PROJECT DESIGN DOCUMENT FORM
FOR CDM PROJECT ACTIVITIES (F-CDM-PDD)
Version 04.1

PROJECT DESIGN DOCUMENT (PDD)

Title of the project activity	Incauca S. A. Fuel Switch from Coal to Green Harvest Residues CDM Project (hereafter simply referred to as "Incauca Fuel Switch Project").
Version number of the PDD	17
Completion date of the PDD	09/10/2013
Project participant(s)	Private entity: Ingenio del Cauca S. A. Multilateral Public entity: Corporación Andina de Fomento (CAF) acting as trustee for the government of The Netherlands represented by its Ministry of Housing, Spatial Planning and the Environment
Host Party(ies)	Colombia
Sectoral scope and selected methodology(ies)	Sectoral Scope 01 and 04. Approved baseline and monitoring methodology AM0036. Fuel switch from fossil fuels to biomass residues in boilers for heat generation. Version 01.1. 29 September 2006
Estimated amount of annual average GHG emission reductions	35,140

SECTION A. Description of project activity
A.1. Purpose and general description of project activity

Incauca S. A. is currently the largest sugar mill in Colombia. It has been in operation since July 29, 1963 and it is since May 1st 1980 part of the Ardilla Lülle Group.

The main sugar sector activities in Colombia are undertaken in the Cauca valley region. It is the main source of economic activities in the region and offers direct and indirect employment to approximately 1 million people, which is one third of the total inhabitants of the area. On a national level, 1.6% of GDP is due to the sugar sector as a whole, which is compounded by the fact that slightly over 50% of the sugar produced is exported. A total number of 13 sugar mills are located in the region and jointly they produce most of the nation's sugar (over 95%).

The general practice of burning sugar cane fields to allow simple harvesting operations has been subject to growing criticism on environmental and health grounds; this leads increasingly to the practice of green cane harvesting, as could be stated in the Environmental Guide for the Sugar Cane Subsector:

“The burned cane area was reduced with the increase of the green harvest in happening of 17% of the area in 1998, to 27% in 2000. (Asocaña, 2000). The area for subsequent burning has to be inferior of 40% in 1998 to the 100% in 2001.”

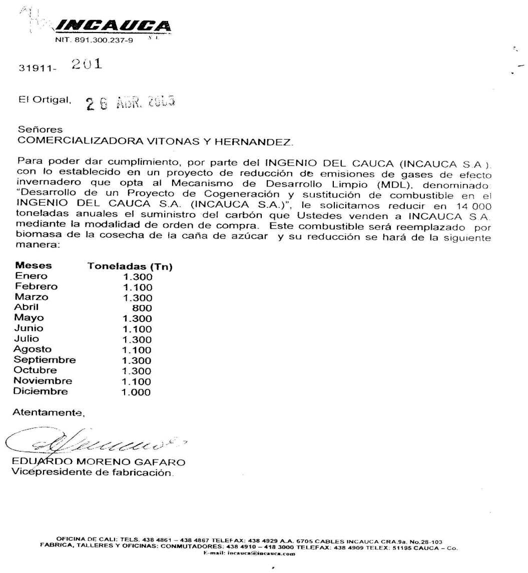
(http://www.minambiente.gov.co/prensa/publicaciones/guias_ambientales)

Green cane harvesting leaves large amounts of biomass (“barbojo”) in the fields that could be used for energy purposes. Currently bagasse and coal are used as primary energy sources of energy at Incauca to produce steam in the boilers. Conservatively it can be assumed that it is possible to double the amount of this biomass at the sugar mill with the collection of the biomass usually left in the field. At this moment, the test developed by Incauca has shown that the barbojo estimated to be collected could be doubled, but in a conservative way the initial amount is maintained.

Hence, to resume, reducing coal use at Incauca Plant, the project sponsor will invest in: new technology, promotion of new practices and in developing new social arrangements to create jobs opportunities in waste collection activities.

With those improvements, sugarcane residues from the harvest, that right now are burned or left to decay in the field will be collected, transported to the mill, chopped and finally used as fuel.

Until now coal has been traded with a local suppliers and a paper factory (Propal) in exchange for bagasse. Propal uses the bagasse as a raw material in the manufacture of paper, and delivers Incauca its calorific value equivalent in coal. With the proposed project activity Incauca will still provide the same amount of bagasse required by Propal and will continue receiving coal needed by the factory according to the contract signed. The replaced coal will not come from the amount exchanged with Propal (this contract will not be modified for the convenience of both companies). Reduced coal consumption will come from the amount purchased to a supplier called “Comercializadora Vitona y Hernandez”. This coal reduction was informed to “Comercializadora Vitona y Hernandez” with the communication shown at Figure 1.



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El Ortigal, 26 ABR. 2003

Señores
COMERCIALIZADORA VITONAS Y HERNANDEZ.

Para poder dar cumplimiento, por parte del INGENIO DEL CAUCA (INCAUCA S.A.), con lo establecido en un proyecto de reducción de emisiones de gases de efecto invernadero que opta al Mecanismo de Desarrollo Limpio (MDL), denominado: "Desarrollo de un Proyecto de Cogeneración y sustitución de combustible en el INGENIO DEL CAUCA S.A. (INCAUCA S.A.)", le solicitamos reducir en 14 000 toneladas anuales el suministro del carbón que Ustedes venden a INCAUCA S.A. mediante la modalidad de orden de compra. Este combustible será reemplazado por biomasa de la cosecha de la caña de azúcar y su reducción se hará de la siguiente manera:

Meses	Toneladas (Tn)
Enero	1.300
Febrero	1.100
Marzo	1.300
Abril	800
Mayo	1.300
Junio	1.100
Julio	1.300
Agosto	1.100
Septiembre	1.300
Octubre	1.300
Noviembre	1.100
Diciembre	1.000

Atentamente,

EDUARDO MORENO GAFARO
Vicepresidente de fabricación.

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Figure 1- Reduced Coal Purchase Order to Supplier

Therefore, the implementation of this CDM project activity will not bring a shortfall in the supply of bagasse to Propal, neither an increase in the demand of coal in other sugar mills or industries in the region. The proposed project activity will consequently contribute to the sustainable development of the host country by increasing the trade in of renewable energy to the grid and cutting coal consumption at the factory in an estimated amount of 14,000 tons per year. Furthermore the collection of sugarcane residues will reduce the need of burning biomass in the fields improving the local quality of air. But the most important issue is that the entire project, if successful, for sure will promote the barbojo collection practice over the other mills on Cauca's Valley.

Figure 2– Incauca aerial view

The objective of the "Incauca Fuel Switch Project" is the displacement of coal consumption in estimated[1] 14,000 tones per year (See Table 1 for fuel consumption) through the recollection of discarded leaves during the harvesting process. The normal recollection process applied in Colombia and as usual in the Latin American sugar cane fields implies the abandoning of a great amount of leaves in the field. When the

[1]The quantity of substituted coal comes from current supplier. There is evidence of a reduction in purchased coal on a document sent to the suppliers (see Figure 1). Purchased coal's humidity and heating power value measured by Incauca's laboratory.

field is burned to collect the sugar cane, between a 10 to 15% rests in the field as "barbojo". This is increased recently due to the new environmental regulations that limit the burning of the cane field previous of the collection, reaching 40 to 45 % of residues abandoned over the harvested field.

For this reason Incauca began in 2004 the process to evaluate the feasibility of recollecting those residues to use them for energy purposes. The project is actually evaluating three different alternatives to collect the barbojo (generically applied term for green foliage, and tops that rest in a harvested field), those are:

(I) The implementation of a collecting machine used for other field collection purposes (Figure 3a);

(II) The incorporation of a local un-employed personnel through the developing of a social project and the creation of collectors cooperatives (Figure 3b);

(III) The use of an adapted tractor with a hydraulic hook and modified sugar cane collection wagons (Figure 3c).

Figure 3.aConventional collecting machine experimenting in the recollection of barbojo.

Figure 3.b Members of the cooperatives created for the collection of barbojo developing a field test to validate modifications over the traditional animal powered wagon and time required for hand collection process. Project sponsored with non returnable funds earned by CAF, and administered by Fundación Carbajal www.fundacioncarbajal.org.co

Figure 3.c First model of adapted tractor with a hydraulic hook developing a field test to validate its productivity.

	Boiler Distral 1	Boiler Distral 2	Boiler Distral 3		Boiler Distral 4	
	(consumption in tonnes)					
Year	bagasse	bagasse	bagasse	coal	bagasse	coal
2004	169,959	201,771	169,182	57,315	226,929	93,045
2005	178,258	198,267	133,203	62,032	216,318	99,242
2006	185,320	185,682	158,728	62,300	245,824	99,682

Table 1 – Incauca S. A. fuel consumption, 2004 to 2006

For each one of the alternatives under evaluation has been considered:

a) The efficiency of the collection process in terms of Tons of barbojo x Ha x day;

b) The final cost of each Ton of barbojo effectively collected;

c) The complexity of technology to be implemented in terms of local and regional experience; and

d) The area (the potential) of barbojo (biomass) that would be able to be collected in a time/cost sustainable way.

(I) Collecting machine used for other field collection purposes:

Incauca has been evaluating this equipment normally used to collect many other type of agriculture products. This procedure could collect 30 Tons of barbojo in 2, 5 hours and accumulate 7 to 8 Tons on each wagon. The essays are running since 2005 and actually are considered viable to collect 110 Tons/Ha and 80 Tons/day. One of the advantages is that the barbojo is already chopped in the field and the wagon could transport a more compacted load. In the other side, the machine only can collect the top of the barbojo pile. The machine collection result in more Tons of barbojo per Hectare, but it picks up also too many stones and earth, that implies that the recovered biomass needs to be washed, cleaned and is not able to collect all the barbojo over the land, just the surface of the “barbojo piles”, and eventually could be damaged by rocks.

(II) Incorporation of a local un-employed personnel through the developing of a social project and the creation of collectors cooperatives

The cooperatives of “carretilleros” may involve 15 unemployed people for each community (Tarragona, Ortigal, Villarrica, Port Tejada and Padilla). For this project, the traditional Colombian animal powered

vehicles “Carretillas” has required to be modified by Incauca for the barbojo collection purpose. Different ways to manipulate and transport the barbojo have been essayed, resulting in efficiency 2 Tons per day, for 1 person and one “carretilla”. This efficiency is calculated over 2 travels per day in a radius of no more than 5 Km long (3 hour each, including recollection and transport). This maybe improved soon to 3 or 4 travels, be separating the collection and transport in two different peoples with 2 wagons. Incauca, supported by a non-returnable fund earned by CAF, and administered by Fundación Carbajal www.fundacioncarbajal.org.co, have reached a program where the collected barbojo, is packed and chopped in different collection centers based on a 5 Km radius.

When Incauca pays for this barbojo, it represents a sufficient income for the cooperatives, to assure a right payment for each member, enough to cover administration costs and offering inclusion of all people involved in the social security system. The buying of the barbojo (among others) is only possible by considering the incomes of the carbon credits expected for Incauca´s project.

The main advantages are that almost all the barbojo could be collected and could create a sustainable employ to many adjacent communities. The inconvenient is the time required for the transportation, but Incauca does not want to improve these through automotive way, to promote the “carretilleros” work.

This method is supported in Incauca´s mill for 3 years of development of a new dedicated chopping line and the boilers system feeding.

(III) Use of an adapted tractor with a hydraulic hook and modified sugar cane collection wagons.

This method called “alzadora mecánica” is 100% proposed by Incauca and the essays begun at February 2006, with the small tractor shown at figure 3.c. In this case the relation in Tons per Ha is very low, but after the design of the model is already reached, a biggest tractor will be adapted.

This method has been developed at Incauca´s mill for 3 years to reach the creation of a new dedicated chopping line and a boilers feeding system.

The major advantages for this procedure is that almost all the barbojo could be collected, without many rocks and earth (avoiding damages as seen in method I), and in a fraction of time of that required by cooperatives. The major inconvenient is that the fact of being new equipment is not easy to operate and require training each of the operators, plus building each machine. The final configuration is still being evaluated, so there is no base to achieve how many Tons per Ha could be collected by this system. Nevertheless, it seems to become one of the most convenient when developed.

At present (June 2007), the experience gained after two years points to use all the described methods depending on the field characteristics. For example, the cooperatives are good for a maximum operation radius of 5 Km from the storing center and to provide job to closest stakeholders. Additionally, where the field is more irregular and the access is not enough friendly for machine operations.

In other side, the collection of barbojo through a mechanical hook permits to collect more tons per hectare, but the method needs a skilled machine operator and takes much more time. Incauca has and still been developing different machine designs, in order to improve the process dynamics and it is reliability.

A.2. Location of project activity
A.2.1. Host Party(ies)

Colombia.

A.2.2. Region/State/Province etc.

Departamento del Cauca.

A.2.3. City/Town/Community etc.

Corregimiento El Ortigal, Municipio de Miranda.

A.2.4. Physical/Geographical location

Geographical coordinates: latitude 3 15 ^{o} North, longitude 76 ^{o} 15' West (50 km to the southeast of the City of Santiago de Cali).

Figure 4 - Geographical location of the Incauca Fuel Switch Project (source: USDoE, 2005)

Figure 5 - Sugar mills in the Cauca River Valley (Incauca S. A. location is indicated by bullet number 2; source: Asociación de Cultivadores de Caña de Azúcar de Colombia

A.3. Technologies and/or measures

At the mill cane, harvest residues will be chopped and prepared for introduction and burning in the boilers. The process for collecting, transporting, chopping, and feeding the residues to the boilers is being developed at Incauca and will be a novelty in the sector.

In the proposed project activity estimated 61,600 tonnes yearly of barbojo (specific heat of 3,500 Btu per pound) will be collected and transported to be used as energy source at the mill in order to substitute the use of at least 14,000 tons of coal (specific heat of 11,000 Btu/pound).

In summary, estimated energy amount in 61,600 tonnes of barbojo, 501,487 GJ, and in 14,000 tonnes of coal, 358,205 GJ. The difference in total energy amount is due to the different thermodynamic efficiency of the boilers burning barbojo (~50%, useful energy = 501,487 × 0.50 = 250,774 GJ) and coal (~70%, useful energy = 358,205 × 0.70 = 250,774 GJ).

A.4. Parties and project participants

Party involved (host) indicates a host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Colombia (host)	Private entity: Ingenio del Cauca S. A.	No
The Netherlands	Multilateral Public entity: Corporación Andina de Fomento (CAF) acting as trustee for the government of The Netherlands represented by its Ministry of Housing, Spatial Planning and the Environment	Yes

A.5. Public funding of project activity

No public funding, including official development assistance, was or will be used in the Incauca Fuel Switch Project.

SECTION B. Application of selected approved baseline and monitoring methodology
B.1. Reference of methodology

Approved baseline and monitoring methodology AM0036. Fuel switch from fossil fuels to biomass residues in boilers for heat generation. Version 01.1. Sectoral Scope 01 and 04. 29 September 2006.

Tools referenced in this methodology:
Tool for the demonstration and assessment of additionality (ver 4)

B.2. Applicability of methodology

The chosen methodology is applicable to project activity to consider the switch from use of fossil fuels to biomass residues, in existing boilers. Under the applicable scenario #1, the "Retrofit of existing boilers" scenario is suited for the application to the Incauca Fuel Switch Project**:**

- The project activity is the retrofit of (an) existing boiler(s). The retrofit is made to the boiler(s) to enable (a) the use of biomass residues or (b) an increase in the use of biomass residues

beyond historical levels, which would not be technically possible in any of the existing boilers without a retrofit or replacement of the boilers.

Regarding applicability conditions, as explained above, at the mill cane harvest residues, previously left in the field, will be used as additional (bio-) energy source in the boilers. The process for collecting, transporting, chopping, and feeding the additional residues to the boilers is being developed at Incauca and will be a novelty in the sector. The existing boiler system (intended as: fuel and biomass feeding equipments plus combustion chamber/furnace plus heat exchanger (air-water) plus gas washers plus chimney) has to be adapted to permit the use of the "barbojo" in those boilers that currently burn bagasse. The modifications over the boiler system have mainly occurred at the feeding system.

The bagasse just needs a transportation band and properly nozzles to feed the bagasse at required quantity to the combustion chamber. To permit the boiler system to process the new biomass (barbojo) a totally new feeding system has to be added to the boiler system. The new Barbojo Feeding Line, have required a totally different approach to render this biomass available for direct burning, The barbojo line have been developed over an abandoned sugar cane mill, by adapting it to adequate de barbojo (wash and chop). A totally new and in-house designed chopping device was placed in the feeding line, by using a rotator dispenser with steel tooth and variable speed motor.

Finally the biomass fuel nozzles where now the barbojo and the bagasse are combined to enter into the combustion chamber have required, from early 2006, a number of essays (shape and operation) to finally find the properly way feed the biomass mix.

Some essays continue to been developed to see the response the boilers to this new fuel never used in the region (according to CENICAÑA). Those are evaluating the effect in the ash formation and incrustations on the boiler's tubulars, with different percentage of bagasse-barbojo. Currently have been determined (based in the Incauca experimental case) that, with a 70% bagasse / 30% barbojo, there is no problem with the actual boiling chamber configuration, but as the percentage of barbojo will for sure be increased progressively, it is possible that the boiler chamber need some improvements. Taken from a paper presented at Tecnicaña Congress (2006).

The barbojo, in order to be correctly incinerated in the boiler, has required the development of a chopping/feeding system added to the existing boilers. Too many essays have been performed to find the correct size and humidity.

Biomass residues (mainly tops and leaves of the sugarcane plant, barbojo) are actually being successfully burned like bagasse, through the modification of an old cane crushing line. Mainly the added "barbojo washing/crushing line" have to eliminate earth, rocks and crush barbojo to a desired size. Nevertheless the boiler feeding had to undergo modifications to avoid obstruction with the new material.

Furthermore, as the main objective of the project is the displacement of coal consumption by additional biomass residues, power generated with the heat from the boilers will not be increased as result of the project activity. Moreover, the implementation of the project activity will not result in increased processing capacity of raw input.

Finally, reviewing the **applicability** conditions one by one, as presented in the methodology, Incauca´s project fulfil the following conditions:

1. *The heat generated in the boiler(s):* <u>Power</u> is generated with heat from the boilers; <u>it is not increased as a result of the project activity.</u>

2. *The use of biomass residues or increasing the use of biomass residues beyond historical levels is technically not possible at the project site without a significant capital investment in*
   a) Either the retrofit or replacements of existing boilers or the installation of new boilers;
   b) Or in a new dedicated biomass supply chain established for the purpose of the project (e.g. collecting and cleaning contaminated new sources of biomass residues that could otherwise not be used for energy purposes).

   The option b) is the one applicable to Incauca´s project: "*a new dedicated biomass supply chain established for the purpose of the project*" and specifically coinciding with the given example: "*e.g. collecting and cleaning contaminated new sources of biomass residues that could otherwise not be used for energy purposes*".

   In Incauca case, the condition b) is the main applicable condition but, due to the descriptions presented above, the condition a) could be also applicable during the project life time if percentage of barbojo burning is increased, particularly to deal with the increased ash formation.

3. *Existing boilers at the project site have used no biomass or have used only biomass residues (but no other type of biomass) for heat generation during the most recent three years prior to the implementation of the project activity.*

   The boilers 3 and 4 burn just bagasse, but never the barbojo have been used, nor in the region, nor in Colombia.

4. *No biomass types other than biomass residues, as defined above, are used in the boiler(s) during the crediting period (some fossil fuels may be co-fired).*

   The boilers 3 and 4 burn just bagasse, as cited above, and will burn the added barbojo. The coal will be displaced over the other Incauca's boilers that use a mixture of bagasse and coal, by using the bagasse displaced from boilers 3 and 4.

5. *For projects that use biomass residues from a production process (e.g. production of sugar or wood panel boards), the implementation of the project shall not result in an increase of the processing capacity of raw input (e.g. sugar, rice, logs, etc.) or in other substantial changes (e.g. product change) in this process.*

   The parameters of steam – energy generated at the plant will be not altered, showing that no production increment will take place due to this project activity.

6. *The biomass residues used at the project site, where the project activity is implemented, should not be stored for more than one year*.

   Barbojo is burned, the same day that is collected or just in a few days if the collection is more than expected; or if steam requirements are lower than normal operation.

7. *No significant energy quantities, except from transportation or mechanical treatment of the biomass residues, are required to prepare the biomass residues for fuel combustion, i.e. projects that process the biomass residues prior to combustion (e.g. esterification of waste oils) are not eligible under this methodology.*

   Effectively, barbojo just require short truck transport in case of machine collection and other, after be collected by cooperatives in a collection centre. Mayor energy requirements will be at the new barbojo

crushing-washing line that as described before is just to prepare the biomass residues. This project related emissions will be monitored at project stage.

8. *The biomass residues are directly generated at the project site or transported to the project site by trucks.*

The barbojo is originated only in Incauca´s field.

9. *In case of project activities that involve the replacement or retrofit of existing boiler(s), all boiler(s) existing at the project site prior to the implementation of the project activity should be able to operate until the end of the crediting period without any retrofitting or replacement.*

For the purpose of demonstrating this applicability condition, the boiler constructor COLAMQUINAS has informed (written way) that the lifetime of the Incauca´s boilers is 50 year.

Number Boiler installed	**Initial Operation date.**
No 1	December 15th, 1975
No 2	April 3rd, 1982
No 3	November 16th, 1988 (275 psig) and April 30th, 1998 (650 psig)
No 4	July 27th, 1994 (275 psig) and November 10th, 1994 (650 psig)

Table 2

B.3. Project boundary

The spatial extent of the project boundary encompasses:

- All the boilers and related equipment at the project site. Besides, the barbojo will be burned in all four boilers. The coal displacement will be generated by the use of the bagasse not used (displaced) by the incorporation of barbojo, in the other boilers that currently require coal.
- The means for transportation of biomass residues to the project site (e.g. vehicles). This item includes the animal powered vehicles, used as one of the means to collect the barbojo. This portion will not be separated at the monitoring procedure, and no GHG reduction will be claimed over this, but is important to consider that emissions from transportation/collection of barbojo will be less than reported.
- The sugar cane fields are included in the project boundary, because biomass residues that would have been left for decay, do so, under aerobic-anaerobic conditions or burned at field (scenarios B1 and B3). In other words, the barbojo is piled or burned usually in a manner were emission factor is very low, but due to the quantity of biomass that could be involved, CH_4 emissions become significant (more than any project leakage).

Source		GHGs	Included?	Justification/Explanation
Baseline scenario	Fossil fuel combustion in boilers for heat generation	CO_2	Yes	
		CH_4	No	Excluded for simplification. This is conservative.
		N_2O	No	Excluded for simplification. This is conservative.
	Uncontrolled burning or decay of the biomass residues	CO_2	No	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	Yes	Project participants may decide to include this emission source, where cases B1, B2 or B3 are identified as the most likely baseline scenario for the use of the biomass residues.
		N_2O	No	Excluded for simplification. This is conservative.
Project scenario	On-site fossil fuel and electricity consumption	CO_2	Yes	
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.
	Off-site transportation of biomass residues	CO_2	Yes	
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.
	Combustion of biomass residues for heat generation	CO_2	No	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	Yes	This emission source must be included if project participants decide to include CH_4 emissions from uncontrolled burning or decay of the biomass residues in the baseline scenario.
		N_2O	No	Excluded for simplification. This emission source is assumed to be small.
	Biomass storage	CO_2	No	It is assumed that CO2 emissions from surplus biomass residues do not lead to changes of carbon pools in the LULUCF sector.
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.

Table 3

B.4. Establishment and description of baseline scenario

The Incauca CDM Project, a greenhouse (GHG) gas-free power generation project, will result in GHG emissions reductions as the result of reduction in coal consumption at the project site.

Alternatives for heat generation:
For Incauca, if this additional amount of biomass was not collected, the boilers will continue the operation using the same fuel mix, in order to respect the supply to propel (**scenario H2**).

Alternatives for biomass residues:
For Incauca, without the financial stimulus of carbon credits input, the idea of recovering the barbojo will not make sense. If this additional amount of biomass was not collected, it will be dumped at fields (mainly

under anaerobic - aerobic conditions due to the barbojo pile heath) or eventually be burned at the same field, but never to use it as fuel for energy generation. The most alternative scenarios for the biomass will be the combination of: **scenario B1 and B3.** The scenario of use the barbojo as fertilizer is really improbable, because Incauca have developed already an extended compost program based on other residues (cachaza and vinaza).

The proposed project activity will go beyond the regulatory requirements that are inscribed on the Environmental Guidelines for the Sugar Cane Sub- sector. http://www.minambiente.gov.co/prensa/publicaciones/guias_ambientales.htm

The proposed project activity will reduce GHG emission by displacing the burning of 14,000 tons of coal with its energy-equivalent in harvested sugarcane green residues, brought to the mill from the cultivated areas. Without the substitution of coal by barbojo in the current boilers, Incauca would continue burning a mixture of bagasse and coal (at an average mass ratio of roughly 70% of bagasse to 30% of coal in the 2004 to 2006 period).

The adoption of a new practice of collection of barbojo residues, aims to displace Incauca´s coal requirements, based on a potential of 220,000 Ton/year of barbojo available as residues of its actual cane production. But this project has considered a conservative amount, because the different collection techniques have to be implemented, consolidated and eventually extended over all its fields.
Additionally, this amount of barbojo it is avoided to be abandon or burned at field, so there will be a component of the GHG reduction that considers this.

B.5. Demonstration of additionality

The proposed baseline methodology includes the application of the additionality tool. The tool is a general framework implemented in a step wise approach for demonstrating and assessing additionality. The application of the additionality tool for the project activity of Incauca Fuel Switch Project is detailed in the next paragraphs.

The additionality tool of the EB Version 4.0 is used.

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

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

The identified realistic alternative to the project activity are:

- **Alternative 1**. Continuation of the current situation, the boilers will continue the operation using the same fuel mix, in order to respect the supply to propel, and using traditional practices to manage the residues of the sugarcane harvest, i.e., left to decay in the field.
- **Alternative 2** The implementation of the project without incentives from the CDM.

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

The both alternatives are in compliance with all applicable legal and regulatory requirements. The alternative 1 that is the current situation fulfilled the regulation. Now, Incauca is operating and has available all permits needed to operate and in the future will not prevent the use of mixed fuels with coal, while the emissions in particulate material in the boiler be behind some caps bellow what it has been established by the environmental authorities. In the case of the implementation of the project without

incentives from the CDM, the situation is similar. The letter of national approval emitted by the Colombian government, involved to have fulfilled all the environmental and not environmental laws, to see resolution 0453 of 2004, annex 2A, Chapter III, Principle: Compliance of the active sectoral law; of the Ministry of Environment, Housing and Territorial Development.

Step 2. Investment Analysis

Sub-step 2a. Determine appropriate analysis method

Alternatives considered are: (i) to continue operating under the current conditions; (ii) or to implement the project activity without considering it a CDM project. In the early stages of the project evaluation, Incauca conducted an investment analysis which considered the IRR and payback period, based on a financial model prepared as part of a GEF study[2]. Using the above mentioned documents a simple cost analysis (option I) will be used here as the appropriate analysis method.

Sub-step 2b. Option I – Simple cost analysis

The financial model was based on a cash flow model which included Incauca's *Earnings Before Interest and Taxes, Depreciation and Amortization* (EBITDA). Key model variables include: (i) green residue collection and transporting, and pre-boiler feeding costs (between US$ 10.8 and 17.8 per ton); (ii) the price of local coal (US$ 22.11/ton), which is considered as savings; and (iii) pre-burning of sugarcane (US$0.0/ton), as conservative approach in the model for the proposed project activity[2]. In every case the resulting IRR of this activity is negative and there was no payback period, resulting in a financially un-feasible project. In other words, the activity produces no economic benefits other than CDM related income.

Sub-step 2c. Calculation and comparison of financial indicators (only applicable to options II and III)

Not applicable.

Sub-step 2d. Sensitivity analysis (only applicable to options II and III)

Although not applicable to option I, the project participants considered its development relevant for transparency and clarity reasons.

The sensitivity analysis included three scenarios based on variations to: (i) the price of coal; (ii) the pre-burning practice of sugarcane in the field, which is considered savings in the model; and (iii) the cost of handling green residues (biomass). Under a scenario of high oil prices other fuels increase, therefore the price of alternative fuels such as green residues (which also includes the cost for drying the biomass when necessary[3]), rises. The costs of pre-burning in the field (avoided practice under the project activity) increase due to a revaluation of the Colombian currency and the opportunity cost resulting from the burning of this new alternative fuel (green residue).

The results of this sensitivity analysis favor the additionality argument for the displacement of coal consumption, as the proposed activity does not result in positive financial returns even in scenarios where

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[2] GEF Study: Electric Power from Green Harvesting Residues of Sugar Cane in Colombia - A Pre Feasibility Study on its Technical and Economical Viability-1999, was based o basic data for calculations in the use of harvest residues in the boilers of the Cauca factory "INCAUCA". Incauca's Electric Power and Financial Departments updated project costs for the GEF financial model in 2004.

[3] Based on the GEF Study, in the absence of rain the moisture content decreases by 3-5% per day when the green residue if left in the field. However, during years of higher than average rain fall, increased moisture requires further drying of the biomass (including increased cost due to drying activity in small bagasse-based boilers at the plant).

the cost of coal doubles. Incauca's cash flow remains negative (a loss) during the entire project operation, only result IRR positive if CERS are included (See Table 6).

Activity 2: Displacing coal consumption in at Incauca's cogeneration plant
Base Year: 2004

Key Assumptions	Base Scenario	Scenario 1	Scenario 2	Scenario 3
Carbon Price US $/TON	22,11	20	30	48
Cost Ton of harvest residue US $	10,8	11	12,5	15
CERs price (Euros /CER)	10	11	8	8,5
IRR 15b or 30 years without CERS	no financial return	no financial return	no financial return	no financial return
IRR 15 years with CERS	9,7%	11,0%	24,0%	18,5%
IRR 30 years With CERS	13,3%	14,4%	25,2%	20,3%

Table 4 - Sensitivity Analysis of Incauca Fuel Switch Project alternatives.

Step 3. Barrier Analysis

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

There are barriers currently hampering the development of co-generation in Colombia as a whole (UNDP-GEF, 2004), and some specifics which are applicable to the Incauca Fuel Switch Project, consisted of technical barriers:

TECHNICAL BARRIERS

- Local investment in innovation: The machinery to prepare the harvest cane residues is a key factor in the energy production of the proposed project component. A new mechanism has been devised by Incauca to prepare the fuel (biomass) which feeds the boiler and therefore the turbine. This machinery is first of its kind in Colombia. It has required a significant investment in research and development (numerous trail and error field tests, redesigning and fabrication, and reconfigurations). There is then a clear risk involved in the application of such new technology.
- Utilization of new energy source: The harvest cane green residue is a new proposed renewable energy source in Colombia. Its characteristics (volume, moisture and general conditions and its availability) depend greatly on cultivation and harvesting practices, rainfall patterns, climate and transportation system from the field to the mills. A good number of these variables cannot be controlled by Incauca. For this reason, there are many risks involved in the utilization of this source. A great deal of testing and learning is required in order to obtain a standard and reliable supply of this harvested cane residue, comparable to the actual supply of coal.
- Availability of skill labour: There is not enough skilled manpower (in terms of numbers as well as expertise) at the sugar sector's research and development facility (Cenicaña) and within the individual sugar mills the required research and development needed for designing the systems, process and machinery to collect, transport and use the harvested cane residue.
- Access to modern equipment and resources: In Colombia there is limited access to (state-of-the art) equipment and resources needed to prepare and use harvest cane residue equipment as a result of constrained know-how, information financial availability.
- Various managerial technological views: Within the sugar sector there exist management differences between the sugar mills, varying from very progressive to very conservative, making it difficult to introduce new approaches and technologies to the sector as a whole. This situation is particularly present in Incauca as it is the oldest sugar mill (1963). A conservative

management position is more critical for new technologies in the electric area within a sugar company.

- New fuel supply operating conditions: Logistics and storage of cane residues other than bagasse are complicated and not fully understood and developed, and do have a major impact on the cost-effective use of these residues for co-generation. No previous experience exists in Colombia on harvest cane residues for co-generation as a business venture.

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

As described above, the realistic alternatives to the project activities are either the continuation of the scenario without the proposed project activities or the implementation of the project activities without the CDM incentives. Clearly the barriers above do not have any effect in the former. For the latter, all the barriers apply and are intensified, making the implementation of the alternative without the incentive from the CDM very unlikely.

Step 4. Common practice analysis

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

As mentioned above, the project activity is the first commercial-scale experience of substitution of coal by harvest cane residues for co-generation plants.

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

The project participants are not aware of any similar option in the Colombian sugar sector, thus this aspect does not apply.

Finally, by means of an internal letter of Incauca, dated 01/10/2004, and previous several analysis carry out by Incauca´s Electrical Department, the Superintendent of the mill accepted to go ahead with the CDM project and initiate the respective construction.

B.6. Emission reductions
B.6.1. Explanation of methodological choices

The methodology is applicable to project activities that switch from use of fossil fuels to biomass residues, in boilers, by increasing the biomass use beyond historical levels.

The project activity will develop different methods to increment the historical biomass availability for energy production without increment the sugar cane production and adapting the existing boilers for receiving it, among with sugarcane bagasse. Therefore, the methodology scenario applicable to the Incauca Fuel Switch Project is:

- **Scenario 1 – Retrofit of existing boilers.** The project activity is the retrofit of (an) existing boiler(s). The retrofit is made to the boiler(s) to enable (a) the use of biomass residues or (b) an increase in the use of biomass residues beyond historical levels, which would not be technically possible in any of the existing boilers without a retrofit or replacement of the boilers.

As mentioned before, CO_2 emission reductions, due to the new biomass used for energy will be considered as the effective replaced coal, and the relation with “barbojo” quantity will be based on the equivalent calorific values.

The project will either include CH_4 emissions for both project and baseline emissions. At the base line calculations the “barbojo” cases B1 or B2 could be present indifferently, depending of the percent of the green harvest developed. Finally, there is no distinction on which process is performed because the same Emission Factor is assumed for both processes. The recommendation expressed at AM0036 V.1 methodology is assumed in a conservative way, considering avoided emissions of 0.0027 Ton CH_4/Ton of collected barbojo.

The potential leakage sources for the project activity have been considered accordingly. The increment of fossil fuel requirements will be monitored and is expected to be very low. Nevertheless, there exists a component of barbojo, which is collected and partially transported by animal powered vehicle (“carretilleros”) it would be considered in the most conservative way, that all the barbojo is transported by requiring the use of fossil fuel.

The approach for the leakage assumption, based on scenarios B1 and B3, will consider the leakage consideration L1: “*Demonstrate that at the sites where the project activity is supplied from with biomass residues, the biomass residues have not been collected or utilized (e.g. as fuel, fertilizer or feedstock) but have been dumped and left to decay, land-filled or burnt without energy generation (e.g. field burning) prior to the implementation of the project activity. Demonstrate that this practice would continue in the absence of the CDM project activity, e.g. by showing that in the monitored period no market has emerged for the biomass residues considered or by showing that it would still not be feasible to utilize the biomass residues for any purposes (e.g. due to the remote location where the biomass residue is generated).*”

In this sense, CENICAÑA constantly monitor the advances in the industrial process of the sugar cane in the Valle del Cauca region, reason why will not be difficult to INCAUCA to demonstrate if there is in the future a market growing up for collecting and using the barbojo, and checking this annually.

B.6.2. Data and parameters fixed ex ante

Data / Parameter	**BFk,n / BFk,n-1 / BFk,n-2**
Unit	Tons of dry matter
Description	Quantity of bagasse residue type *k* fired in all boiler(s) at the project site during the historical year *n*, *n-1* or *n-2*, where *n* corresponds to the year prior to implementation of the project activity
Source of data	On-site measurements
Value(s) applied	2004 767,841 2005 726,046 2006 775,554
Choice of data or Measurement methods and procedures	Use weight meters. Adjusted for the moisture content in order to determine the quantity of dry biomass. The quantity shall be cross-checked with the quantity of heat generated and any fuel purchase receipts (if available).
Purpose of data	Used to determine baseline emissions.
Additional comment	If the three most recent historical years prior to the implementation of the project activity are not representative for the situation at the project site (e.g. a drought in one year, a boiler or plant not operating during a certain year for

	technical reasons, etc), project participants may alternatively select the five most recent historical years from which one year may be excluded if deviating significantly from other years. The selection by project participants should be documented in the CDM-PDD and be applied to all relevant provisions and equations throughout this methodology in a consistent manner, including the applicability condition.

Data / Parameter	$\eta_{boiler,FF}$
Unit	-
Description	Average net efficiency of heat generation in the boiler(s) when fired with fossil fuels.
Source of data	Measured efficiency prior to the implementation of the project activity.
Value(s) applied	68.9%
Choice of data or Measurement methods and procedures	Three years (2004 to 2006) weighted average of directly measured efficiency in the boiler co-firing coal and Bagasse.
Purpose of data	Used to determine baseline emissions.
Additional comment	

Data / Parameter	$\mathbf{HG_{biomass,historic,n}}$ / $\mathbf{HG_{biomass,historic,n-1}}$ / $\mathbf{HG_{biomass,historic,n-2}}$
Unit	GJ
Description	Historical annual heat generation from firing biomass residues in boilers at the project site during the year *n*, *n-1* or *n-2*, where *n* corresponds to the year prior to the implementation of the project activity.
Source of data	Onsite measurements.
Value(s) applied	$HG_{biomass, historic, 2004}$ 6,965,417 $HG_{biomass, historic, 2005}$ 6,586,277 $HG_{biomass, historic, 2006}$ 7,035,385
Choice of data or Measurement methods and procedures	Directly measured data for bagasse consumption. Biomass quantities that enter to the mill as sugar cane are normally monitored, as well as the products amounts. So the bagasse production (as waste) is normally monitored to achieve the whole process efficiency.
Purpose of data	Used to determine baseline emissions.
Additional comment	

Data / Parameter	$\mathbf{FC_{i,n}}$ / $\mathbf{FC_{i,n-1}}$ / $\mathbf{FC_{i,n-2}}$
Unit	Mass or volume unit[5].
Description	Quantity of coal fired in all boiler(s) at the project site during the historical year *2004, 2005 and 2006* prior to implementation of the project activity.
Source of data	Onsite measurements.
Value(s) applied	$FC_{coal,2004}$ 150,360 $FC_{coal,2005}$ 161,275 $FC_{coal,2006}$ 161,982
Choice of data or Measurement methods	Onsite measurements

and procedures	
Purpose of data	Used to determine baseline emissions.
Additional comment	

Data / Parameter	**$EF_{CO2,FF,I}$**
Unit	tCO_2/GJ
Description	CO_2 emission factor for fossil fuel type I.
Source of data	Derived from IPCC default emission factors.
Value(s) applied	0.0946 (Coal) 0.0741 (Diesel)
Choice of data or Measurement methods and procedures	Value determined using IPCC default emission factors (this is conservatively).
Purpose of data	Used to determine baseline and project emissions.
Additional comment	

B.6.3. Ex ante calculation of emission reductions

Please refer to the attached spreadsheet with all ex-ante calculation of emission reductions

1 - Baseline emissions

BEy = BEHG,y + BEBF,y

where:

BE_y Baseline emissions during the year *y* (tCO_2e/yr)

$BE_{HG,y}$ baseline emissions from fossil fuel combustion for heat generation in the boiler(s) (tCO_2/yr)

$BE_{BF,y}$ baseline emissions due to uncontrolled burning or decay of the biomass residues (tCO_2e/yr)

And the result is:

BEy (tCO_2/yr)	BEHG,y (tCO_2/yr)	BEBF,y (tCO_2/yr)
36,706	34,157	2,550

Baseline emissions from fossil fuel combustion in boiler(s) for heat generation are:

$$BE_{HG,y} = \frac{HG_{PJ,biomass,y} \cdot EF_{FF,CO2,y}}{\eta_{boiler,FF}}$$

where:

$BE_{HG,y}$ baseline emissions from fossil fuel combustion for heat generation in the boiler(s) (tCO_2/yr)

$HG_{PJ,biomass,y}$ heat generated with incremental biomass residues used as a result of the project

	activity during the year *y* (GJ/yr)
$EF_{FF,\,CO2,\,y}$	CO_2 emission factor of the fossil fuel type displaced by biomass residues (tCO_2e/GJ)
$\eta_{boiler,\,FF}$	average efficiency pf heat generation in the boiler(s) when fired with fossil fuels

The result is:

$BE_{HG,y}$	$HG_{PJ,\,biomass,\,y}$	$EF_{FF,\,CO2,\,y}$	$\eta_{boiler,\,FF}$
(tCO_2/yr)	(GJ/yr)	(tCO_2/GJ)	(-)
34,157	248,701	9.46E-02	68.9%

The difference between the total quantity of heat generated from biomass residues in all boilers at the project site in the year y (HGPJ,biomass,total,y) and the highest annual historical heat generation with biomass residues among the most recent three years prior to the implementation of the project activity, as follows:

$$HG_{PJ,biomass,y} = HG_{PJ,biomass,total,y} - MAX\left\{HG_{biomass,historic,n}; HG_{biomass,historic,n-1}; HG_{biomass,historic,n-2}\right\}$$

where:

$HG_{PJ,\,biomass,\,y}$	heat generated with incremental biomass residues used in the project activity during year *y* (GJ/yr)
$HG_{PJ,\,biomass,\,total,\,y}$	total heat generated from firing biomass residues in all boilers at the project site during the year *y* (GJ/yr)
$HG_{biomass,\,historic,\,n}$	historical annual heat generation from firing biomass residues in boilers at the project site during the year *n* (GJ/yr)
n	year prior to the implementation of the project activity

And the result is

$HG_{PJ,\,biomass,\,2007}$	$HG_{PJ,\,biomass,\,total,\,2007}$	$HG_{biomass,\,historic,\,2004}$	$HG_{biomass,\,historic,\,2005}$	$HG_{biomass,\,historic,\,2006}$
(GJ/yr)	(GJ/yr)	(GJ/yr)	(GJ/yr)	(GJ/yr)
328,462	7,363,847	6,965,417	6,586,277	7,035,385

The difference between the total quantity of heat generated from biomass residues in all boilers in the year y (HGPJ,biomass,total,y) and the total heat generation during the year y (HGPJ,total,y) multiplied with the highest historical fraction of heat generation with biomass residues from the most recent three years, as follows:

$$HG_{PJ,biomass,y} = HG_{PJ,biomass,total,y} - HG_{PJ,total,y} \cdot MAX\left\{\frac{HG_{biomass,historic,n}}{HG_{total,historic,n}}; \frac{HG_{biomass,historic,n-1}}{HG_{total,historic,n-1}}; \frac{HG_{biomass,historic,n-2}}{HG_{total,historic,n-2}}\right\}$$

where:

$HG_{PJ,\,biomass,\,y}$	heat generated with incremental biomass residues used as a result of the project activity during year *y* (GJ/yr)
$HG_{PJ,\,biomass,\,total,\,y}$	total heat generated from firing biomass residues in all boilers at the project site during the year *y* (GJ/yr)
$HG_{PJ,\,total,\,y}$	total heat generated in boilers at the project site, using both biomass residues and

	fossil fuels, during the year *y* (GJ,yr)
$HG_{biomass, historic, n}$	historical annual heat generation from firing biomass residues in boilers at the project site during the year *n* (GJ/yr)
$HG_{total, historic, n}$	historical annual total heat generation from firing biomass residues and fossil fuels in boilers at the project site during the year *n* (GJ/yr)
n	year prior to the implementation of the project activity

The result of this calculation is:

$HG_{PJ, biomass, 2007}$
(GJ/yr)
248,701

Now, in order to calculate the baseline emissions due to uncontrolled burning or decay of biomass residues using the equation:

$$BE_{BF,y} = GWP_{CH4} \cdot \sum_k BF_{PJ,k,y} \cdot NCV_k \cdot EF_{burning,CH4,k,y}$$

where:

$BE_{BF, y}$	baseline emissions due to uncontrolled burning or decay of biomass residues (tCO_2e/yr)
GWP_{CH4}	global warming potential of methane valid for the commitment period (tCO_2e/tCH_4)
$BF_{PJ, k, y}$	quantity of biomass residue type *k* used for heat generation as result of the project activity during the year *y* (tonnes of dry matter or liter)
NCV_k	net calorific value of biomass type *k* (GJ/tonnes of dry matter or GL/liter)
$EF_{burning, CH4, k,y}$	CH_4 emission factor for uncontrolled burning of the biomass residue type *k* during the year y (tCH_4/GJ)

The result of baseline emissions due to uncontrolled burning or decay of biomass residues is:

$BE_{BF,y}$
(tCO_2/yr)
2,550

2 - Project emissions

$$PE_y = PE_{CO2, FF, y} + PE_{CO2, EC, y} + PE_{CO2, TR, y} + GWP_{CH4} \times PE_{CH4, BF, y}$$

where:

PE_y	project emissions during the year *y* (tCO_2/yr)
$PE_{CO2, FF, y}$	CO_2 emissions from on-site fossil fuel combustions attributable to the project activity (tCO_2/yr)
$PE_{CO2, EC, y}$	CO_2 emissions from on-site electricity consumption attributable to the project activity (tCO_2/yr)
$PE_{CO2, TR, y}$	CO_2 emissions from off-site transportation of biomass residues to the project

	site (tCO_2/yr)
GWP_{CH4}	Global warming potential of methane valid for the commitment period (tCO_2e/tCH_4)
$PE_{CH4, BF, y}$	CH_4 emissions from combustion of biomass residues in the boiler(s) (tCH4/yr)

The result of this calculation is:

PE_y
(tCO_2/yr)
1,566

CO_2 emissions from on-site fossil fuel combustions attributable to the project activity (tCO_2/yr)

As stated before the mechanical methods used to collect the barbojo at field are at the moment under evaluation, so as the only activity (not considered as transport) that consumes fossil fuels it is not possible to present an estimation of this component. For these reason this value is assumed cero at present stage but the monitoring variables for these issue will be inserted at these PDD to ensure that this variable is accounted in the calculation of PE.

$$PE_{CO2, FF, y} = \sum_k FC_{on-site,i,y} * NCVi * EF_{, CO2, FF,i}$$

where:

$PE_{CO2, FF,y}$	CO_2 emissions from on-site fossil fuel combustions attributable to the project activity (tCO_2/yr).
$FC_{tr,i,y}$	Quantity of fossil fuel type *i* combusted at the project site for purposes other than heat generation as a result of the project activity during the year *y* (mass or volume unit)
NCV_i	Net calorific value of the fossil fuel type *i* (GJ / mass or volume unit)
$EF_{CO2,FF,i}$	CO_2 emission factor for fossil fuel type *i* (tCO_2/GJ)

(*) FCon-site,i,y not include fossil fuels co-fired in the boiler(s) but should include all other fossil fuel consumption at the project site that is attributable to the project activity, such as for on-site transportation or treatment of the biomass residues.

The result is:

$PE_{CO2, FF, y}$	$FC_{tr,i,y}$	NCV_i	$EF_{CO2,FF,i}$
(tCO_2/yr)	(Ton / year)	(GJ / Ton)	(tCO_2/GJ)
241	75.21	43.33	0.07406667

CO_2 emissions from off-site transportation of biomass residues to the project site (tCO_2/yr)

For CO_2 emissions from off-site transportation of biomass residues to the project site. Nevertheless coal is transported by rail or truck to Incauca, the project will, thereby reducing coal transport to the operation. A conservative approach is taken in that emission reductions from reduced coal transport are not accounted. In addition, biomass residues from fields are transported over shorter distances (the coal travel is around 200 Km). To maintain a conservative approach, the emission reductions from reduced transport are not

accounted for. Instead, only the additional transport emissions originating from barbojo transport is calculated for the project activity.

We have:

$$PE_{CO2,TR,y} = \frac{\sum_k BF_{PJ,k,y}}{TL_y} \cdot AVD_y \cdot EF_{km,CO2,y}$$

where:

$PE_{CO2,\,TR,\,y}$	CO_2 emissions from off-site transportation of biomass residues to the project site (tCO_2/yr).
AVD_y	Average round trip distance between the biomass fuel supply sites and the site of the project plant during year *y* (km).
$EF_{km,\,CO2,\,y}$	Averaged CO_2 emission factor for the trucks measured during the year *y* (tCO_2/km).
$BF_{PJ,\,k,\,y}$	Quantity of biomass residue type *k* used for heat generation as a result of the project activity during year *y* (tonnes of dry matter or liter).
TL_y	Average truck load of the trucks used (tonnes or liter).

The result is:

$PE_{CO2,\,TR,\,y}$	AVD_y	$EF_{km,\,CO2,\,y}$	$BF_{PJ,\,k,\,y}$	TL_y
(tCO_2/yr)	(km)	(tCO_2/km)	(tonnes)	(tonnes)
51.7	18.0	1.120E-03	61,600	24

CO_2 emissions from on-site electricity consumption attributable to the project activity (tCO_2/yr)

Emissions from the use of additional on-site equipment installed as a result of the project activity are basically attributable to the new barbojo crushing/washing line. This modified crushing line was developed over an existing crushing line for bagasse and where the biggest electrical motors were removed. Due to the reason that Incauca actually generates its own electricity, in terms of the energy consumption in the project boundary there will be a no a significant change (less than 1.1%). Just few the original motors was re-adapted or maintained in order to move the crushing machine developed for barbojo, and those used for the transport are maintained (see table 5 below).

But in order to state this point the calculus of the energy required is estimated as:

Equipment description	**Power (HP)***	**Power (Kw)**	**Absorbed Power (Mwh/day) based on 12 h / day***	**Annual Energy consumed over one year (320 operating days) (MWh/y)**
Crusher motor	350	257.4	3.1	988.5
Feed conveyor	30	22.1	0.3	84.7
transport conveyor	30	22.1	0.3	84.7
transport conveyor	30	22.1	0.3	84.7
Feeder drum **	40	29.4	0.1	28.2
Net energy consumption	480	353.0	4.0	1270.9

Actual energy requirements for Incauca´s sugar mill. 15Mw - hour	360.0	115.200
Increase in power consumption based on Incauca´s actual consumption (%)	1.10%	

** Equipment data*
*** Feeder drum just operate 3 h/day*

Table 5- Analysis of barbojo crushing line electricity consumption based on installed capacity.

On site electricity consumption (power) for each piece of equipment is based on manufacturer data and: Annual energy consumption (KWh/y) = Power (Kw) * Hours of operation (Hours/year).

The operation runs less than the operation of the sugar mill (320 days per year), due to climatic conditions and maintenance annual shut off. Nevertheless, 320 days is maintained as a conservative approach. Idem, the real operation time in the barbojo crushing line will be less than reported, but the 12 hour day it is also considered as a conservative approach.

The electricity consumed in the project is generated by Incauca, by biomass, therefore the emission factor could be zero (0), but the grid emission factor used for this calculation was 0.661 Tons CO2 / Mwh based on data 2004. As the electricity consumption ($EC_{PJ,y}$) is less than 15 GWh/yr, the average grid emission factor (including all grid-connected power plants) was used. It will be calculated ex-post.

When the CDM project operates, the on-site electricity consumption will be measure with a dedicated and exclusive internal meter.

Finally $PE_{CO2,\,EC,}$ is calculated as follows:

$$PE_{CO2,\,EC,\,y} = EC_{PJ,\,y} \,.\, EF_{grid\,y}$$

Where:
$PE_{CO2,EC,y}$ = CO_2 emissions from on-site electricity consumption attributable to the project activity (tCO_2/yr)
$EC_{PJ,y}$ = On-site electricity consumption attributable to the project activity during the year *y* (MWh)
$EF_{grid,y}$ = CO_2 emission factor for electricity used from the grid (tCO_2/MWh). Use ACM0002 to calculate the grid emission factor. If electricity consumption ($EC_{PJ,y}$) is less than 15 GWh/yr, the average grid emission factor (including all grid-connected power plants) may be used.

$PE_{CO2,\,EC,\,y}$
(tCO_2/yr)
840.1

CH_4 emissions from combustion of biomass residues in the boiler(s) (tCH4/yr)

Now the CH_4 emissions from combustion of biomass residues in the boiler(s) ($PECH_4$, BF, y in tCH_4/yr) are calculated:

$$PE_{CH4,BF,y} = EF_{CH4,BF} \cdot \sum_k BF_{PJ,k,y} \cdot NCV_k$$

where:

$PE_{CH4,BF,y}$	CH_4 emissions from combustion of biomass residues in the boiler(s) (tCH_4/yr).
$EF_{CH4,BF}$	CH_4 emission factor for the combustion of the biomass residues in the boilers (tCH_4/GJ).
$BF_{PJ,k,y}$	Quantity of biomass residue type *k* used for heat generation as a result of the project activity during year *y* (tonnes of dry matter or liter).
NCV_k	Net calorific value of biomass type *k* (GJ/tonnes of dry matter or GL/liter).

The result of the calculation is:

$PE_{CH4,BF,y}$ (tCH_4/yr)
20.6

Leakage

No leakage is anticipated as a result of the project activity. The project does not quantify any leakage effect related to biomass availability or due to any potential market for these kind of agricultural discard (barbojo). The amount of biomass available could surpass the initial expectations but Incauca will need all of them to substitute progressively the actual coal consumption. It is guaranteed by the provision of Incaucas's own biomass, and harvesting operations developed for barbojo, that the purposed amount of coal will be displaced and eventually surpassed.

The approach for the leakage assumption, based on scenarios B1 and B3, will consider the leakage consideration L1: "*Demonstrate that at the sites where the project activity is supplied from with biomass residues, the biomass residues have not been collected or utilized (e.g. as fuel, fertilizer or feedstock) but have been dumped and left to decay, land-filled or burnt without energy generation (e.g. field burning) prior to the implementation of the project activity. Demonstrate that this practice would continue in the absence of the CDM project activity, e.g. by showing that in the monitored period no market has emerged for the biomass residues considered or by showing that it would still not be feasible to utilize the biomass residues for any purposes (e.g. due to the remote location where the biomass residue is generated).*"

Note that as part of Incauca´s project an external a business this being promoted on the basis of social cooperatives to stimulate the barbojo´s harvesting. Is expected for these initiative that the number of these cooperatives will grow and that the income of future carbon credits allows sustain an interesting value that justifies the harvesting activity of these bio-fuel. For that reason it is understood that this project component is excluded from the analysis proposed in approach L1.

The issue described above has been demonstrated, at present there is no market for barbojo. To sustain this point during the crediting period project participants will demonstrate that suppliers of the barbojo residues in the project boundary will not be able to sell (any or all) of their biomass residues to an alternative consumer of biomass residues. For this purpose, project participants shall demonstrate that the suppliers of biomass residues (out of Incauca´s personnel) with a representative sample of barbojo that they could not sell which is not utilized by Incauca. A surplus of biomass residue will exist even after implementation of the project activity, but it is expected that will be incremented its use and maybe that

other neighbouring sugar mills could copy this initiative. So the reproduction of this pioneer activity will not be considered as any leakage.

This assumption can be validated yearly, and CENICAÑA, as the regional entity that normally survey the sugar sector, will be asked to be part of this surveillance.

f during any year the approach above cannot be demonstrate that the use of the biomass does not result in leakage, a leakage penalty will be applied to the quantity of biomass. The leakage penalty will adjust emission reductions for leakage effects in a conservative manner, assuming that this quantity of biomass is substituted by the most carbon intensive fuel in Colombia and accordingly to the parameters established by the methodology AM0036 V.3.1.

LE_y (tCO_2/yr)
0,0

3 - Emission reductions

$$ER_y = BE_y - PE_y - LE_y$$

where:

ER_y	emission reductions during the year *y* (tCO_2/yr)
BE_y	baseline emissions during the year *y* (tCO_2/yr)
PE_y	project emissions during the year *y* (tCO_2/yr)
LE_y	leakage emissions during the year *y* (tCO_2/yr)

The result of the calculation is

ER_y (tCO_2/yr)	BE_y (tCO_2/yr)	PE_y (tCO_2/yr)	LE_y (tCO_2/yr)
35,140	36,706	1,566	0.0

B.6.4. Summary of ex ante estimates of emission reductions

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
Year 1 – (2008)	18,353	783	0	17,570
Year 2 – (2009)	36,706	1,566	0	35,140
Year 3 – (2010)	36,706	1,566	0	35,140
Year 4 – (2011)	36,706	1,566	0	35,140
Year 5 – (2012)	36,706	1,566	0	35,140
Year 6 – (2013)	36,706	1,566	0	35,140
Year 7 – (2014)	18,353	783	0	17,570
Total	256,945	10,962	0	245,982
Total number of crediting years	7			
Annual average over the crediting period	36,706	1,566	0	35,140

Table 6 – Estimation of GHG emission by sources

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data / Parameter	**$EF_{FF,CO2,y}$**
Unit	tCO_2e/GJ
Description	CO_2 emission factor of the coal displaced by biomass residues for the year *y*.
Source of data	Value calculated using IPCC default emission factor for coal (25.8 tC/TJ) and directly measured net calorific value (NCV = 11,000 BTU per pound). A value of 26 tC/TJ have been calculated based on information recovered from CORPOICA 1996, but conservatively the IPCC approach is maintained.
Value(s) applied	0.0946
Measurement methods and procedures	None. IPCC default emission factor.
Monitoring frequency	None, but yearly review of IPCC default will be performed, to select the appropriate.
QA/QC procedures	None.
Purpose of data	Is used to determine the baseline emissions.
Additional comment	

Data / Parameter	**$HG_{PJ,total,y}$**
Unit	GJ/yr
Description	Total heat generated in all boilers at the project site, firing both biomass residues and coal, during the year (*y*).
Source of data	Calculations based on on-site measurements.
Value(s) applied	11,044,969
Measurement methods and procedures	Heat generation is determined as the difference of the enthalpy of the steam or hot water generated by the boiler(s) minus the enthalpy of the feed-water, the boiler blow-down and any condensate return. The respective enthalpies should be determined based on the mass (or volume) flows, the temperatures

	and, in case of superheated steam, the pressure. Steam tables or appropriate thermodynamic equations are used to calculate the enthalpy as a function of temperature and pressure.
Monitoring frequency	Data needed for calculations is collected daily and aggregated annually.
QA/QC procedures	The consistency of metered net heat generation should be cross-checked with the quantity of biomass and/or fossil fuels fired (e.g. check whether the net heat generation divided by the quantity of fuel fired results in a reasonable thermal efficiency that is comparable to previous years).
Purpose of data	Is used to determine heat generated with incremental agricultural biomass residues (barbojo) as a result of the project activity.
Additional comment	

Data / Parameter	$\mathbf{BF_{k,y}}$
Unit	Tons of dry matter (barbojo).
Description	Quantity of additional biomass residue (barbojo) fired in boiler Distral 1,2, 3 and 4 at the project site during the year *y*.
Source of data	Calculated from wet tones based on on-site measurements by applying a moisture correction factor determined at Incauca´s laboratory and cross checked with Cenicaña measurements.
Value(s) applied	61,600
Measurement methods and procedures	Use weight or volume meters at Incauca mill. The moisture will be adjusted in order to determine the quantity of dry biomass. The quantity will be crosschecked with the quantity of heat generated and the coal purchase displacement. This will be available by comparing the reduction at coal purchases performed on previous years.
Monitoring frequency	Data needed for calculations is collected daily and aggregated annually
QA/QC procedures	Crosscheck the measurements with an annual energy balance based on purchased coal quantities and sugar cane milled (equal to bagasse fired).
Purpose of data	Is used to determine heat generation from using agricultural biomass residues (barbojo) in boilers.
Additional comment	All the barbojo collected will be additional and is clearly different of bagasse that is directly proportional to sugar production. As the barbojo collection methods still been evaluated and improved is expected that $BF_{k,y}$ will increase, although the harvesting area or the volume of cane stays.

Data / Parameter	$\mathbf{BF_{,by}}$
Unit	Tons of dry matter (bagasse)
Description	Quantity (tons) of bagasse combusted in boiler Distral 1,2, 3 and 4 at the project site during the year *y*.
Source of data	Plant records based on on-site measurements.
Value(s) applied	2004 767,841 2005 726,046 2006 775,554
Measurement methods and procedures	The amount of bagasse combusted is obtained from the bagasse generated on-site at the sugar mill, considering the stocks at the beginning and end of each period and bagasse delivered to third parts. Thus, the bagasse combusted is as follows: Bagasse combusted = Bagasse produced + Bagasse in stock – Bagasse to third parts

	The bagasse produced is obtained from measured factory operation parameters, based on the sugar cane processed according to the fundamental equation for factory control in Sugar Cane Handbook (Chen, James C.P. 1991. Manual de Azúcar de Caña, Ed Limusa). Thus, the bagasse produced is as follows: Bagasse produced = Cane crushed + Maceration water added - Diluted juice produced To ensure reliable data, the cane crushed is measured by weigh bridges (weigh meters), the maceration water added and diluted juice produced are measured by flow meters (volume meters), delivered bagasse to third parts is measured by weigh bridges (weigh meters), and the stock bagasse is determined by changes in stock. In all cases, the moisture will be adjusted in order to determine the quantity of dry biomass. The above measurement procedure is an approved method of monitoring for sugar industries and is used for preparing the monthly and annual manufacturing reports that are submitted to the government of Colombia (Energy and Gas Regulatory Commission).
Monitoring frequency	Data are collected on a daily basis and aggregated annually.
QA/QC procedures	Crosscheck the measurements with an annual energy balance (based on purchased coal quantities and sugar cane milled) and annual factory reports.
Purpose of data	Is used to determine heat generation from using process biomass residues (bagasse) in boilers.
Additional comment	All the barbojo collected will be additional and is clearly different of bagasse that is directly proportional to sugar production. As the barbojo collection methods still been evaluated and improved is expected that $BF_{k,y}$ will increase, although the harvesting area or the volume of cane stays.

Data / Parameter	**MC_k , Moisture content of the barbojo**
Unit	% Water content
Description	Moisture content of barbojo
Source of data	On-site measurements. This data will be cross checked at least annually with investigations performed by Cenicaña.
Value(s) applied	46.5%
Measurement methods and procedures	The moisture content of barbojo will be determined at Incauca´s laboratory, and cross checked with Cenicaña measurements.
Monitoring frequency	Monthly from samples taken for each of collection methods described, mean values will be calculated at annually.
QA/QC procedures	At least yearly samples taken for each of collection methods described would be tested in an accredited external laboratory.
Purpose of data	Is used to determine the quantity of barbojo in dry basis.
Additional comment	

Data / Parameter	**MCb_k , Moisture content of the bagasse**
Unit	% Water content
Description	Moisture content of bagasse
Source of data	On-site measurements. This data will be cross checked at least annually with

	investigations performed by Cenicaña.
Value(s) applied	49%
Measurement methods and procedures	The moisture content of barbojo will be determined at Incauca´s laboratory, and cross checked with Cenicaña measurements.
Monitoring frequency	Monthly from samples taken for each of collection methods described, mean values will be calculated at annually.
QA/QC procedures	At least yearly samples taken for each of collection methods described would be tested in an accredited external laboratory.
Purpose of data	Is used to determine the quantity of bagasse in dry basis.
Additional comment	

Data / Parameter	**$FC_{i,y}$**
Unit	Tons.
Description	Quantity of coal fired in all boiler that use a coal mixture at the project site during the year *y*
Source of data	Calculated based on on-site measurements and cross cheeked against amounts purchased. Annually.
Value(s) applied	$FC_{coal,2004}$ 150,360 $FC_{coal,2005}$ 161,275 $FC_{coal,2006}$ 161,982
Measurement methods and procedures	Based over data of heat generated, after subtracting the component proportioned by bagasse and barbojo and based on on-site measurements of NCV of all fuels
Monitoring frequency	Continuously, aggregated at least annually.
QA/QC procedures	Cross-check the measurements with an annual energy balance that is based on purchased quantities and stock changes.
Purpose of data	Is used to determine heat generation from using fossil fuels in boilers.
Additional comment	The only fossil fuels combusted is coal, in a mix of 50% bituminous and 50% sub bituminous.

Data / Parameter	**$FC_{on\text{-}site,i,y}$**
Unit	t
Description	Quantity of fossil fuel type i combusted at the project site for other purposes than heat generation as a result of project activity during the year y.
Source of data	Fossil fuel purchase invoices / Report for productive hours for machinery in yard (chopped process).
Value(s) applied	3.07
Measurement methods and procedures	According to the internal procedure applied, the fossil fuel consumed at the project site for other purposes than heat generation as a result of project activity will be measured using volume meters and fuel purchase receipts (if available). The measurements are aggregated annually.
Monitoring frequency	Daily (for each shift) and aggregated monthly (with annual chance).
QA/QC procedures	Yearly, the consistency of the measurements is checked by comparing the monitoring results with fuel purchase receipts (only where the fossil fuel has been bought). For those measurement that results different from data compared, is used the most conservative value.
Purpose of data	Is used to calculate project emissions from fossil fuel usage.
Additional comment	

Data / Parameter	**$EC_{PJ,y}$**

Unit	MWh
Description	On-site electricity consumption attributable to the project activity during the year y
Source of data	On-site measurements. (note: ex-ante value based on installed capacity, because electricity consumed by the new project equipment is generated by Incauca using the bagasse-barbojo mixture). The on-site electricity consumption will be measure with a dedicated internal meter.
Value(s) applied	115,200
Measurement methods and procedures	Use electricity meters. The quantity shall be cross-checked with electricity purchase receipts.
Monitoring frequency	Continuously, aggregated at least annually
QA/QC procedures	Power meters will be calibrated periodically according to the national standards and reference points or IEC standards and recalibrated at appropriate intervals according to manufacturer's specifications (at least once every three years). Cross-check measurement results with invoices for purchased electricity if available, because the energy consumed is produced by Incauca.
Purpose of data	Is used to determine CO2 emissions from on-site electricity consumption as a consequence of the project activity.
Additional comment	

Data / Parameter	**$EF_{grid,y}$**
Unit	tCO2/MWh
Description	CO2 emission factor for electricity used from the grid
Source of data	ACM0002 used to calculate the grid emission factor. (note: Electricity consumed by the new project equipment is generated by Incauca using the bagasse-barbojo mixture). As electricity consumption (ECPJ,y) is less than 15 GWh/yr, the average grid emission factor (including all grid-connected power plants) is going to be used. The Source of the data is UPME www.upme.gov.co.
Value(s) applied	0.661
Measurement methods and procedures	
Monitoring frequency	Once at the start of the project activity, consistent with guidance in ACM0002.
QA/QC procedures	Apply procedures in ACM0002.
Purpose of data	Is used to calculate the emissions from use of electricity.
Additional comment	All data and parameters to determine the grid electricity emission factor, as required by ACM0002, shall be included in the monitoring plan.

Data / Parameter	**FCtr,i,y**
Unit	Mass unit5. Tons.
Description	Quantity of fossil fuel type *i* combusted at the project site for other purposes than heat generation as a result of project activity during the year *y. Basically for barbojo collection processes.*
Source of data	On-site measurements and purchase receipts
Value(s) applied	75.21
Measurement methods and procedures	Use weight or volume meters. The quantity will be cross-checked with the quantity of barbojo collected (based on the highest amount of fuel needed to

	collect 1 Ton of barbojo mechanically and considering that all barbojo was collected by this way as the most conservative approach); and any fuel purchase receipts (if available).
Monitoring frequency	Continuously, aggregated at least annually.
QA/QC procedures	Cross-check the measurements with an annual energy balance that is based on purchased quantities and stock changes.
Purpose of data	Is used to calculate project emissions from fossil fuel usage.
Additional comment	The only fossil fuels combusted is coal, in a mix of 50% bituminous and 50% sub bituminous.

Data / Parameter	**TL_y**
Unit	Tons
Description	Average truck load of the trucks used.
Source of data	On-site determinations of a media value.
Value(s) applied	24
Measurement methods and procedures	Determined by averaging the weights of each truck carrying biomass to the project plant.
Monitoring frequency	Aggregated annually, based on any truck replacement.
QA/QC procedures	Cross cheeked against the tons of wet biomass collected.
Purpose of data	Is used to determine CO2 emissions from transportation of barbojo to the project site.
Additional comment	Project participants have to monitor either the number of truck trips Ny or this parameter.

Data / Parameter	**AVD_y**
Unit	Km
Description	Average return trip distance (from and to) between the biomass fuel supply sites and the site of the project plant during the year *y*.
Source of data	Records by project participants on the origin of the biomass.
Value(s) applied	18
Measurement methods and procedures	Maximum radius from Incauca´s mill to the furthermost recollection place over a year operation.
Monitoring frequency	Annually cheeked.
QA/QC procedures	Check consistency of distance records provided by the truckers by comparing recorded distances with other information from other sources (e.g. maps).
Purpose of data	Is used to determine CO2 emissions from transportation of barbojo to the project site.
Additional comment	

Data / Parameter	**NCV_i**
Unit	TJ/103 tonnes
Description	Net calorific value of fossil fuel, coal, type i.
Source of data	Measurements at Incauca´s own laboratory.
Value(s) applied	25.59
Measurement methods and procedures	Measurements according to international standards. Based on ISO 1928-1976 (E) “Solid mineral fuels-determination of the net gross calorific value by the calorimeter bomb method and calculation of the calorific value”.
Monitoring frequency	At least every six months, taking at least three samples for each measurement.
QA/QC procedures	Check consistency of measurements with IPCC determinations.

Purpose of data	Is used to determine project emissions.
Additional comment	IPCC values are considered as reference value.

Data / Parameter	**NCV_i**
Unit	TJ/103 tonnes
Description	Net calorific value of fossil fuel, diesel, type i.
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (Default values - lower limits of the 95% confidence intervals).
Value(s) applied	41.4
Measurement methods and procedures	
Monitoring frequency	At least annually.
QA/QC procedures	Check consistency of measurements with IPCC determinations.
Purpose of data	Is used to determine project emissions.
Additional comment	

Data / Parameter	**NCV_k**
Unit	TJ/103 tonnes
Description	Net calorific value of biomass k.
Source of data	Measurements at Incauca´s own laboratory.
Value(s) applied	NCV of bagasse = 9,071 NCV of barbojo = 8,141
Measurement methods and procedures	Measurements according to international standards.
Monitoring frequency	At least every six months, taking at least three samples for each measurement.
QA/QC procedures	Check consistency of measurements with other entities
Purpose of data	Is used to calculate baseline and project emissions from agricultural biomass residues consumed at the project site.
Additional comment	

Data / Parameter	**$EF_{km,CO2,y}$**
Unit	tCO_2/km
Description	Average CO_2 emission factor per km for the trucks during the year *y*
Source of data	IPCC default values. Alternatively, choose emission factors applicable for the truck types used from the literature in a conservative manner (i.e. the higher end within a plausible range).
Value(s) applied	1.120E-03
Measurement methods and procedures	
Monitoring frequency	At least annually
QA/QC procedures	Cross-check measurement results with emission factors referred to in the literature.
Purpose of data	Is used to determine project emissions for transportation of barbojo.
Additional comment	

Data / Parameter	**$EF_{CH4,BF}$**
Unit	tCH_4/GJ
Description	CH_4 emission factor for the combustion of the biomass residues in the boilers
Source of data	On-site measurements or default values.

Value(s) applied	4.1E-05
Measurement methods and procedures	The CH_4 emission factor may be determined based on a stack gas analysis using calibrated analyzers.
Monitoring frequency	At least quarterly, taking at least three samples per measurement
QA/QC procedures	Check the consistency of the measurements by comparing the measurement results with measurements from previous years, relevant data sources (e.g. values in the literature, values used in the national GHG inventory) and default values by the IPCC. If the measurement results differ significantly from previous measurements or other relevant data sources, conduct additional measurements.
Purpose of data	Is used to determine the project emissions.
Additional comment	Monitoring of this parameter for project emissions is only required if CH_4 emissions from biomass combustion are included in the project boundary. Note that a conservative factor shall be applied, as specified in the baseline methodology.

Data / Parameter	$\mathbf{EF_{burning,CH4,k,y}}$
Unit	tCH_4/GJ
Description	CH_4 emission factor for uncontrolled burning of the biomass residue type *k* during the year *y*
Source of data	Suggested IPCC default value is adopted
Value(s) applied	0.001971 tCH_4/GJ
Measurement methods and procedures	
Monitoring frequency	Review of IPCC default values annually
QA/QC procedures	
Purpose of data	Is used to determine the baseline emissions.
Additional comment	

Data / Parameter	
Unit	
Description	Demonstration that the biomass residue type k from a specific source would continue not to be collected or utilized, e.g. by an assessment whether a market has emerged for that type of biomass residue (if yes, leakage is assumed not be ruled out) or by showing that it would still not be feasible to utilize the biomass residues for any purposes.
Source of data	Information from the site where the biomass is generated.
Value(s) applied	
Measurement methods and procedures	
Monitoring frequency	Annually
QA/QC procedures	
Purpose of data	Is used to determine leakages.
Additional comment	Monitoring of this parameter is applicable if approach L1 is used to rule out Leakage.

B.7.2. Sampling plan

No parameter has been determined by means of a sampling plan.

B.7.3. Other elements of monitoring plan

All necessary operational and management structures necessary to monitor emissions reductions and any leakage effects generated by the project activity are common practice in the operation of the Incauca Fuel Switch Project.

All data will be electronically archived at least during the whole lifetime of the project.

SECTION C. Duration and crediting period
C.1. Duration of project activity
C.1.1. Start date of project activity

01/10/2004

C.1.2. Expected operational lifetime of project activity

30y-0m

C.2. Crediting period of project activity
C.2.1. Type of crediting period

Renewable crediting period

C.2.2. Start date of crediting period

01/07/2008

C.2.3. Length of crediting period

7y-0m

SECTION D. Environmental impacts
D.1. Analysis of environmental impacts

The growing global concern on sustainable use of resources is driving a requirement for more sensitive environmental management practices. Increasingly, this is being reflected in countries' policies and legislation.

Environmental rules and licensing policies are very demanding in line with the best international practices. In Colombia, the sponsor of large scale projects, capable to cause environmental impact, is obliged to secure a series of permits from the relevant environmental agency.

- In Resolution 0605 (*CRC Resolution no. 0605, July 25, 2000*), CRC approved INCAUCA S. A.'s Environmental Management Plan. In the resolution is established an atmospheric emissions permit (Figure 6).

CORPORACIÓN AUTÓNOMA REGIONAL DEL CAUCA

RESOLUCION No 0605 de 2000
(25 JUL. 2000)

Por la cual se establece un Plan de Manejo.

EL DIRECTOR GENERAL DE LA CORPORACION AUTONOMA REGIONAL DEL CAUCA C.R.C. en el ejercicio de sus facultades estatutarias y legales en especial las conferidas en la Ley 99 de 1.993. Decreto Reglámentario No 1753 de 1.994, Resolución 655 de 1.996,. 0011 de 2000 y,

CONSIDERANDO:

LA CORPORACION AUTONOMA REGIONAL DEL CAUCA C.R.C.. le impuso a la sociedad Ingenio del Cauca S.A., los términos de referencia para la presentación de un plan de manejo ambiental mediante resolución 0625 de 4 de ocubre de 1,999. el cual fue notificado personalmente a la apoderada Miriam Arango, identificada con la cc 38.940.372 expedida en Cali. Lo anterior de conformidad con la ley 99 de 1.993, el articulo 38 del decreto 1753 de 1.994 y teniendo en cuenta que el proyecto se esta ejecutando desde antes de la expedición de la ley 99 de 1.993, no es procedente solicitarle a la sociedad Ingenio del Cauca S.A. la licencia ambiental respectiva.

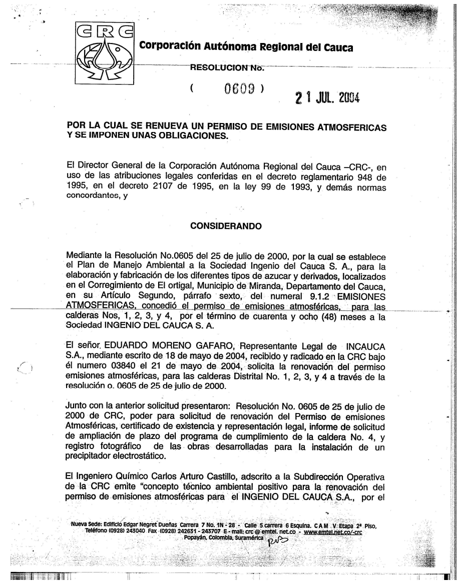
La sociedad INCAUCA S.A., Nit 891.300.237-9 remitió el Plan de Manejo Ambiental, recibido en esta entidad el 29 de diciembre de 1.999 y una vez evaluado y analizado por los profesionales adscritos al programa de licencias ambiéntales. el Subdirector de Gestión Ambiental solicita el 25 de febrero de 2.000 información complementaria, la que fue remitida con oficio 25 de abril de 2.000.

Expedido el auto de trámite que declara reunida toda la información requerida, el 29 de junio de 2.000, los profesionales adscritos al programa de licencias ambientales rindieron el concepto técnico 301-11225. Este concepto es base fundamental de la presente providencia, y hace parte integrante de la presente resolución.

Hasta la fecha no se ha presentado oposición alguna por parte de la comunidad, ni de terceras personas para establecer el Plan de Manejo, ni para la ejecución del presente proyecto, siendo procedente entrar a decidir sobre el establecimiento del Plan de Manejo Ambiental a la sociedad Ingenio del Cauca S.A. El certificado de existencia y representación legal es visible a folios 14 a 17 del expediente RH-V-003-99

Por lo anterior,

RESUELVE:



Corporación Autónoma Regional del Cauca

RESOLUCION No.
(0609) 21 JUL. 2004

POR LA CUAL SE RENUEVA UN PERMISO DE EMISIONES ATMOSFERICAS Y SE IMPONEN UNAS OBLIGACIONES.

El Director General de la Corporación Autónoma Regional del Cauca –CRC-, en uso de las atribuciones legales conferidas en el decreto reglamentario 948 de 1995, en el decreto 2107 de 1995, en la ley 99 de 1993, y demás normas concordantes, y

CONSIDERANDO

Mediante la Resolución No.0605 del 25 de julio de 2000, por la cual se establece el Plan de Manejo Ambiental a la Sociedad Ingenio del Cauca S. A., para la elaboración y fabricación de los diferentes tipos de azucar y derivados, localizados en el Corregimiento de El ortigal, Municipio de Miranda, Departamento del Cauca, en su Artículo Segundo, párrafo sexto, del numeral 9.1.2 EMISIONES ATMOSFERICAS, concedió el permiso de emisiones atmosféricas, para las calderas Nos, 1, 2, 3, y 4, por el término de cuarenta y ocho (48) meses a la Sociedad INGENIO DEL CAUCA S. A.

El señor EDUARDO MORENO GAFARO, Representante Legal de INCAUCA S.A., mediante escrito de 18 de mayo de 2004, recibido y radicado en la CRC bajo él numero 03840 el 21 de mayo de 2004, solicita la renovación del permiso emisiones atmosféricas, para las calderas Distrital No. 1, 2, 3, y 4 a través de la resolución o. 0605 de 25 de julio de 2000.

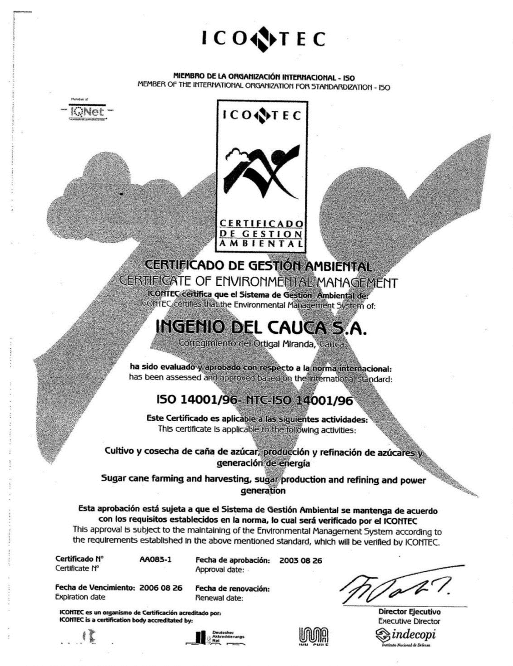
Junto con la anterior solicitud presentaron: Resolución No. 0605 de 25 de julio de 2000 de CRC, poder para solicitud de renovación del Permiso de emisiones Atmosféricas, certificado de existencia y representación legal, informe de solicitud de ampliación de plazo del programa de cumplimiento de la caldera No. 4, y registro fotográfico de las obras desarrolladas para la instalación de un precipitador electrostático.

El Ingeniero Químico Carlos Arturo Castillo, adscrito a la Subdirección Operativa de la CRC emite "concepto técnico ambiental positivo para la renovación del permiso de emisiones atmosféricas para el INGENIO DEL CAUCA S.A., por el

Nueva Sede: Edificio Edgar Negret Dueñas Carrera 7 No. 1N - 28 - Calle 5 carrera 6 Esquina. C A M V Etapa 2ª Piso, Teléfono (0928) 243040 Fax (0928) 242631 - 243707 E - mail: crc @ emtel. net.co - www.emtel.net.co/-crc Popayán, Colombia, Suramérica

Figure 6 – First pages of the resolutions CRC 0605 and CRC 0609.

It is important to notice that Incauca S.A is very much aware of its environmental responsibilities and holds an ISO 14001 Certification for its Environmental Management System for the sugarcane farming and harvesting, sugar production and refining and power generation (Figure 7).



ICONTEC

MIEMBRO DE LA ORGANIZACIÓN INTERNACIONAL - ISO
MEMBER OF THE INTERNATIONAL ORGANIZATION FOR STANDARDIZATION - ISO

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ICONTEC
CERTIFICADO DE GESTION AMBIENTAL

CERTIFICADO DE GESTIÓN AMBIENTAL
CERTIFICATE OF ENVIRONMENTAL MANAGEMENT

ICONTEC certifica que el Sistema de Gestión Ambiental de:
ICONTEC certifies that the Environmental Management System of:

INGENIO DEL CAUCA S.A.
Corregimiento del Ortigal Miranda, Cauca

ha sido evaluado y aprobado con respecto a la norma internacional:
has been assessed and approved based on the international standard:

ISO 14001/96- NTC-ISO 14001/96

Este Certificado es aplicable a las siguientes actividades:
This certificate is applicable to the following activities:

Cultivo y cosecha de caña de azúcar, producción y refinación de azúcares y generación de energía

Sugar cane farming and harvesting, sugar production and refining and power generation

Esta aprobación está sujeta a que el Sistema de Gestión Ambiental se mantenga de acuerdo con los requisitos establecidos en la norma, lo cual será verificado por el ICONTEC
This approval is subject to the maintaining of the Environmental Management System according to the requirements established in the above mentioned standard, which will be verified by ICONTEC.

Certificado N° / Certificate N°: AA083-1
Fecha de aprobación: / Approval date: 2003 08 26
Fecha de Vencimiento: / Expiration date: 2006 08 26
Fecha de renovación: / Renewal date:

Director Ejecutivo
Executive Director

ICONTEC es un organismo de Certificación acreditado por:
ICONTEC is a certification body accreditated by:

Deutscher Akkreditierungs Rat
indecopi

Figure 7 – Incauca S. A. ISO 14001 certificate

The environmental management plan for the power generation processes (10-page document available upon request) is one of the documents required for the ISO 14001 certification. For each potential impact the following aspects are discussed:

- Size and evaluate the impacts and effects of the plant and the mitigation and correction measures.
- Design the prevention, mitigation, correction and compensation of environmental impacts and management plans.
- Estimate the timeline and indicate the responsible for the environmental management actions.
- As result of the assessment done for the ISO 14001 certification, the local environmental agency responsible issued the CRC Resolution 0609 (July 21, 2004, Figure 6) renewed the atmospheric emission permission with the following demand:

Incauca S.A. shall request atmospheric emission permission for the Boiler Distral #4 before operation start. In order to do it shall provide that the emissions are in compliance with the applicable regulation.

To assure compliance Incauca S. A. installed an electrostatic precipitator at the gas output of the mentioned boiler. In the CRC Communication 32711420 Incauca S.A. requested the final approval of the permission renewal.

D.2. Environmental impact assessment

The potential environmental impacts of the project activity are negligible or null, because the project activity will use biomass that otherwise would be decay in field. Its transportation to the mill is carrying out in short distances in tracks or traditional vehicles of human traction (carretillas).

SECTION E. Local stakeholder consultation
E.1. Solicitation of comments from local stakeholders

Two years ago, Incauca´s called for a meeting to the neighboring communities to present the activity project, gather their comments to assess their perceptions and complaints about the project.

Subsequently and as a result of the project description, the community, in the context of this stakeholder consultation, developed by Ingenio del Cauca S.A, basically proposed their desire to be involved in the collection process of the "barbojo".

Due to this Incauca together with CAF went beyond the project consultation itself and decided to permit and promote the involvement of the community as one method to collect the "barbojo". With this alternative has been created the opportunity to get an additional social impact which generates sustainable employment and social welfare as a direct result of the implementation of the CDM activity.

Specifically, the idea was to operate the project with the incorporation of local un-employed personnel through the developing of a social project by the creation of collector's cooperatives. The first of them were developed at El Ortigal and Tarragona (Miranda Municipality and Cauca Department).

At this point, Fundacion Carvajal was committed to be involved into the organization of this cooperative program, and CAF approved and non-refundable technical cooperation (by FONDESHU fund) to support this initiative. This reorganization of the social work sparked a number of meetings with the community that are briefly described below.

One of the first meetings was held in 25th January 2007 in order to Fundacion Carvajal gets information about the project presented by the Corporación Andina de Fomento and Incauca S.A. At this meeting attended Ruben Uchima y el Sr Juan Carlos Muñoz as representation of Ingenio del Cauca, Gersain Castillo (Caloto) as representation of Omni life Manufacture and Esneider Antonio Velez (Ortigal) as representation of Technical industrial INSA.

Additionally others meetings were held on 16th January 2007, 8th February 2007, 16th March 2007, 17th May 2007, 31st May 2007, 7th June 2007 and 9th June 2007. Project meeting minutes copies are available on request.

These meetings permitted to the Fundacion Carvajal verify the viability of the project and to the carretilleros express their interest to participate or either the community concerns about the project. From that point, Incauca started the first approaching to the community giving them more precise information about the intention and the objective of the project.

E.2. Summary of comments received

In general, the project receives favorable comments; basically this could be intended by the interest of the same stakeholders to be involved on it. The project has developed a strong social component because the collection of the harvest leaves is going to be carried out by an organized community, which belongs to zone influence of the mill. The community expressed favorable comments to the project, and due to their involvement in the project many of their proposals and ideas has been incorporated directly on it, focused on the development of the carretilleros cooperatives as it is described in **A.2.II Project Description.**

These meetings were held among Ingenio, Fundación Carvajal, CAF and the carretilleros and some comments were done on how the project is going to improve their incomes and their life quality. Especially the main concerns were related to:

- The price of the tonne of the harvest leaves collected, $(pesos) 18.000 per tonne, which is far from what they are currently earning for collecting sugar cane.
- Whether the activity of collecting "barbojo" excludes to collect the sugar cane.
- They showed interest in getting involved in the project as long as it was considered as an activity to guarantee their work.
- Social security refers to social welfare services.
- Awareness by the possibility to repeat the problem happened in a similar initiative at Ingenio Mayagüez.

E.3. Report on consideration of comments received

As a result of implementing the project, the majority of the community concerns would be solved.

The project will facilitate the creation of collectors' cooperatives in Tarragona and El Ortigal. In this way, the project will permit a sustainable employment within the involved communities improving social wellbeing as a result of it implementation.

In order to guarantee the development of such cooperative, all the activities in the project will be connected to the cogeneration project carried out by INCAUCA S.A. This project is currently elaborating its CDM component and its incomes will support a reliable price for the ton of barbojo collected by the stakeholders. This is the reason why the creation and strengthening of the Cooperative is a fundamental element to collaborate in a sustainable, accurate and integral manner to the development of the communities involved

in the project. The aforementioned will guarantee an important and lasting improvement in the quality of life of part of the communities.

Furthermore, the project also considers compensating carretilleros people when they attend to trainings, guarantying their participation. These workshops will contribute to create a minimum and operative infrastructure to begin the cooperative enterprise to recollect harvest leaves, to run administratively the initiative during at least the last of the CDM monitoring period. Besides, these workshops will also help community to acquire knowledge on administrative and social management.

SECTION F. Approval and authorization

The letter of approval issued by the local Designated Authority is available for validation.

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Appendix 1: Contact information of project participants

Organization name	Ingenio del Cauca S.A. (Incauca S. A.)
Street/P.O. Box	Carrera 9 No 28-103
Building	
City	Cali
State/Region	Valle del Cauca
Postcode	
Country	Colombia
Telephone	
Fax	
E-mail	
Website	
Contact person	
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Salutation	Dr.
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Middle name	
First name	Pedro Nel
Department	
Mobile	
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Organization name	Corporación Andina de Fomento CAF
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Appendix 2: Affirmation regarding public funding

No public funding, including official development assistance, was or will be used in the Incauca Fuel Switch Project.

Appendix 3: Applicability of selected methodology

No comments.

Appendix 4: Further background information on ex ante calculation of emission reductions

All data used in the calculations are presented in the spreadsheet calculation accompanying the PDD.

Appendix 5: Further background information on monitoring plan

As of the procedures set by the "Approved baseline and monitoring methodology AM0036 - Fuel switch from fossil fuels to biomass residues in boilers for heat generation."

Appendix 6: Summary of post registration changes

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History of the document

Version	Date	Nature of revision
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.
04.0	EB 66 13 March 2012	Revision required to ensure consistency with the “Guidelines for completing the project design document form for CDM project activities” (EB 66, Annex 8).
03	EB 25, Annex 15 26 July 2006	
02	EB 14, Annex 06b 14 June 2004	
01	EB 05, Paragraph 12 03 August 2002	Initial adoption.
Decision Class: Regulatory **Document Type:** Form **Business Function:** Registration		