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

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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:

IANCEM Cogeneration Project

Version 02,
14/04/2008

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

The project activity aims at reducing GHG emissions through the use of bagasse (a renewable fuel source, residue from sugarcane processing) to generate power. The biomass based cogeneration facility is at Ingenio Azucarero del Norte Compañía de Economía Mixta, IANCEM.

The project activity consists of increasing efficiency in the cogeneration facility. The implementation of the proposed project activity will lead to the reduction of electricity purchases. Project owner might sell the surplus in case it is generated. By dispatching renewable electricity to a grid, electricity that would otherwise be produced using fossil fuel is displaced, reducing CO_2 emissions from power plants connected to the grid.

The biomass based cogeneration facility will make use of the residue coming from the sugar mill process in order to generate steam and electricity. The project activity involves the steam generation in a 24 TPH bagasse fire boiler and the installation of a new 3 MW turbine for electricity generation.

Bagasse cogeneration is important for the energy strategy of the country. Cogeneration is an alternative that allows postponing the installation and/or dispatch of electricity produced by fossil fuel led generation utilities. The sale of the CER generated by the project will boost the attractiveness of bagasse cogeneration projects, helping to increase the production of this energy and decrease dependency on fossil fuel.

Since the generation of CO_2 from the utilization of biomass is consumed for the growth of biomass plantation on its life cycle basis, the power generation from the project is considered as CO_2 neutral. In other words, CO_2 will be consumed (absorbed) by plants whose biomass is used as fuel, representing a cyclic process of carbon sequestration. Therefore the project does not lead to net on-site CO_2 emissions due to its combustion of biomass in boiler. Since, the biomass contains only negligible quantities of other elements like Nitrogen, Sulphur *etc*. release of other GHGs are considered as negligible.

Contribution to Sustainable Development

The contributions of the project activity towards sustainable development are as follows:

- Reduction of global GHG emissions due to the displacement of energy generation from the grid,

- Less emission of air pollutants (NO_X, PM, among others) due to the displacement of other generation sources, such as thermoelectric plants,

- Improvement of the use of a sustainable renewable energy source instead of non renewable ones due to making good use of bagasse with the consequent contribution to lessen the dependency on fossil fuels,

- Promotion of practices that bring environmental benefits paving the way for others to follow this trend.

Considering all the inherent benefits that the implementation of the project brings, it can be concluded that the proposed activity contributes to the sustainable development of the country.

A.3. Project participants:

Table 1: Project participants

Name of Party involved	Private and/or public entity(ies) project participant (as applicable)	Kindly indicate if the Parte involved wishes to be considered as project participant. (Yes/No)
Ecuador (host)	Ingenio Azucarero del Norte Compañía de Economía Mixta, IANCEM	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):

Ecuador

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

Imbabura

A.4.1.3. City/Town/Community etc:

Ibarra

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

Imbabura is a province in Ecuador that is divided in 6 cantons and the capital is Ibarra. Home to an uncountable number of lakes and other bodies of water, Imbabura is a great place for fishing and adventure sports. Located in Ecuador's northern highlands, the province enjoys a pleasantly dry climate with an average temperature of around 18 degrees centigrade. Its production of handicrafts has made its indigenous population. The province is also well known for its Cotacachi-Cayapas Ecological Reserve.

Ibarra has an estimated population of 157,000 inhabitants and has an area of 1,162.22 km^2. It is situated to 115 km Northeast of Quito and 125 km South of Tulcán.

The project location is 00° 28' 56" N and 078° 05'44" W

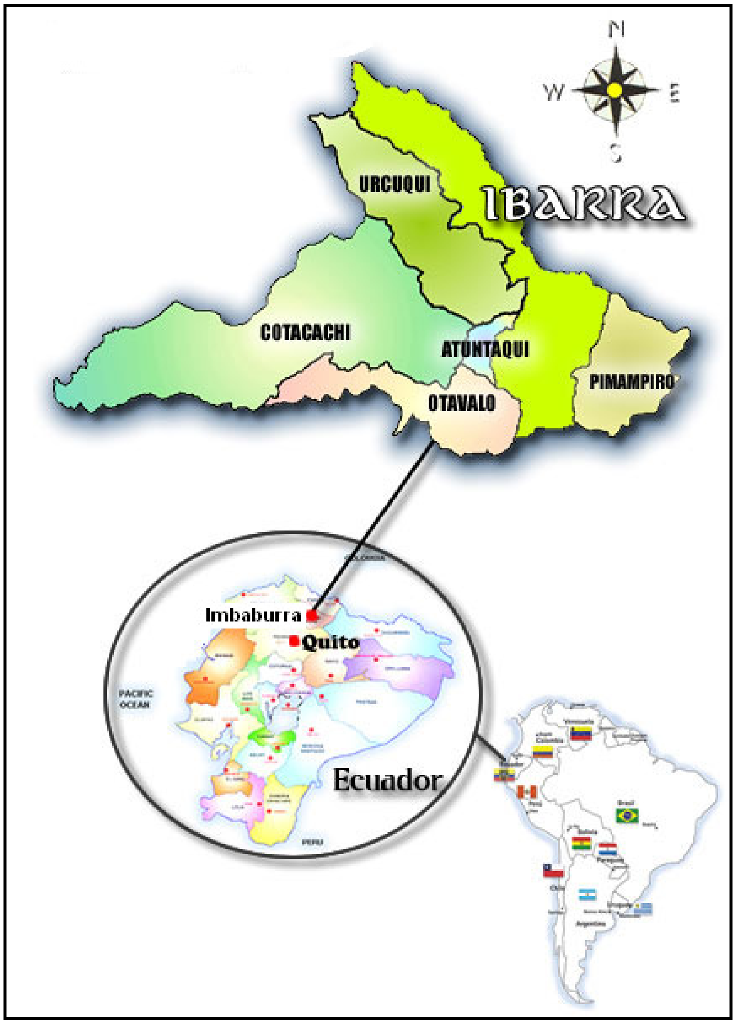

Figure 1: **Maps of Ecuador and Ibarra**

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

Type (I): Renewable energy projects.

Category (C): Thermal energy for the user with or without electricity.

The project is a small scale project activity and falls under the category I.C according to the Appendix B of the Simplified Modalities and Procedures for Small-Scale CDM project activities. It

Technology of the project

The technology used for electricity generation from biomass is the steam-Rankine cycle, which consists of direct combustion of biomass in a boiler to generate steam, which is then expanded through a turbine.

In order to implement the project activity it was necessary to buy a foreign technology for which the necessary *know-how* is not completely developed in the country, incurring in technological barriers that prevent the implementation of the proposed project activity. More details about this issue are provided in the section B.5.

The steam cycle plants is located at industrial site, where the waste heat from the steam turbine is recovered and used for meeting industrial process heat needs. Such combined heat and power (CHP), or cogeneration system provides greater levels of energy services per unit of biomass consumed than systems that generate electric power only.

The project employs the Rankine Cycle technology for steam generation based on direct combustion and single extraction condensing turbine for power generation. The boiler installed is a water-tube boiler technology designed to burn the bagasse with two waterwall furnace technology. The boiler is sized to produce a maximum of 24 tons per hour of steam at a pressure of 300 psi and a temperature of 280ºC. The steam produced will be expanded in backpressure steam turbine where, the energy from pressure inlet steam is efficiently converted into electricity and low-pressure exhaust steam which is provided to the industrial process.

The aim of this project activity is to increase the electricity generation capacity in IANCEM cogeneration unit in two phases:

- **<u>Phase 1 (2006):</u>**
    - Installation of a 3 MW backpressure turbo-generator, which will generate 1.1 MW for the sugar mill consumption
    - The two 830 KW turbo generators will be out of operation.

Technical characteristics of the technology to be employed in the proposed project activity in this phase are given below.

Table 2: Technical characteristics of the generator

Generator brand	General Electric
Generator type	Synchronous
Power	3000 KW
Voltage	13.8 kV

No. Phases	4
Frequency	60 Hz
Power factor	0.8
Synchronous speed	1,800 rpm
Temperature	80 ºC

Table 3: Technical characteristics of the turbine

Turbine brand	NG
Turbine type	DME-700/S
Capacity	3 MW
Synchronous speed	4,927 rpm
Inlet steam pressure	41 Bar
Outlet steam pressure	1.5 Kg/cm^2
Outlet steam temperature	220ºC

- **Phase 2 (2007):**
  - Deactivation of the steam turbines in the sugar mill tandem. The turbines will be replaced by electric motors allowing the use of the steam for electricity generation.
  - The backpressure turbo-generator will generate 2.2 MW that will be used for the sugar mill consumption.

The sponsors are convinced that bagasse cogeneration is a sustainable source of energy that brings not only advantages for mitigating global warming, but also creates a sustainable competitive advantage for the agricultural production in the sugarcane industry in Ecuador. Using the available natural resources in a more efficient way, the IANCEM project activity helps to enhance the consumption of renewable energy.

Moreover, biomass gives thermal energy with zero net carbon dioxide emission on account of sequestration the CO_2 emitted during combustion of biomass is much less than the CO_2 absorbed by the plants growth. Hence, the net CO_2 emission due to burning of biomass for power generation is zero.

In conclusion, the technology described above provides the means to generate the power that will lead to accomplish the project's objective, that is to say, to reduce GHG emissions through the displacement of other energy generation sources from the grid.

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

The *ex-ante* emissions reductions are estimated to be 68,911 tCO_2e for the chosen crediting period of 10 years. Note that actual emission reductions will be based on monitored data and may differ from the estimate shown below.

Table 4: Total emission reductions during the 10-year crediting period

Years	**Annual estimation of emission reductions** (tonnes of CO_2e)
August 2008 - December 2008	2,871
2009	6,891
2010	6,891
2011	6,891
2012	6,891
2013	6,891
2014	6,891
2015	6,891
2016	6,891
2017	6,891
January 2018 - July 2018	4,020
Total estimated reductions (tCO_2e)	**68,911**
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	6,891

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

No funds from public national or international sources are involved in any aspect of the proposed CDM project activity.

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

According to Appendix C of Simplified Modalities & Procedures for small scale CDM project activities, ‘Debundling’ is defined as the fragmentation of a large project activity into smaller parts.

The guide for de-bundling mentioned in paragraph 2 of appendix C of the Simplified Modalities and Procedures for Small-Scale CDM project activities is given as follows:

A proposed small scale project activity shall be deemed to be a de-bundled component of a large project activity, if a registered small-scale CDM project activity or an application to register another small-scale CDM project activity.

- *With the same project participants;*
- *In the same project category and technology/measure; and*
- *Registered within the previous 2 years*
- *Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point.*

Based on the information provided in the guide, this project is not a de-bundled component of a large project activity since there is no registered small scale CDM project activity or an application to register another small scale CDM project activity (previous 2 years) by the same project proponent (IANCEM), in the same project category and technology/measure, with project boundary within 1 km of the project activity.

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:

The project activity uses the simplified baseline and monitoring methodology designated ***"Thermal energy for the user with or without electricity - Version 13"***, Type I.C in Appendix B of the Simplified Modalities and Procedures for Small-Scale CDM project activities.

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

The project is a small scale project activity and falls under the category I.C. according to the Appendix B of the Simplified Modalities and Procedures for Small-Scale CDM project activities.

Biomass-based co-generation systems that produce heat and electricity are included in this category.

The proposed project activity is an 3MW biomass (renewable energy) based cogeneration power plant that displace electricity form an electricity distribution system that is or would have been supplied by at least one fossil fuel fired generating unit.

The categorization is justified by the following parameters:

1. Electricity generation capacity is lower than 15 MW;
2. Fuel type is biomass: bagasse (a renewable fuel source, residue from sugarcane processing).

3. The sums of all forms of energy output not exceed 45 $MW_{thermal}$. The project activity clearly qualifies the said criteria since the rating of the boiler is less than the stipulated limit as show below:

Boiler Capatity:	24 TPH
	6.67 Kg/s
Steam Energy:	2,967 KJ/Kg (at 22 bar pressure and 280ºC temperature)
	2.97 MJ/Kg
Water Energy (at 90ºC):	377 KJ/Kg
	0.38 MJ/Kg
Boiler rating:	$6.67 \times (2.97 - 0.38) = 17.27 MW_{thermal}$

B.3. Description of the project boundary:

As per the simplified baseline and monitoring methodology for selected small-scale CDM project activity category, project boundary encompasses the physical and geographical site of the renewable generation source.

For the project under consideration, the project boundary covers the biomass based cogeneration power plant. However, for the purpose of calculation of baseline emissions, the project boundary also includes the power plants connected physically to the grid that the proposed project activity will affect (Ecuador National Interconnected System).

B.4. Description of baseline and its development:

The project activity involves the use of renewable energy to generate electricity. By self-generating, the proposed project activity will lead to the reduction of electricity purchases. Project owner might sell the surplus in case it is generated. By dispatching renewable electricity to a grid, electricity that would otherwise be produced using fossil fuel is displaced, reducing CO_2 emissions from power plants connected to the grid.

According to the AMS-I.C. Version 13, cogeneration projects shall use one of the five following options for baseline emission calculations depending on the technology that would have been used to produce the thermal energy and electricity in the absence of the project activity:

(a) Electricity is imported from the grid and steam/heat is produced using fossil fuel;

(b) Electricity is produced in an onsite captive power plant (with a possibility of export to the grid) and steam/heat is produced using fossil fuel;

(c) A combination of (a) and (b);

(d) Electricity and steam/heat are produced in a cogeneration unit, using fossil fuel.

(e) Electricity is imported from the grid and/pr produced in an on-site captive power plant (with a possibility of export to the grid); steam/heat is produced from renewable biomass.

The option (e) is used for baseline emission calculations. Therefore, the baseline scenario comprises the electricity imported from the grid and the steam produced from renewable biomass.

Thus, baseline emissions includes CO_2 emissions from fossil fuels that would have been used by the operation of grid-connected power plants and by the addition of new generation sources, in order to generate the quantity of electricity generated by the proposed project activity.

According to the AMS-I.C. Version 13, the baseline emissions for electricity imported from the grid shall be calculated as the amount of electricity produced with the renewable energy technology (GWh) multiplied by the CO_2 emission factor of that grid.

The emission factor for grid electricity is obtained as per the procedures detailed in AMS I.D. Version 12 where the emission coefficient (measured in kg CO_2e/kWh) is calculated in a transparent and conservative manner as:

(a). A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the approved methodology ACM0002 version 6. 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 kg CO_2e/kWh) of the current generation mix. The data of the year in which project generation occurs must be used.

Calculations must be based on data from an official source (where available)[1] *and made publicly available.*

Option (a) is the one selected in this project. Following the methodology ACM0002 version 6, the Baseline Emission Factor (EF_y) is calculated as a combined margin, consisting of the combination of Operating Margin Emission Factor (EF_{OM}) and Build Margin Emission Factor (EF_{BM}).

The consolidated methodology gives 4 different options to calculate the Operating Margin Emission Factor (EF_{OM}). These options are:

(a) Simple OM

[1] *Calculated*, if data on fuel type, fuel emission factor, fuel input and power output can be obtained for each plant; if confidential data available from the relevant host Party authority are used, the calculation carried out by the project participants shall be verified by the DOE and the CDM-PDD may only show the resultant carbon emission factor and the corresponding list of plants.

(b) Simple adjusted OM

(c) Dispatch Data Analysis OM

(d) Average OM

The selection of the appropriate calculation method depends, among other factors, on the characteristics of the electrical national grid and the available information about it.

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

The average emission rate method (d) can only be used where low-cost/must run resources constitute more than 50% of total grid generation and detailed data to apply option (b) and/or (c) is not available.

The methodology recommends the use of option (c) whenever possible.

Dispatch data analysis should be the first methodological choice, but for the proposed project activity the Operating Margin has been calculated using the Simple Adjusted Method due to the following reasons:

- No publicly available information exists to allow the use of option (c) Dispatch Data Analysis OM. According to the methodology, the calculation of the OM emission factor, using option (c), is determined *ex-post*. In order to write the PDD, project developers may use models to estimate the reductions prior to validation. Such models should be able to simulate the operation of the hydroelectric project along with the other interconnected power plants during the crediting period, and, to achieve this, the data of many years of hydrological behavior are needed. The data on hydrology are not available.

- In Ecuador low-cost resources constitute more than 50% of the total generation of the national grid, which prevents from using option (a) Simple OM.

The average of the "operating margin" and the "build margin" is equivalent to 0.66007 tonnes CO_2eq/MWh. This factor will remain fixed during the selected crediting period.

The detailed calculation of the emission factor will be available for the Designed Operational Entity (DOE) during the project's validation process.

According to the baseline methodology, the key data used to determine the baseline scenario is given in the following table:

Table 5: Key data

Parameter	Data Sources
Combined margin emission factor	Calculated according to the methodology ACM0002 version 6.
Variables	**Data sources**

Electricity generation of the industrial facility per year	IANCEM

For further information on key data used for baseline scenario, refer to Annex 3.

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:

According to attachment A to Appendix B of the simplified modalities and procedures for small-scale CDM project activities, project participants shall provide explanation to show that the project activity would not have occurred anyway due to at least one of the barriers (investment, technological or other barriers).

The following explanation provides the reasons that the project activity would not have occurred anyway due to following barriers.

Barriers to financing

Ecuadorian financial entities and multilateral banks perceive high risks in the electricity sector, due to the high debt rate of the distribution companies and their inability to pay. National banks are not interested and impose important barriers for obtaining long-term credits to finance electricity generation projects in Ecuador[2]. As a consequence, several banks have rejected the financing of the IANCEM Cogeneration project.

Since there is not access to credit for this sector in the country, the project received low priority by the management, and only after considering CDM revenues it was possible to obtain approval from the Board of Directors and by deviating limited available own investments and resources for installing new generation capacity was possible to finance part the project. Moreover, as shown in the original basic engineering plan of the project a more ambitious activity was conceived, but neither current resources nor CDM revenues were able to inject enough income as to overcome the investment barrier, reduce the technological risks and alleviate the financial hurdles of that option.

Technological Barriers

Introducing the new biomass based power technology in the sugar mill implies:

- The introduction of risks in the management and operation of the project. In order to acquire the more appropriate and efficient technology as required by the sugar mill, it was necessary to buy a foreign technology for which the necessary *know-how* is not completely developed in the country.

[2] From different sources, it was possible to confirm that electric sector is facing several problems (lack of investment). The description of Ecuador's economic situation regarding electric sector are detailed in the Economic Bulletin No. 36 – Corporación Centro de Estudios y Análisis (CEA), May 2007. Web site: http://www.ccq.org.ec/documents/CEAINFO36.pdf

- The installation of several equipments. The integration of all equipment was complex and additional risks were incorporated to the process. Furthermore, as a consequence of the project activity implementation, the industrial facility had to be modified in order to send the surplus energy to the grid; incurring in new practices with complex work procedures.

- Paying special attention to the maintenance activities. As the technology is imported, spare parts might have to be imported from the manufacturer, causing probable delays in the equipment operation. By the way, several problems have been occurring since the turbine was installed due to its inappropriate functioning. Abroad technical expert and imported spared parts have been required incurring in important costs and delays.

- Training the personnel in charge of the turbine operation. This required professional technicians from abroad from the manufacturing facility. Lack of proper operation might lead to equipment malfunctioning or break, affecting the normal energy generation. Also people in charge of turbine's maintenance had to be properly trained.

- The personnel in charge of the turbogenerator parameters operation and monitoring were trained with a special course. This course was taught by Engineer Paulo Moraes. Furthermore, when the turbogenerator was assembled the operators were trained in an operation and maintenance practice course[3].

Core business Barrier

New investments in the sugar mill are typically related to increase sugar cane production capacity by feeding new hectares. This is the core business of the sugar mill for its short-term business strategy. The proposed project activity has been a steep diversification from the core business in the short term. Deviating limited available own investments and resources for installing new generation capacity only to avoid purchasing electricity from the national grid leads to a significant delay in the sugar cane production expansion, thus redefining the business goals of the sugar mill as a long-term strategy. And this happens since there is not access to credit for this sector in the country. Therefore, the project received low priority by the management, and only after considering CDM revenues it was possible to obtain approval from the Board of Directors. Moreover, as shown in the original basic engineering plan of the project a more ambitious activity was conceived, but neither current resources nor CDM revenues were able to inject enough income as to overcome the investment barrier, reduce the technological risks and alleviate the financial hurdles of that option.

Above barriers are strong enough to affect the decision of the project implementation. In the absence of the project activity, IANCEM will continue producing sugar and will increase its production, purchasing the plant electricity needs to the grid.

The impact of registration of this project activity will be an incentive to overcome all the barriers described above, by bringing more solidity to the investment itself and, therefore, fostering and supporting the project owners' breakthrough decision to go ahead with the implementation of the project activity.

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[3] Training Course Certificates of the personnel in charge for the turbogenerator operation and monitoring parameters are available

Considering all the previous assessment, it is clear that the proposed project activity is additional.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

Project emissions

No project emissions are considered since biomass is the main fuel used for this project activity and no additional quantity of fossil fuel is used.

Leakage

As per the methodology, leakage is considered if the energy generating equipment is transferred form another activity or if existing equipment is transferred to another activity. Since none of these conditions is applicable, no leakage is considered in this project activity.

Baseline emissions

According to the AMS-I.C. Version 13, the baseline is the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in kg CO_2e/kWh) calculated according to the procedures prescribed in the approved methodology ACM0002 version 6.

Emission Factor

Following the methodology ACM0002 version 6, the Baseline Emission Factor (EF_y) is calculated as a combined margin, consisting of the combination of Operating Margin Emission Factor (EF_{OM}) and Build Margin Emission Factor (EF_{BM}) according to the following three steps.

Step 1 Calculate the Operating Margin emission factor (EF_{OM}).

In order to calculate the Operating Margin Emission Factor (EF_{OM}) the Simple Adjusted Method is used. In this method, the EF_{OM} is calculated as the generation-weighted average emission per electricity unit (tCO_2/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*):

$$EF_{OM,simple\_adjusted,y} = (1-\lambda y).\frac{\sum_{i,j} F_{i,j,y}.COEF_{i,j}}{\sum_{j} GEN_{j,y}} + \lambda y.\frac{\sum_{i,k} F_{i,k,y}.COEF_{i,k}}{\sum_{k} GEN_{k,y}}$$

where

$F_{i,j,y}$	=	is the amount of fuel *i* (in a mass or volume unit) consumed by relevant power sources *j* in year(s) *y*,
j	=	refers to the power sources delivering electricity to the grid,
$COEF_{i,j\,y}$	=	is the CO_2 emission coefficient of fuel *i* (tCO_2 / mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant power sources *j* and the

percent oxidation of the fuel in year(s) *y*, and

$GEN_{j,y}$ = is the electricity (MWh) delivered to the grid by source *j*.

$F_{i,k,y}$, $COEF_{i,k}$ and GEN_k are analogous to the variables described above for plants *k*.

The CO_2 emission coefficient $COEF_i$ is obtained as:

$$COEF_i = NCV_i . EF_{CO_2,j} . OXID_i$$

where:

NCV_i = is the net calorific value (energy content) per mass or volume unit of a fuel *i*,
$OXID_i$ = is the oxidation factor of the fuel.
$EF_{CO2,i}$ = is the CO_2 emission factor per unit of energy of the fuel *i*.

Where available, local values of NCV_i and $EF_{CO2,i}$ should be used. If no such values are available, country-specific values are preferable to IPCC world-wide default values.

And,

$$\lambda = \frac{\text{number of hours per year for which low - cost / must - run sources are on margin}}{\text{8,760 hours per year}}$$

where lambda (λ_y) should be calculated as follows:

Step i) Plot a Load Duration Curve. Collect chronological load data (typically in MW) for each hour of a year, and sort load data from highest to lowest MW level. Plot MW against 8,760 hours in the year, in descending order.

Step ii) Organize Data by Generating Sources. Collect data for, and calculate total annual generation (in MWh) from low-cost/must-run resources (i.e. $\Sigma_k GEN_{k,y}$).

Step iii) 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 lowcost/must-run resources (i.e. $\Sigma_k GEN_{k,y}$).

Step iv) Determine the "Number of hours per year for which low-cost/must-run sources are on the margin". First, locate the intersection of the horizontal line plotted in step (iii) and the load duration curve plotted in step (i). The number of hours (out of the total of 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 may conclude that low-cost/must-run sources do not appear on the margin and λ_y is equal to zero. Lambda (λ_y) is the calculated number of hours divided by 8,760.

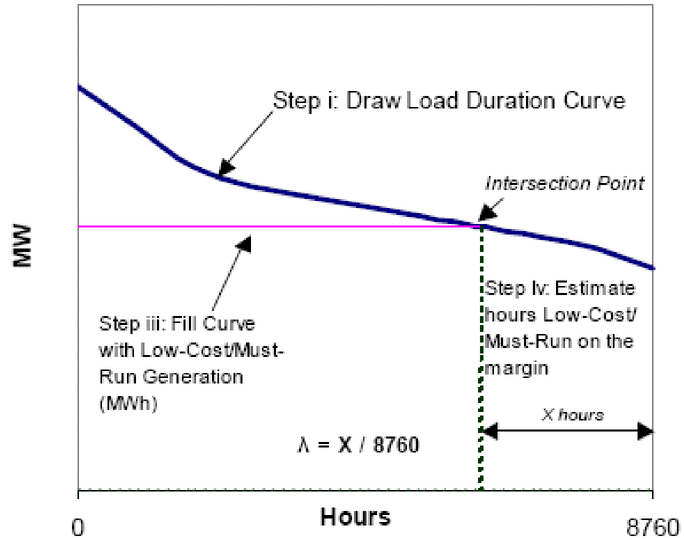

Figure 2: **Illustration of Lambda Calculation for Simple Adjusted OM Method**

Step 2 Calculate the Build Margin emission Factor (EF_{BM})

The Build Margin emission factor ($EF_{BM,y}$) is calculated as the generation-weighted average emission factor (tCO_2/MWh) of a sample of power plants *m*, as follows:

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y}.COEF_{i,m}}{\sum_{m} GEN_{m,y}}$$

where $F_{i,m,y}$, $COEF_{i,m}$ and $GEN_{m,y}$ are analogous to the variables described for the simple adjusted OM method 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.

STEP 3. Calculate the baseline emission factor *EFy* as the weighted average of the Operating Margin emission factor ($EF_{OM,y}$) and the Build Margin emission factor ($EF_{BM,y}$):

$$EF_y = w_{OM}.EF_{OM,y} + w_{BM}.EF_{BM,y}$$

where the weights w_{OM} and w_{BM}, by default, are 50% (i.e., $w_{OM} = w_{BM} = 0.5$), and $EF_{OM,y}$ and $EF_{BM,y}$ are calculated as described in Steps 1 and 2 above and are expressed in tCO_2/MWh.

Electricity Generation

According to the AMS-I.C. Version 13, in the case of project activities that involve the addition of renewable energy units at an existing renewable energy production facility, where the existing and new units share the use of common and limited renewable resources (e.g. stream flow, reservoir capacity, biomass residues), the potential for the project activity to reduce the amount of renewable resource available to, and thus electricity generation by, existing units must be considered in the determination of baseline emissions, project emissions, and/or leakage, as relevant.

For project activities that involve the addition of new generation units (e.g. turbines) at an existing facility, the increase in electricity production associated with the project (EG_y in MWh/ year) should be calculated as follows:

$$EG_y = TE_y - WTE_y$$

where:

TE_y = Total electricity produced in year *y* by all units, existing and new project units.
WTE_y = Estimated electricity that would have been produced by existing units (installed before the project activity) in year *y* in the absence of the project activity.

where

$$WTE_y = MAX(WTE_{actual\ y}, WTE_{estimated\ y})$$

where,

$WTE_{actual,y}$ = the actual, measured electricity production of the existing units in year *y*
$WTE_{estimated,y}$ = the estimated electricity that would have been produced by the existing units under the observed availability of the renewable resource (e.g. hydrological conditions) for year *y*

If the existing units shut down, are derated, or otherwise become limited in production, the project activity should not get credit for generating electricity from the same renewable resources that would have otherwise been used by the existing units (or their replacements). Therefore, the equation for WTE still holds, and the value for $WTE_{estimated,y}$ should continue to be estimated assuming the capacity and operating parameters same as that at the time of the start of the project activity.

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

Data / Parameter:	***EFy***
Data unit:	tCO_2/MWh.
Description:	Baseline emission factor for electricity
Source of data used:	Provided by Cordelim (the Ecuadorian CDM office)
Value applied:	0.66007
Justification of the choice of data or description of measurement methods and procedures actually applied :	The Emission Factor is calculated by “CORDELIM” in collaboration with “Eco-Alianzas Estratégicas Cia.Ltda.” using the Methodology ACM0002/Ver 6. The dispatch data used in this calculation has been provided with the support of the “Power and Communications Sectors Modernization” Project (PROMEC, CONAM), and the National Electricity Dispatch Centre (CENACE).
Any comment:	These data will remain fixed to estimate baseline emissions and emissions reductions during the crediting period.

Data / Parameter:	**WTE_y**

Data unit:	MWh.
Description:	Estimated electricity that would have been produced by existing units (installed before the project activity) in year *y* in the absence of the project activity.
Source of data used:	IANCEM
Value applied:	0.75
Justification of the choice of data or description of measurement methods and procedures actually applied :	According to the AMS-I.C version 13, if the existing units shut down, the project activity should not get credit for generating electricity from the same renewable resources that would have otherwise been used by the existing units. Therefore, the equation for WTE still holds, and the value for $WTE_{estimated,y}$ should continue to be estimated assuming the capacity and operating parameters same as that at the time of the start of the project activity.
Any comment:	These data will remain fixed to estimate baseline emissions and emissions reductions during the crediting period.

B.6.3 Ex-ante calculation of emission reductions:

As stated before, emission reductions are equal to baseline emissions because neither project emissions nor leakage effects are expected.

Baseline emissions

Baseline emissions are the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in kg CO_2e/kWh).

Emission Factor

Following the methodology ACM0002 version 6, the Baseline Emission Factor (EF_y) is calculated as a combined margin, consisting of the combination of Operating Margin Emission Factor (EF_{OM}) and Build Margin Emission Factor (EF_{BM}) according to the following three steps.

Step 1 Calculate the Operating Margin emission factor (EF_{OM})

In order to calculate the Operating Margin, daily dispatch data from the Ecuadorian electricity system manager (CONELEC) needed to be gathered. The provided information comprised years 2003, 2004 and 2005, and is the most recent information available at this stage.

$$EF_{OM,simple\_adjusted,y} = (1-\lambda y).\frac{\sum_{i,j} F_{i,j,y}.COEF_{i,j}}{\sum_{j} GEN_{j,y}} + \lambda y.\frac{\sum_{i,k} F_{i,k,y}.COEF_{i,k}}{\sum_{k} GEN_{k,y}}$$

Following the consolidated methodology, the factor lambda (λ) was calculated on the basis of the number of hours that “low-cost/must-run” resources are on the margin in Ecuador. The hourly dispatch permits the drawing of the Curve (MW against hours) for the calculation of lambda (λ). More details are presented in Annex 3. Lambda values obtained for the years 2003, 2004 and 2005 are as follows:

Table 6: Lambda values

Parameter	Value
Lambda (λ) 2003	0.00833333
Lambda (λ) 2004	0.01331967
Lambda (λ) 2005	0.00011416
Lambda (λ) average	**0.007255720**

The Emission Factor of the Operating Margin (EF_{OM}) is:

$$EF_{OM,simple\_adjusted,y} = (1-\lambda y).\frac{\sum_{i,j} F_{i,j,y}.COEF_{i,j}}{\sum_{j} GEN_{j,y}} + \lambda y.\frac{\sum_{i,k} F_{i,k,y}.COEF_{i,k}}{\sum_{k} GEN_{k,y}} = 0.74673\ tCO_2/MWh$$

The following table summarises the values used to calculate the above result.

Table 7: Input values for calculating EF_{OM}

Parameter	Value	Unit
λ	0.007255720	----
$\sum_{i,j} F_{i,j,y}.COEF_{i,j}$	10144041	tCO_2
$\sum_{j} GEN_{j,y}$	13486064	MWh
$\sum_{i,k} F_{i,k,y}.COEF_{i,k}$	0.00[4]	tCO_2
$\sum_{k} GEN_{k,y}$	26025569	MWh

Build Margin Emission Factor (EF_{CM})

Build Margin emission factor $EF_{BM,y}$ is based on the most recent information available on plants already built for sample group *m* at the time of PDD submission The sample group *m* consists of 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.

The Emission Factor of the Build Margin (EF_{BM}) is:

[4] According to the consolidated methodology ACM0002 version 6, page 3: "For imports from connected electricity system located in another country, the emission factor is 0 tons CO_2 per MWh."

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y}.COEF_{i,m}}{\sum_{m} GEN_{m,y}} = 0.573404 \ \ tCO_2/MWh$$

The following table summarises the values used to calculate the above result.

Table 8: Input values for calculating EF_{BM}

Parameter	Value	Unit
$\sum_{i,m} F_{i,m,y}.COEF_{i,m}$	1,595,611	tCO_2
$\sum_{m} GEN_{m,y}$	2,782,697.97	MWh

For more details refer to Annex 3.

Baseline Emission Factor (EF_y)

This is calculated as the weighted average of the Operating Margin emission factor ($EF_{OM,y}$) and the Build Margin Emission Factor ($EF_{BM,y}$). The weights w_{OM} and w_{BM}, have been chosen as 50% (i.e., w_{OM} = w_{BM} = 0.5), following the default values given in the methodology.

$$EF_y = w_{OM}.EF_{OM,y} + w_{BM}.EF_{BM,y}$$

$$EF_y = 0.5 \times 0.74673 + 0.5 \times 0.573404 = 0.66007 \ tCO_2e/MWh$$

<u>Electricity Generation</u>

The proposed project activity involves the addition of renewable energy generation units at an existing renewable power generation facility. The increase in electricity production associated with the project (EG_y in MWh/ year) is calculated as follows:

$$EG_y = TE_y - WTE_y$$

where:

TE_y = the total electricity produced in year *y* by all units, existing and new project units.
WTE_y = the estimated electricity that would have been produced by existing units (installed before the project activity) in year *y* in the absence of the project activity.

It is expected that IANCEM will self-generate 1.1 MW of electricity through the implementation of the phase 1 of the project activity during the year 2007 up to 2008, and 2.2 MW through the implementation of the phase 2 from 2008.

Therefore, electricity produced by all units, existing and new project units, for the chosen crediting period can be estimated and are shown in the following table.

Table 9: *Ex-ante* electricity generation

Year	Generation (hours per year)	TE_y (MWh/year)	WTE_y (MWh/year)	EG_y (MWh/year)
August 2008 - December 2008	3,000	6,600	2,250	4,350
2009	7,200	15,840	5,400	10,440
2010	7,200	15,840	5,400	10,440
2011	7,200	15,840	5,400	10,440
2012	7,200	15,840	5,400	10,440
2013	7,200	15,840	5,400	10,440
2014	7,200	15,840	5,400	10,440
2015	7,200	15,840	5,400	10,440
2016	7,200	15,840	5,400	10,440
2017	7,200	15,840	5,400	10,440
January 2018 - July 2018	4,200	9,240	3,150	6,090
Total	**72,000**	**158,400**	**54,000**	**104,400**

Electricity generation has been estimated in spreadsheet *Emission Reductions IANCEM.xls*.

Baseline Emissions

As mentioned above, baseline emissions include CO_2 emissions from fuels that would have been used by the operation of grid-connected power plants and by the addition of new generation sources, in order to generate the quantity of electricity generated through the proposed project activity.

$$BE_{electricity,y} = EG_y \times EF_{grid}$$

where

EG_y Net quantity of electricity generated (MWh/year).

EF_{grid} CO_2 baseline emission factor for electricity displaced due to the project activity (tCO_2/MWh).

$BE_{electricity,y}$ Baseline emissions in tonnes of CO_2 equivalent per year

The CO_2 baseline emission factor for electricity displaced due to the project activity is equivalent to 0.66007 tonnes CO_2eq/MWh.

Therefore, GHG baseline emissions for the chosen crediting period can be estimated and are shown in the following table.

Table 10: *Ex-ante* Baseline Emissions

Year	**EGy** (MWh/year)	**Baseline Emissions** (tCO_2/year)
August 2008 - December 2008	4,350	2,871
2009	10,440	6,891
2010	10,440	6,891
2011	10,440	6,891
2012	10,440	6,891
2013	10,440	6,891
2014	10,440	6,891
2015	10,440	6,891
2016	10,440	6,891
2017	10,440	6,891
January 2018 - July 2018	6,090	4,020
Total	**104,400**	**68,911**

Baseline emissions have been estimated in spreadsheet *Emission Reductions IANCEM.xls*.

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

The project activity has the capacity to reduce **68,911** tonnes of CO_2 equivalent emissions over a 10-year time frame.

The emission reduction ER_y achieved by the project activity are given by:

$$ER_y = BE_y - PE_y - LE_y$$

The following table summarises the values obtained above.

Table 11: *Ex-ante* Emission Reductions (tCO_2e)

Year	**Baseline Emissions** (tCO_2/year)	**Project Emissions** (tCO_2/year)	**Leakage** (tCO_2e/year)	**Emissions Reductions** (tCO_2/year)
August 2008 - December 2008	2,871	0	0	2,871
2009	6,891	0	0	6,891
2010	6,891	0	0	6,891
2011	6,891	0	0	6,891
2012	6,891	0	0	6,891
2013	6,891	0	0	6,891
2014	6,891	0	0	6,891
2015	6,891	0	0	6,891
2016	6,891	0	0	6,891
2017	6,891	0	0	6,891
January 2018 - July 2018	4,020	0	0	4,020
Total	**68,911**	**0**	**0**	**68,911**

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

B.7.1 Data and parameters monitored:

Data / Parameter:	**TE_y**
Data unit:	MWh
Description:	Total electricity produced in year *y* by all units, existing and new project units.
Source of data to be used:	IANCEM
Value of data	The total estimated energy generation throughout the first crediting period is 102,420 MWh.
Description of measurement methods and procedures to be applied:	The total electricity produced by existing unit should be estimated assuming the capacity and operating parameters same as that at the time of the start of the project activity. The total electricity produced by the new project unit shall be monitored. Electronic meters will be used to measure energy generation in the new unit.
QA/QC procedures to be applied:	Monitoring systems will follow relevant procedures under ISO 9001-2000, all of which are integrated in IANCEM's Quality Management System.
Any comment:	These data will be recorded monthly and yearly values will be used to calculate emission reductions of the project activity.

B.7.2 Description of the monitoring plan:

According to Type I, Category C of small-scale project activity categories contained in appendix B of the Simplified M&P for CDM Small-Scale Project Activity, monitoring shall consist of metering the electricity generated by the renewable technology and the amount of biomass.

The total electricity produced by existing unit should be estimated assuming the capacity and operating parameters same as that at the time of the start of the project activity and the total electricity produced by the new project unit shall be monitored.

The monitoring of baseline emissions implies the application of an operational and management procedure that shall assure the correct and proper measurement and control of the variable involved in the calculation of emission reductions.

IANCEM has maintenance and operations procedures that include the monitoring of the electricity generated, instruments calibration and quality control, in accordance with company policies and ISO9000-2000 certification.

The electric chief of the electric maintenance department will be the responsible for the monitoring of the electricity generated by the renewable technology according to the **R-MIN-19 V 0.3** which is part of the register format of the quality control system of the ISO 9000-2000.

IANCEM will assign a qualified person to compile the necessary data according to the approved methodology to accurately calculate emission reductions.

The monitoring of electric and mechanic parameters of the turbine and generator will be carried out by the Electric and Turbo Plant Operators, which main roles are to operate and maintain the correct function of the turbogenerators at Ingenio Azucarero del Norte. The assistants shall be in charge in case of absence of the operator.

The operators must monitor and register (R-MIN-19 V 0.3) the following parameters: Voltage, frequency, power factor and power, which are recorded and controlled by the operator. The energy generated is also recorded in the same R-MIN-19 V 0.3.

The operators of the turbogenerator have the following work instructions fulfilled as requirement of the norm ISO 6.3:

- Instructive of checking and starting up of the turboalternator NG IT-MIN-13
- Instructive of operation of the turboalternator NG IT-MIN-14
- Instructive of the energy supply of the Turbogenerator # 3 IT-MIN-15

The Electric Chief checks these records and conduct preventive and corrective actions as required. He is in charge of appointing the personnel working in the turbogenerator, verifying the maintenance actions are being conducted and executing the work orders needed for the good function of the equipment.

Furthermore, there are a set of plans of the electric cogeneration project and an instructions, installation, operation and maintenance handbook of the turbine in the work site, as well as laminated copies of the work instructions related to the turbogenerator.

Generation parameters could also be monitored from a remote station due to the monitoring program ENERVISTA of General Electric. It must be pointed out that this program does not record historic generation data.

The personnel in charge of the turbogenerator parameters operation and monitoring were trained with a special course. This course was taught by Engineer Paulo Moraes. Furthermore, when the turbogenerator was assembled the operators were trained in a operation and maintenance practice course.

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: 14/03/2008

Rocío Rodriguez and Fabián Gaioli, MGM International SRL

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C1113AAQ, Buenos Aires, Argentina

Tel./Fax: (54 11) 5219-1230/32

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Rocío Rodriguez and Fabián Gaioli are not project participants.

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:

01/02/2006

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:

N/A

C.2.1.2. Length of the first crediting period:

N/A

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

01/08/2008

C.2.2.2. Length:

10 years

SECTION D. Environmental impacts

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

An Environmental Impact Assessment was carried out for the proposed project activity dividing it into the following stages:

- Identification of Environmental Impacts: Carried out by means of elaborating a double entry matrix (Leopold Matrix).
- Qualification of Environmental Impacts: with this purpose a methodology based on Environmental Importance Qualification Criteria was designed "Criterios Relevantes Integrados" (Buroz, 1998) that can be applied to these kind of activities.
- Determination of the Importance of Environmental Impacts: in accordance with the application of the calculation formula for Environmental Importance, results within a qualification range from 12 to 52 were obtained, and from that the qualification scale was determined.
- Determination of Significant Environmental Impacts: Based on different indicators, such as importance of the impact, presence of a special condition requiring an specific management due to the effect to be produced (irreversibility, irrecoverable condition, intensity, extension, to name the most representative ones), and based on a qualitative objective with regard to: Legal and regulatory aspects, fulfillment of the valid environmental legal framework; Economic aspects, representing an economic loss or fines to the project; Stakeholders, relationship with the community.

The Environmental Impact Assessment included a Program of Prevention and Mitigation of Environmental Impacts. The objective of the present program is to pose measures so as to prevent, control, mitigate and compensate the effects of described environmental impacts caused to the environmental factors involved in the present process.

Measurements for identified environmental impacts were suggested, following an order in accordance with the project activities, and control and monitoring measures were determined, responsible for the activities and the fulfillment deadline. Measures for impacts have been defined, such as the la alteration of quality of air by noise, particulate material and exhaust gases, visual alteration of landscapes due to facilities, measures so as to properly manage waste, management of the process conflicts, avoid risk to population and occupational health, improvement of the grinding process and measures in order to manage the contamination for solid waste.

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:

This project activity presents no major environmental impacts.

SECTION E. Stakeholders' comments

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

The stakeholders' consultation process has been conduced in two stages. First, in order to obtain the licence as cogenerator by CONELEC, a public discussion with local stakeholders was carried out in April 2006. The people that assisted to the public audience were the following:

Eng. Andino Paola, CONELEC Representative

Eng. Enríquez Diego, BIOSFERA Cía. Ltda Representative

Eng. Enríquez Alberto, IANCEM Board of directors President

Eng. Carlos Valdivieso, IANCEM General Manager

Sr Fausto Endara López, IANCEM Director

Eng. Fausto Rivera, IANCEM Technical Assistant Manager

Ibarra Fire Brigade Representative

Municipality Representative

National Police Representative

Local Community Representative and Inhabitants

The activities executed, with the purpose of informing the community included in the Influence Area of the Environmental Impact Assessment, were as follows:

- During the collection of the Social Baseline information when conducting the Environmental Impact Assessment, the leaders of the surrounding communities, as well as several residents of the area, were invited in order to inform them about the project activities and the elaboration of studies.

- Interviews and surveys to community leaders and residents of the communities included in the Influence Area of the Study were carried out.

- The inquiries, observations and recommendations expressed by the leaders and residents were collected so as to include them in the elaborated diagnosis and as indicators of measures for the Communal Relations Plan.

The invitation to the Public Audience of the Environmental Impact Assessment was published in the Ibarra Canton press.

Radial broadcasting of the aforementioned invitation was made, on April 8-9, in the city of Ibarra.

Written invitations were sent to the leaders of the communities included in the Influence Area of the project.

Written invitations were sent to the public authorities of Ibarra Canton and of CONELEC.

Executive Summary of the Project Environmental Impact Assessment was sent to the attending people.

On Monday April 10th, 2006, in the Sessions Room of the Community Center of the Santa Catalina de Salinas Parish at 16.15, the Public Audience for the Presentation of the Environmental Impact Assessment of the IANCEM Cogeneration Project was carried out.

The attendance of authorities of the Company and from Ibarra Canton, the leaders of the Parish Community Center, residents of involved communities and the representative of CONELEC (Eng. Paola Andino) was verified. The Public Audience was directed by Engineer Diego Enriquez, representative of BIOSFERA CIA. LTDA., Coordinator of the Environmental Impact Assessment of the Project.

In the second stage Project Participant invited, through a survey, a group of stakeholders so as to comment the IANCEM cogeneration project. This survey took place on May 2007.

The following set of questions was sent to a group of stakeholders in order to collect different opinions on the project activity:

1. According to the information available and your knowledge about issues related to Environment, Climate Change, Kyoto Protocol, Clean Development Mechanism and Carbon Market; briefly express your opinion on *IANCEM Cogeneration Project*.

2. Would you recommend to private parties, governmental authorities or other organisations to develop this kind of projects (the use of bagasse a renewable fuel source, residue from sugarcane processing, to generate power projects as a CDM)?

3. Do you consider that *IANCEM Cogeneration Project* will contribute to social, economic and environmental development (Sustainable Development) of both, the region and Ecuador itself?

4. How does the *IANCEM Cogeneration Project* development affect (positively or negatively) yourself or your environment?

5. Any additional comments you would like to express

The questionnaire was sent to the following people:

Table 12: Stakeholders

NAME	POSITION
Paola Chávez	Coordinator of the Environmental Science Faculty of the Catholic University of Ecuador, Ibarra.
Jaidy Lara	“Esperanza Negra” handmade group.
Silvia Salgado Andrade	Parliament Member of the Ecuador National Congress

Diego Francisco Granja Ruales	Corporation for Imbabura
Stalin Muñoz López	Bank Manager “Banco del Pacifico Ibarra”
Gabriel Ortiz	Bank Manager “Banco del Pichincha Zona Norte del País”
Carlos Dávila Holguin	Member of the Ibarra Civic Board
Galo Larrea	Ex Ibarra Mayor
Pablo Jurado Moreno	Ibarra City Mayor
María Dolores Granja	IANCEM Laboratory Chief

E.2. Summary of the comments received:

The following issues were discussed in the Public Audience:

- Explanation of the Project Activities in charge of Engineer Fausto Rivera, Technical Sub-Manager of INACEM.

- Explanation of the Environmental Impact Assessment in charge of Engineer Diego Enriquez, representative of BIOSFERA CIA LTDA. During the expositions, a projector was used in order to show a presentation specially designed so as to assimilate the information in a simple and graphic manner.

- The exposition of the Environmental Impact Assessment comprised the information of the environmental sector diagnosis, the significant environmental impacts generated by the project, and the environmental prevention, mitigation and compensation measures to be applied.

- After the presentation, there was time for hearing the questions and observations of the attending people, which were answered by the expositors.

The main issues discussed in the questions and observations made were as follows:

- The lack of an Environmental Impact Assessment for the sowing and harvest processes of sugarcane, which also generate significant impacts in the surrounding communities. The aforementioned activity is not executed by IANCEM. The Ministry of Environment is responsible for requesting the mentioned study.

- Support in the compensation of the communities involved in the IANCEM process. It was determined that IANCEM contributes with 25% of the Income Tax, as part of the budget for the execution of works in the Santa Catalina de Salinas Parish.

- A representative of Ibarra Canton Municipality made some comments regarding the authority for reviewing the Environmental Impact Assessment of the Project discussed in the Public Audience. It was clarified that CONELEC is the authority responsible for the revision and approval of environmental studies in the sector, power that is directly transferred by the Ministry of Environment.

- Specific aspects about the power generation and volume of sugarcane consumption were discussed. The answers were provided by Eng. Fausto Rivera.

- A deep study and the clarification of environmental control measures regarding gas emissions were requested. Information was provided about the closed system operating in the boiler, with regard to the vapor circulation obtained from sugarcane and the treatment system for gas emissions implemented at the end of the chimney.

Furthermore, the following table shows a synthesis of the comments received through the survey carried out on May 2007:

Table 13: Synthesis of stakeholders' comments

Question Nº	Synthesis of the opinions received
1	Most of the interviewed people supported the project activity, mainly because the project activity would lead to a cleaner environment and helps to avoid an increase on Earth's temperature. Projects based in renewable electricity generation are very important because they involve a benefit for electric sector, which will allow the improvement of our situation and do not contaminate the environment.
2	Yes. Most of the interviewed people would strongly recommend to carry out this kind of projects based on renewable energy generation, due to its inherit benefits regarding the reduction of CO_2 emissions and because it leads the reduction of electricity purchases to the grid. The use of clean energy is important and must be stimulated in order to avoid environmental contamination
3	Yes. Most of the interviewed people think that this project would contribute to Sustainable Development of the region. It promotes the use of cleaner technologies improving the regions' economic, environmental and social development as a whole.
4	Most of the interviewed people say that the project would positively affect their community, their environment and the electrical sector.
5	Most of the interviewed people say that they support the project activity and hope that the project goes ahead because it brings significant benefits trough the use of a renewable source. It is important to become aware of the use of renewable energy and the environmental issues.

One of the consulted stakeholder does not believe that the project would contribute with the CO_2 emission reductions because the bagasse combustion. He would not recommend the use of bagasse because hydroelectric generation is better and the bagasse could be use in the paper industry.

Also, he considers that the project will not contribute to social and economic development because it does not generate direct employment as the paper production. Moreover, he says that there are other alternatives to the suitable use of the renewable source.

This stakeholder will be contacted by IANCEM so as to explain better the project activity and its contribution to the CO_2 emission reductions trough the use of a bagasse to generate power. Since biomass gives thermal energy with zero net carbon dioxide emission on account of sequestration, the CO_2 emitted during combustion of biomass is much less than the CO_2 absorbed by the plants growth. Hence, the net CO_2 emission due to burning of biomass for power generation is zero.

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

The survey consisted on interviewing different people. Most of them had positive opinions related to project activity implementation.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Ingenio Azucarero del Norte Compañia de Economia Mixta, IANCEM
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Represented by:	Eng. Fausto Rivera
Title:	Enginer
Salutation:	Technical Manager
Last Name:	Rivera
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding from Parties included in Annex I is availed for this project activity.

Annex 3

BASELINE INFORMATION

The key data used to determine the *ex-ante* baseline scenario are given in the following table.

Table 14: Key data

Parameter	**Data Sources**
Combined margin emission factor	Calculated according to the methodology ACM0002 version 6.
Variables	**Data sources**
Electricity generation of the industrial facility per year	IANCEM

The project activity involves the use of renewable energy to generate electricity. By self-generating, the proposed project activity will lead the reduction of electricity purchases and permits sell the surplus to the National Interconnected System. By dispatching renewable electricity to a grid, electricity that would otherwise be produced using fossil fuel is displaced, reducing CO_2 emissions from power plants connected to the grid.

Thus, baseline emissions includes CO_2 emissions from fossil fuels that would have been used by the operation of grid-connected power plants and by the addition of new generation sources, in order to generate the quantity of electricity generated by the proposed project activity.

According to the AMS-I.D. Version 12, the baseline is the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in kg CO_2e/kWh) calculated in a transparent and conservative manner as:

(c). A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) 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

(d). The weighted average emissions (in kg CO_2e/kWh) of the current generation mix. The data of the year in which project generation occurs must be used.

Calculations must be based on data from an official source (where available)[5] *and made publicly available.*

[5] *Calculated*, if data on fuel type, fuel emission factor, fuel input and power output can be obtained for each plant; if confidential data available from the relevant host Party authority are used, the calculation carried out by the project participants shall be verified by the DOE and the CDM-PDD may only show the resultant carbon emission factor and the corresponding list of plants;

Option (a) is the one selected in this project. Following the methodology ACM0002 version 6, the Baseline Emission Factor (EF_y) is calculated as a combined margin, consisting of the combination of Operating Margin Emission Factor (EF_{OM}) and Build Margin Emission Factor (EF_{BM}).

The consolidated methodology gives 4 different options to calculate the Operating Margin Emission Factor (EF_{OM}). These options are:

(a) Simple OM

(b) Simple adjusted OM

(c) Dispatch Data Analysis OM

(d) Average OM

The selection of the appropriate calculation method depends, among other factors, on the characteristics of the electrical national grid and the available information about it.

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

The average emission rate method (d) can only be used where low-cost/must run resources constitute more than 50% of total grid generation and detailed data to apply option (b) and/or (c) is not available.

The methodology recommends the use of option (c) whenever possible.

Dispatch data analysis should be the first methodological choice, but for the proposed project activity the Operating Margin has been calculated using the Simple Adjusted Method due to the following reasons:

- No publicly available information exists to allow the use of option (c) Dispatch Data Analysis OM. According to the methodology, the calculation of the OM emission factor, using option (c), is determined ex-post. In order to write the PDD, project developers may use models to estimate the reductions prior to validation. Such models should be able to simulate the operation of the hydroelectric project along with the other interconnected power plants during the crediting period, and, to achieve this, the data of many years of hydrological behavior are needed. The data on hydrology are not available.

- In Ecuador low-cost resources constitute more than 50% of the total generation of the national grid, which prevents from using option (a) Simple OM.

The Operating Margin calculated using the Simple Adjusted Method, which is a variation on the Simple OM method, where the power sources (including imports) are separated in low-cost/must-run power sources (k) and other power sources (j).

The Emission Factor was calculated by “CORDELIM” in collaboration with “Eco-Alianzas Estratégicas Cia. Ltda.” using the Methodology ACM0002 / Ver 6.

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).

b) Simple adjusted OM methodology

The Simple adjusted OM methodology is using dispatch data from the last three years and is calculated as the generation weighed average emissions per electricity unit (tCO_2/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*).

$$EF_{OM,simple\_adjusted,y} = (1-\lambda y).\frac{\sum_{i,j} F_{i,j,y}.COEF_{i,j}}{\sum_{j} GEN_{j,y}} + \lambda y.\frac{\sum_{i,k} F_{i,k,y}.COEF_{i,k}}{\sum_{k} GEN_{k,y}}$$

where

$F_{i,j,y}$	=	is the amount of fuel *i* (in a mass or volume unit) consumed by relevant power sources *j* in year(s) *y*,
j	=	refers to the power sources delivering electricity to the grid,
$COEF_{i,j\,y}$	=	is the CO_2 emission coefficient of fuel *i* (tCO_2 / mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant power sources *j* and the percent oxidation of the fuel in year(s) *y*, and
$GEN_{j,y}$	=	is the electricity (MWh) delivered to the grid by source *j*.

$F_{i,k,y}$, $COEF_{i,k}$ and GEN_k are analogous to the variables described above for plants *k*.

The CO_2 emission coefficient $COEF_i$ is obtained as:

$$COEF_i = NCV_i.EF_{CO_2,j}.OXID_i$$

where:

NCV_i	=	is the net calorific value (energy content) per mass or volume unit of a fuel *i*,
$OXID_i$	=	is the oxidation factor of the fuel.
$EF_{CO2,i}$	=	is the CO_2 emission factor per unit of energy of the fuel *i*.

And,

$$\lambda = \frac{\text{number of hours per year for which low - cost / must - run sources are on margin}}{\text{8,760 hours per year}}$$

where lambda (λ_y) should be calculated as follows:

Step i) Plot a Load Duration Curve. Collect chronological load data (typically in MW) for each hour of a year, and sort load data from highest to lowest MW level. Plot MW against 8,760 hours in the year, in descending order.

Step ii) Organize Data by Generating Sources. Collect data for, and calculate total annual generation (in MWh) from low-cost/must-run resources (i.e. $\Sigma_k GEN_{k,y}$).

Step iii) 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 lowcost/must-run resources (i.e. $\Sigma_k GEN_{k,y}$).

Step iv) Determine the "Number of hours per year for which low-cost/must-run sources are on the margin". First, locate the intersection of the horizontal line plotted in step (iii) and the load duration curve plotted in step (i). The number of hours (out of the total of 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 may conclude that lowcost/must-run sources do not appear on the margin and λy is equal to zero. Lambda (λy) is the calculated number of hours divided by 8,760.

Fuel characteristics and dispatch values used in the calculation were taken from the following references and sources

- The calorific values used are default values taken from the “2006 IPCC Guidelines for National Greenhouse Gas Inventories” and the “Greenhouse Gas assessment Handbook – A practical Guidance Document for the assessment of Project-level Greenhouse Gas Emissions – Global Environment Division, World bank, 1998”

- The fuel oxidation factors used are values taken from the “2006 IPCC Guidelines for National Greenhouse Gas Inventories”

- The Ecuadorian dispatch data from 2003 to 2005 are taken from “Estadística del sector eléctrico Ecuatoriano, año 2003, 2004 & 2005, CONELEC”.

- The Exact Ecuadorian hourly dispatch data have been provided by CENACE.

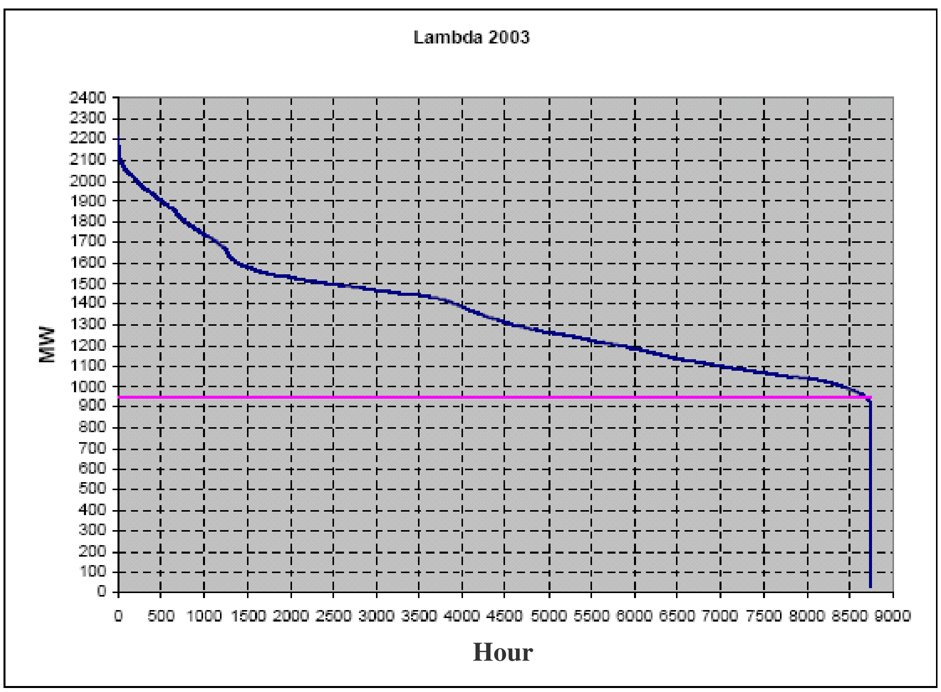
The calorific values and the fuels oxidation factors are given in the following table:

Fuel	Density (ton/m^3)	Net calorific value (TJ/10^3 ton)	TJ/gal	Carbon content (tC/TJ)	t C/gal	Oxidation Factors %	Emission Factors (t C/gal)	Emission Factors (tCO_2/gal)
Fuel oil	0.96	40.4	0.000147	21.1	0.003098	1	0.003098	0.011358
Diesel	0.88	43	0.000143	20.2	0.002893	1	0.002893	0.010609
Nafta	0.74	44.5	0.000125	20	0.002493	1	0.002493	0.009141
Raw	0.86	42.3	0.000138	20	0.002754	1	0.002754	0.010098
Others	0.86	40.2	0.000131	20	0.002617	1	0.002617	0.009597

Fuel	Density (ton/m^3)	Net calorific value (TJ/10^3 ton)	TJ/gal	Carbon content (tC/TJ)	t C/ft^3	Oxidation Factors %	Emission Factors (t C/ ft^3)	Emission Factors (tCO_2/ ft^3)
Natural Gas	0.00074	48	0.000001	15.3	0.000015	1	0.000015	0.000056

Ecuadorian Operating Margin:

Using the above guidelines and references, λ_y was calculated for each year as shown below:



Lambda (λ) 2003

λ = 0.00833333

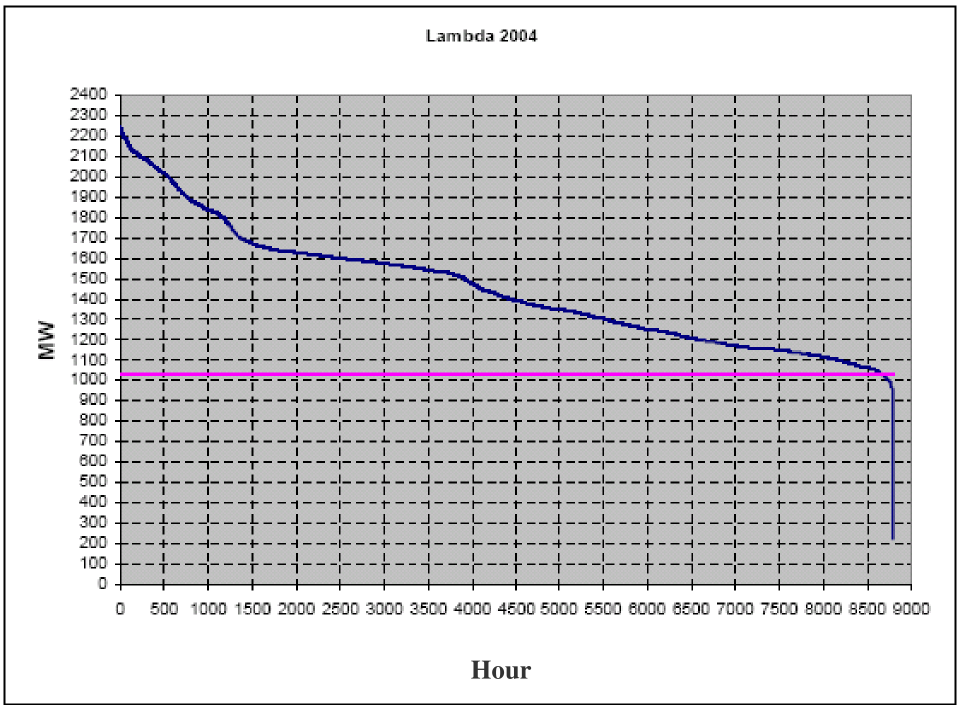
1-λ = 0.99166667

Table 15: Fuel Consumption 2003

Fuel	Unit	Quantity
Fuel oil	gal	180,123,373.41
Diesel	gal	38,043,413.20
Nafta	gal	3,340,320.78
Natural Gas	M $feet^3$	8,782,304.99

Annual Generation 2003

GEN (no low cost – must run) = 4,017,374.31 MWh
GEN (low cost – must run) = 8,296,231.20 MWh



<u>Lambda (λ) 2004</u>

λ = 0.01331967

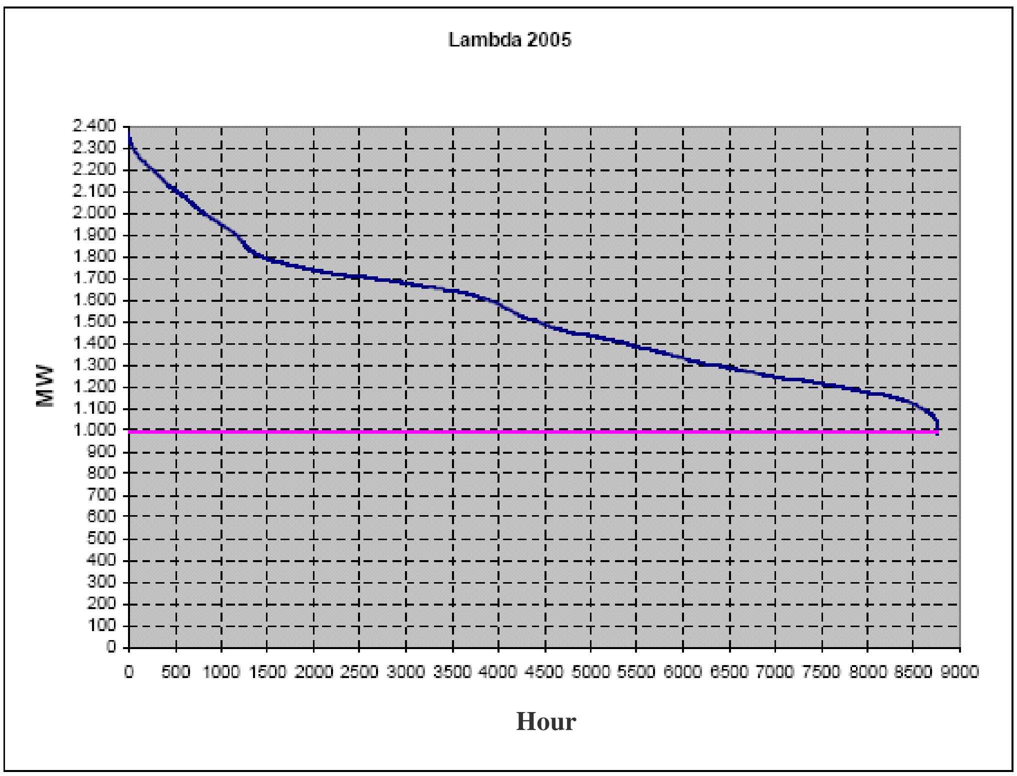
1-λ = 0.98668033.

Table 16: Fuel Consumption 2004

Fuel	Unit	Quantity
Fuel oil	gal	168,400,787.14
Diesel	gal	55,493,120.27
Nafta	gal	5,782,832.00
Natural Gas	M feet^3	8,489,427.00
Raw	gal	-
Others	gal	8,904,731.00

Annual Generation 2004

GEN (no low cost – must run) = 4,151,248.20 MWh
GEN (low cost – must run) = 9,037,269.50 MWh



Lambda (λ) 2005

$\lambda = 0.00011416$

$1-\lambda = 0.99988584$

Table 17: Fuel Consumption 2005

Fuel	Unit	Quantity
Fuel oil	gal	201,288,733.48
Diesel	gal	84,575,676.06
Nafta	gal	26,504,327.20
Natural Gas	M $feet^3$	9,244,613.99
Raw	gal	-
Others	gal	10,655,589.63

Annual Generation 2005

GEN (no low cost – must run) = 5,317,441.96 MWh
GEN (low cost – must run) = 8,692,068.28 MWh

And the Operating Margin from 2003 to 2005 was calculated to **0.74673 tCO_2/MWh.**

Calculating the Build Margin

The Build Margin is calculated as the generation-weighted average emission factor (tCO_2/MWh) of a sample of power plants *m*, as follows:

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} . COEF_{i,m}}{\sum_{m} GEN_{m,y}}$$

where $F_{i,m,y}$, $COEF_{i,m}$ and $GEN_{m,y}$ are analogous to the variables described for the simple adjusted OM method above for plants *m*.

Fuel characteristics and values used in the calculation were taken from the following references and sources:

- The calorific values used are default values taken from the "2006 IPCC Guidelines for National Greenhouse Gas Inventories" and the "Greenhouse Gas assessment Handbook – A practical Guidance Document for the assessment of Project-level Greenhouse Gas Emissions – Global Environment Division, World bank, 1998"

- The fuel oxidation factors used are values taken from the "2006 IPCC Guidelines for National Greenhouse Gas Inventories"

- The Ecuadorian dispatch data from 2003 to 2005 are taken from "Estadística del sector eléctrico Ecuatoriano, año 2003, 2004 & 2005, CONELEC"

Ecuadorian Build Margin

The first option was chosen to calculate the Build Margin, using the power plant capacity additions in the electricity system that compromises 20 % of the most recent added system generation. This combination has been chosen because the data available are *ex-ante*, and because the 20 % recently added system generation has a higher annual electricity generation than the 5 plants recently added to the system. (The 5 most recently added plants only generate 0.9 % of the total annual generation)

Table 18: Recently Built Power Plants in Ecuador.

Power Plant Type	Power Plant	Operation Start Date	Energy (MWh)	Percentage of the system total generation (%)
Hidráulica	Hidroabanico	diciembre-05	442.34	0.00%
Térmica Vapor	Lucega	julio-05	40,282.22	0.33%
Termica Vapor	Ecoelectric	junio-05	59,167.34	0.48%
Térmica MCI	San Carlos	diciembre-04	103,298.63	0.84%
Hidráulica	Perlabí	0-2004	110,214.73	0.90%
Hidráulica	Sillunchi I	0-2004	110,911.25	0.90%
Hidráulica	Sillunchi II	0-2004	113,105.22	0.92%
Térmica MCI	Celso Castellanos	0-2004	128,398.58	1.05%
Térmica MCI	Jivino	0-2004	149,500.14	1.22%
Térmica MCI	Payamino	0-2004	151,883.78	1.24%
Térmica Gas	Enrique García (Pascuales) re-op. *	febrero-04	331,802.05	2.70%
Térmica Vapor	Power Barge I	septiembre-03	379,350.98	3.09%
Térmica Gas Natural	Bajo Alto 1 (Machala Power)	septiembre-02	1,195,639.18	9.73%
Hidráulica	HCJB Loreto	junio-02	1,207,436.88	9.83%
Hidráulica	El Carmen	abril-00	1,261,336.27	10.27%
Térmica Gas	Victoria II	agosto-99	1,539,924.66	12.53%
Hidráulica	Marcel Laniado	abril-99	1,975,514.56	16.08%
Térmica Vapor	Trinitaria	01/11/1997 o 99?	2,782,697.97	22.65%

1) Generation

Total generation of the power plants in the group (m) = 2,782,697.97 MWh

2) Fuel consumption for the group (m) of selected power plants

Table 19: Fuel Consumption for the group (m) of selected power plants

Fuel	Unit	Quantity
Fuel Oil	Gal	55,111,598
Diesel 2	Gal	19,392,236
Nafta	Gal	26,504,327
Natural Gas	M $feet^3$	9,244,614

Raw	Gal	-

The calculated Build Margin is: **0.573404 tCO_2/MWh**

Calculating the Emission Factor

The Emission Factor is a weighted average of the Operating Margin emission factor ($EF_{OM,y}$) and the Build Margin emission factor ($EF_{BM,y}$):

$$EF_y = w_{OM}.EF_{OM,y} + w_{BM}.EF_{BM,y}$$

where the weights w_{OM} and w_{BM}, by default, are 50% (i.e., $w_{OM} = w_{BM} = 0.5$), and $EF_{OM,y}$ and $EF_{BM,y}$ are calculated as described in Steps 1 and 2 above and are expressed in tCO_2/MWh.

Emission Factors - Ecuadorian electricity grid, 2003 – 2005

Default CDM projects - using the default 50 % weights: **0.66007tCO_2/MWh**

Wind and Solar projects – using 75 % OM and 25 % BM: **0.70340 tCO_2/MWh**

<u>Annex 4</u>

MONITORING INFORMATION

The Monitoring and Verification Plan (MVP) describes the procedures for data collection, and auditing required for the project, in order to determine and verify emissions reductions achieved by the project. This project will require only very straightforward collection of data, described below, most of which is already collected routinely by the staff of IANCEM, where the proposed CDM project is to be implemented.

The MVP document fulfills the CDM Executive Board requirement that CDM projects have a clear, credible, and accurate set of monitoring and verification procedures. The purpose of these procedures is to direct and support continuous monitoring of project performance and periodic auditing, verification and certification activities to determine project outcomes, in particular in terms of greenhouse gas (GHG) emission reductions. The MVP is a vital component of project design, and as such is subject to a formal third-party validation process —along with the project baseline and other project design features.

Managers of the project must maintain credible, transparent, and adequate data estimation, measurement, collection, and tracking systems to successfully develop and maintain the proper set of information to undergo an audit for a greenhouse gas (GHG) emission reduction investment. These records and monitoring systems are needed to subsequently allow an Operational Entity to verify project performance as part of the verification and certification process. In particular, this process reinforces the fact that GHG reductions are real and credible to the buyers of the Certified Emissions Reductions (CERs). This set of information will be needed to meet the evolving international reporting standards developed by the UNFCCC.

The document must be used by the project implementers and operators of the Technical Departments of IANCEM. Strict adherence to the guidelines set out in this monitoring plan is necessary for the project managers and operators to successfully measure and track project impacts for audit purposes.

According to Type I, Category C of small-scale project activity categories contained in appendix B of the Simplified M&P for CDM Small-Scale Project Activity, monitoring shall consist of metering the electricity generated by the renewable technology and the amount of biomass.

The equipment used for monitoring the amount of electricity generated is a multifunction relay for the management of energy GE 489 used for the internal monitoring. Also the ABB brand measuring equipment in the Emelnorte connection could be use for metering the electricity generation in order to have quality assurance and quality control procedure to be applied.

The calibration certificate of the ABB measuring equipment, which measures the energy purchase-sale was requested to Emelnorte and is being processed. The 4890 multifunction relay was installed by SINER Engenharia e Comércio Ltda., with process number SN-04292G, a firm specialized in this type of work. The relay data and diagrams are included in the instructions manual of the charts and cubicles, whose printed copy is kept in the Central Office of the Electric Department.

The calibration of the equipment for measuring the generated energy was performed in the testing protocols carried out before the assembling and the copies are included in the inspection and testing report. Annually, as from the start-up of operations, the calibration of the energy purchase-sale measuring equipment will be required. The organism that shall calibrate this equipment is the Empresa Eléctrica del Norte S.A.

The maintenance of the electricity measuring equipment is considered in the IANCEM maintenance plan for the electronic equipment, which describes the actions to be carried out. Since this is electronic equipment without moveable parts, the maintenance involves weekly, monthly and half-yearly cleaning, revision and adjustment, depending on each case.

The methodologies describe the procedure and equations for calculating emissions reductions from monitored data. For the specific project, the methodologies are applied through spreadsheet model. The staff responsible for project monitoring must complete the electronic worksheets on a shift basis. The spreadsheets automatically provide annual totals in terms of GHG reductions achieved through the project.

The models contain a series of worksheets with different functions:

- Data entry sheets: Electricity Generation.

- Result sheet: Emission Reductions

There are worksheets where the user is allowed to enter data. All other cells contain model fixed parameters or 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.

Other sheets include fixed values, or values that are computed from data in the data entry sheets, and the last sheet shows the resulted annual emissions reductions.

The monitored data shall be register by the operator directly from the turbogenerator indicative instruments in the R-MIN-19, a writing file which have the responsible signature. The files shall be kept in the file REPORTES TG 3MW in the Electric Department Central Office. When the data collection system is implemented, the files will be kept electronically, with a back up in CDs.

In case that the monitored data related to the electric energy were missing, it is possible to take the information from the SCHNEIDER half-tension circuit breakers, which show all the parameters to be monitored. In case this information was lost again, the data from the SCHNEIDER low-tension circuit breakers will be collected. That is to say, there are three options of manual data collection, making the system more reliable.

If, for any reason (failure in TCs, TPs, other), an adjustment of data were required, the Chief of the Electric Department will be in charge of this adjustment, considering the work regime in the sugar mill, allowing the reconstruction of information, if necessary. As a last resort, when the information is not reliable it shall not be considered in the emission reductions calculation.

All electronic data will be backed up on a daily basis, and two electronic copies of each document will be kept in different locations (each plant and its respective Head Office). These data will be archived for two years following the end of the crediting period.

Since the registers are included in the ISO system Requirements 6.3 and 7.6 and the equipment incorporated in the electronic maintenance plan, these shall be subject to periodical audits. These auditing plan includes internally and externally audits according to the Ingenio Azucarero del Norte Quality Management System ISO 9001:2000 (Sistema de Gestión de Calidad 9001:2000).

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