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

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

Title: CEMEX Mexico: Alternative fuels and biomass project at kiln # 2 of Yaqui's Cement Plant.
Version: 10
Date: 19/12/2012

A.2. Description of the project activity:

The clinker is the main component of cement. Clinker production process consists on the following steps: First, limestone and clay are blasted from rock quarries and once the rocks have been fragmented, they are transported to the plant. After that, the quarry stone is delivered through chutes to the crushers, where it is reduced by crushing or pounding to chunks approximately 1 ½ inches in size, then materials are pre homogenised and stored. After that, materials are grinded and transported to the calcinations process; calcination is the core portion of the process, in which rotary kilns participate. Inside, the raw material is transformed into clinker.

The most energy consuming and CO2-intensive part of the cement production process is the clinker calcination. In this pyro-process a substantial quantity of heat is required to achieve the necessary chemical reactions in the raw meal. The existing scenario in Yaqui cement plant is the consumption of petcoke (main energy source) and other carbon intensive fossil fuels such as fuel oils for the clinker manufacturing process. The baseline scenario is the same as the scenario existing prior to the start of implementation of the project activity.

The proposed project activity consists in the partial substitution of fossil fuels with alternative fuels such as tires, plastics, textiles, wood residues, paper, cardboard and biomass residues in kiln#2 of CEMEX Yaqui cement plant, in Mexico. Yaqui cement plant aims to substitute up to 47% of its total fuel requirement with alternative fuels by the end of the crediting period.

CEMEX acquired Yaqui cement plant on 1976. It counts with two kilns with an added capacity of 7,000 tonnes per day. The current condition at Yaqui cement plant consists of individual receiving, storing and feeding of fossil fuels in the cement kiln (Yaqui's cement kiln No. 2, which is the one included in this project activity, has a capacity of 3,500 tonnes per day, as described in section B.2 and started operations on year 2008). The new system (for feeding alternative fuels into the kilns) will not have any effect on the existing fuel receiving, storing and feeding. After the project activity is implemented there will be two different fuel feeding systems operating in parallel to meet the fuel requirements of the kiln; this energy is intended to accomplish the transformation of raw materials (mainly limestone and clay) into clinker.

For the adequate utilization of the proposed alternative fuels in the cement manufacturing process, CEMEX will prepare solid and slurry formulated fuels from the mixture of industrial and agricultural alternative fuels sources. The solid formulated fuel will be composed of all biomass residues and solid industrial/municipal residues and the slurry formulated fuel will include all liquid alternative fuels mixed with some share of solid alternative fuels. Therefore, in order to develop and implement the proposed project activity a complete system for receiving, storing, and feeding alternative fuels will be built.

The proposed project activity will reduce emissions of anthropogenic CO_2 from the combustion emissions from fossil fuels displaced in the cement plant and will avoid the methane emissions from preventing the disposal or uncontrolled burning of biomass residues. The project emission sources and gases included in the project boundary and that will be monitored during the crediting period are the CO2 emission from the use of alternative fuels and/or less carbon intensive fossil fuels, from additional electricity and/or fossil fuel consumption and from combustion of fossil fuels for transportation of alternative fuels to the project plant.

Environmental and social benefits other than GHG emission reductions

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

- Decrease in the use of fossil fuels as energy sources and consequently reduction of the dependence on fossil fuels.
- Local economy is benefited due to the employment creation during the construction phase. Furthermore the project activity also will generate employment for the handling and transport implied by the use of alternative fuels and biomass residues in the cement plant. (CEMEX is expecting that a total of 41 people in different shifts will be operating the new equipment for the project activity).
- Biomass, municipal and industrial waste suppliers participate and contribute to protect the environment. This leads to the acquisition of an ecological culture that at the end will make them improve their products handling, storage and transportation systems.
- Additional income for the local alternative fuels and biomass suppliers.
- The project activity enhances the waste management. Most of the alternative fuels that are planned to be used in the project are normally sent to confinement, landfilled, dumped or left to decay or burnt in an uncontrolled manner without utilizing them for energy purposes; the project implementation would dispose these waste 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 to develop more environmental conscience in both the plant’s workforce and the local community

A.3. Project participants:

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Mexico(host)	CEMEX Mexico, S.A. de C.V. (Private entity)	No
United Kingdom	CEMEX International Finance Company (Private entity)	No
United Kingdom	CO_2 Global Solutions International S.A. (Private entity)	No
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Mexico

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

Sonora State.

A.4.1.3. City/Town/Community etc:

Hermosillo City.

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

The Site is located at Carretera a la Colorada km. 17.5 Col. Parque Industrial, CP 85540 in Hermosillo, Sonora, México. The geographic coordinates of the site are + 28.9300, - 110.8279

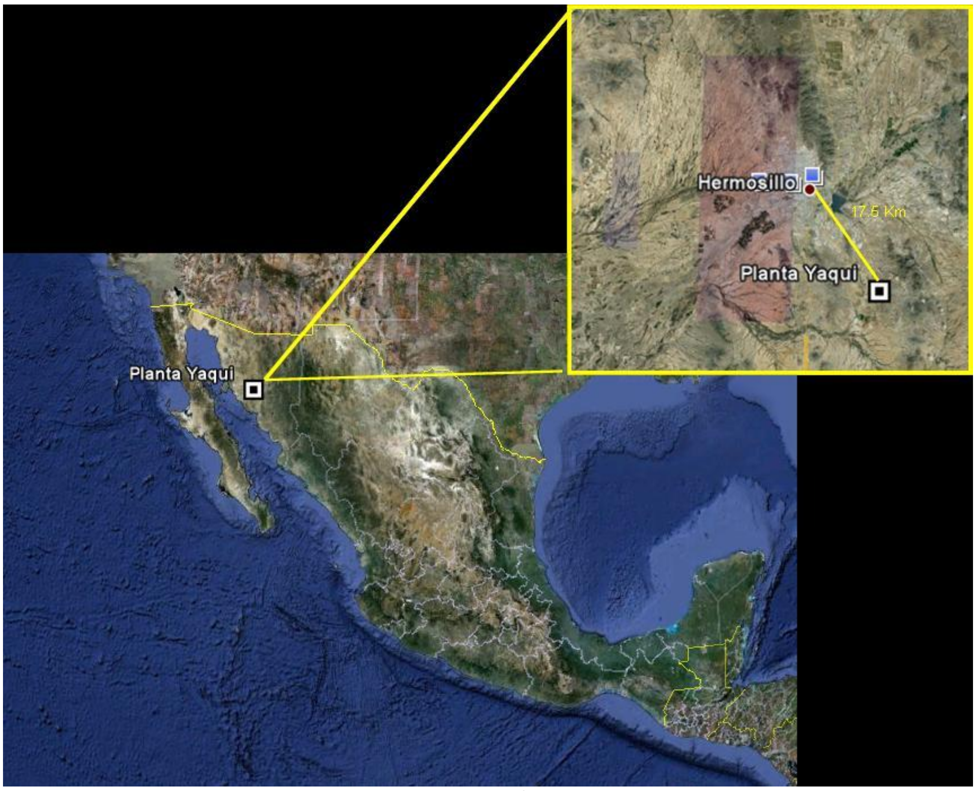

Figure 1. Localization of the Project Site.

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

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:

The alternative fuels that would be used in the project activity are:

Industrial and Municipal Residues:

- Rubber and plastics
- Municipal Solid waste (MSW)
- Paper and cardboard
- Tires
- Liquid waste
- Hydrocarbon liquids (from natural and fossil sources) with high moisture or low LHV (lower heating value).
- Others (such as solvents and other solid industrial residues)

Biomass residues[1]

- Wood residues
- Textiles
- Paper and cardboard
- Organic sludge from water treatment facilities
- Others biomass residues (such as rice husk, coffee husk, corn residues, sugar cane stubbles, agropecuary residues, animal manure, among others).

All of the above industrial, municipal and biomass residues materials are not considered attractive fuels for the cement industry because of several drawbacks such as handling and dosing difficulties, changing chemical composition and physical properties (e.g. extreme viscosity, large variability of composition, low heating value, high and fluctuating moisture, elevated amount of suspended solids), high potential of contamination with substances that are detrimental for the clinkerization process (especially chlorine, alkalis) and the usually disperse sources.

For the adequate utilization of the proposed alternative fuels in the cement manufacturing process, CEMEX will prepare solid and slurry formulated fuels from the mixture of industrial, municipal and agricultural sources. The solid formulated fuel will be composed of all biomass residues and solid industrial/municipal residues and the slurry formulated fuel will include all liquid alternative fuels mixed with some share of solid alternative fuels.

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

<u>Tire Elevator System:</u>

[1] 1 As per the definition of biomass residual, it shall not include municipal waste or other wastes that contain fossilized and/or non-biodegradable material (small fractions of inert inorganic material like soil or sands may be included).

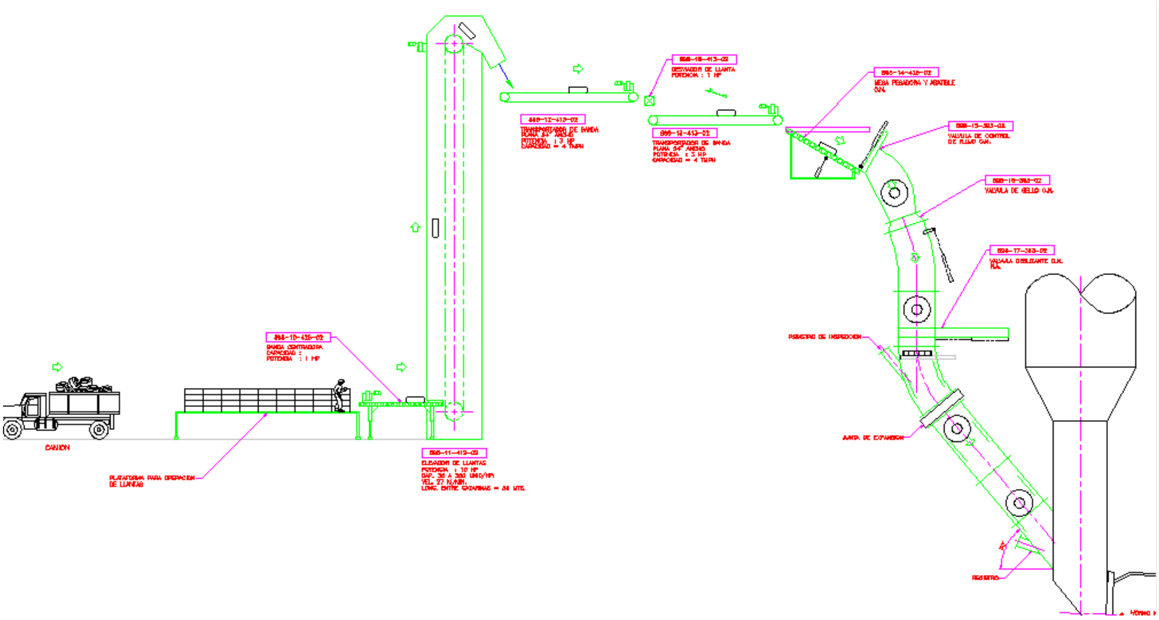

Figure 2. Tires Feeding System.

The tire elevator system consists in a weighing system, three belt conveyors (54"), a chain hoist, a pneumatic valve, a double clam valve and a centering conveyor.

Grinding System:

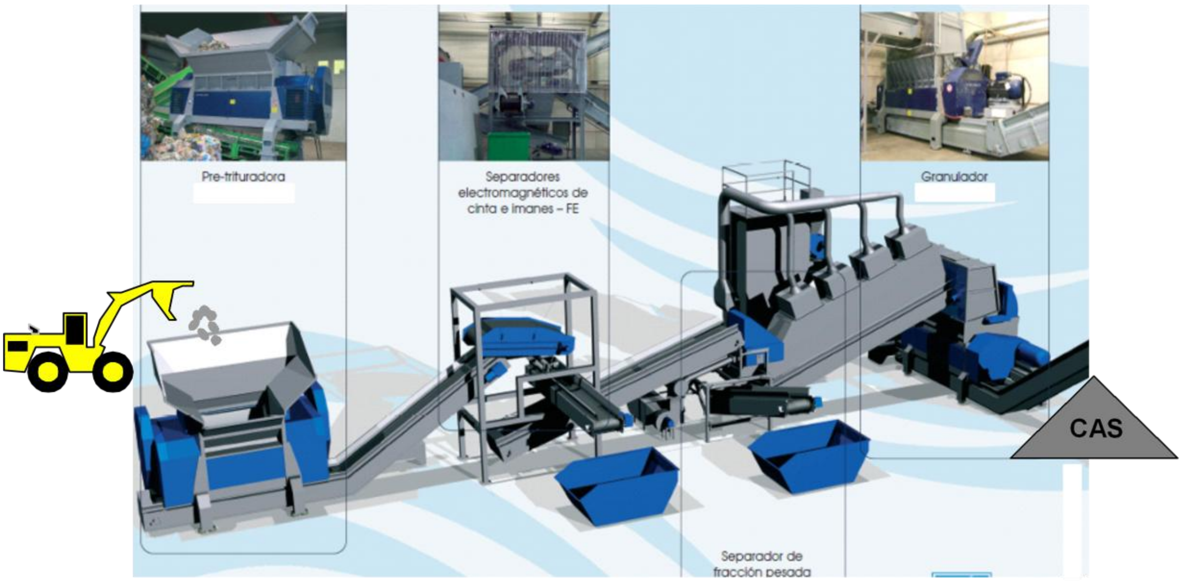

Figure 3. Alternative Fuels Grinding System

The alternative fuels grinding system must include:

+ MSW Crushing Plant
+ Primary Crushing
+ Fine sieve
+ Classifier dust collector
+ Floor Feeder
+ Metal separator
+ Air classifier
+ Belt Conveyors

+ Secondary Crushing
+ Support structure, stairways, corridors
+ Stacker Harrows
+ Civil construction,

<u>Swelling system:</u>

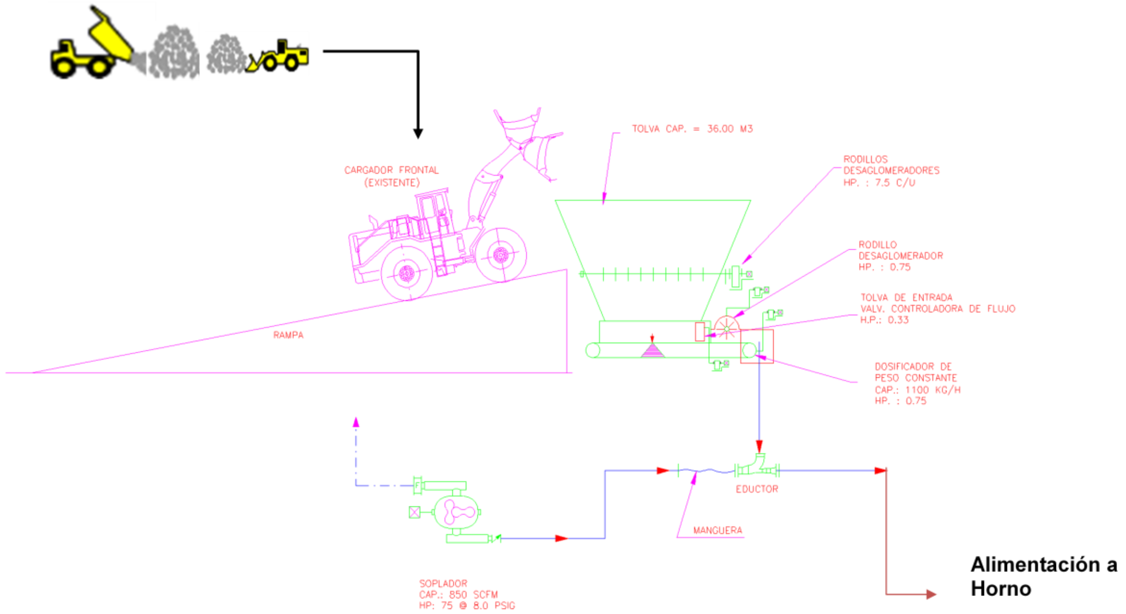

Figure 4. Swelling system

The swelling system includes:

+ Hopper and de-agglomerators
+ Weighing bridge
+ Roofing
+ Blower
+ Conveyor Belt
+ Magnetic Pulley
+ Rotary Valve
+ PLC board and electrical work

A.4.4 Estimated amount of emission reductions over the chosen <u>crediting period</u>:

A fixed crediting period starting on March 1, 2013, has been selected, with an overall CO_2 emission reduction expected of 458,292 tCO_2 for Yaqui cement plant.

Years	**Annual estimation of emission reductions in tonnes of CO2 e**
Year 1	17,238
Year 2	39,605
Year 3	41,028
Year 4	73,481
Year 5	92,205
Year 6	97,083
Year 7	97,652
Total estimated reductions (tonnes of CO2 e)	458,292
Total number of crediting years	7 Years (renewable)
Annual average over the crediting	65,470

period of estimated reductions (tonnes of CO2 e)	

A.4.5. Public funding of the project activity:

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:

For the project activity, the approved baseline methodology used is ACM0003 Version 7.4.1, consolidated baseline methodology for *"***Emissions reduction through partial substitution of fossil fuels with alternative fuels or less carbon intensive fuels in cement or quicklime manufacture***"*.

This methodology also refers to the latest approved version of:

- The "Combined tool to identify the baseline scenario and demonstrate additionality"(version 04.0.0);
- The tool "Emissions from solid waste disposal sites" (version 06.0.1);
- The "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion" (version 02);
- The "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (version 01);
- The "Tool to calculate the emission factor for an electricity system (version 02.2.1)"

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

The CEMEX Mexico 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 or quicklime manufacture*":

- The methodology is applicable to project activities in the cement or quicklime industry where fossil fuel(s) used in an existing clinker or quicklime production facility are partially replaced by less carbon intensive fossil fuel(s) and/or alternative fuel(s).;

The fossil fuels consumed (mainly petcoke) in the clinker kiln of Yaqui existing cement plant are partially replaced by biomass residues (e.g. wood residues, paper, biomass residues from agricultural and forestry activities) and industrial waste from fossil sources (e.g. plastics, rubber).

- A significant investment is required to enable the use of the alternative fuel(s) and/or the less carbon intensive fossil fuel(s).

The project activity will require a significant investment in order to develop the infrastructure of the handling, storage and feeding system for the alternative fuel consumption. All the investments that have been taken on account for this project activity are required to correctly receive, store, feed an consume (burn) alternative fuels (See more details in Section B.5: Investment Analysis of the Tool for demonstration and assessment of additionality)

- During the last three years prior to the start of the project activity, no alternative fuels have been used in the project plant;

Yaqui´s kiln # 2 construction was finished by the end of 2007 and it has only been operating since 2008. In all the time this kiln has been active, no alternative fuels have been consumed. As per clarification AM_CLA_0237, it can be demonstrated that kiln # 2 was commissioned prior to the start date of the project activity and it is not designed as an integrated kiln with the alternative fuel feeding system commissioned simultaneously; also, the practice for the plant (both kilns) is the use of fossil fuels[2]. Both kilns are part of the same project plant as described by applicable methodology. To keep a conservative approach, information from kiln # 1 was used as historical data for year 2007, to ensure that the baseline specific energy consumption is the most conservative possible.

The fuel used for baseline and project emissions calculation is shown as follows:

Fuel type	2007[3]	2008	2009
Petcoke	98.9%	98.5%	99.3%
Fuel Oils	1.1%	1.5%	0.4%
Liquids	0%	0%	0.3%

Table 1: Yaqui kiln #2 Historical Fuel Mix

The current fuel feeding and clinker manufacturing system in the plant was designed for the use of traditional fuels of high and constant quality such as petcoke and fuel oil.

Hence, based on this it can be confirmed that the project activity is in accordance with the methodology requirements.

- The CO2 emissions reduction relates to CO2 emissions generated from fuel combustion only and is unrelated to the CO2 emissions from decarbonisation of raw materials (i.e. CaCO3 and MgCO3 bearing minerals);

CO2 emissions from decarbonisation of raw materials (i.e. CaCO3 and MgCO3 bearing minerals) are not taken into account for the emissions reduction calculation. Only the CO2 emissions reduction related to CO2 emissions generated from fuel combustion are taken into account.

- 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 Kiln #2 of Yaqui cement plant with a total installed capacity of 3,500 tonnes/day (1’277,500 tonnes/year).

Plant	Kiln	Capacity (ton clinker/day)	Cement Type
Yaqui	2	3,500	Gray

[2] National statistics show no consumption of alternative fuels in cement industry in Mexico. Source: Energy consumption and sources for Mexico cement industry, SENER “Balance Nacional de Energía 2008” Cuadro 44, page 110

[3] Information from kiln # 1 was used for year 2007, to ensure a conservative approach, given that kiln #2 only had a 2 year history of operation

Table 2. CEMEX clinker production capacity considered for the project activity.

In case of project activities using biomass residues or renewable biomass, the following applicability conditions apply:

- The biomass is not chemically processed (e.g. esterification to produce biodiesel, production of alcohols from biomass, etc) prior to combustion in the project plant but it may be processed mechanically or be dried at the project site. Moreover, any preparation of the biomass, occurring before use in the project activity, does not cause other significant GHG emissions (such as, for example, methane emissions from anaerobic treatment of waste water or from char coal production);

The biomass residues will be directly transported to the project site without any chemical processing at the alternate fuel supply site and project site. No chemicals are used or added to the biomass residues and there are no other significant GHG emissions prior to their use.

- The biomass used by the project facility is stored under aerobic conditions.

The project activity will install the required facilities to store the biomass residues under aerobic conditions.

- Dedicated plantation for renewable biomass:

The project activity will not use any renewable biomass from dedicated plantation. This condition is not relevant to the project activity.

- The methodology is not applicable to project activities that implement efficiency measures in production of clinker, such as changing the configuration/number of pre-heaters.

The project activity will not implement efficiency measures in production of clinker.

It has been proven that the project activity complies with all applicability conditions existing in methodology. Yaqui cement plant project activity also fulfils all the applicability conditions of the following tools:

a) Combined tool to identify the baseline scenario and demonstrate additionality: This tool is only applicable to methodologies for which if the potential alternative scenarios to the proposed project activity available to project participants cannot be implemented in parallel to proposed project activity.

   The project activity cannot be implemented in parallel with other potential alternative scenarios, as it is described in section B.4.

b) Tool "emissions from solid waste disposal sites", if B2 is identified as the most plausible baseline scenario for the use of biomass residues; The tool can be used to determine emissions for the following types of applications:

   • Application A: The CDM project activity mitigates methane emissions from a specific existing SWDS. Methane emissions are mitigated by capturing and flaring or combusting the methane (e.g. ACM0001). The methane is generated from waste disposed in the past, including prior to the start of the CDM project activity. In these cases, the tool is only applied for an ex- ante estimation of emissions in the CDM-PDD. The emissions will then be monitored during the crediting period using the applicable approaches in the relevant methodologies (e.g. measuring the amount of methane captured from the SWDS).

• Application B: The CDM project activity avoids or involves the disposal of waste at a SWDS. An example of this application of the tool is AM0025, in which MSW is treated with an alternative option, such as composting or anaerobic digestion, and is then prevented from being disposed of in a SWDS. The methane is generated from waste disposed or avoided from disposal during the crediting period. In these cases, the tool can be applied for both ex-ante and ex-post estimation of emissions.

For the specific case of this project, Application B is suitable from the project since it avoids the disposal of waste at a solid waste disposal site.

c) Tool to calculate project or leakage CO2 emissions from fossil fuel combustion; it can be used in cases where CO2 emissions from fossil fuel combustion are calculated based on the quantity of fuel combusted and its properties. Methodologies using this tool should specify to which combustion process j this tool is being applied.

Project emissions calculation includes the quantity and type of fuel expected to be combusted and its properties.

d) The tool may, for example, be used in methodologies where auxiliary electricity is consumed in the project and/or the baseline scenario. The tool can also be applied in situations where electricity is only consumed in the baseline or in the project or as leakage source.
   Methodologies which refer to this tool should:
   (a) Specify clearly which sources of project, baseline and leakage electricity consumption should be calculated with this tool;
   (b) Provide the necessary procedures, equations and monitoring provisions to determine the quantity of electricity that is consumed by each identified source; and
   (c) Provide the necessary procedures to determine the most likely baseline scenario for each source of baseline electricity consumption.

   The tool is only applicable if one out of the following three scenarios applies to the sources of electricity consumption:

   Scenario A: Electricity consumption from the grid. The electricity is purchased from the grid only. Either no captive power plant is installed at the site of electricity consumption or, if any on-site captive power plant exits, it is not operating or it can physically not provide electricity to the source of electricity consumption.

   Scenario B: Electricity consumption from (an) off-grid fossil fuel fired captive power plant(s). One or more fossil fuel fired captive power plants are installed at the site of the electricity consumption source and supply the source with electricity. The captive power plant(s) is/are not connected to the electricity grid.

   Scenario C: Electricity consumption from the grid and (a) fossil fuel fired captive power plant(s). One or more fossil fuel fired captive power plants operate at the site of the electricity consumption source. The captive power plant(s) can provide electricity to the electricity consumption source. The captive power plant(s) is/are also connected to the electricity grid.

   This tool is not applicable in cases where captive renewable power generation technologies are installed to provide electricity in the project activity, in the baseline scenario or to sources of leakage.

The calculation of the possible project emissions for electricity consumption has been included. The scenario applicable to the sources of electricity consumption is Scenario A. Electricity consumption from the grid (According SENER "Electricity Sector Outlook 2009-2024" p.102, 88% of the electricity consumed in the country comes from the National grid, which is the case of this cement plant). Project participants have chosen Option A1 for the determination of the emission factors for electricity generation: Calculate the combined margin emission factor of the applicable electricity system, because all data for its calculation is available and therefore it is not necessary to use a default value. For this calculation, project proponents wish to include only grid power plants in the calculation, while off-grid plants will be excluded. In cases where electricity will come from renewable sources, the grid emission factor will acquire a value of 0, and proper explanations will be given. Captive renewable power generation technologies are not installed to provide electricity in the project activity or to sources of leakage.

Therefore the project activity meets the applicability conditions of the approved methodology ACM0003 Version 07.4.1 and related tools. This baseline methodology shall be used in conjunction with the approved monitoring methodology ACM0003 ("Monitoring methodology for emissions reduction through partial substitution of fossil fuels with alternative fuels in cement or quicklime manufacture")

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

The physical project boundary covers all production processes related to clinker production, including:

- The pre-heaters, where the heat of exhaust gas is used to heat the inputs for clinker production;
- The pre-calciner, where fuels are fired for the pre-calcination of the inputs for clinker production;
- The kiln tube, where fuels are also fired and where the calcinations process takes place;
- On-site storage and on-site transportation and drying of alternative fuels (if alternative fuels are used in the project activity);
- The vehicles used for transportation of alternative fuels to the project site;
- Where biomass residues are used, the project boundary includes the sites where the biomass residues would be dumped, left to decay or burnt in the absence of the project activity;

Project boundary

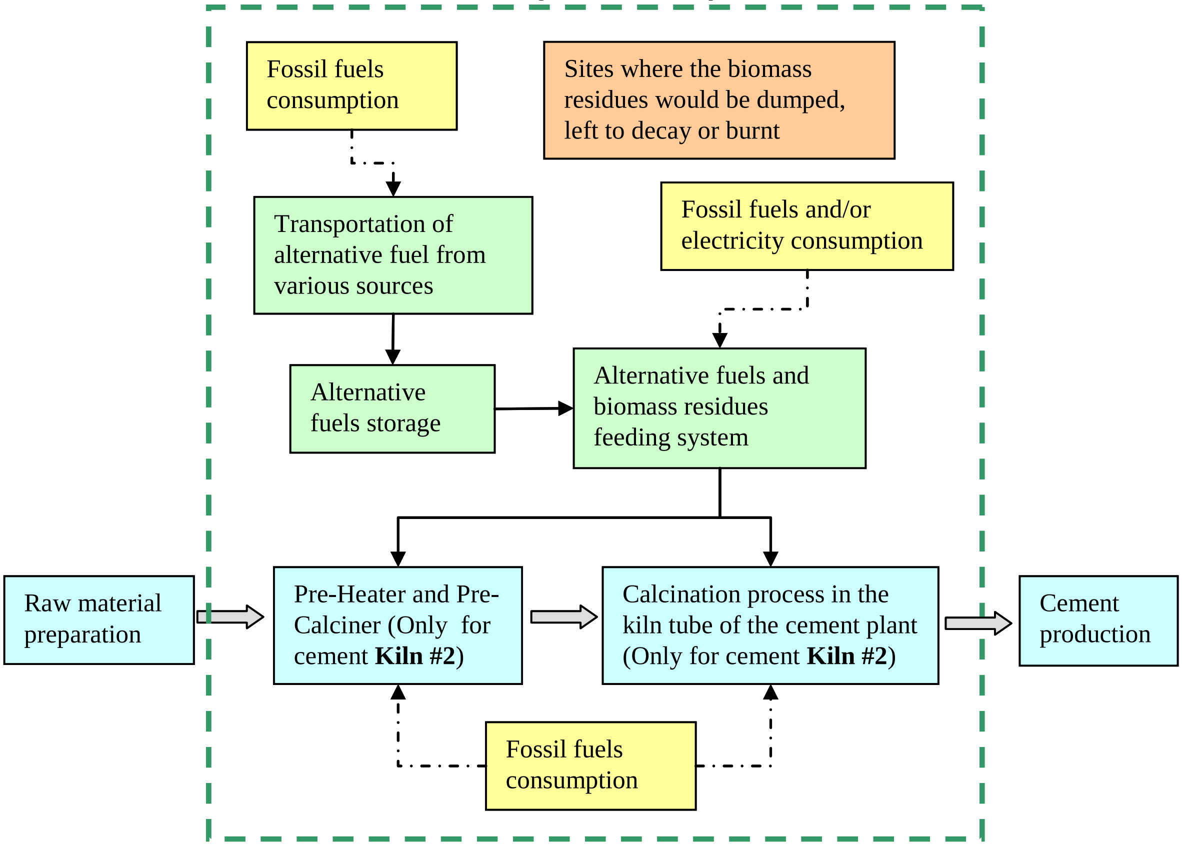

Figure 5. Project boundary.

The table below depicts the gases to be included in the calculations for the emissions and emissions reduction to be achieved by the Project.

	Source	Gas	Included?	Justification/Explanation
Baseline	Emissions from fossil fuels displaced in the project plant (BEFF,y)	CO_2	Yes	Main emission source. The project activity consists on substituting fossil fuels by alternative fuels.
		CH_4	No	Minor source. Neglected for simplicity.
		N_2O	No	Minor source. Neglected for simplicity.
	Methane emissions avoided from preventing disposal or uncontrolled burning of biomass residues	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	Yes	Included, since leakage can be ruled out. The project activity prevents disposal and uncontrolled burning of biomass residues.
		N_2O	No	Minor source.
Project Activity	Emissions from the use of alternative fuels and/or less carbon intensive fossil fuels	CO_2	Yes	Main emission source. The project activity considers the use of alternative fuels.
		CH_4	No	Minor source. Neglected for simplicity.
		N_2O	No	Minor source. Neglected for simplicity.

	(*PEk,y*)			
	Emissions from additional electricity and/or fossil fuel consumption as a result of the project activity (*PEFC,y* and *PEEC,y*)	CO_2	Yes	Is a significant emissions source. The project activity includes the installation of new equipment that may increase electricity consumption.
		CH_4	No	Minor source. Neglected for simplicity.
		N_2O	No	Minor source. Neglected for simplicity.
	Emissions from combustion of fossil fuels for transportation of alternative fuels to the project plant (*PET,y*)	CO_2	Yes	Can be a significant emissions source. The use of trucks for alternative fuels transportation has been considered.
		CH_4	No	Minor source. Neglected for simplicity.
		N_2O	No	Minor source. Neglected for simplicity.
	Emissions from the cultivation of renewable biomass at the dedicated plantation (PEBC,y)	CO_2	No	The project activity does not include biomass from a dedicated plantation
		CH_4	No	The project activity does not include biomass from a dedicated plantation
		N_2O	No	The project activity does not include biomass from a dedicated plantation
Leakage	Leakage emissions related to the use of biomass residues	CO_2	Yes	Can be a significant emissions source. Estimated to zero, but value will be monitored ex post.
		CH_4	No	Minor source. Neglected for simplicity.
		N_2O	No	Minor source. Neglected for simplicity.

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

Procedure for the selection of the most plausible baseline scenario and demonstration of additionality

The baseline scenario is identified and additionality is assessed using the most recent approved version of the "Combined tool to identify the baseline scenario and demonstrate additionality". This section highlights how specific sections of the tool are to be applied to this project context.

Step 1. Identification of alternative scenarios.

Step 1a. Define alternative scenarios to the proposed CDM project activity

As per ACM0003 (version 7.4.1), for each of these scenarios, project participants shall quantify the amount of fossil fuel(s) and alternative fuels that is expected to be used for clinker production during the crediting period.

F1: The proposed project activity not undertaken as a CDM project activity.

The project participant proposes the use of alternative fuels in clinker production. It is in compliance with all applicable legal and regulatory requirements. However, this alternative faces several barriers (as detailed in Section B.5.) making it predictably prohibitive. As outlined in the description of scenario 1 and detailed in section B.5. the implementation of any fuel mix with significant shares of industrial and biomass residues requires efforts and investments that go clearly beyond business as usual. There are no regulations in Mexico requiring to burn waste as alternative fuels in cement kilns. Hence this scenario should not be taken as the baseline scenario.

The estimated fuel mix and fuel consumption (tons/year) during the first crediting period is given below:

Fuel type	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Fuel Oil	0.74%	0.74%	0.74%	0.74%	0.74%	0.74%	0.74%
Petcoke	79.41%	69.52%	68.52%	59.71%	53.90%	51.90%	51.90%
Liquids	0.26%	0.26%	0.26%	0.26%	0.26%	0.26%	0.26%
Wood residues	0.00%	0.00%	0.00%	0.02%	0.02%	0.02%	0.02%
Fabric and Textiles	0.00%	0.00%	0.00%	0.02%	0.02%	0.02%	0.02%
Paper and cardboard	0.00%	1.50%	1.50%	2.50%	2.50%	3.50%	3.50%
Organic sludge	0.00%	0.00%	0.00%	0.02%	0.02%	0.02%	0.02%
Other Biomass Residues	1.15%	1.15%	1.15%	8.85%	13.66%	13.66%	13.66%
MSW	3.00%	8.50%	8.50%	8.50%	8.50%	8.50%	8.50%
Plastics	0.00%	0.00%	0.00%	0.02%	0.02%	0.02%	0.02%
Liquid Wastes	1.00%	1.00%	2.00%	2.00%	3.00%	4.00%	4.00%
Refinery residues	0.00%	0.00%	0.00%	0.02%	0.02%	0.02%	0.02%
Tires	14.43%	17.32%	17.32%	17.32%	17.32%	17.32%	17.32%
Industrial sludge	0.00%	0.00%	0.00%	0.02%	0.02%	0.02%	0.02%

Table 3: Proposed fuel mix for the proposed CDM project activity

Fuel type	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Fuel Oil	736	736	736	736	736	736	736
Petcoke	89,719	78,546	77,416	67,456	60,889	58,629	58,629
Liquids	351	351	351	351	351	351	351
Wood residues	0	0	0	46	46	46	46
Fabric and Textiles	0	0	0	46	46	46	46
Paper and cardboard	0	3,949	3,949	6,582	6,582	9,214	9,214
Organic sludge	0	0	0	26	26	26	26
Other Biomass Residues	3,038	3,038	3,038	23,299	35,970	35,970	35,970
MSW	6,490	18,390	18,390	18,390	18,390	18,390	18,390
Plastics	0	0	0	32	32	32	32
Liquid Wastes	1,536	1,536	3,071	3,071	4,607	6,143	6,143
Refinery residues	0	0	0	37	37	37	37
Tires	17,728	21,279	21,279	21,279	21,279	21,279	21,279
Industrial sludge	0	0	0	44	44	44	44

Table 4: Expected fuel consumption (Ton/year) for the proposed CDM project activity

F2: Continuation of current practice.

Historically kiln #2 of Yaqui cement plant has been using mainly petcoke and a small percentage of fuel oil and liquids like gas oil, diesel oil and gasoline (mainly for start-ups) in cement manufacturing process due to the nature of the facilities installed - i.e., the fuel feeding and clinker manufacturing system in the plant has been designed to use traditional fuels of high and constant quality such as conventional fossil fuels (petcoke, coal, etc.), hence the implementation of an alternative fuels project would face several technical and investment barriers. Therefore in the absence of the project activity, kiln #2 of Yaqui cement plant will continue the consumption of the same fuel mix (petcoke and fuel oils) as in baseline scenario F2 showed below:

Fuel type	Mix
Petcoke	99.00%

Fuel Oils	0.74%
Liquids	0.26%

Table 5: Average Fossil Fuel mix in kiln #2 of Yaqui cement plant from 2008 to 2009 and kiln # 1 for year 2007

Fuel type (Ton/year)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Petcoke	111,844	111,844	111,844	111,844	111,844	111,844	111,844
Fuel Oils	736	736	736	736	736	736	736
Liquids	351	351	351	351	351	351	351

Table 6: Expected fuel consumption for the continuation of current practice scenario.

F3: The continuation of using only fossil fuels and no alternative fuels, however, with a different fuel mix portfolio, taking into account relative prices of fuels available.

The following table describes the evolution in the fuel mix of Mexican cement industry. The data was obtained from the National Balance of Energy of the Secretary of Energy (*Secretaría de Energía*, “SENER”), this data clearly shows that the common practice in the cement industry in Mexico is the consumption of fossil fuels, mainly petcoke.

	2001	2002	2003	2004	2005	2006	2007	2008
Cement (Petajoules)	**96.31**	**93.42**	**95.72**	**120.04**	**126.04**	**138.78**	**159.49**	**134.15**
Petcoke	29.82%	44.39%	50.24%	61.48%	57.12%	66.28%	68.41%	67.39%
Fuel Oil	61.09%	43.74%	35.05%	29.19%	33.16%	23.29%	21.63%	21.03%
Dry Gas	6.31%	6.77%	6.64%	5.52%	5.63%	5.51%	4.91%	5.71%
Coal	2.46%	4.86%	7.88%	3.63%	3.90%	4.75%	4.88%	5.66%
Diesel	0.31%	0.25%	0.19%	0.17%	0.20%	0.18%	0.17%	0.21%

Table 7: Energy consumption and sources for Mexico cement industry. Source: SENER *“Balance Nacional de Energía 2008”*[4] *Cuadro 44, page 110.*

This information also shows that for the Mexican cement industry, the consumption of petcoke and coal has been increasing in the last years.

Additionally the historical and expected fuel prices for Yaqui cement plant demonstrate that the more economically feasible scenario is to continue with a high share of petcoke consumption for the cement manufacturing process:

Fuel Cost (USD/Gcal)	2012	2013	2014	2015	2016	2017	2018	2019	2020
Petcoke	10.04	11.41	11.38	11.41	11.48	11.48	11.48	11.48	11.48
(Ultra) Heavy Fuel Oil, Residual Fuel Oil, Mazout	54.58	54.58	54.58	54.58	54.58	54.58	54.58	54.58	54.58
Liquids	73.11	77.42	77.42	77.42	77.42	77.42	77.42	77.42	77.42

Table 8: Fossil fuels prices

Although petcoke is the most attractive fuel due to its low price compared to the others, a reduction of the share of fuel oil or liquids is highly unlikely because they are required for kiln start-up and other special situations in the cement process.

[4] Document available at http://www.sener.gob.mx/webSener/res/PE_y_DT/pub/Balance_2008.pdf

Based on the mentioned above it can be stated that there are no other possible scenarios using only fossil fuels with a different fuel mix portfolio. As a consequence the fossil fuels mix will remain the same as the current practice.

F4: The currently used fuels are partially substituted with alternative fuels and/or less carbon intensive fossil fuels other than those used in the CDM project activity and/or any other fuel types, without using the CDM.

Kiln #2 of Yaqui cement plant could consume other alternative fuels in addition to those used in the CDM project activity, i.e. bagasse, food residues, other types of biomass or some others. However due to the fact that the available sources are scattered and also that their physical and chemical properties are not stable or predictable, same barriers (see section B5) as those foreseen in the proposed project activity would be faced.

For example, in the case of the food residues an important investment would be required for the development of the infrastructure for the storage, management, handling and preparation of this fuel. New equipment and processes would have to be implemented in order to adjust the plant operation to the quality and characteristics of these new alternative fuels, etc.

Also, as the biomass availability study that has been carried out demonstrates, other alternative fuels cannot even be considered because the distances between the sources and the cement plant rule out this possibility. (Transportation times and prices would increase significantly).

Additionally there are other aspects that must be considered beyond the control of the project proponent for the implementation of an alternative fuel project, alternative fuels consumption is attractive and feasible only in those countries where waste producers have incentives or certain pressure to dispose their waste in other way rather than in a landfill. Even then, collection, processing etc. require not only know-how and significant investment, but also to be integrated in a recycling business in order to be economically viable.

Therefore, the use of food residues and other alternative fuels in the cement industry in Mexico is not feasible without using the CDM and cannot be considered as the baseline scenario. This scenario is therefore excluded.

F5: The construction and operation of a new cement plant.
This scenario is practically not possible in the short term, therefore this is not applicable. Even if a new plant is built, a considerable investment would be required and again many of the barriers described in Step 2a would be faced.

Fuel mix baseline scenario selection

Among all the feasible alternatives described above, the one that does not face any prohibitive barrier should be considered as the baseline scenario. From the identified alternatives above it can be found that "Baseline scenario F2: continuation of current practice" is the baseline scenario.

The project participant has determined what would happen to the alternative fuels in the absence of the project activity:

1. Waste originating from fossil sources:

W1: Incineration of the waste in a waste incinerator without utilizing the energy from the incineration.

In the absence of the project activity, waste from fossil sources would not be incinerated. Because of incinerators high prices this is not the common practice in Mexico.Currently only 1% of the total wastes generate in Mexico are incinerated, the common practice (more than 50% of the total wastes generated) is to treat the wastes and dispose them in a managed or unmanaged landfill. (See page 37 of the National Program for Residues Prevention and Integral Management[5])

W2: Incineration of the waste in a waste incinerator with use of the energy (e.g. for heat and/or electricity generation).

This type of waste is not generally incinerated to generate energy due to incinerators high prices. Instead, the common practice for waste disposal is send it to landfills or specialized confinements sites.

W3: Disposal of the waste at a managed or unmanaged landfill

As it is stated in page 41 of the National Program for Residues Prevention and Integral Management, the current strategy for the final disposition of wastes is mainly centered in the construction of municipal landfills. The objective of the proposed National Program for Residues Prevention and Integral Management is the construction of regional landfills with an specific waste volume reception capacity that would allow to obtain the maximum use and benefit from the biogas generated and the amount of valuable materials contained in the inorganic residues; also this new Integral Waste Management proposal will encourage the utilization of complementary technologies to reduce the volume of residues that are currently sent to landfill (e.g. incineration, anaerobic treatment of organic residues, recycling, etc.). However, this new initiative of Mexican government and environmental authority for the development of a National Integral Waste Management System will take several years for its approval and implementation.

Based on the above, it can be confirmed that the disposal of the waste at managed or unmanaged landfill is the current practice. In the absence of the project activity, the wastes to be used in Yaqui cement plant would be confined in specialized confinement sites.

W4: The use of the waste at other facilities, e.g. other cement or quicklime plants or power plants, as a feedstock or for the generation of energy.
The use of the waste proposed in the project activity is not feasible. Main reasons are:

- This type of waste cannot be used in power plant as per Mexican regulations emissions restrictions
- The use of waste in other cement or quicklime plants faces several technological and investment barriers described in Section B.5. that hinder the consumption in the cement sector.

W5: The recycling or reutilization of the waste

The waste to be used in the project activity would be not recycled in the absence of the project activity. The recycling or reutilization of this material would require performing a lobbying process with the authorities in order to modify the applicable regulations. Unfortunately this process would yield significant results probably not before a decade.

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[5] http://www.semarnat.gob.mx/programassubsidios/Documents/PNPGIR.pdf

The National Program for Residues Prevention and Integral Management (Page 17) [6], recognizes that in the last years the regulation of wastes and residues management has been expanded and strengthened. However, the required capacities to solve the waste and residues management problem have not been developed since the existing regulation is hard to fulfill due to the important lack of infrastructure required for recycling, reutilization or adequate treatment of the wastes and residues. The proposed National Program for Residues Prevention and Integral Management is working in the development of new regulations and norms to facilitate the waste management and to implement in Mexico an Integral Waste Management System.

W6 : The proposed project activity, not undertaken as a CDM project activity, i.e. the use of the waste in the project plant.

This alternative is not the most plausible scenario due to the technological and investment barriers (described in Section B.5) that the project participant would have to face in order to develop the project activity not undertaken as a CDM project activity.

2. <u>Biomass residues:</u>

B1 The biomass residues are dumped or left to decay under mainly aerobic conditions. This applies, for example, to dumping and decay of biomass residues on fields.
B2 The biomass residues are dumped or left to decay under clearly anaerobic conditions. This applies, for example, to deep landfills with more than 5 meters. This does not apply to biomass residues that are stock-piled or left to decay on fields.
B3 The biomass residues are burnt in an uncontrolled manner without utilizing them for energy purposes.
B4 The biomass residues are sold to other consumers in the market and used by these consumers, such as for heat and/or electricity generation, for the generation of biofuels, as feedstock in processes (e.g. the pulp and paper industry), as fertilizer, etc.
B5 The biomass residues are used for other purposes at the project site, such as for heat and/or electricity generation, for the generation of biofuels, as feedstock in processes (e.g. the pulp and paper industry), as fertilizer, etc.
B6 The proposed project activity, not undertaken as a CDM project activity, i.e. the use of the biomass residue in the project plant.

A study[7] was carried out to determine the common practice of the biomass residues considered for the project activity. The results of this study show there is availability at the Yaqui cement plant region of 42.5 million tons of biomass residues, annually, mainly coming from agricultural activities, without formal markets for its commercialization. The results from this study clearly show that there is a surplus availability of the biomass residues and, that even though there is an informal trading of these residues for cattle feeding and fertilizing purposes, still, due to the huge generation, without the implementation of the alternative project activity, there is an important quantity of biomass residues that would be dumped or left to decay under aerobic conditions on the generation sites or sent to landfills. Therefore, in absence the project activity the most plausible scenario is: B1, B2 or B3.

[6] http://www.semarnat.gob.mx/informacionambiental/publicaciones/Publicaciones/SEMARNAT%20Residuos%2009.pdf

[7] The study was carried out by CO2 Solutions based on national statistics.

Based on the above assumptions the approved methodology ACM0003 Version 07.4.1 is applicable to the proposed project activity due to:

- The alternative F2 has been selected as the most plausible baseline scenario for the fuel mix used in cement production.
- The alternative W3 has been selected as the most plausible baseline scenario for the fate of the waste from fossil sources in the absence of the project activity.
- The alternatives B1, B2, and B3 have been selected as the most plausible baseline scenario for the fate of the biomass residues in the absence of the project activity.

Step 1b. Consistency with mandatory applicable laws and regulations.

The regulatory framework which may be applicable to all the previously listed scenarios is the environmental regulations on air emissions. All scenarios meet all the environmental requirements in this regards. (For further information, please see section D of the PDD).

Step 2. Barrier analysis
This Step serves to identify barriers and to assess which alternatives are prevented by these barriers.

Step 2a. Identify barriers that would prevent the implementation of alternative scenarios.

The following table shows the barriers preventing the implementation of each of the alternatives discussed in Step 1.

Alternative Scenario	Investment Barriers	Technological Barriers	Barriers due to prevailing practice	Other Barriers
Scenario F1	High capital investment required. (See detail on Step 3)	As detailed below, the utilization of alternative fuels in clinker production faces several technological barriers due to unstable energy flow rates, impact in the clinker chemistry and the combustion properties of the alternative fuels.	As shown in Table 7, the common practice in the cement industry in Mexico is the consumption of fossil fuels, mainly petcoke	No
Scenario F2	No initial capital investment. In the absence of the project activity this is the most likely baseline scenario	No technological barriers. The cement plant will operate with this scenario in the absence of the project activity	This is the prevailing practice. No barriers.	No
Scenario F3	No initial capital investment. However, as stated in Table 8 petcoke is the most attractive fuel for Yaqui cement plant due to its	No technological barriers.	The utilization of fossil fuels is the common practice.	No

	low price compared to the other fossil fuels. Therefore, the utilization of a different fuel mix portfolio is not feasible because it will represent higher costs in clinker production.			
Scenario F4	High capital investment required.	The utilization of other alternative fuels such as food residues and organic sludge will face similar barriers as in Scenario F1 due to the fact that the available sources are scattered and also that their physical and chemical properties are not stable or predictable.	As shown in Table 7, the common practice in the cement industry in Mexico is the consumption of fossil fuels, mainly petcoke	No
Scenario F5	High capital investment required.	Conventional cement plants are planned and designed to operate using fossil fuels (i.e. coal and petroleum coke). The construction and operation of a new cement plant using alternative fuels will face the same barriers as in Scenario F1	Not applicable	No

Table 9.1: Barrier Analysis. Fuel Mix for Cement Manufacturing

Alternative scenario	**Technological barriers**	**Barriers due to prevailing practices**	**Other barriers**
W1	Most technologies are under research or pilot phases only[8].	It is not common practice in Mexico.	In the absence of the project activity, wastes from fossil sources would be not incinerated since this procedure is very restricted according to Mexican Laws (NOM-098-SEMARNAT-2002)
W2	Most technologies are under research or pilot phases only[9].	It is not common practice in Mexico.	These types of wastes are not generally incinerated to

[8] See page 93 of the National Program for Residues Prevention and Integral Management.

[9] See page 93 of the National Program for Residues Prevention and Integral Management.

			generate energy due to the Mexican Laws restrictions. Instead, the common practice for waste disposal is send it to landfills or specialized confinements sites.
W3	No	No	No
W4	Most technologies are under research or pilot phases only[10].	It is not common practice in Mexico.	There is no market interest. This type of waste cannot be used in power plant as per Mexican regulations
W5	Lack of the infrastructure for the collection and management of wastes.	It is not common practice in Mexico.	The required capacities to solve the waste and residues management problem have not been developed since the existing regulation is hard to fulfil due to the important lack of infrastructure required for recycling, reutilization or adequate treatment of the wastes and residues.
W6	As shown in F1.	As shown in F1.	As shown in F1.

Table 9.2: Barrier Analysis. Wastes from fossil sources

Alternative scenario	**Technological barriers**	**Barriers due to prevailing practices**	**Other barriers**
B1	No	No	No
B2	No	No	No
B3	No	No	No
B4	Most technologies are under research or pilot phases only[11].	It is not common practice in Mexico.	There is no market interest.
B5	Most technologies are under research or pilot phases only[12].	It is not common practice in Mexico.	There is no market interest.
B6	As shown in F1.	As shown in F1.	As shown in F1.

Table 9.3: Barrier Analysis. Biomass residues

The use of non-primary fuels in developing countries and emerging economies is typically restricted to tires and liquids, such as waste oil, that have a high heating value, stable quality and a low risk of contamination with chlorines or alkalis. In addition to this, the use of biomass residues is significantly much less attractive; even where considerable sources can be identified. As a consequence, the projects

[10] See page 93 of the National Program for Residues Prevention and Integral Management.

[11] See page 93 of the National Program for Residues Prevention and Integral Management.

[12] See page 93 of the National Program for Residues Prevention and Integral Management.

that imply a consumption of this type of fuels often require the registration as a CDM project in order to be implemented. In the case of the alternative fuels project that CEMEX Mexico is proposing, the task is even more challenging, as detailed ahead.

In order to have an idea of the progressive nature of the proposed project activity please consider that even in Germany (where different kinds of waste-derived fuels make up more than half of the thermal energy used by CEMEX operations) the use of these fuels has become significant only in the recent years, as waste related legislation increased the tipping fees for the disposal of unprocessed waste. Considering the tipping fee levels that can be obtained in Mexico this achievement in the fuel mix would be impossible.

If the project obtains the registry as CDM and thus becomes feasible to be implemented, CEMEX Mexico will be supported by CEMEX specialists from Europe, especially Germany, that have accumulated expertise in the use of alternative fuels. However, the experience in other countries shows that due to the large differences between waste types, technical solutions and feeding strategies cannot be just copied from one place to another but need to be tailor made to fit every single case.

Technical Barriers:

The waste considered for this project is composed by very heterogeneous fuels typically with low heating value, with relatively high content of substances that can negatively impact the clinker quality and the kiln operation (e.g. chlorines), and with rheological properties that differ significantly from conventional fuels. Also, a particular characteristic of these fuels is the large variability of key parameters such as humidity and chemical composition.

These characteristics lead to the following technical challenges:

a. Unstable energy flow rates[13]

Two main 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 more difficult to control the volumetric or mass flow of these fuels. The flow rate of pulverized fuels (petcoke) and liquids with low and moreover stable viscosity (natural gas, fuel oil, other oils) can be easily controlled with high precision. Even tires do not present a particular problem, as they are typically chopped to particles within certain size range with homogeneous density. Alternative fuels, however, vary significantly in density, particle size and viscosity. In addition, there is an increased risk of blockages in the fuels feeding system: in the case solid formulated fuels, particles of certain size or of low density are prone to accumulation e.g. in the transport pipes; in the case of slurry formulated fuels, impurities and solids can form sediments on tubes and pumps that form bottlenecks or can even completely block the flow of the alternative fuel.

ii. The lack of stability in the alternative fuels heating value represents another problem. Even if it were possible to perfectly control the volumetric or mass flow of these fuels the variations in the energy flow would still be noticeable.

[13] "Charcoal-Oil Mixture as an Alternative Fuel: A Preliminary Study", available at http://www.scipub.org/fulltext/ajas/ajas63393-395.pdf and "ROTAFLAM® burner performance firing alternative fuels at CEMENTOS POLPAICO (Holcim Group, Chile)", available at http://www.fivesgroup.com/fivespillard/en/Articles/Documents/Polpaico_GB.pdf

The effects of instable energy flows are numerous. They include inefficient energy use (and therefore higher fuel cost), lower clinker quality (the clinker might be even 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 a careful selection of the fuels, the development of appropriate blending strategies and processes, the selection of advanced and sophisticated feeding systems, and a better process control in the kiln system. However, operations agree that even considering all these measures there is still a substantial risk of severe impacts on the core business, this is the production of clinker and cement, when increasing the share of proposed alternative fuels in the mix.

b. Oxygen demand[14]
Due to chemical composition and moisture content the oxygen demand for alternative fuels combustion is higher than that of conventional fuels. Since air flow rate is one of the main limiting factors in a clinker kiln this will typically result in a reduced 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 clinker chemistry[15]
Two main effects are distinguished:

i. The ashes generated from the proposed alternative fuels combustion contain elements such as Ca, Si, Al, Fe that are major ingredients of the 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. Such adjustments are relatively easy to accomplish if the composition and flow rate of alternative fuels is stable over time; they just require some experimenting after the chemical adjustments are done so that all parameters are adapted to the new conditions. However, the situation changes completely if the amount and composition of ashes vary over a short period of time. The reason why a cement plant cannot react quickly to those fluctuations is the following: Cement plants do not consume the raw meal online, but several days of full load of the raw meal are formulated 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 chemical composition of ashes that are entered into the kiln with the alternative fuels that will be used in this project, however, will change at a much shorter time scale (typically less than a day). A well-designed sourcing and blending strategy can surely mitigate this effect, but the options to control the amount and composition of ashes will be limited by the amount of parameters that have to be controlled (not only the amount of major clinker ingredients, but also the heating value, moisture content, maximum content of some trace elements etc.), the number of different fuel types and other restrictions such as the contractual obligation to take off all waste produced by a certain source.

   For these reasons it is inevitable that CEMEX operations switch to a much more sophisticated raw meal strategy that might even include additional infrastructure (storage sites, dosage

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[14] "Benchmarking Biomass Gasification Technologies for Fuels, Chemicals and Hydrogen Production", available at http://www.netl.doe.gov/technologies/coalpower/gasification/pubs/pdf/BMassGasFinal.pdf

[15] "Combustion Characteristics of Mixed Fuels", available at http://www.chem-eng.utoronto.ca/facultystaff/profs/tran.htm

systems) to be able to change the raw meal chemistry on a much shorter time scale and/or compensate in line for fluctuations.

ii. Compared to conventional fuels, alternative fuels contain significantly higher concentrations of certain trace elements that have a negative impact on kiln operation and clinker quality. The main concern is the elevated levels of chlorine that can be found in certain plastics, but also in other alternative fuels. As part of the quality control procedures for alternative fuels it will be ensured that the chlorine levels are below the threshold where they represent a risk for the day-to-day operation. However, experience in other CEMEX plants (e.g. Kollenbach plant in Germany) shows that even lower levels of chlorine or other trace elements cause additional corrosion in the refractory and metal structures in the kiln. The latter is a rather complicated form of corrosion because in one side it is difficult to detect but it can implicate significant repair costs and kiln downtime, promoted by the dissociation of chlorine into Cl^-, which later reacts with metal structures forming ferric chloride ($FeCl_3$). Other dangerous effects of chlorine include salt formation in association with sodium (NaCl) and potassium (KCl), which sticks calcined raw material into the refractory clogging as a consequence the bottom part of the preheater.

d. Combustion properties[16]

Alternative fuels take longer to burn out than pulverized fuels or low-viscosity liquids that can be easily dispersed and offer a large specific surface for the oxidation to take place. This means that the thermal energy from combustion of alternative fuels is set free over a longer distance from the burner (the fuels are injected with a certain speed); the energy is given off in a less concentrated form, which in turn flattens the temperature profile of the kiln. The alternate fuel will ultimately suffer complete combustion, but as a certain temperature profile with clear distinction between the different zones (i.e. sinterizing zone, cooling zone) is important for the quality of the clinker produced, measures have to be taken to counter this effect. Thus, investing in laboratory analysis, preparation (i.e. size and moisture reduction), and homogenization of materials, control & instrumentation and training is needed. In addition, it is important to test materials in realistic situations to know their effect upon process and thus be able to estimate the implicit risks on production.

Additionally to all the previous technological challenges, the project activity will also require plant operators to work with a fuels dossification completely different from what they are used to; alternative fuels do not completely fit into what they have been taught about basic fuel properties and handling requirements. The new processes will also shift certain patterns; for instance, the fuel feeding process in the cement plant will require more attention than before. The potential changes in the raw material preparation strategy will break paradigms of cement manufacturing.

Overcoming all those barriers will require the development of technologies and procedures, trial periods, in some cases investment, and most of all a very extensive training and development of know-how for all operational personnel involved in all the different production steps.

Step 2b. Eliminate alternative scenarios which are prevented by the identified barriers:

[16] "Combustion Characteristics of Mixed Fuels", available at http://www.chem-eng.utoronto.ca/facultystaff/profs/tran.htm and "ROTAFLAM® burner performance firing alternative fuels at CEMENTOS POLPAICO (Holcim Group, Chile)", available at http://www.fivesgroup.com/fivespillard/en/Articles/Documents/Polpaico_GB.pdf

The only alternative not prevented by any prohibitive barrier is Scenario F2: Continuation of current practice. This option corresponds to the business as usual scenario. Kiln #2 of CEMEX Yaqui cement plant will carry on its cement production using the same fossil fuel mix as historically used.

Since there is only one alternative scenario (Scenario F2) that is not prevented by any barrier, and this alternative is not the proposed project activity undertaken without being registered as a CDM project activity, then this alternative scenario is identified as the baseline scenario.

In the case of the alternatives for wastes from fossil sources and biomass residues the situation is the same. The only alternatives not prevented by any prohibitive barrier are:

- W3: Disposal of the waste at a managed or unmanaged landfill, for the case of wastes from fossil sources
- B1: The biomass residues are dumped or left to decay under mainly aerobic conditions. This applies, for example, to dumping and decay of biomass residues on fields; B2: The biomass residues are dumped or left to decay under clearly anaerobic conditions; or, B3: The biomass residues are burnt in an uncontrolled manner without utilizing them for energy purposes, for the case of biomass residues.

Hence, these alternative scenarios (W3 and B1/B2/B3) are identified as the baseline scenario.

Next in section B.5., Step 3: Investment Analysis of the "Combined tool to identify the baseline scenario and demonstrate additionality" is used as a quantitative argument to explain and demonstrate how the registration of the CDM project activity will alleviate the barriers that prevent the proposed project activity from occurring in the absence of the CDM.

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):

Timeline of events of the project

Date	Event
16/03/2010	The Prior CDM Consideration Form was sent to UNFCCC.
01/04/2010 to 27/07/2010	Quotations for the project were obtained. Biomass availability study was carried out.
27/07/2010	Final version of financial analysis was concluded. PDD was elaborated.
13/08/2010	Mexico's letter of approval was obtained.
17/08/ 2010	Validation of the project started with the global stakeholders consultation
18/09/2010	Purchase order for civil works for tires feeding system (start date)
07/03/2011 and 21/02/2012	Letters of Approval from UK's DNA were obtained.

This section continues with the application of the "Combined tool to identify the baseline scenario and demonstrate additionality" and describes how the CDM alleviates the identified barriers that prevent the proposed project activity from occurring.

Step 3: Investment analysis

According to paragraph 19 of the "Guidance on the Assessment of Investment Analysis" the benchmark approach is suited to circumstances where the baseline does not require investment or is outside the direct control of the project developer, i.e. cases where the choice of the developer is to invest or not to invest. Based on the analysis carried out in Section B.4., the resulting baseline scenario is Scenario F2, W3, B1/B2/B3: Continuation of current practice, which does not involve any investment. Therefore the benchmark approach can be applied to evaluate if the proposed project activity is economically or financially attractive without the CDM related revenue.

According to the "Combined tool to identify the baseline scenario and demonstrate additionality" the financial/economic analysis shall be based on parameters that are standard in the market, considering the specific characteristics of the project type, but not linked to the subjective profitability expectation or risk profile of a particular project developer. In the particular case where the project activity can only be implemented by the project participant, the specific financial/economic situation of the company undertaking the project activity can be considered.

The discount rate (in the case of the NPV) or the financial benchmark (in the case of the IRR) shall be derived from:

(a) Government bond rates, increased by a suitable risk premium to reflect private investment and/or the project type, as substantiated by an independent (financial) expert or documented by official publicly available financial data;

For the current project activity, the Federal Government Development Bond (Bono del Desarrollo del Gobierno Federal, BONDES), with maturity of 20 years and a yield of 7.79%[17] has been chosen. In addition, the equity risk premium for México is 5.77%[18], which results in a benchmark of 13.6%. (Post-tax benchmark)

On the other hand, the "Guidelines on the assessment of investment analysis" version 05, defines 12.2% as a default value for the expected return on equity for Mexico. (Post-tax benchmark)

From the two options available, the lowest value is chosen, and then the benchmark for the project is 12.2%. This value is used to be compared with the equity IRR and demonstrate the project's additionality.

CEMEX México S.A. will invest in the infrastructure and equipment for project activity implementation such as:

1. Waste procurement, handling and preparation
2. Fuel handling and dosing
3. Monitoring and control systems

In addition, CEMEX has to invest in developing activities and extensive training of the cement process operators.

The summary of IRR calculation for the project activity is given below. Please note that the calculation does not take into account the risk implied in the use of alternative fuels, which may lead to damage in the kiln system that would require a cost-intensive repair and a significant kiln downtime, as outlined in the analysis of technical barriers of the project. For the investment analysis the life time of the project activity

[17] Source: "Banco de Mexico webpage" http://www.banxico.org.mx/SieInternet/consultarDirectorioInternetAction.do?accion=consultarCuadro&idCuadro=CF107&sector=22&locale=es as available in 03/06/2010

[18] Souce: http://pages.stern.nyu.edu/~adamodar/pdfiles/papers/ERP2010.pdf February 2010 edition

(20 years) has been considered. It is important to remark that even though benchmark is intended for a post-tax analysis, taxes have been assumed as zero as a conservative approach.

Parameters	Value
Investment	4,947 kUSD
Petcoke	81.91 USD/ton
Fuel Oil	508.72 USD/ton
Liquids	492.78 USD/ton
Wood residues	26.47 USD/ton
Fabric and Textiles	42.06 USD/ton
Paper and cardboard	42.06 USD/ton
Organic sludge	17.57 USD/ton
Other Biomass Residues	26.47 USD/ton
MSW	42.06 USD/ton
Plastics	42.06 USD/ton
Liquid waste	180.03 USD/ton
Refinery residues	17.57 USD/ton
Tires	61.37 USD/ton
Industrial sludge	17.57 USD/ton
IRR without CERs	0.60 %
IRR with CERs (14.4 USD/tCO2)	22.68 %
Equity IRR without CERs	-4.48%
Equity IRR with CERs	32.10%

Table 10: IRR analysis for the proposed CDM project activity. Source: CEMEX Energy Outlook[19] and Equipment quotations. (Prices included in this table are those for the first year of the project activity).

The financial benchmark for CEMEX Mexico is 12.20%. This implies that for any project to be attractive it should yield returns higher than 12.20%, to be considered for implementation.

The CER price of 14.4 USD has been chosen based on Platts's prediction for the next two years, which is expected to be around 13 EUR/CER (18 USD); it was assumed that 80% of this price is a realistic value given the intrinsic uncertainty and the transaction costs (verification, etc.). The sensitivity analysis shows that the financial attractiveness of the project is rather robust to realistic discounts to this value.

[19] The Energy Outlook is an internal tool developed by CEMEX Central Energy Department with the objective of assessing the energy cost evolution with the participation of all cement operations. In this database it is consolidated the historical energy data for each installation and it is projected the main energy performance and cost indicators for the next five years based on current fuels & power contracts and also considering the international energy market forecasts. CEMEX Energy Outlook is also used to monitor initiatives and improvements and update future yearly Outlooks, this tool operates using predetermined templates provided by Regional Plant Operations, Regional Planning, and Energy VP.

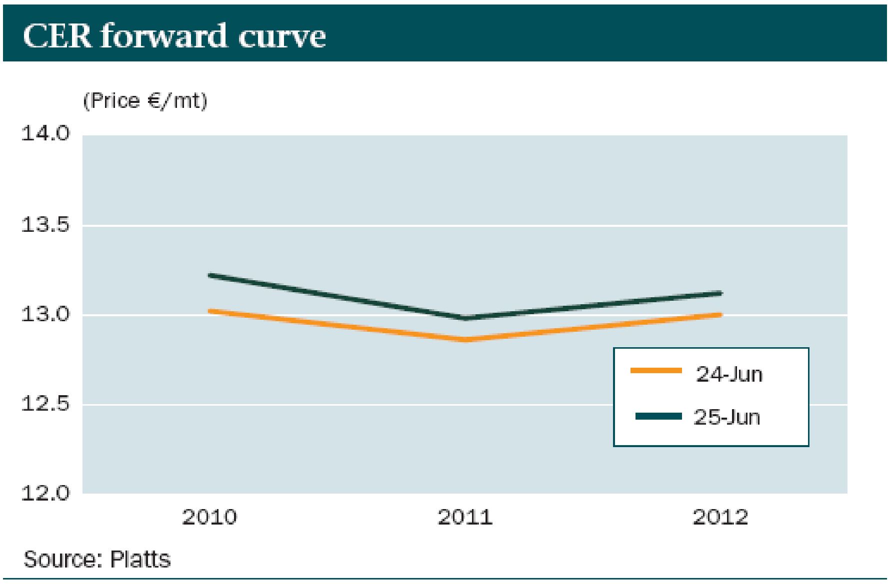

Figure 6. CER's projected price. Source: Platts, Emissions Daily (June 28th, 2010)

The equity IRR calculations of the project show a value below the financial benchmark (12.20%) that would be achieved without the CDM revenues. The equity IRR improves to 32.11% if the CDM revenues are considered.

Sensitivity Analysis

According to the "Combined tool to identify the baseline scenario and demonstrate additionality" a sensitivity analysis is included in order to assess whether the conclusion regarding the financial attractiveness of the proposed project activity is robust to reasonable variations in the critical assumptions.

Sensitivity analysis is conducted based on the variations in the investment, the alternative fuels and fossil fuels price, since they constitute more than 20% of either total project costs or total project revenues. The investment amount and fuel prices used in the IRR calculations are taken as reference (100%), a range of +10% and –10% is covered and the variation in the IRR is calculated and explained in the following tables:

Alternative fuels price fluctuation % of Base price	Equity IRR
90%	14.84%
95%	7.55%
100%	-4.48%
105%	N.A.
110%	N.A.

Table 11: Sensitivity Analysis for change in the alternative fuels prices.[20]

[20] NA refers to "Not Available" this means that the resulting IRR value is too negative, the Excel calculation spreadsheet shows as result "#¡NUM!" or "#¡DIV/0!", hence, there is not a numerical value that can be used to represent the resulting IRR value.

Investment fluctuation % of Investment	Equity IRR
90%	-3.75%
95%	-4.12%
100%	-4.48%
105%	-4.82%
110%	-5.14%

Table 12: Sensitivity Analysis for change in the investment

Petcoke price fluctuation % of base price	Equity IRR
90%	N.A.
95%	N.A.
100%	-4.48%
105%	8.48%
110%	16.31%

Table 13: Sensitivity Analysis for change in the fossil fuels prices

Maintenance costs fluctuation % of base costs	Equity IRR
90%	-3.59%
95%	-4.03%
100%	-4.48%
105%	-4.95%
110%	-5.45%

Table 14: Sensitivity Analysis for change in Maintenance costs

In almost all the scenarios made for the sensitivity analysis the resulting IRR without the CDM income is very low, and in most of the cases negative, demonstrating that the proposed project activity is not economically or financially feasible without the revenue from the sale of certified emission reductions.

Discussion of scenarios on which the IRR reaches the benchmark value:

- +10% of fossil fuel prices
  - The scenario in which the change of +10% of fuel prices result in an IRR higher than benchmark is not credible. This is mainly due to the reason that also the alternative fuels final cost is related to the fossil fuels cost.
  - The alternative fuels cost is composed by several factors such as collection, preparation, transportation, etc. Among this, the transportation cost represents around 30 to 40% of the final alternative fuels costs.
  - Also, the operational cost involved in the transportation of materials is highly related to the fossil fuels cost. In Mexico, the fuels consumption represents the 50%[21] of the

[21] Newspaper reports establishing that the fuels consumption represents the 50% of the transportation costs: http://www.emedios.com.mx/testigospdfs/20090225/25022009_12_10_CONACYT%20701.pdf and http://www.tractoportal.com/front_content.php?idcat=592&idart=2415

transportation costs. Therefore, the fossil fuels directly affect (around 20 – 30%, considering only the fuels consumption from transportation activities) the final cost of the alternative fuels. Hence, in the case in which the fossil fuel increases also the alternative fuels will do.

- Based on the above, when the fossil fuels increase by 10% the real scenario will also have an increase in the alternative fuels cost of about 5% resulting in an IRR lower than the benchmark.
- It is also important to remark that petcoke's availability in the region is expected to increase in the following years[22], and with a higher availability prices are expected to decrease significantly.

- –10% of alternative fuel prices
  - The scenario in which the change in –10% of alternative fuel prices result in IRR higher than the benchmark is not credible, specially because for the investment analysis the alternative fuels cost was considered constant for the entire lifetime of the project and at least this price would be increased in the future based on the country inflation.
  - Additionally, the alternative fuels cost is composed by several factors such as collection, preparation, transportation, etc. Among this, the transportation cost represents around 30 to 40%[23] of the final alternative fuels costs.
  - The operational cost involved in the transportation of materials is highly related to the fossil fuels cost. In Mexico, the fuels consumption represents the 50% of the transportation costs. Therefore, the fossil fuels directly affect (around 20 – 30%, considering only the fuels consumption from transportation activities) the final cost of the alternative fuels.
  - Two alternatives were analyzed of how the alternative fuels costs can be reduced:
    - Remaining the transportation cost fixed: Assuming that fossil fuels does not change in time, the alternative fuels costs may be lower by reducing the operational cost from the collection and preparation activities. In order to achieve a reduction of 10% the total cost, the collection and preparation activities will need to be reduced at least a 15% from the base cost. However, since these activities involve man power and also in some cases fossil fuels or electricity consumption, the trend of this cost is to be increased at least by the inflation factor in the country.
    - A general reduction of all the factors affecting the alternative fuels: As explained above the total alternative fuels cost has a narrow relation with the fossil fuels cost. Therefore, in the case where a general reduction of the alternative fuels costs is obtained, this will imply that also the fossil fuels costs will be reduced. Hence, the net savings from consuming alternative fuels will remain the same as in the base scenario.
  - In conclusion this is not a credible scenario taking into account that for the project investment analysis the alternative fuels cost was considered constant and also due to the stretch relation between the alternative fuels total cost and the fossil fuels cost, which is derived from the fuels consumption involved in the alternatives fuels collection, preparation and transportation activities.

[22] Sources: www.energia.gob.mx/res/85/Refinacion_Web.pdf (page 13) and http://www.pemex.com/index.cfm?action=news&sectionID=8&catID=40&contentID=20775

[23] Studies and reports where it is analyzed that the transportation costs represents around the 30 to 40% of the total alternative fuels (biomass residues) costs: http://www.biocap.ca/rif/report/Sokhansanj_S.pdf and http://www.sener.gob.mx/webSener/res/169/Biocombustibles_en_Mexixo_Estudio_Completo.pdf

An alternative fuel price which is below 90% of the reference price is considered extremely unrealistic because the costs implied in transportation and handling that can hardly be reduced. Even if such reductions were achievable the risk profile would make the project financially unattractive. It is also worth to mention that alternative fuels prices have been left fixed for IRR calculations as a very conservative approach, even though CEMEX experience with similar registered CDM projects is that alternative fuels prices increase at a higher rate than country's inflation rate.

Therefore in spite of the sensitivity analysis on the basis of realistic deviations in the assumptions, the IRR of project activity without the CDM revenue remains not attractive.

These results confirm that the most likely baseline scenario is Scenario F2, W3, B1/B2/B3: Continuation of current practice, because it does not require any additional investment; and demonstrates that the registration of the CDM project activity will alleviate the investment barriers that prevent the proposed project activity from occurring in the absence of the CDM.

The registration of the project activity as a CDM project will provide additional returns on the considerable investments. The sale of the CERs will also serve as some kind of insurance against the considerable risks that the project activity involves in the cement process (see analysis of technical barriers for details).

The formal recognition of the UNFCCC that the project fulfils the criteria for a CDM project and the generation of the additional value in using more alternative fuels will motivate operators to overcome all the major and minor problems that the introduction of such an aggressive fuels program will bring and that can make the whole project activity fail.

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

There are no other activities similar to the project activity in Mexico. As it is shown on Table 7 the data from the National Balance of Energy of the Secretary of Energy (*Secretaría de Energía*, "SENER") demonstrates that the common practice in the cement industry in Mexico is the consumption of fossil fuels. The evolving fuel mix in Mexico cement industry has completely changed from a 60.57% fuel oil on 2001[24] to a 67.39% petcoke in 2008, and taking into account the expected price increase in oil based fuels, the cement industry will increase petcoke consumption and thus GHG emissions derived from the cement manufacturing process will also increase. Therefore, the proposed project cannot be considered "business as usual".

According to the guideline on common practice version 02.0, the following points must be assessed:

I. Definitions

1. The applicable geographical area should be the entire host country:
Mexico is selected as geographical area.

2. Measure (for emissions reduction activities) a broad class of greenhouse gas emission reduction activities possessing common features. Four types of measures are currently covered in the framework:
In this project, option a) Fuel switch is the most appropriate.

3. Output- goods or services with comparable quality, properties, and application areas (e.g. clinker, electricity, methane):

[24] The fuel consumption for the cement industry in Mexico was obtained from the report "Balance Nacional de Energía 2006" Cuadro 23, page 116 available at <http://www.sener.gob.mx/webSener/res/PE_y_DT/pub/Balance%20Nacional%20de%20Energia%202006.pdf>

The applicable output for this project is clinker production.
4. Different technologies are technologies that deliver the same output and differ, in this case, by the energy source/fuel:
Different technologies to this project activity would be defined as those with a minimal or no use of alternative fuels.

II. Stepwise approach for common practice
Step 1: Calculate applicable output range as +/-50% of the design output or capacity of the proposed project activity.
- +50% increment in the design output or capacity of the proposed project activity: 5,250 ton/day. Upper level
- 0% increment in the design output or capacity of the proposed project activity: 3,500 ton/day.
- -50% increment in the design output or capacity of the proposed project activity: 1,750 ton/day. Lower level

Step 2: Identify similar projects (both CDM and non-CDM) which fulfil all of the following conditions:

(a) The projects are located in the applicable geographical area;
(b) The projects apply the same measure as the proposed project activity;
(c) The projects use the same energy source/fuel and feedstock as the proposed project activity, if a technology switch measure is implemented by the proposed project activity;
(d) The plants in which the projects are implemented produce goods or services with comparable quality, properties and applications areas (e.g. clinker) as the proposed project plant;
(e) The capacity or output of the projects is within the applicable capacity or output range calculated in Step 1;
(f) The projects started commercial operation before the project design document (CDM-PDD) is published for global stakeholder consultation or before the start date of proposed project activity, whichever is earlier for the proposed project activity.

At the time project was published for global stakeholder consultation there was no similar project activity operating in Mexico[25], and CEMEX had started validation of 5 similar project activities in the country.[26]

Step 3: within the projects identified in Step 2, identify those that are neither registered CDM project activities, project activities submitted for registration, nor project activities undergoing validation. Note their number Nall.

As described at the previous step, there was no similar project in operation in Mexico, and all projects to be developed were on validation status. Hence, 0 projects can be considered in the current analysis.

Nall = 0

Step 4: within similar projects identified in Step 3, identify those that apply technologies that are different to the technology applied in the proposed project activity. Note their number Ndiff.

Since none of the cement plants in Mexico uses biomass residues and alternative fuels in their fuel mix at the rate proposed by project activity, it can be concluded that:

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[25] National statistics show no consumption of alternative fuels in cement industry in Mexico. Source: Energy consumption and sources for Mexico cement industry, SENER "Balance Nacional de Energía 2008" Cuadro 44, page 110

[26] Source: http://cdm.unfccc.int/Projects/Validation/index.html

Ndiff = 0

Step 5: Calculate factor F=1-Ndiff/Nall representing the share of similar projects (penetration rate of the measure/technology) using a measure/technology similar to the measure/technology used in the proposed project activity that deliver the same output or capacity as the proposed project activity.

F = 1- Ndiff/ Nall = undetermined and
Nall – Ndiff = 0 (lower than 3)

The proposed project activity would be "common practice" within the sector in the applicable geographical area if the factor F were greater than 0.2 and Nall-Ndiff were greater than 3, since F = undetermined, but it has been demonstrated that the cement industry in Mexico do not consume alternative fuels, and Nall-Ndiff = 0, the project activity cannot be considered "common practice."

Based on the results of the "Combined tool to identify the baseline scenario and demonstrate additionality" application, it is demonstrated that the proposed project activity will be only implemented if the CDM registration is obtained and the expected emission reductions would have not occurred in the absence of the project activity. Hence, the proposed CDM project activity for using alternative fuels in kiln #2 of Yaqui cement plants is additional.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

The following equations will be applied for the emission reductions:

Project emissions:

Project emissions include project emissions from the use of alternative fuels and/or less carbon intensive fossil fuels ($PE_{k,y}$), project emissions from additional electricity and/or fossil fuel consumption as a result of the project activity ($PE_{EC,y}$ and $PE_{FC,y}$), project emissions from combustion of fossil fuels for transportation of alternative fuels to the project plant ($PE_{T,y}$), and, if applicable, project emissions from the cultivation of renewable biomass at the dedicated plantation ($PE_{BC,y}$):

$$PE_y = PE_{k,y} + PE_{FC,y} + PE_{EC,y} + PE_{T,y} + PE_{BC,y} \quad \textbf{(1)}$$

Where:

PE_y = Project emissions during the year y (tCO_{2e})
$PE_{k,y}$ = Project emissions from combustion of alternative fuels and/or less carbon intensive fossil fuels in the project plant in year y (tCO_2)
$PE_{FC,y}$ = Project emissions from additional fossil fuel combustion as a result of the project activity in year y (tCO_2)
$PE_{EC,y}$ = Project emissions from additional electricity consumption as a result of the project activity in year *y* (tCO_2)
$PE_{T,y}$ = CO2 emissions during the year y due to transport of alternative fuels to the project plant (tCO_2)
$PE_{BC,y}$ = Project emissions from the cultivation of renewable biomass at the dedicated in year y (tCO_{2e})

Project emissions are calculated in the following steps:

Step 1. Calculate project emissions from the use of alternative fuels and/or less carbon intensive fossil fuels.
Step 2. Calculate project emissions from additional electricity and/or fossil fuel consumption as a result of the project activity
Step 3. Calculate project emissions from combustion of fossil fuels for transportation of alternative fuels to the project plant
Step 4. Calculate project emissions from the cultivation of renewable biomass at the dedicated plantation

Step 1. Calculate project emissions from the use of alternative fuels and/or less carbon intensive fossil fuels

Project emissions from the use of alternative fuels and/or less carbon intensive fossil fuels in the project plant are calculated as follows:

$$PE_{k,y} = \sum_k FC_{PJ,k,y} \text{ x } NCV_{k,y} \text{ x } EF_{CO2,k,y} \quad \textbf{(2)}$$

Where:

$PE_{k,y}$ = Project emissions from combustion of alternative fuels and/or less carbon intensive fossil fuels in the project plant in year *y* (tCO2)
$FC_{PJ,k,y}$ = Quantity of alternative fuel or less carbon intensive fossil fuel type *k* used in the project plant in year *y* (tons)
$EF_{CO2,k,y}$ = Carbon dioxide emissions factor for alternative or less carbon intensive fossil fuels type *k* in year *y* (tCO2/GJ)
$NCV_{k,y}$ = Net calorific value of the alternative or less carbon intensive fossil fuel type *k* in year *y* (GJ/tonne)
k = Alternative fuel types and less carbon intensive fossil fuel types used in the project plant in year *y*

Step 2. Calculate project emissions from additional electricity and/or fossil fuel consumption as a result of the project activity

Project emissions from consumption of electricity are calculated based on the quantity of electricity consumed by the equipment to be installed in CEMEX Yaqui plant for the project activity, an emission factor for electricity generation and a factor to account for transmission losses, as follows:

$$PE_{E,C,y} = \sum_j EC_{PJ,j,y} \times EF_{EL,j,y} \times (1 + TDL_{j,y}) \quad \textbf{(3)}$$

$PE_{EC,y}$ = Project emissions from electricity consumption in year y (tCO2/yr)
$EC_{PJ,j,y}$ = Quantity of electricity consumed by the project electricity consumption source j in year y (MWh/yr)
EFEL,j,y = Emission factor for electricity generation for source *j* in year *y* (tCO2/MWh)
TDLj,y = Average technical transmission and distribution losses for providing electricity to source *j* in year *y*

For the emission factor calculation, the applicable scenario is the one described by the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" as Scenario A: Electricity consumption from the grid. Project participants have chosen Option A1 for the determination of the emission factors for electricity generation: Calculate the combined margin emission factor of the applicable electricity system, because all data for its calculation is available, using the procedures in the latest approved version of the "Tool to calculate the emission factor for an electricity system"

Calculation of the grid emission factor ($EF_{EL,j,y}$):

Grid emission factor was calculated using the *"Tool to calculate the emission factor for an electricity system"*, Version 02.2.1

The steps to following for calculate emission factor are:
1. Identify the relevant electric system.
2. Choose whether to include off-grid power plants in the project electricity system (optional).
3. Select a method to determine the operating margin (OM).
4. Calculate the operating margin emission factor according to the selected method.
5. Calculate the build margin (BM) emission factor.
6. Calculate the combined margin (CM) emissions factor.

Step 1.Identify the relevant electric power system.

The regions in the Mexican grid are interconnected; for this, the relevant electric power system is the entire Mexican grid (Source: SENER "Electricity Sector Outlook 2009-2024"), moreover the public information of the Mexican Energy Ministry "SENER" is for type of fuel for consumption and fuel share and technology for gross generation and power share, not for regions.

Imports and exports of electricity are treated as defined in the methodology: For imports from an on-line electricity system located in another country, the emission factor is 0 tCO_2/MWh in order to ensure a conservative approach. Electricity exports will not be subtracted from electricity generation data used for calculating the baseline emission factor.

Step 2: Choose whether to include off-grid power plants in the project electricity system (optional)

Project participants may choose between the following two options to calculate the operating margin and build margin emission factor:
Option I: Only grid power plants are included in the calculation.
Option II: Both grid power plants and off-grid power plants are included in the calculation.

The project proponent wishes to include only grid power plants in the calculation, while off-grid plants will be excluded, this means: Option I.

Step 3. Select an operating margin (OM) method.

The Operating Margin refers to the actual energy generation mix installed in Mexico. The total fuel consumption for generation is divided into the different types of power plants, in order to determine the weighted average of the actual CO_2 emissions in Mexico.

For its calculations, the simple OM method has been selected from the four options proposed in the *"Tool to calculate the emission factor for an electricity system version 02.2.1"*. Dispatch data analysis would be more accurate and therefore preferable, but this method cannot be applied for this project due to the lack of available published data. To be able to use the Dispatch data analysis method, the hourly generation-weighted average emissions per electricity unit (tCO_2/MWh) of a set of plants in the top 10% of the grid system dispatch order is needed. For confidentiality reasons, hourly-based dispatch order generation is not publicly available, so this method cannot be used for calculating the Operating Margin emission factor.

The reason for selecting the simple OM method over the other two methods (simple adjusted OM or Average OM) is that the low-cost/must-run resources in Mexico are well below 50% of total grid generation in both the average of the five most recent years and in the long-term normal for hydroelectricity production:

In addition, data for calculating the emission factor using the simple OM method is very robust and reliable. In accordance with the approved methodology chosen, the simple OM method has been finally chosen to determine the relevant operating margin.

The Simple OM emission factor can be calculated using either of the two following data vintages for year (s):

- A 3-year average, based on the most recent statistics available at the time of PDD submission (*ex-ante*), or
- The year in which project generation occurs, if EF_{OM} is updated based on *ex-post* monitoring.

The first option has been chosen because the yearly statistics provided by SENER that are necessary to calculate the OM *ex-post* are published normally more than one year after the end of the reporting year, leading to large delays between emission reduction on one hand and monitoring, verification and issuance of CERs on the other. Another reason to choose this option is that *ex-ante* monitoring is simpler for the project development and also for the emission reduction verification.

Step 4: Calculate the operating margin emission factor according to the selected method.

For calculating the Simple OM, the generation-weights average emission per electricity unit (tCO_2/MWh) of all generating sources serving the system excluding the low-cost/must-run generation units is used. It may be calculated:

- Based on the net electricity generation and a CO2 emission factor of each power unit (Option A), or
- Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system. (Option B), or

Option B can only be used if:
a) The necessary data for Option A is not available; and
b) Only nuclear and renewable power generation are considered as low-cost/must-run power sources and the quantity of electricity supplied to the grid by these sources is known; and
c) Off-grid power plants are not included in the calculation (i.e., if Option I has been chosen in Step 2).

Option B is used because total net electricity generation of all power plants serving the system as well as the fuel types and total fuel consumption of the project electricity system are available. Information needed for the Option A is not available.

$$EF_{grid,OM,simple,y} = \frac{\sum_i FC_{i,y} \cdot NCV_{i,y} \cdot EF_{CO2,i,y}}{EG_y} \qquad \textbf{(4)}$$

Where:

$EF_{grid,OM,simple,y}$ Simple operating margin CO_2 emission factor in year *y* (tCO_2/MWh).
$FC_{i,y}$ Amount of fossil fuel type *i* consumed in the project electricity system in year *y* (mass or volume unit).
$NCV_{i,y}$ Net calorific value (energy content) of fossil fuel type *i* in year *y* (GJ/mass or volume unit).
$EF_{CO2,i,y}$ CO2 emission factor of fossil fuel type *i* in year *y* (tCO2/GJ).
EG_y Net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost / must-run power plants / units, in year *y* (MWh).
i All fossil fuel types combusted in power sources in the project electricity system in year *y*.
y Either the three most recent years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex-ante option).

This $EF_{CO2,i,y}$ (in tC/TJ) can be found in the Reviewed 2006 IPCC Guidelines for Greenhouse Gas Inventories: Workbook,. Data for $FC_{i,m,y}$ can be found in TJ/day in the three Electricity Sector Outlooks (*Prospectivas)* so total annual consumption per fuel source can be calculated by multiplying by 365.

Step 5: Calculate the build margin (BM) emission factor.

In terms of vintage of data Option 1 has been selected, the calculation of the build margin emission factor ex ante is based on the most recent information available on units already built. This option states that for the first crediting period, calculate the build margin emission factor *ex ante* based on the most recent information available on units already built for sample group *m* at the time of CDM-PDD submission to the DOE for validation.

The sample group of power units "*m"* used to calculate the build margin is determined as per the following procedure, consistent with the data vintage selected above:

a) Identify the set of five power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently ($SET_{5\text{-units}}$) and determine their annual electricity generation ($AEG_{SET\text{-}5\text{-units}}$, in MWh);

b) Determine the annual electricity generation of the project electricity system, excluding power units registered as CDM project activities (AEGtotal, in MWh). Identify the set of power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently and that comprise 20% of AEG_{total} (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) ($SET_{\geq 20\%}$) and determine their annual electricity generation ($AEG_{SET\text{-}\geq 20\%}$, in MWh);

c) From $SET_{5\text{-units}}$ and $SET_{\geq 20\%}$ select the set of power units that comprises the larger annual electricity generation (SET_{sample});

$SET_{\geq 20\%}$ has been selected to calculate the BM because generation of five power plants built most recently is lower than 20% of the system generation; the five plants built most recently have a gross generation of 582 GWh that is less than 0.03% of total annual generation (215,276,000 MWh).

Identify the date when the power units in SET_{sample} started to supply electricity to the grid. If none of the power units in SET_{sample} started to supply electricity to the grid more than 10 years ago, then use SET_{sample} to calculate the build margin.

Since none of the power units in SET_{sample} started to supply electricity to the grid more than 10 years ago, then SET_{sample} was used to calculate the build margin.

The build margin emissions factor is the generation-weighted average emission factor (tCO2/MWh) of all power units m during the most recent year *y* for which power generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \cdot EF_{EL,m,y}}{\sum_m EG_{m,y}} \qquad \textbf{(5)}$$

Where:

$EF_{grid,BM,y}$ Build margin CO2 emission factor in year y (tCO2/MWh).
$EG_{m,y}$ Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh).
$EF_{EL,m,y}$ CO2 emission factor of power unit m in year y (tCO2/MWh).
m Power units included in the build margin.
y Most recent historical year for which power generation data is available.

The CO2 emission factor of each power unit m (EFEL,m,y) should be determined as per the guidance in Step 4 (a) for the simple OM, using options A1, A2 or A3, using for y the most recent historical year for which power generation data is available, and using for m the power units included in the build margin. Because of data availability option A2 has been chosen.

Step 6: Calculate the combined margin (CM) emissions factor.

The calculation of the combined margin (CM) emission factor ($EF_{grid,CM,y}$) is based on one of the following methods:

(a) Weighted average CM; or
(b) Simplified CM.

The weighted average CM method (option A) should be used as the preferred option.

The simplified CM method (option b) can only be used if:

• The project activity is located in a Least Developed Country (LDC) or in a country with less than 10 registered projects at the starting date of validation; and

• The data requirements for the application of step 5 above cannot be met.

Option A has been chosen since it is the preferred option and the project does not accomplish the requirements for choosing Option B.

The combined margin emissions factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$$

(6)

Where:

$EF_{grid,OM,y}$	Operating margin CO2 emission factor in year y (tCO2/MWh).
$EF_{grid,BM,y}$	Build margin CO2 emission factor in year y (tCO2/MWh).
w_{OM}	Weighting of operating margin emissions factor (%).
w_{BM}	Weighting of build margin emissions factor (%).

For this project, the default weights are as follows: $w_{OM} = 0.50$ and $w_{BM} = 0.50$.

Project emissions from additional fossil fuel consumption are calculated as follows:

According to the “Tool to calculate project or leakage CO2 emissions from fossil fuel combustion”, version 02, CO2 emissions from fossil fuel combustion in process j are calculated based on the quantity of fuels combusted and the CO2 emission coefficient of those fuels, as follows:

$$PE_{FC,j,y} = \sum_i FC_{i,j,y} \times COEF_{i,y} \qquad \textbf{(7)}$$

Where:
PEFC,j,y are the CO2 emissions from fossil fuel combustion in process j during the year y (tCO2 /yr);
FCi,j,y is the quantity of fuel type i combusted in process j during the year y (mass or volume unit / yr);
COEFi,y is the CO2 emission coefficient of fuel type i in year y (tCO2 / mass or volume unit);
i are the fuel types combusted in process j during the year y.

The CO2 emission coefficient COEFi,y can be calculated following two procedures, depending on the available data on the fossil fuel type i:

• Option A: The CO2 emission coefficient COEFi,y is calculated based on the chemical composition of the fossil fuel type i.
• Option B: The CO2 emission coefficient COEFi,y is calculated based on net calorific value and CO2 emission factor of the fuel type i.

Project participants are not expecting additional fossil fuels consumption for fuels drying, on-site transportation or flue gas treatment; however, if it becomes necessary to consume additional fossil fuels the corresponding formulae will be used and consumption will be monitored. Option B is chosen for calculations in case additional fossil fuels are consumed.

Step 3. Project emissions from combustion of fossil fuels for transportation of alternative fuels to the project plant

Option 1 has been chosen by CEMEX Mexico in order to calculate project emissions from combustion of fossil fuel for transportation of alternative fuels to the project plant.

Emissions are calculated on the basis of distance and the number of trips (or the average truck load):

$$PE_{T,y} = N_y \cdot AVD_y \cdot EF_{km,CO2,y} \qquad \textbf{(8)}$$

or

$$PE_{T,y} = \frac{\sum_k AF_{T,k,y}}{TL_y} \cdot AVD_y \cdot EF_{km,CO2,y} \qquad \textbf{(9)}$$

Where:

$PE_{T,y}$ = CO2 emissions during the year *y* due to transport of alternative fuels to the project (tCO2/yr)
Ny = Number of truck trips during the year y
AVD_y = Average round trip distance (from and to) between the alternative fuel supply sites and the site of the project plant during the year y (km)
$EF_{km,CO2,y}$ = Average CO2 emission factor for the trucks measured during the year y (tCO2/km)
$AF_{T,k,y}$ = Quantity of alternative fuel type k that has been transported to the project site during the year y (mass or volume units)
TL_y = Average truck load of the trucks used (tons or liter) during the year y.
k = Types of alternative fuels used in the project plant and that have been transported to the project plant in year y

Step 4. Calculate project emissions from the cultivation of renewable biomass at the dedicated plantation

The project activity will not use renewable biomass in the project activity. Therefore, this step is not applicable.

Baseline emissions

The project reduces CO2 emissions by using alternative fuels and/or less carbon intensive fossil fuels in cement kilns. If applicable, the project may also reduce CH4 emissions from preventing disposal or uncontrolled burning of biomass residues. Baseline emissions are calculated as follows:

$$BE_y = BE_{FF,y} + BE_{CH4,biomass,y} \qquad \textbf{(10)}$$

Where:

BE_y = Baseline emissions in year y (tCO2)
$BE_{FF,y}$ = Baseline emission from fossil fuels displaced by alternative fuels or less carbon intensive fossil fuels in year y (tCO2)

$BE_{CH4,biomass,y}$ = Baseline methane emissions avoided during the year y from preventing disposal or uncontrolled burning of biomass residues (tCO2e)

Baseline emissions are determined in the following steps:

Step 1. Estimate the project specific "fuel penalty"
Step 2. Calculate baseline emissions from the fossil fuels displaced by the alternative or less carbon intensive fuel(s)
Step 3. Calculate baseline emissions from decay, dumping or burning of biomass residues

Step 1. Estimate the project specific "fuel penalty"

A project specific fuel "penalty" is applied because the combustion of typically coarser biomass or other alternative fuels will reduce the heat transfer efficiency in the cement or quicklime manufacturing process. The use of alternative fuels will therefore require a greater heat input to produce the same quantity and quality of clinker or quicklime. The chemical content and ease of absorption into cement clinker of all fuel ashes also differs, and this also contributes to the need for a project specific "fuel penalty".

This project specific fuel penalty (FP_y) should be determined as follows:

$$FP_y = P_{clinker,y} x (SEC_{clinker,PJ,y} - SEC_{clinker,BL}) \quad \textbf{(11)}$$

Where:

FP_y = Fuel penalty in year *y* (GJ)
$P_{clinker,y}$ = Production of clinker in year *y* (tons)
$SEC_{clinker,PJ,y}$ = Specific energy consumption of the project plant in year *y* (GJ/t clinker)
$SEC_{clinker,BL}$ = Specific energy consumption of the project plant in the absence of the Project activity (GJ/t clinker)

The specific energy consumption in the project is calculated based on the quantity of all fuels used in the project plant and the quantity of clinker produced in year *y*, as follows:

$$SEC_{clinker,PJ,y} = \frac{\sum_i (FC_{PJ,i,y} x NCV_{i,y}) + \sum_k (FC_{PJ,k,y} x NCV_{k,y})}{P_{clinker,y}} \quad \textbf{(12)}$$

Where:
$SEC_{clinker,PJ,y}$ = Specific energy consumption of the project plant in year y (GJ/t clinker)
$FC_{PJ,i,y}$ = Quantity of fossil fuel type i fired in the project plant in year y (tons)
$NCV_{i,y}$ = Net calorific value of the fossil fuel type i in year y (GJ/ton)
$FC_{PJ,k,y}$ = Quantity of alternative fuel or less carbon intensive fossil fuel type k used in the project plant in year *y* (tons)
$NCV_{k,y}$ = Net calorific value of the alternative or less carbon intensive fuel type *k* in year y (GJ/tonne)
$P_{clinker,y}$ = Production of clinker in year *y* (tons)
k = Alternative fuel types and less carbon intensive fossil fuel types used in the project plant in year *y*
i = Fossil fuel types used in the project plant in year *y* that are not less carbon intensive

fossil fuel types

As a conservative approach, the specific energy consumption in the absence of the project activity should be calculated as the lowest annual ratio of fuel input per clinker production among the most recent three years prior to the start of the project activity, as follows:

$$SEC_{clinker,BL} = MIN\left[\frac{HG_x}{P_{clinker,x}};\frac{HG_{x-1}}{P_{clinker,x-1}};\frac{HG_{x-2}}{P_{clinker,x-2}};\right] \quad \textbf{(13)}$$

with

$$HG_x = \sum_i FC_{i,x} x NCV_i \quad \textbf{(14)}$$

Where:

$SEC_{clinker,BL}$ = Specific energy consumption of the project plant in the absence of the project activity (GJ/t clinker)
HG_x = Heat generated from fuel combustion in the project plant in the historical year *x* (GJ)
$FC_{i,x}$ = Quantity of fossil fuel type *i* used in the project plant in year *x* (tons)
NCV_i = Net calorific value of the fossil fuel type *i* (GJ/ton)
$P_{clinker,x}$ = Production of clinker in year *x* (tons)
x = Year prior to the start of the project activity
i = Fossil fuel types used in the project plant in the last three years prior to the start of the project activity

Step 2. Calculate baseline emissions from the fossil fuels displaced by the alternative or less carbon intensive fuel(s)

Baseline emissions from displacement of fossil fuels are calculated as follows:

$$BE_{FF,y} = \left[\sum_k \left(FC_{PJ,k,y} x NCV_{k,y}\right) - FP_y\right] \times EF_{CO2,BI,y}$$

(15)

Where:

$BE_{FF,y}$ = Baseline emission from fossil fuels displaced by alternative fuels or less carbon intensive fossil fuels in year *y* (tCO2)
$FC_{PJ,k,y}$ = Quantity of alternative fuel or less carbon intensive fossil fuel type *k* used in the project plant in year *y* (tons)
$NCV_{k,y}$ = Net calorific value of the alternative or less carbon intensive fuel type *k* in year y (GJ/tonne)
FPy = Fuel penalty in year *y* (GJ)
EFCO2,BL,y = Carbon dioxide emissions factor for the fossil fuels displaced by the use of alternative fuels or less carbon intensive fossil fuels in the project plant in year *y* (tCO2/GJ)
k = Alternative fuel types and less carbon intensive fossil fuel types used in the project plant in year *y*

The baseline emissions factor ($EF_{CO2,BL,y}$) is estimated as the lowest of the following CO2 emission factors:

A. The weighted average CO2 emission factor for the fossil fuel(s) consumed during the most recent three years before the start of the project activity, calculated as follows:

$$EF_{CO2,BL,y} = \frac{\sum_i \left(FC_{i,x-2} + FC_{i,x-1} + FC_{i,x}\right) \times NCV_i \times EF_{CO2,FF,i}}{\sum_i \left(FC_{i,x-2} + FC_{i,x-1} + FC_{i,x}\right) \times NCV_i} \tag{16}$$

Where:

$EF_{CO2,BL,y}$ = Carbon dioxide emissions factor for the fossil fuels displaced by the use of alternative fuels or less carbon intensive fossil fuels in the project plant in year *y* (tCO2/GJ)
$FC_{i,x}$ = Quantity of fossil fuel type *i* used in the project plant in year *x* (tons)
NCV_i = Net calorific value of the fossil fuel type *i* (GJ/ton)
$EF_{CO2,FF,i}$ = CO2 emission factor for fossil fuel type *i* (tCO2/GJ)
x = Year prior to the start of the project activity
i = Fossil fuel types used in the project plant in the last three years prior to the start of the project activity

B. The weighted average annual CO2 emission factor of the fossil fuel(s) that are not less carbon intensive fossil fuels and that are used in the project plant in year *y*, calculated as follows:

$$EF_{CO2,BL,y} = \frac{\sum_i FC_{PJ,i,y} \times NCV_i \times EF_{CO2,FF,i}}{\sum_i FC_{PJ,i,y} \times NCV_i} \tag{17}$$

Where:

$EF_{CO2,BL,y}$ = Carbon dioxide emissions factor for the fossil fuels displaced by the use of alternative fuels or less carbon intensive fossil fuels in the project plant in year *y* (tCO2/GJ)
$FC_{PJ,i,y}$ = Quantity of fossil fuel type *i* fired in the project plant in year *y* (tons)
$NCV_{i,y}$ = Net calorific value of the fossil fuel type *i* in year y (GJ/ton)
$EF_{CO2,FF,i,y}$ = Carbon dioxide emission factor for fossil fuel type *i* in year *y* (tCO2/GJ)
i = Fossil fuel types used in the project plant in year *y* that are not less carbon intensive fossil fuel types

Step 3. Calculate baseline emissions from decay, dumping or burning of biomass residues

The calculation of baseline methane emissions from biomass residues dumped, left to decay or burnt in an uncontrolled manner without utilizing them for energy purposes depends on the applicable baseline scenario (B1, B2 or B3). If for a certain biomass residue type k, leakage cannot be ruled out by using one of the approaches L1, L2 or L3 outlined in the leakage section, then no baseline methane emissions can be claimed from decay, dumping or uncontrolled burning of that biomass quantity. Baseline emissions from decay, dumping or burning of biomass residues are calculated as follows:

$$BE_{CH4,biomass,y} = BE_{CH4,B1/B3,y} + BE_{CH4,B2,y} \tag{18}$$

Where:

$BE_{CH4,biomass,y}$ = Baseline methane emissions avoided during the year *y* from preventing disposal or uncontrolled burning of biomass residues (tCO2e)
$BE_{CH4,B1/B3,y}$ = Baseline methane emissions avoided during the year *y* from aerobic decay and/or

uncontrolled burning of biomass residues (tCO2e)

$BE_{CH4,B2,y}$ = Baseline methane emissions avoided during the year *y* from anaerobic decay of biomass residues at a solid waste disposal site (tCO2e)

Uncontrolled burning or aerobic decay of the biomass residues (cases B1 and B3)

If the most likely baseline scenario for the use of a biomass residue type *k*, used as alternative fuel in the project plant, is that the biomass residue would be dumped or left to decay under mainly aerobic conditions (B1) or burnt in an uncontrolled manner without utilizing them for energy purposes (B3), baseline emissions are calculated assuming, for both scenarios viz., natural decay and uncontrolled burning, that the biomass residues would be burnt in an uncontrolled manner.

Baseline emissions avoided from aerobic decay and/or uncontrolled burning of biomass residues are calculated as follows:

$$BE_{CH4,B1/B3,y} = GWP_{CH4} \cdot \sum_{k} FC_{PJ,k,y} \cdot NCV_{k,y} \cdot EF_{burning,CH4,k,y} \qquad \textbf{(19)}$$

Where:

$BE_{CH4,B1/B3,y}$ = Baseline methane emissions avoided during the year *y* from aerobic decay and/or uncontrolled burning of biomass residues (tCO2e)

GWP_{CH4} = Global Warming Potential of methane valid for the commitment period (tCO2e/tCH4)

$FC_{PJ,k,y}$ = Quantity of alternative fuel or less carbon intensive fossil fuel type *k* used in the project plant in year *y* (tons)

$NCV_{k,y}$ = Net calorific value of the alternative or less carbon intensive fuel type *k* in year *y* (GJ/tonne)

$EF_{burning,CH4,k,y}$ = CH4 emission factor for uncontrolled burning of the biomass residue type *k* during the year *y* (tCH4/GJ)

k = Types of biomass residues used as alternative fuel in the project plant in year *y* for which the identified baseline scenario is B1 or B3 and for which leakage effects could be ruled out with one of the approaches L1, L2 or L3 described in the leakage section.

A default emission factor has been used in order to determine the CH4 emissions of 0.0027 tCH_4 per ton of biomass as default value for the product of NCV_k and $EF_{burning,CH4,k,y}$. The uncertainty can be deemed to be greater than 100%, resulting in a conservativeness factor of 0.73. Thus, in this case, an emission factor of 0.001971 tCH_4/t biomass will be used.

Anaerobic decay of the biomass residues (case B2)

According to tool "*Emissions from solid waste disposal sites"* it can be used to determine emissions for the following types of applications:

Application A: The CDM project activity mitigates methane emissions from a specific existing SWDS. Methane emissions are mitigated by capturing and flaring or combusting the methane (e.g. ACM0001). The methane is generated from waste disposed in the past, including prior to the start of the CDM project activity. In these cases, the tool is only applied for an ex- ante estimation of emissions in the CDM-PDD. The emissions will then be monitored during the crediting period using the applicable approaches in the relevant methodologies (e.g. measuring the amount of methane captured from the SWDS).

Application B: The CDM project activity avoids or involves the disposal of waste at a SWDS. An example of this application of the tool is AM0025, in which MSW is treated with an alternative option, such as composting or anaerobic digestion, and is then prevented from being disposed of in a SWDS. The methane is generated from waste disposed or avoided from disposal during the crediting period. In these cases, the tool can be applied for both ex-ante and ex-post estimation of emissions.

For the specific case of this project, Application B is suitable from the project since it avoids the disposal of waste at a solid waste disposal site.

The avoided emissions are calculated as follows:

$$BE_{CH4,B2,y} = \varphi_y * (1 - f_y) * GWP_{CH4} * (1 - OX) * \frac{16}{12} * F * DOC_{f,y} * MCF_y * \sum_{x=1}^{y} \sum_j W_{jx} * DOC_j * e^{-k_j*(y-x)} * (1 - e^{-k_j}) \quad \textbf{(20)}$$

Where:

$BE_{CH4,B2,y}$ = Baseline, project or leakage methane emissions occurring in year y generated from waste disposal at a SWDS during a time period ending in year y (t CO2e / yr)
x = Years in the time period in which waste is disposed at the SWDS, extending from the first year in the time period (x = 1) to year y (x = y).
y = Year of the crediting period for which methane emissions are calculated (y is a consecutive period of 12 months)
$DOC_{f,y}$ = Fraction of degradable organic carbon (DOC) that decomposes under the specific conditions occurring in the SWDS for year y (weight fraction)
$W_{j,x}$ = Amount of solid waste type j disposed or prevented from disposal in the SWDS in the year x (t)
φ_y = Model correction factor to account for model uncertainties for year y
f_y = Fraction of methane captured at the SWDS and flared, combusted or used in another manner, that prevents the emissions of methane to the atmosphere in year y
GWP_{CH4} = Global Warming Potential of methane
OX = Oxidation factor (reflecting the amount of methane from SWDS that is oxidised in the soil or other material covering the waste)
F = Fraction of methane in the SWDS gas (volume fraction)
MCFy = Methane correction factor for year y
DOCj = Fraction of degradable organic carbon in the waste type j (weight fraction)
kj = Decay rate for the waste type j (1 / yr)
j = Type of residual waste or types of waste in the MSW

Conservative default values have been chosen for φ_y, OX, F, $DOC_{f,y}$, MCFy, Kj and DOCj parameters. (For Kj parameter tropical and dry weather conditions have been chosen as they are descriptive for the region where the project will take place and where the MSW is expected to be obtained)[27].

The amount of different waste types will be determined through sampling and calculating the mean from the samples using equations as follows:

$$W_{j,x} = W_x * \rho_{j,x} \quad \textbf{(21)}$$

Where:

$W_{j,x}$ = Amount of solid waste type j disposed or prevented from disposal in the SWDS in the year x (t)
W_x = Total amount of solid waste disposed or prevented from disposal in the SWDS in year x (t)

[27] Sources: http://mapserver.inegi.org.mx/geografia/espanol/estados/son/temperat.cfm?c=444&e=26 and http://mapserver.inegi.org.mx/geografia/espanol/estados/son/precipit.cfm?c=444&e=26

$p_{j,x}$ = Average fraction of the waste type j in the waste in year x (weight fraction)
j = Types of solid waste
x = Years in the time period for which waste is disposed at the SWDS, extending from the first year in the time period (x = 1) to year y (x = y)

The fraction of the waste type j in the waste for the year x are calculated as follows:

$$\rho_{j,y} = \frac{\sum_{n=1}^{z_x} \rho_{n,j,x}}{Z_x} \tag{22}$$

Where:

$p_{j,x}$ = Average fraction of the waste type j in the waste in year x (weight fraction)
$p_{n,j,x}$ = Fraction of the waste type j in the sample n collected during the year x (weight fraction)
z_x = Number of samples collected during the year x
n = Samples collected in year x
j = Types of solid waste
x = Years in the time period for which waste is disposed at the SWDS, extending from the first year in the time period (x = 1) to year y (x = y)

Baseline emissions from anaerobic decay of the biomass residues will be calculated using the latest approved version of the tool "*Emissions form solid waste disposal sites*". The variable $BE_{CH4,SWDS,y}$ calculated by the tool is then corresponds to $BE_{CH4,B2,y}$ in this methodology. Use as waste quantities prevented from disposal ($W_{j,x}$) in the tool, those quantities of biomass residues ($BF_{PJ,k,y}$) for which B2 has been identified as the most plausible baseline scenario and for which leakage could be ruled out using one of the approaches L1, L2 or L3 described in the leakage section.

Leakage

For this type of project activity, two leakage sources have to be considered:

- In case of project activities using biomass residues, the project activity may result in an increase in emissions from fossil fuel combustion or other sources due to diversion of biomass residues from other uses to the project plant as a result of the project activity;
- In case of project activities using (a) less carbon intensive fossil fuel(s), leakage may result from fuel extraction, processing, liquefaction, transportation, re-gasification and distribution of fossil fuels outside of the project boundary. This includes mainly fugitive CH4 emissions and CO2 emissions from associated fuel combustion and flaring.

Leakage emissions are calculated as follows:

$$LE_y = LE_{BR,y} + LE_{FF,upstreamy} \tag{23}$$

Where:
LE_y = Leakage emissions during the year *y* (tCO2e/yr)
$LE_{BR,y}$ = Leakage emissions related to the use of biomass residues during the year *y* (tCO2)
$LE_{FF,upstream,y}$ = Upstream leakage emissions from fossil fuel use in year *y* (tCO2e)

Leakage emissions are calculated in two steps:

Step 1. Calculation of leakage emissions related to the use of biomass residues
Step 2. Calculation of upstream leakage emissions from fossil fuel use

Step 1. Calculation of leakage emissions related to the use of biomass residues

The project proponent used approach L2 to rule out leakage. According to L2 the project proponent has to demonstrate that there is an abundant surplus of the biomass residue in the region of the project activity which is not utilized. For this purpose, the project participants has to demonstrate that the quantity of available biomass residue of type k in the region is at least 25% larger than the quantity of biomass residues of type k that are utilized (e.g. for energy generation or as feedstock), including the project plant.

The region in the project plant would cover a radius around the project cement plants of 200 km.

A study was carried out to determine the common practice of the biomass residues considered for the project activity and their availability in the region. The results from this study clearly show that there is a surplus availability of the biomass residues and that without the implementation of the alternative project activity, there is an important quantity of biomass residues that would be dumped or left to decay under aerobic conditions on the generation sites. According to the study the following biomass residues have been identified for Yaqui cement plant:

Biomass Residues	Availability (Ton/year)
Sawdust and other wood residues	375,589
Corn Stubble	3,862,173
Barley Stubble	202,072
Sorghum Stubble	1,260,852
Wheat Stubble	3,417,597
Green Alfalfa Stubble	10,764,208
Oats Stubble	5,512,211
Bovine residues	14,651,153
Hog residues	2,175,073
Chicken litter	100,765
Ovine residues	199,528
Total	**42,521,221**

Table 15. Yaqui cement plant Biomass residues availability

Based on the data of Table 15 the quantity of available biomass residues in the region is at least 25% larger than the quantity of biomass residues that are utilized. In fact, the project activity expects to consume a maximum of 61.4 kton of biomass per year (mainly sorghum stubble, wood residues, corn, rice, oats, barley, wheat and alfalfa stubble and chicken litter) meaning a surplus availability of 73,457% Therefore, no leakage emission has been applied for the project activity. This information can be confirmed by studies made by public institutions INEGI and SAGARPA[29] where only biomass residues with no commercial use are considered and where it is defined that at least 1,519 PJ per year could be generated by the use of these residues. Using this information as a confirmation of previous data, a surplus availability of 171,186% is obtained. (1,519,000TJ/ 887TJ, where 887 TJ is the maximum energy

[29] Reference document:
"Estimación del Recurso y Prospectiva Tecnológica de la Biomasa Como Energético Renovable en México"
http://www.sener.gob.mx/webSener/res/168/A2_Biomasa.pdf
"Energías renovables para el desarrollo sustentable en México 2009"
http://www.sener.gob.mx/res/0/ER_para_Desarrollo_Sustentable_Mx_2009.pdf

per year to be generated by biomass residues in this project activity[30])

During the project implementation, CEMEX Mexico shall demonstrate that the use of the biomass residues does not result in increased fossil fuel consumption elsewhere. For this purpose, CEMEX Mexico will monitor the supply situation for the types of biomass residues used in the project activity using one of the approaches L1, L2 or L3 of the applicable methodology. The approach used will depend on the biomass residues situation in the region and the information available each year.

Project participant shall apply a leakage emission to the type of biomass residues k, for which project CEMEX Mexico cannot demonstrate with one of the approaches (L1, L2 &L3) that the use of the biomass does not result in leakage. The leakage emission aims at adjusting emission reductions for leakage effects in a conservative manner, assuming that this quantity of biomass residue is substituted by the most carbon intensive fuel in the country.

If for a certain type of biomass residue *k* used in the project activity, leakage effects cannot be ruled out with one of the approaches above; leakage effects for the year *y* shall be calculated as follows:

$$LE_{BR,y} = EF_{CO2,LE} \cdot \sum_{k} FC_{PJ,k,y} \cdot NCV_{k,y} \quad \textbf{(24)}$$

Where:
$LE_{BR,y}$ = Leakage emissions during the year *y* (tCO_2/yr)
$EF_{CO2,LE}$ = CO_2 emission factor of the most carbon intensive fuel used in the country (tCO_2/GJ)
$FC_{PJ,k,y}$ = Quantity of biomass residue type *k* used in the project plant in year *y* (tons)
$NCV_{k,y}$ = Net calorific value of the biomass residue type *k* in year y (GJ/ton of dry matter)
k = Types of biomass residues for which leakage effects could not be ruled out with one of the approaches L1, L2 or L3 above

Step 2. Calculation of upstream leakage emissions from fossil fuel use

Less carbon intensive fossil fuels will not be used in the project activity. Therefore leakage emissions from fossil fuel use will be not considered.

Emission Reductions

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y \quad \textbf{(25)}$$

Where:
ER_y = Emission reductions during the year *y* (tCO_2/yr)
BE_y = Baseline emissions during the year *y* (tCO_2e/yr)
PE_y = Project emissions during the year *y* (tCO_2e/yr)
LE_y = Leakage emissions during the year *y* (tCO_2e/yr)

Changes required for methodology implementation in 2nd and 3rd crediting periods:

At the renewal of the crediting period, CEMEX Mexico will evaluate whether the project activity continues not to be the baseline scenario, i.e. whether it would have been implemented in the absence of the project activity. The procedure outlined under baseline scenario selection and demonstration of

[30] Calculations included in emissions reduction spreadsheet

additionality above will be used for that purpose. Furthermore, all relevant data contained under "Data and parameters not monitored" will be updated.

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

(Copy this table for each data and parameter)

Data / Parameter:	**$FC_{i,x}$, $FC_{i,x-1}$ and $FC_{i,x-2}$**
Data unit:	Tons
Description:	Quantity of fossil fuel of type *i* used in the project plant in year *x, x-1* and *x-2* where *x* is the year prior to the start of the project activity and *i* are the fossil fuel types used in the project plant in the last three years prior to the start of the project activity
Source of data used:	Three years data from fuel consumption data logs at the project site
Value applied:	(see table below)
Justification of the choice of data or description of measurement methods and procedures actually applied :	Instrument used: Scale. Data based on online measurements and cross checked with fuels purchase records and stock changes.
Any comment:	Data will be archived 2 years after the end of the crediting period. All data is available and recorded according to ISO 9001 and ISO 14001 management systems.

	Fuel consumption (tons/year)		
Fuel type	**2007**[31]	**2008**	**2009**
Petcoke	106,048	34,939	62,656
Fuel Oil	1,062	474	169
Liquids	0	0	306

Data / Parameter:	**$P_{clinker,x}$, $P_{clinker,x-1}$ and $P_{clinker,x-2}$**
Data unit:	Tons
Description:	Production of clinker in year x, x-1 and x-2 where x is the year prior to the start of the project activity
Source of data used:	Three years data from fuel consumption data logs at the project site
Value applied:	(see table below)
Justification of the choice of data or description of	Instrument used: Scale. Data based on online measurements and cross checked with annual reports.

Clinker production (tons/year)		
2007[32]	**2008**	**2009**
1,086,286	365,124	640,650

[31] Information from kiln # 1 was used for year 2007, to ensure a conservative approach, given that kiln #2 only had a 2 year history of operation

[32] Information from kiln # 1 was used for year 2007, to ensure a conservative approach, given that kiln #2 only had a 2 year history of operation

measurement methods and procedures actually applied :	
Any comment:	Data will be archived 2 years after the end of the crediting period. All data is available and recorded according to ISO 9001 and ISO 14001 management systems.

Data / Parameter:	**NCV_i**
Data unit:	GJ/Ton
Description:	Net calorific value of fossil fuel type i where i are the fossil fuel types used in the project plant in the last three years prior to the start of the project activity
Source of data:	Plant records.
Value applied:	see table below
Justification of the choice of data or description of measurement methods and procedures actually applied :	Instrument used: Calorimeter. Analysis by project proponent.
Any comment:	Data will be archived 2 years after the end of the crediting period. All data is available and recorded according to ISO 9001 and ISO 14001 management systems.

Fuel Type	**GJ/ton**	**kcal/kg**
Petcoke	34.1	8,156
Fuel Oil	39.0	9,321
Liquids	28.2	6,740

Data / Parameter:	**$EF_{CO2,FF,i}$**
Data unit:	tCO_2/GJ
Description:	Weighted average CO_2 emission factor for fossil fuel type i where i are the fossil fuel types used in the project plant in the last three years prior to the start of the project activity
Source of data used:	IPCC and plants records
Value applied:	see table below
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data archived: entire crediting period. IPCC default value and plants records.
Any comment:	

Fuel Type	**Ton CO2/GJ**
Petcoke	0.0925
Fuel Oil	0.0755
Liquids	0.0722

Data / Parameter:	**$EF_{grid,y}$**
Data unit:	tCO_2/MWh
Description:	Ex-ante emission factor for the grid in year y
Source of data used:	Revised 2006 IPCC, CFE and Sener: *“Prospectiva del Sector Eléctrico 2009-2024”*, *“Prospectiva del Sector Eléctrico 2008-2017”* and *“Prospectiva del Sector Eléctrico 2007-2016”.*
Value applied:	0.528 tCO_2/MWh
Justification of the choice of data or description of measurement methods and procedures actually applied :	We have chosen the emission factor ex ante because is simpler for the project development and also for the emission reduction verification. The procedures applied are provided in Annex 3.
Any comment:	The ex-ante combined margin emission factor was calculated using the procedures in the latest approved version of the “Tool to calculate project emissions from electricity consumption”.

Data / Parameter:	**$TDL_{,y}$**
Data unit:	-
Description:	Average technical transmission and distribution losses in the grid in year y for the voltage level at which electricity is obtained from the grid at the project site
Source of data to be used:	Using the procedures in the latest approved version of the “Tool to calculate project emissions from electricity consumption”.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Default value of 20%
Description of measurement methods and procedures to be applied:	
QA/QC procedures to be applied:	As per the “Tool to calculate project emissions from electricity consumption”. All data is available and recorded according to ISO 9001 and ISO 14001 management systems.
Any comment:	Applicable for cases A and C of the “Tool to calculate project emissions from electricity consumption”

Data / Parameter:	**$\Phi_{default}$**
Data unit:	-
Description:	Default model correction factor to account for model uncertainties
Source of data used:	Default value from tool “Emissions from Solid Waste Disposal Sites”
Value applied:	0.80
Justification of the choice of data or description of measurement methods and procedures actually	For the application indicated at the applied tool (B), and conditions existing at the region where residues will be obtained (dry) this value is applicable.

applied :	
Any comment:	-

Data / Parameter:	OX
Data unit:	-
Description:	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
Source of data used:	Based on an extensive review of published literature on this subject, including the IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied:	0.1
Justification of the choice of data or description of measurement methods and procedures actually applied :	When methane passes through the top-layer, part of it is oxidized by methanotrophic bacteria to produce CO2. The oxidation factor represents the proportion of methane that is oxidized to CO2 This should be distinguished from the methane correction factor (MCF) which is to account for the situation that ambient air might intrude into the SWDS and prevent methane from being formed in the upper layer of SWDS
Any comment:	-

Data / Parameter:	F
Data unit:	-
Description:	Fraction of methane in the SWDS gas (volume fraction)
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied:	0.5
Justification of the choice of data or description of measurement methods and procedures actually applied :	This factor reflects the fact that some degradable organic carbon does not degrade, or degrades very slowly, under anaerobic conditions in the SWDS. A default value of 0.5 is recommended by IPCC
Any comment:	Upon biodegradation, organic material is converted to a mixture of methane and carbon dioxide

Data / Parameter:	$DOC_{f,default}$
Data unit:	Weight fraction
Description:	Default value for the fraction of degradable organic carbon (DOC) in MSW that decomposes in the SWDS
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied:	0.5
Justification of the choice of data or description of measurement methods and procedures actually applied :	This factor reflects the fact that some degradable organic carbon does not degrade, or degrades very slowly, in the SWDS. According to applicable tool, This default value can only be used for i) Application A; or ii) Application B if the tool is applied to MSW. (This condition applies)
Any comment:	-

Data / Parameter:	$MCF_{default}$
Data unit:	-
Description:	Methane correction factor
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories

Value applied:	1.0
Justification of the choice of data or description of measurement methods and procedures actually applied :	MSW is expected to be obtained from a SWDS accomplishing the following conditions: the SWDS does not have a water table above the bottom of the SWDS and has a controlled placement of waste (i.e.waste directed to specific deposition areas, a degree of control of scavenging and a degree of control of fires) and will include at least one of the following: (i) cover material; (ii) mechanical compacting; or (iii) leveling of the waste; In case of unmanaged SWS aerobic decomposition is assumed, according to methodology ACM0003.
Any comment:	-

Data / Parameter:	DOCj
Data unit:	-
Description:	Fraction of degradable organic carbon in the waste type j (weight fraction)
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Tables 2.4 and 2.5)
Value applied:	see table below
Justification of the choice of data or description of measurement methods and procedures actually applied :	The percentages listed in Table 4 are based on a wet waste basis, which are concentrations in the waste as it is delivered to the SWDS. The IPCC Guidelines also specify DOC values on a dry waste basis, which are the concentrations after complete removal of all moist from the waste, which is not believed practical for this situation
Any comment:	-

Biomass Residues	DOCj
Wood	0.43
Textiles	0.24
Paper	0.4
Other Biomass	0.15
Garden, yard, and park waste	0.2
Glass, plastic and other inert	0

Data / Parameter:	kj
Data unit:	1/yr
Description:	Decay rate for the waste type j
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 3.3)
Value applied:	see table below
Justification of the	As explained in sections B.6.1 and B.6.3, the presented values are

Biomass Residues	kj
Wood	0.025
Textiles	0.045
Paper	0.045
Other Biomass	0.085
Garden, yard, and park waste	0.065

choice of data or description of measurement methods and procedures actually applied :	corresponding with conditions where MSW will be obtained (Tropical and dry)
Any comment:	-

Data / Parameter:	GWP_{CH4}
Data unit:	t CO2e / t CH4
Description:	Global Warming Potential of methane
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied:	21 for the first commitment period. Shall be updated for future commitment periods according to any future COP/MOP decisions
Justification of the choice of data or description of measurement methods and procedures actually applied :	As recommended by the Tool Emissions from solid waste disposal sites.
Any comment:	-

B.6.3 Ex-ante calculation of emission reductions:

Project emissions:

Project emissions include project emissions from the use of alternative fuels and/or less carbon intensive fossil fuels ($PE_{k,y}$), project emissions from additional electricity and/or fossil fuel consumption as a result of the project activity ($PE_{EC,y}$ and $PE_{FC,y}$), project emissions from combustion of fossil fuels for transportation of alternative fuels to the project plant ($PE_{T,y}$), and, if applicable, project emissions from the cultivation of renewable biomass at the dedicated plantation ($PE_{BC,y}$):

$$PE_y = PE_{k,y} + PE_{FC,y} + PE_{EC,y} + PE_{T,y} + PE_{BC,y}$$

Where:

PE_y = Project emissions during the year y (tCO_{2e})
$PE_{k,y}$ = Project emissions from combustion of alternative fuels and/or less carbon intensive fossil fuels in the project plant in year y (tCO_2)
$PE_{FC,y}$ = Project emissions from additional fossil fuel combustion as a result of the project activity in year y (tCO_2)
$PE_{EC,y}$ = Project emissions from additional electricity consumption as a result of the project activity in year *y* (tCO_2)
$PE_{T,y}$ = CO2 emissions during the year y due to transport of alternative fuels to the project plant (tCO_2)
$PE_{BC,y}$ = Project emissions from the cultivation of renewable biomass at the dedicated in year y (tCO_{2e})

Step 1. Calculate project emissions from the use of alternative fuels and/or less carbon intensive fossil fuels

Project emissions from the use of alternative fuels and/or less carbon intensive fossil fuels in the project plant are calculated as follows:

$$PE_{k,y} = \sum_{k} FC_{PJ,k,y} \text{ x } NCV_{k,y} \text{ x } EF_{CO2,k,y}$$

Alternative Fuels	NCVk,y (kcal/kg)	EFCO2,k,y (Ton CO2/TJ)
Wood residues	4,000	0.0
Fabric and Textiles	4,000	0.0
Paper and cardboard	3,500	0.0
Organic sludge	7,000	0.0
Other Biomass Residues	3,500	0.0
MSW	4,259	24.6
Plastics	5,800	74.4
Liquid waste	6,000	74.4
Refinery residues	5,000	74.4
Tires	7,500	74.4
Industrial Sludge	4,200	79.9

Table 16. Alternative fuels net calorific value and emission factor data. Sources: IPCC 2006 Guidelines, Volume II and plant records.

Alternative fuels consumption (Tons/year)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Wood residues	0	0	0	46	46	46	46
Fabric and Textiles	0	0	0	46	46	46	46
Paper and cardboard	0	3,949	3,949	6,582	6,582	9,214	9,214
Organic sludge	0	0	0	26	26	26	26
Other Biomass Residues	3,038	3,038	3,038	23,299	35,970	35,970	35,970
MSW	6,490	18,390	18,390	18,390	18,390	18,390	18,390
Plastics	0	0	0	32	32	32	32
Liquid waste	1,536	1,536	3,071	3,071	4,607	6,143	6,143
Refinery residues	0	0	0	37	37	37	37
Tires	17,728	21,279	21,279	21,279	21,279	21,279	21,279
Industrial Sludge	0	0	0	44	44	44	44

Table 17. Proposed alternative fuels consumption for the seven year crediting period.

Project emissions from the use of alternative fuels and/or less carbon intensive fossil fuels

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
PEk,y (TonCO2/year)	47,052	60,535	63,400	63,576	66,442	69,308	69,308

Table 18. Calculated project emissions from the use of alternative fuels and/or less carbon intensive fossil fuels.

Step 2. Calculate project emissions from additional electricity and/or fossil fuel consumption as a result of the project activity

Project emissions from the consumption of additional grid electricity are calculated as follows:

Since the project activity will be consuming electricity only from the grid. Scenario A, Option A1, of the latest approved version of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" is applicable.

$$PE_{E.C,y} = \sum_j EC_{PJ,j,y} \times EF_{EL,j,y} \times (1 + TDL_{j,y}) \quad \textbf{(3)}$$

The grid emission factor (EFgrid,y) was calculated using the procedures in the latest approved version of the "Tool to calculate the emission factor for an electricity system", Version 02.2.1, resulting in a value of 0.528 tCO_2/MWh. See Annex 3 for the detailed calculation.

Based on the latest approved version of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" a default 20% value was chosen for the TDL (Transmission and Distribution Loses)

The expected additional grid electricity consumption derived from the CDM project activity implementation is shown in the following table (it is assumed that project equipments will work at a 90% capacity, such as the cement kiln):

Equipment	**Electricity Consumption ($EC_{PJ,y}$) in MWh/year**
Centering conveyor	6
Chain hoist	29
Belt Conveyors	53
Hopper and agglomerator	118
Rotatory valve	59
Blower	670
Total	**936**

Table 19. Expected grid electricity consumption. Source: Based on equipment power capacity.

Based on the above the resulting project emissions from grid electricity consumption ($PE_{EC,y}$) are:

	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**
EC_{PJjy} (MWh/yr)	936	936	936	936	936	936	936
$EF_{grid,,y}$ (TonCO2/MWh)	0.528	0.528	0.528	0.528	0.528	0.528	0.528
TDL (%)	20%	20%	20%	20%	20%	20%	20%
$PE_{EC,y}$ (TonCO2/year)	593	593	593	593	593	593	593

Table 20. Calculated project emissions from the consumption of additional grid electricity.

Project emissions from additional fossil fuel consumption are calculated as follows:

According to the "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion", version 02, CO2 emissions from fossil fuel combustion in process j are calculated based on the quantity of fuels combusted and the CO2 emission coefficient of those fuels, as follows:

$$PE_{FC,j,y} = \sum_i FC_{i,j,y} \times COEF_{i,y} \quad \textbf{(7)}$$

Currently there is not available an ex-ante estimation of the additional fossil fuels that might be consumed from the Project activity because there is no certainty if this additional fossil fuels will be consumed during the project implementation. However, as required by the methodology this emission source is included in the monitoring parameters.

Step 3. Project emissions from combustion of fossil fuels for transportation of alternative fuels to the project plant

Option 1 has been chosen by CEMEX Mexico in order to calculate project emissions from combustion of fossil fuel for transportation of alternative fuels to the project plant.

Emissions are calculated on the basis of distance and the average truck load:

$$PE_{T,y} = \frac{\sum_k AF_{T,k,y}}{TL_y} \cdot AVD_y \cdot EF_{km,CO2,y} \qquad \textbf{(9)}$$

		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
$AF_{T,k,y}$	**tons/year**	28,792	48,191	49,727	72,851	87,058	91,226	91,226
TLy	**ton/veh.**	28	28	28	28	28	28	28
AVDy	**km/veh**	400	400	400	400	400	400	400
$EF_{km,CO2,y}$	**kgCO2e/km**	0.88	0.88	0.88	0.88	0.88	0.88	0.88

Table 21. Alternative fuels transportation data. Sources: IPCC 2006 Guidelines, Volume II; Plant records and Alternative Fuels suppliers.

Project emissions from combustion of fossil fuels for transportation of alternative fuels to the project plant

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
$PE_{T,y}$ (TonCO2/year)	362	606	625	916	1,095	1,147	1,147

Table 22. Calculated project emissions from combustion of fossil fuels for transportation of alternative fuels to the project plant.

Step 4. Calculate project emissions from the cultivation of renewable biomass at the dedicated plantation

The project activity will not use renewable biomass from a dedicated plantation. Therefore, this step is not applicable.

Total Project Emissions

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
PEk,y (TonCO2/year)	47,052	60,535	63,400	63,576	66,442	69,308	69,308
$PE_{FC,y}$ (TonCO2/year)	0	0	0	0	0	0	0
$PE_{EC,y}$ (TonCO2/year)	593	593	593	593	593	593	593
$PE_{t,y}$ (TonCO2/year)	362	606	625	916	1,095	1,147	1,147
$PE_{BC,y}$ (TonCO2/year)	0	0	0	0	0	0	0
PE_y	**48,007**	**61,733**	**64,618**	**65,085**	**68,130**	**71,048**	**71,048**

(TonCO2/year)							

Table 23. Calculated total project emissions.

Baseline emissions

The project reduces CO2 emissions by using alternative fuels and/or less carbon intensive fossil fuels in cement kilns. If applicable, the project may also reduce CH4 emissions from preventing disposal or uncontrolled burning of biomass residues. Baseline emissions are calculated as follows:

$$BE_y = BE_{FF,y} + BE_{CH4,biomass,y} \qquad \textbf{(10)}$$

Where:

BE_y = Baseline emissions in year y (tCO2)
$BE_{FF,y}$ = Baseline emission from fossil fuels displaced by alternative fuels or less carbon intensive fossil fuels in year y (tCO2)
$BE_{CH4,biomass,y}$ = Baseline methane emissions avoided during the year y from preventing disposal or uncontrolled burning of biomass residues (tCO2e)

Step 1. Estimate the project specific "fuel penalty"

This project specific fuel penalty (FP_y) should be determined as follows:

$$FP_y = P_{clinker,y} x (SEC_{clinker,PJ,y} - SEC_{clinker,BL}) \qquad \textbf{(11)}$$

	Net calorific value		Fuel consumption (tons/year)		
Fuel type	**GJ/ton**	**kcal/kg**	**2007**	**2008**	**2009**
Petcoke	34.1	8,156	106,048	34,939	62,656
Fuel Oil	39.0	9,321	1,062	474	169
Liquids	28.2	6,740	0	0	306

Table 24. Fossil fuel net calorific value and historical consumption data. Source: Plant Records and IPCC 2006 Guidelines, Volume II.

Clinker production (tons/year)		
2007	**2008**	**2009**
1,086,286	365,124	640,650

Table 25. Historical clinker production data. Source: Plant Records.

Specific energy consumption (SEC) is obtained as follows:

$$SEC_{clinker,PJ,y} = \frac{\sum_i (FC_{PJ,i,y} x NCV_{i,y}) + \sum_k (FC_{PJ,k,y} x NCV_{k,y})}{P_{clinker,y}} \qquad \textbf{(12)}$$

and

$$SEC_{clinker,BL} = MIN\left[\frac{HG_x}{P_{clinker,x}}; \frac{HG_{x-1}}{P_{clinker,x-1}}; \frac{HG_{x-2}}{P_{clinker,x-2}};\right] \qquad \textbf{(13)}$$

with

$$HG_x = \sum_i FC_{i,x} x NCV_i \quad \textbf{(14)}$$

According to methodology ACM0003, as a conservative approach, the specific energy consumption in the absence of the project activity is calculated as the lowest annual ratio of fuel input per clinker or quicklime production among the most recent three years prior to the start of the project activity. The specific energy consumption for the project activity has been estimated as the most recent energy consumption (from year 2009), as follows:

	2007	**2008**	**2009**	**$SEC_{clinker,BL}$**	**$SEC_{clinker,PJ,y}$**
Specific Fuel consumption (GJ/ton clk)	3.37	3.31	3.36	3.31	3.36

Table 26. Specific fuel consumption data for the clinker manufacturing process. Source: Plant Records.

With those results, then the fuel penalty is calculated, obtaining the following results:

	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**
$P_{clinker,y}$ (tons)	1,147,000	1,147,000	1,147,000	1,147,000	1,147,000	1,147,000	1,147,000
$SEC_{clinker,PJ,y}$ (GJ/t clinker)	3.36	3.36	3.36	3.36	3.36	3.36	3.36
$SEC_{clinker,BL}$ (GJ/t clinker)	3.31	3.31	3.31	3.31	3.31	3.31	3.31
FP_y(GJ)	**51,729**	**51,729**	**51,729**	**51,729**	**51,729**	**51,729**	**51,729**

Table 27. Calculated project specific "fuel penalty".

Step 2. Calculate baseline emissions from the fossil fuels displaced by the alternative or less carbon intensive fuel(s)

Baseline emissions from displacement of fossil fuels are calculated as follows:

$$BE_{FF,y} = \left[\sum_k \left(FC_{PJ,k,y} xNCV_{k,y} \right) - FP_y \right] \times EF_{CO2,BI,y} \quad \textbf{(15)}$$

Alternative fuels consumption		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Wood residues	(Ton/year)	0	0	0	46	46	46	46
Fabric and Textiles	(Ton/year)	0	0	0	46	46	46	46
Paper and cardboard	(Ton/year)	0	3,949	3,949	6,582	6,582	9,214	9,214
Organic sludge	(Ton/year)	0	0	0	26	26	26	26
Other Biomass Residues	(Ton/year)	3,038	3,038	3,038	23,299	35,970	35,970	35,970
MSW	(Ton/year)	6,490	18,390	18,390	18,390	18,390	18,390	18,390
Plastics	(Ton/year)	0	0	0	32	32	32	32
Liquid waste	(Ton/year)	1,536	1,536	3,071	3,071	4,607	6,143	6,143
Refinery residues	(Ton/year)	0	0	0	37	37	37	37
Tires	(Ton/year)	17,728	21,279	21,279	21,279	21,279	21,279	21,279
Industrial Sludge	(Ton/year)	0	0	0	44	44	44	44

Table 28. Alternative fuels consumption

Alternative fuel	NCV

	(GJ/ton)
Wood residues	16.7
Fabric and Textiles	16.7
Paper and cardboard	14.6
Organic sludge	29.3
Other Biomass Residues	14.6
MSW	17.8
Plastics	24.3
Liquid waste	25.1
Refinery residues	20.9
Tires	31.4
Industrial Sludge	17.6

Table 29. Alternative fuels NCV

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
FP_y(GJ)	51,729	51,729	51,729	51,729	51,729	51,729	51,729
$EF_{CO2,BL,y}$ (A) (tCO2/GJ)	0.092	0.092	0.092	0.092	0.092	0.092	0.092
$EF_{CO2,BL,y}$ (B) (tCO2/GJ)	0.092	0.092	0.092	0.092	0.092	0.092	0.092
$EF_{CO2,BL,y}$ (tCO2/GJ)	0.092	0.092	0.092	0.092	0.092	0.092	0.092
$BE_{FF,y}$(Ton CO2/year)	**64,824**	**99,936**	**103,484**	**134,745**	**155,332**	**162,409**	**162,409**

Table 30. Calculated baseline emissions from the fossil fuels displaced by the alternative or less carbon intensive fuel(s).

Step 3. Calculate baseline emissions from decay, dumping or burning of biomass residues

The calculation of baseline methane emissions from biomass residues dumped, left to decay or burnt in an uncontrolled manner without utilizing them for energy purposes depends on the applicable baseline scenario (B1, B2 or B3). If for a certain biomass residue type k, leakage cannot be ruled out by using one of the approaches L1, L2 or L3 outlined in the leakage section, then no baseline methane emissions can be claimed from decay, dumping or uncontrolled burning of that biomass quantity. Baseline emissions from decay, dumping or burning of biomass residues are calculated as follows:

$$BE_{CH4,biomass,y} = BE_{CH4,B1/B3,y} + BE_{CH4,B2,y} \quad \textbf{(16)}$$

Where:

$BE_{CH4,biomass,y}$ = Baseline methane emissions avoided during the year *y* from preventing disposal or uncontrolled burning of biomass residues (tCO2e)

$BE_{CH4,B1/B3,y}$ = Baseline methane emissions avoided during the year *y* from aerobic decay and/or uncontrolled burning of biomass residues (tCO2e)

$BE_{CH4,B2,y}$ = Baseline methane emissions avoided during the year *y* from anaerobic decay of biomass residues at a solid waste disposal site (tCO2e)

Uncontrolled burning or aerobic decay of the biomass residues (cases B1 and B3)

Alternative fuels considered:

- Wood residues
- Fabric and Textiles
- Paper and cardboard

- Organic sludge
- Other Biomass Residues (such as rice husk, coffee husk, corn residues, agropecuary residues, pollinase, etc)

Baseline emissions avoided from aerobic decay and/or uncontrolled burning of biomass residues are calculated as follows:

$$BE_{CH4,B1/B3,y} = GWP_{CH4} \cdot \sum_{k} FC_{PJ,k,y} \cdot NCV_{k,y} \cdot EF_{burning,CH4,k,y} \qquad \textbf{(17)}$$

$EF_{burning,CH4,k,y}$ (tCH_4/t biomass)	0.0027
Conservativeness factor	0.73
GWP_{CH4} (tCO2e/tCH4)	21.00

Table 31. Uncontrolled burning or aerobic decay of the biomass residues factors. Sources: Methodology ACM0003 version 7.4.1

Alternative Fuels	NCVk,y (kcal/kg)	EFCO2,k,y (Ton CO2/TJ)
Wood residues	4,000	0.0
Fabric and Textiles	4,000	0.0
Paper and cardboard	3,500	0.0
Organic sludge	7,000	0.0
Other Biomass Residues (e.g. rice husk, coffee husk, etc.)	3,500	0.0

Table 32. Biomass residues net calorific value and emission factor data. Sources: IPCC 2006 Guidelines, Volume II and plant records.

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Wood residues (Tons/year)	0	0	0	46	46	46	46
Fabric and Textiles (Tons/year)	0	0	0	46	46	46	46
Paper and cardboard (Tons/year)	0	3,949	3,949	6,582	6,582	9,214	9,214
Organic sludge (Tons/year)	0	0	0	26	26	26	26
Other Biomass Residues (Tons/year)	3,038	3,038	3,038	23,299	35,970	35,970	35,970
$BE_{CH4,B1/B3,y}$ (tCO2e/year)	**126**	**289**	**289**	**1,242**	**1,766**	**1,875**	**1,875**

Table 33. Calculated baseline emissions from the uncontrolled burning or aerobic decay of the biomass residues.

Anaerobic decay of the biomass residues (case B2)

Alternative fuels considered:

- Municipal Solid Waste

Baseline emissions from anaerobic decay of the biomass residues will be calculated using the latest approved version of the tool “Emissions from solid waste disposal sites”. The variable $BE_{CH4,SWDS,y}$ calculated by the tool is then corresponds to $BE_{CH4,B2,y}$ in this methodology. Use as waste quantities prevented from disposal ($W_{j,x}$) in the tool, those quantities of biomass residues ($BF_{PJ,k,y}$) for which B2 has been identified as the most plausible baseline scenario and for which leakage could be ruled out using one of the approaches L1, L2 or L3 described in the leakage section.

Baseline emissions avoided from anaerobic decay and of biomass residues are calculated as follows:

$$BE_{CH4,B2,y} = \varphi_y * (1 - f_y) * GWP_{CH4} * (1 - OX) * \frac{16}{12} * F * DOC_{f,y} * MCF_y * \sum_{x=1}^{y} \sum_{j} W_{jx} * DOC_j * e^{-k_j*(y-x)} * (1 - e^{-k_j}) \qquad \textbf{(20)}$$

The following values were used for calculations:

Parameter	Value
φ	0.80
f	0.00
GWP_ch4	21.00
OX	0.10
F	0.50
DOCf	0.50
MCF	1.00

Table 34. Parameters for calculation of CH4 from anaerobic decomposition

Weather conditions		Conditions
Mean Annual Temperature (°C)	20 - 26	Tropical
Mean Annual Precipitation (mm)	100 - 500	Dry

Table 35. Weather conditions for determination of kj[33]

Biomass Residues	DOCj	kj
Wood	0.43	0.025
Textiles	0.24	0.045
Paper	0.40	0.045
Other Biomass	0.15	0.085

Table 36. Fraction of degradable organic carbon in the waste and decay rates of different types of wastes

MSW composition	
Organic	53%
Wood	0%
Paper and cardboard	14%
Textiles	1%
Plastics	4%
Glass	6%
Metals	3%
Others	19%

Table 37. Composition of Municipal solid wastes[34]

[33] Sources: http://mapserver.inegi.org.mx/geografia/espanol/estados/son/temperat.cfm?c=444&e=26 and http://mapserver.inegi.org.mx/geografia/espanol/estados/son/precipit.cfm?c=444&e=26

[34] According to national statistics. Evidences will be delivered to the DOE

As it has been described in section B.6.1, Conservative default values have been chosen for φy, OX, F, DOCf,y, MCFy, Kj and DOCj parameters. For Kj parameter tropical and wet weather conditions have been chosen as they are descriptive for the region where the project will take place.

The following results were obtained (See Annex 3 for further details):

		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
QAFLj,x wood biomass residue quantity	ton/year	0	0	0	0	0	0	0
LW CH4 emissions due to anaerobic decomposition	tCO2e/year	0	0	0	0	0	0	0
QAFLj,x textiles biomass residue quantity	ton/year	65	184	184	184	184	184	184
LW CH4 emissions due to anaerobic decomposition	tCO2e/year	3	13	22	31	40	48	55
QAFLj,x paper biomass residue quantity	ton/year	909	2,575	2,575	2,575	2,575	2,575	2,575
LW CH4 emissions due to anaerobic decomposition	tCO2e/year	81	305	520	726	922	1,110	1,290
QAFLj,x other biomass residue quantity	ton/year	3,440	9,746	9,746	9,746	9,746	9,746	9,746
LW CH4 emissions due to anaerobic decomposition	tCO2e/year	212	795	1,331	1,823	2,275	2,690	3,071
LW CH4 Total emissions due to anaerobic decomposition	**tCO2e/year**	**296**	**1,114**	**1,873**	**2,580**	**3,236**	**3,847**	**4,416**

Table 38. Calculated baseline emissions from anaerobic decay of the biomass residues.

Total Baseline Emissions

	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**
$BE_{FF,y}$ (TonCO2/year)	64,824	99,936	103,484	134,745	155,332	162,409	162,409
$BE_{CH4,B1/B3,y}$ (TonCO2/year)	126	289	289	1,242	1,766	1,875	1,875
$BE_{CH4,B2,y}$ (TonCO2/year)	296	1,114	1,873	2,580	3,236	3,847	4,416
BE_y (TonCO2/year)	**65,246**	**101,339**	**105,647**	**138,567**	**160,335**	**168,131**	**168,700**

Table 39. Calculated total baseline emissions.

Leakage

For this type of project activity, two leakage sources have to be considered:

- In case of project activities using biomass residues, the project activity may result in an increase in emissions from fossil fuel combustion or other sources due to diversion of biomass residues from other uses to the project plant as a result of the project activity;
  These emissions are considered as zero, since there is a surplus availability of biomass residues in the project location.

- In case of project activities using (a) less carbon intensive fossil fuel(s), leakage may result from fuel extraction, processing, liquefaction, transportation, re-gasification and distribution of fossil fuels outside of the project boundary. This includes mainly fugitive CH4 emissions and CO2 emissions from associated fuel combustion and flaring.
  Not applicable for the proposed project activity.

Leakage emissions are considered as zero.

Emission Reductions

Emission reductions are calculated as follows:
ERy= BEy - PEy - LEy

		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
BE,y	**tCO2e/year**	65,246	101,339	105,647	138,567	160,335	168,131	168,700
PE,y	**tCO2e/year**	48,007	61,733	64,618	65,085	68,130	71,048	71,048
LE,y	**tCO2e/year**	0	0	0	0	0	0	0
ERy	**tCO2e/year**	**17,238**	**39,605**	**41,028**	**73,481**	**92,205**	**97,083**	**97,652**

Table 40. Calculated total emission reductions.

Please, see Annex 3 (Baseline Information) for further details.

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

Total emission reduction during the first crediting period: 458,292 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)**
Year 1	48,007	65,246	0	17,245
Year 2	61,733	101,339	0	39,616
Year 3	64,618	105,647	0	41,039
Year 4	65,085	138,567	0	73,498
Year 5	68,130	160,335	0	92,226
Year 6	71,048	168,131	0	97,107
Year 7	71,048	168,700	0	97,675
Total (tonnes of CO2 e)	**449,669**	**907,964**	**0**	**458,292**

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

B.7.1 Data and parameters monitored:

Data / Parameter:	**$FC_{PJ,k,y}$ and $FC_{PJ,i,y}$**
Data unit:	Tonnes
Description:	Quantity of alternative fuel or less carbon intensive fossil fuel of type k ($FC_{PJ,k,y}$) and fossil fuel of type i ($FC_{PJ,i,y}$) used in the project plant in year y
Source of data to be used:	Measurements by the project participants (GrafOper)
Value of data applied	See Annex 3.

for the purpose of calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	Instrument used: Scale. Recorded continuously and reported monthly and adjusted according to stock change. The consistency of metered fuel consumption quantities should be crosschecked by an annual energy balance that is based on purchased quantities and stock changes. 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 and ISO 14001 management systems.
Any comment:	

Data / Parameter:	**$EF_{CO2,k,y}$ and $EF_{CO2,FF,i,y}$**
Data unit:	tCO2/GJ
Description:	Weighted average CO_2 emission factor for alternative or less carbon intensive fuels of type k ($EF_{CO2,k,y}$) and for fossil fuel of type i ($EF_{CO2,FF,i}$) in year y
Source of data to be used:	Option a) Values provided by the fuel suppliers in invoices Option b) Measurements by the project participants. Option c) Regional or national default values Option d) IPCC default values at the upper/lower limit of uncertainty at a 95 Only if conditions stated in methodology ACM0003 are met.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	If data from fuel suppliers, measures by the plant or regional or national default values are not available, IPCC default values at the upper/lower limit of uncertainty at a 95 are selected. EFCO2,k,y is zero for the following alternative fuels: - Biomass residues; - Renewable biomass See Annex 3.
Description of measurement methods and procedures to be applied:	Data archived: entire crediting period. For a) and b): The CO2 emission factor should be obtained for each fuel delivery, from which weighted average annual values should be calculated For c): Review appropriateness of the values annually For d): Any future revision of the IPCC Guidelines should be taken into account
QA/QC procedures to be applied:	All data is available and recorded according to ISO 9001 and ISO 14001 management systems.
Any comment:	For the composition measurement procedures of fuel supplier will be applied. These procedures are in line with national regulation.

Data / Parameter:	**NCVk,y and NCVi,y**
Data unit:	GJ/ton
Description:	Weighted average net calorific value of the alternative or less carbon intensive fuel types k (NCVk,y) and fossil fuel types i (NCVi,y) in year y.
Source of data to be	Option a) Values provided by the fuel suppliers in invoices

used:	Option b) Measurements by the project participants. Option c) Regional or national default values Option d) IPCC default values at the upper/lower limit of uncertainty at a 95 Only if conditions stated in methodology ACM003 are met.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	See tables below. See Annex 3.

Fuel Type	GJ/ton	kcal/kg
Petcoke	34.1	8,156
Fuel Oil	39.0	9,321
Liquids	38.2	6,740

Component	LHV (GJ/ton)	LHV (kcal/kg)
Wood residues	16.72	4,000
Fabric and Textiles	16.72	4,000
Paper and cardboard	14.63	3,500
Organic sludge	29.26	7,000
Other Biomass Residues	14.63	3,500
MSW	17.80	4,259
Plastics	24.24	5,800
Liquid waste	25.08	6,000
Refinery residues	20.9	5,000
Tires	31.35	7,500
Industrial Sludge	17.56	4,200

Description of measurement methods and procedures to be applied:	The NCV should be obtained for each fuel delivery, from which weighted average annual values should be calculated Instrument used: Calorimeter. Recording frequency: monthly. Data Archived: 2 years after the end of the crediting period.
QA/QC procedures to be applied:	Verify if the values under a), b) and c) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values fall below this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in a), b) or c) should have ISO17025 accreditation or justify that they can comply with similar quality standards. Instrument should be calibrated according to manufacturer's guidelines. All data is available and recorded according to ISO 9001 and ISO 14001 management systems.
Any comment:	Measurements by the project participants were used for an ex-ante estimation of the project activity emission reductions. For the alternative fuels the NCV were obtained biomass suppliers data and the biomass study. One of the activities that will result from the project implementation will be the introduction of laboratory equipment (new calorimeters) to have a continuous

	monitoring of the fossil fuels and alternative fuels net calorific value.

Data / Parameter:	**$FC_{i,j,y}$**
Data unit:	Mass or volume unit per year (e.g. ton/yr or m3/yr)
Description:	Quantity of fuel type i combusted in process j during the year y
Source of data to be used:	Onsite measurements
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:	As per the “Tool to calculate project or leakage CO2 emissions from fossil fuel combustion”: Use either mass or volume meters. In cases where fuel is supplied from small daily tanks, rulers can be used to determine mass or volume of the fuel consumed, with the following conditions: The ruler gauge must be part of the daily tank and calibrated at least once a year and have a book of control for recording the measurements (on a daily basis or per shift); • Accessories such as transducers, sonar and piezoelectronic devices are accepted if they are properly calibrated with the ruler gauge and receiving a reasonable maintenance; • In case of daily tanks with pre-heaters for heavy oil, the calibration will be made with the system at typical operational conditions. Recorded continuously The consistency of metered fuel consumption quantities should be cross-checked by an annual energy balance that is based on purchased quantities and stock changes. Data Archived: 2 years after the end of the crediting period.
QA/QC procedures to be applied:	As per the “Tool to calculate project or leakage CO2 emissions from fossil fuel combustion”. Where the purchased fuel invoices can be identified specifically for the CDM project, the metered fuel consumption quantities should also be cross-checked with available purchase invoices from the financial records. All data is available and recorded according to ISO 9001 and ISO 14001 management systems.
Any comment:	

Data / Parameter:	**$EC_{EJj,y}$**
Data unit:	MWh/yr
Description:	Quantity of electricity consumed by the project electricity consumption source j in year y
Source of data to be used:	Measurements by the project participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	See Annex 3
Description of	Instrument used: Electricity meters

measurement methods and procedures to be applied:	Measured continuously, aggregated at least annually 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 and ISO 14001 management systems.
Any comment:	

Data / Parameter:	$\mathbf{f_y}$
Data unit:	-
Description:	Fraction of methane captured at the SWDS and flared, combusted or used in another manner that prevents the emissions of methane to the atmosphere in year y
Source of data to be used:	Select the maximum value from the following: (a) contract or regulation requirements specifying the amount of methane that must be destroyed/used (if available) and (b) historic data on the amount captured
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:	As per the tool "Emissions from solid waste disposal sites". Monitored annually Data Archived: 2 years after the end of the crediting period.
QA/QC procedures to be applied:	As per the tool "Emissions from solid waste disposal sites". All data is available and recorded according to ISO 9001 and ISO 14001 management systems.
Any comment:	

Data / Parameter:	**Wx or Wi**
Data unit:	tons
Description:	Total amount of waste disposed in a SWDS in year x or month i
Source of data to be used:	Measurements by project participants
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:	Measure on wet basis. As per the tool "Emissions from solid waste disposal sites". Continuously, aggregated at least annually for year x or monthly for month i Data Archived: 2 years after the end of the crediting period.
QA/QC procedures to be applied:	As per the tool "Emissions from solid waste disposal sites". All data is available and recorded according to ISO 9001 and ISO 14001 management systems.
Any comment:	

Data / Parameter:	$\mathbf{p_{n,j,x}}$ **or** $\mathbf{p_{n,j,i}}$
Data unit:	-
Description:	Weight fraction of the waste type j in the sample n collected during the year x

	or month i
Source of data to be used:	Sample measurements by project participants
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:	Sample the waste composition, using the waste categories j, as provided in the table for DOCj and kj, and weigh each waste fraction (measure on wet basis) As per the tool "Emissions from solid waste disposal sites". Minimum of three samples every three months. Data Archived: 2 years after the end of the crediting period.
QA/QC procedures to be applied:	As per the tool "Emissions from solid waste disposal sites". All data is available and recorded according to ISO 9001 and ISO 14001 management systems.
Any comment:	

Data / Parameter:	**z**
Data unit:	-
Description:	Number of samples collected during the year x
Source of data to be used:	Project participants
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:	Minimum of three samples every three months As per the tool "Emissions from solid waste disposal sites". Monitored continuously, aggregated at least annually Data Archived: 2 years after the end of the crediting period.
QA/QC procedures to be applied:	As per the tool "Emissions from solid waste disposal sites". All data is available and recorded according to ISO 9001 and ISO 14001 management systems.
Any comment:	This only applies for the biomass residues for which anaerobic decomposition can be clearly demonstrated and if the waste prevented from disposal includes several waste categories j, as categorized in the tables for DOCj and kj of corresponding tool.

Data / Parameter:	**AVD_y**
Data unit:	km
Description:	Average round trip distance (from and to) between the alternative fuel supply sites and the site of the project plant during the year y
Source of data to be used:	Measurements by the project participants, Biomass supplier.
Value of data applied for the purpose of calculating expected emission reductions in	See Annex 3

section B.5	
Description of measurement methods and procedures to be applied:	Measured Recorded and reported continuously. Data Archived: 2 years after the end of the crediting period.
QA/QC procedures to be applied:	Check consistency of the number of truck trips with the quantity of biomass combusted, e.g. by the relation with previous years. All data is available and recorded according to ISO 9001 and ISO 14001 management systems.
Any comment:	

Data / Parameter:	**$EF_{km,CO2,y}$**
Data unit:	tCO_2/km
Description:	Average CO_2 emission factor for the trucks measured during the year y
Source of data to be used:	IPCC, Measurements by the project participants, biomass supplier
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:	Measured Recorded and reported annually. Data Archived: 2 years after the end of the crediting period.
QA/QC procedures to be applied:	Cross check with published literature. All data is available and recorded according to ISO 9001 and ISO 14001 management systems.
Any comment:	

Data / Parameter:	**$AF_{T,h,y}$**
Data unit:	Ton/year
Description:	Quantity of alternative fuel type k that has been transported to the project site during the year y.
Source of data to be used:	Measurements by the project participants, Biomass supplier.
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:	Measured The consistency of metered fuel consumption quantities should be crosschecked by an annual energy balance that is based on purchased quantities and stock changes. Where the purchased fuel invoices can be identified specifically for the CDM project, the monitored quantities should also be cross-checked with available purchase invoices from the financial records. 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:	All data is available and recorded according to ISO 9001 and ISO 14001 management systems.
Any comment:	

Data / Parameter:	**TL_y**
Data unit:	Ton/truck
Description:	Average truck load of the trucks used during the year y.
Source of data to be used:	Measurements by the project participants, Biomass supplier.
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:	Measured Recorded/calculated and reported continuously 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 and ISO 14001 management systems.
Any comment:	

Data / Parameter:	**$P_{clinker,y}$**
Data unit:	Tons/year
Description:	Production of clinker in year y
Source of data to be used:	Measurements by the project participants (GrafOper)
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:	Measured Instrument used: Weighing feeders. Recorded and reported annually. 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 and ISO 14001 management systems.
Any comment:	

Data / Parameter:	**$EF_{CO2,BL,y}$**
Data unit:	tCO_2/GJ
Description:	Carbon dioxide emissions factor for the fossil fuels displaced by the use of alternative fuels or less carbon intensive fossil fuels in the project plant
Source of data to be used:	Calculated as follows as 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 most recent three years before

	the start of the project activity; – The weighted average annual CO_2 emission factor of the fossil fuel(s) consumed in the project plant in year y that are not less carbon intensive fossil fuels, – If F2 has been determined as the most likely baseline scenario: the weighted average annual CO_2 emission factor for the fossil fuel(s) that would have been consumed according to fuel mix determined in "Procedure for the selection of the most plausible baseline scenario" above.
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 Recorded and reported annually. 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 and ISO 14001 management systems.
Any comment:	

Data / Parameter:	**$EF_{CO2,LE}$**
Data unit:	tCO_2/GJ
Description:	Carbon dioxide emission factor of the most carbon intensive fuel used in the country
Source of data to be used:	IPCC default values
Value of data applied for the purpose of calculating expected emission reductions in section B.5	-
Description of measurement methods and procedures to be applied:	Measured Recorded and reported annually. 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 and ISO 14001 management systems.
Any comment:	Will be monitored in case leakage is not ruled out by any of the scenarios L1, L2 or L3.

Data / Parameter:	**$FC_{BL,i,y}$**
Data unit:	Ton
Description:	Quantity of fossil fuel type i displaced in the project plant as a result of the project activity in year y
Source of data to be used:	The quantities and types of fossil fuels i that are displaced as a result of the project activity ($FC_{BL,i,y}$) should be determined consistent with the guidance above on the determination of the baseline CO_2 emission factor ($EF_{CO2,BL,y}$).
Value of data applied for the purpose of	See Annex 3

calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	Measured Recorded and reported annually. 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 and ISO 14001 management systems.
Any comment:	

Data / Parameter:	**Biomass residue type k**
Data unit:	Tons
Description:	Quantity of biomass residues of type k that are utilized (e.g. for energy generation or as feedstock) in the defined geographical region
Source of data to be used:	Surveys or statistics
Value of data applied for the purpose of calculating expected emission reductions in section B.5	-
Description of measurement methods and procedures to be applied:	Estimated based on independent surveys, published statistics and biomass studies. Recorded and reported annually. 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 and ISO 14001 management systems.
Any comment:	Monitoring of this parameter is applicable if approach L_2 is used to rule out leakage

Data / Parameter:	**Biomass residue type k**
Data unit:	Tons
Description:	Quantity of available biomass residues of type k in the region
Source of data to be used:	Surveys or statistics
Value of data applied for the purpose of calculating expected emission reductions in section B.5	-
Description of measurement methods and procedures to be applied:	Estimated based on independent surveys, published statistics and biomass studies. Recorded and reported annually. 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 and ISO 14001 management systems.
Any comment:	Monitoring of this parameter is applicable if approach L_2 is used to rule out leakage

Data / Parameter:	$EF_{burning,CH4,k,y}$
Data 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 to be used:	IPCC default values
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.0027
Description of measurement methods and procedures to be applied:	As per methodology. Reviewed annually. 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 and ISO 14001 management systems.
Any comment:	Monitoring of this parameter is applicable because alternative B1/B3 has been selected as the most plausible baseline scenario for the fate of the biomass residues in the absence of the project activity

B.7.2 Description of the monitoring plan:

The project meets the applicability criteria under the monitoring methodology, ACM0003 Version 7.4.1 **"Emissions reduction through partial substitution of fossil fuels with alternative fuels in cement or quicklime manufacture"**

The following diagram describes the metering points for the correct monitoring of the project activity:

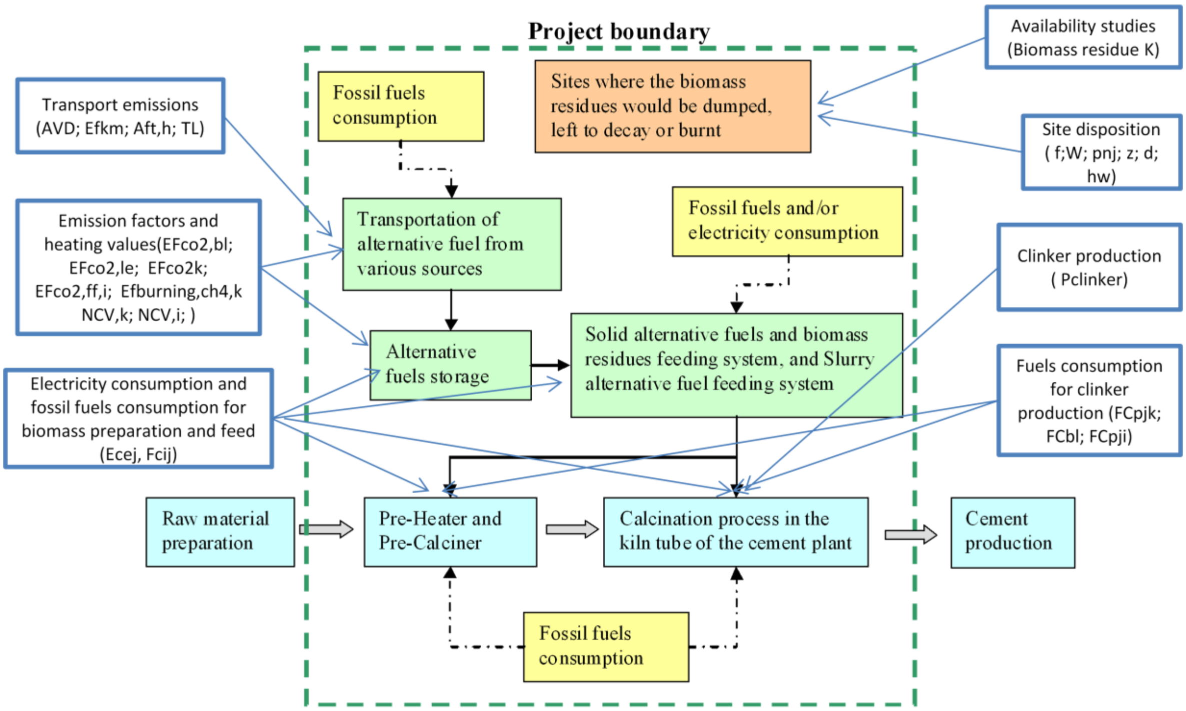

Figure 6. Draft monitoring diagram with monitoring points

For the training of personnel involved with the project activity a training manual for new systems will be elaborated. Accuracy or measurement range as well as calibration requirements of measurement instruments will be in line with relative regulations and equipment specifications and the guide.

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

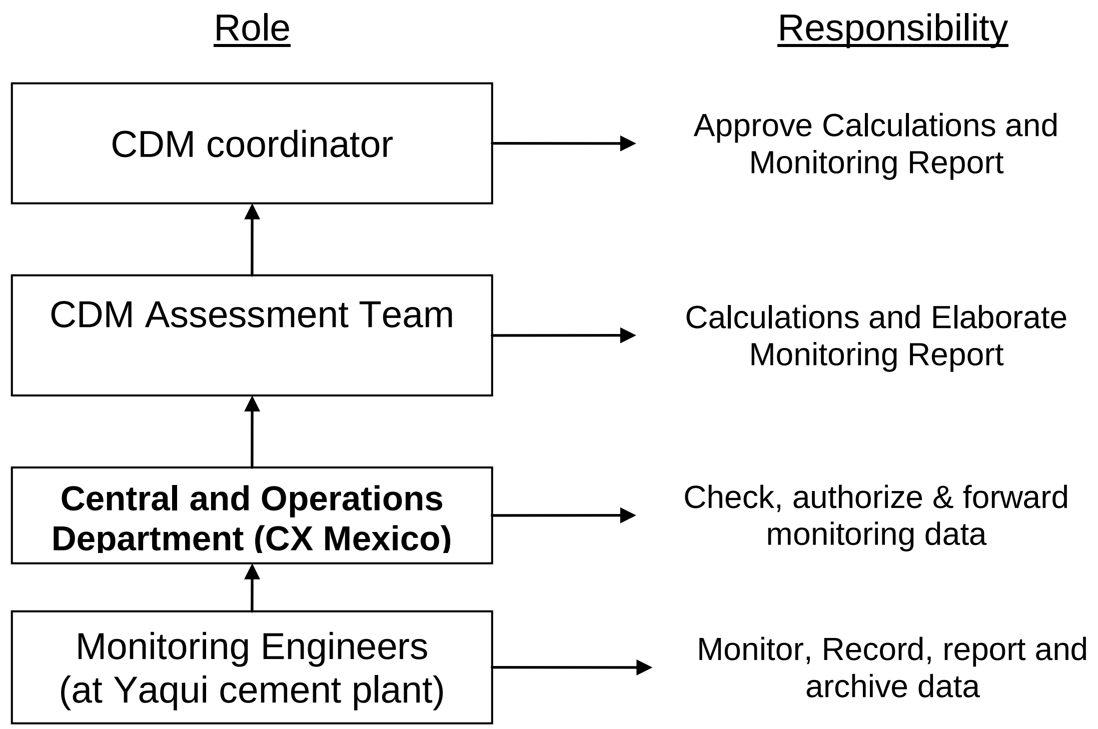

Figure 7. Operational and management structure for the monitoring plan

Emission Monitoring and Calculation Procedure	
Data Source and collection	Data is taken from plant records.
	Most data are available and registered according to the existing data management system (GrafOper and SICA).
	Frequency of data will be based on the methodology requirements and the existing data management system.
	Data is monitored by monitoring engineers in Yaqui 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	Data from every plant is centralized at Monterrey.
	Data is collected by 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 transcribed by CDM Team, using an excel spreadsheet. Monitoring Report will be elaborated from calculations 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 41. Monitoring procedures.

Details of CEMEX Mexico Operational Data Management System (GrafOper)

General Description.

- The Operational Executive Information System, known as GrafOper (Operational Graphics), is the official database used to store and consult all the data associated to cement production in CEMEX business units. This certified tool monitors the operative indicators involved in the different stages of cement manufacturing process such as cement and clinker production, fuels and raw material consumption, etc. The data stored in GrafOper is continuously verified and crosschecked daily, monthly and yearly to avoid any mistake in the fed values. .

Data Registration Process in GrafOper.

- CEMEX employees can have access to the GrafOper system but only for consulting the historical data but not for performing any changes or adjustments on the shown information.
- Only one person per CEMEX installation (GrafOper Manager) has the permission and accessibility to update, modify and verify all production data of the plant registered in GrafOper. Each GrafOper Manager is in charge of monitoring daily all operational indicators and parameters (clinker production, fuel consumption, etc) and verifying and crosschecking the data with the Procurement and Comptrollership departments.
- All data fed by the GrafOper Managers to the database is verified by the GrafOper Administrator who coordinates the system functioning and the data quality of the 15 CEMEX Mexico cement plants. Once that the monthly registry is completed and the information is consolidated, it is officially reported to CEMEX shareholders. In case of detecting a mistake or discrepancy in the data, a serial of standard procedures have to be followed in order to obtain the authorization from the GrafOper Administrator located in CEMEX Mexico Headquarters to carry out the corrective actions.
- In case of an emergency, any stoppage must be reported in its corresponding category according to the definitions of equipment stoppage. This must be done so that chronic failures can be detected.
- Information about fuels consumption can by cross-checked by using GrafOper data, revising inventories and comparing them with providers' invoices.

Archiving Policy

- All historical data for the 5 last years is available in the CEMEXnet for consultation.
- The entire history of each cement plant is archived electronically.

Auditable

- The data management system and archiving policy is included in the ISO 9001 quality management systems.

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: 21/07/2010

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CEMEX Central S.A. de C.V. is not a project participant

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

The starting date of the project activity is 18/09/10 (Purchase order for civil works for tires feeding system)

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

20 years (from date of equipment installation)

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

C.2.1. Renewable crediting period

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

01/03/2013 (or on the date of registration of the CDM project activity, whichever is later)

C.2.1.2. Length of the first crediting period:

7 years renewable credit period

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

N/A

C.2.2.2. Length:

N/A

SECTION D. Environmental impacts

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

Mexico's Secretary of Environment and Natural Resources (SEMARNAT) is in charge of regulating environment quality preservation and restoration, the sustainable use of natural resources, the disposal of dangerous materials and industrial residues, etc. The norm NOM-040-SEMARNAT-2002[36], created by this government entity, states the maximum levels of particles allowed into the atmosphere, nitrogen oxides, sulfur dioxide, carbon monoxide, heavy metals, dioxins and furans, total hydrocarbons and hydrochloric acid originated from fixed sources dedicated to hydraulic cement manufacture, that use conventional fuels or their mixes with other materials or residues.

Norm NOM-040-SEMARNAT-2002 establishes the following:

Fuels Definitions

- *Conventional fuels:* These are the fossil fuels such as natural gas and mineral coal, petroleum products such as liquefied petroleum gas (LPG), gasoil, diesel, fuel oil and petroleum coke.
- *Formulated fuel:* Fuel derivate from a controlled mixture of several residues, liquid or solid, sources including hazardous residues with a net calorific value susceptible to be recovered and that may be elaborated by a formulation plant authorized by the Secretariat. The following residues are excluded from use: pesticides, polychlorated dioxins, polichlorated dibenzofurans, radioactive residues, compressed gases, biological-infectious residues, organochlorated compounds and cyanides.
- *Recovery fuel:* It refers to those materials or residues with a net calorific value higher than 15 megajoules per kilogram (MJ/kg) such as used lubricants, textiles, tires, and other residues classified by the current environmental normative as non-hazardous, which do not require formulation.

Performance levels

The performance levels and the substitution percentages of conventional fuels for each type and volume of fuel are defined in the table 42. In the case that two or more types of non conventional fuels are used in the same process, the higher performance level should prevail.

[36] www.climate-policy-map.econsense.de/legalbasis_download/mexico/NOM_040_Semarnat_2002_cemento.pdf

Conventional Fuel Substitution (%)	Tires	Recovery Fuel	Formulated Fuel
0 – 5	Level 0	Level 0	Level 1
5 – 15	Level 1	Level 1	Level 2
15 – 30	Level 1	Level 2	Level 3
> 30	Level 2	Subject to validation	

Table 42. Performance levels, Type and Volume of fuel substitution. Source: Norm NOM-040-SEMARNAT-2002

Levels 0 to level 2 require annual or biannual (only for Level 2) monitoring frequency for atmospheric emissions. In the case of Level 3 a continuous monitoring frequency is required. For the development of the project new equipment for continuous monitoring of the gases leaving the kiln will be installed once the fuels substitution established by the law is expected to be reached. For further details please consult NOM-040-SEMARNAT-2002.

CEMEX Yaqui cement plant counts with the environmental permission required for co-processing hazardous residues such as formulated or recovery fuels and other residues classified as non-hazardous by the current legislation under the terms of the norm NOM-040-SEMARNAT-2002. The number of this Environmental Authorization for Yaqui installations is 26-IV-92-08 and it allows a maximum of 30% of conventional fuel substitution considering formulated and recovery fuels. The mentioned cement plant will install and implement all the required monitoring activities to fulfill the corresponding specifications of NOM-040-SEMARNAT-2002.

The biomass residues are considered "Special Management Residues" in Mexico and even though there are some initiatives to develop specific environmental regulations that delimit their usage (see National Program for Residues Prevention and Integral Management, page 56[37]), currently there are no official legislation that restricts these. Therefore, up to date no authorization is required from any national or local authorities in order to allow consumption of biomass residues as alternative fuels in the cement industry.

However, bearing in mind that the fuel definitions established in NOM-040-SEMARNAT-2002 state that "Recovery fuel" refers to those materials or residues with a net calorific value higher than 15 megajoules per kilogram (aprox. 3,580 kcal/kg), biomass residues can be considered as a recovery fuel since they are solid residues with a net calorific value around the 3,500 and 4,500 kcal/kg, they are classified by the current environmental normative as non-hazardous and they are materials which do not require formulation. Hence, the current Environmental Authorization number 26-IV-92-08 can be applied for both industrial residues (including some type of hazardous residues) and biomass residues.

The proposed project activity expects to reach a final conventional fuel substitution of 46.7% and the current authorization allows up to 30%. However, since the substitution rate will be increasing each year once the project activity reaches a level of 30%, an extension of this environmental authorization will be requested claiming for a 50% substitution. Additionally, CEMEX Yaqui is committed to be in a constant communication with the national authorities and to keep itself updated about any new legislation regarding the utilization of industrial, municipal and biomass residues in order to always fulfill the required parameters and permissions involved in the project activity.

Therefore, based on the above, the proposed project activity is in accordance with all the current legislation of the cement sector and residues utilization in Mexico, and its implementation will not result in any environmental impacts or transboundary impacts since it respects in every possible manner the sustainable utilization of industrial, municipal and biomass residues.

[37] www.semarnat.gob.mx/QUEESSEMARNAT/PROGRAMAS/Pages/pnpgir.aspx and www.semarnat.gob.mx/queessemarnat/programas/Documents/PNPGIR_version%20_CONSULTA_INTERNET_bis.pdf

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:

None negative environmental impacts derived from the project activity have been identified by the Host Country. On the other hand, it is possible to emphasize that this project substantially reduces the disposal of biomass and industrial residues as well as uncontrolled biomass residues burning in an open field, activity that does not fulfill the environmental regulations in Mexico.

SECTION E. Stakeholders' comments

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

Stakeholder's comments have been obtained through two routes:

- National stakeholders: The project participant has interviewed the following authorities and entities:
    - CANACEM (*"Cámara Nacional de Cementos"*) has been informed of the project activity. This entity expressed a positive opinion in favour for the project implementation since it contribute to the sustainable development with environmental, social and economical benefits and also positions CEMEX as an example for other enterprises.
    - *Designated National Authority* (DNA). It is important to clarify that the DNA is a division integrated to SEMARNAT, México's Environment and Natural Resources Secretariat. The DNA agreed that under the proposed terms, the implementation of the project activity will contribute to Mexico's sustainable development. This body coincide with the sustainability implied by the project activity given that no related environmental risks were found and also considering that the project has the potential to represents an innovative and adequate residues disposal strategy in Mexico.

- Local stakeholders: the consultation process that included this group was carried out on May 11th, 2010. In general, the procedure went as follows:

    - CEMEX Mexico invited, by sending them letters, different representative groups from the local community (neighbours, plant personnel, local authorities, etc.) to visit Yaqui plant to inform them about a project proposal.
    - The project activity was presented to the assistants.
    - After the presentation, questions and comments were clarified and then CEMEX asked each participant to answer a questionnaire in order to know their opinion and concerns about the project. At the end they confirmed if they agreed with the project implementation.

E.2. Summary of the comments received:

All questions from the stakeholders were answered at the consultation sessions. No objections were received. The local stakeholders proposed several activities to CEMEX Mexico to keep contributing with the GHG mitigation and/or the community environment improvement, some of these activities are:

Patricia Molina (Sonora Entrepreneur Foundation):
- *To make cross-sector partnerships.*

Paloma Peñuelas (Clean Hermosillo Program):
- *To keep informing the community about the project's progress.*

Luis Burruel (Red Cross Hermosillo):
- *To involve other institutions in recollection of garbage that could be used by CEMEX.*

Luis Figueroa (Meoky Foundation):
- *To have collection centers for some products.*

Agustín Téllez (CEMEX worker):
- *To integrate the region's industries.*

Jesús Edgardo Okamura (CEMEX worker):
- *To make changes gradually*

Antonio Jaguey Pérez (CEMEX worker):
- *To communicate to the community simple practices that could help on taking care of the environment.*

In many occasions the positive impression of the presentation made the stakeholders not only support the project but even start to think about ways on how they and their local communities could reduce their environmental footprint.

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

All comments received by the stakeholders were positive. No suggestions concerning the project activity were received.

Annex 1

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

N/A

Annex 3

BASELINE INFORMATION

A complete spreadsheet will be provided to the Designated Operational Entity.

Alternative Fuels

Component	LHV (kcal/kg)	Ton CO2/TJ	Burned biomass	Landfilled Biomass
Wood residues	4,000	0.0	100%	0%
Fabric and Textiles	4,000	0.0	100%	0%
Paper and cardboard	3,500	0.0	100%	0%
Organic sludge	7,000	0.0	100%	0%
Other Biomass and Agropecuary Residues	3,500	0.0	100%	0%
MSW	4,259	24.6	0%	100%
Plastics	5,800	74.4	0%	0%
Liquid waste	6,000	74.4	0%	0%
Refinery residues	5,000	74.4	0%	0%
Tires	7,500	74.4	0%	0%
Industrial Sludge	4,200	79.9	0%	0%

	Yaqui II		
	%	Ton CO2/TJ	kcal/kg
Fuel oil	0.95%	75.5	9,321
Petcoke	98.93%	92.5	8,156
Liquids	0.12%	72.2	6,740
Total	100.00%		
Emission Factor	**92.3**	Ton CO2/TJ	

Project Scenario

		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Fuel oil	Ton	736	736	736	736	736	736	736
Petcoke	Ton	89,719	78,546	77,416	67,456	60,889	58,629	58,629
Liquids	Ton	351	351	351	351	351	351	351
Wood residues	Ton	0	0	0	46	46	46	46
Fabric and Textiles	Ton	0	0	0	46	46	46	46
Paper and cardboard	Ton	0	3,949	3,949	6,582	6,582	9,214	9,214
Organic sludge	Ton	0	0	0	26	26	26	26
Other Biomass Residues	Ton	3,038	3,038	3,038	23,299	35,970	35,970	35,970
MSW	Ton	6,490	18,390	18,390	18,390	18,390	18,390	18,390
Plastics	Ton	0	0	0	32	32	32	32
Liquid waste	Ton	1,536	1,536	3,071	3,071	4,607	6,143	6,143
Refinery residues	Ton	0	0	0	37	37	37	37
Tires	Ton	17,728	21,279	21,279	21,279	21,279	21,279	21,279
Industrial Sludge	Ton	0	0	0	44	44	44	44
Fuel oil	%	0.74%	0.74%	0.74%	0.74%	0.74%	0.74%	0.74%
Petcoke	%	79.41%	69.52%	68.52%	59.71%	53.90%	51.90%	51.90%
Liquids	%	0.26%	0.26%	0.26%	0.26%	0.26%	0.26%	0.26%
Wood residues	%	0.00%	0.00%	0.00%	0.02%	0.02%	0.02%	0.02%
Fabric and Textiles	%	0.00%	0.00%	0.00%	0.02%	0.02%	0.02%	0.02%
Paper and cardboard	%	0.00%	1.50%	1.50%	2.50%	2.50%	3.50%	3.50%
Organic sludge	%	0.00%	0.00%	0.00%	0.02%	0.02%	0.02%	0.02%
Other Biomass Residues	%	1.15%	1.15%	1.15%	8.85%	13.66%	13.66%	13.66%
MSW	%	3.00%	8.50%	8.50%	8.50%	8.50%	8.50%	8.50%
Plastics	%	0.00%	0.00%	0.00%	0.02%	0.02%	0.02%	0.02%
Liquid waste	%	1.00%	1.00%	2.00%	2.00%	3.00%	4.00%	4.00%
Refinery residues	%	0.00%	0.00%	0.00%	0.02%	0.02%	0.02%	0.02%
Tires	%	14.43%	17.32%	17.32%	17.32%	17.32%	17.32%	17.32%
Industrial Sludge	%	0.00%	0.00%	0.00%	0.02%	0.02%	0.02%	0.02%

		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
CPr Total Clinker production	tClinker	1,147,000	1,147,000	1,147,000	1,147,000	1,147,000	1,147,000	1,147,000

Project Emissions Reductions	tCO2e/year	65,470

Specific Fuel consumption		2007	2008	2009	Baseline	Project
Yaqui	kcal/kg clk	805	793	803	793	803

Baseline Emissions		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
SEC_clinker,bl								
Yaqui 2	GJ/ton clinker	3.31283	3.31283	3.31283	3.31283	3.31283	3.31283	3.31283
SEC_clinker,PJ,y								
Yaqui 2	GJ/ton clinker	3.35793	3.35793	3.35793	3.35793	3.35793	3.35793	3.35793
FP (fuel penalty)								
Yaqui 2	GJ	51,729	51,729	51,729	51,729	51,729	51,729	51,729
BE_ff,y								
Yaqui 2	tCO2/year	64,824	99,936	103,484	134,745	155,332	162,409	162,409
BE_ch4,biomass,y								
BE_ch4,B1,B3	tCO2/year	126	289	289	1,242	1,766	1,875	1,875
BE_ch4,B2	tCO2/year	296	1,114	1,873	2,580	3,236	3,847	4,416
BE_y	tCO2/year	65,246	101,339	105,647	138,567	160,335	168,131	168,700
EFff expost emission factor	tCO2e/GJ	0.092	0.092	0.092	0.092	0.092	0.092	0.092
EFff exante emission factor	tCO2e/GJ	0.092	0.092	0.092	0.092	0.092	0.092	0.092

		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Project Emissions								
PE_k,y								
Yaqui 2	tCO2/year	47,052	60,535	63,400	63,576	66,442	69,308	69,308
PE_ec,y	tCO2/year	593	593	593	593	593	593	593
EC_PJ,y	MWh/year	936	936	936	936	936	936	936
EF_grid,y	TonCO2/MWh	0.528	0.528	0.528	0.528	0.528	0.528	0.528
TDL	%	20%	20%	20%	20%	20%	20%	20%
PE_t,y	tCO2/year	362	606	625	916	1,095	1,147	1,147
TC_AF average truck capacity AF	ton/veh.	28	28	28	28	28	28	28
D_AF average round-trip distance AF	km/veh	400	400	400	400	400	400	400
EFCO2 transport AF	kgCO2e/km	0.88	0.88	0.88	0.88	0.88	0.88	0.88
PE_y	tCO2/year	48,007	61,733	64,618	65,085	68,130	71,048	71,048

		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Emission reductions								
BE,y	tCO2e/year	65,246	101,339	105,647	138,567	160,335	168,131	168,700
PE,y	tCO2e/year	48,007	61,733	64,618	65,085	68,130	71,048	71,048
LE,y	tCO2e/year	0	0	0	0	0	0	0
Emission reductions	tCO2e/year	17,238	39,605	41,028	73,481	92,205	97,083	97,652
Emission reductions for 10 years	tCO2e	458,292						

Ex-ante grid emission factor

Grid emission factor was calculated using the *"Tool to calculate the emission factor for an electricity system"*, Version 02.2.1

Step 1.Identify the relevant electric power system.

The regions in the Mexican grid are interconnected; for this, the relevant electric power system is the entire Mexican grid (Source: SENER "Electricity Sector Outlook 2009-2024"), moreover the public information of the Mexican Energy Ministry "SENER" is for type of fuel for consumption and fuel share and technology for gross generation and power share, not for regions.

For determining the Operating Margin (OM) emission factor, it is necessary to determine the net electricity imports. There are no imports from other systems inside Mexico. The Mexican electricity imports and exports with other electric systems in other countries (imports from USA and exports to Belize) are:

	2006	2007	2008	% of total generation
Imports (GWh)	523	277	351	0.15%
Exports (GWh)	1,299	1,451	1,452	0.62%
Net Exchange (GWh)	776	1,174	1,102	

Table 43. Grid electricity imports and exports. Source: SENER. "Electricity Sector Outlook 2009-2024. Cuadro 17 p. 95"

Imports and exports of electricity are treated as defined in the methodology: For imports from an on-line electricity system located in another country, the emission factor is 0 tCO_2/MWh in order to ensure a conservative approach. Electricity exports will not be subtracted from electricity generation data used for calculating the baseline emission factor.

Step 2: Choose whether to include off-grid power plants in the project electricity system (optional)

Project participants may choose between the following two options to calculate the operating margin and build margin emission factor:
Option I: Only grid power plants are included in the calculation.
Option II: Both grid power plants and off-grid power plants are included in the calculation.

The project proponent wishes to include only grid power plants in the calculation, while off-grid plants will be excluded, this means: Option I.

Step 3. Select an operating margin (OM) method.

The Operating Margin refers to the actual energy generation mix installed in Mexico. The total fuel consumption for generation is divided into the different types of power plants, in order to determine the weighted average of the actual CO_2 emissions in Mexico.

For its calculations, the simple OM method has been selected from the four options proposed in the *"Tool to calculate the emission factor for an electricity system version 02.2.1"*. Dispatch data analysis would be more accurate and therefore preferable, but this method cannot be applied for this project due to the lack of available published data. To be able to use the Dispatch data analysis method, the hourly generation-weighted average emissions per electricity unit (tCO_2/MWh) of a set of plants in the top 10% of the grid system dispatch order is needed. For confidentiality reasons, hourly-based dispatch order generation is not publicly available, so this method cannot be used for calculating the Operating Margin emission factor.

The reason for selecting the simple OM method over the other two methods (simple adjusted OM or Average OM) is that the low-cost/must-run resources in Mexico (hydroelectric, geothermic, wind and nuclear) are well below 50% of total grid generation in both the average of the five most recent years and in the long-term normal for hydroelectricity production:

	2004	2005	2006	2007	2008
Low-cost/must run %	19.58%	20.88%	21.28%	19.40%	23.74%

Table 44. Electricity generation share by source. Source: SENER. “Electricity Sector Outlook 2009-2024. Cuadro 21 p. 110”

The average low-cost/must-run generation resource in the last five years is 20.98%, well below the 50% threshold defined by the baseline methodology. Coal is not included under the low-cost/must-run category, because the Mexican coal-fired power plants cannot be considered must-run plants (for example, the largest coal-fired plant, Carbón II en Nava, in 2006 produced with a capacity factor of 67%[38] - this being clearly below what a must-run plant would achieve). Therefore the Simple OM method can be used to calculate the baseline emissions.

In addition, data for calculating the emission factor using the simple OM method is very robust and reliable. In accordance with the approved methodology chosen, the simple OM method has been finally chosen to determine the relevant operating margin.

The Simple OM emission factor can be calculated using either of the two following data vintages for year (s):

- A 3-year average, based on the most recent statistics available at the time of PDD submission (*ex-ante*), or
- The year in which project generation occurs, if EF_{OM} is updated based on *ex-post* monitoring.

We have chosen the first option because the yearly statistics provided by SENER that are necessary to calculate the OM *ex-post* are published normally more than one year after the end of the reporting year, leading to large delays between emission reduction on one hand and monitoring, verification and issuance of CERs on the other. Another reason to choose this option is that *ex-ante* monitoring is simpler for the project development and also for the emission reduction verification.

Step 4: Calculate the operating margin emission factor according to the selected method.

For calculating the Simple OM, the generation-weights average emission per electricity unit (tCO_2/MWh) of all generating sources serving the system excluding the low-cost/must-run generation units is used. It may be calculated:

- Based on the net electricity generation and a CO2 emission factor of each power unit (Option A), or
- Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system. (Option B), or

Option B can only be used if:
a) The necessary data for Option A is not available; and
b) Only nuclear and renewable power generation are considered as low-cost/must-run power sources and the quantity of electricity supplied to the grid by these sources is known; and
c) Off-grid power plants are not included in the calculation (i.e., if Option I has been chosen in Step 2).

[38] See document from the SENER. “Electricity Sector Outlook 2007-2016. Tabla 4 page 162”

Option B is used because total net electricity generation of all power plants serving the system as well as the fuel types and total fuel consumption of the project electricity system are available. Information needed for the Option A is not available.

$$EF_{grid,OM,simple,y} = \frac{\sum_i FC_{i,y} \cdot NCV_{i,y} \cdot EF_{CO2,i,y}}{EG_y} \quad (4)$$

Where:

$EF_{grid,OM,simple,y}$ Simple operating margin CO_2 emission factor in year y (tCO_2/MWh).
$FC_{i,y}$ Amount of fossil fuel type i consumed in the project electricity system in year y (mass or volume unit).
$NCV_{i,y}$ Net calorific value (energy content) of fossil fuel type i in year y (GJ/mass or volume unit).
$EF_{CO2,i,y}$ CO2 emission factor of fossil fuel type i in year y (tCO2/GJ).
EG_y Net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost / must-run power plants / units, in year y (MWh).
i All fossil fuel types combusted in power sources in the project electricity system in year y.
y Either the three most recent years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex-ante option).

This $EF_{CO2,i,y}$ (in tC/TJ) can be found in the Reviewed 2006 IPCC Guidelines for Greenhouse Gas Inventories: Workbook,. Data for $FC_{i,m,y}$ can be found in TJ/day in the three Electricity Sector Outlooks (*Prospectivas)* so total annual consumption per fuel source can be calculated by multiplying by 365.

Step 5: Calculate the build margin (BM) emission factor.

In terms of vintage of data Option 1 has been selected, the calculation of the build margin emission factor ex ante is based on the most recent information available on units already built. This option states that for the first crediting period, calculate the build margin emission factor *ex ante* based on the most recent information available on units already built for sample group *m* at the time of CDM-PDD submission to the DOE for validation.

The sample group of power units "*m"* used to calculate the build margin is determined as per the following procedure, consistent with the data vintage selected above:

a) Identify the set of five power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently ($SET_{5\text{-units}}$) and determine their annual electricity generation ($AEG_{SET\text{-}5\text{-units}}$, in MWh);

b) Determine the annual electricity generation of the project electricity system, excluding power units registered as CDM project activities (AEGtotal, in MWh). Identify the set of power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently and that comprise 20% of AEG_{total} (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) ($SET_{\geq 20\%}$) and determine their annual electricity generation ($AEG_{SET\text{-}\geq 20\%}$, in MWh);

c) From $SET_{5\text{-units}}$ and $SET_{\geq 20\%}$ select the set of power units that comprises the larger annual electricity generation (SET_{sample});

$SET_{\geq 20\%}$ has been selected to calculate the BM because generation of five power plants built most recently is lower than 20% of the system generation; the five plants built most recently have a gross generation of 582 GWh that is less than 0.03% of total annual generation (215,276,000 MWh).

Identify the date when the power units in SET_{sample} started to supply electricity to the grid. If none of the power units in SET_{sample} started to supply electricity to the grid more than 10 years ago, then use SET_{sample} to calculate the build margin.

Since none of the power units in SET_{sample} started to supply electricity to the grid more than 10 years ago, then SET_{sample} was used to calculate the build margin.

The build margin emissions factor is the generation-weighted average emission factor (tCO2/MWh) of all power units m during the most recent year *y* for which power generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \cdot EF_{EL,m,y}}{\sum_m EG_{m,y}} \quad \textbf{(5)}$$

Where:

$EF_{grid,BM,y}$ Build margin CO2 emission factor in year y (tCO2/MWh).
$EG_{m,y}$ Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh).
$EF_{EL,m,y}$ CO2 emission factor of power unit m in year y (tCO2/MWh).
m Power units included in the build margin.
y Most recent historical year for which power generation data is available.

The CO2 emission factor of each power unit m (EFEL,m,y) should be determined as per the guidance in Step 4 (a) for the simple OM, using options A1, A2 or A3, using for y the most recent historical year for which power generation data is available, and using for m the power units included in the build margin. Because of data availability option A2 has been chosen.

Step 6: Calculate the combined margin (CM) emissions factor.

The calculation of the combined margin (CM) emission factor ($EF_{grid,CM,y}$) is based on one of the following methods:

(a) Weighted average CM; or
(b) Simplified CM.

The weighted average CM method (option A) should be used as the preferred option.

The simplified CM method (option b) can only be used if:

• The project activity is located in a Least Developed Country (LDC) or in a country with less than 10 registered projects at the starting date of validation; and
• The data requirements for the application of step 5 above cannot be met.

Option A has been chosen since it is the preferred option and the project does not accomplish the requirements for choosing Option B.

The combined margin emissions factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM} \quad \textbf{(6)}$$

Where:

$EF_{grid,OM,y}$	Operating margin CO2 emission factor in year y (tCO2/MWh).
$EF_{grid,BM,y}$	Build margin CO2 emission factor in year y (tCO2/MWh).
w_{OM}	Weighting of operating margin emissions factor (%).
w_{BM}	Weighting of build margin emissions factor (%).

For this project, the default weights are as follows: w_{OM} = 0.50 and w_{BM} = 0.50.

For the calculation of these two terms (BM and OM), the information used can be found in the "*Electricity Sector Outlook 2009-2024; 2008-2017; 2007-2016"*, prepared by the SENER. These documents can be accessed at http://www.sener.gob.mx/portal/publicaciones.html

Ex-ante grid emission factor calculations

	2006			
	Fuel share	Fuel consumption (TJ)	Carbon content (tC/TJ)	Emission CO_2 (tCO_2)
Fuel Oil	32.00%	514,738	21.1	39,823,532
Natural Gas	47.00%	756,021	15.3	42,412,770
Diesel	1.00%	16,086	20.2	1,191,403
Coal	20.00%	321,711	25.8	30,433,861
Total	100%	1,608,555		113,861,566

Table 45. 2006 Fuel consumption per fuel type in the grid system. Source: Prospectiva del sector eléctrico 2007-2016 Gráfica 40 p.116.

	2007			
	Fuel share	Fuel consumption (TJ)	Carbon content (tC/TJ)	Emission CO_2 (tCO_2)
Fuel Oil	28.90%	477,531	21.1	36,944,950
Natural Gas	52.00%	859,225	15.3	48,202,500
Diesel	0.50%	8,262	20.2	611,922
Coal	18.50%	305,686	25.8	28,917,865
Total	100%	1,652,355		114,677,237

Table 46. 2007 Fuel consumption per fuel type in the grid system. Source: Prospectiva del sector eléctrico 2008-2016 Gráfico 31 p.90.

	2008			
	Fuel share	Fuel consumption (TJ)	Carbon content (tC/TJ)	Emission CO_2 (tCO_2)
Fuel Oil	24.21%	399,975	21.1	30,944,719
Natural Gas	64.55%	1,066,600	15.3	59,836,233
Diesel	0.53%	8,743	20.2	647,537
Coal	10.71%	177,038	25.8	16,747,798
Total	100%	1,652,355		121,110,296

Table 47. 2008 Fuel consumption per fuel type in the grid system. Source: Prospectiva del sector eléctrico 2009-2024 Gráfica 34 p.104.

Generation by sources:

	2006		2007		2008	
	0.00%	0	5.75%	12,161,569	2.92%	6,282,013
Dual	40.50%	83,380,590	44.15%	93,359,025	45.72%	98,414,858
Combined cycle	0.70%	1,441,146	1.15%	2,424,130	1.19%	2,557,344
Gas turbine	14.10%	29,028,798	7.78%	16,458,809	7.54%	16,235,759
Coal	0.40%	823,512	0.49%	1,035,666	0.52%	1,126,254
Internal	4.80%	9,882,144	4.48%	9,475,567	4.16%	8,947,967
Nuclear	23.10%	47,557,818	21.28%	44,992,805	18.37%	39,542,092
Standard Thermoelectric	16.50%	33,969,870	14.92%	31,546,429	19.59%	42,168,800
Renewables (Hydro, Geo, Wind …)		225,079,000		232,552,000		235,871,000
Total Generation		19,201,000		21,098,000		20,595,000
Self-consumption	100%	205,878,000	100%	211,454,000	100%	215,276,000
Total	0.00%	0	5.75%	12,161,569	2.92%	6,282,013

Table 48. Generation by sources. Source: SENER. "*Prospectiva del sector eléctrico 2009-2024 Gráfico 33 p.103*"; "*Prospectiva del sector eléctrico 2008-2016 Gráfico 30 p.89*"; *Self-consumption data* was obtained from: SENER. "*Prospectiva del sector eléctrico 2009-2024 Tabla 21 p 110*"

Total % under methodology				
2004	2005	2006	2007	2008

19.58%	20.88%	21.28%	19.40%	23.74%

Table 49. Low-cost/must-run generation share. Source: SENER. "*Prospectiva del sector eléctrico 2009-2024 Tabla 21 p 110"*

Total generation in baseline (MWh)		
2006	2007	2008
162,231,864	170,432,004	164,158,320

Table 50. Total power generation considered for the baseline. Source: SENER. "*Prospectiva del sector eléctrico 2009-2024 Tabla 21 p 110"*

Imports (MWh)		
2006	2007	2008
523,000	277,000	351,000

Table 51. Electricity Imports. Source: SENER. "*Prospectiva del sector eléctrico 2009-2024 Tabla 21 p 110"*

Baseline calculations:

- Operating Margin:

Operating Margin = total CO_2 emission / (total generation under baseline + imports)

Operating Margin 2006 = 113,861,566/ (162,231,864 + 523,000) = 0.700 tCO_2/MWh
Operating Margin 2007 = 114,677,237 / (170,432,004 + 277,000) = 0.672 tCO_2/MWh
Operating Margin 2008 = 121,110,296 / (164,158,320 + 351,000) = 0.658 tCO_2/MWh

OM = **0.676 tCO_2/MWh**

- Build Margin:

Calculation of Build Margin:

Build Margin = (Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh) * CO2 emission factor of power unit *m* in year *y* (tCO2/MWh)) / Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)

CO2 emission factor of power unit = 3.6 * Average CO2 emission factor of fuel type *i* used in power unit *m* in year *y* (tCO2/GJ) / Average net energy conversion efficiency of power unit *m* in year *y* (%)

Plant Name	Technology	Capacity (MW)	Net Electricity Generation (MWh)	Efficiency (%)	Fuel Type	Cumulative percentage (%)
Additions 2008						
Humeros	GEO	40	321000	100.00%	N.A	0.15%
Cuidad del Carmen	TG		0	39.42%	GAS	0.15%
Ciudad del Carmen	TG	47	0	39.42%	GAS	0.15%
Additions 2007						
La Venta II	Wind	0	0	100.00%	N.A	0.15%
El Cajón (Leonardo Rodríguez Alcaine)	HID	750	1829000	100.00%	N.A	1.00%
El Cajón (Leonardo Rodríguez Alcaine)	HID	0	0	100.00%	N.A	1.00%

Tamazunchale (PIE)	CC	1135	7492100	53.11%	GAS	4.48%
Río Bravo (Emilio Portes Gil)	CC	0	0	53.11%	GAS	4.48%
Río Bravo (Emilio Portes Gil)	CC	0	0	53.11%	GAS	4.48%
Río Bravo (Emilio Portes Gil)	CC	511	260764	53.11%	COM Y GAS	4.60%
Ecatepec (LFC)	TG	0	0	39.42%	GAS	4.60%
Remedios (LFC)	TG	0	0	39.42%	GAS	4.60%
Victoria (LFC)	TG	0	0	39.42%	GAS	4.60%
Villa de Flores (LFC)	TG	0	0	39.42%	GAS	4.60%
Cuautitlán (LFC)	TG	0	0	39.42%	GAS	4.60%
Coyotepec (LFC)	TG	0	0	39.42%	GAS	4.60%
Coyotepec (LFC)	TG	0	0	39.42%	GAS	4.60%
Vallejo (LFC)	TG	0	0	39.42%	GAS	4.60%
Santa Rosalía	CI	0	0	45.07%	DI	4.60%
Santa Rosalía	CI	0	0	45.07%	DI	4.60%
Santa Rosalía	CI	0	0	45.07%	DI	4.60%
Holbox	CI	0	0	45.07%	DI	4.60%
Holbox	CI	0	0	45.07%	DI	4.60%
Additions 2006						
Tuxpan V (PIE)	CC	495	1628802	52.47	COM & GAS	6.31%
Valladolid III (PIE)	CC	525	1818537	52.47	GAS	7.96%
Altamira V (PIE)	CC	1121	1988812	52.47	GAS	11.62%
Chihuahua II (El Encino)	CC	619	3138898	52.47	GAS	13.48%
Atenco	GT	0	0	38.4	NG	13.48%
Additions 2005						
Ixtaczoquitlán	Hydro	0	0	100	na	13.48%
Botello	Hydro	0	0	100	na	13.48%
Hermosillo	CC	227	1344686	52.47	NG	14.36%
Rio Bravo IV	CC	500	3002678	52.47	NG	15.52%
La Laguna II	CC	498	3719779	52.47	NG	17.13%
Yécora	IC	0	0	45.17	DI	17.13%
Hol Box	IC	0	0	45.17	DI	17.13%
Additions 2004						
Chicoasén (Manuel Moreno Torres)	Hydro	2400	6682000	100	na	18.19%
El Sauz	CC	601	2859647	52.47	NG	20.96%
Rio Bravo III	CC	495	2479204	52.47	NG	20.96%
Tuxpan (Pdte. Adolfo López Mateos)	GT	2263	11031040	38.4	NG	21.39%
San Lorenzo Potencia	GT	0	0	38.4	NG	24.94%
Additions 2003						

Los Azufres	GEO	195	1522000	100	na	25.65%
Transalta Chihuahua III	CC	259	1192898	52.47	NG	26.42%
Transalta Campeche	CC	252	1810753	52.47	NG	27.25%
Naco Nogales	CC	258	1890537	52.47	NG	28.22%
Tuxpan III y IV	CC	983	7057169	52.47	NG	31.48%
Altamira III y IV	CC	1036	6464612	52.47	NG	34.27%
El Verde	GT	0	0	38.4	NG	34.27%
Las Cruces	GT	0	0	38.4	NG	34.27%
Dos Bocas	GT	452	2732808	38.4	NG	35.26%
Calera	IC	0	0	45.17	DI	35.26%

Table 52. New power plants installed. Source: SENER. "*Prospectiva del sector eléctrico 2007-2016 Cuadro 19 p.77; Prospectiva del sector eléctrico 2006-2015 Cuadro 13 p.57; Prospectiva del sector eléctrico 2005-2014 Cuadro 14 p.51; Prospectiva del sector eléctrico 2004-2013 Cuadro 9 p.44* and *Prospectiva del sector eléctrico 2003-2012 Cuadro 8 p.39"*. Abbreviations: Hydro: hydropower plant; Geo: geothermal plant, CC: combined cycle plant, fuelled with natural gas, GT: Gas turbine, fuelled with natural gas. IC: Internal combustion. Generation by power plant for 2006. Source: SENER. "Prospectiva del sector eléctrico 2007-2016 Tabla 04 p.162"

BM factor: **0.379** tCO2/MWh

Emission factor ex-ante = 0.5*OM+ 0.5*BM = **0.528** tCO_2/MWh

Annex 4
MONITORING INFORMATION

Please refer to Section B.7.