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

CONTENTS

A. General description of project activity

B. Application of a baseline and monitoring methodology

C. Duration of the project activity / crediting period

D. Environmental impacts

E. Stakeholders' comments

Annexes

Annex 1: Contact information on participants in the project activity

Annex 2: Information regarding public funding

Annex 3: Baseline information

Annex 4: Monitoring plan

Annex 5: Stakeholder consultation

SECTION A. General description of project activity

A.1 Title of the project activity:

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Title: CEMEX Colombia: Biomass project at Caracolito cement plant.
Version 01
Date: 16/07/2007

A.2. Description of the project activity:

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CEMEX Colombia operates the Caracolito cement plant near Ibagué, Colombia, where it produces clinker and cement. For the production of clinker two kilns are available.

Driven by a corporate initiative to develop CDM projects CEMEX Colombia started to analyze the feasibility of a partial substitution of fossil fuels with alternative fuels (Rice Husk, Coffee Husk, Palm residues …) in cement manufacturing at Caracolito cement plant.

The most energy- and CO2-intensive part of cement production is the burning of clinker. In this pyro-process a substantial quantity of heat is required to achieve the necessary chemical reactions in the raw meal. In Caracolito´s cement plant the predominant fuel used in the clinker kilns is coal. The aim of the project activity is to substitute as much coal as possible for biomass residues. This will result in significant reductions of anthropogenic CO2 emissions as all the fuels planned in the project are biomass residues.

<u>Environmental and social benefits other than GHG emission reductions</u>

In addition to lower GHG emissions, other environmental and social benefits would include:

- Decrease in the use of fossil fuels:
  - Reduction of the dependence on fossil fuels;
  - Conservation of resources;
  - Upstream environmental impacts related to coal mining, processing etc. are reduced.
- Positive impacts on the local economy, e.g.:
  - Additional income for local biomass suppliers;
  - Creation of new jobs in the whole biomass supply chain (transport and handling).
- Improved waste management. Biomass residues that are planned to be used in the project are normally burnt in the open field; the project implementation would dispose these wastes in a sustainable manner in cement plants and recover their energy content; in addition, it will likely encourage indirectly the development of waste management infrastructure.
- The project will be an illustrative example of sustainable development that can help develop more environmental conscience in both the plant's workforce and the local community

A.3. Project participants:

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Name of Party involved (*) ((host) indicates a host Party)	**Private and/or public entity(ies) project participants (*) (as applicable)**	**Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)**
Govt. of Colombia	CEMEX Colombia, S.A.	No

Table 1. Project participants

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

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A.4.1.1. Host Party(ies):

>>

Colombia

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

>>

Department of Tolima.

A.4.1.3. City/Town/Community etc:

>>

Ibagué.

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

>>

The project will take place in Caracolito cement plant, which is located at 28.5 km from Ibagué, a municipality in the Department of Tolima. The plant is at km 3.5 on the Buenos Aires – Payandé road. The location of the city is shown on the following map of Colombia.

Figure 1: Project activity location.

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

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The project is a cement sector project activity and may principally be categorized in the scope 4: Manufacturing Industries.

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

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In order to develop the proposed project activity a complete system for receiving, storing, and feeding alternative fuels needs to be built.

A storage shed with a surface of 1’250 m^2 will reduce losses, protect the fuel from humidity and provide a buffer of three days of full consumption in order to decouple biomass deliveries and consumption.

The feeding system of alternative fuel consists of:

- A freight elevator for the alternative fuel handling.
- A band-conveyer that will be fed through the freight elevator.
- A crusher.
- An elevator of containers that will feed a silo
- A silo with a capacity of 60 ton of capacity as a short-term buffer to make up for operational problems.
- Two weigh feeders
- Two rotatory valves

The flow of the proposed system would be the following one:

1. The freight elevator feeds to a conveyor.
2. The conveyor will transport the material to crushing equipment.
3. The crusher will send the material to an elevator of containers.
4. The elevator of buckets will feed the silo.
5. Of the silo the material will be sent to two weigh feeders and from there to two rotatory valves. These feed an expulsion pipe that will inject the fuel to the kilns 1 and 2.

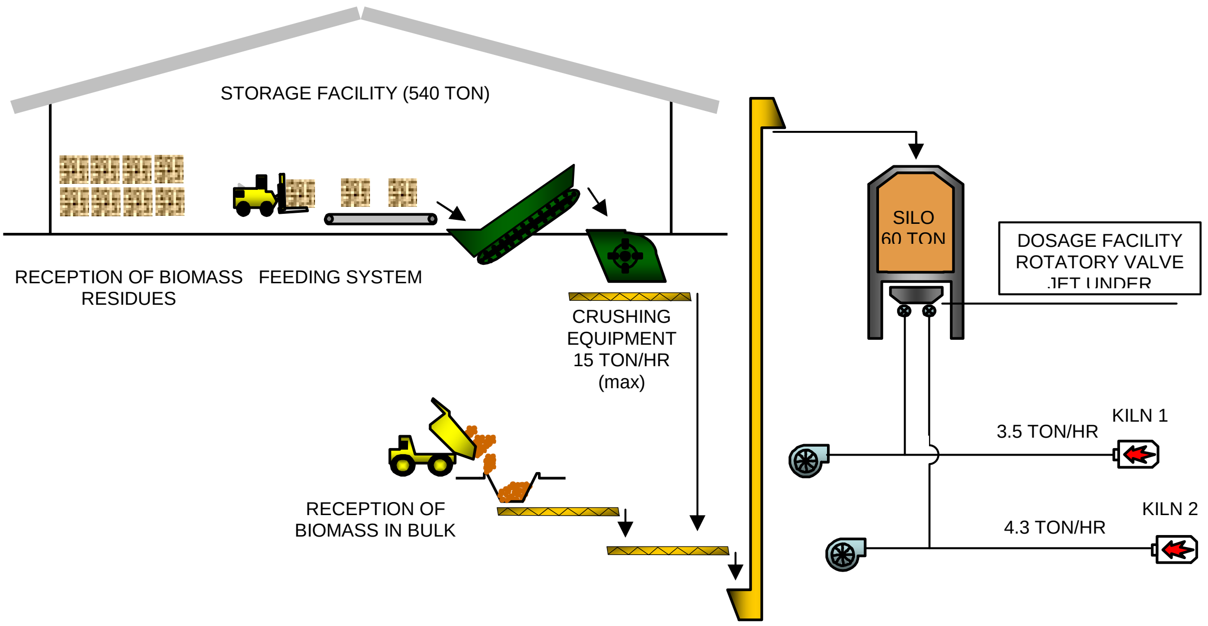

Figure 2: Biomass feeding system.

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

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A fixed crediting period formula starting in January 1, 2008, has been selected, with an overall CO_2 emission reduction expected of tCO_2 for the cement plant.

Year	Annual estimation of emission reductions in tonnes of CO2 e
2008	95.232
2009	101.541
2010	101.541
2011	101.541
2012	101.541
2013	101.541
2014	101.541
2015	101.541
2016	101.541
2017	101.541
Total estimated reductions (tonnes of CO2 e)	100.910
Total number of crediting years	10 Years
Annual average over the crediting period of estimated reductions (tonnes of CO2 e)	1.009.098

Table 2. Emission reductions

A.4.5. Public funding of the project activity:

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No public funding is used for this project activity.

SECTION B. Application of a baseline and monitoring methodology

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

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For the project activity, the approved baseline methodology used is ACM0003 Version 04, consolidated baseline methodology for *"emissions reduction through partial substitution of fossil fuels with alternative fuels in cement manufacture"*.

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

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The Caracolito project activity fulfils all the applicability conditions of the consolidated baseline methodology for *"emissions reduction through partial substitution of fossil fuels with alternative fuels in cement manufacture*":

- Fossil fuel(s) used in cement manufacture are partially replaced by the following *alternative fuels*:

  (b) Biomass residues where they are available in surplus and would in the absence of the project activity be dumped or left to decay or burned in an uncontrolled manner without utilizing them for energy purposes;

The fossil fuel consumed in the clinker kiln is partially replaced by biomass residues (rice husk, coffee husk, and other biomass residues).

- In case of project activities using biomass residues, any preparation of the biomass, occurring before use in the project activity, does neither require significant energy quantities (e.g. etherification of waste oils), except from transportation and/or drying of the biomass, nor does it cause significant GHG emissions (such as, for example, methane emissions from anaerobic treatment or char coal production).

The alternative fuels used in the project do not require significant energy quantities for preparation.

- CO_2 emissions reduction relates to CO_2 emissions generated from fuel burning requirements only and is unrelated to the CO_2 emissions from decarbonisation of raw materials (i.e. $CaCO_3$ and $MgCO_3$ bearing minerals);

The calculation of emission reductions is based on the substitution of fossil fuels; no effect on emissions from calcination of raw materials has been identified.

- The methodology is applicable only for installed capacity (expressed in tonnes clinker/year) that exists by the time of validation of the project activity;

The project is restricted to the existing two clinker kilns with a combined capacity of 6.600 tonnes/day (2.178.000 tonnes/year).

- The amount of alternative fuels available for the project is at least 1.5 times the amount required to meet the consumption of all users consuming the same alternative fuels, i.e. the project and other alternative fuel users.

The alternative fuels are available in abundance in the project activity region. The project proponent has proposed to use three agriculture fuels included in the project activity:

a. Rice Husk: Unused Rice Husk is available in abundance (214,300 ton/year[1], more than 3.5 times the plant's planned consumption) in the region (Tolima).

[1] A complete survey has been carried out in order to determine the availability of biomass residues used in the Project activity. This survey will be available to the Designated Operational Entity.

b. Coffee Husk: Unused Coffee Husk is available in abundance (12.500 ton/year, more than 4 times the plant's planned consumption).

c. Palm residues: Unused Palm residues are available in abundance (9.720 ton/year, more than 2.5 times the plant's planned consumption) in the region.

Therefore the availability of agricultural fuels meets the applicability condition of the methodology.

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

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The following diagram shows the project boundary:

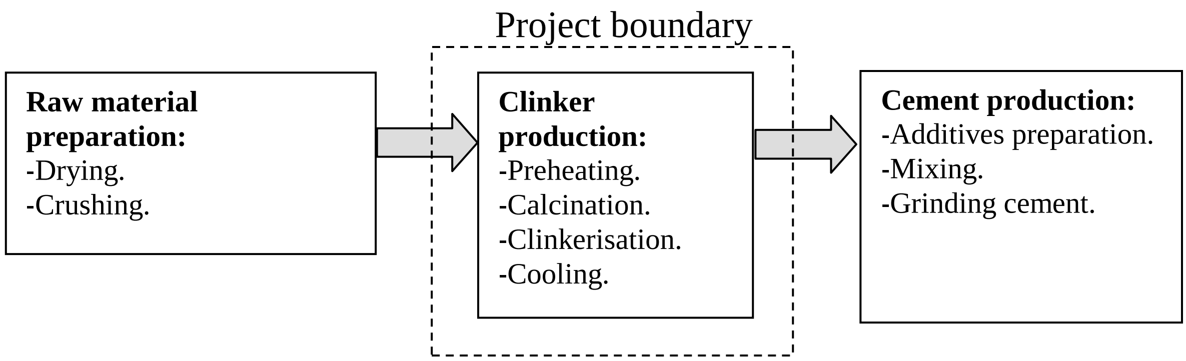

Figure 3. Project boundary.

	Source	Gas	Included?	Justification / Explanation
Baseline Emission	Clinker kiln in baseline scenario	CO_2	Yes	Clinker production is based on baseline fuel mix.
		CH_4	No	Negligible.
		N_2O	No	Negligible.
Project Activity Emissions	Clinker kiln in project activity plant	CO_2	Yes	Clinker production is based on project fuel mix.
		CH_4	No	Negligible.
		N_2O	No	Negligible.
	On-site transportation and drying of alternative fuels	CO_2	No	Negligible.
		CH_4	No	Negligible.
		N_2O	No	Negligible.
Leakage	Burning leakage methane emissions	CO_2	No	NA
		CH_4	Yes	Methane emissions due to biomass residues that would be burned in the absence of the project
		N_2O	No	NA
	Decomposition leakage methane emissions	CO_2	No	NA
		CH_4	No	NA
		N_2O	No	NA
	Off-site transport and drying leakage emissions	CO_2	Yes	Off-site transportation fuels are mainly fossil fuels.
		CH_4	No	Due to incomplete combustion.
		N_2O	No	Due to the combustion process.

Table 3. Sources and gases included in the project boundary

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

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Project activity

The project activity is emission reduction in cement production through partial substitution of fossil fuels with alternative fuels.

Approach

The baseline approach is based on paragraph 48 of the CDM modalities and procedures “Emissions from a technology that represents an economically attractive course of action, taking into account barriers to investments.”

Baseline scenario selection

Define alternative scenario for the fuel mix

Baseline scenario 1: Continuation of current practice scenario

The Caracolito cement plant has been using mainly coal, a small percentage of fuel oil (mainly for kiln startup) and an insignificant quantity of waste oil, reflecting the current fuel feeding and clinker manufacturing system in the plant. The Caracolito cement plant fuel mix before the project activity is as follows:

Coal	99,54%
Diesel	0,45%
Waste oil	0,01%

Table 4. Fuel mix in Caracolito cement plant. Year 2006.

Scenario 1 is the same fuel mix as shown in Table 3.

Baseline scenario 2: Scenario in which traditional fuels are partially substituted with alternative fuels (i.e. the proposed CDM project activity).

In the proposed CDM project activity it is planned to use up to 16.5% of biomass fuels.

The details of the estimated fuel mix during the crediting period is given below:

Year	Coal (%)	Diesel (%)	Rice Husk (%)	Coffee Husk (%)	Palm residues (%)
2008	84,1%	0,4%	14,5%	1,0%	0,0%
2009	83,1%	0,4%	14,5%	1,0%	1,0%
2010	83,1%	0,4%	14,5%	1,0%	1,0%
2011	83,1%	0,4%	14,5%	1,0%	1,0%
2012	83,1%	0,4%	14,5%	1,0%	1,0%
2013	83,1%	0,4%	14,5%	1,0%	1,0%
2014	83,1%	0,4%	14,5%	1,0%	1,0%
2015	83,1%	0,4%	14,5%	1,0%	1,0%
2016	83,1%	0,4%	14,5%	1,0%	1,0%
2017	83,1%	0,4%	14,5%	1,0%	1,0%

Table 5: Fuel mix during the crediting period (2008 – 2017).

Option 2: Select baseline scenario through barriers analysis

For sake of simplicity the barrier analysis is used in this step. As is shown in the following section B.5, the financial analysis would yield the similar result.
For a detailed discussion of the barriers mentioned please see B.5

Alternative scenario	Investment barriers	Technological barriers	Barrier due to prevailing practice	Other barriers
Scenario 1	No initial capital investment required.	No technological barriers.	This is the prevailing practice.	No

Scenario 2	Significant investment is required to develop the project activity.	E.g. • Additional procedures to maintain clinker quality. • Potential impact on kiln capacity. • Production losses due to increased maintenance times and kiln shut-down during infrastructure construction.	Operators have to adapt to the new process. They are not familiar with alternative fuel feeding system. No similar practices in place in Colombia.	Necessary control of fuel mix requires efforts to develop a dependable supply network for alternative fuels.

Table 6: Barrier analysis

Based on above barrier analysis the scenario 1 (continuation of current practice) is the most likely scenario in the absence of the incentives generated by the CDM.

The parameters and data source for the baseline scenario estimation are given in the table below:

Parameter	***Data Source***
Fossil fuel consumption in 2006	Caracolito cement plant
Fossil fuel consumption monitored during the crediting period	Caracolito cement plant

Table 7: Parameters required for baseline scenario

The baseline emission factor (tCO_2/TJ) is determined as the lowest emission factor between:

- The weighted average annual CO2 emission factor for the fossil fuel(s) consumed and monitored ex ante during the year before the validation (2006).
- The weighted average annual CO2 emission factor for the fossil fuel(s) consumed and monitored during the crediting period (e.g. the period during which the emission reductions to be certified have been achieved).

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

Analysis of the additionality of the project

To demonstrate the additionality of the project, the last version of the Tool for demonstration and assessment of additionality approved has been used, following all steps defined. These steps will demonstrate that the project activity is not the baseline scenario.

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

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

All realistic scenarios have been developed in baseline scenario selection. The alternatives are:

1. Scenario 1: Continuation of current practice scenario
2. Scenario 2: Scenario in which traditional fuels are partially substituted with alternative fuels (i.e. the proposed CDM project activity).

Sub-step 1b. Consistency with mandatory laws and regulations.

The regulatory framework which may be applicable to the two scenarios is the environmental regulations on air emissions. Both scenarios are meeting all the compliances of environment in this regards.

Step 2. Investment analysis

Sub-step 2a. Determine appropriate analysis method

The project activity will generate incomes other than CDM related income, so Option I (simple cost analysis) can not be used for the investment analysis. Option II (investment comparison analysis) is not applicable since scenario 1 does not involve any investment. Therefore the benchmark analysis (Option III) will be used for the project activity.

Sub-step 2b. Option III. Apply benchmark analysis

For the benchmark analysis the opportunity cost of capital for CEMEX Colombia is considered as benchmark i.e. 10% (WACC: weighted average capital cost). The financial analysis – internal rate of return (IRR) is conducted for the alternative fuel project activity.

Sub-step 2c. Calculation and comparison of financial indicators:

The following table summarizes the main parameters and results of the IRR calculation.

Parameters	**Value**
Investment	1,9 MUSD
Coal	42,26 USD/ton
Diesel	717,86 USD/ton
Rice husk	20,40 USD/ton
Coffee husk	26,46 USD/ton
Palm residues	28,37 USD/ton
IRR without CERs	-4,28%
IRR with CERs (15 USD/tCO2)	54,61%

Table 8: IRR analysis for the proposed CDM project activity

The Weighted average cost of capital (WACC) (financial benchmark) for CEMEX Colombia is 10% which is calculated based on Return on Debt and Return on Equity. This implies that any project should yield returns more than 10%, to consider it for implementation.

The IRR calculations shows that the IRR of the project is below the financial benchmark i.e. WACC (10%) that can be achieved without CDM revenues. It improves IRR to 54,61% with CDM revenues thanks to CERs income, which is more than WACC.

Sub-step 2d. Sensitivity Analysis

Sensitivity analysis is conducted based on variations in the price of the major alternative fuel, rice husk. The fuel prices in the IRR calculations are taken as base (100%) and the variation in the IRR with increasing and decreasing fuel prices are calculated and explained in the following table:

Table 9: Sensitivity Analysis for change in Rice Husks prices

Price fluctuation % of Base price	Price of fuel (USD/ton)	IRR without CDM revenues	IRR with CDM revenues
85%	17,3	6,21%	60,62%
90%	18,4	3,04%	58,62%
95%	19,4	-0,41%	56,61%
100%	20,4	-4,28%	54,61%
105%	21,4	-8,78%	52,59%
110%	22,4	-11,96%	50,57%

A rice husk price of below 85% of the base price is considered extremely unrealistic because of the costs for transportation and handling that can hardly be reduced.

Therefore in spite of sensitivity analysis on the basis of realistic deviations in assumptions, the IRR of project activity without CDM revenue remains less attractive than financial benchmark.

<u>Step 3. Barrier analysis</u>

The project proponent is required to determine whether the project activity faces barriers that:

(a) Prevent the implementation of this type of project activity; and
(b) Do not prevent the implementation of at least one of the alternatives through the following sub-steps

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

Technological Barrier:

The implementation of the project will impact the plant in several ways; not only does it require new equipment and facilities to receive, store, handle and feed the alternative fuels, but it also has a significant impact on the operation and maintenance of the kilns.

The main technological barriers identified are:

a. Unstable energy flow rates

Two effects make energy flow much more unstable and difficult to control compared to conventional fuels:

i. The mechanical and handling properties of alternative fuels make it much more difficult to control the volumetric or mass flow of these fuels. The flow rate of pulverized fuels (coal) and liquids with low and moreover stable viscosity (fuel oil, waste oil) can be easily controlled with high precision. Alternative fuels, however, vary significantly in density and particle size; moreover, biomass particles are prone to sticking together, implying an increased risk of blockages in the alternative fuel system. The typically much lower density of biomass fuels adds to these problems.
ii. The heterogeneity of the heating value adds to the problem; the heating value of biomass is largely influenced by its humidity, which in turn depends on e.g., the weather, atmospheric humidity, transport conditions or time at the storage site. Even if it were possible to perfectly control the volumetric or mass flow of the alternative fuels the variations in energy flow would still be noticeable.

The effects of instable energy flows are numerous. They include inefficient energy use (and therefore higher fuel cost), lower clinker quality (the clinker might even be completely worthless in case of serious over- or underburn), process instabilities, higher maintenance costs (refractory lifetime) and even lower kiln lifetime due to the formation of hot spots and/or thermal tensions.

The instability in the energy flow rate can be mitigated by appropriate selection of fuel types and suppliers, development of appropriate blending strategies and processes, advanced, sophisticated feeding systems, frequent maintenance of the feeding system and better process control in the kiln system. However, operations have to accept that even with all these measures in place there is still a substantial risk when going to significant shares of biomass fuels.

b. Oxygen demand

Due to the chemical composition and the moisture content the oxygen demand of alternative fuels is higher than that of conventional fuels. Since the flow rate of air is one of the main limiting factors in a clinker kiln this will typically result in a reduced kiln capacity (if the total air flow is constant and the air demand per unit of product is increased, the output has to be reduced).

c. Impact on kiln chemistry

The ashes of biomass fuels proposed contain elements such as Ca, Si, Al, Fe that are major ingredients of clinker; in order to ensure stable clinker quality the shares of these materials have to be carefully maintained within narrow bands, and at the envisaged substitution rates adjustments to the raw meal (the mix of ground minerals that is fed to the kiln as feedstock) are necessary. The main concern is silica which makes up around 95% of the ashes of rice husk. In fact, the maximum amount of silica coming with the rice husk that the operations can compensate for limits the use of rice husk to a certain substitution rate.

Such adjustments are relatively easy to accomplish if the composition and flow rate of alternative fuels is stable over time. After a short trial period the operating parameters will have been adjusted to the new conditions and operation will run smoothly. However, a cement plant cannot react quickly to significant changes in the amount and composition of ashes fed to the kiln is the following: Cement plants do not consume the raw meal online, but several days of full load of the raw meal are blended and stored in a raw meal bunker. This buffer is necessary to decouple the kiln operation (which has to run steadily) from raw meal preparation (where problems at the mining site or unforeseen outages in crushers and mills frequently cause long production interruptions).

The amount and (to a lesser extent) chemical composition of ashes that are entered into the kiln with the alternative fuels that will be used in this project, however, might change at a much shorter time scale (typically less than a day) without additional measures. These measures include a sufficient buffer (storage) on the site of the plant and the development of a well-functioning supply network. However, even with a well functioning strategy seasonal variations cannot be completely avoided, so regular adjustments (that are always a critical phase) are necessary.

Training will be a key factor for the successful introduction of alternative fuels. Kiln operators and management have to understand what will be the changes that these alternative fuels will bring in the operation, maintenance and quality assurance of the process. They have to develop new ways of operation in order to avoid problems.

Investment Barrier:

The project activity will have a high cost associated with the equipment required to use of alternative fuel in cement manufacturing. CEMEX Colombia S.A. will invest in the infrastructure of project activity implementation in order to ensure proper and effective utilization of alternative fuels. This investment needs to be approved by the corporate planning department of CEMEX; approval is conditional on the project activity being registered as CDM Project by the UNFCCC because otherwise the project is not profitable.

Prevailing practice Barrier:

The ICPC[2] has provided evidence that there is no experience in the use of biomass in cement plants in Colombia. Therefore the project activity is the “first of its kind” in the host country.

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

None of the barriers would prevent the implementation of scenario 1 (continuation of current practice).

[2] ICPC: Instituto Colombiano de Productores de Cemento.

<u>Step 4. Common practice analysis</u>

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

There are no other activities similar to the project activity in Colombia as evidenced by the ICPC.

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

NA.

B.6. Emission reductions:

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B.6.1. Explanation of methodological choices:

The following equations will be applied for the emission reductions:

1. Project emissions:

Step 1. Calculate project heat input from alternative fuels

Heat input from alternative fuels with significant moisture content is calculated first to allow for the calculation of a project-specific moisture "penalty" for alternative fuel heat input requirements.

$$HI_{AF} = \sum Q_{AF} \times HV_{AF} \quad \textbf{(1)}$$

where:

HI_{AF} = heat input from alternative fuels (TJ/yr)
Q_{AF} = quantity of each alternative fuel (tonnes/yr)
HV_{AF} = lower heating value of the alternative fuel(s) used (TJ/tonne fuel).

Step 2. Estimate project specific moisture "penalty"

This project specific penalty should be determined as follows:

$$\mathrm{MP_y} = \mathrm{C_{Pr,y}} \mathrm{x} (\mathrm{HC_{AF}} - \mathrm{HC_{FF}}) \quad \textbf{(1)}$$

where:

MP_y moisture penalty (TJ/yr) for year y
$C_{Pr,y}$ is the clinker production for year y
$HC_{AF,y}$ is the specific fuel consumption on project case (TJ/tClinker) in year y
HC_{FF} is the specific fuel consumption in the baseline when only fossil fuel is used, in TJ/tClinker.

$$HC_{AF} = \frac{\left(\sum Q_{FF,Pr} \times HV_{FF}\right) + HI_{AF}}{\left(C_{Pr}\right)} \quad \textbf{(2)}$$

where:

$Q_{FF,pr}$ is the quantity of fossil fuel used in the project case;
HV_{FF} is the lower heating value of the fossil fuel used (TJ/tonne);
HI_{AF} is heat input from alternative fuels (TJ/yr) in project case;
C_{Pr} is the production of clinker in the project case; and

$$HC_{FF} = \frac{\left(\sum Q_{FF,Ba} \times HV_{FF}\right)}{C_{Bl}} \quad \textbf{(3)}$$

where:

$Q_{FF,Ba}$ is the quantity of fossil fuel used in the baseline case;
HV_{FF} is the lower heating value of the fossil fuel used (TJ/tonne) used in the baseline (it would be the same as project case if the fossil fuel used in the project case is same as that in the baseline)
C_{Bl} is clinker production in the base case corresponding to the $Q_{FF,Ba}$

Step 3 Calculate GHG emissions from the use of alternative fuels in kilns:

$$AF_{GHG} = \Sigma(Q_{AF} * HV_{AF} * EF_{AF}) \quad \textbf{(4)}$$

where:

AF_{GHG}	=	GHG emissions from alternative fuels (tCO_{2e}/yr)
Q_{AF}	=	monitored alternative fuels input in clinker production (tonnes/yr).
HV_{AF}	=	heating value(s) of the alternative fuel(s) used (TJ/tonne fuel).
EF_{AF}	=	emission factor(s) of alternative fuel(s) used (tCO_{2e}/TJ).

2. Baseline emissions:

Step 4 Calculate the baseline GHG emissions from the fossil fuel(s) displaced by the alternative fuel(s)

$$FF_{GHG} = [(Q_{AF} * HV_{AF}) - MP_{total}] * EF_{FF} \quad \textbf{(5)}$$

where:

FF_{GHG}	=	GHG emissions from fossil fuels displaced by the alternatives ($tCO_{2/yr}$)
$Q_{AF} * HV_{AF}$	=	total actual heat provided by all alternative fuels (TJ/yr)
MP_{total}	=	total moisture penalty (TJ/yr)

EF_{FF} = emissions factor(s) for fossil fuel(s) displaced (tCO_2/TJ).

EF_{FF} is the estimated baseline value and would be the lowest of the following CO_2 emission factors:

- the weighted average annual CO_2 emission factor for the fossil fuel(s) consumed and monitored ex ante during the year before the validation,
- the weighted average annual CO_2 emission factor for the fossil fuel(s) consumed and monitored during the corresponding verification period (e.g. the period during which the emission reductions to be certified have been achieved),
- the weighted average annual CO_2 emission factor for the fossil fuel(s) that would have been consumed according to the baseline scenario determined in section 1 and 2 of the “Additionality and baseline scenario selection” section above.

Step 5. Calculate GHG emissions due to on-site transportation and drying of alternative fuels

This step will not be applied due to the following reasons:

- The project proponent or biomass suppliers will not use fossil fuels for drying of alternative fuels.
- Alternative fuels will be fed to the kiln directly without significant transportation on – site.

Step 6. Calculate emission savings from reduction of on-site transport of fossil fuels

Emissions savings from reduction of on – site transport of fossil fuels will not be considered in a conservative manner.

3. Leakage emissions:

Step 1. Calculate CH_4 emissions due to biomass residues that would be burned in the absence of the project

$$BB_{CH4} = Q_{AF\text{-}B} * BCF * CH_4F * CH_4/C * GWP\_CH_4 \quad \textbf{(8)}$$

where:

BB_{CH4} = GHG emissions due to burning of biomass residue that is used as alternative fuel (tCO_{2e}/yr)
$Q_{AF\text{-}B}$ = amount of biomass residue used as alternative fuel that would have been burned in the open field in the absence of the project (t/yr)
BCF = carbon fraction of the biomass residue (tC/t biomass) estimated on basis of default values,
CH_4F = fraction of the carbon released as CH_4 in open air burning (expressed as a fraction),
CH_4/C = mass conversion factor for carbon to methane (16 tCH_4/12 tC), and
GWP_CH_4 = global warming potential of methane (21).

Step 3. Calculate emissions from off-site transport of alternative and fossil fuels

The emissions from transportation should be calculated as follows:

$$LK_{trans} = LK_{AF} - LK_{FF} \quad \textbf{(10)}$$
$$LK_{AF} = (Q_{AF}/CT_{AF}) * D_{AF} * EF_{CO2e}/1000 \quad \textbf{(11)}$$
$$LK_{FF} = (RQ_{FF}/CT_{FF}) * D_{FF} * EF_{CO2e}/1000 \quad \textbf{(12)}$$

where:

LK_{trans} = leakage from transport of alternative fuel less leakage due to reduced transport of fossil fuels (tCO_2/yr)
LK_{AF} = leakage resulting from transport of alternative fuel (tCO_2/yr)
LK_{FF} = leakage due to reduced transport of fossil fuels (tCO_2/yr)
Q_{AF} = quantity of alternative fuels (tonnes)
CT_{AF} = average truck or ship capacity (tonnes/truck or ship)
D_{AF} = average round-trip distance between the alternative fuels supply sites and the cement plant sites (km/truck or ship)
RQ_{FF} = quantity of fossil fuel (tonnes) that is reduced due to consumption of alternative fuels estimated as:
CT_{FF} = average truck or ship capacity (tonnes/truck or ship)
D_{FF} = average round-trip distance between the fossil fuels supply sites and the cement plant sites (km/truck or ship)
EF_{CO2e} = emission factor from fuel use due to transportation (kg CO_{2e}/km) estimated as:

$$EF_{CO2e} = EF_{T\ CO2} + (EF_{T\ CH4} * 21) + (EF_{T\ N2O} * 310) \quad \textbf{(13)}$$

where:

$EF_{T\ CO2}$ = emission factor of CO_2 in transport (kg CO_2/km)
$EF_{T\ CH4}$ = emission factor of CH_4 in transport (kg CH_4/km)
$EF_{T\ N2O}$ = emission factor of N_2O in transport (kg N_2O/km)

21 and 310 are the Global Warming Potential (GWP) of CH_4 and N_2O respectively

4. Emission Reductions

Total emission reductions are given by the following formula:

$$AF_{ER} = FF_{GHG} – AF_{GHG} – LK_{trans} + BB_{CH4} \quad \textbf{(15)}$$

where:

FF_{GHG} = GHG emissions from fossil fuels displaced by the alternatives ($tCO_{2/yr}$)
AF_{GHG} = GHG emissions from alternative fuels (tCO_{2e}/yr)
LK_{trans} = leakage from transport of alternative fuel less leakage due to reduced transport of fossil fuels (tCO_2/yr)

BB_{CH4} = GHG emissions due to burning of biomass residue that is used as alternative fuel (tCO_{2e}/yr)

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

(Copy this table for each data and parameter)

Data / Parameter:	**EF_{AF}**
Data unit:	tCO_2/TJ
Description:	Emission factor of alternative fuel
Source of data used:	IPCC
Value applied:	Rice Hisk: 0 Coffee Husk: 0 Palm residues: 0
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data archived: entire crediting period. IPCC default value.
Any comment:	Biomass residues are considered as CO2 – neutral.

Data / Parameter:	**EF_{FF}**
Data unit:	tCO_2/TJ
Description:	Emission factor of fossil fuel
Source of data used:	IPCC
Value applied:	Bituminous coal: 94,60. Diesel: 74,07
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data archived: entire crediting period. IPCC default value.
Any comment:	For each fossil fuel consumed: (i) in year prior to the validation (ii) during the crediting period (iii) in the baseline scenario

Data / Parameter:	**$EF_{T\ CO2}$**
Data unit:	gCO_2/km
Description:	Emission factor
Source of data used:	ACM0003 ver 04, reference notes
Value applied:	1097
Justification of the choice of data or description of	Data archived: entire crediting period. Value is as per UNFCCC guidance.

measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter:	**$EF_{T\ CH4}$**
Data unit:	gCH_4/km
Description:	Emission factor
Source of data used:	ACM0003 ver 04, reference notes
Value applied:	0,06
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data archived: entire crediting period. Value is as per UNFCCC guidance.
Any comment:	

Data / Parameter:	**$EF_{T\ N2O}$**
Data unit:	gN_2O/km
Description:	Emission factor
Source of data used:	ACM0003 ver 04, reference notes
Value applied:	0,031
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data archived: entire crediting period. Value is as per UNFCCC guidance.
Any comment:	

Data / Parameter:	**EF_{TCO2e}**
Data unit:	gCO_{2e}/km
Description:	Emission factor
Source of data used:	ACM0003 ver 04, reference notes
Value applied:	1107,87
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data archived: entire crediting period. Value is as per UNFCCC guidance.
Any comment:	

Data / Parameter:	**$Q_{AF-D/B}$**

Data unit:	Tonnes
Description:	Biomass residues which would have been burnt in the absence of the project activity.
Source of data used:	Estimated and 100% biomass residues have been considered on conservative basis.
Value applied:	See Annex 3.
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data Archived: 2 years after the end of the crediting period.
Any comment:	Conservative assumption.

Data / Parameter:	**BCF**
Data unit:	tC/ ton of biomass
Description:	Carbon fraction of the biomass residue
Source of data used:	IPCC default value
Value applied:	Rice Hisk: 0,41 Coffee Husk: 0,47 Palm residues: 0,44
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data Archived: 2 years after the end of the crediting period.
Any comment:	

Data / Parameter:	**CH_4F**
Data unit:	%
Description:	Carbon released as CH4 in open air burning
Source of data used:	IPCC default value
Value applied:	0,5%
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data Archived: 2 years after the end of the crediting period.
Any comment:	

Data / Parameter:	**Alternative fuels availability**
Data unit:	Tonnes
Description:	Alternative fuels availability
Source of data used:	Biomass availability report.

Value applied:	Not used in emission reductions calculations.
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data Archived: 2 years after the end of the crediting period.
Any comment:	This report will be updated yearly

B.6.3 Ex-ante calculation of emission reductions:

>>
Please, see Annex 3 (Baseline Information).

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

>>
Total emission reduction during the crediting period: 1.009.098 tCO_2 (See Annex 3)

Year	Estimation of project activity emissions (tonnes of CO_2 e)	Estimation of baseline emissions (tonnes of CO_2 e)	Estimation of leakage (tonnes of CO_2 e)	Estimation of overall emission reductions (tonnes of CO_2 e)
2008	0	91.802	3.431	95.232
2009	0	97.915	3.626	101.541
2010	0	97.915	3.626	101.541
2011	0	97.915	3.626	101.541
2012	0	97.915	3.626	101.541
2013	0	97.915	3.626	101.541
2014	0	97.915	3.626	101.541
2015	0	97.915	3.626	101.541
2016	0	97.915	3.626	101.541
2017	0	97.915	3.626	101.541
Total (tonnes of CO2 e)	0	973.037	36.061	1.009.098

Table 10. Ex-ante estimation emission reductions.

The registration of the project will take place before its commissioning, so there will be no emission reductions prior to its registration.

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

B.7.1 Data and parameters monitored:	
(Copy this table for each data and parameter)	
Data / Parameter:	**C_{Pr}**
Data unit:	Tonnes
Description:	Clinker production
Source of data to be used:	Plant records (GrafOper)
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1.960.200
Description of measurement methods and procedures to be applied:	Instrument used: Weighing feeders. Recorded and calculated and reported monthly. Data Archived: 2 years after the end of the crediting period.
QA/QC procedures to be applied:	Instrument should be calibrated according to manufacturer's guidelines. All data is available and recorded according to ISO 9001 management system.
Any comment:	

Data / Parameter:	**Q_{AF}**
Data unit:	Tonnes
Description:	Fuel Type
Source of data to be used:	Plant records.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	See Annex 3.
Description of measurement methods and procedures to be applied:	Instrument used: Scale. Recorded continuously and reported monthly and adjusted according stock change. Data Archived: 2 years after the end of the crediting period.
QA/QC procedures to be applied:	Instrument should be calibrated according to manufacturer's guidelines. All data is available and recorded according to ISO 9001 management system.
Any comment:	

Data / Parameter:	**HV_{AF}**
Data unit:	TJ/Tonne
Description:	Fuel heating value
Source of data to be used:	Plant records.
Value of data applied	Fuel Type | Kcal/kg | TJ/tonne

for the purpose of calculating expected emission reductions in section B.5	Rice Husk | 3.700 | 0,0155 Coffee Husk | 4.800 | 0,0201 Palm residues | 4.500 | 0,0188
Description of measurement methods and procedures to be applied:	Instrument used: Calorimeter. Recording frequency: monthly. Data Archived: 2 years after the end of the crediting period.
QA/QC procedures to be applied:	Instrument should be calibrated according to manufacturer's guidelines. All data is available and recorded according to ISO 9001 management system.
Any comment:	

Data / Parameter:	**Q_{FF}**
Data unit:	Ton
Description:	Fuel type
Source of data to be used:	Plant records.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	See Annex 3.
Description of measurement methods and procedures to be applied:	Instrument used: Scale. Recorded continuously and reported monthly and adjusted according to stock change. Data Archived: 2 years after the end of the crediting period.
QA/QC procedures to be applied:	Instrument should be calibrated according to manufacturer's guidelines. All data is available and recorded according to ISO 9001 management system.
Any comment:	

Data / Parameter:	**HV_{FF}**
Data unit:	TJ/Tonne
Description:	Heating value.
Source of data to be used:	Plant records.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Fuel Type | Kcal/kg | TJ/tonne **Bit. Coal** | 6.577 | 0,0275 **Diesel** | 10.800 | 0,0451
Description of measurement methods and procedures to be applied:	Instrument used: Calorimeter. Recording frequency: monthly. Data Archived: 2 years after the end of the crediting period.
QA/QC procedures to be applied:	Instrument should be calibrated according to manufacturer's guidelines. All data is available and recorded according to ISO 9001 management system.

Any comment:	

Data / Parameter:	**HI_{AF}**
Data unit:	TJ
Description:	Heat input from alternative fuels
Source of data to be used:	Plant records.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	See Annex 3.
Description of measurement methods and procedures to be applied:	Calculated with formula provided by the methodology applicable ACM0003. Calculated and reported monthly. Data Archived: 2 years after the end of the crediting period.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	**MP_y**
Data unit:	TJ
Description:	Moisture penalty.
Source of data to be used:	Plant records.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	See Annex 3
Description of measurement methods and procedures to be applied:	Calculated with formula provided by the methodology applicable ACM0003. Calculated and reported monthly. Data Archived: 2 years after the end of the crediting period.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	**C_{Bl}**
Data unit:	Ton
Description:	Clinker production
Source of data to be used:	Plant records.
Value of data applied for the purpose of	1.693.428

calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	Instrument used: Weighing feeders. Recording frequency: at the start of project. Data Archived: 2 years after the end of the crediting period.
QA/QC procedures to be applied:	Instrument should be calibrated according to manufacturer's guidelines. All data is available and recorded according to ISO 9001 management system.
Any comment:	

Data / Parameter:	**CT_{AF}**
Data unit:	Tonnes/truck
Description:	Average truck capacity for transport alternative fuels.
Source of data to be used:	Plant records, Biomass supplier.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	36 ton/truck
Description of measurement methods and procedures to be applied:	Calculated. Recording frequency: monthly. Data Archived: 2 years after the end of the crediting period.
QA/QC procedures to be applied:	All data is available and recorded according to ISO 9001 management system.
Any comment:	Average truck capacity for transport alternative fuels.

Data / Parameter:	**D_{AF}**
Data unit:	Km/truck
Description:	Average distance for transport alternative fuel
Source of data to be used:	Plant records, Biomass supplier.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	190 Km/truck
Description of measurement methods and procedures to be applied:	Calculated. Recording frequency: monthly. Data Archived: 2 years after the end of the crediting period.
QA/QC procedures to be applied:	All data is available and recorded according to ISO 9001 management system.
Any comment:	

Data / Parameter:	**CT_{FF}**
Data unit:	Tonnes/truck
Description:	Average truck capacity for transport fossil fuels.
Source of data to be used:	Plant records.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	50 ton/truck
Description of measurement methods and procedures to be applied:	Calculated. Recording frequency: monthly. Data Archived: 2 years after the end of the crediting period.
QA/QC procedures to be applied:	All data is available and recorded according to ISO 9001 management system.
Any comment:	

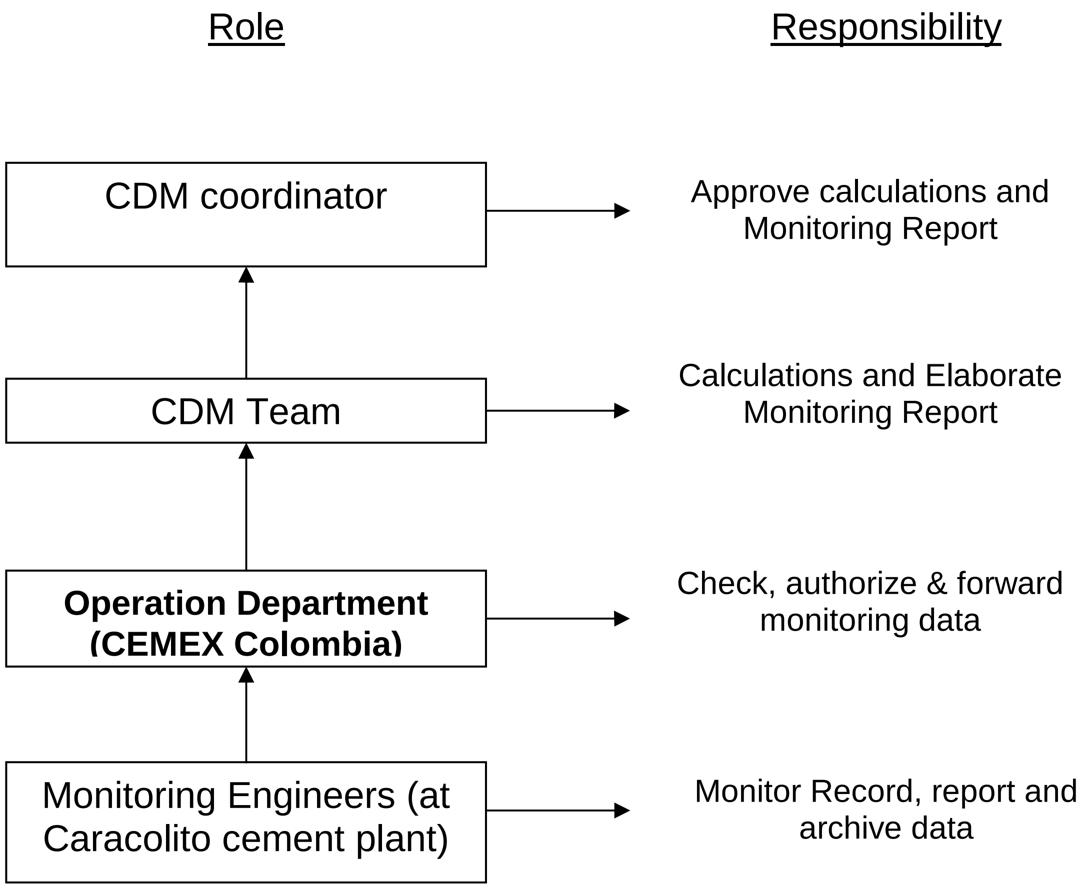
Data / Parameter:	**D_{FF}**
Data unit:	Km/truck
Description:	Average distance for transport fossil fuels.
Source of data to be used:	Plant records, Fuel supplier.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	277 Km/truck
Description of measurement methods and procedures to be applied:	Calculated. Recording frequency: monthly. Data Archived: 2 years after the end of the crediting period.
QA/QC procedures to be applied:	All data is available and recorded according to ISO 9001 management system.
Any comment:	

B.7.2 Description of the monitoring plan:

>>

The project meets the applicability criteria under the monitoring methodology, ACM0003 Version 05 **“Emissions reduction through partial substitution of fossil fuels with alternative fuels in cement manufacture”**

This figure describes the operational and management structure that will monitor emissions reductions generated by the project activity.



Emission Monitoring and Calculation Procedure	
Data Source and collection	Data are taken from plant records.
	Most data are available and recorded according to the existing data management system (GrafOper and SICA).
	Frequency of data is based on existing data management system.
	Data are monitored by monitoring engineers in Caracolito cement plant. All data are reviewed by Operation Department. The role of monitoring engineer is assigned to the person that is responsible for the proper management of all operational data at the plant.
Data compilation	All data from every plant is centralised at Bogotá.
	Data is transmitted to CDM Team
Emission calculation and Monitoring Report	Emission calculations are conducted on yearly basis from data which is collected daily, monthly or annually, depending on the nature of the data.
	All data is calculated by CDM Team, using an excel

	spreadsheet. Monitoring Report will be elaborated by CDM Team.
Emission data review and approval	Calculation and Monitoring Report is reviewed and approved by CDM coordinator.
Record keeping	All data will be recorded electronically. Monitoring engineers are responsible for record keeping.

Table 11. Monitoring procedures.

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

>>
Date of completion: July 2007

Alexander Röder
Energy & CO2 Advisor
CEMEX Global Center for Technology & Innovation
Alexander.Roeder@cemex.com

David López Alonso
CDM Project Manager
CO2 Global Solutions International S.A.
dlopez@co2-solutions.com

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

>>
Commercial operation of the new biomass facilities at Caracolito Cement plant will begin 01/01/2008.

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

>>
The project activity is expected to have a minimum operational lifetime of 20 years from starting date; this is, until the end of 2027.

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

C.2.1. Renewable crediting period

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

>>
N/A

C.2.1.2. Length of the first crediting period:

>>
N/A

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>
01/01/2008

C.2.2.2. Length:

>>
10 years

SECTION D. Environmental impacts

>>

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

>>
On 8 of July of 2005, CEMEX Colombia S.A. presented the request for the partial modification of the Permission of Emissions for Caracolito plant granted by means of Resolution 1569 of 28 of September of 1998, for the use of rice husk as alternative fuel in cement manufacturing. In response to this request, the Regional Independent Corporation of Tolima by means of Resolution 587 of the 8 of June of the 2006 partially modified the Permission of Emissions for Caracolito cement plant making the following recommendations when Caracolito cement plant start the consumption of biomass residues:

- A hermetic test should be done in the trucks that transport rice husk.

- Isokinetic studies should be done, fulfilling the following aspects:
  - Selection of the sampling site, determination of the number of points and its location in chimneys of fixed sources.
  - Determination of the speed of the emissions.
  - Analysis of the measurements to determine the percentage of CO_2, O_2 y CO.
  - Determination of humidity content of the emissions.
  - Determination of particles emissions from chimneys.
  - Determination of SO_x and NO_x emissions.

- An Emissions Report (IE-1) should be presented to the Environmental Ministry according to the *“Resolución No. 1351 de 1995”*.

- An Inventory Emissions should be carried out for the cement plant.

- A monthly report about Rice Husk transported and consumed in cement plant should be elaborated.

- A study about lands should be presented.

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

>>

Negative environmental impacts from the activity of the project have not been identified. On the contrary, the project reduces significantly the unsustainable practice of burning biomass residues in the open field.

SECTION E. Stakeholders' comments

>>

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

>>

The local stakeholders were invited throughout the following transparent media:

- Radio channels:
    - La Voz del Tolima Radio.
    - Tolima FM Stereo.
- Local newspapers:
    - Nuevo Día (See Annex 5).
    - Tolima 7 días (See Annex 5).

The local stakeholder consultation took place in one of the meeting rooms of Altamira Hotel (Ibagué). The consultation consisted in the explanation to the guests of what the project consist and a presentation was shown for explaining what activities CEMEX Colombia is currently doing and what are the plans to develop the project.

After the presentation, a discussion started in which doubts were cleared; after that, CEMEX handed out to each of the participants a questionnaire (see Annex 5) in which they were asked their opinion about the project, their preoccupations and if they agreed or not that CEMEX develops this project.

At the end of the presentation the guest signed an Assistance registry. Also photos were taken from the presentation as evidence for the stakeholder consultation (See Annex 5).

E.2. Summary of the comments received:

>>

The majority of stakeholders supported the project activity and they had no objections. The questionnaires completed by the stakeholders will be provided to the Designated Operational Entity.

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

>>
No objections were received.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

PRIMARY PROJECT SPONSOR

Organization:	CEMEX Colombia, S.A.
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

N/A

Annex 3

BASELINE INFORMATION

(for abbreviations not explained here please refer to the formulae in section B.6 Emission Reductions)

Baseline scenario: Year 2006.

Baseline Scenario (2006)		
	Ton	%
Bituminous Coal	201.422	99,54%
Diesel	549	0,45%
Used Oils	19	0,01%

Clinker production 2006	tClinker	1.693.428

Fuel data:

Basic Fuel data	Heat value	Heat value	Carbon content	Emission factor
	kcal/kg	TJ/ton	tC/TJ	tCO2/TJ
Bituminous Coal	6.577	0,0275	25,8	94,60
Diesel	10.800	0,0451	20,2	74,07
Used Oils	10.100	0,0422	20,00	73,33
Rice Husk	3.700	0,0155	0,00	0,00
Coffee husk	4.800	0,0201	0,00	0,00
Palm residues	4.500	0,0188	0,00	0,00

Fuel consumption and clinker production in project scenario:

Project scenario		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Bituminous Coal	Ton	197.902	195.548	195.548	195.548	195.548	195.548	195.548	195.548	195.548	195.548
Diesel	Ton	602	602	602	602	602	602	602	602	602	602
Used Oils	Ton	0	0	0	0	0	0	0	0	0	0
Rice Husk	Ton	60.663	60.663	60.663	60.663	60.663	60.663	60.663	60.663	60.663	60.663
Coffee husk	Ton	3.225	3.225	3.225	3.225	3.225	3.225	3.225	3.225	3.225	3.225
Palm residues	Ton	0	3.440	3.440	3.440	3.440	3.440	3.440	3.440	3.440	3.440
Clinker production H1	tClinker	920.700	920.700	920.700	920.700	920.700	920.700	920.700	920.700	920.700	920.700
Clinker production H2	tClinker	1.039.500	1.039.500	1.039.500	1.039.500	1.039.500	1.039.500	1.039.500	1.039.500	1.039.500	1.039.500
CPr Total Clinker production	tClinker	1.960.200	1.960.200	1.960.200	1.960.200	1.960.200	1.960.200	1.960.200	1.960.200	1.960.200	1.960.200

H1, H2: Kiln 1 and Kiln 2, respectively.

Heat input from project alternative fuels in project scenario:

Heat Input from alternative fuels Project		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
HIaf input in project scenario	TJ/year	1.003	1.068	1.068	1.068	1.068	1.068	1.068	1.068	1.068	1.068

Moisture penalty

		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
MPy moisture penalty											
HCpr specific fuel consumption in project scenario	TJ/tClinker	0,00330	0,00330	0,00330	0,00330	0,00330	0,00330	0,00330	0,00330	0,00330	0,00330
HCbl specific fuel consumption in baseline	TJ/tClinker	0,00328	0,00328	0,00328	0,00328	0,00328	0,00328	0,00328	0,00328	0,00328	0,00328
MPy moisture penalty	TJ/año	31	31	31	31	31	31	31	31	31	31

Alternative fuel emissions

N/A

Baseline emissions:

		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Baseline emissions											
EFff expost emission factor	tCO2e/TJ	94,50	94,50	94,50	94,50	94,50	94,50	94,50	94,50	94,50	94,50
EFff exante emission factor	tCO2e/TJ	94,51	94,51	94,51	94,51	94,51	94,51	94,51	94,51	94,51	94,51
FFghg GHG baseline emissions from fossil fuels	tCO2e	91.802	97.915	97.915	97.915	97.915	97.915	97.915	97.915	97.915	97.915

Calculation of CH4 emissions due to biomass residues that would be burned in absence of the project.

		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Biomass residues burnt in absence of the project activity											
Rice Husk burnt in the open field	ton/year	60.663	60.663	60.663	60.663	60.663	60.663	60.663	60.663	60.663	60.663
Coffee Husk burnt in the open field	ton/year	3.225	3.225	3.225	3.225	3.225	3.225	3.225	3.225	3.225	3.225
Palm husk burnt in the open field	ton/year	0	3.440	3.440	3.440	3.440	3.440	3.440	3.440	3.440	3.440
BCF carbon fraction of Rice Husk	tC/tbiomass	0,41	0,41	0,41	0,41	0,41	0,41	0,41	0,41	0,41	0,41
BCF carbon fraction of Coffee Husk	tC/tbiomass	0,47	0,47	0,47	0,47	0,47	0,47	0,47	0,47	0,47	0,47
BCF carbon fraction of Palm Husk	tC/tbiomass	0,44	0,44	0,44	0,44	0,44	0,44	0,44	0,44	0,44	0,44
CH4F	%	0,5%	0,5%	0,5%	0,5%	0,5%	0,5%	0,5%	0,5%	0,5%	0,5%
CH4/C mass conversion factor		1,33	1,33	1,33	1,33	1,33	1,33	1,33	1,33	1,33	1,33
GWP CH4 global warming potential of methane	tCO2e/tCH4	21	21	21	21	21	21	21	21	21	21
BB CH4	tCO2e/year	3.733	3.944	3.944	3.944	3.944	3.944	3.944	3.944	3.944	3.944

Calculation emissions from off-site transport of alternative and fossil fuels

		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Emissions from off-site transport											
Q_AF	ton/year	63.888	67.328	67.328	67.328	67.328	67.328	67.328	67.328	67.328	67.328
CT_AF average truck capacity AF	ton/veh.	36	36	36	36	36	36	36	36	36	36

D_AF average round-trip distance AF	km/trip	190	190	190	190	190	190	190	190	190	190
RQff quantity of fossil fuel reduced	ton/año	11.691	12.214	12.214	12.214	12.214	12.214	12.214	12.214	12.214	12.214
CT_FF average truck capacity AF	ton/veh.	50	50	50	50	50	50	50	50	50	50
D_FF average round-trip distance AF	km/trip	277	277	277	277	277	277	277	277	277	277
EFCO2 transport	kgCO2e/km	1,1079	1,1079	1,1079	1,1079	1,1079	1,1079	1,1079	1,1079	1,1079	1,1079
LK_trans	tCO2e/year	302	319	319	319	319	319	319	319	319	319

Emission reductions

Emission reductions		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
FFghg BL	tCO2e/año	91.802	97.915	97.915	97.915	97.915	97.915	97.915	97.915	97.915	97.915
AFghg	tCO2e/año	0	0	0	0	0	0	0	0	0	0
LK-trans	tCO2e/año	302	319	319	319	319	319	319	319	319	319
BB CH4 emissions	tCO2e/año	3.733	3.944	3.944	3.944	3.944	3.944	3.944	3.944	3.944	3.944
Leakege	tCO2e/año	3.431	3.626	3.626	3.626	3.626	3.626	3.626	3.626	3.626	3.626
AFER emission reductions	tCO2e/año	95.232	101.541	101.541	101.541	101.541	101.541	101.541	101.541	101.541	101.541

Annex 4

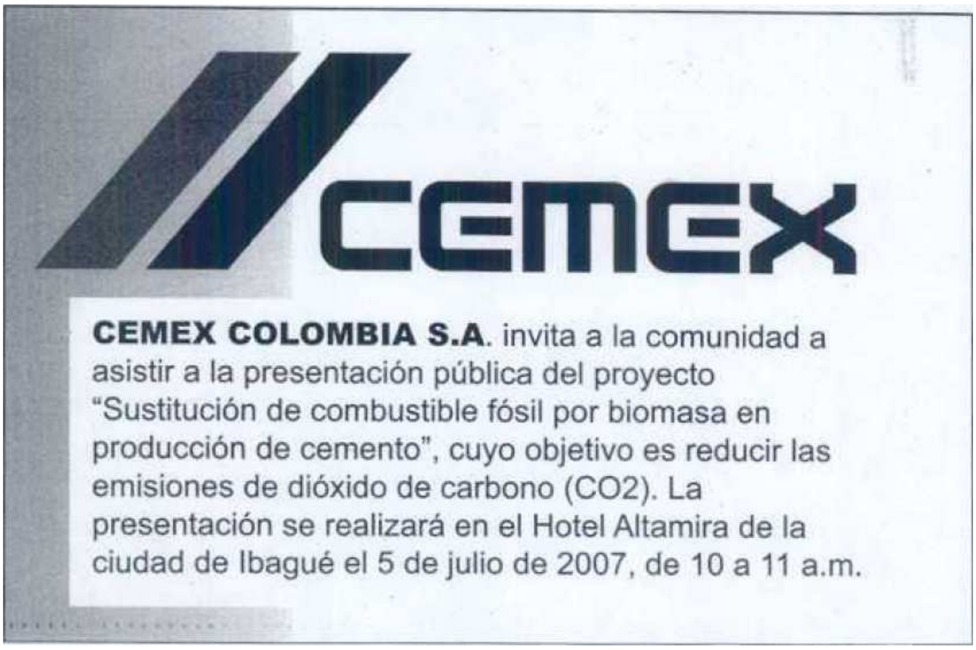
MONITORING INFORMATION

Please refer to Section B.7.

Annex 5

LOCAL STAKEHOLDER CONSULTATION INFORMATION

Announcement of stakeholder consultation in Nuevo Día and Tolima 7 Días.



Questionnaire (at local language: Spanish)[3].

Fecha:

<table>
<tr><td rowspan="7">Información del entrevistado</td><td>Nombre</td><td></td><td>Sexo</td><td></td></tr>
<tr><td>Ocupación</td><td></td><td>Edad</td><td></td></tr>
<tr><td>Educación</td><td></td><td>Nacionalidad</td><td></td></tr>
<tr><td>Dirección</td><td colspan="3"></td></tr>
<tr><td>Lugar de trabajo</td><td colspan="3"></td></tr>
<tr><td>¿Cuántos años ha vivido en este area?</td><td colspan="3">☐ Menos de 10 años ☐10-20 años ☐ 20-30 años
☐ Más de 30 años</td></tr>
<tr><td>¿A qué distancia del proyecto vive?</td><td colspan="3">☐ Menos de 500 m ☐ 500-1000 m ☐ 1000-2000 m
☐ Más de 2000 m</td></tr>
<tr><td>Opinión del entrevistado</td><td>1. ¿Está satisfecho con el ambiente local actual?</td><td colspan="3">☐ Satisfecho ☐ No satisfecho ☐ No está seguro</td></tr>
</table>

[3] The questionnaires completed by stakeholders will be provided to the Designated Operational Entity.

sobre el proyecto	2. ¿Piensa que es importante desarrollar este proyecto?	□ Muy importante □ Importante □ No es importante □ No sabe
	3. ¿Está de acuerdo con el desarrollo de este proyecto?	□ A favor □ En contra □ No sabe
	4. ¿Cómo será el impacto ambiental del proyecto?	□ Positivo □ Negativo □ No tendrá impacto
	5. ¿Qué impacto tiene el proyecto sobre la economía local?	□ Positivo □ Negativo □ No tendrá impacto
Comentarios y sugerencias	¿Tiene algún comentario sobre el proyecto?	
	¿Tiene sugerencias para el proyecto? (Por favor indique las medidas que desea que tomemos al desarrollar el proyecto)	

List of stakeholders:

Name	Last Name	City	Company / Authority / Association	E-MAIL
RAUL	SALAMANCA	ESPINAL	ENMIENDAS SALAMANCA	
CARLOS ANDRES	LUGO GONZALEZ	IBAGUE	UNIVERSIDAD DE IBAGUE	carlosandreslugo@hotmail.com
LILIANA	DELGADILLO	IBAGUE	UNIVERSIDAD DE IBAGUE	liliana.delgadillo@unibague.edu.co
NATALIA	SALAZAR	IBAGUE	UNIVERSIDAD DE IBAGUE	natalia.salazar@unibague.edu.co
AGUSTIN	VALVERDE	IBAGUE	UNIVERSIDAD DE IBAGUE	agustin.valverde@unibague.edu.co
DANIEL	GONZALEZ	IBAGUE	PAJONALES	daniel.gonza112@gmail.com
JIMY	AREINIEGAS	IBAGUE	FUNDACION SAVIA	fundacionsavia@hotmail.com
GUILLERMO	GARCES	IBAGUE	ACI LTDA	aciltda@hotmail.com
ANDRES	TURRIAGO	IBAGUE	INAGROTOL LTDA	aturri@hotmail.com
DIANA	PARRA HERRERA	IBAGUE	ANSPAC-RENACER	celdipaher@yahoo.com
INES	PELAEZ	IBAGUE	INGEOMINAS	iepelaez@ingeominas.gov.co
HERNAN	MURRILLO ROJAS	IBAGUE	INGEOMINAS	hmurrillo@ingeominas.gov.co
JOSE LUIS	GARNICA	BOGOTA	CEMEX COLOMBIA	joseluis.garrica@cemex.com
DARIO ARMANDO	LOPEZ CAPERA	BOGOTA	CEMEX COLOMBIA	darioarmando.lopez@cemex.com

JHON JAIRO	GIRALDO	IBAGUE	CEMEX COLOMBIA	jhonjairo.giraldo@cemex.com
HKAREN	BARCENAS	IBAGUE	PROCURADORIA AGRARIA	erleidacas69@yahoo.es
LILIANA	ZULUAGA	PAYANDE	COMUNIDAD PAYANDE	lilizulua@hotmail.com.co
CLAUDIA	SOLANO	IBAGUE	FUDIMED	fudimed39@gmail.com
CLARA	PARDO	IBAGUE	CONSUL COLOMBIA PUERTO RICO	clarapardorod@yahoo.com
GLORIA	SANTOS	IBAGUE	PARTICULAR	fudimed39@gmail.com
ISABEL	PEARRA	BOGOTA	BIO + A S.A.	iparra@biomassa.com.co
JAIRO	ECHAVARRIA	BOGOTA	BIO + A S.A.	jechavarria@nucleo.com.co
SERGIO RICARDO	MATALLANA	BOGOTA	INSTITUTO DEL CEMENTO	rmatallana@icpc.org.co
ORLANDO	TOCORA	IBAGUE	LAVASECO SUPERIOR	lavasecosuperior4427@yahoo.com
OSCAR RICARDO	LOZANO	GUAMO	SECRETARIA DE EDUCACION	oscarricardolozano@hotmail.com
PABLO ARMANDO	DIAZ	IBAGUE	SENA	pablo1302@hotmail.com
JOSE	TIQUE	PAYANDE	JUNTA DE ACCION COMUNAL	josetiha21@hotmail.com
PEDRO LUIS	ZAMBRANO	IBAGUE	ASOCIACION PARA EL DESARROLLO	pzambrano862@gmail.com
LEOPOLDO	GUEVARA RUBIANO	IBAGUE	FITOQUIMICA COLOMBIANA	lguevarar@yahoo.com
ANDREA	GARCIA	BOGOTA	MINISTERIO DE MEDIO AMBIENTE	resmeral@minambiente.gov.co
ROBERTO	ESMERAL	BOGOTA	MINISTERIO DE MEDIO AMBIENTE	
MAURICIO	MANTILLA	IBAGUE	CEMEX COLOMBIA	
EDGAR	HERRERA	IBAGUE	CEMEX COLOMBIA	
OSCAR	RAMIREZ	IBAGUE	RAMOCOL LTDA	oscarole@hotmail.com
ALEJANDRA MARIA	TIQUE	IBAGUE	COMUNIDAD PAYANDE	alematis-53@hotmail.com
GONZALO	BARBOSA	IBAGUE	COMUNIDAD	gobarbosa@hotmail.com
MAURICIO	SALAMANCA	IBAGUE	ENMIENDAS SALAMANCA	
NESTOR DEGARIO	VARON	IBAGUE	COOPERATIVA PRODECOM	nestorolegariovaron@gmail.com
MAURICIO	HENANDEZ	IBAGUE	UNIVERSIDAD DE IBAGUE	mauriciohernandez@unibague.edu.co
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NELSON	RESTREPO	IBAGUE	ACI LTDA	aci@gmail.com
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SOSIMO		IBAGUE	UNIVERSIDAD DE IBAGUE	scsimo.arevalo@unibague.edu.co
DIEGO	SAAVEDRA	IBAGUE	PARTICULAR	
EUSEBIO	MENDEZ	IBAGUE	CEMEX COLOMBIA	
MARCELA	LOPEZ	IBAGUE	CORCUENCAS	corcuenc@hotmail.com
TULIO	RODRIGUEZ MONTOYA	IBAGUE	UNION TEMPORAL	tuliono212@hotmail.com

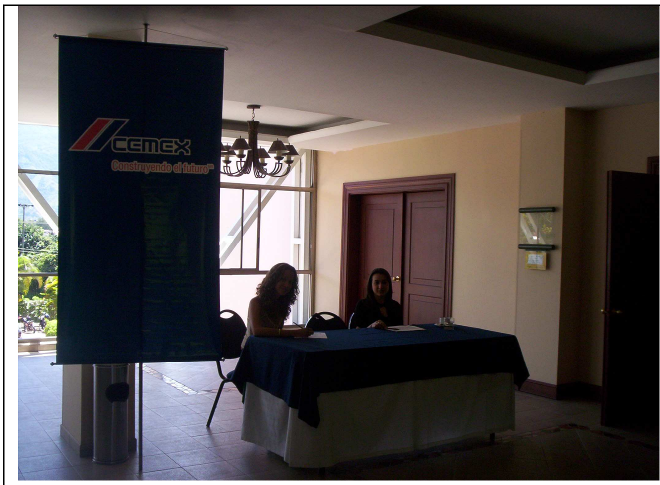

Figure 1: Stakeholder registration

Figure 2: Stakeholder consultation in process


Figure 3: Questions from stakeholders.


Figure 4: Stakeholder consultation in process