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

CONTENTS

Annexes

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:

PROJECT: CHORRILLOS HYDROELECTRIC PROJECT
DATE: 17/08/2007
VERSION: 01

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

The Chorrillos Hydroelectric Project is a 3.96 MW run-of river hydroelectric power plant that will use the river fall force, with a conventional intake, from the Chorrillos stream to the Zamora river.

The Chorrillos Hidroelectric Project has as its main objective to generate clean electricity for the Wholesale Electricity Market (Mercado Eléctrico Mayorista, MEM) in order to face Ecuador's rising demand for energy; reducing the share of oil based generation[1] and creating, at the same time, other sources of income for the Municipality of Zamora and its population, as well as cooperating to the sustainable development of the Canton.

The hydroelectric plant will be connected to the Ecuador's Interconnected National System (Sistema Nacional Interconectado, SNI) through a 69 kV electrical transmission line to the Cumbaratza transmission substation, owned by the transmission company Transelectric S.A. and located at 17 kilometers from the power station. The project will contribute to the national system with an average production of 23,178 MWh per year.

The project involves the regulated collection and deflection of the Chorrillos stream, between the elevations of 1,919 m and 965 m above sea level. After the filter and sand collector, the water will be lead through a 408 m^3 loading tank, a 561 m low-pressure pipe, a 2,171 m high-pressure pipe, and finally the turbine house. Excess waters will be redirected to the river.

A triphasic and synchronized electric generator will be coupled to a horizontal turbine PELTON type installed in the engine room. The designed project allows the above-mentioned 3.96 MW generation capacity (see Figure 1).

[1] Following CONELEC documents, in the last decade, the power supply has been increasing at a rate of 6% per year, but most of this energy comes from oil and gas burning generation as well as energy imports (CONELEC Statistics, 2006).

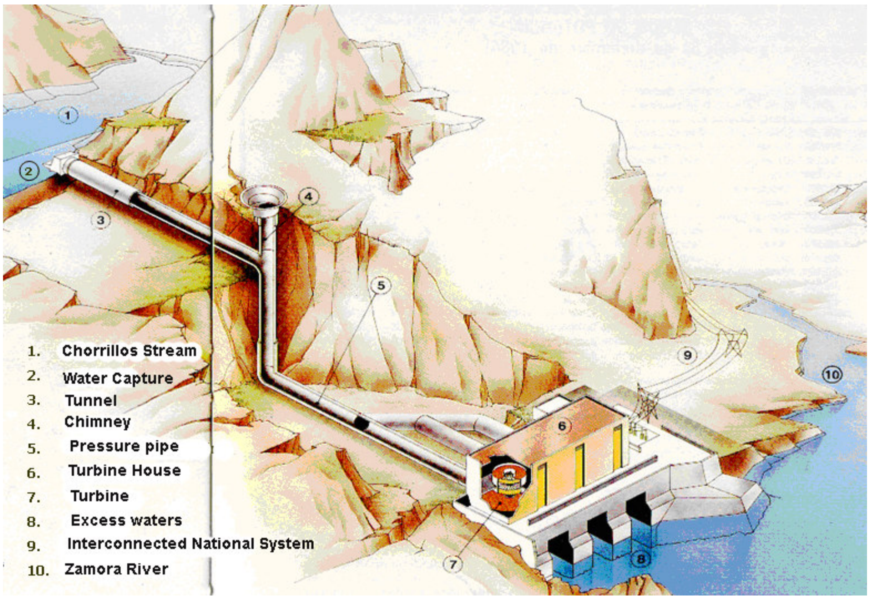

Figure 2: Technical description of Chorrillos

The implementation of this project will promote clean energy investment in Ecuador, public as well as private. The developers of the project, HIDROZAMORA C.E.M. and the Municipality of Zamora, aim to contribute to the responsible use and sustainable management of the natural resources of their communities, as well as the efficient management of the Chorrillos and Zamora river basins.

HIDROZAMORA, a company of mixed economy, is owned by the Municipality of Zamora in a 99% of its shares and is oriented to the sustainable use of renewable sources for energy. The operation of the Chorrillos Project will generate clean electricity displacing thermal energy from fossil fuel power plants, thus, reducing Greenhouse Gas (GHG) emissions and helping to avoid the greenhouse effect that is affecting worldwide with an abnormal rise in the average temperature in the planet. At the same time, the project will contribute to support a shift in the development process in Zamora Chinchipe, one of the lowest income provinces in Ecuador, helping to reorient its development plans to sustainable activities and also to the diversification of Ecuador's energy production.

The Chorrillos Hydroelectric Project will create important benefits that surpass all legal and environmental requirements, through the implementation of an Integrated Management Plan, which will benefit the river basin's communities and, at the same time, will conjugate its sustainable development plans with the Municipality and different community development intents.

Actually the Constitution of the Ecuadorian State foments the sustainable management of its natural resources; also, Ecuador has signed several international treaties and national laws, such as the Declaration of Brasilia[2]. The National Climate Committee has defined the use of renewable energies as key politics in the mitigation of the climatic change, also the National Strategy of Sustainable

[2] In this Declaration, the Latin American and Caribbean initiative for the Sustainable Development is looking for the achieving by 2010 (in the whole region) of using at least 10% of renewable energies as percentage of the total energy consumption.

Development. Finally, the National Strategy against the Poverty foments projects sustainable development projects in the poorest areas of the country; among other laws and regulations. Also is important to mention the Electric Sector Regime Law that foments the development and use of the renewable energy sources through the public organisms, universities, and the private institutions (Art. 5 and 63). The National Council of Electricity (Consejo Nacional de Electricidad, CONELEC) has also assigned priority resources from FERUM (fund for rural electrification projects using non conventional energy resources) and has issued the regulation 004/04 in order to promote the use of renewable energy sources, but until today, it looks like this has not being enough, that's why the possibility of selling CERs is of great importance.

A.3. Project participants:

Table 1: 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)
Ecuador (Host)	HIDROZAMORA C.E.M. (public and private)	No
	Municipality of Zamora (public)	
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party (ies) involved is required.		

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):

Ecuador

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

Zamora Chinchipe Province

A.4.1.3. City/Town/Community etc:

Zamora Municipality

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

The project is located 45 km east from the city of Loja and 5.5 km from the city of Zamora, in the Municipality of Zamora, Province of Zamora Chinchipe, in the southern east part of Ecuador.

The Chorrillos Hydroelectric Project will use the river fall force from the Chorrillos stream, located in the El Líbano hill, to the Zamora river, in the coordinates 722,520 East and 9,955,308 North. The place where the reception works will be built is around the coordinates 9,550,744 North and 722,520 East in an altitude of 1,919 meters above the sea level. The power station will be built in La Fragancia area, on a small terrace in the Zamora river's right margin, in the coordinates 723,530 East and 9,552,610 North in an altitude of 965 meters above sea level (see Figure 2).

Figure 2: Project location

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

In accordance with the List of Categories for Small-Scale CDM Projects included on Annex B of the Methodologies and Procedures for Small-Scale CDM Projects, the Chorrillos Project corresponds to:

Type I: Renewable Energy Project
Category D: Electricity Generation for a System

Chorrillos is a run-of-river project that consists of the use of water directly from the river to generate electricity. The water's gravitational power is used to move the turbine, and by doing so generates electric power. Hydroelectric energy is considered as clean and environment friendly, because it does not contributes to greenhouse gases emissions or to the mission of other contaminant gases such as SO_2 and

NO_x. This project will contribute to the reduction of emissions generated by fossil fuels, which would occur in absence of the project since thermoelectric generation is an important part of the baseline of the electric generation of the country.

The equipment required for the implementation of the project activity is imported and transferred to the host party.

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

Utilizing the methodology described in section B, the operation of the project would generate an emission reduction of approximately 15,299 tCO_2e per year.

Table 2: Estimated amount of emission reductions over the first 7-year crediting period

Years	Estimation of annual emission reductions in tonnes of CO_2e
December 2008	1,275
2009	15,299
2010	15,299
2011	15,299
2012	15,299
2013	15,299
2014	15,299
January – November 2015	14,024
Total estimated reductions (tonnes of CO_2e)	**107,094**
Total number of crediting years	**7**
Annual average of the estimated reductions over the crediting period (tCO_2e)	**15,299**

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

There is no public funding coming from Parties included in Annex I of the Convention.

The funds has been obtained through the Municipality Budget for the implementation of the project and not through any Party included in Annex I. HIDROZAMORA has been developing the project, using the Municipality financial resources and right now is expecting a bank loan from a private bank in Ecuador, as well as the resources coming from the CER's negotiations for finishing the project.

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

In accordance with Appendix C of the Simplified M&P for the Small-Scale CDM Project Activities, this project is not a de-bundled component of a larger CDM project activity. The project activity is an independent hydro power plant generating electricity and supplying the grid. It is unrelated to any other CDM project activity in the region existing or planned. The project proponent has not registered another small-scale CDM project activity or applied to register another small-scale CDM project activity:

- in the same project category;
- registered within the previous 2 years; or
- whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point.

SECTION B. Application of a baseline and monitoring methodology

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

As mentioned before, according to the List of Categories for Small-Scale CDM Projects included on Annex B of the Methodologies and Procedures for Small-Scale CDM Projects, the Chorrillos Project corresponds to:

Type I: Renewable Energy Project
Category D: Electricity Generation for a System

Therefore, the methodology selected is the AMS ID (version 12) applicable to electricity generation projects from renewable sources connected to the transmission and distribution grid.

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

The Chorrillos Project meets the applicability conditions of the selected methodology:

1. The project activity is a run of river hydroelectric power plant.
2. The project will supply electricity to the distribution system that is or would have been supplied by at least one fossil fuel fired generating unit as it is stated in AMS I.D.
3. The installed capacity of the project is 3.96 MW, lower than 15 MW (the maximum allowed limit for being considered as a small-scale project).

B.3. Description of the project boundary:

The SNI is the only interconnected national grid system in Ecuador. The SNI distributes the energy to the entire country. Power projects connected to the Ecuadorian national grid can be developed in any location within the geographical country limits, for which these limits represent the SNI boundaries. The project's electrical system is the SNI, and the energy generation plants used for the calculation of the baseline emissions are all those feeding the SNI.

The Chorrillos' project boundaries are defined by the emissions targeted or directly affected by the project activities, construction and operation. It encompasses the physical, geographical site of the hydropower generation source, which is represented by the Chorrillos stream, close to the power plant facility.

Ecuador is a country divided in four macro-geographical regions: Coast, Andean, Amazon forest, and Galapagos. The majority of the population is concentrated in the Coast and Andean regions. Thus the energy generation and, consequently, the transmission are concentrated in these two regions. Galapagos region has isolated systems supplied by diesel (see Figure 3).

Part of the electricity consumed in Ecuador is imported from Colombia and Peru. Around 12% of the electricity is imported from Colombia (CONELEC Statistics 2005).

Figure 3: Ecuadorian Interconnected System (Statistics, 2005)

B.4. Description of baseline and its development:

According to the project category and corresponding methodology, the baseline is the energy produced by the renewable generating unit (MWh) multiplied by an emission coefficient (tCO_2e/MWh) calculated in a transparent and conservative manner as:

a) A combined margin (CM) emission factor, consisting of the combination of operating margin (OM) and build margin (BM) emission factors according to the procedures prescribed in the approved methodology ACM0002. Any of the four procedures to calculate the operating margin can be chosen, but the restrictions to use the Simple OM and the Average OM calculations must be considered, or
b) The weighted average emissions (in tCO_2e/MWh) of the current generation mix. The data of the year in which project generation occurs must be used.

For this project activity, option (a) was selected.

Calculation of the Ecuadorian Emission Factor

The baseline emission factor is calculated as a combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) factors.

Calculation of the Operating Margin Emission Factor

ACM0002 suggest four different methods to calculate the OM:

(a) Simple OM, or
(b) Simple adjusted OM, or
(c) Dispatch Data Analysis OM, or
(d) Average OM

The option (c) dispatch data analysis should be the first methodological choice if possible. However, dispatch data are not public available in Ecuador, and therefore it was chosen to use one of the three other methods. The option (a) simple OM can only be used if the low-cost/most run resources are less than 50% of the total grid generation. In Ecuador, the low-cost/must run resources are higher than 50%, and therefore this method is not applicable. The option (d) average OM can only be used if there is no data available to apply options (b) and (c). In Ecuador, data to apply option (b) are available and therefore the Simple Adjusted OM method is used.

According to the methodology, the simple adjusted operating margin emission factor can be calculated using one of the following data vintages:

- The full generation-weighted average for the most recent 3 years for which data are available at the time of PDD submission (ex-ante).
- The year in which project generation occurs, if the operating margin emission factor is updated based on data monitored (ex-post).

In this particular case, the ex-ante vintage is selected among the two options proposed by the methodology.

Calculation of the Build Margin Emission Factor

According to the methodology, the build margin emission factor can be calculated using one of the following options:

- ***Option 1:*** Calculate the Build Margin emission factor ex-ante based on the most recent information available on plants already built for sample group *m* at the time of PDD submission.

- ***Option 2:*** For the first crediting period, the Build Margin emission factor must be updated annually ex-post for the year in which actual project generation and associated emissions reductions occur. For subsequent crediting periods, the Build Margin emission factor should be calculated ex-ante, as described in Option 1 above.

In this particular case, Option 1 is selected among the two options proposed by the methodology.

Calculation of the Combined Margin Emission Factor

The baseline emission factor is calculated as the weighted average of operating margin emission factor and the build margin emission factor. In this case, for weighting these two factors, the default value of 50% will be considered for both the operating margin and the build margin emission factors.

Thus, according to the methodology, the key data used to determine the baseline scenario is given in the following table.

Table 3: Key data

Data	Source
Electricity generation by the project	HIDROZAMORA C.E.M.
Combined margin emission factor	CORDELIM[3], CDM Projects Promotion Bureau of Ecuador, with the collaboration of Eco-Alianzas Estratégicas Cia Ltda.

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:

National Energy Market

The proposed project activity is a clean source of electricity that will have an important contribution to environmental sustainability by avoiding electricity generation by fossil fuel sources, which would be generated and emitted in the absence of the project activity.

As could be seen in Table 4 and Figure 4, the energy sector in Ecuador has been suffering some very important changes in the last years. The hydroelectric power generation has been decreasing in relative terms and, in the last years, the thermal generation as well as the imports of energy, has been increasing considerably, despite the important hydro potential as well as other renewable energy generation sources available in Ecuador. This scenario has not changed in 2007.

Table 4: Evolution of energy generation structure (%)

	Hydroelectric	Thermoelectric	Photovoltaic	Import
2005	45.5	43.1	0.00	11.4
2000	71.7	28.3		
1995	61.2	38.8		
1990	78.5	21.5		

[3] http://www.cordelim.net/

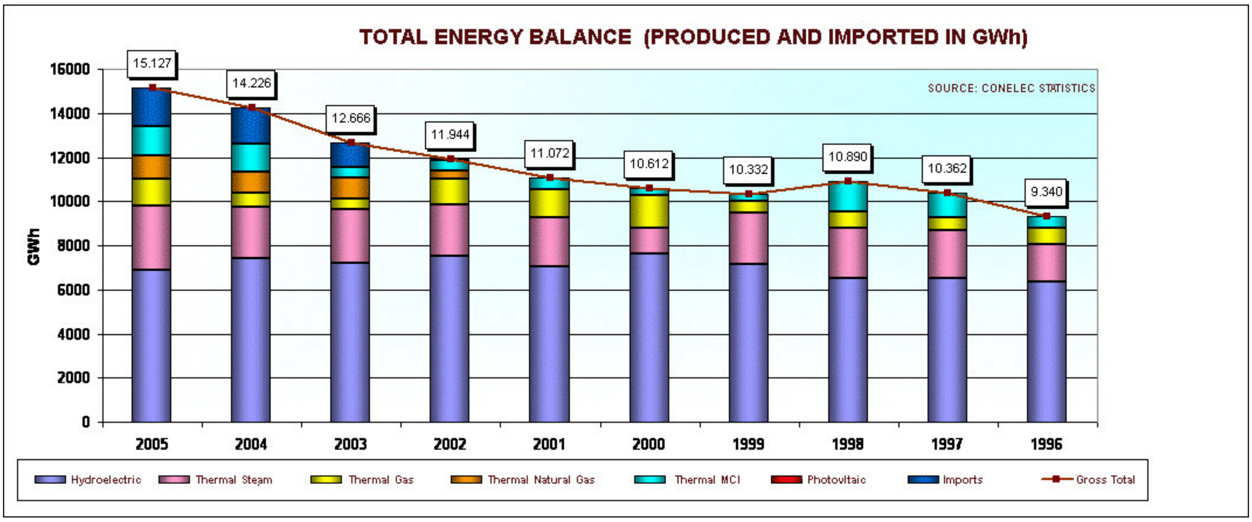

Figure 4: Total energy balance in Ecuador

As Table 4 shows, the percentage of thermoelectric generation has doubled the last 15 years, leading to an increasing CO_2 emission in Ecuador.

CONELEC states that the gross generation in Ecuador in 2005 was 15,127 GWh, 45.5% of which were hydroelectric, mainly large hydro plants, and 43.1% came from power plants using thermal sources, mainly from fossil fuel sources. The remaining electricity is supplied by imports from Colombia and Peru (see Figure 5).

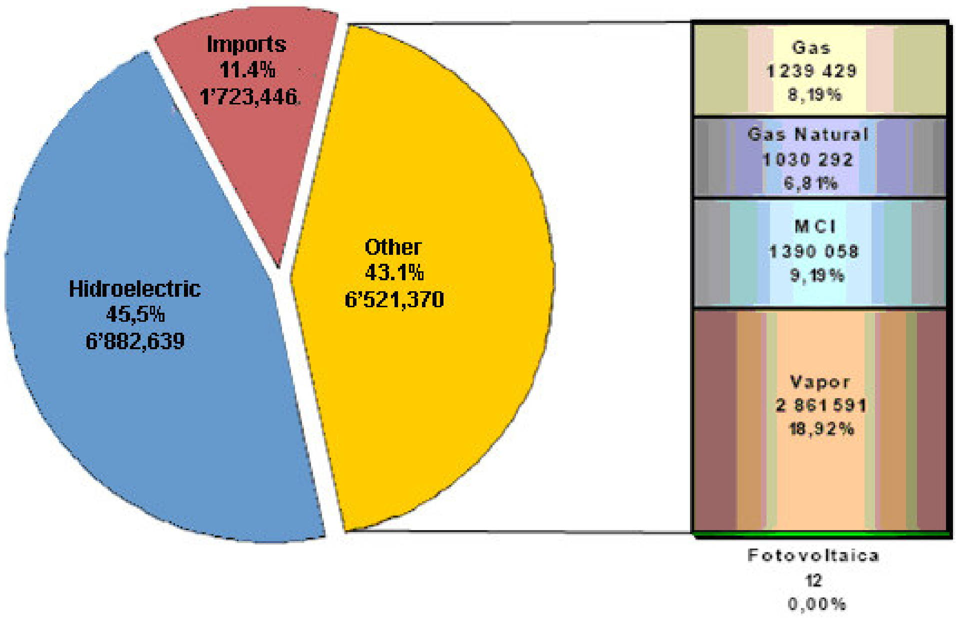

Figure 5: Total energy sources in Ecuador

The hydroelectric generation, even when is the most important source of energy in Ecuador, it is clear that is not enough and there is an important increment of the thermal generation projects and the imports of energy. The Ecuadorian government has realized this fact and is trying to support the implementation of projects that use renewable energy sources, but the government support is clearly not enough for achieving this goal. In this scenario, plays an important role the possibility of commercialization of CER's in the market.

The electricity sector in Ecuador has been declared by national government as priority, within the strategic vision of the country, but due to several barriers, the situation of the sector have not being able of any improvement.

Only 5 to 6% is currently being used from existing hydroelectric resources in Ecuador. This is a clear demonstration that hydroelectric energy is an energy source not developed in the country. On the other hand, from all hydroelectric plants of Ecuador, only 20% are small-scale plants.

From the 3,159 MW of the SNI –by December 2006– 46% corresponds to thermal energy, which not only puts up the price of electricity fees for users, but consumes resources for purchase of fuels for its generation, as well as contaminates the environment due to the combustion of fossil fuels.

On the other hand, the demand for energy increases with a rising rate that is approximately 6% (see Table 5 and Figure 6). If the supply situation continues in the same path that in the last years, we will see an increment of the energy production coming from thermal origins. Only if renewable energy projects like hydroelectric, geothermic, or wind power generation start entering to the market, we could see some important CO_2 emission avoided.

Table 5: Ecuadorian electricity generation (GWh)

	Hydroelectric	Thermoelectric	Photovoltaic	Import	Total
2005	6,882.6	6,521.4	0.01	1,723.4	15,127.5
2000	7,611.2	3,001.2			10,612.4
1995	5,160.6	3,268.0			8,428.6
1990	4,986.7	1,362.2			6,348.9

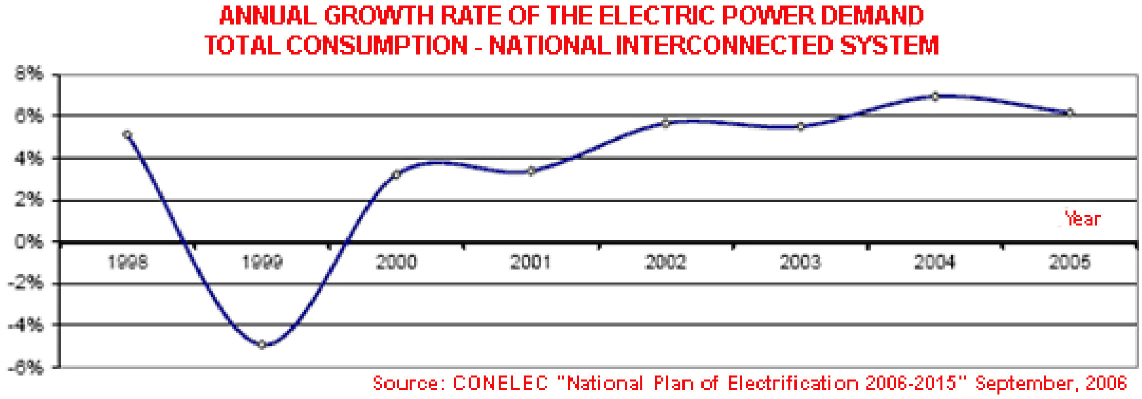

Figure 6: Total Ecuadorian energy demand

The expected energy and power growth estimated by CONELEC for next 4 years is shown below:

Table 6: Annual rate of demand growth (%)

Year	Energy	Power
2006	5.6	7.1
2007	6.3	5.7
2008	5.2	4.6
2009	5.0	4.4

According to Table 6, there would be an increasing electricity demand of between 100 MW and 150 MW per year.

If renewable projects like Chorrillos do not enter in the SNI, the fossil fuel based energy could keep increasing their participation in the energy balance and, consequently, the emissions of CO_2 and other greenhouse gases to the atmosphere will rise. It is easy to understand how the operation of Chorrillos Project in the SNI will avoid the use of new non-renewable energy sources based on fossil fuel, controlling in that way the emission of important amounts of new contaminants to the atmosphere.

The most convenient solution for the generation expansion problem of the SNI would be to take full advantage of renewable natural resources, specially the hydro-energy. With this purpose, the possible effects of hydroelectric projects that may provide clean and cheap energy to the country have been assessed. Nevertheless, the characteristics of the national electricity sector and the barriers described below have as result, the existence of about 90 hydroelectric projects that still have not being started operation.

Legal Framework of the Electricity Sector

The electricity sector of Ecuador is in a period of transition when important changes are being carried out, with a free market of sale-purchase of energy, a energy dispatch system depending on the marginal production of plants, and with the responsibility of financing with private funds the growth and maintenance of electric generation and distribution.

At the beginning of the electricity industry in Ecuador, private companies built and operated the first energy generation and distribution systems. By the middle of the 50's, private companies handed the responsibility of developing the electricity sector over to City Councils.

In 1961 the, Ecuadorian Institute of Electrification (Instituto Ecuatoriano de Electrificación, INECEL), was created being a government entity responsible of the electrification of the country in all its stages.

In that time, with important incomes coming from oil, the INECEL build up Pisayambo, Paute, and Agoyán hydroelectric projects, as well as the Quito, Guayaquil, and Esmeraldas thermal projects. It also formulated the Main Plan for the Electrification of Ecuador, which conducted and inventory of hydro-energy resources of the country, with results published in different Catalogues. In addition, it integrated the country with the transmission ring (the SNI) and had an important contribution to the expansion of the urban and rural electrification through electricity companies.

With the Law for the Electricity Sector from 1996, the INECEL grants its shares of the distribution company to the Solidarity Fund, with the purpose of leading them to the privatization. From its electricity generation plants the INECEL constitute 6 companies as public limited corporations so that they can comprise the portfolio of the Solidarity Fund.

These electricity generation companies are:

- Termo Esmeraldas (132.5 MW)
- Termo Pichincha (85.2 MW)
- Termo Guayas (412 MW)
- Hidro Paute (1,075 MW)
- Hidro Agoyán (156 MW)
- Hidro Pisayambo (70 MW)

A public limited corporation was created with the assets of the SNI known as Empresa Nacional de Transmisión Transelectric S.A. the shares of this company were transferred to be controlled by the Solidarity Fund.

The new law expressly divides the generation, transmission, and distribution business in independent business units. An agent from the new electricity market cannot generate energy and being a distributor.

With the purpose of allowing the free competence among generators, any generator can pay a transmission or distribution fee and send their energy to the point they want because the National Transmission System is obligated to allow the free to its transmission lines.

The law created two entities so as to support the electricity market.

- National Council of Electricity (Consejo Nacional de Electricidad, CONELEC): it is created in order to represent the State and plan, regulate, and control the electricity market, as well as establish the fees for regulated consumers. Other functions of the CONELEC are to give licenses, permits, and awarding for generators and distributors, as well as “guarantee the operation of electricity market in a new competitive scheme".

- National Energy Control Center (Centro Nacional de Control de Energía, CENACE): it is responsible of the dispatch of generation units in the whole country, and of the technical, commercial, and financial operations of the MEM.

The distributors will have to acquire and pay for electric energy to different sources, if considered as required. Such companies, just like big consumers, can accede to negotiate contracts with any generator providing them advantages.

There are two ways of entering in the MEM for distributors as well as for big consumers so as to buy energy: in the Term market or in the Spot Market.

The Term Market is that where parties enter by means of a formal contract in which the generator commits to supply as much energy as to be paid at such price by the distributor during a period of more than one year. These contracts are safe, since the generation supply is controlled by the CENACE and, in case of the generator cannot supply the energy committed, the CENACE, with other generator, will supply the energy contracted and subsequently invoice the cost of it to the generator. Thus, the term market has a high safety and confidence in the fulfillment of contracts agreed that by law must be informed to the CENACE and the CONELEC.

The Spot market is the one that occurs in any moment. If a big consumer registered in the CONELEC as such starts consuming energy without having a long term firm contract with a generator, the CENACE will invoice the energy on the "spot" price, that is, the market price valid for that hour and that day. This spot price is the marginal cost of the last generation unit dispatched in the system. This way a purchase in the MEM is being carried out; nevertheless, there is no certainty about the invoicing price for the energy consumption.

The Big Consumers are mainly industrials requiring a capacity of more than 1 MW. These companies can directly accede to transaction in the MEM in order to obtain the price advantages arising from the direct wholesaler market purchase. It is important to point out that currently many big consumers have self-generation plants and receive energy from electricity companies and they are invoiced for that.

Chorrillos Project

On July 21st, 2004, an Inter-institutional Cooperation Agreement was signed between the Energy and Mines Ministry and the Municipality of Zamora for the construction and administration of the Generation System of the Chorrillos Hydroelectric Project.

Due to the importance that Municipality of Zamora and HIDROZAMORA C.E.M. are giving for several years to the sustainable development strategies for improving the social and environmental conditions of the Municipality and province of Zamora Chinchipe, the alternative of registering the project for being able to negotiate CER’s in the market was assumed as a necessary step for the success of the project, due to the fact that this potential additional income has been considered as an important part of the financial feasibility of the project as well as the additional financial source for supporting the sustainable development strategy that the Municipality has started implementing in the Municipality.

Additionally to the consideration of CER's negotiation for co-financing the sustainable development strategy of the Municipality, the CER's negotiation was also seriously considered in the financial decision in order to proceed with the Chorrillos Project activity and without any doubt is a necessary step for transforming the project in financially attractive for the Ecuadorian and international financial market. It is important to consider that, in order to get the bank loan in Ecuador, loan that is indispensable for finishing the construction and starting with the generation stage of the hydroelectric project of Chorrillos, the IRR of the project has to be at least over 15%, and this kind of IRR would be only achieved if CER's negotiation is considered inside the financial closing of the project.

It was concluded after being revised and analyzed the cash flows that included the CDM figures, that these CDM resources are necessary in order to finish the project construction at the end of 2008.

Several evidences, among others, could be mentioned for demonstrating that CER's negotiation was considered seriously in the financial and sustainable developing planning of the Chorrillos Project.

1. On June 14th 2005, the Technical Director of HIDROZAMORA sent a communication to the President and General Manager of the company including the different IRR of the project in scenarios with and without the CER's negotiation.

2. There is a document signed by the President of HIDROZAMORA and its new General Manager to the Minister of Energy of Ecuador, dated on June 28th 2005, in which it was stated the serious financial situation of the project, asking for its help for covering several costs that were not considered during the planning. In this area could be of great help to be capable of including part of the cash flow generated by a future negotiation of CERs.

3. There are financial statements, developed by the company, where was considered the CER's negotiation as part of the future cash flow. And was a corporative and municipal decision, through a formal meeting of the Municipality Council, where is stated that the Chorrillos Project has to committed itself to claim carbon credits in order to partially financing the sustainable development strategy of the Municipality and for obtaining the necessary line of credit coming from private banks for finishing the construction. This could be supported through the letter sent by the President of HIDROZAMORA and Major of Canton Zamora to Eng. Raúl Auquilla Ortega, former General Manager of HIDROZAMORA on July 15th 2005.

4. The Chorrillos Project has been included in the list of eligible projects for CDM in the CORDELIM data base and Web page since year 2004.

All these evidences will be presented to the DOE during the validation process.

According to the methodology selected, a barrier analysis was conducted so as to demonstrate the project additionality.

Investment Barrier

It is important to take into account that the opportunity cost of investments such as a mini hydroelectric project, is really high in a country like Ecuador, where there exist almost no opportunity for obtaining the appropriate financial resources and the demand for loans, in the public, as well as, in the private sector is really high, with very small opportunities. This causes that the financial analysis must use very high discount rates, giving more importance to additional sources of revenues such as the negotiation of CER's.

In the same arena, the actual political instability is another crucial factor for increasing the country risk measurements and also to make even scarcer the opportunities of obtaining financial resources coming from the financial sector.

The Chorrillos Project was set up with an expected financial IRR (Internal Rate of Return) of approximately 13.5% without the benefit of the CER revenues, giving a non-attractive scenario considering the high level of country risk of Ecuador that is actually over 700 basic points. The project could be considered as a riskier investment, especially in the actual political Ecuadorian situation. The inclusion of the revenues from CERs makes the project's IRR increase by approximately 200 basis points, to 15.5%, giving it a more attractive scenario for loan and investment determination. As mentioned above, in order to get the bank loan in Ecuador, loan that is indispensable for finishing the construction and starting with the generation stage of the hydroelectric project of Chorrillos, the IRR of the project has to be at least over 15%, and this kind of IRR would be only achieved if CER's negotiation is considered inside the financial closure of the project.

There was no access to international capital markets and, today, the possibility is almost null due to the negative of the new elected Government to sign the Free Trade Agreement with United States due to real or perceived risks associated with domestic or foreign direct investment in Ecuador. CERs' negotiation guarantee is very important to decrease perceived risk as long as HIDROZAMORA committed itself with the banks contacted until now to claim carbon credits.

Technological barriers

Even though the technology used in these hydro power plants is quite known in Ecuador and Latin America, there are barriers of technological and logistical nature associated with its application and maintenance. The equipment for the operation of this small hydroelectric project is not produced in Ecuador; it must be imported from overseas. This represents a problem to the project developer, since they depend on imports to set up and maintain the new facilities and also in overseas availability for delivering such equipments.

The Chorrillos Project also utilizes other kind of equipments and parts to deliver electricity to the grid. These are not the typical and traditional equipments used by neither HIDROZAMORA nor the Municipality of Zamora, and their usage represents also a technological barrier. Additionally, such equipments are also imported, thus increasing the proportion of the barrier mentioned in the idea stated above.

For allowing the project to function properly, HIDROZAMORA had to train its personal and acquire knowledge in electric transmission, as well as in the operational and price strategies for the electricity market. Such training and capacity building could not be achieved without important investments. The incentives of the CDM will help to ease such expenditures.

Institutional Barriers

It is a reality that in Ecuador the whole process of obtaining all the legal and administrative permits and licenses to operate hydro power plants takes more time than the necessary permits for operating a thermal power plant projects.

This is more evident when the project is being developed in a less developed province located far from the administrative and financial centers. For small Municipalities is even harder to get the necessary appointments and meetings with private and public central authorities in order to deliver all the permits, licenses and financial support that a project such this need.

Anyhow, the project has managed for keeping its construction process, but the time has come for increasing the cash flow in order to finish the construction process, and here the CER's negotiation will play a key role.

In accordance with the features of the national electricity sector and the barriers described, in absence of the CDM project activity, the electric generation of the Chorrillos Project would have been produced by generators connected to the SNI, mainly through thermal units that generate emissions from the burn of fossil fuels.

For that reason, the proposed project activity is additional.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

According to the project category and the corresponding methodology, project emissions are zero and leakage is to be considered only when the energy generating equipment is transferred from another activity. This is not the case of the proponed project activity. The energy conversion equipment for the project was manufactured new for specific site conditions. Therefore, there is no leakage associated to the project activity.

Then, emission reductions obtained during the year *y* are equal to baseline emissions calculated by multiplying the combined margin emission factor by the electricity generated by the proposed project activity during the year *y*, as follows:

$$ER_y = EG_y \times EF_{grid} \qquad \textbf{(1)}$$

where

EG_y is the electricity generation of the project activity during the year *y* (MWh/year); and

EF_{grid} is the grid emission factor (tCO_2e/MWh).

The grid emission factor is calculated as a combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) factors.

Calculation of the Operating Margin Emission Factor

As mentioned above, in order to determine the combined margin emission factor, the Simple Adjusted Operating Margin method has been selected from the four options proposed in the methodology since the low-cost/must-run resources constitute more than 50% of total grid generation.

The Simple adjusted OM emission factor is calculated as the generation weighed average emissions per electricity unit (tCO_2e/MWh) of all generating sources serving the system, where the power sources (including imports) are separated in low-cost/must run power sources (*k*) and other power sources (*j*), as follows:

$$EF_{OM} = (1-\lambda)\frac{\sum_{i,j} F_{i,j}.COEF_i}{\sum_j GEN_j} + \lambda\frac{\sum_{i,k} F_{i,k}.COEF_i}{\sum_k GEN_k} \qquad \textbf{(2)}$$

where

λ is the fraction of time during low-cost/must-run sources are on the margin;

$F_{i,j,}$ and $F_{i,k}$ are the amount of fuel *i* consumed by relevant power sources *j* and *k*, respectively (mass or volume unit);

$COEF_i$ is the CO_2 emission coefficient of fuel *i* (tCO_2e/mass or volume unit); and

GEN_j and GEN_k are the electricity delivered to the grid by power sources *j* and *k*, respectively (MWh).

The CO_2 emission coefficient is obtained as follows:

$$COEF_i = NCV_i \times EF_{CO2,i} \times OXID_i \quad \textbf{(3)}$$

where

NCV_i is the net calorific value of fuel *i* (energy unit/mass or volume unit);

$EF_{CO2,i}$ is the CO_2 emission factor per unit of energy of the fuel *i* (tCO_2e/energy unit); and

$OXID_i$ is the oxidation factor of the fuel *i* (%).

On the other hand, the lambda factor (λ) is the determined as:

$$\lambda = \frac{number\,of\ hours\ per\ year\ for\ which\ low-\cos t / must-run\,sources\ are\,on\ m\arg in}{8760 hours\,per\ year} \quad \textbf{(4)}$$

According to the methodology, the number of hours during low-cost/must-run sources are on the margin is obtained through the following procedure:

1. Plot a Load Duration Curve. Collected chronological load data (typically in MW) for each hour of a year, and sorted load data from highest to lowest MW level. Plotted MW against 8760 hours in the year, in descending order.

2. Organize Data by Generating Sources. Collect data for, and calculate total annual generation (in MWh) from low-cost/must-run resources.

3. Next Fill Load Duration Curve. Plot a horizontal line across load duration curve such that the area under the curve (MW times hours) equals the total generation (in MWh) from low-cost/must-run resources.

4. After that determine the "Number of hours per year for which low-cost/must-run sources are on the margin". First, located the intersection of the horizontal line plotted in step 3 and the load duration curve plotted in step 1. Then, the number of hours (out of the total of 8,760 hours) to the right of the intersection is the number of hours for which low-cost/must-run sources are on the margin. If the lines do not intersect, then one should conclude that low cost/must-run sources do not appear on the margin and lambda is equal to zero. Lambda was the calculated number of hours divided by 8,760.

Calculation of the Build Margin Emission Factor

The Build Margin is calculated as the generation-weighted average emission factor (tCO_2e/MWh) of a sample of power plants *m*, as follows:

$$EF_{BM} = \frac{\sum_{i,m} F_{i,m} . COEF_i}{\sum_m GEN_m} \qquad \textbf{(5)}$$

Where $F_{i,m}$, $COEF_i$, and GEN_m are analogous to the variables described above, for plants *m*.

The sample group *m* consists of either the five power plants that have been built most recently or the power plant capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently. Project participants should use from these two options that sample group that comprises the larger annual generation.

Calculation of the Combined Margin Emission Factor

The baseline emission factor is calculated as the weighted average of operating margin emission factor and the build margin emission factor. For weighting these two factors applying the default value of 50% for both, the operating margin and the build margin emission factors, the combined margin emission factor is obtained as follows:

$$EF_{grid} = \frac{(EF_{OM} + EF_{BM})}{2} \qquad \textbf{(6)}$$

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

Table 7: Data available at validation

Data / Parameter:	***EF_{grid}***
Data unit:	tCO_2e/MWh
Description:	Emission factor of the Interconnected System of Ecuador
Source of data used:	CORDELIM[4]
Value applied:	0.66007
Justification of the choice of data or description of measurement methods and procedures actually applied:	The value used is the official emission factor of Ecuador's grid, calculated according to procedures described in the ACM0002 and using the updated information available at the moment of submitting this PDD.
Any comment:	This value will be used in the ex-ante calculation of emission reductions and will be considered fixed along the first 7-year crediting period.

B.6.3 Ex-ante calculation of emission reductions:

As mentioned above, since project emissions and leakage are equal to zero, the emission reductions obtained through the project are equal to baseline emissions, which are calculated from the energy generated by the hydroelectric plant multiplied by the emission factor of the electric transmission and distribution grid:

The project is estimated to produce 23,178 MWh per year and, according to the studies carried out by a joint cooperation between CORDELIM and EcoAlianzas Estratégicas, the emission factor for the national grid in Ecuador is 0.66007 tCO_2e/MWh (see more details in Annex 3 of this PDD).

The emission factor was calculated by CORDELIM in collaboration with Ecoalinzas Estratégicas Cia. Ltda. using version 06 of the methodology ACM0002, and was also part of a collaboration agreement with EcoAlianzas Estratégicas Cia. Ltda. and its Executive President, Economist Diego Burneo. This Emission factor was decided to be used freely crediting CORDELIM and EcoAlianzas Estratégicas Cia. Ltda.

Therefore, by applying the official grid emission factor of Ecuador, the emission reductions result to be:

ER_y = 23,178 MWh/year x 0.66007 tCO_2e/MWh = 15,299 tCO_2e/year

[4] http://www.cordelim.net/

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

Table 8: Emission reductions over the first 7-year crediting period

Year	Estimation of project activity emissions (tCO_2e)	Estimation of baseline emissions (tCO_2e)	Estimation of leakage (tCO_2e)	Estimation of overall emission reductions (tCO_2e)
December 2008	0	1,275	0	1,275
2009	0	15,299	0	15,299
2010	0	15,299	0	15,299
2011	0	15,299	0	15,299
2012	0	15,299	0	15,299
2013	0	15,299	0	15,299
2014	0	15,299	0	15,299
January – November 2015	0	14,024	0	14,024
Total (tonnes of CO_2e)	**0**	**107,094**	**0**	**107,094**

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

B.7.1. Data and parameters monitored

Table 9: Data to be monitored

Data / Parameter:	***EG_y***
Data unit:	MWh/year
Description:	Electricity generation of the hydroelectric plant in the year *y*
Source of data to be used:	Chorrillos Hydroelectric plant
Value of data	23,178
Description of measurement methods and procedures to be applied:	Data monitored continuously and registered monthly. The electricity delivered to the grid will be measured by the project participant as well as by CENACE.
QA/QC procedures to be applied:	The value monitored by Chorrillos Hydroelectric plant will be compared with the invoices of sale of electricity to the distribution grid.
Any comment:	

Data / Parameter:	***EF_{grid}***
Data unit:	tCO_2e/MWh
Description:	Emission factor of the Interconnected System of Ecuador
Source of data to be used:	CORDELIM[5]
Value of data	0.66007
Description of measurement methods and procedures to be applied:	The value used is the official emission factor of Ecuador's grid, calculated according to procedures described in the ACM0002.
QA/QC procedures to be applied:	
Any comment:	It will be used in the ex-post calculation of emission reductions and will be updated at the beginning of each 7-year crediting period.

The data monitored will be kept until two years after finishing the selected crediting period.

[5] http://www.cordelim.net/

B.7.2 Description of the monitoring plan:

CENACE is the Ecuadorian entity provided by law to supervise operation of power grid (generation and transmission) and liquidate commercial transactions in the MEM. All generators with a capacity equal or higher than 1 MW are dispatched by CENACE.

To start the operation of this hydroelectric plant, the project participant shall install all metering equipment according to the Ecuadorian law, under supervision of and means to comply with local regulations. CENACE will supervise and approve these equipment and means to enter in operation, and as soon as the project enter in operation, CENACE will officially inform the amount of energy delivered by this and all generation dispatched in the system on an hourly, daily and monthly basis.

The monitoring procedure to be applied by the project participant shall consist of metering the electricity generated by the power plant, which will be done in cooperation with CENACE.

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

Date of completion: 18/11/2006 (updated in June 2007)

A joint effort between CORDELIM and Diego Burneo from EcoAlianzas Estratégicas Cia. Ltda. developed the baseline.

Neither CORDELIM nor Diego Burneo and EcoAlianzas Estratégicas are project participants.

E-mail: dburneo@ecoalianzasecuador.com

This PDD was revised on May and August 2007 by MGM International SRL. MGM is not project participant.

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:

The project is expected to be operative since 01/12/2008.

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

Fifty 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:

01/12/2008

C.2.1.2. Length of the first crediting period:

7 years

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Not Applicable

C.2.2.2. Length:

Not Applicable

SECTION D. Environmental impacts

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

The CONELEC is responsible for issuing permission for plants with installed capacity lower than 50 MW and only granted its approval after the project fulfilled all the required conditions.

The CONELEC received the Environmental Impact Assessment (EIA) of the Chorrillos Project on February 20th 2006. The EIA was also presented to the Ministry of Environment on March 15th 2006 with the previous approval of CONELEC. Finally, the environmental license for the Chorrillos Project was issued on August 30th 2006.

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:

In point of fact that the Chorrillos Project is being built using existing reservoirs, where the volume of their dams will not increase, their environmental impacts were very low.

SECTION E. Stakeholders' comments

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

Public discussions with local stakeholders were carried out. In these sections it was informed that the Chorrillos Project would bring several economic and social advantages for the community.

In addition to the mandatory requirements, the project sponsor is working with local communities on environmental education projects, regular water quality assessment, hiring of local manpower, and erosion control.

E.2. Summary of the comments received:

In all the process were made efforts to change the previous wrong information and ideas. Local communities supposed, at first, that the small hydro plant would consume the water from the reservoirs, affecting its availability for agricultural use. Afterwards, it was clarified that the water would only circulate through the turbines, without reducing the quantity available for use by the communities.

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

The project is being developed as planned and following the requests and suggestions made by CONELEC and the National Environmental Agency.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Table 10: Non-annex 1 project participant

Organization:	HIDROZAMORA C.E.M.
Street/P.O.Box:	Diego de Vaca y Pio Jaramillo
Building:	
City:	Zamora
State/Region:	Zamora Chinchipe
Postfix/ZIP:	
Country:	Ecuador
Telephone:	593 7 2 605996 ext 103
FAX:	593 7 2 605996 ext 103
E-Mail:	jvaguirre@speedtelecom.net.ec
URL:	
Represented by:	
Title:	Eng.
Salutation:	
Last Name:	Aguirre
Middle Name:	Vicente
First Name:	Jose
Department:	
Mobile:	593 9 7305339
Direct FAX:	
Direct tel:	
Personal E-Mail:	josev.aguirre@gmail.com

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding was and will be used in the present project. This project is not a diverted ODA from an Annex 1 country.

Annex 3

BASELINE INFORMATION

The emission factor of the national electric grid is calculated by CORDELIM[6] in collaboration with Eco-Alianzas Estratégicas Cia. Ltda. using version 06 of the methodology ACM0002. The Emission factor is to be used freely crediting CORDELIM and Eco-Alianzas Estratégicas Cia. Ltda.

The dispatch data used in this calculation has been provided with the gentle support of the Power and Communications Sectors Modernization Project (PROMEC, CONAM), and the National Electricity Dispatch Centre (CENACE).

The calculation of baseline emissions of the Chorrillos Hydroelectric Project uses such emission factor, applicable to big and small-scale projects, as considered by the CDM.

The emission factor is calculated as a combined margin (CM), which consists of the combination of two factors: the operating margin (OM) and the build margin (BM).

The calculation method used for obtaining the operating margin emission factor is the Simple Adjusted Method proposed by the ACM0002. The results are the following:

Lambda (λ) 2003	0.00833333
Lambda (λ) 2004	0.01331967
Lambda (λ) 2005	0.00011416
Emission factor of the operating margin (EF_{OM}) 2003-2005	0.74673
Emission factor of the build margin (EF_{BM}) 2005	0.57340
Emission factor of the combined margin, using the default weights (50%)	**0.66007**

The detailed calculations, as well as all the information used for it, are available in the following address: http://www.cordelim.net/cordelim.php?c=835.

[6] http://www.cordelim.net/

Annex 4

MONITORING INFORMATION

The monitoring plan of the project specifies the monitoring of electric generation at Chorrillos Hydroelectric Plant.

The baseline emission factor of the grid will be recalculated at the beginning of each crediting period. Thus, for the second and third crediting periods, the estimated emission reductions will be calculated taking into account any possible modification to the current baseline emission factor.

In each crediting period, the amount of emission reductions obtained by the project activity will vary in relation to the total measured power generation. Thus, accurate measurement of the generated electricity will constitute an important aspect in claiming emission reduction once this project is implemented.

The methodology describes the procedure and equations for calculating emission reduction from monitored data. For this specific project, the methodology is applied through a spreadsheet model. The staff responsible for project monitoring must complete the electronic worksheets on a monthly basis. The spreadsheet automatically provides annual totals in terms of GHG reductions achieved by the project.

There are cells where the user is allowed to enter data. All other cells contain computed values that cannot be modified by the staff.

A color-coded key is used to facilitate data input. The key for the code is as follows*:*

- ***Input Fields:*** Pale yellow fields indicate cells where project operators are required to supply data input, as is needed to run the model;
- ***Result Fields:*** Green fields display result lines as calculated by the model.

All the monitored data will be archived for two years following the end of the crediting period.

Additionally, an annual report will be prepared with the following information related with de EIA:

1) Assessment of the implementation and effectiveness of the identified mitigation measures.
2) Assessment of the implementation and effectiveness of the identified compensation measures.
3) Monitoring of the impacts.