL,j,y}}{\sum_j EG_{j,y}} + \lambda_y \times \frac{\sum_k EG_{k,y}EF_{EL,k,y}}{\sum_k EG_{k,y}}$$

[Equation 3]

Where:

- $EF_{grid,OM-adj,y}$ is the annual operating margin emission factor, and
- $EG_{j,y}$, $EG_{k,y}$ is the net electricity generated and supplied to the grid by plant j or k during the year and in MWh.

[IV] In this case, the values provided by the 2006 SIN Expansion Plan drafted by ETESA have been used, for the fuels used in Panama (Bunker, Light Diesel and Marine Diesel).

[V] In this case, the lowest values have been used within a 95% confidence interval, as shown on table 1.4 of page 1.23 of document “2006 IPPC Guidelines for National Greenhouse Gas Inventories”, using in each plant the factor applied, in accordance with the fuel used.

- $EF_{EL,m,y}$ is the emission factor of plant j or k, during year y and in t CO_2/MWh. It is calculated with equation No. 1.

After downloading the data corresponding to year 2006 from the web page of the National Dispatch Centre of Panama and applying the corresponding steps, the following value has been obtained for the operating margin emission factor:

$EF_{gird,OM\text{-}adj,2006} = 0{,}775$ t CO_2/MWh

Annex 3 includes more information about the calculations that have been carried out.

b) Build margin emission factor ($EF_{BM,y}$)

Option 2 of the "Tool used to calculate the emission factor of an electricity system", version 01, has been selected for the calculation of the build margin calculation factor, which states that, for the first crediting period, the build margin emission factor must be updated annually (ex-ante) so that it can be recalculated annually. The factor must be updated with the latest information available for the second period and this value will be used for the third crediting period.

The set of plants used for the calculation of the build margin factor is made up of the alternative that represents the greatest quantity of energy between the five plants that have been built recently, which generated 20% of the system's energy[VI].

Both cases have not included the plants registered as CDM project activities, as established in the methodology.

Once the option of the number of plants to use is selected, the build margin emission factor will be calculated with the following equation:

$$EF_{grid,BM,y} = \frac{\sum_{i,m} EF_{EL,m,y} \ x \ EG_{m,y}}{\sum_{m} EG_{m,y}}$$ **[Equation 4]**

Where:

- $EF_{grid,BM,y}$ is the build margin emission factor of the system in year y.
- $EF_{EL,m,y}$ is the emission factor of plant m in tCO_2/MWh, of the set of plants selected for the calculation of the build margin emission factor and it is obtained from equation 1.

[VI] While the PDD was being drafted, the five plants built most recently generated less than 20% of the system's energy, so that, to carry out the ex-ante calculations of the build margin emission factor, the set of plants that have been built recently and generated 20% of the system's energy during 2006 was selected for the calculations.

- $EG_{m,h}$ is the quantity of energy generated by plant m. This calculation uses the annual information per plant, provided on the web page of the National Dispatch Centre.

For the year 2006, following the previous steps, we have obtained the following build margin emission factor:

$EF_{gird,BM,2006} = 0.497\ tCO_2/MWh$

Annex 3 includes more information about the calculations that have been carried out.

c) Combined margin emission factor (EF_y)

The baseline emission factor (EF_y) is obtained with the combination of the operating and build margin emission factors:

$$EF_y = w_{OM} EF_{grid,O-adj,y} + w_{BM} EF_{grid,BM,y}$$ **[Equation 5]**

Where:

- EF_y is the baseline emission factor during year y.
- W_{OM} is the weight of the operating margin emission factor. A value of 0.5 has been taken.
- $EF_{grid, OM-adj, y}$ is obtained from Equation 3.
- W_{BM} is the weight of the build margin emission factor. A value of 0.5 has been taken.
- $EF_{gris,BM,y}$ is obtained with Equation 4.

The following global emission factor is obtained with the combination of the aforesaid factors for 2006:

$EF_{2006} = 0.636\ tCO_2/MWh$

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

>>

Data/Parameter:	Emission Factors
Data Unit:	$kgCO_2/TJ$
Description:	Emission factor of the plants, in accordance with the fuel used for the generation of energy.
Source of data used:	Table 1.4 on page 1.23 of the document “2006 IPPC Guidelines for National Greenhouse Gas Inventories”. Volume 2. (lower values with a 95% confidence interval)
Value applied:	See annex 3.
Justification of the choice of data or description of measurement methods and procedures actually applied:	Document “Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual” does not provide specific emission factors per thermal energy unit for Panama, so that the general values stated in Volume 2 of the “2006 IPPC Guidelines for National Greenhouse Gas Inventories” have been used.
Any comment:	These values will be revised when relevant bibliography is available.

Data/Parameter:	NCV
Data Unit:	Kcal/gal
Description:	Calorific value of the different fuels used in thermal power plants.
Source of data used:	2006 SIN Expansion Plan drafted by ETESA, for the fuels used in Panama (Bunker, Light Diesel and Marine Diesel)
Value applied:	See annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied:	The data published by ETESA has been used for the different fuels used in thermal power plants, since there is no official information available from the operators of each plant. Likewise, the data provided by ETESA is more representative for the plants in Panama than the general data of the IPCC.
Any comment:	These values will be revised when relevant bibliography is available.

Data/Parameter:	Installed capacity of the Hydroelectric Power Plant of Cañazas
Data Unit:	MW
Description:	---
Source of data used:	Project data
Value applied:	5.94
Justification of the choice of data or description of measurement methods and procedures actually applied:	---
Any comment:	---

B.6.3 Ex-ante calculation of emission reductions:

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

$$ER_y = BE_y - PE_y - L_y$$ **[Equation 6]**

Where:

- ER_y is the emission reductions (tCO_2e) in year y
- BE_y are the baseline emissions in year y
- PE_y are the project emissions in year y
- L represents the leakage emissions in year y

In accordance with the AMS methodology- I.D., version 13 and the “Tool used to calculate the emission factor of an electricity system”, version 01, there are no project emissions related to the generation of energy based on a renewable energy source. Likewise, the emissions caused by leakages are very low, since the plant will have a water reservoir, so that they should not be calculated.

Therefore, the calculation of the reduction of emissions only takes into account the baseline emissions. Its calculation will be carried out in accordance with the procedure stated in section B.6.1.

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

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The methodology presented in the previous sections and, based on known generation data, the forecasts are aimed at a reduction in the emissions during the three periods of the project’s activity, as shown on the following table:

Year	Forecast of the emissions of the project’s activity (tonnes of CO_2e)	Forecast of baseline emission(tonnes of CO_2e)	Forecast of leakages (tonnes of CO_2e)	Forecast of the reduction of emissions (tonnes of CO_2e)
2010	0	17,288.6	0	17,288.6
2011	0	17,288.6	0	17,288.6
2012	0	17,288.6	0	17,288.6
2013	0	17,288.6	0	17,288.6
2014	0	17,288.6	0	17,288.6
2015	0	17,288.6	0	17,288.6
2016	0	17,288.6	0	17,288.6
2017	0	17,288.6	0	17,288.6
2018	0	17,288.6	0	17,288.6
2019	0	17,288.6	0	17,288.6
2020	0	17,288.6	0	17,288.6
2021	0	17,288.6	0	17,288.6
2022	0	17,288.6	0	17,288.6
2023	0	17,288.6	0	17,288.6

Year	Forecast of the emissions of the project's activity (tonnes of CO_2e)	Forecast of baseline emission(tonnes of CO_2e)	Forecast of leakages (tonnes of CO_2e)	Forecast of the reduction of emissions (tonnes of CO_2e)
2024	0	17,288.6	0	17,288.6
2025	0	17,288.6	0	17,288.6
2026	0	17,288.6	0	17,288.6
2027	0	17,288.6	0	17,288.6
2028	0	17,288.6	0	17,288.6
2029	0	17,288.6	0	17,288.6
2030	0	17,288.6	0	17,288.6

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

The project's monitoring activities are carried out with the "Tool used to calculate the emission factor of an electricity system", version 01, following its monitoring methodology section (Section III). The project's activity of the Hydroelectric Power Plant of Cañazas is established within this document, whereby the following data must be monitored:

1. Electricity generated by the project's activity

2. Data required to recalculate the operating margin emission factor

3. Data required to recalculate the build margin emission factor

All data required for the verification and issue of RCEs will be stored in electronic format during at least two years after the end of the crediting period or the last issue of RCEs for the project.

B.7.1 Data and parameters monitored:

Data/Parameter:	Quantity of electricity generated by the Small-Scale Hydroelectric Power Plant of Cañazas
Data Unit:	MWh
Description:	Electricity generated by the Hydroelectric Power Plant of Cañazas during one year
Source of data used:	Measured with the hourly frequency. The corresponding data can also be downloaded from the web page of the National Dispatch Centre of Panama (www.cnd.com.pa).
Value of data applied with the purpose of calculating expected emission reductions in section B.5	27,170 MWh/ year
Description of the measurement methods and procedures to be applied:	The quantity of energy generated will be monitored each hour. The data obtained will be recorded once a month on a spreadsheet.
QA/QC procedures to be applied:	The measurement units of the energy transferred from the plant to the grid will be calibrated periodically in accordance with the standards established for such purposes.
Any comment:	---

Data/Parameter:	Electricity generated by each plant (m, j or k) of the National Interconnected System of Panama.
Data Unit:	MWh
Description:	Annual electricity generated by each plant (m, j or k) of the National Interconnected System of Panama.
Source of data used:	Web page of the National Dispatch Centre of Panama (www.cnd.com.pa)
Value of data applied with the purpose of calculating expected emission reductions in section B.5	The data obtained in the web page of the National Dispatch Centre of Panama for the year 2006 has been used.
Description of the measurement methods and procedures to be applied:	The quantity of energy generated by the plants during one year will be registered in the web page of the National Dispatch Centre of Panama, within the Report section. This system will be accessed once a year to download all annual data, which will be stored in an electronic spreadsheet.
QA/QC procedures to be applied:	The hourly data of the total generation of the system and the hourly data corresponding to each plant will be downloaded. The sum of all individual data will be checked, in order to ensure that it is similar to the total system generation data. In case there are differences between the two types of data, the reasons and sources will be analysed and errors will be corrected.
Any comment:	

Data/Parameter:	Total hourly electricity of the National Interconnected System of Panama.
Data Unit:	MWh
Description:	Hourly electricity generated by the National Interconnected System of Panama.
Source of data used:	Web page of the National Dispatch Centre of Panama (www.cnd.com.pa)
Value of data applied with the purpose of calculating expected emission reductions in section B.5	The hourly data obtained in the web page of the National Dispatch Centre of Panama for the year 2006 has been used.
Description of the measurement methods and procedures to be applied:	The quantity of energy generated by the plants during one year will be registered in the web page of the National Dispatch Centre of Panama, within the Report section. This system will be accessed once a year to download all annual data, which will be stored in an electronic spreadsheet.
QA/QC procedures to be applied:	The hourly data of the total generation of the system and the hourly data corresponding to each plant will be downloaded. The sum of all individual data will be checked, in order to ensure that it is similar to the total system generation data. In case there are differences between the two types of data, the reasons and sources will be analysed and errors will be corrected.
Any comment:	See data / parameter: Electricity generated by each plant (m, j or k) of the National Interconnected System of Panama.

Data/Parameter:	Plants considered for the calculation of the operating margin emission Factor (j and k).
Data Unit:	Text
Description:	Identification of the plants for the calculation of the operating margin emission Factor.
Source of data used:	National Dispatch Centre and Electricity Transmission Company of Panama
Value of data applied with the purpose of calculating expected emission reductions in section B.5	The data corresponding to year 2006 has been applied, provided by the National Dispatch Centre of Panama
Description of the measurement methods and procedures to be applied:	The information about plants that have dispatched electricity to the National Interconnected System will be gathered once a year, which will be registered electronically in a spreadsheet.
QA/QC procedures to be applied:	To detect potential errors, the list of plants included in the calculations will be compared with the plants used during previous years.
Any comment:	The generation reports of the National Dispatch Centre are valid to detect the plants that have been in operation during a year, in order to efficiently detect the plants that must be included in the GHG emission calculations.

Data/Parameter:	Plants considered for the calculation of the build margin emission Factor (m).
Data Unit:	Text
Description:	Identification of the plants for the calculation of the build margin emission Factor.
Source of data used:	National Dispatch Centre and Electricity Transmission Company of Panama
Value of data applied with the purpose of calculating expected emission reductions in section B.5	When using ex-ante calculations, the data have been provided by the National Dispatch Centre and the Electricity Transmission Company of Panama (see Annex 3)
Description of the measurement methods and procedures to be applied:	The information about the new plants built and which have been commissioned in the National Interconnected System of Panama will be gathered each year (for the first crediting period) and once (at the start of the second crediting period, for the second and third crediting period). The data will be registered in an electronic spreadsheet.
QA/QC procedures to be applied:	Comparison of the plants used in previous periods to detect potential errors. The differences found will be analysed one by one.
Any comment:	The web page of the National Dispatch Centre can be used to detect the plants that have been in operation throughout a year, so we can assess which plants might have been put in operation.

Data/Parameter:	Performance
Data Unit:	gal/MWh
Description:	Performance of the different plants connected to the National Interconnected System of Panama.
Source of data used:	2006 SIN Expansion Plan
Value of data applied with the purpose of calculating expected emission reductions in section B.5	See annex 3
Description of the measurement methods and procedures to be applied:	The data is recorded in the SIN Expansion Plans by ETESA.
QA/QC procedures to be applied:	---
Any comment:	The data can be updated in accordance with the latest information available.

Data/Parameter:	Emission factor of each plant ($EF_{EL,m,y}$)
Data Unit:	tCO_2/MWh
Description:	Emission factor of each plant, in accordance with the type and characteristics of the fuel used to obtain energy.
Source of data used:	---
Value of data applied with the purpose of calculating expected emission reductions in section B.5	See annex 3
Description of the measurement methods and procedures to be applied:	Calculated once a year with the application of Equation 1, section B.6.1.
QA/QC procedures to be applied:	---
Any comment:	The data will be updated in accordance with the latest information facilitated by the Panamanian electricity authorities.

Data/Parameter:	Operating margin emission factor ($EF_{grid,OM-adj,y}$)
Data Unit:	t CO_2/MWh
Description:	Operating margin emission factor
Source of data used:	---
Value of data applied with the purpose of calculating expected emission reductions in section B.5	0.775
Description of the measurement methods and procedures to be applied:	Calculated once a year, as specified in section B.6.1.
QA/QC procedures to be applied:	---
Any comment:	---

Data/Parameter:	Build margin emission factor ($EF_{grid,BM,y}$)
Data Unit:	t CO_2/MWh
Description:	Build margin emission factor
Source of data used:	---
Value of data applied with the purpose of calculating expected emission reductions in section B.5	0.497
Description of the measurement methods and procedures to be applied:	Calculated once a year, as specified in section B.6.1.
QA/QC procedures to be applied:	---
Any comment:	---

Data/Parameter:	Baseline emission factor (EF_y)
Data Unit:	t CO_2/MWh
Description:	Baseline emission factor
Source of data used:	---
Value of data applied with the purpose of calculating expected emission reductions in section B.5	0.636
Description of the measurement methods and procedures to be applied:	Calculated once a year, as specified in section B.6.1.
QA/QC procedures to be applied:	---
Any comment:	---

B.7.2 Description of the monitoring plan:

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This section will describe the tasks developed in the project, with the purpose of the regular monitoring and follow-up of the project's activity, thereby designing a monitoring plan aimed at guaranteeing that the project's activity will be correctly organised in terms of the gathering and maintenance of information, from the start of the operation, in order to carry out realistic calculations of the GHG emissions.

Therefore, the responsibilities of the personnel involved in the project activity monitoring and follow-up tasks will be defined before the start of the crediting period. In this sense, the first task developed has been the appointment of a Project Manager who shall assume the global responsibility for the development and execution of the plan.

The Project Manager will be responsible for the implementation and update of the list of procedures, making sure that the calculations for the reduction of emissions obtained are realistic and based on evidence. Likewise, he will be in contact with the person responsible for the execution of the Environmental Handling Plant of the Small-Scale Hydroelectric Power Plant, with the purpose of guaranteeing the execution of the project and that it contributes to the social and environmental development of the District of Cañazas. A set of spreadsheets has been designed to automate the process for the calculation of the emission factors with the purpose of facilitating the calculations required in the follow-up and monitoring tasks, which will be analysed in Annex 4 of this document. The successive calculation of the reduction of emissions in these spreadsheets will be summarised in monitoring and follow-up reports that will be subject to third-party verification.

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

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Date of completion of the application of the baseline study and monitoring methodology:

14th of January, 2008

Name of responsible person(s) / entity(ies):

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NOVOTEC CONSULTORES S.A. is not a participant of the project.

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:

>>
30/05/2008

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

>>
40 years

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

C.2.1. Renewable crediting period

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

>>
31/03/2010

C.2.1.2. Length of the first crediting period:

>>
7 years (renewable)

C.2.2. Fixed crediting period:

Not selected.

C.2.2.1. Starting date:

>>

C.2.2.2. Length:

>>

SECTION D. Environmental impacts

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D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity will be provided:

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The project's promoter commissioned Soluciona, S.A. to carry out the "Environmental Impact Study for the development of the Hydroelectric Power Station Project in Cañazas", which will be used to define the prevention and mitigation measures required to control, compensate and prevent the negative impacts generated by the project and to maximise positive impacts.

This document was presented to be processed by the National Environmental Authority and was approved by Environmental Resolution No. IA-053-2005 on the 24th of June, 2005.

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:

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In this sense the positive and negative impacts on the project were identified, analysed and classified in a hierarchy, from the environmental point of view. The assessment of the impacts was carried out during the build and operating phase, where the following sources of environmental impact were identified:

- Build phase:
    - Topographical survey and geologic studies
    - Installation of temporary facilities
    - Rehabilitation and construction of access paths
    - Cutting down of vegetation
    - Cleaning works sites
    - Earthwork and excavations
    - River processing
    - Civil works, excluding earthworks and excavations
    - Handling of waste
    - Commissioning of the plant

- Operating phase:
    - Operation of the plant
    - Presence of structures
    - Discharge of sediments
    - Cleaning of the channel
    - Maintenance of the plant and structures

One of the sections of the Environmental Impact Study deals with the Environmental Handling Plan, which is made up of four plans, corresponding to the set of activities that must be carried out with the purpose of preventing, correcting or compensating the potential negative impacts and promote positive impacts identified. The main objectives of the Plan are:

- To establish a set of Programs and procedures so that the project can be executed in a way that is compatible with the environment throughout all stages.
- To prepare the plans required to prevent and face anomalous or unforeseen situations.
- To assess the evolution of environmental components that are sensitive to the activities generated by the project.
- To verify the need to carry out complementary actions to correct environmental impacts.
- To supervise the compliance with the animal protection measures.
- To determine the efficacy of the environmental protection measures.

The four plans of the Environmental Handling Plan are:

- Plan to address the prevention, mitigation, compensation and repair measures.
- Monitoring, supervision and control program.
- Risk prevention plan.
- Contingency plan.

This document defines a project with moderate, compatible or beneficial environmental impacts, both in terms of the effects on the physical environment (inert, biotic and perceptual) and the socio-economic and cultural environments. Therefore, we can conclude that the Hydroelectric Power Plant Project in Cañazas is viable from the environmental point of view, since the most important impacts can be adequately mitigated.

SECTION E. Stakeholders' comments

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

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Given the nature of social dynamics and the environmental implications of the Project, a chapter dedicated to the Citizen Participation Plan was added to the Environmental Impact Study. Therefore, a big effort was undertaken as regards the rapprochement policy with the communities of the area of influence of the project, while maintaining an absolutely transparent policy, in relation to the project's information revealed to the communities involved and to the organisation itself. This policy of rapprochement with local communities has materialised in the informative actions and the surveys undertaken with local communities, with the purpose of knowing their opinion about the project.

Two techniques were used, based on the specific characteristics of the communities:

- *Surveys*: the surveys obtained the data about the perception on the execution of the Project and the immediate needs of the inhabitants of said communities from the population that would receive the potential impact. The surveys were carried out in the homes nearest the Project area. At the same time, the district authorities and boroughs were interviewed and surveyed.
- *Meetings*: the actions executed in the hydroelectric project of Cañazas were presented in the meetings, obtaining the opinions of the communities in relation to the action, so that these could be included in the environmental decision.

E.2. Summary of the comments received:

>>

- *Surveys:*

    - A total of 27 surveys were conducted in the areas near the project site. Given the low level of knowledge about the type of project and the type of activity of the project, it was necessary to establish a different mechanism to inform the communities of Coteral and Alto Ibala about the project and the environmental implications for the area as a result of the construction and commissioning of the power plant.
    - A meeting was held on the 16th of July 2004 with the district authorities and respective boroughs (El Picador and Cañazas) to explain them the project and its implications. In addition, they received a questionnaire with the main purpose of determining the level of understanding of the authorities on the project, as well as their perception towards the communities in the area.

50% of the authorities surveyed stated that they knew about these types of projects and the same percentage stated that they have a positive impact. Likewise, as regards the benefits, 100% of the authorities agree on the development of the Project. The benefits expected by the authorities are: communication paths and roads, development of poultry-related projects, employment growth and an improved standard of living.

- *Meetings:*

  - Meeting with the Community of Alto Ibala (24th of July 2004): the main concerns of the public attending the meeting were the dimensions of the conduction channel, the potential contamination of water discharged and the depth of the pressure pipe. In addition, they suggested the creation of a community committee for the supervision of the compliance with the Environmental Handling Plan.
  - The labour force available in the communities must be inventoried, finding a large number of inhabitants linked to construction and electricity activities.
  - Meeting with the borough of Cañazas (25th of July, 2004): The main concerns presented by the public were the impact of the pedestrian bridge over the Cañazas River, the possible contamination of discharged water, what would happen if owners do not wish to sell their property, benefits to the inhabitants of the area, why was the Cañazas River chosen, existence of a preferential price of electricity for neighbouring communities and the social benefits of the project.
    The labour force available in the communities must be inventoried, finding a large number of inhabitants linked to construction and electricity activities.

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

>>

A series of compensation measures have been included in the Environmental Impact Study, with the purpose of creating an alternative positive impact that is equivalent to an adverse effect identified within the project. The compensation measures are described next:

- Improvements in the community infrastructure:
  These will be implemented in two stages: during the first stage, improvements will be implemented in the Health Centre and the second stage will include series of improvements in the School of Alto Ibala.

- Economic aid with educational purposes:
  An annual scholarship will be granted to the top three 6th grade students who start their studies in the First Cycle of the César Clavel Méndez School located in Cañazas.

- Training in appropriate and sustainable agricultural technologies:

Preliminary, informative and transfer workshops will be developed to train and assist workers in the techniques and technologies based on conservation and development, since the agricultural and livestock farming reconversion requires a degree of training.

- Acquisition of plots:
  The plots in the boundary used for the construction of the project will be acquired within the town of Alto Ibala, between the boroughs of Cañazas and Coteral, in the district of Cañazas.

- Reforestation within the hydrographical basin of the Cañazas River:
  The reforestation process will include a maximum of 50 hectares, within the Municipality of Cañazas and the hydrographical basin of the Cañazas River.

- A damping area will be marked with the same dimensions of the Project area, which will be reforested with native tree species, especially those with a rapid growth. In addition, a natural vegetation regeneration area will be established.

- An ecological compensation payment must be made, in accordance with resolution AG-0235-2003.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Direct telephone:	
Personal email:	

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

This project does not include Public finance sources.

Annex 3

BASELINE INFORMATION

Net calorific value of fuels

The calorific value of the fuels used in the different plants of Panama, assuming all applicable calculations, have been obtained from the Expansion Plan of the 2006 National Interconnected System of Panama (page 190)

Net calorific value	
Type of fuel	**Calorific value (Kcal/gal)** $NCV_{i,y}$
Bunker C	36,514
Marine Diesel	33,515
Light Diesel	32,684

Fuel emission factors

The emission factors (effective CO_2 emission factor) assumed in all calculations have been obtained from table 1.4, page 1.23 of Document "*2006 IPPC IPPC Guidelines for National Greenhouse Gas Inventories*". The values selected correspond to lower values with a 95% confidence interval.

CO_2 Emission factors	
Type of fuel	**Effective emission factor (kgCO2/TJ)** $FE_{i,m}$
Bunker C	75,500
Marine Diesel	72,600
Light Diesel	72,600

Performance and type of fuel used in each thermal power plant

The performance of the different plants of the Interconnected System of Panama has been extracted from the 2006 SIN Expansion Plan.

Name of the Plant		Performance (gal/MWh)	Main fuel
Bahía las minas	**BLM2**	86.07	Bunker C
	BLM3	80.58	
	BLM4	81.62	
	JB5	82.76	Marine Diesel
	JB6	82.76	
	BLM8	82.76	Light Diesel
	CICLO	64.83	Marine Diesel
CT. COPESA		72.22	Light Diesel
CT. Pan-Am		59.66	Bunker C
PACORA		59.66	Bunker C
ACP	**C.T.Miraflores**	75.66	Bunker C and Light Diesel

Emission factors by plant

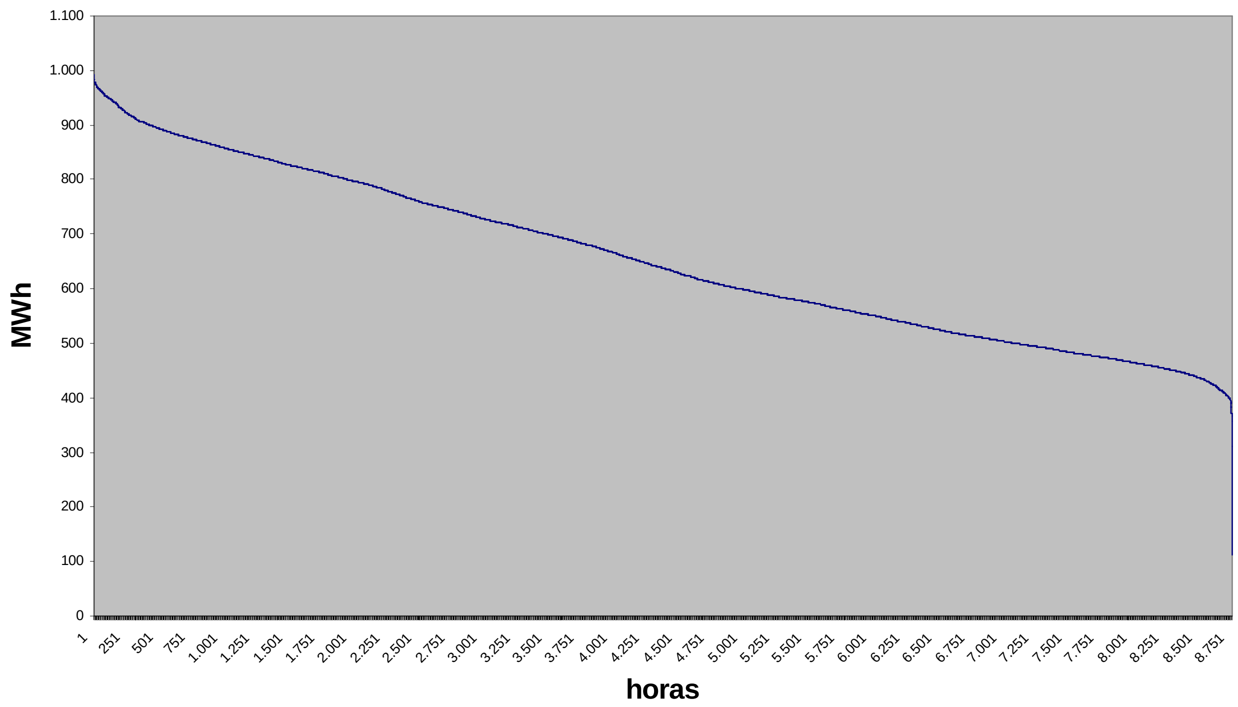
The combination of the data of the three tables shown above can be used to obtain the following factors of emission per MWh generated for the thermal power plants.

Name of the Plant		Emission factor (t CO_2/MWh) $EF_{EL,m,y}$
Bahía las minas	**BLM2**	0.989
	BLM3	0.926
	BLM4	0.938
	JB5	0.839
	JB6	0.839
	BLM8	0.818
	CICLO	0.657
CT. COPESA		0.714
CT. Pan-Am		0.685
PACORA		0.685
ACP	**C.T.Miraflores**	0.808

Calculation of λ $_m$

Step i: The total hourly generation data of the year are presented, from high to low, in comparison to the total 8760 hours of the year.

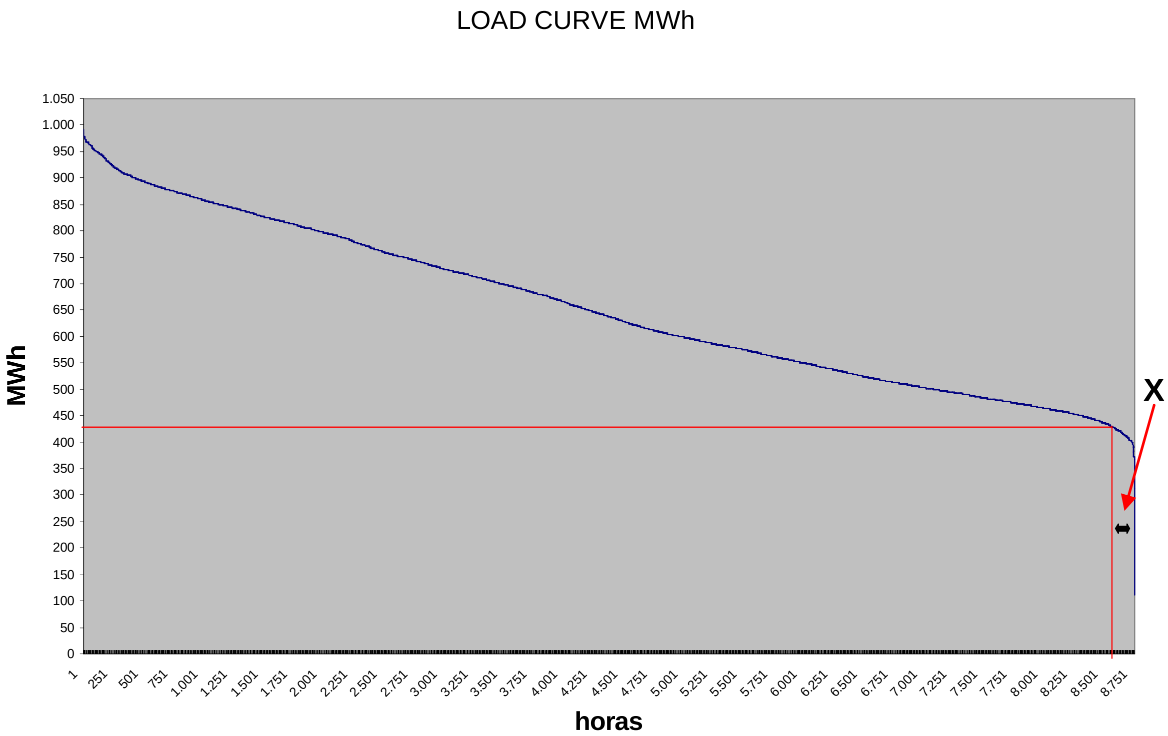
LOAD CURVE MWh



Step ii: Calculate the total annual generation of low-cost/must-run plants ($\sum_k EG_{k,y}$).

In accordance with the data downloaded from the web page of the National Dispatch Centre of Panama (www.cnd.com.pa), the total generation for the year 2006 is 5,737,581 MWh, taking into account the country's exports. From this total, the quantity generated by low-cost/must-run plants has a value of 3,390,485 MWh, obtaining the value of $\sum_k EG_{k,y}$.

Step iii: Draw a horizontal line that crosses the line represented, so that the area under the curve represents the total generation of low-cost/must-run plants ($\sum_k EG_{k,y}$).



Step iv: Determine value λ_y, taking into account that λ_y is calculated as X/8760, where X represents the hours on the right of the point of intersection.

$$\lambda_y = \frac{8760 - 8761{,}5}{8760\,hours..per..year} = 0{,}00103$$

Operating Margin Emission Factor

Name		Type	Fuel	MWh	tCO_2
Fortuna	Fortuna 1	H	-	489,414.89	0.00
	Fortuna 2		-	462,366.69	0.00
	Fortuna 3		-	516,595.88	0.00
Bayano	Bayano 1	H	-	232,805.83	0.00
	Bayano 2		-	196,221.06	0.00
	Bayano 3		-	245,867.57	0.00
Estrella	EST1	H	-	110,462.77	0.00

Name		Type	Fuel	MWh	tCO_2
	EST2		-	109,810.85	0.00
Valles	**Val1**	H	-	98,176.03	0.00
	Val2		-	153,606.78	0.00
Estí	**Esti 1**	H	-	265,955.32	0.00
	Esti 2		-	269,777.85	0.00
DOLEGA		H	-	6,919.46	0.00
MACHO MONTES		H	-	4,622.28	0.00
Hidro PANAMÁ		H	-	1,042.05	0.00
Hidro CANDELA		H	-	1,730.21	0.00
Bahía las Minas	**BLM2**	T	Búnker C	193,166.30	190,975.78
	BLM3			189,582.40	175,477.08
	BLM4			183,205.85	171,763.56
	JB5	T	Diésel Marino	679.65	570.23
	JB6			947.69	795.12
	BLM8	T	Diésel Liviano	1,742.69	1,425.88
	CICLO	T	Diesel Marino	146,211.74	96,099.89
CT. COPESA		T	Diesel Liviano	10,714.46	7,650.48
CT. Pan-Am		T	Búnker C	668,985.85	458,453.51
PACORA		T	Búnker C	414,773.37	284,242.65
ACP	**CH. Madden**	H	-	168,131.35	0.00
	CH.Gatún	H	-	56,977.85	0.00
	CT. Miraflores	T	Búnker y Diesel Liviano	537,086.26	433,797.37
TOTAL				5,737.580.9	1,821,251.5

Build Margin Emission Factor

The calculation of the marginal build factor involved the calculation of 20% of the total energy generated during the year 2006, obtaining a value of 1,147,516.2 MWh. The plants were classified, in accordance with the most recently built plants, adding the energy generated per plant during 2006, so that the total would provide a value equal to or slightly above 1,147,516.2

MWh and which would include a complete plant, for calculation purposes, as stated in the methodology.

PLANTS BUILT THAT REPRESENT 20% OF THE TOTAL GWh DURING 2006					
COMMERCIAL COMMISSIONING DATE	**GENERATING PLANT**	**NOMINAL CAPACITY (MW)**	**MWh**	**t CO2**	**tCO_2/MWh**
2006	Hidro PANAMÁ	2.8	1,042.05	0.000	0.000
2006	Hidro CANDELA	0.53	1,730.21	0.000	0.000
2003	PACORA	54	414,773.37	284,242.648	0.685
2003	Esti 1	120	265,955.32	0.000	0.000
	Esti 2		269,777.85	0.000	0.000
2000	CICLO	160	146,211.74	96,099.888	0.657
2000	C.T.Miraflores	115	537,086.26	433,797.371	0.808
			1,636,576.8	814,139.9073	-

If we analyse the energy generated by the last five plants installed, we can see that the energy generated is lower than that generated by the plants that make up 20% of the total energy in 2006, so that, in accordance with the methodology, the plants that make up 20% of the total are selected. The table shown next includes the energy generated by the last five plants, to justify the selection.

LAST FIVE PLANTS INTALLED UNTIL 2006					
COMMERCIAL COMMISSIONING DATE	**GENERATING PLANT**	**NOMINAL CAPACITY (MW)**	**MWh**	**t CO2**	**tCO_2/MWh**
2006	Hidro PANAMÁ	2.8	1,042.05	0.000	0.000
2006	Hidro CANDELA	0.53	1,730.21	0.000	0.000
2003	PACORA	54	414,773.37	284,242.648	0.685
2003	Esti 1	120	265,955.32	0.000	0.000
	Esti 2		269,777.85	0.000	0.000
2000	CICLO	160	146,211.74	96,099.888	0.657
			1,099,490.5	380,342.536	-

Consideration of exports and imports

The “Tool used to calculate the emission factor of an electricity system”, version 01, establishes that the importation of electricity from other connected systems must be considered as another plant in the calculation of the operating margin factor. However, when the imports come from other countries they are not taken into account, as is the case.

As regards exports, in accordance with the said tool, they must not be extracted from the system's electricity generation for the calculation of the emission factors, as is the case.

However, both imports and exports represent a small quantity when compared to the total energy generated by the system, as shown on the following table.

2006 General SIN Data	
Data	GWh
Generation	5,662,579.2853
Imports	34,393.1540
Exports	75,001.6943
% imports/generation	0.62
% exports/generation	1.34

Source: NDC

Taking into account this situation, we can determine how imports can modify the values of the factors obtained with negative results, increasing the degree of uncertainty in the calculations while not providing a greater precision. Therefore, the import data has not been included in the calculation of GHG emissions.

Annex 4

MONITORING INFORMATION

MONITORING PLAN

The Monitoring Plan established can be used to calculate the reduction of GHG emissions generated by the project's activity with a simple process. The calculations will be mainly based on the gathering of data on the electricity generated by all plants connected to the National Interconnected System, including that corresponding to the Small-Scale Hydroelectric Power Plant of Cañazas. The data will be gathered throughout the duration of the project and the crediting period, which is composed by a period of 7 years and which can be extended for another two 7-year periods.

The plant's emissions will be zero, since it will not use fossil fuels or have a reservoir, so that the project's activity emissions will not have to be monitored. Likewise, the leakages associated to the project will be practically zero. Therefore, only the baseline emissions must be calculated.

These are basically composed of the CO_2 emissions of the thermal power plants that use bunker, light and marine diesel, which will be shifted by the generation of the project's activity. To assess their performance, the operating and build margin factors will be calculated, as explained next:

The calculation of the **operating margin emission factor** will use a spreadsheet to guarantee the dynamic and automatic monitoring of the reduction of GHG emissions attained after the implementation of the project. The spreadsheet will include seven pages:

- The first sheet (plants) will be used to enter the data of all existing plants and their generation, which can be downloaded from the webpage of the National Dispatch Centre of Panama, including the information of new plants added to the system.

- The second sheet (hourly generation) will be used to enter the total hourly generation data downloaded from the web page or supplied by the National Dispatch Centre.

- The third sheet (lambda) will calculate the value of lambda, checking the intersection point of the curve and horizontal to calculate the value of X and, therefore, of λm.

- The fourth sheet (O.M.) is used to calculate the operating margin emission factor, so that the performance values of the plants must be entered, which can be provided by the National Dispatch Centre or extracted from the SIN Expansion Plan of the corresponding year. This page can also be used to calculate the emission factors of each plant in t CO2/MWh with the performance values of the plants, the emission factors extracted from table 1.4, page 1.23 of document "2006 IPCC Guidelines for National Greenhouse Gas Inventories" and the calorific value of the different fuels, extracted from the SIN Expansion Plan.

- The fifth sheet (B.M.) is used to calculate the **build margin emission factor**, entering the data for the new plants commissioned and taking into account the ones that complete 20% of the year's generation, updating the said factor.

- The sixth sheet (E.F.) calculates the emission factor of the project's activity and all associated yearly tCO2 per year.