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

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SECTION A. General description of project activity

A.1 Title of the project activity:

Chumbagua Cogeneration Project

PDD version 7

Date of completion: 14/03/2007.

A.2. Description of the project activity:

Chumbagua Cogeneration Project consists of the installation of more efficient equipment for the better use of the bagasse generated in the production of sugar. Through the installation of a high pressure boiler and a 20MW turbo-generator project's, Chumbagua will be able to generate not only the necessary electricity for powering the sugar mill, but also will create surplus energy to be sold to the national grid. This electricity to be given to the grid will displace energy that the Government would provide with a strong use of fossil fuels. This displacement of energy thus creates a reduction of emission of Greenhouse gases. This project also creates social and economical benefits that constitute a real contribution to Honduras' sustainable development.

The Chumbagua Cogeneration Project was developed by Energia Chumbagua S.A. de C.V. in Honduras, a subsidiary of Azucarera Chumbagua, a sugarcane mill. Both companies are located in San Marcos, Santa Barbara, Honduras. Energia Chumbagua was founded in 2005. The sugar mill was founded in 1948 and currently produces 658 thousand quintals of sugar. Up to 10% of its production is exported, being the US the primary destination.

The Honduran government has done efforts to reduce the country's dependency on fossil fuels. Nevertheless, those initiatives have been very modest in promoting the development of projects in renewable energies different than hydro. The Chumbagua Cogeneration Project thus comes to enforce the idea that with the commercialization of CERs, it is viable to develop a generation project in Honduras. This will have a positive effect for the country beyond the evident reductions in GHG.

The revenues obtained from the sale of the CERs will also help Chumbagua to continue supporting the community. Chumbagua contributes with more than 200K dollars to the local community, in the form of a reforestation effort and direct funding to local schools and the local police. This revenue distribution and social efforts must be added to the environmental benefits when evaluating the contribution to sustainable development of this project activity.

The project will permit Chumbagua to grant the sons of their employees with scholarships and transportation to the school. It will donate fuel to brigades who combat epidemics in Honduras. It will also permit to strengthen Chumbagua financially, making them less vulnerable to the impacts of the sugar market. In addition, it will bring foreign currency to Honduras's economy, permitting the country to spend less with the imports of fossil fuel and invest more in infrastructure. A program for compensation of environmental impacts will also be implemented, with protection of flora and fauna and reduction of the use of agrochemical products.
The project also permits to strengthen Chumbagua financially, making them less vulnerable to the impacts of the sugar market and bringing hard currency to Honduras' economy.

A.3. Project participants:

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Honduras (host)	• Energia Chumbagua S.A. de C.V. (private entity)	No
Japan	• Mitsui & Co., Ltd. (private entity)	No
(*) 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 project activity:

A.4.1. Location of the project activity:

Figure 1 – Location of the department of Santa Barbara

A.4.1.1. Host Party(ies):

Honduras. The Honduran Designated National Authority is the Secretaria de Estado de Recursos Naturales y Ambiente (SERNA).

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

Northwest Region/ Department of Santa Barbara

A.4.1.3. City/Town/Community etc:

City of San Marcos

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

The cogeneration project is located inside Chumbagua Sugar Cane Company in San Marcos. The exact coordinates of the project are 15°14’15” North and 88°29’2” West. The project is surrounded by the sugar cane plantations and small settlements of employees of the sugar cane company.

San Marcos is located in the Valley of Quimistán, northwest region of Honduras. San Marcos has a total population of 13,535 habitants (6,091 men and 7,444 women) spread around its 226.3 Km^2 in 21 small settlements.

The principal economical activities performed in area surrounding the cogeneration project are agriculture and cattle ranching. There’s also commercialization of products of massive consumption and an important group of people is employed by small assembly plant in Santa Barbara and the Cortés departments.

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

Type: Energy and Power.

Sectoral Scope: 1 – Energy industries (renewable - / non-renewable sources).

Category: Renewable electricity generation for a grid (energy generation, supply, transmission and distribution).

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

Biomass power conversion technologies for power production can be classified into three categories: direct combustion technologies, gasification technologies, and pyrolysis. Direct combustion technologies, such as the used in the Chumbagua Project, are probably the most widely known for simultaneous power and heat generation using biomass. It involves the oxidation of biomass with excess air in a process that yields hot gases that are used to produce steam in boilers. The steam from the boilers is used to produce electricity in a Rankine cycle turbine (diagram below). Rankine cycle turbines could also be divided into two categories: condensing and backpressure depending on the proportion of the steam used for industrial processes and where in the turbine that steam is obtained. Typically, electricity is only produced in a “condensing” steam cycle, while electricity and steam are co-generated in an “extracting” steam cycle.

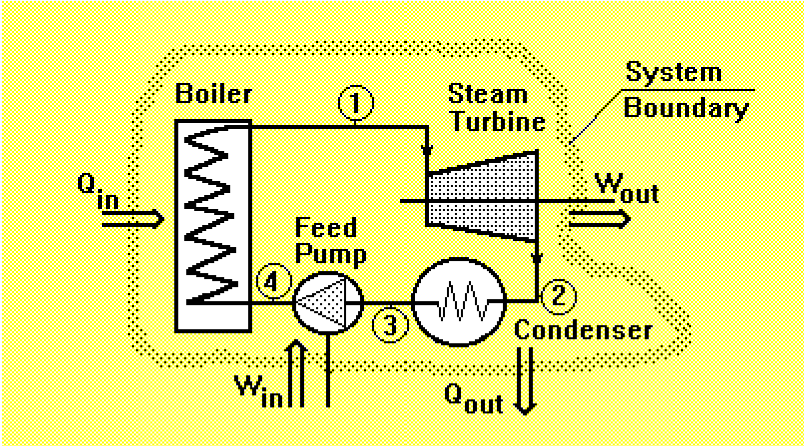

Figure 2 - Rankine Cycle

The Chumbagua Cogeneration project consists on the installation of a boiler and a 20MW turbogenerator for the usage of leftover bagasse from the manufacturing of sugar. The project will replace the existing plant altogether. The old equipment (three backpressure turbogenerators, one of 2 MW and two of 1.0 MW) will be deactivated. The generator to be installed has the following characteristics:

Technical Description:

BASELINE:

BOILER:

Brand: Fymisa
Capacity: 60 ton/h
Pressure: 250 Psig
Temperature:
Steam enthalpy: 250 Kcal/Kg
Specific production: 2.5 Kg steam/Kg bagasse
Efficency:60%

TURBOS:

Brand: Westinghouse
Power: 2 MW
Rated speed: 1,200 rpm

Brand: Elliott Company
Power: 1 MW
Rated speed: 3,600 rpm

Brand: Elliott Company
Power: 1 MW
Rated speed: 3,600 rpm

PROJECT ACTIVITY

BOILER:

Brand: Sermatec
Capacity: 100 ton/h
Pressure: 900 Psig
Temperature: 900 º F
Steam enthalpy: 805 Kcal/Kg
Specific production: 2 Kg steam/Kg bagasse
Efficiency: 86%

TURBINE:
Brand: NG Metalúrgica
Model: H2/630
Steam Pressure (In): 900 Psig
Steam Temperature: 900°F.
Rated Speed: 8,500 rpm

GENERATOR:
Type: Brushless
Power: 20,000 KW
Power factor: 0.8
Number of Poles: 4
Rated Speed: 1,800 rpm
Frequency: 60 Hz

At full capacity, Chumbagua is expected to generate 44,400 MWh per crop, from which 28,000 MWh are to be delivered to the grid. Chumbagua has signed a Power Purchase Agreement with national energy company ENEE for the purchase of the power mentioned above.

Figure 3 – Chumbagua Turbo generator and control panels

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

The chosen crediting period for this project is the renewable crediting period. For the first crediting period, the project is to reduce 156,267 tCO_2e:

Years	Annual estimation of emission reductions in tonnes of CO_2 e
2007 (*)	13,923
2008 (*)	23,724
2009 (*)	23,724
2010 (*)	23,724
2011 (*)	23,724
2012 (*)	23,724
2013 (*)	23,724
Total estimated	**156,267**

reductions (tonnes of CO_2 e)	
Total number of crediting years	**7**
Annual average over the crediting period of estimated reductions (tonnes of CO_2 e)	**22,324**

(*) estimated

Figure 4 – Estimated emission reductions for Chumbagua Cogeneration project

A.4.5. Public funding of the project activity:

There is no public funding involved on the Chumbagua Project.

SECTION B. Application of a baseline methodology

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

ACM0006 – "Consolidated baseline methodology for grid-connected electricity generation from biomass residues", version 4, 02/11/2006.

ACM0002 - "Consolidated baseline methodology for grid-connected electricity generation from renewable sources", Version 6, dated on 19/05/2006.

Tool for the demonstration and assessment of additionality, Version 2, dated on 28/11/2005.

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

The ACM0006 methodology is applied to Chumbagua because the project complies with all the conditions limiting the applicability of the methodology:

(i) No other biomass types than biomass residues are used in the project plant and these biomass residues are the predominant fuel used in the project plant. Biomass is defined as a by-product, residue or waste stream from agriculture, forestry and related industries.

The fuel used in the project plant is bagasse, a by-product from the production of sugar carried our in the facility. It is not planned to use any other fuel, either fossil or biomass. The bagasse used in the Chumbagua Cogeneration Project comes from the production of sugar carried on the same facility where the project is located.

(ii) The implementation of the project shall not result in an increase of the processing capacity of raw input or other substantial changes in the process:

Any increase in the bagasse production is due to business expansion of the Chumbagua Sugarcane Company and could not be attributed to the implementation of the cogeneration project. "*Costos y precios para etanol combustible en America Central*" (Costs and prices for ethanol in Central America), a study prepared by CEPAL (*Comisión Económica para América Latina y Caribe*) in May/2006 (copy under request) shows that there has been recently a "notable advance in the consciousness on the potentiality of ethanol in Central America", specially in Honduras, where a law is being discussed regarding the production and use of ethanol as fuel in the country and for export. This shows an unequivocal trend for the expansion of the production of sugar cane in Honduras. The *Asociación de Productores de Azúcar de Honduras* (APAH- Honduras' Sugar Producers Association) estimates an increase of approx.13% in sugar production in Honduras from 2007 to 2011 (see annexed file "Honduras_Estimation Sugar production.jpg". A report of Chumbagua's 52th General Shareholders Assembly, with date 08/03/2002, shows that Chumbagua's share of the Honduras's exports to the U.S. was increased from 10.1%, in 2001, to 11.2%, for the period 2002-2007 (see annexed file "Chumbagua Strategic Plan 2002.mdi"). On the graph below it could be seen that the production for the sugar mill has shown an incrementing trend for years, long before the start of this project. The increase projected for the crop starting in 2006 might seem significant in absolute values, but actually is smaller percentage-wise than the increase experimented from 1995 to 1996. 2006 increase corresponds to an adjustment to bring production to the trend initiated in 1995 (in black in the graph below).

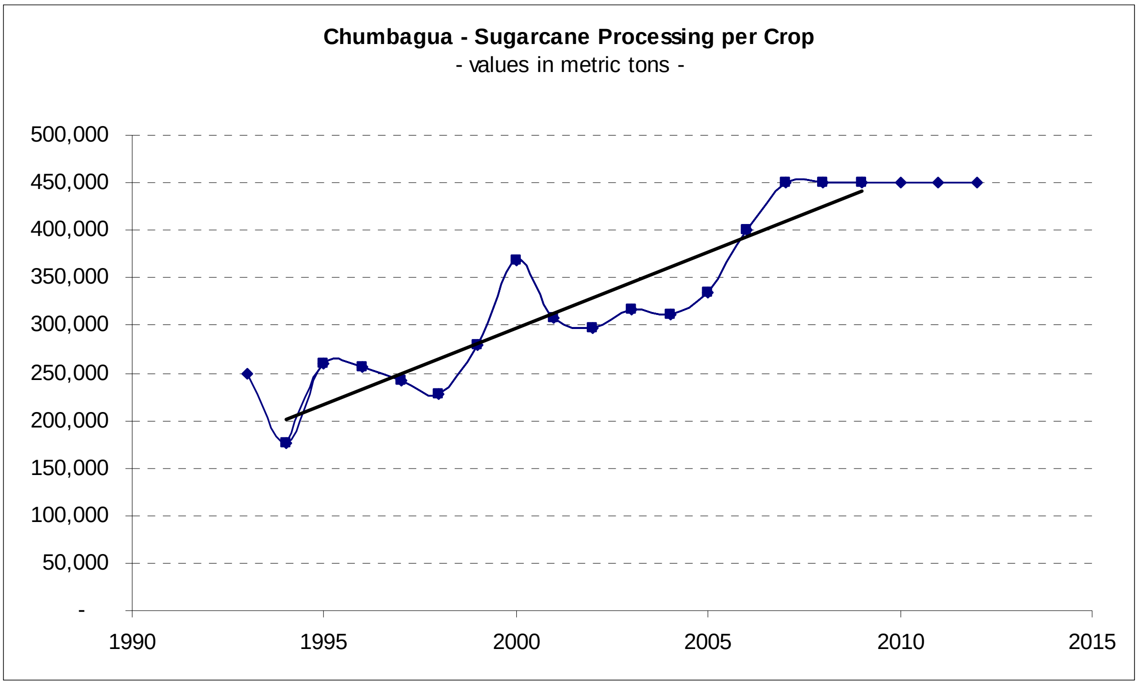

Figure 5 – Chumbagua Sugarcane Processing per Crop[1]

(iii) The biomass used at the project facility should not be stored for more than one year.

[1] Values obtained from Chumbagua Sugarcane Company.

It is of general practice for sugar mills to keep some bagasse until the beginning of the next season to ease the start of operation of the cogeneration system. This practice avoids the consumption of fossil fuels or electricity from the grid. Nevertheless the amount of bagasse stored seasons is minimal as it accounts for less than 5% of total bagasse generated in a regular season. Most importantly, this bagasse is always stored less than a year: from the end of the crop in late May until mid January, the start of the new crop.

(iv) No significant energy quantities, except for transportation of the biomass, are required to prepare the biomass residues for fuel consumption:

The biomass used in this project is not transformed in any way before its use as a fuel. This biomass is readily available for its use at the project facility.

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

	Source	Gas		Justification/Explanation
Baseline	Grid electricity generation	CO_2	Included	Main emission source
		CH_4	Excluded	Excluded for simplification. This is conservative
		N_2O	Excluded	Excluded for simplification. This is conservative
	Heat generation	CO_2	Included	Main emission source
		CH_4	Excluded	Excluded for simplification. This is conservative
		N_2O	Excluded	Excluded for simplification. This is conservative
	Uncontrolled burning or decay of surplus biomass residues	CO_2	Excluded	It is assumed that CO_2 emissions from surplus biomass residues do not lead to changes of carbon pools in the LULUCF sector
		CH_4	Excluded	Project participants decided to not include this emission source, because cases B1, B2 and B3 of ACM0006 are not the most likely baseline scenarios
		N_2O	Excluded	Excluded for simplification. This is conservative. Note also that emissions from natural decay of biomass are not included in GHG inventories as anthropogenic sources
Project Activity	On-site fossil fuel consumption	CO_2	Excluded	There are no emissions due to fossil fuel consumption
		CH_4	Excluded	Excluded for simplification. This emission source is assumed to be very small
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small
	Off-site transportation of biomass residues	CO_2	Excluded	Bagasse is produced inside the mills. No off-site transportation of bagasse is necessary
		CH_4	Excluded	Excluded for simplification. This emission source is assumed to be very small
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small
	Combustion of biomass	CO_2	Excluded	It is assumed that CO_2 emissions from surplus biomass do not lead to changes of carbon pools in the LULUCF sector

	residues for electricity and / or heat generation	CH_4	Excluded	This emission source is not included because CH_4 emissions from uncontrolled burning or decay of biomass in the baseline scenario are not included
		N_2O	Excluded	Excluded for simplification. This emissions source is assumed to be very small
	Storage of biomass residues	CO_2	Excluded	It is assumed that CO_2 emissions from surplus biomass residues do not lead to changes of carbon pools in the LULUCF sector
		CH_4	Excluded	Excluded for simplification. Since bagasse is stored for not longer than one year, this emission source is assumed to be small
		N_2O	Excluded	Excluded for simplification. This emissions source is assumed to be very small

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

Chumbagua uses bagasse for the generation of heat and electricity. The project activity replaces less efficient equipment that used the biomass to generate electricity to the sugar mill. This corresponds to scenario #14, considering the replacement of equipment for more efficient technology.

The alternatives to the project activity are as follows: a) power generation: in the absence of the project, energy would have been generated partially in existing and new grid-connected power plants (alternative P4) and partially in the existing cogeneration plant using the same biomass until the end of the lifetime of the existing plant. The project activity would have been in that case not implemented as a CDM project activity at the end of the lifetime of the existing plant (alternative P5); b) biomass: in the absence of the project, the biomass would have been used for heat and electricity generation in the project site (alternative B4); c) Heat: in the absence of the project activity, heat would have been generated in boilers using the same type of biomass until the existing plant would have been replaced without the incentives of the CDM (alternative H5). The identified alternatives for the different components of the project activity correspond to scenario 14, an energy efficiency project, obtained by the replacement of the existing biomass power units by new highly efficient ones.

Scenario 14 is valid because the old and less efficient equipment is replaced by the new and more efficient one. This change would have occurred without the incentives of the CDM at the end of the lifetime of the old equipment. For Chumbagua Cogeneration Project, it was estimated that the replaced equipment at the time of the replacement still had over 20 years of life. This corresponds to typical average technical lifetime of this type of equipment in this industry in Honduras According to the manufacturers, this kind of equipment has a technical lifetime of 30 years, and common practice in Honduras shows that sugar mill equipment can be used, with good maintenance, for over 60 years. *Asociacion de Produtores de Azucar de Honduras* (APAH- Honduras Sugar Producers Association), referring (see annexed document “honduras_lifetime.jpg”) to the common practice in the country, assures that sugar mill equipment can be used, with good maintenance, for over 60 years.Technical literature (Babcock & Wilcox Corporation. “Our boilers and enviroment equipment. (catalog); Perez, G. L. “La remodelación de la caldera alemana de 25t/h”. Energia, no. 5, pp. 14-27, 1985; Foster Wheeler Corporation. “Heat engineering. CFB technology aids in redevelopment”, 1999) states that boilers with good maintenance can work for periods over 50 years.

It can be added that the equipments are used at most 5 months per year, during the harvest period. Old boiler was installed in 1991. The old turbos were installed in 1983 and in 1996.

Emission reductions from heat are not considered because the heat efficiency of the new plant (1610 Kcal/Kg bagasse) is larger than the heat efficiency of the pre-project equipment (625 Kcal/Kg bagasse) and, for conservativeness reasons, they are excluded, i.e., ERheat,y = 0.

Biomass decay was non-existent, nor have biomass been burned in an uncontrolled manner, as biomass was used in the past to generate electricity for internal use. For scenario #14, BEbiomass, y=0.

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

The “additionality tool” shall be applied in conjunction with ACM0006 to describe how the anthropogenic emissions of GHG are reduced below those that would have occurred in the absence of the Chumbagua Project. The additionality tool provides a general step-wise framework for demonstrating and assessing additionality. These steps, numbered from 0 to 5, include:

0. Preliminary screening
1. Identification of alternatives to the project activity
2. Investment analysis AND/OR
3. Barrier analysis
4. Common practice analysis
5. Impact of CDM registration

The application of the additionality tool to the Chumbagua Project follows:

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

a) Project Start date: The starting date of the CDM project activity, October 29, 2004, falls between 1 January 2000 and the date of the registration of a first CDM project activity, 18 November 2004.

b) Evidence demonstrates that CDM incentives were seriously considered in the development of the Chumbagua Project.

In February 18, 2004, Pedro Rachadell, from Ecoinvest, sent a message to Hector Portillo and Orlando Maldonado, from Chumbagua, asking for information (energy generated, days of operation, capacity factor) for the calculation of the carbon credits of the Project

To the initiative mentioned above, it is noticeable efforts undertaken by the Honduran Government to promote the Clean Development Mechanism and the role of Honduras in the provision of economical emissions reductions. The Government has been very proactive in informing its most important industries (sugar cane among them) on the opportunities that this market has to offer. It is therefore clear that Chumbagua Project, as well as other sugar cane producers in Honduras, were aware of the CDM incentives and included them in the planning of the expansion to its cogeneration facilities.

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

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

To define alternatives to the project activity, we must complete a two-sided analysis, taking into consideration the perspective of the project owner and the perspective of the country.

From the project owner's perspective, the cogeneration project provides the company with electricity and heat for the production of sugar. It also provides excess electricity to be exported to the grid. Without the project, the plant would continue to operate with low energy efficiency. From an investment point of view, the alternative to the project activity for the sponsors is the continuation of the current (previous) situation, i.e., no project activity

From the country's perspective, the alternative for producing a similar amount of energy as the one Chumbagua is to provide is to use current generation system; a system that continuously increases its dependency on thermal plants (using diesel and bunker).

According to the statistic provided by ENEE, Honduras' electrical company, the interconnected system has shown an increment of the share of thermal electricity in the total installed capacity. In 1985, hydro stations accounted for 76.28% of total installed capacity (424.3MW of the total 556.2MW). Since then, hydro power has shown almost no new developments (hydro plants owned by the State only grew 40.1MW since 1985). Thermal, on the other hand, has shown a tremendous growth, representing today 57.4% of the total 1162.3MW capacity of Honduras (since 1985, thermal plants grew 535.4MW or 306%). Hydro lost its predominant position of the 80's, accounting today for only 41.1% of that installed capacity.[2]

All indicates that the observed trend of increased use of thermal plants will continue in the years to come. The present generation expansion plan in Honduras (a plan developed by ENEE with the help of OLADE, Latin American Organization of Energy) shows that thermal energy plays a major role.[3] Between 2006 and 2019, a total of 607.4 MW of thermal plants will be installed, whereas the increase of power from hydro plants will be of 545.3 MW in the same period.

[2] http://www.enee.hn/Estadisticas2005/PDF/GraficoCP3.pdf

[3] http://www.enee.hn/PDFS/PlanExpansionGen.pdf (see also annexed Excel spreadsheet Honduras_Plan de Expansion ENEE 2006 - 2020.xls)

Although there are some incentives in place by the Honduran Government to promote the development of small renewable energy projects (such as a price incentive of 10% above short term marginal cost for small projects below 50MW capacity), the results have been very modest. Since 1967, only 17MW of biomass have been implemented. Today biomass represents only 1.5% of total installed capacity in Honduras. Below, a list of the general practices in Central America:

Costa Rica	El Salvador	Guatemala	Honduras	Nicaragua	Panamá
Executive Decree no. 30480-Minae; Directive no. 22, Promotion of the renewable sources of energy (11-03-2003)		Support for the promotion to the development of new and renewable sources of energy (Decree of law 20-86) and Law of incentives for the development of renewable energy projects (Decree 52-2003, 28-10-2003)	Support to projects of renewable energy (Decree 103-2003, 14-10-2003); Aeolian project Honduras 2000 (decree 9-2001), and Incentives to the renewable energies and their reforms (Decrees 85-98 of 20-4-1998 and 267-98 of 5-12-1998)	Incentives to the renewable sources of energy for electrical generation and for the development of aeolian and hydroelectric resources (Presidential Agreement 279-2002 of the 9-07-2002). Law of incentives for the development of renewable energy projects	Legislative decree establishing regime of incentives and promotion for new and renewable (june-2004)

Source: Cepal (2004)[4]

Considering the actual and foreseen situation of the electric sector in Honduras, and the expansion plan of ENEE, it is accurate to conclude that thermal plants will be the most likely source of power to meet the increasing demand. Thermal energy is therefore the alternative to the proposed CDM project activity.

Sub-step 1b. Enforcement with applicable laws and regulations

The project activity and the alternative scenario are in compliance with the legal and regulatory requirements.

Step 2. Investment Analysis

Sub-step 2a. Determine appropriate analysis method

Additionality is demonstrated through an investment benchmark analysis (option III)

Sub-step 2b and 2c– Option III - benchmark analysis

The process of funding a project such as the cogeneration project for Chumbagua is a very challenging task. Honduras suffers from weak local economy and local banks charged high interest rates at the time the investment decision was made (higher than 30%, in 2004, for loans based in Lempiras, see below).

[4] *Estrategia para el fomento de las fuentes renovables de energía en América Central. Naciones Unidas – Comisión Económica para América Latina y el Caribe. 2004.*

Date	Commercial Active rate for loans	Commercial Passive rate (90 days)	Associations Active rate for loans	Associations Passive rate (90 days)	Average Active rate for loans	Average Passive rate (90 days)
	Annual maximum interest rates in national currency - Honduras (in %)					
2004						
January	32.27	11.61	26.00	11.45	31.75	11.59
February	30.53	11.48	26.00	11.45	30.25	11.48
March	30.93	11.59	26.00	11.45	30.63	11.58
April	32.40	10.89	26.00	11.45	32.00	10.93
May	30.87	11.28	26.00	11.45	30.56	11.30
June	30.57	11.32	26.00	11.45	30.27	11.34
July	31.36	11.74	26.00	12.50	31.00	11.85
August	30.53	11.47	27.00	12.00	30.31	11.53
September	31.40	11.66	27.00	12.00	31.13	11.70
October	32.86	10.95	23.00	11.00	32.20	10.96
November	31.53	11.05	23.00	10.50	31.00	11.00
December	31.33	10.35	23.00	13.00	30.81	10.57

Honduras' Interest Rate Source: Honduras' Central Bank
(source: **http://www.bch.hn/esteco/monetaria/tasamax.pdf**)

Chumbagua's cash flow (see annexed spreadsheet "Chumbagua_IRR_2007.03.27.xls") shows that the IRR of the project, 10.7%, is lower than the bank active rates at the time the investment decision was made.

Sub-step 2d: Sensitivity analysis

A sensitivity analysis was conducted by altering the following parameters:
• Increase in project revenue
• Reduction in running costs

Those parameters were selected as being the most likely to fluctuate over time. Financial analyses were performed altering each of these parameters by 10%, and assessing what the impact on the project IRR would be (see results in the Table below). As it can be seen, the project IRR remains lower than its alternative even in the case where these parameters change in favor of the project.

Table: Sensitivity analysis

Scenario	% change	IRR (%)
Original		10.7%
Increase in project	10%	11.9%

revenue		
Reduction in project costs	10%	10.8%

We can conclude therefore that Chumbagua project could not be implemented without the CER revenue.

Step 3. Barrier Analysis

Sub-step 3a. Identify barriers that would prevent the implementation of type of the proposed project activity

Technological and Logistic Barrier

Even though the technology used in the cogeneration project is well known in Honduras, there are barriers of technological and logistical nature associated with its application. Rankine Cycle steam turbines are not produced in Honduras, so they must be imported mostly from Brazil and the US. This represents a problem to the project developer since they must depend on outside know-how to set up and maintain the new facility. The development of cogeneration project also required engineers and technical personnel from abroad, thus making this logistic barrier extensive to manpower as well as equipment.

Besides the Rankine-cycle technology, Chumbagua also utilizes equipment to deliver electricity to the grid and complex control systems for the new facility. This is not the typical traditional equipment of sugar cane producing and its usage represents also a technological barrier. This control equipment is also imported, thus increasing the importance of the barrier mentioned in the paragraph above.

To ensure the proper function of the project, Chumbagua had also to acquire new knowledge in electric transmission and the sale of electricity in the spot market. Such knowledge acquisition could not be achieved without important investments. The incentives of the CDM would help to ease the acquisition of this knowledge.

Core Business Barrier

In addition to all those barriers mentioned above, it is important to understand that the sale of electricity from cogeneration represents only a small share of total annual revenues of sugar mills. As a consequence, sugar mills prefer investing in equipment related to their core business, the production of sugar and molasses. This situation is exacerbated by the additional performance and market risks associated with the cogeneration business. For the Chumbagua cogeneration project, the sale of electricity represents less than 10% of the total annual revenues.

Regulatory Barrier

According to OLADE, 1997, waste from the wood, paper, and cellulose, and sugar industries are highly appropriate for the cogeneration of electricity and heat for own use and sale to the electric power

grid. In Guatemala, Jamaica, Brazil, and other countries of the region, important steps have been taken in the sugar industry. The economic conditions for cogeneration have not improved in the course of the reforms (energy sectors restructurings), owing to the relative depreciation of electricity supplied to the public grid. Thus, the significant potential for cogeneration in sugar mills has taken time to materialize.

In addition to the above exposed, current legislation in Honduras gives thermal plants a series on incentives that includes the exoneration of sales taxes on all fossil fuel bought for electrical generation and a much higher price per KWh than other cleaner alternatives. Thermal plants in Honduras also receive compensation from ENEE for their available installed capacity, regardless of their generation. Renewable energy does not receive this type of compensation as they only receive payment for the electricity they deliver to the grid. This is another clear example of regulatory barriers to the mentioned clean technologies in the country.

Because of the reasons explained, Honduran electric system continuously increases its dependency on thermal plants (using diesel and bunker). According to the statistic provided by ENEE (see sub-step 1a above), Honduras' electrical company, the interconnected system has shown an increment of the share of thermal electricity in the total installed capacity.

Considering the actual and foresee situation of the electric business in Honduras, it is accurate to conclude that thermal plants will be the most likely source of power to meet the increasing demand of the country. Thermal energy is therefore the alternative to the proposed CDM project activity.

Sub-step 3 b. Show that the identified barriers would not prevent the implementation of at least one of the alternatives.

As described above, the main alternative to the project activity is continuing the current situation without the expansion, i.e., no project activity. This alternative would not be prevented by the barriers identified above.

Step 4. Common Practice Analysis

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

Besides hydro, biomass constitutes the only clean energy technology in operation in Honduras. Although cogeneration is a widespread practice among sugar cane producers, it is worth mentioning that only a few of those producers generate excess energy to be sold to the grid. The traditional goal of a cogeneration project has been first, to produce enough energy to maintain the companies independent from the grid and second, to eliminate (burn) the bagasse, sugar cane's byproduct. There are currently 6 cogeneration projects in Honduras: La Grecia, Santa Matilde, Tres Valles, Chumbagua, Inversiones Hondureñas and Yojoa. All of them are participating in CDM (at different stages of the process).

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

As mentioned above, six cogeneration projects that will deliver energy to the grid are participating in CDM.

Step 5. Impact of CDM Registration

As described above, the reliability of Honduras on thermal generation has increased dramatically in the past years and it is expected to increase, according to ENEE's generation expansion plans. The usage of this technology to produce electricity has a strong impact on the environment and the economy (fossil fuel has increased in prices dramatically in the last two years).

Honduras has tried to reduce its dependency on fossil fuels but the efforts implemented until now have not proved very useful. The registration of the CDM project activity will contribute to solve this situation, giving incentives to clean energy cogeneration.

The CERs would increase the project's Internal Rate of Return and contribute to it to overcome other barriers, thus making the project a better investment option and a sound option in comparison to national benchmarks.

Moreover, the registration might influence other sugar cane producers in Honduras to set up new cogeneration plants (or expand old ones). The registration of the proposed project activity will have a strong impact in paving the way for similar projects to be implemented in Honduras. This would help promote sustainable development of this Central American country.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

a) ACM0006 - "Consolidated baseline methodology for grid-connected electricity generation from biomass residues", version 4, October 2006, was chosen.

ACM0006 is applicable to biomass-based cogeneration projects connected to the grid. The methodology considers emission reductions generated from cogeneration projects using sugarcane bagasse. This fits perfectly the operation at Chumbagua, so the choice of methodology is justified.

The equations which will be used in calculating emission reductions are the following:

$ER_y = ER_{thermal,y} + ER_{electricity,y} - PE_y - L_y$	**Equation 1**

Where:

ER_y are the emission reductions of the project activity during year y
$ER_{electricity,y}$ are the emissions reductions due to displacement of electricity in year y
$ER_{thermal,y}$ are the emissions reductions due to displacement of thermal energy in year y. This term is zero, as stated in section B.4.
PE_y are project emissions in year y (zero for this project activity)
L_y are the leakage emissions in year y (zero for this project activity)

Estimate of project emissions:

No activities increasing GHG emissions were identified. Therefore, no calculation of estimate of GHG emissions is necessary. The project emissions (PE_y) are zero.

Estimated leakage emissions:

The main source of leakages in the ACM0006 methodology is considered to be the increase of fossil fuel consumption due to the diversion of the biomass. No diversion of biomass occurs, therefore no leakages are present. For the reasons explained, leakages (L_y) are considered to be zero.

Estimated emissions reductions:

The amount of electricity to be considered for the displacement of power from the grid is calculated using the equation below. This equation corresponds to the chosen scenario #14 of the ACM0006 methodology:

$$EG_y = EG_{projectplant,y} * \left(1 - \frac{\varepsilon_{el,preproject}}{\varepsilon_{el,projectplant,y}}\right)$$ **Equation 2**

EG_y is determined based on the average net efficiency of electricity generation in the project plant prior to project implementation, $\varepsilon_{el,pre\ project}$, and the average net efficiency of electricity generation in the project plant after project implementation, $\varepsilon_{el,project\ plant,y}$, shown in Equation 2, where:

EG_y is the net quantity of increased electricity generation as a result of the project activity (incremental to baseline generation) during the year *y* in MWh,
$EG_{project\ plant,y}$ is the net quantity of electricity generated in the project plant during the year *y* in MWh,
$\varepsilon_{el,project\ plant,y}$ is the average net energy efficiency of electricity generation in the project plant, expressed in $MWh_{el}/MWh_{biomass}$. by dividing the electricity generation during the year *y* by the sum of all fuels (biomass residue types *k* and fossil fuel types *i*), expressed in energy units, as follows:

$$\varepsilon_{el,project\ plant,y} = \frac{EG_{project\ plant,y}}{\sum_k NCV_k \cdot BF_{k,y} + \sum_i NCV_i \cdot FF_{project\ plant,i,y}}$$

where:

εel,project plant,y = Average net energy efficiency of electricity generation in the project plant
EGproject plant,y = Net quantity of electricity generated in the project plant during the year *y* (MWh)
BFk,y = Quantity of biomass residue type *k* combusted in the project plant during the year *y*
(tons of dry matter or liter)
NCVk = Net calorific value of the biomass residue type *k* (GJ/ton of dry matter or GJ/liter)
NCVi = Net calorific value of fossil fuel type *i* (GJ / mass or volume unit)
FFproject plant,i,y = Quantity of fossil fuel type *i* combusted in the biomass residue fired power plant during the year *y* (mass or volume unit per year)9

For the first crediting period, the emissions reductions due to displacement of electricity ($ERelectricity_y$) will be calculated as follows:

$$ERelectricity_y = 0.668 \times EG_y \qquad \textbf{Equation 3}$$

The emission reduction by the project activity (ER_y in tCO_2e) during a given year (y) is the difference between the emissions reductions due to displacement of electricity ($ERelectricity_y$), project emissions (PE_y) and due to leakage (L_y), as follows:

$$ER_y = ERelectricity_{,y} - PE_y - L_y = 0.668\ x\ EG_y - PE_y - 0 \qquad \textbf{Equation 4}$$

b) ACM0002 - “Consolidated baseline methodology for grid-connected electricity generation from renewable sources”, Version 6, dated on 19/05/2006.

Since the power generation capacity of the project plant is of more than 15 MW, *EFgrid,y* should be calculated as a combined margin (CM), following the guidance in the section “Baselines” in the “Consolidated baseline methodology for grid-connected electricity generation from renewable sources” (ACM0002, version 6, May 19, 2006).

The calculation of emissions reductions from the displacement of electricity form the grid includes a calculation for baseline emission factor (EF_y) that is equal to a combined margin (CM) consisting of a weighted average of the operating margin (*OM*) and build margin (*BM*) factors. The methodology thus starts with the calculation of the OM and BM emission factors and concludes with the calculation of the electricity baseline emission factor. ACM0002 follows a three-step approach, namely:

- **STEP 1** - Calculation of the operating margin emission factor(s), based on one of the following methods:
  - (a) Simple operating margin
  - (b) Simple adjusted operating margin
  - (c) Dispatch data analysis operating margin

(d) Average operating margin.

Although the methodology calls for giving priority to the Dispatch data analysis method, lack of data for Honduras prevented the application of this option. Additionally, Honduras is a country where less than 50% of total grid generation comes from low-cost/ must-run resources. For these reasons, the Simple OM method (a) was chosen.

The simple operating margin emission factor ($EF_{OM,simple,y}$) is calculated as the generation-weighted average emissions per electricity unit (in tCO_2/MWh) of all generating sources except low-cost/ must-run power plants over the past three years:

$$EF_{OM,simple,y} = \frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_{j} GEN_{j,y}} \quad \text{(Equation 5)}$$

Where:

- $F_{i,j,y}$ is the amount of fuel i (in mass or volume unit) consumed by relevant power sources j in year(s) y,
- $COEF_{i,j}$ is the CO_2e coefficient of fuel i (tCO_{2e}/mass or volume unit of the fuel), taking into account the carbon dioxide equivalent emission potential 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 in year(s) y

- **STEP 2** – Calculation of the build margin mission factor ($EF_{BM,y}$) as the generation weighted average emission factor (tCO_{2e}/MWh) of a sample of power plants m, as follows:

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} \cdot COEF_{i,m}}{\sum_{m} GEN_{m,y}} \quad \text{(Equation 6)}$$

Where $F_{i,m,y}$, $COEF_{i,m}$ and $GEN_{m,y}$ are analogous to the variables described for the Simple OM method (ACM0002) for plants m, based on the most recent information available on plants already built . The sample group m consists of either:

- The five power plants that have been built most recently, or
- The power plants capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

For Chumbagua cogeneration project, m consisted on the five most recently built plants as they comprises the larger annual generation.

STEP 3 – Calculate the baseline emission factor EF_y, as the weighted average of the operating margin factor ($EF_{OM,y}$) and the build margin factor ($EF_{BM,y}$):

$$EF_y = w_{OM} \cdot EF_{OM,y} + w_{BM} \cdot EF_{BM,y} \quad \text{(Equation 7)}$$

Where the weights are w_{OM} and w_{BM}, by default are 50% (i.e., w_{OM} = w_{OM} = 0.5). Alternative weights can be used, as long as w_{OM} + w_{BM} = 1, and appropriate evidence justifying the alternative weights is presented.

The OM emission factor is calculated as the generation-weighted average emissions per electricity unit (in tCO_2/MWh) of all generating sources except low-cost/ must-run power plants:

$$EF_{OM,y} = \frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_{j} GEN_{j,y}}$$

Where:

- $\sum_{i,j} F_{i,j,y}$ is the amount of fuel i (in mass or volume unit) consumed by relevant power sources j in year(s) y,
- $COEF_{i,j}$ is the CO_2e coefficient of fuel i (tCO_{2e}/mass or volume unit of the fuel), taking into account the carbon dioxide equivalent emission potential of the fuels used by relevant power sources j and the percent oxidation of the fuel in year(s) y and,
- $\sum_{j} GEN_{j,y}$ is the electricity (MWh) delivered to the grid by source j,

The calculation of the Simple OM was done using the most recent numbers for Honduras' national interconnected system obtained from the national dispatch center. Data from 38 power plants, comprising 1.375 GW of installed capacity and over 14.564 TWh of electricity generation for the 3-year period comprised between 2003 and 2005 were considered.

Non-low-cost/must-run resources in Honduras' national interconnected system are thermo power plants diesel and fuel oil.

The product $\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}$ for each one of the plants was obtained from the following formulae:

$$F_{i,j,y} = GEN_{i,j,y} \cdot \eta_{i,j,y} \qquad \text{(Equation 8)}$$

Where,

$$\eta_{i,j,y} = \frac{DEN_i \cdot NCV_i \cdot 1000}{TE_{i,j}} \qquad \text{(Equation 9)}$$

$$COEF_{i,j} = EF_{CO2,i} \cdot 44/12 \cdot OXID_i \qquad \text{(Equation 10)}$$

Hence,

$$F_{i,j,y} \cdot COEF_{i,j} = GEN_{i,j,y} \cdot EF_{CO2,i} \cdot 44/12 \cdot OXID_i \cdot \eta_{i,j,y} \qquad \text{(Equation 11)}$$

Where variable and parameters used are:

- $\sum_{i,j} F_{i,j,y}$ is given in TJ, $COEF_{i,j}$ in tCO_2e/TJ and $F_{i,j,y} \cdot COEF_{i,j}$ in tCO_2e
- $GEN_{i,j,y}$ is the electricity generation for plant *j*, with fuel *i*, in year *y*, obtained from the National Dispatch Center, in MWh.
- $\eta_{i,j}$ is the fuel consumption factor of plant *j*, operating with fuel *i*, in TJ/MWh.
- DEN_i is the density of fuel *i* in tonnes/Gallon.
- NCV_i is the net calorific value of fuel *i,* obtained from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, in TJ/10^3 tonnes.
- 1,000 is the conversion factor from MWh to KWh.
- $TE_{i,i}$ is the thermal efficiency of plant *j*, operating with fuel *i*, obtained from the National Dispatch Center in KWh/Gallon.
- $EF_{CO2,i}$ is the emission factor for fuel *i*, obtained from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, in tC/TJ.
- 44/12 is the carbon conversion factor from tC to tCO_2.
- $OXID_i$ is the oxidization factor for fuel *i*, obtained from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, in %.

$\sum_{j,y} GEN_{j,y}$ is obtained from the National Dispatch Center, as the sum of non-low-cost/must-run resources electricity generation, in MWh.

See results of this calculation in Annex 3.

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

Data / Parameter:	*EF*
Data unit:	tCO_2/MWh
Description:	Emission factor for Honduras interconnected grid
Source of data used:	ENEE
Value applied:	0.668, at the start of the project activity. For the first crediting period, the emission factor $EF_{OM,y}$ will be calculated *ex-ante.*
Justification of the choice of data or description of measurement methods and procedures actually applied :	According to ACM0002, version 6, May 19, 2006, the calculation of emissions reductions from the displacement of electricity form the grid included a calculation for baseline emission factor (EF_y) that is equal to a combined margin (CM) consisting of a weighted average of the operating margin (*OM*) and build margin (*BM*) factors. The methodology thus starts with the calculation of the OM and BM emission factors and concludes with the calculation of the electricity baseline emission factor.
Any comment:	*EF* is the value used for $CEF_{electricity,y}$

Data / Parameter:	**EF**BM**grid,y**
Data unit:	tCO_2/MWh
Description:	CO_2 build margin emission factor for grid electricity during the year *y*
Source of data used:	The latest approved version of ACM0002 to calculate the grid emission factor: version 6, May 19, 2006.
Value applied:	0.667
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter:	**EF**OM**grid,y**
Data unit:	tCO_2/MWh
Description:	CO_2 operating margin emission factor for grid electricity during the year *y*
Source of data used:	The latest approved version of ACM0002 to calculate the grid emission factor: version 6, May 19, 2006.
Value applied:	0.670
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter:	**εel, pre project**
Data unit:	MWh_{el} / $MWh_{biomass}$
Description:	Average net efficiency of electricity generation in the project plant prior to project implementation.
Source of data used:	On-site measurements conducted prior to the implementation of the project activity.
Value applied:	0.033
Justification of the choice of data or description of measurement methods and procedures actually applied :	Measure the quantity of fuels fired and the electricity generation during a representative time period and divide the quantity of electricity generated by the energy quantity of the fuels fired. The three most recent historical years should preferably be used to determine the average efficiency, where such data is available and where this time period is reasonably representative.
Any comment:	Applicable to scenario 14

Data / Parameter:	**$BF_{Bagasse, pre project}$**
Data unit:	Metric tones
Description:	Quantity of bagasse that has been fired in boilers for heat

	generation during the most recent three years at the project site
Source of data used:	On-site measurements
Value applied:	See annexed spreadsheet “Chumbagua_CERs_calculation_scenario14_2007.03.13.xls”
Justification of the choice of data or description of measurement methods and procedures actually applied :	Use weight or volume meters. Adjust for the moisture content in order to determine the quantity of dry biomass. The quantity shall be crosschecked with the quantity of electricity (and heat) generated and any fuel purchase receipts (if available).
Any comment	

B.6.3 Ex-ante calculation of emission reductions:

The implementation of Chumbagua Cogeneration Project connected to the Honduran grid will yearly avoid estimated emissions of roughly 22,324 tCO_2 and a total reduction of about 156,267 tCO_2 over the first 7-year period:

Year	Energy exported (MWh)	Energy consumed (MWh)	Auxiliary systems (MWh)
2004	0	6,028	63.5
2005	0	4,356	63.5
2006	0	7,812	63.5
2007 (*)	10,800	18,000	527.4
2008 (*)	28,000	16,400	527.4
2009 (*)	28,000	16,400	527.4
2010 (*)	28,000	16,400	527.4
2011 (*)	28,000	16,400	527.4
2012 (*)	28,000	16,400	527.4
2013 (*)	28,000	16,400	527.4

The consumption of the auxiliary systems were estimated according to the following:

Baseline: total of 14.7 KW. For 5 months operation, we have 3,600 hours. Considering that the old equipment is inefficient, we added 20% consumption, and reached the value of 63.5 MWh.

Project: total of 146.5 KW, leading to an estimated consumption of 527.4 MWh in 3,600 hours.

Year	Bagasse consumption (tones)
2004	92,075

2005	90,405
2006	97,250
2007 (*)	116,120
2008 (*)	130,635
2009 (*)	130,635
2010 (*)	130,635
2011 (*)	130,635
2012 (*)	130,635
2013 (*)	130,635

Year	EG power plant (MWh)
2007 (*)	28,273
2008 (*)	43,873
2009 (*)	43,873
2010 (*)	43,873
2011 (*)	43,873
2012 (*)	43,873
2013 (*)	43,873

Calculation of $\varepsilon_{el,\ preproject}$

2004	0.034
2005	0.025
2006	0.041

Average: 0.033

Calculation of $\varepsilon_{el,\ project}$

2007 (*)	0.1262
2008 (*)	0.1740
2009 (*)	0.1740
2010 (*)	0.1740
2011 (*)	0.1740
2012 (*)	0.1740
2013 (*)	0.1740

Calculation of EGy

2007 (*)	20,843
2008 (*)	35,515

2009 (*)	35,515
2010 (*)	35,515
2011 (*)	35,515
2012 (*)	35,515
2013 (*)	35,515

Since ER_y= 0.668 X EGy.

Calculation of ERy

2007 (*)	13,923
2008 (*)	23,724
2009 (*)	23,724
2010 (*)	23,724
2011 (*)	23,724
2012 (*)	23,724
2013 (*)	23,724
Total	**156,267**

(*) estimated

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

The full implementation of the Chumbagua project connected to the Honduran grid will avoid an average estimated yearly emission of around 22,324 tCO2e, and a total reduction of about 156,267 tCO2e over the first 7 years crediting period (up to and including 2013, see Table 2 below). Note: the calculation of the baseline emissions is not required, as per methodology ACM0006, version 4.

Years	**Estimation of project activity emissions**	**Estimation of baseline emissions**	**Estimation of leakage**	**Estimation of overall emissions reductions**
	(tonnes of CO2e)	**(tonnes of CO2e)**	**(tonnes of CO2e)**	**(tonnes of CO2e)**
2007 (*)	0	0	0	13,923
2008 (*)	0	0	0	23,724
2009 (*)	0	0	0	23,724
2010 (*)	0	0	0	23,724
2011 (*)	0	0	0	23,724
2012 (*)	0	0	0	23,724
2013 (*)	0	0	0	23,724
Total (tonnes of CO2e)	0	**0**	0	**156,267**

Table 2 - Summary of the ex-ante estimation of emission reductions

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

B.7.1 Data and parameters monitored:

Data / Parameter:	**EGproject plant$_y$**
Data unit:	MWh
Description:	Net quantity of electricity generated in the project plant during the year y
Source of data to be used:	Readings of the energy metering connected to the project plant
Value of data applied for the purpose of calculating expected emission reductions in section B.5	43,873 MWh at the end of the first crediting period
Description of measurement methods and procedures to be applied:	Meter should be calibrated regularly according to ENEE's norms. Measurement results for the energy exported should be cross-checked with the quantity of invoices from the grid operator. Data is being archived and administered by Chumbagua. Data will be archived during the crediting period and two years after.
QA/QC procedures to be applied:	Data on the energy exported to the grid is being monitored by Chumbagua and the utility company (ENEE). This duplicity of counting will ensure the accuracy of the amount of electricity delivered to the grid. The utility company will also perform audits to the measurement equipments of the plant to assure correct monitoring.
Any comment:	

Data / Parameter:	**EG$_y$**
Data unit:	MWh
Description:	Net quantity of increased electricity generation as a result of the project activity during the year y
Source of data to be used:	Calculated according to equation 2, in section B.6.1
Value of data applied for the purpose of calculating expected emission reductions in section B.5	35,515 MWh at the end of the first crediting period
Description of measurement methods and procedures to be applied:	Calculated quarterly. Data will be archived during the crediting period and two years after.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	**εel,project plant,y**
Data unit:	Non dimensional
Description:	Electric energy efficiency
Source of data to be used:	Net energy efficiency of electricity generation in the project plant
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.033 at the end of the crediting period. Data is being calculated by Chumbagua, as in annexed spreadsheet "Chumbagua_CERs_calculation_scenario14_2007.03.13.xls"
Description of measurement methods and procedures to be applied:	Calculated quarterly. Data will be archived during the crediting period and two years after.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	**$FC_{bagasse}$**
Data unit:	Metric tones
Description:	Quantity of bagasse combusted in the project plant during the year *y*
Source of data to be used:	Weight on-site measurements
Value of data applied for the purpose of calculating expected emission reductions in section B.5	See table in section B.6.3
Description of measurement methods and procedures to be applied:	Monitored continuously, with an annual energy balance. Adjust for the moisture content in order to determine the quantity of dry biomass. The quantity shall be crosschecked with the quantity of electricity (and heat) generated and any fuel purchase receipts (if available). Data will be archived during the crediting period and two years after.
QA/QC procedures to be applied:	Crosscheck the measurements with an annual energy balance that is based on purchased quantities and stock changes.
Any comment:	

Data / Parameter:	**$NCV_{bagasse}$**
Data unit:	MWh/tones
Description:	Net calorific value of bagasse
Source of data to be used:	On-site measurements
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1.93

Description of measurement methods and procedures to be applied:	Data will be measured every six months by Chumbagua. The net calorific value should be determined separately for all types of biomass. Measurements shall be carried out at reputed laboratories and according to relevant international standards. Data will be archived during the crediting period and two years after.
QA/QC procedures to be applied:	Check consistency of measurements and local / national data with default values by the IPCC. If the values differ significantly from IPCC default values, possibly collect additional information or conduct measurements.
Any comment:	

B.7.2 Description of the monitoring plan:

Data that has to be monitored during the life of the contract are the net quantity of electricity generated in the project plant ($EG_{project\ plant,y}$) and the quantity of bagasse (and its NCV) used yearly. The project owner will continuously measure these values.

The electricity data will be monitored by the meters installed at the substation of the cogeneration system and compiled in a spreadsheet. The amount of electricity will be corroborated with the invoices to be electrical company and in case of discrepancies, the latter will prevail.

The project sponsor will proceed with the necessary measures for the power control and monitoring, according to the information produced by ENEE.

Chumbagua are responsible for the project monitoring and reporting. The calibration of the monitoring instruments will be done according to the regulations of ENEE

The plant has monitoring and control of residual waters, monitoring and control of emission of solid particles, CO and SO_2.

The plant has programs for the management of chemical products, maintenance of equipments and control of accidents.

There is also a program for compensation of environmental impacts, with forestation and reforestation activities, protection of flora and fauna, reduction of the use of agrochemical products.

There is full training of the personnel during the whole year, both for the workers in the industrial area, as well as for the workers in the agriculture area. To review project performance meetings are scheduled with staff engineers and consultants.

All the monitoring and training procedures are described in the "*Plan de Manejo Ambiental*" (Plan of Environment Management) (copy under request)

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

The baseline and monitoring studies were conducted according to approved methodology ACM0006 – "Consolidated baseline methodology for grid-connected electricity generation from biomass residues". They were completed on March 13st, 2007 by Ricardo Besen of Ecoinvest Carbon S.A.

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Brazil

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 starting date of the CDM project is 29/10/2004

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

25y-0m

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:

01/01/2007

C.2.1.2. Length of the first crediting period:

7y-0m

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

This section is left blank on purpose.

C.2.2.2. Length:

This section is left blank on purpose.

SECTION D. Environmental impacts

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

Although the most notorious environmental impact of the implementation of the Chumbagua cogeneration project is positive (the reduction of GHG in Honduras), Chumbagua had to undergo an environmental impact assessment customary for all constructions and energy projects in Honduras. Such analysis was completed successfully in regards to the fact that Chumbagua obtained from the National Environmental Ministry (Secretaria de Recursos Naturales y Ambiente), the necessary environmental licences for operation (environmental license Nº 008-2005).

The environmental impact assessment of Chumbagua cogeneration project included:

- Usage of Resources
- Legislation to be observed
- Impacts to climate and air quality
- Geological and soil impacts
- Hydrological impacts (surface and groundwater)
- Impacts to the flora and animal life
- Socio-economic (necessary infra-structure, legal and institutional, etc.)
- Local stakeholders comments
- Mitigation measures
- Monitoring plan

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

No significant environmental issues aroused from the Environmental Impact Assessment undergone by Chumbagua. This process concluded successfully leading to the granting of Environmental License Nº 008-2005 by the National Environmental Ministry (Secretaria de Recursos Naturales y Ambiente), which was updated in the document 193-2206, of 07/09/2006 (see annexed documents).

Sugar production has some environmental impact such as bagasse burning. Nevertheless, those activities were conducted prior to the implementation of the project and thus could not be attributed to the CDM project activity. The project does not increase bagasse production; therefore, those environmental impacting activities mentioned above are not increased nor intensified.

SECTION E. Stakeholders' comments

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

The process for obtaining the Environmental Licence includes two site visits to the project by the so-called National System of Evaluation of Environmental Impact (SINEIA for its initials in Spanish). SINEAI is composed by representatives of the following Government agencies:

- Secretariat of National Resources and Environment (SERNA, in Spanish).
- General Commission of Evaluation and Environment Control (CEDA).
- Water Resources Comission (DRH).

- Honduran Association of Sugar Producers (APAH).
- Center for Pollution Studies and Control.
- Municipal Environmental Unit (UMA).
- National Electric Company (ENEE).
- Secretariat for Agricultural Sanitation (SENASA).
- Secretariat for Agriculture and Cattle Rising (SAG).
- Independent Service for Aqueducts and Sewer Systems (SANAA).

The first site visit from the SINEIA occurs after the request for the Environmental License is rendered together with the technical report and the feasibility study. After this first visit, the project sponsor hired the independent company for the development of the environmental impact assessment.

Once the environmental impact assessment is delivered, the SINEAI does the second site visit to corroborate the information mentioned in the study in hand. During this visit, SINEIA will deliver its final recommendations and comments. The compliance to these comments is mandatory for the issuance of the Mitigation Contract, a preliminary step for obtaining the Environmental License.

For the issuance of the Operational License, Honduras legislation requires the Project owner to publish the Cogeneration Project Operation Contract, authorized by the DNA and the National Congress. It was published in an official newspaper (see annexed file "Chumbagua_Operation Contract).

Local stakeholders, among them authorities from Municipal Environmental Unit and local political authorities, were invited to make comments on the project:

E.2. Summary of the comments received:

During the process preceding the granting of the Environmental License, national stakeholders delivered comments on small operational issues such as the disposal of the ashes after the burning of the bagasse. No major issues were commented and all of the comments were incorporated into the final design of the system and its operation.

Denia Patricia Lontero Altamirano, Municipal Environment Coordinator of San Marcos, states that the generation of energy with renewable sources contributes to the environmental sustainable development.

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

All comments received from national stakeholders during the process of obtaining the Environmental License and Operational Permit were incorporated into the project. It is important to remember that the issuance of those licenses is contingent to the compliance with all comments from the SINEIA. Chumbagua obtained both the Environmental and the Operational License in 2005, thus providing enough evidence that that due account of stakeholders comment was taken.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2 – Information regarding public Funding

There is no public funding involved in this project.

Annex 3 – Baseline Information

Years	Installed Capacity (In MW)	Internally consumed energy (MWh/year)	Total energy generated (MWh/year)	Sold energy (MWh/year)
2004	2.2	6,208	6,208	
2005	2.2	4,356	4,356	
2006	20	7,812	7,812	
2007	20	18,000	28,800	10,800
2008	20	18,000	44,400	28,000
2009	20	18,000	44,400	28,000
2010	20	18,000	44,400	28,000
2011	20	18,000	44,400	28,000
2012	20	18,000	44,400	28,000
2013	20	18,000	44,400	28,000

The resulting operating margin using the Simple OM method was:

- $EF_{OM,simple,2003\text{-}2005} = 0.670\ tCO_2e/MWh.$

- **STEP 2** – Calculate the build margin mission factor ($EF_{BM,y}$) as the generation weighted average emission factor (tCO_{2e}/MWh) of a sample of power plants *m*, as follows:

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

Where $F_{i,m,y}$, $COEF_{i,m}$ and $GEN_{m,y}$ are analogous to the variables described for the Simple OM method (ACM-0002) for plants *m*, based on the most recent information available on plants already built . The sample group m consists of either

- The five power plants that have been built most recently, or
- The power plants 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. For Chumbagua project, the 20% option was chosen.

From the obtained data, the build margin emission factor for Honduras is:

- $EF_{BM,2005} = 0.667\ tCO_{2e}/MWh.$

- **STEP 3** – Calculate the baseline emission factor EF_y, as the weighted average of the operating margin factor ($EF_{OM,y}$) and the build margin factor ($EF_{BM,y}$):

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

For the weights w_{OM} and w_{BM} the default values of 50% (each) were used.

- EF_{2005} = *0.668 tCO_{2e}/MWh.*

Summary of the results:

Baseline Emission Factor - Honduras			
	According to Approved Methodology ACM0002		
Year 2003			
	EF_{OM} (tCO_2/MWh)	0.6790	
	Annual generation[1] (MWh)	4,850,200	
Year 2004			
	EF_{OM} (tCO_2/MWh)	0.6537	
	Annual generation[1] (MWh)	5,178,630	
Year 2005			
	EF_{OM} (tCO_2/MWh)	0.6766	
	EF_{BM} (tCO_2/MWh)	0.6670	
	Annual generation[1] (MWh)	5,483,300	
	Generation weighted $EF_{OM,2003-2005}$	0.670	(tCO_2/MWh)
EF_{CM} = 0.5*$EF_{OM,2003-2005}$ + 0.5*$EF_{BM,2005}$ =		**0.668**	**(tCO_2/MWh)**

Annex 4 – Monitoring Plan

This section is intentionally left blank (see section B.7 for monitoring plan).