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

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Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

Partial Substitution of Coal by Jatropha Fruits and Biomass Residues in the Production of Portland Cement
PDD Version 5
Date: 2nd December 2011

A.2. Description of the project activity:

Pre project activity

SOCOCIM Industries (Senegal), a member of the VICAT Group since 1999, has its cement manufacturing facility in Rufisque, 30 km West of Dakar, with an annual installed capacity for clinker production of 1,350,000 tons based on the two existing kilns n°3 and n°4[1]. An additional kiln (n°5), just built, is operational since 2010, but this new production line is excluded from the project activity as explained later. Clinker production and fuel consumption are as presented in the table below.

	2004	2005	2006
Clinker production (tons)	1,047,128	1,037,623	1,066,330
Coal consumption (tons)	126,634	151,855	167,393
Heavy fuel oil (HFO) (tons)	16,549	3,494	2,421

Table 1 : *Fuel mix consumptions before project activity.*

SOCOCIM industries started using coal in May 2004 as a substitute to heavy fuel oil to reduce its energy expenses. Before this date, heavy fuel oil was the only fuel used in both kilns n°3 and n°4.

In the pre project scenario, SOCOCIM Industries is using coal as main fuel for its clinker production and small quantities of heavy fuel oil (HFO) for start ups. Waste oils, which supply chain was recently formalized[2], have also become part of the existing fuel mix (3,981 tons in 2009).

Project scenario

The purpose of the project activity is the partial replacement, up to 35 % of the heat demand, of a fossil fuel, coal, by whole Jatropha fruits for combustion in the cement plant (kilns n°3 and n°4), and to a lesser extent, by biomass residues (groundnut shells, rice husks, cashew nut shells, palm oil kernels, cotton stems, Jatropha shells and cakes issued from potential future biofuel producers), if such biomass residues are effectively available, are not already commonly used in Senegal and are not significantly competing with other activities.

Jatropha is an endemic tree which will be cultivated locally in dedicated plantations. Jatropha Curcas is a tropical plant which can grow on poor soils which makes it suitable for areas which would otherwise remain uncultivated. The plant can withstand dry conditions, low nutrient levels and exposed conditions. The dropping of leaves also generates compost around the plant which increases in return biologic

[1] In this Project Design Document, all weights are expressed in metric tons of dry matter.
[2] See Document 06 : « *Government decree on management of waste oils 2007-10-05.pdf* » (*Arrêté Interministériel portant gestion des huiles usagées)*

activity in the soil, thus improving its fertility. During very dry conditions the plant sheds its leaves in order to avoid unnecessary water evaporation. Due to the fact that the Jatropha is a perennial plant which has low demands on its environment, it can fight soil erosion. Jatropha Curcas is traditionally used in Senegal in protecting hedges around arable land and housing. Also due to its toxicity, Jatropha Curcas oil is not edible and is traditionally used for manufacturing soap and medicinal applications.

In addition to Jatropha fruits issued from dedicated plantations under the supervision of SOCOCIM Industries, the cement plant envisage to use, on a limited scale, other biomass residues such as groundnut shells, rice husks, cotton stems or shells, cashew nut shells, palm tree kernels, and possibly later, in the long term, Jatropha shells or cakes issued from tentative future Jatropha oil production plants.

Contribution to Sustainable Development

In addition to reducing greenhouse gas emissions by 54,315 tCO_2/year, the proposed project activity will contribute to sustainable development in many respects.

Upstream, the entire biomass supply chain including planting, cultivating, harvesting, handling and transportation will give employment and income opportunities to rural communities, farmers and biomass dealers thus improving the social and economic situation of rural communities which are facing growing difficulties due to climate change, decrease of agricultural yields and continuous degradation of agricultural soils mainly due to overutilization, excessive grazing and drought. In particular, the new cash crop will complement incomes issued from groundnut production which are highly variable from year to year.

The dedicated Jatropha plantations will contribute to restore the rural environment by creating "green belts" in areas where soils have been severely degraded thus protecting indirectly nearby environment of local rural communities (limitation of erosion by sand winds, better retention of seasonal rains in the underground, etc.). Taking into account the fact that the plantations will only be done in marginal lands after government approval through the "*Institut National de Pédologie* (INP)", place under the Ministry of Agriculture, according to a detailed "Cultivation Charter"[3]; there will be no competition with food cultivations such as rice, maize, millet, vegetables or cash crops like cotton or groundnuts.

Downstream, the substitution of imported coal by Jatropha will reduce local pollution around the Rufisque cement plant due to coal dusts and sulfur emissions while it will result in a major reduction of

[3] See Document 01: « *Cultivation chart for Jatropha suppliers 2008-06-30.doc* » (*Charte applicable aux producteurs de Jatropha approvisionnant en exclusivité la cimenterie de Rufisque – SOCOCIM Industries*) & English translation.

emissions thereby contributing to the global environmental initiative of reducing green house gas emissions.

The use of a local renewable energy such as Jatropha or other biomass wastes in substitution to coal will contribute to reduce the critical energy dependency of Senegal over energy imports (about 50% of its exports in value) and open a new government energy strategy focused on the use of local clean energy resources.

Up to now, Jatropha fruits have never been used on a significant scale in the world in cement kilns[4]. Therefore, the project, with its 11,000 ha of plantations, is pioneering this technology and will improve technical know-how of the cement industry in mastering a full biomass supply chain and give impetus to the introduction of clean technology in cement manufacturing.

The initiative of SOCOCIM Industries is supported by the Senegalese Government at the highest level[5]. Other initiatives for plantations of Jatropha by other actors are under consideration for production of biofuels but their scope is less ambitious and much less advanced.

A.3. Project participants:

Name of Parties involved ((hosts) 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)
Senegal (Host Party)	SOCOCIM Industries (Private entity)	No

Project proponent

SOCOCIM Industries is the leader (and pioneer) of the West African cement industry. It was funded in 1946, and has participated to the development of local and national economies for more than 60 years. The company was acquired by VICAT group in 1999, a major French cement group listed on NYSE Euronext.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

[4] According to the bibliography on Jatropha Curcus reviewed, a few cement manufacturers have conducted preliminary researches and small pilot plantations of Jatropha, such as ICC in India, INDOCEMENT in Indonesia (71 ha) in 2007/2008, but none, apparently, is using the whole Jatropha fruits in its clinker kilns on a significant scale. The World Congress on Jatropha held in Hamburg in October 2008 did not either refer to such Jatropha fruits biomass projects in cement plants.

[5] See Documents 02a & 02b illustrating the official support for the project activity. This Jatropha project developed by SOCOCIM Industries is strongly supported by the Senegalese government. The President of the Republic visited the cement plant and the Jatropha pilot farm of Bargny on 14th December 2007. The project is actively supported by the relevant Ministers in charge as proven by several official letters from Ministry of Decentralization and Local Communities dated 6 June 2009, and Ministry of Interior on 26 September 2007. Indeed, such Jatropha project is fully consistent with its ambitious national project focused on the development of sustainable biomass energy.

Senegal

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

Dakar region, Cap Vert Peninsula

A.4.1.3. City/Town/Community etc:

SOCOCIM Industries, Ancienne route de Thiès, BP 29, Rufisque, Senegal

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

The project activity is located at the SOCOCIM Industries cement plant in Rufisque, 30 km West of Dakar, off the main road N1. Latitude: 14°42'24.20'' N – Longitude: 17°14'51.31'' W

The project activity includes dedicated plantations of Jatropha within a 150 km radius from the cement plant in Rufisque (see map) and the eventual collection and transport of biomass residues from existing agro industries (groundnut shells, cotton shells, rice husks, cashew nuts, palm kernels …) within the same geographical region.

Figure 1: *Map of Senegal and distances from Rufisque SOCOCIM Industries cement plant*

Figure 2: *Map of "Presqu'ile du Cap Vert", Senegal*

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

The project activity belongs to Sectoral Scope 4: Manufacturing industries.

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

Main components

The following figure illustrates the main components of the activity from Jatropha plantations up to the combustion of Jatropha fruits and biomass residues in the clinker kilns N°3 and N°4.

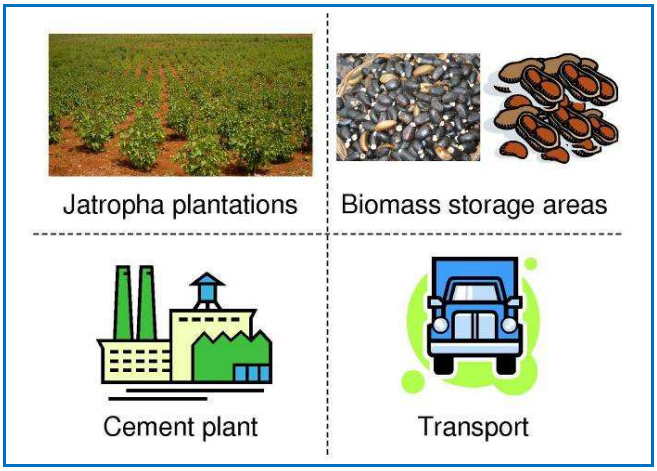

Figure 3: *Jatropha CDM project boundary: main components*

Technology used for the production of Jatropha fruits

The production of Jatropha fruits in quality and sufficient quantities is the key for project success. To achieve this objective, SOCOCIM Industries has developed a unique know-how and organization scheme which involves selection of soils and lands in an area of 150 km around the Cement Plant, respecting the cultivation charter[6] of Jatropha plantations dedicated to SOCOCIM Industries cement plant in Rufisque with the support of the "*Institut National de Pédologie (INP)"*[7]. The selection and distribution of Jatropha seeds will be provided with the support of the "*Institut Sénégalais de Recherche Agronomique"* (ISRA), who will provide technical assistance to farmers/cooperatives under contract[8] for developing nurseries, planting, plantation maintenance and Jatropha fruits harvesting.

The main operations needed for Jatropha plantation and cultivation, based on acquired field test experience in 2007, 2008 and 2009 are the following:

- Development of nurseries for Jatropha plants through manual activities;
- Initial soil preparation using a tractor or bulldozer to level the ground and clear stones and remaining dry grass;
- Manual plantation by peasants of young plants in small holes;
- Initial manual incorporation of a very small quantity of organic fertilizer, (150 kg of organic fertilizer per ha, on the basis of the experience acquired on Pout plantation) based on vegetal waste compost nearby each young plant;
- Eventually, a small irrigation for the very young plants using a tractor with a water tank, if the plantation is not carried out just before the rainy season as recommended;
- Manual follow up of the plant growth and cleaning of nearby soil;
- Manual harvest and transport of mature Jatropha fruits;

No synthetic fertilizer will be used, as requested in the cultivation chart contract. No irrigation scheme is also foreseen, apart from punctual watering of young plants, if really needed, taking into account the fact that the Jatropha plant is very resistant to drought.

The Jatropha fruits will be stored in aerobic condition, first on the surroundings of farms and transferred by horse or donkey carriages or small trucks to the main storage centers called "seccos", at a maximum distance of 15 km from dedicated Jatropha farms. "Seccos" are existing covered storage areas mainly used for the storage of cash crops and biomass, offering large spare capacities. There are managed by the Ministry of Agriculture and the "*Institut National de Pédologie*", and kept under supervision by watchmen.

There are more than 50 "seccos" installed in the project activity cultivation area; a map of "seccos" position in Fatick, one of the five regions involved in the project area (<150 km from cement plant) is presented hereafter[9].

[6] The selection of cultivation lands will take into account the applicability criteria of ACM0003 which have been replicated in the cultivation charter for dedicated Jatropha plantations. This selection will be supervised by INP, a Senegalese government research institution.

[7] See Document 03, 03a & 03b "*Convention de coopération entre l'Institut National de Pédologie"* between INP and SOCOCIM Industries signed in March 2010 with related letter and English translation.

[8] See Document 11: "*Contract for Jatropha suppliers - template June 2008"*

[9] See Document 04: List and maps displaying the location of the "seccos" in the five regions selected for the development of dedicated Jatropha plantations farms.

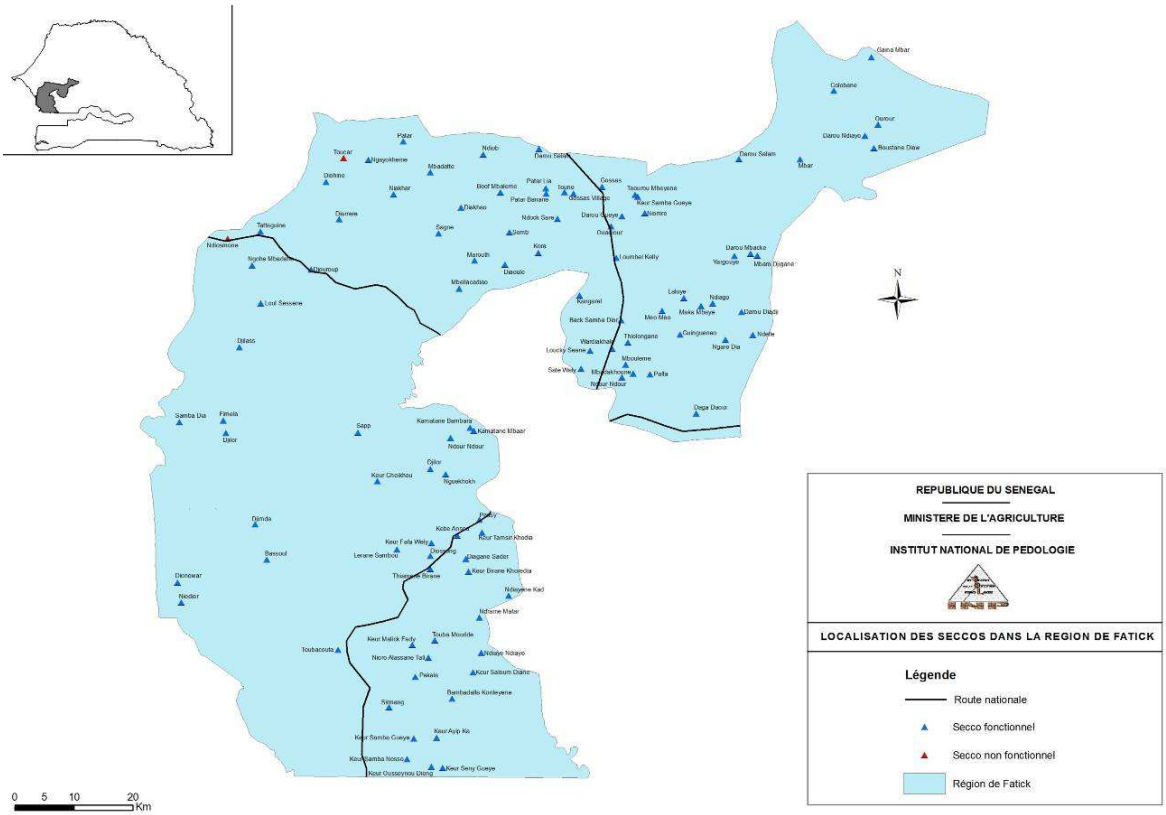

Figure 4: *Location of "Seccos" storage areas in Fatick Region*

No specific drying activity is necessary as the Jatropha fruits are naturally very dry (about 8% humidity according to laboratory tests) and are not exposed to humidity during transport and intermediary storage. Actually, when the Jatropha fruit is becoming dark and ripe, the fruit is near totally dry.

The Jatropha fruits will be collected from "seccos" and transported to Rufisque cement plant by trucks. All trucks will be weighted at entrance of SOCOCIM Industries cement plant before emptying the load at a reception area and weighted again when leaving the cement plant to determinate the net tonnage of Jatropha fruits delivered. In the cement plant, an official storage authorization for 20,000 tons of biomass has been obtained[10].

Selection and certification of eligible lands for dedicated Jatropha plantations

The total surface of Jatropha plantations will be 11,000 ha. This total surface will be split into 13 to 20 different locations/plantation areas of less than 900 ha each, all meeting the CDM ACM0003 eligibility criteria and the Senegalese legislation for small and medium size plantations.

There are no official criteria for definition of degraded land in Senegal. SOCOCIM will provide to the verifying DOE for each plantation area used in the project activity a written statement from the Senegalese administration certifying that the related land is degraded and has not been valorized for more than 10 years. The "*Institut National de Pédologie" (INP)*, placed under the Ministry of Agriculture, will

[10] See Document 07a & 07b: "*Government authorisation for processing of biomass in SOCOCIM 2009-10-02*" in French and English.

assess in advance all Jatropha plantation projects developed by cooperatives or individuals. He will deliver an agreement for plantation if all applicable conditions of ACM0003 methodology are met and if the plantation project is meeting Senegalese environment protection. A partnership agreement between SOCOCIM Industries and the INP institute has been established to provide the necessary field services for verifications before issuance of government authorizations.

In line with this procedure, the project proponent has obtained[11] a confirmation of the eligibility of the 450 ha of lands used by SOCOCIM Industries for its pilot plantations carried out since mid 2007. These lands were already owned by the company as limestone quarries reserve. Young Jatropha plantations, less than one year old, will be protected from animal grazing through human supervision. After one year, the plants are large enough to develop without any specific protection. Furthermore Jatropha is not edible by animals.

Technology used for biomass fuel feeding in the cement plant

Technology to substitute coal with biomass in the pre-calciner of the cement kilns was developed in conjunction with the VICAT Technical Department in France. In general terms, this development consisted in the in-house design of a new and additional biomass fuel feeding system which includes conveyors, hoppers, weighing equipment, safety equipment, etc. and adjustment of process parameters to meet SOCOCIM Industries cement quality standards[12] and optimize energy efficiency.

Two biomass feeding lines will be installed on kilns n°3 and n°4. This investment includes, in particular, for each line[13]:

- A reception area for trucks,
- A storage hall of about 1,700 m^3 with an automatic crane handling equipment,
- A workshop with conveyor belts, screening tables, weighing equipment, magnetic separator,
- Pneumatic conveyors and filters to feed the kiln,
- Electrical unit for supervision and regulation of equipment,
- Security installations against fire and staff accidents,
- Firefighting equipment.

Existing technology for coal storing, grinding, kiln feeding, etc. will be kept operational but will be used at a reduced rate. The project activity will save a significant quantity of electricity by reducing the yearly use of the coal grinding mills, the power required by the biomass feeding lines being lower.

[11] See Document 10a & 10b: « INP pilot plantations eligibility report 2010-09-30» (*Procès verbal de validation des sites de production de Jatropha de la SOCOCIM industries*) and English translation.

[12] SOCOCIM Industries has obtained in 2008 CE certification for all cement products and ISO 9001 in October 2009. The cement plant is under certification for ISO 14001 for 2010. Very few African cement plants are meeting these international standards.

[13] See Annex 6: Technical presentation of Jatropha Fruits feeding installations at SOCOCIM Industries Cement Plant in Rufisque, Senegal.

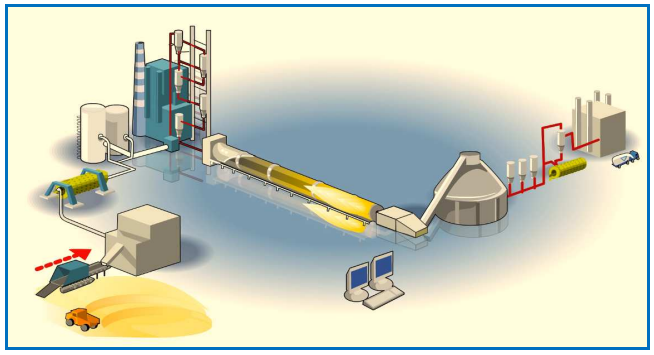

Figure 5: *Typical lay out of a cement plant*

According to the simulations and expected yield of the Jatropha plantations (6.4 tons/ha based on recent field experience and bibliography), the contribution of Jatropha fruits and biomass residues used instead of coal will amount to 35.1% of the heat demand, of which 31.7% of Jatropha fruits and 3.4% of groundnut shells and other biomass residues. These small quantities of biomass residues will facilitate the start up of the project when Jatropha plantations are too young to provide significant quantities of Jatropha fruits.

Jatropha fruits will be, after the initial period of four years with limited input due to development of young plantations, the key part of the biomass fuel (approximately 85%); other biomass, such as groundnuts, will be only a limited input taking into account the limited availability and the irregularity of supply of biomass residues within an economic transport radius. The 35% biomass ratio of heat supply in kilns n°3 and n°4 will only be achieved after the start-up period.[14]

Equipment required for the project activity

The following table provides a summary of the equipment used upstream (supply of Jatropha fruits and other biomass residues) and downstream at plant level to carry out the proposed project activity.

Section of Activity	Equipments	Specifications
Plantation		
Soil Preparation	Agricultural Tractor with ploughing tool	Power from 150 to 200 Hp
	occasional irrigation tank	Diesel consumption: 150 liters/ha
Jatropha and other biomass transports		
Transportation from farms surroundings to SECCOS	Horse or donkey hitch	
	Small trucks (2 tons of jatropha fruits load)	
Transportation from SECCOS to the cement plant	Trucks (10 tons of jatropha fruits load)	Diesel consumption:40 liters/100 km
Cement Plant		
Reception weighting and metering	Cement Plant entrance weighbridge	Capacity: 10 to 90 tons
	Water content measurement	
	Heat value	

[14] See attached Excel file: "*SOCOCIM CDM data file 2010_10_30.xls*"

	Jatropha fruits and biomass feeder	
	Weighting at precalciner introduction	
	Crude material feeder weighting at the top of the heater(existing)	
	Waste oils introducing weighting	
	Coal weighting for the kiln	
	Heavy fuel weighting for the kiln	
Introduction installation per kiln		
	Automatic grape crane	Power : 85 kW
	Introducing hopper	Capacity: 25 m^3; 2.2 tons
	Feeder weighting system	Capacity: 0.6 to 6.0tons/h, Power: 3kW
	Introducing rotary valve	Capacity: 80 m^3/h, Power : 15 kW
	Pneumatic conveyor air pressuring	Capacity: 33 m^3/min, power: 55 kW
Kiln n°3 Precalciner		
	Precalciner 3,490 x 4,600 x 1,100	Burner Pillard
Kiln n°4 Precalciner		
	Precalciner 3,050	Burner Pillard

Table 2: *List of main equipment and specifications for the project activity*[15]

Lifespan of Jatropha plantations is approximately 50 years, whereas the equipment to be installed will have a lifetime above 25 years. Existing kiln lines are still operational for more than 25 years from now.

Training, maintenance and technology transfer

Upstream technology transfer and training of operators in the cement plant for the use of biomass as alternative fuel in clinker production line will be provided by INP and ISRA through the protocol and convention established with SOCOCIM Industries, as well as by the management of SOCOCIM Industries and the VICAT technical support group. VICAT group has developed a special department in charge of the development of alternative fuels in cement processing and the dissemination of the best practices available. SOCOCIM Industries has also a Training Department developing internal sessions for new workers and confirmed operators, globally called "*Ecole du Ciment*" (Cement School). Alternatives fuels and biomass utilization in the clinker processing lines will be integrated into the yearly programs of this "cement school" and all the operators concerned with the project activity will attend regularly the sessions.

All training actions will be realized under the SOCOCIM Industries Quality System certified ISO 9001 obtained on 24th August 2009, along with regular training and maintenance programs for all activities of the cement plant. ISO 14001 Certification is foreseen for October 2010. The Company is developing a Computer Aided Maintenance program that will integrate also the CDM project activity. Each year, SOCOCIM Industries is financing and implementing specific training programs for most of its professional staff. The budget for SOCOCIM Industries' training programs amounted to 90 M. FCFA (about 137,000 EUR) in 2009. A tailored made training program will be implemented for the staff in charge of the maintenance of the new biomass installations foreseen for the project activity as well as for the technicians and engineers in charge of project activity monitoring. The training specific to the project activity should not be a problem in this plant using already the most recent technologies with a fully computerized supervision.

[15] See also File 05: "*List of equipments in kilns 3 and 4* ***before*** *project activity.zip*"

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

The chosen crediting period is 7 years, renewable at most 2 times.
The emission reductions amount to 54,315 tons per year during the first 7 years long crediting period:

Years	Annual estimation of emission reductions in tons of CO_2e
01/03/2012 to 28/02/2013	2,035
01/03/2013 to 28/02/2014	8,393
01/03/2014 to 28/02/2015	24,802
01/03/2015 to 29/02/2016	51,114
01/03/2016 to 28/02/2017	81,604
01/03/2017 to 28/02/2018	101,282
01/03/2018 to 28/02/2019	110,975
Total estimated reductions (tonnes of CO_2e)	**380,205**
Total number of crediting years	7
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	**54,315**

A.4.5. Public funding of the project activity:

No public funding is involved in the project activity.

SECTION B. Application of a baseline and monitoring methodology

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

ACM0003 / Version 07.4.0: "Emissions reduction through partial substitution of fossil fuels with alternative fuels or less carbon intensive fuels in cement or quicklime manufacture".

In line with this methodology, the latest approved versions of the following tools were used[16]:

- Version 03.0.1 of "Combined tool to identify the baseline scenario and demonstrate additionality".
- Version 02 of "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion".
- Version 01 of "Tool to calculate baseline, project and/or leakage emissions from electricity consumption".

In addition, the following applicable methodologies are referred to:

- Version 02.1 of AM0042 - "Grid-connected electricity generation using biomass from newly developed dedicated plantations"

[16] The methodology also refers to the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site" but it is not relevant for the proposed project activity since alternative scenario B2 has not been identified as the most plausible baseline scenario for the use of biomass residues (see section B.4 below).

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

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 fuel(s) and/or alternative fuel(s). The proposed project activity fully meets this main condition.

The methodology is applicable to the project activity since all the applicability conditions described hereafter are fulfilled:

i) General Applicability conditions

Applicability conditions	Demonstration of compliance
A significant investment is required to enable the use of the alternative fuel(s) and/or the less carbon intensive fossil fuel(s).	In addition to a large investment upstream in Jatropha production (crop nurseries, plantations, maintenance, harvest, transportation, storage, technical assistance, equipment, and manpower) which is estimated at 19.16 M. EUR, to be financed by various players, including SOCOCIM Industries, significant investment is foreseen at the cement plant itself which will have to invest 6.36 M. EUR[17] in engineering studies, civil works, industrial equipment and services to store and weight the biomass (up to 250 tons/day) as well as conveyors, injectors and special equipment to feed and supervise the clinker production. In the absence of the project activity, these investments would appear as excessive to the project participant and would not be implemented. Presently, the financing of large agricultural projects in Senegal is very uncommon taking into account the fact that the agricultural sector, hampered by difficult climatic and pedologic conditions, is characterized by 440,000 very small farms (61% have less than 1 ha) mainly owned by poor peasants (85% of rural population is below the poverty line according to UNDP) thus offering no significant guarantees for large loans as anticipated in the project activity. The overall investment (25.52 M. EUR) to enable the use of alternative fuels in the project activity in replacement of coal for clinker production is

[17] See Annex 6 which includes the cost of the facilities

	indeed very significant in relation to common investment in the agricultural sector of Senegal[18]. It is also a significant investment for SOCOCIM Industries in such a new development area characterized by large risks as explained later and if compared to the total average annual investment carried out by the company in the last ten years: 15 M. EUR/year; mainly due to the retrofitting of this existing plant, bought by the VICAT Group in 2000, to meet environmental standards and improve its overall efficiency in line with the performances of the other cement plants of VICAT Group). The investment in this new agro-industrial activity is totally different in terms of levels of risks with the investment just carried out in clinker capacity expansion (n°5).
During the last three years prior to the start of the project activity, no alternative fuels have been used in the project plant.	The cement plant has been using exclusively coal and small quantities of heavy fuel oil (HFO) for startups during the last three years prior to the start of the project activity (July 2007).
The CO_2 emissions reduction relates to CO_2 emissions generated from fuel combustion only and is unrelated to the CO_2 emissions from decarbonisation of raw materials (i.e. $CaCO_3$ and $MgCO_3$ bearing minerals).	The method described in part B.6 to calculate CO_2 emissions reduction of the project relates to CO_2 emissions generated from fuel combustion only and is unrelated to the CO_2 emissions from decarbonisation of raw materials.
The methodology is applicable only for installed capacity (expressed in tons clinker/year or tons of quicklime/year) that exists by the time of validation of the project activity.	The present methodology is applicable for the existing kilns n°3 and n°4 with a combined clinker production capacity of 1,350,000tons/year; the expected clinker production during the crediting period is estimated at 1,234,000 tons/year i.e. below the existing installed capacity.

ii) Applicability conditions related to the use of biomass residues and renewable biomass:

Applicability conditions	Demonstration of compliance
The biomass is not chemically processed (e.g. esterification to produce biodiesel, production of alcohols from biomass, etc.) prior to combustion	The biomass will not be chemically processed prior to combustion. The Jatropha fruits and biomass residues will be simply stored before

[18] The global value added of the Senegalese agricultural sector was about 410 M. EUR in 2007 according to national statistics. Investment in the whole agricultural sector is very likely much less than 50 M. EUR per year. A 20 M. EUR investment in Jatropha production is consequently very significant for the Senegal and the project proponent. Senegal has been suffering from a low economic growth for many years (see chart 1 of http://www.imf.org/external/pubs/ft/survey/so/2010/car052610a.htm). In 2009, the IMF estimated the GNP growth at +1.9%. In 2008, the net foreign direct investment in Senegal was only 170 M. USD and the net total long term loans public + private was only 360 M. USD according the World Bank/IMF Country Assistance Strategy.

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 charcoal production).*	introduction into the kilns. No significant GHG emissions will occur before the use of the biomass in the project activity.
The biomass used by the project facility is stored under aerobic conditions.	The biomass will always be stored under aerobic conditions to avoid fermentation and risks of self-ignition.

iii) Applicability conditions related to the use of renewable biomass from a dedicated plantation:

Applicability conditions	Demonstration of compliance
The site preparation at the dedicated plantation does not cause longer-term net emissions from soil carbon. Carbon stocks in soil organic matter, litter and deadwood can be expected to decrease more due to soil erosion and human intervention or increase less in the absence of the project activity.	The Jatropha will be cultivated on poor land without significant vegetation (no agriculture, no tree…). The Jatropha plantations will therefore improve the quality of the soil and increase carbon stocks on the cultivated area.
After harvest, regeneration will occur either by direct planting or natural sprouting.	Only the fruits will be collected every year (natural sprouting once or twice a year). Jatropha trees have a life expectancy of approximately 50 years.
Grazing will not occur within the plantation.	Animals will be kept away from the Jatropha fields through initial human supervision, since their presence would damage the young plantations; moreover the Jatropha fruits are not edible by animals.
In the absence of the project activity, natural revegetation would not result in growth of a forest due to natural or human pressures	The land which will be used for the Jatropha plantations is poor land where natural revegetation cannot occur spontaneously.
Prior to the implementation of the project activity, no fuel wood has been collected from the land area where the dedicated plantation will be established	The Jatropha plantations will be implemented on poor lands where no fuel wood has been collected for the last 10 years.
For at least ten years before the implementation of the project activity, no forest was on the land where the dedicated plantation will be established	The Jatropha plantations will be implemented on poor lands previously without forest for at least 10 years.[19]
If relevant, workers for any activities on the land	No activities or household will be shifted away for

[19] The selection of the Jatropha cultivation lands meeting these applicability conditions will be done under the supervision of the "*Institut National de Pédologie (INP)*" placed under the Ministry of Agriculture. A cooperation agreement between the "*Institut National de Pédologie (INP)*" and SOCOCIM Industries has been signed on 9 March 2010; it provides assistance for selection of relevant lands and their optimal utilization to save local environment. See Document 03, 03a & 03b already mentioned in section A.4.3.

prior to project implementation continue to be employed for the biomass plantation activity, i.e. no households are shifted from the project site	the culture of Jatropha since the plantations will be implemented on inhabited lands. No households should be shifted from the project site. If ever, for an unexpected reason, some workers were to be shifted, SOCOCIM Industries would make sure to employ them for the biomass plantation activity. For example, SOCOCIM Industries has planted 150 ha of Jatropha in 2007 on the limestone quarry of the cement plant in Rufisque employing local labor.
The land area where the dedicated plantation will be established is, prior to project activity, able to *meet one of the following criteria:* *a) Either being severely degraded and would in absence of the project activity have not been used for any other agricultural or forestry activity, or;* *b) Has been used for agricultural purposes, provided the project participants can demonstrate that no natural forest exists in the host country.* *If the land area is severely degraded, land degradation can be demonstrated using one or more of the following indicators:* *(a) Vegetation degradation, e.g.* - *Crown cover of pre-existing trees has decreased in the recent past for reasons other than sustainable harvesting activities;* *(b) Soil degradation, e.g.* - *Soil erosion has increased in the recent past;* - *Soil organic matter content has decreased in the recent past;* *(c) Anthropogenic influences, e.g.* - *There is a recent history of loss of soil and vegetation due to anthropogenic actions; and* *Demonstration that there exist anthropogenic actions/activities that prevent possible occurrence of natural regeneration.*	The full purpose of this CDM project is to cultivate Jatropha on degraded land which has no agricultural or forestry potential and where natural regeneration to forest would not be possible, as specified in the cultivation chart.

iv) Applicability conditions related to the tools used by the methodology

The applicability conditions outlined in the latest versions of the following tools are also fulfilled:

Combined tool to identify the baseline scenario and demonstrate additionality	The project activities consist of making modifications to an existing installation that is

	operated by the project participant; therefore, the potential alternatives scenarios to the proposed project activities available to the project participant cannot be implemented in parallel to the proposed project activity.
Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site	Not relevant, since alternative scenario B2 has not been identified as the most plausible baseline scenario for the use of biomass residues (see section B.4 below).
Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion	CO_2 emissions from fossil fuel combustion for the project activity are calculated based on the quantity of fuel burnt and its properties.
Tool to calculate baseline, project and/or leakage emissions from electricity consumption	This tool is applicable since the electricity used by the cement plant is, so far, produced with fossil fuel. However no additional electricity consumption is foreseen as a result of the project.

The condition that the methodology is not applicable to project activities that implement efficiency measures in production of clinker or quicklime, such as changing the configuration/number of pre-heaters, is not relevant to the project, as in this context, no efficiency measures are implemented in clinker production.

Finally, this methodology is applicable to the proposed project activity as per the results of the *Procedure for the selection of the most plausible baseline scenario and demonstration of additionality* (see section B.4 below), since:

- **F3** (continuation of using only fossil fuels with a different fossil fuel mix portfolio) is the most plausible baseline scenario for the use of fuels in the cement plant, and
- The most plausible baseline scenarios for the use of alternative fuels are:
  - **B1** for the fate of biomass residues investigated (groundnut shells, palm kernels, rice husks, cashew nuts shells, cotton stems and Jatropha cakes and shells)
  - **R1** for the fate of Jatropha as a renewable biomass.

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

Project boundary

The physical project boundary, as illustrated in the following figure, covers all production processes from cultivation fields up to clinker kiln n°3 and kiln n°4, including:

- The sites where the renewable biomass is cultivated,
- The sites where the biomass residues would be dumped, left to decay or burnt in the absence of the project activity,
- Off-site storage areas ("*seccos*")
- The vehicles used for transportation of alternative fuels to the project activity site,

- The equipment for handling biomass within the cement plant,
- On-site storage and on-site transportation of alternative fuels (Jatropha fruits, rice husks, cotton shells, cashew nut shells…) including weighing and biomass feeding lines (no drying needed),
- 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 kilns tubes n°3 and n°4, where fuels are fired and where the calcinations process of the inputs for clinker production takes place.

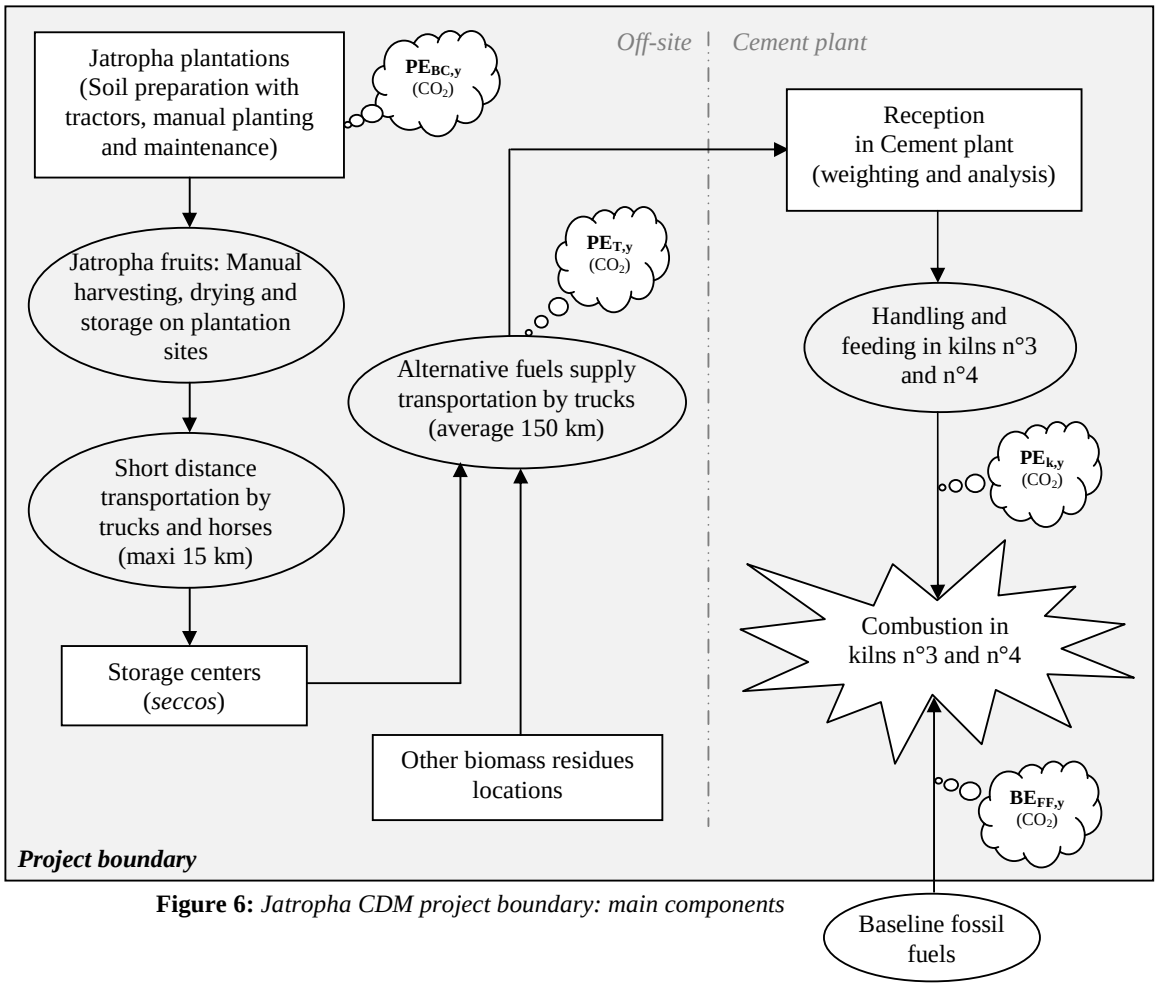

Figure 6: *Jatropha CDM project boundary: main components*

The new kiln n°5, just started in April 2010, is <u>not included</u> in the project boundary.

The following exhibits show the configuration of the pre-heaters, pre-calciner and kiln tube for clinker production, with and without, the project activity[20]:

[20] See <u>Annex 7</u>: Detailed layouts of CDM Jatropha project before and after project activity.

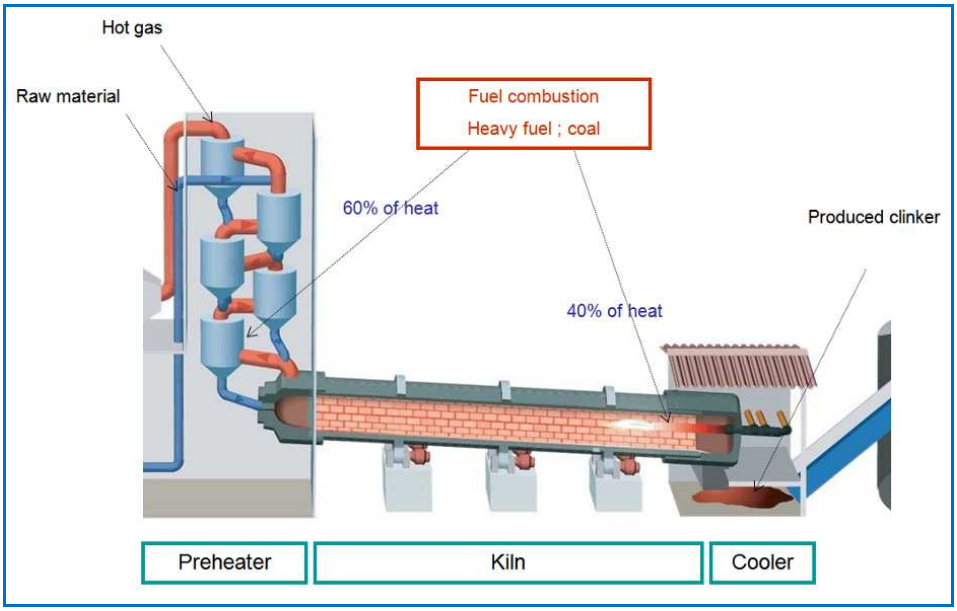

Figure 7: *Simplified configuration of kilns n°3 and n°4 without biomass utilization*

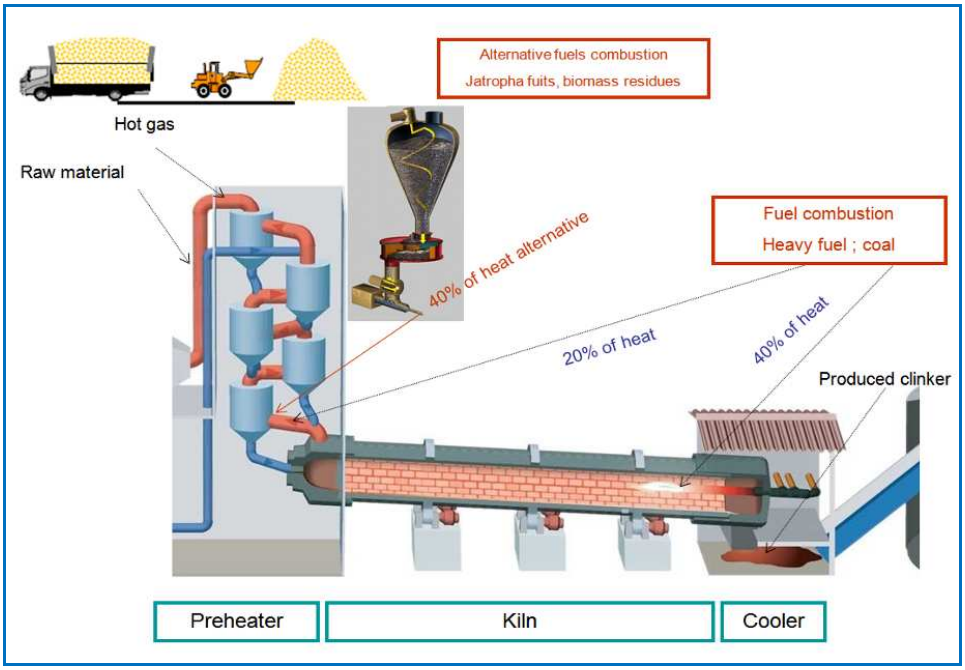

Figure 8: *Simplified configuration of kilns n°3 and n°4 with biomass utilization*

The main emission sources and type of GHGs in the project boundary are listed in the table below:

	Source	Gas	Included?	Justification/Explanation
Baseline	Emissions from fossil fuels displaced in the project plan ($BE_{FF,y}$)	CO_2	Yes	Main emission source.
		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 CO_2 emissions from surplus biomass residues do not lead to changes of carbon pools in the LULUCF sector (Land Use, Land-Use Change and Forestry).
		CH_4	No	Not included because no or insignificant fermentation of the biomass residues involved.
		N_2O	No	Minor source. Neglected for simplicity.
Project Activity	Emissions from the use of alternative fuels and/or less carbon intensive fossil fuels ($PE_{k,y}$)	CO_2	Yes	Although renewable biomass and biomass residues have an emission factor of 0.
		CH_4	No	Minor source. Neglected for simplicity.
		N_2O	No	Minor source. Neglected for simplicity.
	Emissions from additional electricity and/or fossil fuel consumption as a result of the project activity ($PE_{FC,y}$ and $PE_{EC,y}$)	CO_2	Yes	Neglected because of energy savings as a result of the project activity.
		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 ($PE_{T,y}$)	CO_2	Yes	Significant emission source.
		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 ($PE_{BC,y}$)	CO_2	Yes	Minor source since very little use of mechanization and no irrigation scheme.
		CH_4	No	No field burning before Jatropha plantation.
		N_2O	Yes	Minor source because of marginal use of organic fertilizers only.

Table 3*: Gases included in the boundary related to the project activity.*

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

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" (Version 03.0.1).

The following four Steps are applied:

STEP 1. Identification of alternative scenarios;
STEP 2. Barrier analysis;
STEP 3. Investment analysis (if applicable);
STEP 4. Common practice analysis.

Step 1: Identification of alternative scenarios

This step serves to identify all alternative scenarios for SOCOCIM Industries to the proposed CDM project activity which might be the baseline scenario via the following sub-steps:

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

This step identifies all alternative scenarios that (a) are available to SOCOCIM Industries, (b) cannot be implemented in parallel to the proposed project activity, and (c) provide outputs or services with comparable quality, properties and application areas as the proposed CDM project activity, i.e. clinker production as in the project activity.

Alternatives for the fuel mix for cement manufacturing:

The five alternative scenarios F1 to F5 analyzed for the fuel mix for the cement plant (kilns n°3 and n°4) are:

	Description of alternative scenarios	Comments	Plausible and credible alternative?
F1	The proposed project activity **not** undertaken as a CDM project activity *Coal + HFO + Waste Oil* *+ Jatropha Fruits* *+ Biomass Residues*	Under this scenario, the SOCOCIM Industries cement plant is fuelled by Coal, small quantities of HFO and Waste Oils and a large share of biomass (about 35% of energy) made of Jatropha fruits coming from dedicated plantations and, to a lesser extent, by biomass residues (groundnut shells, rice husks, cashew nut shells, palm oil kernels, cotton stems, Jatropha shells and Jatropha cakes issued from potential future biofuel producers), if such biomass residues are effectively available, are not already commonly used in Senegal and are not significantly competing with other activities. These small quantities of biomass residues will permit the start up of the project when Jatropha plantations are too young to provide significant quantities of Jatropha fruits. The scenario requires an important investment, upstream and downstream, to produce, transport and process about 250 tons/day of Jatropha fruits and biomass residues into kilns n°3 and n°4. This scenario would not occur in the absence of CDM due the major barriers to be faced (see the description of technological and financial barriers in Step 2 below).	**YES**

<table>
<tr><td></td><td></td><td><table><tr><th>Fuel</th><th>Quantity (tons)</th></tr><tr><td>Coal</td><td>111,716</td></tr><tr><td>Heavy Fuel Oil</td><td>3,200</td></tr><tr><td>Waste oil</td><td>5,000</td></tr><tr><td>Jatropha fruits</td><td>70,400</td></tr><tr><td>Biomass residues (mainly groundnut shells, other residues being difficult to collect)</td><td>10,000</td></tr></table>Typical quantities for scenario F1 in normal year (after start up period)</td><td></td></tr>
<tr><td>F2</td><td><u>Continuation of current practice, i.e. scenario before the start of the project activity</u> in which SOCOCIM Industries continues clinker production in kilns n°3 and n°4 using the existing technology, materials and fossil fuel mix

Coal + HFO</td><td>This scenario is the continuation of the current practice prior to the start of the project activity, with coal being predominantly used and minor quantities of HFO for start-ups.

<table><tr><th>Fuel</th><th>Quantity (tons)</th></tr><tr><td>Coal</td><td>167,393</td></tr><tr><td>Heavy Fuel Oil</td><td>2,421</td></tr></table>Corresponding to year 2006 (before the start up of the project activity)

This scenario would in all likeliness be credible as it has been the case for several years.</td><td>YES</td></tr>
<tr><td>F3</td><td><u>The continuation of using only fossil fuels and no alternative fuels</u>, however, with a <u>different fuel mix portfolio</u>, taking into account relative prices of fuels available.

Petcoke + HFO

+ Waste Oil</td><td>In this different fossil fuel mix scenario, Petcoke and Waste Oils are respectively being used in replacement to Coal and in addition to HFO.

<u>Waste Oils:</u> The supply chain of waste oils was recently organized and they have already been introduced in the kilns consumption (3,981 tons in 2009). Waste oils origin is a mixture of used engine oils and residues of HFO filtration available from diesel power plants.

Waste oils are left on unmanaged, unofficial and unsafe landfills or nearby habitations all over the country, thus generating critical conditions for the local environment[21]. SOCOCIM Industries is authorized to burn waste oils in its high temperature clinker kilns by the Ministry of Environment. The combustion of waste oil at very high temperature when the clinker kiln has reached its nominal operating temperatures allows the safe destruction</td><td>YES</td></tr>
</table>

[21] Source : African Institute for Urban Management (IAGU) Report 2004-2007, page 24: http://www.iagu.org/PDF/rapport_IAGU.pdf .

		of waste oil in accordance with the new Senegalese regulations regarding this hazardous waste. Today, small quantities of waste oils (1,500 tons) are yearly recycled by SRH, the only existing recycling Senegalese company ("*Société de Régénération des Huiles"*)[22]. Available quantities of waste oils in Senegal for the cement plant in the coming years are small (about 16,000 tons of lubricants are yearly consumed in Senegal[23]) and a study has estimated the potential for waste oil recovery between 4,000 and 4,800[24]tons). In 2009, 3,981 tons of waste oils were consumed by SOCOCIM Industries in kilns 3 and 4; for 2010 and later, 5,000 tons of waste oils are expected to be available for SOCOCIM Industries. <u>Petcoke</u> contains necessarily high levels of sulfur (4% minimum) which would lead to high levels of SO_2 emissions at the kilns' chimneys, probably above authorized limits. High levels of sulfur cause concretions in fans, and are a source of important breakdowns and losses of productivity. Indeed, the raw materials used in the cement plant contain already high levels of sulfur. Therefore, fuels containing high levels of sulfur cannot be used in the Rufisque cement plant. Petcoke is also harder to grind than coal and its use would increase the electricity consumption for solid fuel grinding and reduce also the grinding capacity, two constraints that do not meet SOCOCIM energy policy. However, the use of petcoke instead of coal being increasingly common elsewhere in the world's cement industry and more conservative than coal, it is favored as a valid alternative scenario.[25] **Fuel** / **Quantity (tons)** Petcoke: 142,912 Heavy Fuel Oil: 3,200 Waste Oils: 5,000 *Based on the heat balance corresponding to a forecasted*	

[22] AFRICACLEAN Report, page 21 and 33.

[23] Urban Management (IAGU) Report 2004-2007, page 24: http://www.iagu.org/PDF/rapport_IAGU.pdf

[24] Ecole Polytechnique de Thiès, Page 90 http://www.beep.ird.fr/collect/thies/index/assoc/HASH69f9.dir/pfe.gm.0512.pdf

[25] A letter from El Hadji MBaye Diagne (member of the UNFCCC roster of experts for Senegal) is available for the DOE. This letter confirms that the use of petcoke is a less plausible alternative but more conservative scenario than coal to the proposed project activity for SOCOCIM.

		typical year.	
F3bis	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. *Coal + HFO* *+ Natural Gas*	In this fuel mix scenario, Petcoke and Natural Gas are envisaged besides Coal and HFO. Natural gas has been found under "Cap Vert" peninsula, but serious uncertainties remain on existing reserves to ensure a regular long term supply and the unit price proposed by the private supplier FORTEZA (145 FCFA/Nm^3), is much higher than imported coal for heating purposes[26]. Natural gas in Senegal is consequently only used to supply a small independent private power plant (2 x 6 MW) delivering electricity to SOCOCIM Industries since 2009, as a complement to its own HFO power plant. Its purchase price is almost twice more expensive than coal in heat equivalent. Heavy Fuel Oil, being about thrice more expensive than coal, it will remain only used for kiln startups. Taking into account the existing technical and economic constraints for natural gas, this scenario is not plausible.	**NO**
F4	The currently used fuels, Coal and HFO, are partially substituted with alternative fuel 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. *Coal + HFO* *+ Used Tires + Plastics*	Used tires and Plastic Wastes are not suitable alternatives due to availability and supply issues. In 2005, 5,475 tons of tyres have been burnt as source of energy for the smoking of skins and for the iron.[27] About 40,000 tons[28] of waste plastics are left on unmanaged landfills or nearby habitations in the Dakar area. Small units for recycling small quantities of specific plastics exist in Senegal. These units belong to industrials and two of them are managed by a NGO. They grind plastics wastes for recycling.[29] This scenario is not plausible, as it is hampered by used tires and plastics limited and scattered availability, prevailing regulations and excessive costs for processing in small quantities.	**NO**
F5	The construction and operation of a new	The construction of a new cement plant to replace the present one is not plausible.	**NO**

[26] See gas supply protocol with Fortenza compared to a recent coal supply invoice, both provided to the DOE.
[27] Report May 2006, "Inventory of some informal sector activities releasing POPs in Senegal" Table 6 : http://www.ipen.org/ipepweb1/library/ipep_pdf_reports/9sen%20dioxins%20and%20informal%20sector%20in%20senegal.pdf "The scrap dealers of Senegal are also interested in the iron contained in tyres. For that purpose, tyres are completely burnt to access the iron. In Dakar, this activity is performed in the landfill site of Mbeubeuss and in Hann on the beach."
[28] In the Dakar area, field studies have estimated that about 120t/day of waste plastics are generated and that the potential for recovery could be about 20%, according to APROSEN ("*Agence pour la Propreté du Sénégal*") publication in 2008.
[29] Report 2006, page 21 and 44, PROPLAST project : http://www.lvia.it/sites/default/files/capitalisation_plastique_senegal.pdf

	cement plant. *Coal + HFO*	Large investment has been made in recent years in the existing SOCOCIM Industries plant to increase its capacity (installation of kiln n°5), improve its economic performances and reduce its environmental impact. Such plan of a new cement plant is clearly not realistic taking into account the ongoing expansion scheme.	

→ F1, F2 and F3 are the most plausible alternative scenarios for the fuel mix for cement manufacturing

Since the project activity uses alternative fuels, project participants determined what would happen to the alternative fuels in the absence of the project activity:

Alternatives for the biomass residues

The biomass residues potentially envisaged for utilization as alternative fuels in the project activity are: groundnut shells, palm kernels, rice husks, cashew nuts shells, cotton stems and shells, and Jatropha cakes and shells. The alternative scenarios for the use of each type of biomass residues are analyzed hereafter in accordance with the methodology.

Regarding biomass residues in Senegal which might be used in the SOCOCIM Industries cement plant, if they are available in sufficient quantities and at reasonable costs taking into account their distance from the cement plant and their density, the situation regarding their existing alternative valorizations can be summarized as following:

- Groundnut shells and palm kernels are available in oil producing plants, but part of these residues is utilized[30] on site for production of steam for oil processing. Nevertheless, significant stocks of residues without utilization can be identified in some places, especially during years of high production.

- Rice husks, which are mainly available in the North and South of Senegal, have presently no alternative use and are left to decay on large stacks, dumped over the fields under aerobic conditions or burnt in an uncontrolled manner in the fields or on the outskirts of rice mills which are usually too small to envisage their use in local steam power plants like in Thailand, for example. Their use is hampered by high transportation challenges.

- Cashew nuts shells, from Casamance region, have no use after nut extraction and are either burnt in the open air or left to decay.

- Cotton stems are usually burnt on cotton fields and cotton shells issued from cotton plants

[30] Among the three existing Senegalese oil plants, only one is using part of its groundnut shells for internal use to produce steam, surplus residues in these three oil plants are usually available. In remote decorticating plants, the groundnut shells are left aside in the absence of local use. The use of such waste residues by SOCOCIM Industries would never be at the detriment of existing users (groundnut oil plants generating themselves their residues in sufficient quantities). The main constraint for the project activity in using these residues are its irregular yearly supply and its high unit cost when collected from remote places. SOCOCIM Industries will use these residues but only on a limited scale to avoid delivery difficulties.

(ginneries) which have no oil production facilities are left aside in the open air.

- Jatropha cakes or shells issued from tentative future Jatropha oil production plants might be available in the long term, if such products have no alternative uses.

Table 4 presented hereafter, provides an estimate of the potential biomass residues generated in Senegal

Crops	Biomass Residues	Annual crop production (tons)	Waste yield (%)	Annual residues production (tons)
Groundnut	*shell*	*884,185*	*25%*	*221,046*
Sugarcane	*bagasse*	*881,800*	*30%*	*264,540*
Palm Oil	*wastes*	*65,800*	*72.5%*	*47,705*
Cotton	*stem*	*27,442*	*20%*	*5,488*
Millet	*wastes*	*5,220,023*	*200%*	*1,044,005*
Maize	*wastes*	*90,405*	*600%*	*542,432*
Sorghum	*wastes*	*145,877*	*250%*	*364,692*
Rice	*husk*	*208,300*	*170%*	*354,109*
Coco	*wastes*	*4,700*	*87%*	*4,089*
TOTAL		*7,528,532*		*2,848,107*

Table 4: *Estimation of biomass crop residues production in Senegal*

Source: Household Energy Network http://www.hedon.info/agriculturalresidues?bl=y"

SOCOCIM Industries has carried out in the last 3 years prior to the start of the project activity several field surveys in Senegal to identify the biomass potential which might be available as biomass fuel for the clinker kilns.

The overall result is that most of the biomass wastes issued from Senegalese agriculture offer low supply reliability and are expensive to mobilize as alternative fuel for clinker kilns taking into account:

(i) the distance and road conditions to reach these potential resources,
(ii) the dispersion of resources, a large share of the biomass residues being disseminated over thousands of small farms in low density areas and only a small share being processed in modern agro industries (rice mills, oil plants, cotton plants, …),
(iii) the low density of most crop residues,
(iv) the humidity and the net calorific value of the residue,
(v) the existing alternative uses of the crop residues, in particular as domestic fuel for cooking, food for cattle and handicrafts activities,
(vi) and above all the high variability of crop production in a Sahelian country like Senegal, as a consequence of changing climate conditions and repeated droughts.

Some temporary market niches may exist but only as a complement to a regular main fuel supply, such as coal or dedicated very large Jatropha plantations, as anticipated in this CDM activity[31].

According to the requirements of the methodology, an analysis of available scenarios for each biomass residues considered as a possible biomass fuel in the project activity is presented hereafter.

Alternative scenarios for groundnut shells residues

	Description of alternative scenarios	Comments	Plausible and credible alternative
B1	The groundnut shell residues are dumped or left to decay under mainly aerobic conditions. This applies for example, to dumping and decay of biomass residues on fields	Most plausible alternative (see photo hereafter) This alternative is the current practice.	**YES**
B2	The groundnut shell 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	Not plausible No existence of deep landfills. The very dry climate of the country is unfavorable to anaerobic decay.	**NO**
B3	The groundnut shell residues are burnt in a uncontrolled manner without utilizing them for energy purposes	Plausible alternative although forbidden by National Forest Laws to prevent bush fires	**YES**
B4	The groundnut shell 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.	Not plausible, no regular trade of groundnut shell residues existing in Senegal. Moreover, most groundnuts are decorticated in small plants spread in rural areas of Senegal. Apart from use of groundnut shells in two groundnut oil plants for heat generation[32], groundnut shells are left unused in the open air around decorticating plants. Their use is hampered by incertitude on their availability which is particularly uncertain with strong yearly variations (1 to 4)[33] according to climate conditions.	**NO**
B5	The groundnut shell 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	Not plausible, at the project site, no other alternatives than using biomass residues in kilns exist, where the cement plant does not and is not expected to involve any biofuels generation, relevant feedstock processing or fertilizer production.	**NO**

[31] Internal mission reports of field surveys on biomass residues resources in 2005 and 2006 are available for the DEO upon request.

[32] PERACOD report : « Renewable energies », April 2011, page 46, http://www.peracod.sn/spip.php?article144

[33] For example, the annual production of groundnuts in Senegal was 265 kt in 2002, 441 kt in 2003, 603 kt in 2004, 703 kt in 2005, 460 kt in 2006, 331 kt in 2007, 731 kt in 2008 and 1,033 kt in 2009 according to Ministry of Agriculture statistics (http://www.countrystat.org/sen/cont/pxwebquery/ma/195cpd010/fr).

	industry), as fertilizer, etc.		
B6	The proposed project activity, not undertaken as a CDM project activity, i.e. the use of the groundnut shell residues in the project plant	Groundnut shells have never been used before the start of the project activity and – consistently with alternative scenario F1 – their use in the absence of CDM would not occur due to the major barriers faced for the kilns adaptation and supply (see the description of technological and financial barriers in Step 2 below).	**YES**

→ The most plausible alternative scenarios for groundnut shell residues are B1, B3 and B6

Figure 9: *Groundnut shells residues left in the open air near a decorticating plant or burning outside*

Alternative scenarios for palm kernels residues

	Description of alternative scenarios	**Comments**	**Plausible and credible alternative**
B1	The palm kernels residues are dumped or left to decay under mainly aerobic conditions. This applies for example, to dumping and decay of biomass residues on fields	Most plausible alternative. This alternative is the current practice.	**YES**
B2	The palm kernels 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	Not plausible No existence of deep landfills.	**NO**
B3	The palm kernels residues are burnt in a uncontrolled manner without utilizing them for energy purposes	Plausible alternative, although forbidden by National Forest Laws to prevent bush fires	**YES**
B4	The palm kernels residues are sold	Not plausible,	**NO**

	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.	No trade of palm kernels residues in Senegal, palm kernels are produced in Casamance[34], which is an outlying region with very few industries. Local palm oil plants are very small, and artisanal.	
B5	The palm kernels 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.	Not plausible, at the project site, no other alternatives than using biomass residues in kilns exist, where the cement plant does not and is not expected to involve any biofuels generation, relevant feedstock processing or fertilizer production.	**NO**
B6	The proposed project activity, not undertaken as a CDM project activity, i.e. the use of the palm kernels residues in the project plant	Palm kernels have not been used before the start of the project activity and – consistently with alternative scenario F1 – their use in the absence of CDM would not occur due to the major barriers faced for the kilns adaptation and supply (see the description of technological and financial barriers in Step 2 below).	**YES**

→ The most plausible alternative scenarios for palm kernel residues are B1, B3 and B6

Alternative scenarios for rice husk residues

	Description of alternative scenarios	Comments	Plausible and credible alternative
B1	The rice husk residues are dumped or left to decay under mainly aerobic conditions. This applies for example, to dumping and decay of biomass residues on fields	Most plausible alternative (see photos as example hereafter) This alternative is the current practice.	**YES**
B2	The rice husk 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	Not plausible No existence of deep landfills. The very dry climate of the country is unfavorable to anaerobic decay.	**NO**
B3	The rice husk residues are burnt in a uncontrolled manner without utilizing them for energy purposes	Plausible alternative, although forbidden by National Forest Laws to prevent bush fires. Rice husks, which are mainly available in the North and South of Senegal, have presently no alternative use and are left to decay on large stacks, dumped over the fields under aerobic conditions or burnt in an uncontrolled	**YES**

[34] http://www.ceps.gouv.sn/doc_publication/planification/PAER/paer_ziguinchor.pdf, Section 3.1.1.1

		manner in the fields or on the outskirts of rice mills which are usually too small to envisage their use in local steam power plants like in Thailand, for example. Their use is hampered by high transportation costs.	
B4	The rice husk 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.	Not plausible, The rice mills are mainly situated along the Senegal river in the North of the country, and in Casamance far from the industrial zone of Dakar. [35] The low density of rice husk and the distance from Dakar area makes its use by other consumers as a not plausible alternative. Moreover, the existing rice mills, of small sizes, use electricity issued from the national grid or generating sets and do not operate steam power plants.	**NO**
B5	The rice husk 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.	Not plausible, at the project site, no other alternatives than using biomass residues in kilns exist, where the cement plant does not and is not expected to involve any biofuels generation, relevant feedstock processing or fertilizer production.	**NO**
B6	The proposed project activity, not undertaken as a CDM project activity, i.e. the use of the rice husk residues in the project plant	Rice husk residues have not been used before the start of the project activity and – consistently with alternative scenario F1 – their use in the absence of CDM would not occur due to the major barriers faced for the kilns adaptation and supply (see the description of technological and financial barriers in Step 2 below).	**YES**

→ The most plausible alternative scenarios for rice husk residues are B1, B3 and B6

Figure 10: *Rice husks residues left in the open air at a rice mill in Senegal*

Alternative scenarios for cashew nut shells residues

[35] Please refer to "casier rizicole" (= rice paddies) on the map: "Les espaces agricoles" (=agricultural areas in Senegal): http://www.au-senegal.com/L-agriculture-senegalaise.html

	Description of alternative scenarios	Comments	Plausible and credible alternative
B1	The cashew nut shells residues are dumped or left to decay under mainly aerobic conditions. This applies for example, to dumping and decay of biomass residues on fields	Most plausible alternative Cashew nuts shells, from Casamance region, have no use after nut extraction and are either burnt in the open air or left to decay. This alternative is the current practice.	**YES**
B2	The cashew nut shells 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	Not plausible No existence of deep landfills. The very dry climate of the country is unfavorable to anaerobic decay.	**NO**
B3	The cashew nut shells residues are burnt in a uncontrolled manner without utilizing them for energy purposes	Plausible alternative, although forbidden by National Forest Laws to prevent bush fires	**YES**
B4	The cashew nut shells 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.	Not plausible, Cashew nuts are produced in small plantations, far from the industrial area of Dakar; the shells are removed in small artisanal workshops. [36]There is no potential for use by other consumers.	**NO**
B5	The cashew nut shells 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.	Not plausible, at the project site, no other alternatives than using biomass residues in kilns exist, where the cement plant does not and is not expected to involve any biofuels generation, relevant feedstock processing or fertilizer production.	**NO**
B6	The proposed project activity, not undertaken as a CDM project activity, i.e. the use of the cashew nut shells residues in the project plant	Cashew nuts shells have not been used before the start of the project activity and – consistently with alternative scenario F1 – their use in the absence of CDM would not occur due to the major barriers faced for the kilns adaptation and supply (see the description of technological and financial barriers in Step 2 below).	**YES**

→ The most plausible alternative scenarios for cashew nuts shells residues are B1, B3 and B6

Alternative scenarios for cotton stems and shells residues

[36] "Upgrading in The Cashew Nut Value Chain: The Case of The Casamance, Senegal", By Steffen Cambon, Published in September 1, 2003, http://organiccashewnuts.com/chap2.htm"

	Description of alternative scenarios	Comments	Plausible and credible alternative
B1	The cotton stems and shells residues are dumped or left to decay under mainly aerobic conditions. This applies for example, to dumping and decay of biomass residues on fields	Plausible alternative, The cotton stems are usually burnt in the fields to clean the cultivated land and avoid phytosanitary problems. The cotton shells issued from cotton plants (ginneries) which have no oil production facilities are left aside the ginneries in the open air. This alternative is the current practice.	**YES**
B2	The cotton stems and shells 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	Not plausible, No existence of deep landfills. The very dry climate of the country is unfavorable to anaerobic decay.	**NO**
B3	The cotton stems and shells residues are burnt in a uncontrolled manner without utilizing them for energy purposes	Most plausible and common alternative, although forbidden by National Forest Laws to prevent bush fires	**YES**
B4	The cotton stems and shells 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.	Not plausible, There is no market for cotton stems and shells for heat and/or electricity generation or biofuels generation. Usually cotton stems are not transported outside of plantation areas. Small quantities may be used for cattle feeding. Most of cotton stems are burnt in the cotton fields; mineral content of these stems is stocked by the soils, thus reducing fertilizer needs.[37]	**NO**
B5	The cotton stems and shells 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.	Not plausible, at the project site, no other alternatives than using biomass residues in kilns exist, where the cement plant does not and is not expected to involve any biofuels generation, relevant feedstock processing or fertilizer production.	**NO**
B6	The proposed project activity, not undertaken as a CDM project activity, i.e. the use of the cotton stems and shells residues in the project plant	Cotton stems or shells have not been used before the start of the project activity and – consistently with alternative scenario F1 – their use in the absence of CDM would not occur due to the major barriers faced for the kilns adaptation and supply (see the description of technological and financial barriers in Step 2 below).	**YES**

[37] PERACOD report : « Renewable energies », April 2011, page 48, http://www.peracod.sn/spip.php?article144 », section 2.9.2.

→ The most plausible alternative scenarios for cotton stems residues are B1, B3 and B6

Alternative scenarios for Jatropha cakes and shells residues

	Description of alternative scenarios	Comments	Plausible and credible alternative
B1	The Jatropha cakes and shells residues are dumped or left to decay under mainly aerobic conditions. This applies for example, to dumping and decay of biomass residues on fields	Most plausible alternative, But, so far, there is no production of Jatropha cakes and shells in Senegal. This alternative is the current practice.	**YES**
B2	The Jatropha cakes and shells 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	Not plausible, No existence of deep landfills. The very dry climate of the country is unfavorable to anaerobic decay.	**NO**
B3	The Jatropha cakes and shells residues are burnt in a uncontrolled manner without utilizing them for energy purposes	Plausible alternative, although forbidden by National Forest Laws to prevent bush fires	**YES**
B4	The Jatropha cakes and shells 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.	Not plausible, This scenario is very unlikely to appear in the future. (May potentially appear feasible if the Jatropha biofuels industry in Senegal develops beyond pilot experiences - the residues in such cases might be used for process heat in biofuels production and therefore wouldn't be diverted for use in the project activity).	**NO**
B5	The Jatropha cakes and shells 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.	Not plausible in the near future; at the project site, no other alternatives than using biomass residues in kilns exist, where the cement plant does not and is not expected to involve any biofuels generation, relevant feedstock processing or fertilizer production.	**NO**
B6	The proposed project activity, not undertaken as a CDM project activity, i.e. the use of the Jatropha cakes and shells residue in the project plant	Not plausible in the near future, as SOCOCIM is focusing only on Jatropha fruit production and whole fruit utilization as fuel for cement manufacturing, subject to CDM approval and that there is no Jatropha cakes and shells residue available in Senegal in the near future. Consistently with alternative scenario F1, their use in the absence of CDM would not occur due to the major barriers faced for the kilns adaptation and supply (see	**YES**

		the description of technological and financial barriers in Step 2 below).	

→ The most plausible alternative scenario for Jatropha cakes and shells residues are B1, B3 and B6

Alternatives for the renewable biomass from new dedicated plantations

SOCOCIM Industries intends to secure its supply of Jatropha fruits in very large quantities through direct production in its own new plantations or through exclusive contracts with individuals or organizations which will be committed to supply all their production to SOCOCIM Industries through detailed specifications aimed at guaranteeing the quality and regularity of supply while ensuring that these plantations are fully meeting the applicability conditions of ACM0003 Version 07.4.0, so to ensure environmental protection, absence of competition with food production, minimization of greenhouse gas leakages and economic and social promotion in rural areas through fair additional income distribution within a partnership approach.

So far, SOCOCIM Industries is the first Senegalese company to have launched significant pilot Jatropha plantations with 450 ha achieved and having established close partnerships with government relevant administrations and research centers ("*Institut Sénégalais de Recherche Agronomique"* (ISRA)[38] and "*Institut National de Pédologie"* (INP)[39], both under Ministry of Agriculture).

	Description of alternative scenarios	Comments	Plausible and credible alternative
R1	No establishment of dedicated Jatropha plantations and thus no generation of renewable biomass	Most plausible alternative. This alternative is the current practice.	**YES**
R2	Establishment of new dedicated Jatropha plantations and sale of the renewable biomass from the plantations to other consumers in the market, which may use the renewable biomass 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.	Not a plausible alternative The establishment of a new dedicated Jatropha plantation and sale of the renewable biomass from the plantation to other consumers is not a plausible alternative. No market exists or is anticipated in the near future in Senegal and the project developer would not enter into such activity which is not in the core of its main activities (construction materials).	**NO**
R3	The proposed project activity, not undertaken as a CDM project activity, i.e. the establishment of	SOCOCIM has never envisaged carrying out this project activity without CDM. Consistently with alternative scenario F1 – the establishment of the Jatropha plantations	**YES**

[38] See Document 08: «*Protocol Jatropha ISRA-SOCOCIM October 2008*» (*Protocole d'accord de coopération entre l'Institut Sénégalais de Recherche Agronomique)*, providing details on partnership for Jatropha seeds selection and technical advice to farmers for Jatropha cultivation.

[39] See Document 03 quoted above: *«Partnership agreement INP-SOCOCIM»* which provides official support to ensure that the Cultivation Charter signed by Jatropha producers will be fully met. For example, selection of marginal lands, characterization of selected soils, environmental follow up of Jatropha production, etc.

	new dedicated Jatropha plantations and use of the renewable biomass from these plantations in the project plant	and use of the biomass in the project plant in the absence of CDM would not occur taking into account its high technological and investment risks as illustrated below in the barrier analysis Step 2.	

→ The most plausible alternative scenarios for renewable biomass from new dedicated plantations are R1 and R3

Outcome of Step 1a: List of plausible alternative scenarios to the project activity

Following the above analysis, the plausible alternative scenarios further considered are:

- For the fuel mix: F1, F2 and F3
- For biomass residues: B1, B3 and B6
- For renewable biomass from new dedicated plantations: R1and R3.

Sub-step 1b: Consistency with mandatory applicable laws and regulations:

The plausible alternative scenarios must be in compliance with all mandatory applicable laws and regulatory requirements. A review of their consistency with these laws and regulations is presented hereafter.

Plausible alternatives for the fuel mix:

	Regulatory analysis	Consistency with laws & regulations?
F1	<u>The proposed activity not undertaken under the CDM:</u> SOCOCIM Industries cement plant is authorized[40] to store and co-process any 100% biomass fuel issued from plantations or biomass residues: Jatropha fruits, rice husks, cashew nut shells, cotton shells or seeds, groundnut shells, palm kernels, Jatropha shells or cakes if they become available and without alternative uses on biomass production sites. Jatropha plantations will be implemented only on authorized lands certified by local administration and in accordance with the Jatropha cultivation charter and Senegalese environment regulations as explained above. As the project activity, this alternative scenario complies with all mandatory applicable legal and regulatory requirements.	**YES**
F2	<u>Continuation of the current practice:</u> SOCOCIM Industries is currently in compliance with all mandatory applicable legal and regulatory requirements.	**YES**

[40] See <u>Documents 07a&b</u> quoted above: Letter of Ministry of Environment authorizing the handling and storage of biomass in SOCOCIM Industries cement plant dated 2nd October 2009

	In particular, the SOCOCIM Industries plant must comply with an Environmental Scheme ("*Plan global de Suivi Environnemental*")[41] elaborated with the Ministry of Environment. At least one meeting is organized every year with the administration to make sure that the scheme is properly carried out. Therefore, this alternative scenario corresponding to continuation of the pre-project scenario complies with all mandatory applicable legal and regulatory requirements.	
F3	<u>The continuation of using only fossil fuels with a different portfolio:</u> In addition to the current practice already consistent with laws and regulations, SOCOCIM Industries is authorized to burn waste oils in its high temperature clinker kilns by the Ministry of Environment. The cement plant has received authorization to store and co-process waste oils as a complement to fossil fuels (coal/petcoke and HFO). An agreement for waste oils use (supplanting the temporary authorization for initial tests) has been obtained[42].	**YES**

Plausible alternatives for biomass residues (groundnut shells, palm kernels, rice husks, cashew nuts shells, cotton stems & shells and Jatropha cakes & shells):

	Regulatory analysis	**Consistency with laws & regulations?**
B1	<u>Dumping or decay under mainly aerobic conditions:</u> No prohibition whatsoever and it is currently the most widespread common practice.	**YES**
B3	<u>Uncontrolled burning without energy purposes:</u> This alternative is strictly forbidden by National Forest Laws[43] to prevent bush fires.	**NO**
B6	<u>Use of the biomass residues in the plant, not undertaken under the CDM:</u> SOCOCIM Industries cement plant is authorized[44] to store and co-process any 100% biomass fuel issued from plantations or biomass residues.	**YES**

Plausible alternatives for renewable biomass from new dedicated plantations:

	Regulatory analysis	**Consistency with laws & regulations?**
R1	<u>No establishment of a new plantation thus no generation of renewable biomass:</u>	**YES**

[41] See <u>Documents 09 a, b & c</u>: "Minutes of environmental plan follow-up" (*Plan global de Suivi Environnemental des Activités de la SOCOCIM-Industries)* approved by the *"Direction de l'Environnement et des Etablissements Classés"* under Ministry of Environment and Minutes of visits carried out by the Ministry representatives on 27th February 2007, 13th July 2007 and 30th January 2008. The plan and minutes of visits include a detailed monitoring table for each sector with a follow up of specific actions and observations of Ministry of Environment.

[42] See <u>Documents 21</u>: « Agrement pour l'elimination des huiles usagees » dated 24th August 2010.

[43] See Article R.56 of the Senegalese Forest Code available at http://www.environnement.gouv.sn/IMG/pdf/code-forestier-2.pdf

[44] See <u>Documents 07a&b</u> quoted above: Letter of Ministry of Environment authorizing the handling and storage of biomass in SOCOCIM Industries cement plant dated 2nd October 2009

	This alternative is obviously consistent with all applicable laws and regulations as it consists in no particular action; moreover the project activity of establishing such plantations is not undertaken under any regulatory constraints, which confirms that this alternative wouldn't be prevented by any law or regulation.	
R3	Establishment of a new plantation and use of the renewable biomass, not undertaken under the CDM: Jatropha plantations will be implemented only on authorized lands certified by local administration and in accordance with the Jatropha cultivation charter and Senegalese environment regulations as explained above. The establishment of Jatropha plantations and use of the renewable biomass as a substitution to coal complies with all prevailing regulations, as demonstrated in the Environmental Impact Analysis on carried out in 2009 at the request of the Ministry of Environment[45].	**YES**

Outcome of Step 1b: **List of alternative scenarios to the project activity that are in compliance with mandatory legislation and regulations** taking into account the enforcement in the region or country and Board decisions on national and/or sectoral policies and regulations.

Following the above analysis, the plausible alternative scenarios compliant with mandatory legislation and regulations in force in Senegal are:

- For the fuel mix: F1 (project activity without the CDM), F2 (current practice) and F3 (different fossil fuel mix portfolio)
- For biomass residues: B1 (current practice) and B6 (use without the CDM)
- For renewable biomass from new dedicated plantations: R1 (current practice) and R3 (establishment and use without the CDM).

According to methodology ACM0003, all credible combinations of baseline scenarios should subsequently be identified and documented as part of Step 1 of the tool, hence the following credible combinations of baseline scenarios still under consideration at this stage:

Baseline scenario			**Description of the situation**
Fuel mix	**Biomass residues**	**Renewable biomass**	
F1	B6	R3	The proposed project activity, **not undertaken as a CDM** project activity: - Fuel mix: *Coal + HFO + Waste Oil + Jatropha Fruits + Biomass Residues* - Use of the biomass residues in the project plant; - Establishment of new dedicated Jatropha plantations and use of the renewable biomass from these plantations in the project plant; without the CDM.

[45] See Document 11: *« Projet de Cultures Industrielles Jatropha pour une utilisation de bio combustibles en substitution au charbon importé à SOCOCIM INDUSTRIES, **Evaluation Environnementale Stratégique**, (EES)* » Gertrude COULIBALY & Al Assane SENE, January 2010.

Baseline scenario			Description of the situation
Fuel mix	Biomass residues	Renewable biomass	
F2	B1	R1	Continuation of the current practice: - The fuel mix would remain: *Coal + HFO for start ups*; - Biomass residues would still be dumped or left to decay under aerobic conditions; - No dedicated Jatropha plantation would be established.
F3	B1	R1	Different fossil fuel mix portfolio: - Fuel mix: *Petcoke + HFO + Waste Oil* - Biomass residues would still be dumped or left to decay under aerobic conditions; - No dedicated Jatropha plantation would be established.

These combinations should be considered in applying the following steps of the tool.

Step 2: Barrier analysis

This step serves to identify existing barriers and to assess which alternative scenarios for SOCOCIM Industries are prevented by these barriers. The "Guidelines for objective demonstration and assessment of barriers", available on the UNFCCC website, are taken into account when applying this step.

Sub-step 2a: Identify barriers that would prevent the implementation of alternative scenarios:

SOCOCIM Industries, in line with its mother company VICAT, is strongly committed to local and global environment protection in all its aspects. The use of biomass in replacement of fossil fuel is fully in line with this policy provided it does not alleviate too significantly the unit costs and does not has impact on the quality of its cement.

After long internal discussions, it appeared that the use of biomass is a possible option provided that it permits a significant replacement of fossil fuel (above 30%) justifying corresponding investment and that the supply of biomass is ensured all over the year on a regular basis in large quantity to meet the target replacement ratio. From field analysis, it appeared that only dedicated plantations of Jatropha can provide in Senegal a reliable biomass supply all over the year at the required scale (about 70,000 t/year).

Other crop residues, taking into account their availability and cost of delivery will be consequently used only as a complement to the production issued from dedicated Jatropha plantations to alleviate the risks of irregularity of biomass residues supply.

This corporate policy for environment, focused on fossil fuel substitution, is nevertheless hampered by the complex financing of the necessary high investment upstream for cultivation and transport and downstream for preparation and combustion, the technical complexity and novelty and the uncertainties on biomass supply. SOCOCIM Industries is presently expecting that the project activity registration will facilitate the upstream and downstream funding and implementation of the project. In the absence of

CDM, the corporate group does not plan to invest further under present and medium term economic conditions[46].

Below is the complete list of realistic and credible barriers that may prevent alternative scenarios to occur:

- **Investment barrier (other than insufficient financial returns):**

Currently, the financing of large agricultural projects in Senegal is very uncommon taking into account the fact that the agricultural sector is hampered by difficult climatic condition and is characterized by 440,000 very small farms (61% have less than 1 ha) mainly owned by poor peasants (85% of rural population is below the poverty line according to UNDP) offering no significant guarantees for large loans as envisaged in the project activity.

SOCOCIM Industries has indeed to face an investment barrier taking into account the fact that commercial or soft, long-term credits are not available for large agricultural projects in rural areas[47]. Senegal has a Standard & Poor's credit rating of B+ only[48], and has been qualified in February 2000 for debt relief as part of the Heavily Indebted Poor Countries (HIPC) initiative, and on 15th May 2009, Senegal has beneficiated of the Multilateral Debt Relief Initiative for 137 million US$[49] demonstrating that it is not attractive to private lenders for large, long-term loans.

In addition to a large investment upstream in Jatropha production (nurseries, technical assistance, equipment, manpower, etc.) which is estimated at 19.16 M. EUR, to be financed by soft medium and long term loans[50] and equity, a significant additional investment is necessary at the cement plant itself which will have to invest 6.36 M. EUR in engineering studies, civil works, industrial equipment and services to store and weight the biomass (up to 250 tons/day) as well as conveyors, injectors and special equipment to feed the kilns and supervise the clinker production. In the absence of the project activity, these investments would appear as excessive to the project participants (rural organizations, individuals and SOCOCIM) and would not be implemented.

The different meetings and communication held in 2006 and 2007 with local banks and international development banks (World Bank/IDA, International Finance Corporation (IFC), *Banque d'investissement et de Développement* (BIDC) of *Communauté des Etats de l'Afrique de l'Ouest* (CDEAO), *Agence Française de Développement (*AFD*),* Biofuel and Renewable Energy African Fund managed by BIDC, have shown that the banks were not negative but reluctant in financing the project activity taking into account the large size of the investment in comparison with most agricultural projects, its specific risks, and its local institutional and organizational frameworks including land ownership issues. Clearly, the

[46] See Document 22a,b and 23a,b: "*SOCOCIM CEO letter to VICAT"* dated 22/11/2010 and "*VICAT CDM expectations to SOCOCIM"* dated 24/11/2010, both with English translations.

[47] The financing of large agricultural projects in Senegal is presently a major barrier, the main donor institutions having shifted their assistance from agriculture to social, governance, business framework and environment issues. The government of Senegal is trying to alleviate this barrier by inviting foreign investors from Asia and Arabic countries to invest in the country but many legal issues are still pending, including land property issues, political and ethical problems.

[48] http://www.standardandpoors.com/ratings/govs-sovereigns/en/us

[49] IMF site : http://www.imf.org/external/np/exr/facts/mdri.htm

[50] The upstream part of the Jatropha CDM project needs a long term financing with a long grace period taking into account the fact that the plantation are generating significant incomes only after 5 years. The rural organizations and individual peasants must have advance payments to survive during this long period.

perspective of CDM incomes was quoted by several financial institutions as an important prerequisite for further instruction of the proposed Jatropha project[51].

The overall investment (25.52 M. EUR) to enable the use of alternative fuels in the project activity in replacement of coal for clinker production is indeed very significant in relation to common investment in the agricultural sector of Senegal, as also described in section *B.2 Applicability conditions*. For SOCOCIM itself, the activity is also a significant investment in a new development area characterized by large risks as explained later. The investment in this new agro-industrial activity is totally different in terms of levels of risks with the investment just carried out in clinker capacity expansion.

SOCOCIM, heavily indebted by its recent rehabilitation and development financing through commercial loans and VICAT Group equity, is not authorized by the board of VICAT to invest further in the non-strategic Jatropha project until the CDM validation is secured[52], given its large risks and its low anticipated returns.

In summary, the financing of the whole Jatropha project (upstream and downstream) is a major barrier. Despite several approaches of financial institutions, no financing scheme was successfully developed so far by SOCOCIM Industries with potential project participants, the expenses being mainly limited to small pilot Jatropha plantations to study agricultural and environmental conditions.
The investment barrier for such a project can only be tentatively settled with the firm financial commitment of major financial institutions such as European Investment Bank, World Bank, International Development Agency, International Monetary Fund or Agence Française de Développement or other Arabic financial institutions, complemented by significant additional revenues issued from CER generation.[53]
As explained earlier, the Senegalese government itself is dramatically lacking of financial resources to provide a suitable financing for this scheme despite its strong political support for the project activity which is expected to have a high social and environmental impact in poor rural areas.

Without Jatropha as a main biomass source for the cement plant in large quantity and regular supply, SOCOCIM Industries considers that the other biomass issued from agricultural residues (groundnut shells, rice husks, cotton wastes, …) are in too small quantities or too uncertain to justify a significant investment for a major modification of kilns lines n°3 and n°4 to store and process these alternative solid fuels.

To the contrary, the continuation of the current practice and the different fossil fuel mix scenario do not face any investment barrier because no additional infrastructures or heavy supply chains are involved. Imported coal remains today the least cost energy solution, especially following the recent unit price decrease of imported coal from South Africa (about - 33% between 2009 and 2010)[54]. Improvements in harbor handling for coal and the installation of a nearby large coal power plant (125 MW at Bargny, near Rufisque) by the national utility SENELEC may improve the competitiveness of coal in front of other energies.

[51] See letter from EBID-ABREF bank dated April 8th 2011, confirming the decisive aspect of CDM revenues in the loan assessment process.
[52] See correspondence 22a,b and 23a,b between SOCOCIM Industries and VICAT of November 2010.
[53] According to the World Bank (2007), the global Overseas Development Assistance (ODA) to Africa for agricultural development projects has been dramatically reduced from 3.2 billion US$ in 1988 to less than 1.2 billion in 2005. This critical reduction of financial assistance makes the soft financing of large agricultural projects like the proposed project activity much more difficult than 10 years ago. This decreasing trend is still ongoing.
[54] Recent coal supply contracts are available upon request.

- **Technological barrier**

The large-scale organization of Jatropha plantations (about 11,000 ha) is totally new in Senegal and the region, where Jatropha was, so far, only an endemic plant used for fencing of habitations. This activity requires indeed a very complex management scheme for all steps of the Jatropha production chain (nurseries, plantations, maintenance, harvesting, transport, storage, and processing in the cement plant) with a lot of individual and collective actors involved and sophisticated contractual and financial arrangements.

So far, SOCOCIM Industries has no experience of large agricultural schemes scattered over many locations, and thus faces high technological and organizational risks or uncertainties, such as the crop resistance to insects and virus, the climate variations over the years, the level of appropriation of this new culture by local population, the availability of necessary manpower during plantation or harvesting, the quality of the technical assistance and field organization, the production and transportation costs, etc.[55]

The production and use of biomass on a large scale as alternative fuel will require a major training program and the development of a new and additional know how at the level of the main actors involved upstream and downstream.

The transport and process of about 250 tons/day all over the year of Jatropha fruits and other biomass residues (equivalent to about 25 trucks/day) issued from rural areas with variable road and climatic conditions is in particular a major challenge for SOCOCIM Industries. Specific transport equipment will have to be introduced to allow an efficient transport of Jatropha fruits and biomass residues taking into account their rather low densities and the need to prevent dust releases.

Another technical barrier is linked to the need to ensure a smooth operation of the kilns combustion to ensure the ISO quality standards for the clinker[56], the logistic organization for storage of large quantities of biomass at production, transport and cement plant levels.

Furthermore, there are large uncertainties existing on actual yearly yields[57] of Jatropha fruits under variable soil and rain conditions and seed varieties[58] and the actual time lag required to fully develop 11,000 ha of plantations taking into account all organizational and socio-economic aspects including financing of investment. Also, the utilization of a wide range of biomass residues, with variable densities, calorific values, humidity rates and highly variable proportions depending on spot supplies is a technological challenge for SOCOCIM Industries to ensure a smooth operation of the kiln lines n°3 and n°4.

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[55] See Document 17: " *Low-carbon Energy Projects for Development in Sub-Saharan Africa: Unveiling the Potential, Addressing the Barriers », 2008*, the World Bank, Carbon Finance Assist, Ministry of Foreign Affairs, Norway. This study on Africa underlines clearly the multiple obstacles existing to develop clean energy projects in most African country (lack of information, small scale of markets, lack of capital, bureaucracy, lack of available technology, lack of financial incentives, unsuitable legal frameworks, etc.).

[56] The kilns are supervised by fully automatic computing systems. Their software and operating procedures will need significant adaptations to keep kiln stability despite the introduction of various alternative fuels in variable proportions and variable physical and chemical characteristics (NCV, humidity, density, SiO2, etc).

[57] The Jatropha fruit yield/ha has been reduced in this revised PDD version from 8.0 to 6.4 tons/ha on the basis of actual fields results and bibliography.

[58] See Document 13b: "Jatropha: A Smallholder Bioenergy Crop: The Potential for Pro-Poor Development, Integrated Crop Management Vol. 8–2010", published by FAO in 2010, pages 39-40, quotes that Jatropha fruits yields may vary from 0.1 to 12 tons per hectare depending on seeds quality, soil conditions, temperature and rain conditions and fertilizer use.

Major technological barriers consequently exist towards the implementation of the project activity, upstream and downstream, at all steps of the project activity. This is further confirmed by the lack of local capacity to undertake clean technology projects[59].

At the contrary, neither the continuation of the current practice nor the different fossil fuel mix portfolio do face any significant technological barrier, as modern cement manufacturing technologies are already used for fossil fuel consumption.

- **Lack of prevailing practice barrier**

Large scale plantation of Jatropha in Senegal is totally new; no plantations exceeding a few tens of hectares exist in the country apart from SOCOCIM Industries Jatropha pilot farm. Indeed, it is the first time that a cement plant in the world intends to substitute about 35% of its coal consumption by biomass issued from very large dedicated plantations of Jatropha as it appeared from the proceedings of the World Conference on Jatropha, held in Hamburg on 20-22th October 2008, from Internet investigations and recent international cement conferences. The use of whole Jatropha fruits in clinker kilns is also a world unique project.

The overall organization of this activity is indeed highly complex at this scale of production and extremely innovative in terms of organization of plantation, social promotion of rural population, partnership with Jatropha producers, protection of local environment by utilization of degraded soils, adjustment of the cement process, etc. These aspects increase the lack of visibility for the project activity at medium and long term. It is further confirmed by the lack of demonstration cases in the cement sector and the unavailability of upstream information and benchmark needed for CDM project development[45].

To the contrary, neither the continuation of the current practice nor the different fossil fuel mix portfolio face any significant lack of prevailing practice as SOCOCIM Industries cement plant, which is more than 30 years old, as well as another private cement plant existing nearby (*Ciments du Sahel*), have been both using coal and fuel oils as main fuels for years.

- **Unreliability of biomass supply barrier**

Internal field studies carried out by SOCOCIM Industries have shown that in Senegal, the potential for biomass residues within a reasonable distance from the plant is limited and subject to high yearly variations for most of the crops (groundnut, rice, cotton) as it can be verified from agricultural statistics. In addition, it is possible that in the future , the agro-industries (groundnut and cotton oil plants, rice mills) generating these biomass residues might be using a higher share of their biomass residues for their own energy needs, making these residues more difficult to obtain in quantity at a competitive price with coal at SOCOCIM level.

The envisaged biomass residues (groundnut shells, rice husks, cotton stems and shells, cashew nut shells, palm kernels) are not sufficiently available in large quantities, with a regular yearly supply and at acceptable cost to justify a large investment in SOCOCIM plant to install biomass feeding lines.

[59] The World Bank 2009 – Cement Sector Program in Sub-Saharan Africa: Barrier Analysis to CDM and solutions (p. xxii), accessible at: http://wbi.worldbank.org/wbi/Data/wbi/wbicms/files/drupal-acquia/wbi/FinalReportAfricaCementSector090420.pdf

SOCOCIM management and VICAT, the mother company, do not want to invest under this scenario too uncertain and consider that the establishment of Jatropha plantations would be a prerequisite to ensure a smooth and regular biomass supply, biomass residues being only complements used whenever available at acceptable costs.

Still, there are significant risks that the supply of about 250 tons/day of Jatropha fruits to SOCOCIM Industries cannot be ensured on a regular basis, at least during the first years and that the availability of other biomass residues to complement Jatropha fruits is insufficient taking into account the fact that Senegal is a dry Sahelian country subject to major annual crop variations linked with the variability of climatic conditions and that additional constraints are prevailing for the use of biomass residues in the cement plant (distance, cost of transport, other utilizations, humidity) [60]. Groundnut shells, for example, are only available in limited quantities, taking into account the fact that a significant share of this residue is abandoned at the decortications sites and a minor part used by groundnut oil plants. Groundnut shells availability is particularly uncertain with strong yearly variations (1 to 4)[61] according to climate conditions.

To the contrary, moreover, low sulfur coal/petcoke imports are easy and reliable, in particular from South Africa, since the cement plant is close to Dakar deep harbor. The current practice continuation would be even more likely with planned improvements for coal/petcoke unloading, transport and storage at Dakar harbor, and the project of a new coal power plant in Bargny, close to the cement plant.

Sub-step 2b: Eliminate alternative scenarios which are prevented by the identified barriers:

The following table indicates whether or not the alternative scenarios are prevented by the identified barriers, in the light of the above analysis.

	The proposed project activity without the CDM (F1 + B6 + R3)	**Continuation of the current practice (F2 + B1 + R1)**	**Different fossil fuel mix portfolio (F3 + B1 + R1)**
Investment barrier (other than insufficient financial returns)	YES	NO	NO
Technological barrier	YES	NO	NO
Lack of prevailing practice barrier	YES	NO	NO
Unreliability of biomass supply	YES	NO	NO

[60] See http://unfccc.int/resource/docs/napa/sen01f.pdf "Communication nationale sur le changement climatique", 2006, which shows clearly the climate change and its consequences on rains, hydrology and agricultural production.

[61] For example, the annual production of groundnuts in Senegal was 265 kt in 2002, 441 kt in 2003, 603 kt in 2004, 703 kt in 2005, 460 kt in 2006, 331 kt in 2007, 731 kt in 2008 and 1,033 kt in 2009 according to Ministry of Agriculture statistics (http://www.countrystat.org/sen/cont/pxwebquery/ma/195cpd010/fr).

barrier			
Conclusion	**There is at least one significant barrier that prevents implementation of the proposed project activity without the CDM.**	**There is no significant barrier that prevents the continuation of the current practice.**	**There is no significant barrier that prevents the use of a different fossil fuel mix portfolio with waste oils.**

Table 5: *Barrier analysis*

Outcome of step 2b:

The alternative scenarios to the project activity that are not prevented by any barrier are the following combinations:

Baseline scenario			**Description of the situation**
Fuel mix	**Biomass residues**	**Renewable Biomass**	
F2	B1	R1	Continuation of the current practice: - The fuel mix would remain: *Coal + HFO for start ups*; - Biomass residues would still be dumped or left to decay under aerobic conditions; - No dedicated Jatropha plantation would be established.
F3	B1	R1	Different fossil fuel mix portfolio: - Fuel mix: *Petcoke + HFO + Waste Oil* - Biomass residues would still be dumped or left to decay under aerobic conditions; - No dedicated Jatropha plantation would be established.

According to the "Combined tool to identify the baseline scenario and demonstrate additionality":

If there are still several alternative scenarios remaining, but which do not include the proposed project activity undertaken without being registered as a CDM project activity, explain – using qualitative or quantitative arguments – 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.

→ The benefits and incentives derived from the CDM registration of the project activity help alleviating the identified barriers and thus enable the project to be undertaken. Indeed, as described above:

- The investment barrier, both for equity and debt raise, is overcome thanks to the guarantee of CDM future revenues, which are the keys for mobilizing and convincing the investors.
- The technological barrier, the lack of prevailing practice barrier and the unreliability of biomass supply barrier are all overcome thanks to the CDM label, requirements and benefits, which compensate for the range of major risks face by this unique initiative and strengthen its dynamics and quality.

If the CDM alleviates the identified barriers that prevent the proposed project activity from occurring,

project participants may choose to either:

- *Option 1: Go to Step 3 (investment analysis); or*
- *Option 2: Identify* ***the alternative scenario with the lowest emissions (i.e. the most conservative) as the baseline scenario****, and proceed to Step 4.*

Option 2 is selected, and the baseline scenario is conservatively identified as the lowest emissions one:

- Since waste oils and petcoke can only be burnt at high temperature and cannot replace HFO for start-ups, the 5,000 tons/y of waste oils and the petcoke in scenario F3 (different fossil fuel mix portfolio) would only displace coal from scenario F2 (continuation of the current practice).

- According to 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 2 (Energy) Chapter 1 Table 1.4, the default CO_2 Emission Factors for combustion are 72.2 tCO_2/TJ for waste oils and 82.9 tCO_2/TJ for petcoke against 87.3 tCO_2/TJ for coking coal (lower values of the 95% confidence interval).

→ Therefore, scenario F3 involves lower baseline emissions than scenario F2 and the baseline is thus conservatively identified as:

Baseline scenario			Description of the situation
Fuel mix	**Biomass residues**	**Renewable Biomass**	
F3	B1	R1	Different fossil fuel mix portfolio: - Fuel mix: *Petcoke + HFO + Waste Oil* - Biomass residues would still be dumped or left to decay under aerobic conditions; - No dedicated Jatropha plantation would be established.

Applicability of the ACM0003 methodology

Following the above detailed analysis of possible alternative scenarios for the fuel mix, the biomass residues and the renewable biomass, it appears that the methodology ACM0003 Version 07.4.0 is indeed applicable, taking into account the fact that:

- **F3** (different fossil fuel mix portfolio) is the most plausible baseline scenario for the use of fuels in the cement plant, and
- The most plausible baseline scenarios for the use of alternative fuels are:
  - **B1** for the fate of biomass residues investigated (groundnut shells, palm kernels, rice husks, cashew nuts shells, cotton stems and Jatropha cakes and shells)
  - **R1** for the fate of Jatropha as a renewable biomass.

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):

Steps 1 and 2 of the *Combined tool to identify the baseline scenario and demonstrate additionality* (applied and documented above in section B.4) identified the baseline scenario as:

Baseline scenario			Description of the situation
Fuel mix	**Biomass residues**	**Renewable Biomass**	
F3	B1	R1	Different fossil fuel mix portfolio: - Fuel mix: *Petcoke + HFO + Waste Oil* - Biomass residues would still be dumped or left to decay under aerobic conditions; - No dedicated Jatropha plantation would be established.

The tool further requires the Project Proponent to *explain – using qualitative or quantitative arguments – 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,* before proceeding to *Step 4, otherwise the project activity is not additional.*

Senegal being a Least Developed Country, guideline 7 (§10) of the *Guidelines for objective demonstration and assessment of barriers Version 01 (EB50 Annex13)* is applicable: *"for projects in Least Developed Countries it is sufficient to transparently describe the relevant barriers, as less stringency is needed with regards to data availability in the actual demonstration of barrier, as compared to the projects in other countries".*

→ As described above in Step 2, the benefits and incentives derived from the CDM designation of the project activity help alleviating the identified barriers and thus enable the project to be undertaken, by contributing to unlock investments despite a whole range of major risks, facilitating the mobilization of agricultural credits from local and foreign sources, and strengthening the dynamic towards an unprecedented, long awaited and widely supported biomass cultivation framework and market in Senegal.

Step 4: Common practice analysis

At the most conservative worldwide level, the proposed activity will be a unique event, as there are no cement factories throughout the world which have established such large scale renewable biomass plantations (11,000 ha) for their own energy use.

Only a few projects have been reported, but with much smaller plantation surfaces: 25 acres energy crop planted by LAFARGE North America in June 2008[62], 71.2 ha Jatropha Curcas plantation project by INDOCEMENT in Indonesia in 2007/2008[63]. Even under the Clean Development Mechanism, all fuel substitution projects in development in cement plants solely target biomass residues or waste, with the exception of a minor surface of 1,000 acres (405 ha) of dedicated Casurina plantation in Egypt[64] mainly complemented by biomass residues and waste.

Moreover, no available reference documents[65] on Jatropha Curcas mentions the use of whole Jatropha fruits as an alternative fuel for industrial purposes. All Jatropha projects are orientated towards oil extraction, mainly for biodiesel production. IFAD (FAO) document "Jatropha, a Smallholder Bioenergy crop" published in 2010 mentions the following uses of Jatropha products and by-products for energy production: (i) "the wood of Jatropha is soft and hallow and, contrary to some reports in the literature, it is not good fuel wood" (page 18), (ii) Jatropha oil can be used for cooking fuel instead of traditional biomass or kerosene (page 49), (iii) "Jatropha fruit shells and seed husks can be used for direct combustion" (page 52). Therefore, SOCOCIM Industries' Jatropha project is also unique in so far as the whole Jatropha fruit will be used for energy production.

Conclusion: *Sub-step 4 is satisfied, i.e.* ***(i) similar activities cannot be observed*** *or (ii) similar activities are observed but essential distinctions between the proposed CDM project activity and similar activities can reasonably be explained;* ***therefore the proposed project activity is additional.***

Early consideration of the CDM and project implementation timeline

The following table demonstrates that the project activity was anticipated as a CDM activity from the very early stages before the start of the project activity and that continuous efforts were made by the project proponent to secure CDM[66] in order to alleviate major barriers to its implementation.

In accordance with the *Glossary of CDM terms Version 05*, the starting date of the project activity was conservatively defined as July 1st 2007, date of implementation of the 1st pilot Jatropha plantation (75ha at Bargny[67], near the cement plant).

SOCOCIM Industries has carried on small scale Jatropha plantation tests in year 2007 (150 ha in total) and 2008 (150 ha), without burning the renewable biomass in the cement plant. In January 2009, a pilot project for biomass introduction into kiln n°4 at small scale has been carried out (less than 3% of total heat content introduced in the kiln) to monitor its impact on clinker manufacturing process. Later in 2009, additional surfaces (150 ha in Pout[68]) have been planted, permitting the creation of a stock of seeds for nurseries to allow a fast expansion of cultivated surfaces from 2011, expecting the 11,000 ha to be achieved by 2015.

[62] http://www.lafargenorthamerica.com/wps/portal/na/en/1_8_2-Archive_NewsDetail?WCM_GLOBAL_CONTEXT=/wps/wcm/connectlib_na/Site_na/AllPR_Archives/PressRelease_1289486704047/PressReleaseHeader

[63] http://www.indocement.co.id/en/upload/documents/newsDoc-158.pdf (aside from their blended cement CDM Project 0526)

[64] See CDM Project 3706

[65] See Document 18: short bibliography on Jatropha Curcas.

[66] All relevant justifications are available for the consideration of the DOE upon request.

[67] Bargny site geographic coordinates are 14°43'24"N & 17°14'0"W. See Document 20a: Bargny pilot map.

[68] Pout site geographic coordinates are 14°48'26"N & 17° 1'15"W. See Document 20b: Pout pilot map.

Milestones	Date	Comments/Evidence
Presentation by B. Meunier, CDM expert, of a PowerPoint presentation on CDM opportunities for the cement industry to the top management of Vicat Group and discussion on CDM perspectives offered to Vicat cement plants abroad.	July 2006	The VICAT Group management informed on these new carbon opportunities was eager to start a CDM initiative within its new corporate environment policy.
Presentation of a PIN for a SOCOCIM substitution project at a CDM workshop in Dakar, organized by the Ministry of Environment.	August 1st 2006	SOCOCIM Industries presented for the first time a project of substitution of coal by alternative fuels in kilns N°3 and n°4 showing that CDM carbon revenues were necessary to reach economic viability.
Contract between VICAT Group (SOCOCIM mother company) and SEED (PDD consultant) to identify CDM projects in the subsidiary cement companies outside of France.	October 2006	The senior management of VICAT Group, aware of the CDM potential, wished to identify a few pilot CDM projects in line with the new environment policy of the VICAT group. Among the countries investigated was Senegal.
Progress report of SEED identifying CDM opportunities in Senegal	November 2006	The utilization of biomass residues as CDM project activity is suggested for further consideration
Mission of the VICAT group director in charge of alternative fuels to evaluate the potential in biomass residues and contact potential suppliers of biomass	November 2006	Evaluation with groundnut oil plants managers of the potential surplus available in groundnut shells residues and establishment of cost estimates to evaluate economic feasibility of this option. Same evaluation for rice husks with rice mills managers along the valley of Senegal river.
Second progress report of the SEED consultant on CDM opportunities	December 2006	The consultant underlines the issues linked with the limited availability of biomass residues in Senegal and suggest other biomass resources such as Jatropha plantations
Training workshop on methodologies applicable for CDM energy and forestry projects	February 2007	The workshop was organized by the Carbon Finance assistance program of the World Bank. SOCOCIM Industries was a participant.
International conference of VICAT Group plant managers focused on alternative fuels and raw materials for clinker manufacturing	May 2007	Presentation of a draft corporate strategy 2007-2010 for the use of secondary fuels
Joint mission of the environment manager of SOCOCIM Industries and the VICAT Group manager for alternative fuels to evaluate the implementation of a Jatropha pilot plantation project and meetings with local Senegalese authorities and financial institutions	Early June 2007	VICAT Group management considers the Jatropha project as a long term option if CER can be obtained through CDM to improve its viability. The implementation during summer 2007 of a small pilot plantation of Jatropha over 75ha is approved. Meetings with several technical and financial partners were carried out (GIE SEEV, ISRA, CIRAD, AFD, and IFC). The official

		communication made on this Jatropha project underlines that it is not feasible without the support of CDM.
Benchmarking mission in Mali on Jatropha cultivation projects	Mid June 2007	Mission carried out by Dr M. Diatta, agronomist, manager of Gie SEEV to evaluate implemented pilot Jatropha projects in Mali, issues encountered and best practices. Meetings with NGO and official institutions from Mali.
Starting date of the project activity	July 2007	Implementation of a Jatropha nursery for 150,000 plants and plantation of Jatropha on SOCOCIM quarry reserves over 75ha.
Reception of the Letter of Approval by the DNA of Senegal, placed under Ministry of Environment (initial version of the LoA)	September 2008	-
Start of the CDM validation (Submission by DNV of the PDD on the UNFCCC website for GSP)	27th September 2008	DOE involvement (contracted on 6th September 2009)
On-site visit of the DOE	October 2008	-
Biomass introduction pilot	January 2009	-
Reception by SOCOCIM Industries of DNV comments on the PDD Ver. 1	Early 2009	
Additional Jatropha seeds pilot in Pout (150 ha)	Mid 2009	-
Preparation by SOCOCIM Industries of reply and clarifications for DNV and revision of PDD Version 2	2009	-
Exchange with the DOE DNV for further revisions and clarifications	2009-2010	-
Completion of the Strategic Environmental Assessment study	January 2010	Ministry of Environment validation letter
Submission to the DOE DNV of a revised PDD Version 3	July 2010	-
Involvement of an additional carbon consultant	August 2010	ecosur afrique services (contracted on 6th September 2010)
Submission of a revised PDD Ver. 4	November 2010	-
Financial Closure suspension	24th November 2010	VICAT Board statement conditioning further financial commitments to the Final Validation Report/registration.
Reception of the Letter of Approval by the DNA of Senegal, placed under Ministry of Environment (corrected version of the LoA)	January 2011	-

Table 6 : *Project timeline and early consideration of carbon credits*

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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 project emissions from the cultivation of renewable biomass at the dedicated plantation ($PE_{BC,y}$):

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

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)

$PE_{T,y}$ = CO_2 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 plantation 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 in the project plant are calculated as follows:

$$\mathbf{PE_{k,y} = \Sigma_k FC_{PJ,k,y} \times NCV_{k,y} \times EF_{CO2,k,y}}$$

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* (tCO_2)

$FC_{PJ,k,y}$ = 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* (tCO_2/GJ)

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

k = Alternative fuel types and less carbon intensive fossil fuel types used in the project plant in year *y*

➔ In the Project context, the only alternative fuels are renewable biomass residues and jatropha fruits, which use does not result in any emissions therefore **$PE_{k,y} = 0$**.

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

The use of alternative fuels or less carbon intensive fossil fuels may result in additional fossil fuel and/or electricity consumption at the project site or off-site. This may include, inter alia, the following emission sources:

- Drying or mechanical treatment of the fuels;
- On-site transportation of the fuels;
- Flue gas treatment required as a result of the project activity.

Project participants should identify in the CDM-PDD all relevant emission sources for additional fuel combustion and electricity generation and, if applicable, explain any changes in monitoring reports.

CO_2 emissions from on-site combustion of fossil fuels ($PE_{FC,y}$) should be calculated using the latest approved version of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion". For each fossil emission source *j*, the fuel consumption of each fuel type *i* ($FC_{i,j,y}$) should be monitored, consistent with the guidance in the tool.

CO_2 emissions from on-site electricity consumption ($PE_{EC,y}$) should be calculated using the latest approved version of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption". Electricity consumption from each relevant source should be monitored and summed up to $EC_{PJ,y}$.

➔ In our specific case, the project activity does not involve any drying of alternative fuels. Moreover, coal grinding requiring more electricity than biomass feeding, electricity consumption resulting from the project activity will be reduced compared to the baseline (see section B.6.3), therefore **$PE_{FC,y} = PE_{EC,y} = 0$**.

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

Project participants shall determine CO_2 emissions resulting from transportation of alternative fuels to the project plant. In many cases transportation is undertaken by vehicles. Project participants may choose between two different approaches to determine emissions: an approach based on distance and vehicle type (Option 1) or on fuel consumption (Option 2).

➔ The transportation is undertaken by vehicles. As the project may use the services of other goods transporters, an approach based on distance and vehicle type (**Option 1** of ACM0003) is more suitable.

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

$$\mathbf{PE_{T,y} = \Sigma_k AF_{T,k,y} / TL_y \cdot AVD_y \cdot EF_{km,CO2,y}}$$

Where:

$PE_{T,y}$ = CO_2 emissions during the year *y* due to transport of alternative fuels to the project plant (tCO_2/yr)

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 CO_2 emission factor for the trucks measured during the year *y* (tCO_2/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) 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

As the Jatropha is cultivated from a dedicated plantation and used as alternative fuel, project emissions from the cultivation of this renewable biomass ($PE_{BC,y}$) shall be calculated as:

$$\mathbf{PE_{BC,y} = PE_{FC,PL,y} + PE_{FP,y} + PE_{FA,y} + PE_{BB,y} + PE_{IR,y}}$$

Where:

$PE_{BC,y}$ = Project emissions from the cultivation of renewable biomass at the dedicated plantation in year *y* (tCO_2e)

$PE_{FC,PL,y}$ = Project emissions related to fossil fuel consumption at the plantation during agricultural operations in year *y* (tCO_2/yr). This emission source should be calculated using the latest approved version of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"

$PE_{FP,y}$ = Project emissions related to the production of synthetic fertilizer[69] that is used at the dedicated plantation in year *y* (tCO_2e/yr). This emission source should be calculated using the procedures provided in the latest approved version of the baseline and monitoring methodology AM0042. In case of using organic fertilizers (compost), emissions from production of organic fertilizers are negligible and assumed to be zero

[69] The production of synthetic fertilizer is not envisaged in this project.

$PE_{FA,y}$ = Project emissions related to the application of fertilizers[70] at the plantation in year *y* (tCO_2e/yr). This emission source should be calculated using the procedures provided in the latest approved version of the baseline and monitoring methodology AM0042

$PE_{BB,y}$ = Project emissions arising from field burning[71] of biomass at the plantation site (tCO_2e/yr). This emission source should be calculated using the procedures provided in the latest approved version of the baseline and monitoring methodology AM0042. In case the land has been previously used for agriculture, it is conservatively assumed that all plantations (vegetation, trees, etc.) on the land prior to project implementation have been burnt and emissions are estimated accordingly using the same procedures provided in the latest approved version of the baseline and monitoring methodology AM0042

$PE_{IR,y}$ = Project emissions from irrigation[72] of the plantation should be estimated as per the procedure given in Step 2 above. Emissions from fuel combustion due to irrigation ($PE_{FC,IR,y}$) are estimated as per the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" while emissions from electricity consumption due to irrigation ($PE_{EC,IR,y}$) are estimated as per the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption"

In case of conversion of land from crop land to forest land, soil carbon is likely to increase. Consistent with guidance by EB 20, as contained in Annex 8 to the meeting report, the change in soil carbon is assumed to be zero and no CERs are claimed for such increase.

➔ Applicable project emissions from the cultivation of renewable biomass at the dedicated plantation are accounted accordingly as detailed in section B.6.3 below.

Baseline emissions

The project reduces CO_2 emissions by using Jatropha fruits or biomass residues as alternative fuels in the pre-calciners and the kilns n°3 and n°4 for the production of clinker in cement manufacture.

Baseline emissions are calculated as follows:

$$\mathbf{BE_y = BE_{FF,y} + BE_{CH4,biomass,y}}$$

Where:

BE_y = Baseline emissions in year *y* (tCO_2)

$BE_{FF,y}$ = Baseline emission from fossil fuels displaced by alternative fuels or less carbon intensive fossil fuels in year *y* (tCO_2)

$BE_{CH4,biomass,y}$ = Baseline methane emissions avoided during the year *y* from preventing disposal or uncontrolled burning of biomass residues (tCO_2e)

[70] Only initial manual incorporation of a very small quantity of organic fertilizer is foreseen (150 kg of organic fertilizer per ha, based on vegetal waste compost nearby each young plant). This emission source is demonstrated as negligible in the ex-ante project emissions calculation (<1% of total Emission Reductions over the crediting period) although included in the monitoring, including for the cultivation years anterior to the crediting period start.

[71] Field burning of biomass at the plantation sites is not envisaged as the Jatropha cultivation will be done in the severely degraded land of Thies region and in the former 'bassin arachidier' region characterized by vegetation and soil degradation. No land that has been previously used for agriculture in the recent years will be used for the Jatropha plantation.

[72] Irrigation is not envisaged except for negligible irrigation of newly planted trees during their first 6 months if not coinciding with the rainy season as recommended.

Baseline emissions are determined in the following steps:

- Step 1. Estimate the project specific "fuel penalty"
- Step 2. Calculate baseline emissions from the coal displaced by the alternative 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 clinker or quicklime 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:

$$\mathbf{FP_y = P_{clinker/quicklime,y} \times (SEC_{clinker/quicklime,PJ,y} - SEC_{clinker/quicklime,BL})} \quad \mathbf{(6)}$$

Where:

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

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 or quicklime produced in year *y*, as follows:

$$\mathbf{SEC_{clinker/quicklime,PJ,y} = (\Sigma_i (FC_{PJ,i,y} \times NCV_{i,y}) + \Sigma_k (FC_{PJ,k,y} \times NCV_{k,y})) / P_{clinker/quicklime,y}}$$

Where:

$SEC_{clinker/\mathbf{quicklime},PJ,y}$	=	Specific energy consumption of the project plant in year *y* (GJ/t clinker or GJ/t quicklime)
$FC_{PJ,i,y}$	=	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/ton)
$P_{clinker/\mathbf{quicklime},y}$	=	Production of clinker or quicklime 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 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, as follows:

$$\mathbf{SEC_{clinker/quicklime,BL} = MIN\ (HG_x / P_{clinker/quicklime,x};\ HG_{x-1} / P_{clinker/quicklime,x-1};\ HG_{x-2} / P_{clinker/quicklime,x-2})}$$

With

$$\mathbf{HG_x = \sum FC_{i,x} \times NCV_i}$$

Where:

$SEC_{clinker/\mathbf{quicklime},BL}$ = Specific energy consumption of the project plant in the absence of the project activity (GJ/t clinkeror GJ/t quicklime)

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)

$P_{clinker/\mathbf{quicklime},x}$ = Production of clinker or quicklime 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

➔ The project specific fuel penalty is calculated accordingly, based on the specific energy consumption as the lowest annual ratio of fuel input per clinker production between 2004 and 2006.

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:

$$\mathbf{BE_{FF,y} = (\sum_k (FC_{PJ,k,y} \times NCV_{k,y}) - FP_y) \times EF_{CO2,BL,y}}$$

Where:

$BE_{FF,y}$ = Baseline emission from fossil fuels displaced by alternative fuels or less carbon intensive fossil fuels in year *y* (tCO_2)

$FC_{PJ,k,y}$ = 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/ton)

FP_y = Fuel penalty in year *y* (GJ)

$EF_{CO2,BL,y}$ = 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* (tCO_2/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 CO_2 emission factors:

A. The weighted average CO_2 emission factor for the fossil fuel(s) consumed during the most recent three years before the start of the project activity, calculated as follows:

$$\mathbf{EF_{BL,CO2,y} = (\Sigma_i (FC_{i,x-2} + FC_{i,x-1} + FC_{i,x}) \times NCV_i \times EF_{CO2,FF,i}) / \Sigma_i (FC_{i,x-2} + FC_{i,x-1} + FC_{i,x}) \times NCV_i}$$

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* (tCO_2/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)
$EF_{CO2,FF,i}$	=	CO_2 emission factor for fossil fuel type *i* (tCO_2/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 CO_2 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:

$$\mathbf{EF_{BL,CO2,y} = (\Sigma_i FC_{PJ,i,y} \times NCV_{i,y} \times EF_{CO2,FF,i,y}) / \Sigma_i FC_{PJ,i,y} \times NCV_i}$$

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* (tCO_2/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* (tCO_2/GJ)
i	=	Fossil fuel types used in the project plant in year *y* that are not less carbon intensive fossil fuel types

C. As F3 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", as follows:

$$\mathbf{EF_{BL,CO2,y} = (\Sigma_i FC_{BL,F3,i,y} \times NCV_{i,y} \times EF_{CO2,i,y}) / \Sigma_i FC_{BL,F3,i,y} \times NCV_i}$$

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* (tCO_2/GJ)
$FC_{BL,F3,i,y}$	=	Quantity of fossil fuel type *i* that would in the absence of the project activity be used in the project plant according to the selected baseline scenario F3 in year *y* (tons)
$NCV_{i,y}$	=	Net calorific value of the fossil fuel type *i* in year *y* (GJ/ton)
$EF_{CO2,i,y}$	=	Carbon dioxide emission factor for fossil fuel type *i* in year *y* (tCO_2/GJ)
i	=	Fossil fuel types that are not less carbon intensive fossil fuel types and that would in the absence of the project activity be used in the project plant according to the selected baseline scenario F3 in year *y*

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

The project aims to utilize all type of available biomass residues, including, possibly, groundnut shells and rice husk. For these types of biomass residues, baseline scenario is B1 and leakage can be ruled out by using one of the approaches L1, L2 or L3 outlined in the leakage section. So the project could claim baseline methane emissions avoidance from decay, dumping or uncontrolled burning of that biomass.

➔ However for conservativeness reasons no emissions reductions are claimed for decay, dumping or burning of biomass residues. Therefore, $\mathbf{BE_{CH4,biomass,y} = 0}$.

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 CH_4 emissions and CO_2 emissions from associated fuel combustion and flaring.

Leakage emissions are calculated as follows:

$$LE_y = LE_{BR,y} + LE_{FF,upstream,y}$$

Where:

LE_y	=	Leakage emissions during the year *y* (tCO_2e/yr)
$LE_{BR,y}$	=	Leakage emissions related to the use of biomass residues during the year *y* (tCO_2)
$LE_{FF,upstream,y}$	=	Upstream leakage emissions from fossil fuel use in year *y* (tCO_2e)

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 biomass residues use in the project activity (mainly groundnut shells) will represent only a small share of total biomass, after the initial years where Jatropha plantations will have limited outputs. The use of biomass residues will not result in increased fossil fuel consumption elsewhere. The monitoring plan will assess the supply situation for all the types of biomass residues that will be used in the project plant.

To demonstrate that the biomass residues used in the project plant do not increase fossil fuel consumption elsewhere, the following option is selected:

L2: Demonstrate that there is an abundant surplus of the biomass residue in the region of the project activity which is not utilized (i.e. 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), the geographical boundary of the region covering a radius of 150 km around the project activity, as documented in section A.4.1.4 of the PDD.

The biomass supply and demand will be monitored if new markets have emerged and leakage will be ignored only if there is an abundant surplus of biomass (availability 25% higher than utilization). Otherwise, a leakage penalty will be applied to the type of biomass residues for which it cannot be demonstrated that its use by the project does not result in leakage.

➔ Since leakage effects can be ruled out according to L2 demonstration[73], no leakage penalty needs to be applied for biomass residues used. Therefore, $\underline{LE_{BR,y} = 0}$.

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

Since no less carbon intensive fossil fuels are used in the project activity, no upstream leakage emissions from fossil fuel are accounted for. Actually, total net leakage effects from upstream emissions would be negative because coal is displaced by the project activity.

➔ Therefore, $\underline{LE_{FF,upstream,y} = 0}$.

Note: Waste oils being part of the identified baseline scenario, they are not considered as less carbon intensive fuels as per the project activity alternatives fuels definition because independent from the project activity.

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

Data / Parameter:	$FC_{c,x}$, $FC_{c,x-1}$ and $FC_{c,x-2}$
Data unit:	tons
Description:	Quantity of coal used in the project plant for kilns n°3 and n°4 in year *x, x-1* and and *x-2* where *x* is the year prior to the start of the project activity and *c* indicate indicate the coal used in the project plant in the last three years prior to the start

[73] Biomass residues availability analysis in section B.4 highlights that the groundnut shells utilization is far below their actual availability.

	of the project activity
Source of data used:	Three years data from coal consumption data logs at the project site
Value applied:	**2004**: 126,634; **2005**: 151,855; **2006**: 167,393
Justification of the choice of data or description of measurement methods and procedures actually applied :	Bridge weight measurement is used. The consistency of metered coal consumption quantities should be crosschecked by an annual mass balance that is based on purchased quantities and stock changes. Where the purchased coal invoices can be identified specifically for the CDM project, the metered coal consumption quantities should also be cross-checked with available purchase invoices from the financial records.
Any comment:	-

Data / Parameter:	$FC_{hf,,x}$, $FC_{hf,x-1}$, and $FC_{hf,x-2}$
Data unit:	tons
Description:	Quantity of heavy fuel used in the project plant for kilns n°3 and n°4 in year *x, x-1* and *x-2* where *x* is the year prior to the start of the project activity and *hf* indicate the heavy fuel 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 heavy fuel consumption data logs at the project site
Value applied:	**2004**: 16,549; **2005**: 3,494; **2006**: 2,421
Justification of the choice of data or description of measurement methods and procedures actually applied :	Cumulative mass flow meter is used. The consistency of metered heavy fuel consumption quantities should be crosschecked by an annual mass balance that is based on purchased quantities and stock changes. Where the purchased heavy fuel invoices can be identified specifically for the CDM project, the metered heavy fuel consumption quantities should also be cross-checked with available purchase invoices from the financial records.
Any comment:	-

Data / Parameter:	$P_{clinker/quicklime,x}$, $P_{clinker/quicklime,x-1}$, and $P_{clinker/quicklime,x-2}$
Data unit:	tons
Description:	Production of clinker or quicklime in year *x, x-1* and *x-2* for kilns n°3 and n°4 where *x* is the year prior to the start of the project activity
Source of data used:	Three years data from production data logs at the project site
Value applied:	**2004**: 1,047,128; **2005**: 1,037,623; **2006**: 1,066,330
Justification of the choice of data or description of measurement methods and procedures actually applied :	Use of appropriate mass meters. The production coefficient of clinker used in kilns n°3 and n°4 is 0.61 (ratio between fed raw materials and clinker production). This coefficient is regularly validated by production balance calculations at least once a year for each kiln in accordance with prevailing ISO 9001 procedures.
Any comment:	-

Data / Parameter:	$FC_{BL,F3,i,y}$
Data unit:	Mass or volume unit
Description:	Quantity of fossil fuel type *i* that would in the absence of the project activity be used in the project plant according to the selected baseline scenario F3 in year *y*
Source of data used:	Baseline scenario determination
Value applied	**Fuel** / **Quantity (tons)**: Petcoke 142,912; Heavy Fuel Oil 3,200; Waste Oils 5,000
Justification of the choice of data or description of measurement methods and procedures actually applied :	Based on availability studies and the fact that in 2009 3,981 tons of waste oils were consumed by SOCOCIM Industries in kilns 3 and 4; for 2010 and later, 5,000 tons of waste oils are expected to be available for SOCOCIM Industries. Hypothetical petcoke consumption for F3 is back calculated as the balance to meet historical average specific heat demand based on all other expected fuel consumptions and clinker production, as detailed in Excel sheet attached.
Any comment:	Applicable since F3 has been determined as the most likely baseline scenario

Data / Parameter:	NCV_c
Data unit:	GJ/ton of coal
Description:	Net calorific value of the coal used in the project plant in the last three years prior to the start of the project activity
Source of data used:	IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Value applied:	24.0
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC default value is preferred and deemed conservative as no recent value is available from any fuel supplier invoice.
Any comment:	-

Data / Parameter:	NCV_{hf}
Data unit:	GJ/ton of heavy fuel
Description:	Net calorific value of the heavy fuel used in the project plant in the last three years prior to the start of the project activity
Source of data used:	IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Value applied:	39.8
Justification of the choice of data or description of measurement methods	IPCC default value is preferred and deemed conservative as no recent value is available from any fuel supplier invoice.

and procedures actually applied :	
Any comment:	-

Data / Parameter:	$EF_{CO2,FF,c}$
Data unit:	tCO_2/GJ
Description:	Weighted average CO_2 emission factor for the coal used in the project plant in the last three years prior to the start of the project activity
Source of data used:	IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in Table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Value applied:	0.0873
Justification of the choice of data or description of measurement methods and procedures actually applied :	Refer to 2006 IPCC guidelines (no available value from the fuel supplier).
Any comment:	-

Data / Parameter:	$EF_{CO2,FF,hf}$
Data unit:	tCO_2/GJ
Description:	Weighted average CO_2 emission factor for heavy fuel used in the project plant in the last three years prior to the start of the project activity
Source of data used:	IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in Table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Value applied:	0.0755
Justification of the choice of data or description of measurement methods and procedures actually applied :	Refer to 2006 IPCC guidelines (no available value from the fuel supplier).
Any comment:	-

Data / Parameter:	$EF_{N2O-N,dir}$
Data unit:	kg N_2O-N / kg N input
Description:	Emissions factor for direct N_2O emissions from N inputs
Source of data used:	2006 IPCC Guidelines, Vol. 4, Ch. 11. Table 11.1
Value applied:	0.01
Justification of the choice of data or description of measurement methods and procedures actually applied :	According to ACM0003 methodology which refers to AM0042 methodology "Grid-connected electricity generation using biomass from newly developed dedicated plantations".
Any comment:	-

Data / Parameter:	$EF_{N2O,ATD}$
Data unit:	t N_2O-N / t N volatilized
Description:	Emissions factor for atmospheric deposition of N on soils and water surfaces
Source of data used:	2006 IPCC Guidelines, Vol. 4, Ch. 11. Table 11.3
Value applied:	0.01
Justification of the choice of data or description of measurement methods and procedures actually applied :	According to ACM0003 methodology which refers to AM0042 methodology "Grid-connected electricity generation using biomass from newly developed dedicated plantations".
Any comment:	-

Data / Parameter:	$EF_{N2O-N,L}$
Data unit:	t N_2O-N / t N leached and runoff
Description:	Emissions factor for N_2O emissions from N leaching and runoff
Source of data used:	2006 IPCC Guidelines, Vol. 4, Ch. 11. Table 11.3
Value applied:	0.0075
Justification of the choice of data or description of measurement methods and procedures actually applied :	According to ACM0003 methodology which refers to AM0042 methodology "Grid-connected electricity generation using biomass from newly developed dedicated plantations".
Any comment:	-

Data / Parameter:	$Frac_{GASM}$
Data unit:	kg N volatilized / kg N applied
Description:	Fraction of organic N fertilizer that volatilizes as NH_3 and NO_X
Source of data used:	2006 IPCC Guidelines, Vol. 4, Ch. 11. Table 11.3
Value applied:	0.2
Justification of the	According to ACM0003 methodology which refers to AM0042 methodology

choice of data or description of measurement methods and procedures actually applied :	"Grid-connected electricity generation using biomass from newly developed dedicated plantations".
Any comment:	-

Data / Parameter:	$Frac_{LEACH}$
Data unit:	kg N leached and runoff / kg N applied
Description:	Fraction of synthetic and organic fertilizer N that is lost through leaching and runoff
Source of data used:	2006 IPCC Guidelines, Vol. 4, Ch. 11. Table 11.3
Value applied:	0.3
Justification of the choice of data or description of measurement methods and procedures actually applied :	According to ACM0003 methodology which refers to AM0042 methodology "Grid-connected electricity generation using biomass from newly developed dedicated plantations".
Any comment:	-

Data / Parameter:	$Frac_{GASF}$
Data unit:	kg N volatilized / kg N applied
Description:	Fraction of synthetic fertilizer N that volatilizes as NH_3 and NO_X
Source of data used:	2006 IPCC Guidelines, Vol. 4, Ch. 11. Table 11.3
Value applied:	0.1
Justification of the choice of data or description of measurement methods and procedures actually applied :	According to ACM0003 methodology which refers to AM0042 methodology "Grid-connected electricity generation using biomass from newly developed dedicated plantations".
Any comment:	-

B.6.3 Ex-ante calculation of emission reductions:

Project emissions

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

- ***Project emissions from the use of alternative fuels***

The only alternative fuels in the project activity are renewable biomass residues and jatropha fruits, which use does not result in any emissions therefore $\mathbf{PE_{k,y} = 0}$.

- ***Project emissions from additional electricity and/or fossil fuel consumption as a result of the project activity***

The electricity consumption for coal grinding before introduction in cement kilns N°3 or N°4 is 47.6 kWh/ton of coal, according to the conservative interpretation of SOCOCIM Industries coal grinding mills tests and performance results[74], whereas the two feeding line installations for introduction of Jatropha fruits and other biomass residues in kilns N° 3 and N°4 will have a capacity of 6 tons/hour and an installed electric capacity of 190 kW each[75], resulting in 31.7 kWh/ton of biomass fed.

As a consequence of the Project activity, the introduction of approximately 80,400 tons of jatropha fruits and groundnut shells annually fed into kilns n°3 and n°4 which ultimately displace approximately 65,000 tons of coal per year will result in yearly electricity savings of more or less 300 MWh in comparison to the current situation (detailed yearly calculations included in the Excel sheet). To be conservative, the project participant is not claiming the emissions reductions related to electricity savings.

Moreover, no increase of fossil fuel consumption due to the project activity is foreseen, except for the mineral coal due to the lower heat transfer efficiency of the kilns with the use of biomass (already accounted for in "Project specific fuel penalty" section below).

Therefore, $\mathbf{PE_{FC,y} = 0}$.

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

35% of the heat needed to the kiln will be produced using biofuels (Jatropha fruits and biomass residues). The transportation is undertaken by vehicles. As the project may use the services of other goods transporters, the approach based on distance and vehicle type (option 1 of ACM0003) has been retained.

Emissions are calculated on the basis of distance and the number of trips (at an average truck load of 10 tons). The average transportation distance is conservatively taken as 300km as the radius of biomass collection is expected at 150km maximum from the project plant site.

The diesel specific consumption of the truck is 40 liters per 100 km. This is a conservative data. 36 liters per 100 km is specified in standard of trucks offered to SOCOCIM for biomass transportation.

	$PE_{T,y} = \frac{\sum_k AF_{T,k,y}}{TL_y} \cdot AVD_y \cdot EF_{km,CO2,y}$			*(Option 1)*
	$PE_{T,y}$	**$\Sigma AFT,k,y$**	**AVDy**	**$EF_{km,CO2,y}$**
	tCO_2	*tons*	*km*	*t CO_2/km*
01/03/2012 to 28/02/2013	**459**	13,490	300	0.001135
01/03/2013 to 28/02/2014	**599**	17,579	300	0.001135

[74] See Document 15 "*SOCOCIM Coal grinding tests & performances*". These parameters are checked continuously as part of the clinker line monitoring activities. The installed power of each coal grinding mill is 2.1 MW and the average electrical load is 1.5 MW.

[75] The breakdown of feeding lines equipment is displayed in Table 2 section A.4.3 of the PDD; the total of 158 kW is conservatively majored by 20% to account for lights, vibrators, etc. thus an installed capacity taken as 190 kW. The actual electricity consumption would be less taking into account the fact that we have considered the installed power and not the average electrical load.

01/03/2014 to 28/02/2015	**946**	27,764	300	0.001135
01/03/2015 to 29/02/2016	**1,497**	43,956	300	0.001135
01/03/2016 to 28/02/2017	**2,117**	62,170	300	0.001135
01/03/2017 to 28/02/2018	**2,533**	74,384	300	0.001135
01/03/2018 to 28/02/2019	**2,738**	80,400	300	0.001135
Total	**10,887**			

The following parameters were used:
Diesel oil density: 0.0008763 tons/liter (independent laboratory measurement)
Diesel oil emission factor: 74.8 tCO_2/TJ (IPCC 2006)
Diesel oil NCV: 43.3 GJ/ton (IPCC 2006)

- ***Project emissions from the cultivation of Jatropha at the dedicated plantation***

$$PE_{BC,y} = PE_{FC,PL,y} + PE_{FP,y} + PE_{FA,y} + PE_{BB,y} + PE_{IR,y}$$

Project emissions related to fossil fuel consumption at the plantation during agricultural operations

Based on measurements performed during the pilot plantation phase at Pout, a conservative value of 150 liters/ha planted has been accounted for fossil fuel consumption at the plantation. This is one-time diesel consumption for each plantation, which includes furrow drilling and mobile irrigation with tractors. It is conservatively considered for all new plantations, although furrow drilling and irrigation of new plantations is not systematic but depends on the soil quality and the rainy season. After these initial potentially mechanized plantation operations, the harvesting is carried out manually.

	Tool to calculate project or leakage CO2 emissions from fossil fuel combustion (Option B)			
	$PE_{FC,PL,y}$	$FC_{plantation,y}$	$NCV_{diesel,y}$	$EF_{CO2,diesel,y}$
	t CO_2e	tons	GJ/tonne	tCO_2/GJ
01/03/2012 to 28/02/2013	1,061	327.71	43.33	0.0748
01/03/2013 to 28/02/2014	1,277	394.34	43.33	0.0748
01/03/2014 to 28/02/2015	1,277	394.34	43.33	0.0748
01/03/2015 to 29/02/2016	1,067	329.51	43.33	0.0748
01/03/2016 to 28/02/2017	0	0.00	43.33	0.0748
01/03/2017 to 28/02/2018	0	0.00	43.33	0.0748
01/03/2018 to 28/02/2019	0	0.00	43.33	0.0748
Total	**4,682**			

No synthetic fertilizer is foreseen to be produced: $PE_{FP,y} = 0$

Project emissions related to the application of fertilizers at the plantation

Since only initial manual incorporation of a very small quantity of organic fertilizer is foreseen (150 kg of organic fertilizer per ha, based on vegetal waste compost nearby each young plant), this emission source is demonstrated as negligible in the ex-ante project emissions calculation (<1% of total Emission Reductions over the crediting period). Indeed, according to the procedures provided in the latest approved version of the baseline and monitoring methodology AM0042 and based on a conservative nitrogen content of the organic fertilizer of 3% ("a rural compost generally contains 0.5 to 1.0% nitrogen, 0.2% phosphorus and 0.5% potassium, whereas urban compost has about 1.5 to 2.0 %"; The Fertilizer Encyclopedia, Vasant Gowariker), the sum of $PE_{FA,y}$ over the 7-year crediting period equals 341 tCO_2e only, as detailed in the Excel ER file.

However it will be included in the monitoring for conservativeness purposes:

$$PE_{FA,y} = GWP_{N_2O} \cdot \frac{44}{28} \cdot \left(PE_{N_2O-N,dir,y} + PE_{N_2O-N,ind,y}\right)$$

There is no field burning of biomass at the plantation site: $PE_{BB,y} = 0$

Project emissions from marginal irrigation of some of the new plantations is accounted for in $PE_{FC,PL,y}$

Summary of the Project Emissions:

	PE_y	$PE_{k,y}$	$PE_{FC,y}$	$PE_{EC,y}$	$PE_{T,y}$	$PE_{BC,y}$
	t CO_2e	*t CO_2e*	*t CO_2e*	*t CO_2e*	*t CO_2e*	*t CO_2e*
01/03/2012 to 28/02/2013 [76]	**1,597**	0	0	0	459	1,138
01/03/2013 to 28/02/2014	**1,968**	0	0	0	598	1,370
01/03/2014 to 28/02/2015	**2,315**	0	0	0	945	1,370
01/03/2015 to 29/02/2016	**2,642**	0	0	0	1,497	1,145
01/03/2016 to 28/02/2017	**2,117**	0	0	0	2,117	0
01/03/2017 to 28/02/2018	**2,533**	0	0	0	2,533	0
01/03/2018 to 28/02/2019	**2,738**	0	0	0	2,738	0
TOTAL	**15,910**	**-**	**-**	**-**	**10,887**	**5,023**

Baseline emissions

$$\mathbf{BE_y = BE_{FF,y} + BE_{CH4,biomass,y}}$$

- ***project specific "fuel penalty"***

[76] Including project emissions related to cultivation years anterior to the crediting period start (2007-2011).

$$FP_y = P_{clinker/qu\ icklime,\ y} \times (SEC_{\ clinker/qu\ icklime,\ PJ,\ y} - SEC_{\ clinker/qu\ icklime,\ BL})$$

	FP_y	$P_{clinker/quicklime,y}$	$SEC_{clinker/quicklime,PJ,y}$	$SEC_{clinker/quicklime,BL}$
	GJ	*tons*	*GJ/t clinker*	*GJ/t clinker*
01/03/2012 to 28/02/2013	**193,448**	1,234,000	3.688	3.531
01/03/2013 to 28/02/2014	**197,750**	1,234,000	3.692	3.531
01/03/2014 to 28/02/2015	**208,467**	1,234,000	3.700	3.531
01/03/2015 to 29/02/2016	**225,503**	1,234,000	3.714	3.531
01/03/2016 to 28/02/2017	**244,667**	1,234,000	3.730	3.531
01/03/2017 to 28/02/2018	**257,517**	1,234,000	3.740	3.531
01/03/2018 to 28/02/2019	**263,847**	1,234,000	3.745	3.531

With

$$SEC_{\ clinker/qu\ icklime,\ PJ,\ y} = \frac{\sum_i \left(FC_{\ PJ,i,y} \times NCV_{\ i,y}\right) + \sum_k \left(FC_{\ PJ,k,y} \times NCV_{\ k,y}\right)}{P_{\ clinker/qu\ icklime,\ y}}$$

	$SEC_{clinker/quicklime,PJ,y}$	$P_{clinker/quicklime,y}$	Coal		HFO		Waste Oils		Jatropha fruits		Groundnut shells	
			$FC_{PJ,c,y}$	$NCV_{c,y}$	$FC_{PJ,hf,y}$	$NCV_{hf,y}$	$FC_{PJ,wo,y}$	$NCV_{wo,y}$	$FC_{PJ,j,y}$	$NCV_{i,y}$	$FC_{PJ,gn,y}$	$NCV_{gn,y}$
	GJ/t clinker	*tons*	*tons*	*GJ/to n*	*tons*	*GJ/to n*	*tons*	*GJ/to n*	*tons*	*GJ/to n*	*tons*	*GJ/to n*
01/03/2012 to 28/02/2013	**3.688**	1,234,000	167,450	24.0	3,200	39.8	5,000	33.5	3,490	21.0	10,000	16.4
01/03/2013 to 28/02/2014	**3.692**	1,234,000	164,043	24.0	3,200	39.8	5,000	33.5	7,579	21.0	10,000	16.4
01/03/2014 to 28/02/2015	**3.700**	1,234,000	155,559	24.0	3,200	39.8	5,000	33.5	17,764	21.0	10,000	16.4
01/03/2015 to 29/02/2016	**3.714**	1,234,000	142,072	24.0	3,200	39.8	5,000	33.5	33,956	21.0	10,000	16.4
01/03/2016 to 28/02/2017	**3.730**	1,234,000	126,901	24.0	3,200	39.8	5,000	33.5	52,170	21.0	10,000	16.4
01/03/2017 to 28/02/2018	**3.740**	1,234,000	116,728	24.0	3,200	39.8	5,000	33.5	64,384	21.0	10,000	16.4
01/03/2018 to 28/02/2019	**3.745**	1,234,000	111,716	24.0	3,200	39.8	5,000	33.5	70,400	21.0	10,000	16.4

And

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

	$SEC_{clinker/quicklime,BL,y}$	HG_x	$P_{clinker/quicklime,x}$
	GJ/t clinker	*GJ*	*tons*
2004	**3.531**	3,697,866	1,047,128
2005	**3.646**	3,783,581	1,037,623
2006	**3.858**	4,113,788	1,066,330
MIN	**3.531**		

$$HG_x = \sum_i FC_{i,x} \times NCV_i$$

	Coal		HFO	
HG_x	$FC_{c,x}$	NCV_c	$FC_{hf,x}$	NCV_{hf}
GJ	*tons*	*GJ/ton*	*tons*	*GJ/ton*
3,697,866	126,634	24.0	16,549	39.8
3,783,581	151,855	24.0	3,494	39.8
4,113,788	167,393	24.0	2,421	39.8

A decrease of the energy performance of the kiln in relation with the use of biofuels (Jatropha fruits and groundnut shells) estimated to be 5%[77] has been considered. This reduction of heat transfer efficiency is compensated by an additional consumption of coal which is equal to 5% of heat value of the Jatropha fruits and biomass residues introduced in the kilns 3 and 4.

Therefore, the coal consumption after the starting period of the project was estimated as:

$$\mathbf{FC_{PJ,c,y} = ((P_{clinker/quicklime,y} \times AVG(SEC_{clinker/quicklime,BL}[2004,2005,2006]) + 5\% \times \Sigma\, k(FC_{PJ,k,y} \times NCV_{k,y})) - (\Sigma\, i\,(FC_{PJ,i,y} \times NCV_{i,y}) + \Sigma\, k(FC_{PJ,k,y} \times NCV_{k,y}))) / NCV_{c,y}}$$

- ***baseline emissions from the fossil fuels displaced by the alternative or less carbon intensive fuel(s)***

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

	$BE_{FF,y}$	Jatropha fruits		Groundnut shells			
		$FC_{PJ,j,y}$	$NCV_{j,y}$	$FC_{PJ,gn,y}$	$NCV_{gn,y}$	FP_y	$EF_{CO2,BL,y}$
	t CO_2e	*tons*	*GJ/ton*	*tons*	*GJ/ton*	*GJ*	*tCO_2/GJ*
01/03/2012 to 28/02/2013	**3,632**	3,490	21.0	10,000	16.4	193,448	0.0823
01/03/2013 to 28/02/2014	**10,361**	7,579	21.0	10,000	16.4	197,750	0.0823
01/03/2014 to 28/02/2015	**27,117**	17,764	21.0	10,000	16.4	208,467	0.0823
01/03/2015 to 29/02/2016	**53,756**	33,956	21.0	10,000	16.4	225,503	0.0823

[77] The activity report of the Research Institute of the Cement Industry from Germany (period 2005-2007 http://www.vdz-online.de/fileadmin/gruppen/vdz/3LiteraturRecherche/Activity_Report/Taetigkeitsbericht.pdf – published in January 2008 – Table I.3 page 32) illustrates the heat loss of the clinker kiln with alternative fuels. In the context of Sococim Project with 40% thermal substitution, the corresponding scenario is "40 % substitution, constant raw gas volume flow". If we compare it to the reference scenario BREF (3,027 kJ/kg clinker), the difference is of 126 kJ/kg of clinker, that is + 4.16 %. For Sococim project a + 5% as fuel penalty has been retained to take into account that the two kilns are old (more than 20 years) and that there are 4 stages preheating towers, which are significantly less efficient than the one quoted on the reference scenario on the slide (5 to 6 stages preheating tower). The less the kiln is efficient, the more are the energy losses when using substitution fuels.

01/03/2016 to 28/02/2017	**83,721**	52,170	21.0	10,000	16.4	244,667	0.0823
01/03/2017 to 28/02/2018	**103,815**	64,384	21.0	10,000	16.4	257,517	0.0823
01/03/2018 to 28/02/2019	**113,713**	70,400	21.0	10,000	16.4	263,847	0.0823
Total	**396,115**						

The baseline emission factor ($EF_{CO2,BL,y}$) is estimated as the lowest of the following CO_2 emission factors:

	$EF_{CO2,BL,y}$	**EF option A**	**EF option B**	**EF option C**
	tCO_2/GJ	*tCO_2/GJ*	*tCO_2/GJ*	*tCO_2/GJ*
01/03/2012 to 28/02/2013	**0.08230**	0.08639	0.08637	0.08230
01/03/2013 to 28/02/2014	**0.08230**	0.08639	0.08635	0.08230
01/03/2014 to 28/02/2015	**0.08230**	0.08639	0.08630	0.08230
01/03/2015 to 29/02/2016	**0.08230**	0.08639	0.08621	0.08230
01/03/2016 to 28/02/2017	**0.08230**	0.08639	0.08609	0.08230
01/03/2017 to 28/02/2018	**0.08230**	0.08639	0.08600	0.08230
01/03/2018 to 28/02/2019	**0.08230**	0.08639	0.08595	0.08230

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

No aerobic decay /uncontrolled burning of biomass residues is accounted for, therefore $\mathbf{BE_{CH4,biomass,y} = 0.}$

Leakage

As demonstrated in B.6.1, no leakage is to occur as a result of the Project activity, i.e. $\mathbf{LE_y =}$ 0

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

The ex ante estimation of the emission reductions is summarized at the following table:

Year	**Estimation of baseline emissions (tons of CO_2 e)**	**Estimation of project activity emissions (tons of CO_2 e)**	**Estimation of leakage emissions (tons of CO_2 e)**	**Estimation of overall emission reductions (tons of CO_2 e)**

01/03/2012 to 28/02/2013	3,632	**1,597**	**-**	2,035
01/03/2013 to 28/02/2014	10,361	**1,968**	**-**	8,393
01/03/2014 to 28/02/2015	27,117	**2,315**	**-**	24,802
01/03/2015 to 29/02/2016	53,756	**2,642**	**-**	51,114
01/03/2016 to 28/02/2017	83,721	**2,117**	**-**	81,604
01/03/2017 to 28/02/2018	103,815	**2,533**	**-**	101,282
01/03/2018 to 28/02/2019	113,713	**2,738**	**-**	110,975
Total (tCO_2e)	**396,115**	**15,910**	**-**	**380,205**
Average (tCO_2e)	**56,588**	**2,273**	**-**	**54,315**

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

The monitoring plant will follow carefully instructions provided in methodology ACM 0003 Version 7.3.

The monitoring plan of this CDM activity will beneficiate of the existing, fully operational, detailed global manufacturing and performance monitoring system for the SOCOCIM Industries cement plant which provides detailed and reliable measurements and recording of hundreds of plant parameters.

On the basis of its high quality internal monitoring, SOCOCIM Industries has obtained in 2008 the Certification label "CE" for all the qualities of cements produced. SOCOCIM Industries is also the first Cement plant performing ISO 9001 Certification in West Africa. Both Certifications confirm the reliability of SOCOCIM Industries Quality Management System and its Manufacturing and Performance Monitoring plan respecting International Organization Standards. SOCOCIM Industries is now in the process of ISO 14000 certification which is expected during year 2010.

All the data and parameters necessary for the CDM project monitoring and CERs verification and issuance will be regularly controlled by surveys and procedures described in the Quality Manual and kept in archive for at least two years after the end of the crediting period or the last issuance of CERs for the project activity whichever occurs later.

B.7.1 Data and parameters monitored:

Data / Parameter:	$FC_{PJ,j,y}$
Data unit:	Tons
Description:	Quantity of Jatropha used in the project plant during year *y*
Source of data to be used:	Measurements in the manufacturing plant
Value of data applied	

for the purpose of calculating expected emission reductions in section B.5	<table><tr><th>Year</th><th>$FC_{PJ,j,y}$</th></tr><tr><td>01/03/2012 to 28/02/2013</td><td>3,490</td></tr><tr><td>01/03/2013 to 28/02/2014</td><td>7,579</td></tr><tr><td>01/03/2014 to 28/02/2015</td><td>17,764</td></tr><tr><td>01/03/2015 to 29/02/2016</td><td>33,956</td></tr><tr><td>01/03/2016 to 28/02/2017</td><td>52,170</td></tr><tr><td>01/03/2017 to 28/02/2018</td><td>64,384</td></tr><tr><td>01/03/2018 to 28/02/2019</td><td>70,400</td></tr></table>
Description of measurement methods and procedures to be applied:	A weighing bridge will be used at the entrance of the Cement Plant. The consistency of metered Jatropha consumption quantities will be crosschecked by an annual mass balance that is based on quantities provided to the cement plant and stock changes. The purchased Jatropha invoices from the financial records will be used to cross-check the metered Jatropha consumption quantities. Continuously measured, aggregated at least annually.
QA/QC procedures to be applied:	Instrument should be calibrated regularly according to manufacturer's guidelines and According to ISO 9001 Certification procedures Data Archived: Entire Crediting Period + 2 years
Any comment:	All the trucks delivering jatropha fruits to the Cement Plant will be weighed and electronic documents will be collected for monthly crosschecking to determine quantity of alternative fuel.

Data / Parameter:	$FC_{PJ,rh,y}$
Data unit:	Tons
Description:	Quantity of rice husk used in the project plant during year *y*
Source of data to be used:	Measurements in the manufacturing plant
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0
Description of measurement methods and procedures to be applied:	A weighing bridge will be used. The consistency of metered rice husk consumption quantities will be crosschecked by an annual mass balance that is based on quantities provided to the cement plant and stock changes. The purchased rice husk invoices from the financial records will be used to cross-check the metered rice husk consumption quantities. Continuously measured, aggregated at least annually.
QA/QC procedures to be applied:	According to ISO 9001 Certification procedures Data Archived: Entire Crediting Period + 2 years Instrument should be calibrated regularly according to manufacturer's guidelines.
Any comment:	All the trucks delivering rice husk to the Cement Plant will be weighed and electronic documents will be collected for monthly crosschecking to determine quantity of alternative fuel.

Data / Parameter:	$FC_{PJ,gn,y}$

Data unit:	Tons
Description:	Quantity of groundnut shells used in the project plant during year *y*
Source of data to be used:	Measurements in the manufacturing plant
Value of data applied for the purpose of calculating expected emission reductions in section B.5	10,000
Description of measurement methods and procedures to be applied:	A weighing bridge will be used. The consistency of metered groundnut shells consumption quantities will be crosschecked by an annual mass balance that is based on quantities provided to the cement plant and stock changes. The purchased groundnut shells invoices from the financial records will be used to cross-check the metered groundnut shells consumption quantities. Continuously measured, aggregated at least annually.
QA/QC procedures to be applied:	According to ISO 9001 Certification procedures Data Archived: Entire Crediting Period + 2 years Instrument should be calibrated regularly according to manufacturer's guidelines.
Any comment:	All the trucks delivering groundnut shells to the Cement Plant will be weighed and electronic documents will be collected for monthly crosschecking to determine quantity of alternative fuel.

Data / Parameter:	$FC_{PJ,cs,y}$
Data unit:	Tons
Description:	Quantity of cotton stems and shells used in the project plant during year *y*
Source of data to be used:	Measurements in the manufacturing plant
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0
Description of measurement methods and procedures to be applied:	A weighing bridge will be used. The consistency of metered cotton stems and shells consumption quantities will be crosschecked by an annual mass balance that is based on quantities provided to the cement plant and stock changes. The purchased cotton stems and shells invoices from the financial records will be used to cross-check the metered cotton stems and shells consumption quantities. Continuously measured, aggregated at least annually.
QA/QC procedures to be applied:	According to ISO 9001 Certification procedures Data Archived: Entire Crediting Period + 2 years Instrument should be calibrated regularly according to manufacturer's guidelines.
Any comment:	All the trucks delivering cotton stems and shells to the Cement Plant will be weighed and electronic documents will be collected for monthly crosschecking to determine quantity of alternative fuel.

Data / Parameter:	$FC_{PJ,pk,y}$

Data unit:	Tons
Description:	Quantity of palm kernel shells used in the project plant during year *y*
Source of data to be used:	Measurements in the manufacturing plant
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0
Description of measurement methods and procedures to be applied:	A weighing bridge will be used. The consistency of metered palm kernel shells consumption quantities will be crosschecked by an annual mass balance that is based on quantities provided to the cement plant and stock changes. The purchased palm kernel shells invoices from the financial records will be used to cross-check the metered palm kernel shells consumption quantities. Continuously measured, aggregated at least annually.
QA/QC procedures to be applied:	According to ISO 9001 Certification procedures Data Archived: Entire Crediting Period + 2 years Instrument should be calibrated regularly according to manufacturer's guidelines.
Any comment:	All the trucks delivering palm kernel shells to the Cement Plant will be weighed and electronic documents will be collected for monthly crosschecking to determine quantity of alternative fuel.

Data / Parameter:	$FC_{PJ,cn,y}$
Data unit:	Tons
Description:	Quantity of cashew nuts used in the project plant during year *y*
Source of data to be used:	Measurements in the manufacturing plant
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0
Description of measurement methods and procedures to be applied:	A weighing bridge will be used. The consistency of metered cashew nuts consumption quantities will be crosschecked by an annual mass balance that is based on quantities provided to the cement plant and stock changes. The purchased cashew nuts invoices from the financial records will be used to cross-check the metered cashew nuts consumption quantities. Continuously measured, aggregated at least annually.
QA/QC procedures to be applied:	According to ISO 9001 Certification procedures Data Archived: Entire Crediting Period + 2 years Instrument should be calibrated regularly according to manufacturer's guidelines.
Any comment:	All the trucks delivering cashew nuts to the Cement Plant will be weighed and electronic documents will be collected for monthly crosschecking to determine quantity of alternative fuel.

Data / Parameter:	$FC_{PJ,c,y}$

Data unit:	Tons
Description:	Quantity of coal used in the project plant during year *y*
Source of data to be used:	Measurements in the manufacturing plant
Value of data applied for the purpose of calculating expected emission reductions in section B.5	<table><tr><th>Year</th><th>$FC_{PJ,c,y}$</th></tr><tr><td>01/03/2012 to 28/02/2013</td><td>167,450</td></tr><tr><td>01/03/2013 to 28/02/2014</td><td>164,043</td></tr><tr><td>01/03/2014 to 28/02/2015</td><td>155,559</td></tr><tr><td>01/03/2015 to 29/02/2016</td><td>142,072</td></tr><tr><td>01/03/2016 to 28/02/2017</td><td>126,901</td></tr><tr><td>01/03/2017 to 28/02/2018</td><td>116,728</td></tr><tr><td>01/03/2018 to 28/02/2019</td><td>111,716</td></tr></table>
Description of measurement methods and procedures to be applied:	A weighing bridge will be used for continuous measurement. The consistency of metered coal consumption quantities will be aggregated and crosschecked by an annual mass balance that is based on quantities provided to the cement plant and stock changes. The purchased coal invoices from the financial records will be used to cross-check the metered coal consumption quantities.
QA/QC procedures to be applied:	According to ISO 9001 Certification procedures Data Archived: Entire Crediting Period + 2 years Instrument should be calibrated regularly according to manufacturer's guidelines.
Any comment:	All the trucks delivering coal to the Cement Plant will be weighed and electronic documents will be collected for monthly crosschecking to determine quantity of coal.

Data / Parameter:	$FC_{PJ,hf,y}$
Data unit:	Tons
Description:	Quantity of fuel-oil used in the project plant during year *y*
Source of data to be used:	Measurements in the manufacturing plant
Value of data applied for the purpose of calculating expected emission reductions in section B.5	3,200
Description of measurement methods and procedures to be applied:	A flow meter totalizer will be utilized for continuous measurement. The consistency of metered fuel-oil consumption quantities will be aggregated and crosschecked by an annual mass balance that is based on quantities provided to the cement plant and stock changes. The purchased fuel-oil invoices from the financial records will be used to cross-check the metered fuel-oil consumption quantities.
QA/QC procedures to be applied:	According to ISO 9001 Certification procedures Data Archived: Entire Crediting Period + 2 years Instrument should be calibrated regularly according to manufacturer's guidelines.
Any comment:	All the trucks delivering fuel-oil to the Cement Plant will be weighed and electronic documents will be collected for monthly crosschecking to determine quantity fuel-oil.

Data / Parameter:	$FC_{PJ,wo,y}$
Data unit:	Tons
Description:	Quantity of waste oil used in the project plant during year *y*
Source of data to be used:	Measurements in the manufacturing plant
Value of data applied for the purpose of calculating expected emission reductions in section B.5	5,000
Description of measurement methods and procedures to be applied:	A flow meter totalizer will be utilized for each kiln injection for continuous measurement. The consistency of metered waste oil consumption quantities will be aggregated and crosschecked by an annual mass balance that is based on quantities provided to the cement plant and stock changes. The purchased waste oil invoices from the financial records will be used to cross-check the metered waste oil consumption quantities.
QA/QC procedures to be applied:	According to ISO 9001 Certification procedures Data Archived: Entire Crediting Period + 2 years Instrument should be calibrated regularly according to manufacturer's guidelines.
Any comment:	All the trucks delivering waste oil to the Cement Plant will be weighed and electronic documents will be collected for monthly crosschecking to determine quantity of alternative fuel.

Data / Parameter:	$EF_{CO2,FF,pc,y}$
Data unit:	tCO_2/GJ
Description:	Weighted average CO_2 emission factor for petcoke during year *y*
Source of data to be used:	IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in Table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.0829
Description of measurement methods and procedures to be applied:	In case during year y SOCOCIM Industries can undertake the measurement locally in line with international fuel standards, the measurement will be the option otherwise the IPCC guidelines will be used.
QA/QC procedures to be applied:	-
Any comment:	Data used for the *ex-post* calculation of the conservative baseline F3.

Data / Parameter:	$EF_{CO2,FF,c,y}$
Data unit:	tCO_2/GJ
Description:	Weighted average CO_2 emission factor for coal during year *y*

Source of data to be used:	IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in Table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.0873
Description of measurement methods and procedures to be applied:	In case during year y SOCOCIM Industries can undertake the measurement locally in line with international fuel standards, the measurement will be the option otherwise the IPCC guidelines will be used.
QA/QC procedures to be applied:	According to ISO 9001 Certification procedures Data Archived: Entire Crediting Period + 2 years
Any comment:	If measurements are made, the CO_2 emission factor will be determined for each fuel delivery, from which weighted average annual values should be calculated if measurement. If the IPCC values are used then any future revision of the IPCC Guidelines will be taken into account.

Data / Parameter:	$EF_{CO2,FF,hf,y}$
Data unit:	tCO_2/GJ
Description:	Weighted average CO_2 emission factor for fuel-oil during year *y*
Source of data to be used:	IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in Table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.0755
Description of measurement methods and procedures to be applied:	In case during year y SOCOCIM Industries can undertake the measurement locally in line with international fuel standards, the measurement will be the option otherwise the IPCC guidelines will be used.
QA/QC procedures to be applied:	According to ISO 9001 or similar quality systems Data Archived: Entire Crediting Period + 2 years
Any comment:	If measurements are made, the CO_2 emission factor will be determined for each fuel delivery, from which weighted average annual values should be calculated if measurement. If the IPCC values are used then any future revision of the IPCC Guidelines will be taken into account.

Data / Parameter:	$EF_{CO2,FF,wo,y}$
Data unit:	tCO_2/GJ
Description:	Weighted average CO_2 emission factor for waste oil during year *y*
Source of data to be used:	IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in Table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories

Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.0722
Description of measurement methods and procedures to be applied:	In case during year y SOCOCIM Industries can undertake the measurement locally in line with international fuel standards, the measurement will be the option otherwise the IPCC guidelines will be used.
QA/QC procedures to be applied:	According to ISO 9001 or similar quality systems Data Archived: Entire Crediting Period + 2 years
Any comment:	If measurements are made, the CO_2 emission factor will be determined for each fuel delivery, from which weighted average annual values should be calculated if measurement. If the IPCC values are used then any future revision of the IPCC Guidelines will be taken into account.

Data / Parameter:	$EF_{CO2,gn,y}$
Data unit:	tCO_2/GJ
Description:	Weighted average CO_2 emission factor for groundnut shells during year *y*
Source of data to be used:	According to ACM0003, $EF_{CO2,k,y}$ is zero for the following alternative fuels: - Biomass residues;
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0
Description of measurement methods and procedures to be applied:	-
QA/QC procedures to be applied:	-
Any comment:	In case of biomass residues it is assumed that CO_2 emissions from surplus biomass residues do not lead to changes of carbon pools in the LULUCF sector and that the biomass residues are available in surplus. If this condition is not met any more during the crediting period, CO_2 emissions are taken into account by applying a leakage penalty (see leakage section)

Data / Parameter:	$EF_{CO2,rh,y}$
Data unit:	tCO_2/GJ
Description:	Weighted average CO_2 emission factor for rice husk during year *y*
Source of data to be used:	According to ACM0003, $EF_{CO2,k,y}$ is zero for the following alternative fuels: - Biomass residues;
Value of data applied for the purpose of calculating expected emission reductions in	0

section B.5	
Description of measurement methods and procedures to be applied:	-
QA/QC procedures to be applied:	-
Any comment:	In case of biomass residues it is assumed that CO_2 emissions from surplus biomass residues do not lead to changes of carbon pools in the LULUCF sector and that the biomass residues are available in surplus. If this condition is not met any more during the crediting period, CO_2 emissions are taken into account by applying a leakage penalty (see leakage section)

Data / Parameter:	$EF_{CO2,cn,y}$
Data unit:	tCO_2/GJ
Description:	Weighted average CO_2 emission factor for cashew nuts during year *y*
Source of data to be used:	According to ACM0003, $EF_{CO2,k,y}$ is zero for the following alternative fuels: - Biomass residues;
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0
Description of measurement methods and procedures to be applied:	-
QA/QC procedures to be applied:	-
Any comment:	In case of biomass residues it is assumed that CO_2 emissions from surplus biomass residues do not lead to changes of carbon pools in the LULUCF sector and that the biomass residues are available in surplus. If this condition is not met any more during the crediting period, CO_2 emissions are taken into account by applying a leakage penalty (see leakage section)

Data / Parameter:	$EF_{CO2,cs,y}$
Data unit:	tCO_2/GJ
Description:	Weighted average CO_2 emission factor for cotton shells and stems during year *y*
Source of data to be used:	According to ACM0003, $EF_{CO2,k,y}$ is zero for the following alternative fuels: - Biomass residues;
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0
Description of measurement methods and procedures to be	-

applied:	
QA/QC procedures to be applied:	-
Any comment:	In case of biomass residues it is assumed that CO_2 emissions from surplus biomass residues do not lead to changes of carbon pools in the LULUCF sector and that the biomass residues are available in surplus. If this condition is not met any more during the crediting period, CO_2 emissions are taken into account by applying a leakage penalty (see leakage section)

Data / Parameter:	$EF_{CO2,pk,y}$
Data unit:	tCO_2/GJ
Description:	Weighted average CO_2 emission factor for palm kernel shells during year *y*
Source of data to be used:	According to ACM0003, $EF_{CO2,k,y}$ is zero for the following alternative fuels: - Biomass residues;
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0
Description of measurement methods and procedures to be applied:	-
QA/QC procedures to be applied:	-
Any comment:	In case of biomass residues it is assumed that CO_2 emissions from surplus biomass residues do not lead to changes of carbon pools in the LULUCF sector and that the biomass residues are available in surplus. If this condition is not met any more during the crediting period, CO_2 emissions are taken into account by applying a leakage penalty (see leakage section)

Data / Parameter:	$EF_{CO2,j,y}$
Data unit:	tCO_2/GJ
Description:	Weighted average CO_2 emission factor for Jatropha fruits during year *y*
Source of data to be used:	According to ACM0003, $EF_{CO2,k,y}$ is zero for the following alternative fuels: - Renewable biomass;
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0
Description of measurement methods and procedures to be applied:	-
QA/QC procedures to be applied:	-
Any comment:	In case of renewable biomass, emissions from the cultivation of the biomass are estimated

	separately ($PE_{BC,y}$).

Data / Parameter:	$NCV_{pc,y}$
Data unit:	GJ/ton
Description:	Weighted average net calorific value of the petcoke during year y.
Source of data to be used:	IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Value of data applied for the purpose of calculating expected emission reductions in section B.5	29.7
Description of measurement methods and procedures to be applied:	IPCC default value is preferred and deemed conservative as no recent value is available from any fuel supplier invoice. Once a year minimum, external analysis or measurements will be provided by the fuel supplier in offers and/or by SOCOCIM laboratory analysis.
QA/QC procedures to be applied:	-
Any comment:	Data used for the *ex-post* calculation of the conservative baseline F3.

Data / Parameter:	$NCV_{c,y}$
Data unit:	GJ/ton
Description:	Weighted average net calorific value of the coal during year y.
Source of data to be used:	IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Value of data applied for the purpose of calculating expected emission reductions in section B.5	24.0
Description of measurement methods and procedures to be applied:	IPCC default value is preferred and deemed conservative as no recent value is available from any fuel supplier invoice. Once a year minimum, external analysis or measurements will be provided by the fuel supplier in offers and/or by SOCOCIM laboratory analysis.
QA/QC procedures to be applied:	Measurements will be undertaken in line with international fuel standards, according to ISO 9001 or similar quality systems Data Archived: Entire Crediting Period + 2 years
Any comment:	If the NCV is obtained for each coal delivery, weighted average annual values will be calculated.

Data / Parameter:	$NCV_{hf,y}$
Data unit:	GJ/ton
Description:	Weighted average net calorific value of the fuel-oil during year y.
Source of data to be used:	IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006

	IPCC Guidelines on National GHG Inventories
Value of data applied for the purpose of calculating expected emission reductions in section B.5	39.8
Description of measurement methods and procedures to be applied:	IPCC default value is preferred and deemed conservative as no recent value is available from any fuel supplier invoice. Once a year minimum, external analysis or measurements will be provided by the fuel supplier in offers and/or by SOCOCIM laboratory analysis.
QA/QC procedures to be applied:	Measurements will be undertaken in line with international fuel standards, according to ISO 9001 or similar quality systems Data Archived: Entire Crediting Period + 2 years
Any comment:	If the NCV is obtained for each heavy fuel delivery, weighted average annual values will be calculated

Data / Parameter:	$NCV_{wo,y}$
Data unit:	GJ/ton
Description:	Weighted average net calorific value of the waste oils during year y.
Source of data to be used:	IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Value of data applied for the purpose of calculating expected emission reductions in section B.5	33.50 (lubricants)
Description of measurement methods and procedures to be applied:	No available value from fuel supplier invoices, however when it becomes available, such value will be preferred during monitoring. Once a year minimum, external analysis or measurements will be provided by the fuel supplier in offers and/or by SOCOCIM laboratory analysis.
QA/QC procedures to be applied:	Measurements will be undertaken in line with international fuel standards, according to ISO 9001 or similar quality systems Data Archived: Entire Crediting Period + 2 years
Any comment:	If the NCV is obtained for each waste oils delivery, weighted average annual values will be calculated

Data / Parameter:	$NCV_{i,y}$
Data unit:	GJ/ton
Description:	Weighted average net calorific value of the Jatropha fruits during year y.
Source of data to be used:	Values provided by the fuel supplier in offers and/or by SOCOCIM laboratory analysis. Once a year, external analysis and measurements will be provided.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	21.043

Description of measurement methods and procedures to be applied:	Measurements are undertaken in line with international standards.
QA/QC procedures to be applied:	According to ISO 9001 or similar quality systems Data Archived: Entire Crediting Period + 2 years
Any comment:	The NCV will be measured by SOCOCIM Industries for each Jatropha delivery, from which weighted average annual values should be calculated

Data / Parameter:	$NCV_{gn,y}$
Data unit:	GJ/ton
Description:	Weighted average net calorific value of the groundnut shells during year y.
Source of data to be used:	Values provided by the fuel supplier in offers and/or by SOCOCIM laboratory analysis. Once a year, external analysis and measurements will be provided.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	16.416
Description of measurement methods and procedures to be applied:	Measurements are undertaken in line with international standards.
QA/QC procedures to be applied:	According to ISO 9001 or similar quality systems Data Archived: Entire Crediting Period + 2 years
Any comment:	The NCV will be measured by SOCOCIM Industries for each groundnut shells delivery, from which weighted average annual values should be calculated

Data / Parameter:	$NCV_{rh,y}$
Data unit:	GJ/ton
Description:	Weighted average net calorific value of the rice husk during year y.
Source of data to be used:	Values provided by the fuel supplier in offers and/or by SOCOCIM laboratory analysis. Once a year, external analysis and measurements will be provided.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	12.560
Description of measurement methods and procedures to be applied:	Measurements are undertaken in line with international standards.
QA/QC procedures to be applied:	According to ISO 9001 or similar quality systems Data Archived: Entire Crediting Period + 2 years
Any comment:	The NCV will be measured by SOCOCIM Industries for each rice husk delivery, from which weighted average annual values should be calculated

Data / Parameter:	$NCV_{cn,y}$
Data unit:	GJ/ton
Description:	Weighted average net calorific value of the cashew nuts during year y.
Source of data to be used:	Values provided by the fuel supplier in offers and/or by SOCOCIM laboratory analysis. Once a year, external analysis and measurements will be provided.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	20.097
Description of measurement methods and procedures to be applied:	Measurements are undertaken in line with international standards.
QA/QC procedures to be applied:	According to ISO 9001 or similar quality systems Data Archived: Entire Crediting Period + 2 years
Any comment:	The NCV will be measured by SOCOCIM Industries for each cashew nuts delivery, from which weighted average annual values should be calculated.

Data / Parameter:	$NCV_{cs,y}$
Data unit:	GJ/ton
Description:	Weighted average net calorific value of the cotton stems and shells during year y.
Source of data to be used:	Values provided by the fuel supplier in offers and/or by SOCOCIM laboratory analysis. Once a year, external analysis and measurements will be provided.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	16.747
Description of measurement methods and procedures to be applied:	Measurements are undertaken in line with international fuel standards.
QA/QC procedures to be applied:	According to ISO 9001 or similar quality systems Data Archived: Entire Crediting Period + 2 years
Any comment:	The NCV will be measured by SOCOCIM Industries for each cotton stems and shells delivery, from which weighted average annual values should be calculated.

Data / Parameter:	$NCV_{pk,y}$
Data unit:	GJ/ton
Description:	Weighted average net calorific value of the palm kernel shells during year y.
Source of data to be used:	Values provided by the fuel supplier in offers and/or by SOCOCIM laboratory analysis. Once a year, external analysis and measurements will be provided.
Value of data applied for the purpose of	19.678

calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	Measurements are undertaken in line with international fuel standards.
QA/QC procedures to be applied:	According to ISO 9001 or similar quality systems Data Archived: Entire Crediting Period + 2 years
Any comment:	The NCV will be measured by SOCOCIM Industries for each palm kernel shells delivery, from which weighted average annual values should be calculated.

Data / Parameter:	$P_{clinker,y}$
Data unit:	ton
Description:	Clinker production during year y.
Source of data to be used:	Cement plant data logs
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1,234,000
Description of measurement methods and procedures to be applied:	Instrument used: Weighing feeders. The clinker production standard of both kilns is estimated to 0.61. This standard is verified at least one's a year for every kiln by Standard production weighting operation related to SOCOCIM manufacturing procedures Data Archived: 2 years after the end of crediting period Monitoring frequency: Recorded daily and reported monthly.
QA/QC procedures to be applied:	Instrument should be calibrated regularly according to manufacturer's guidelines.
Any comment:	For the purpose of cross-checking, clinker production is calculated based on the raw meal consumption and raw meal to clinker conversion factor. SOCOCIM Industries has in house procedure for periodic verification of the factor and calibration of the weighing feeders.

Data / Parameter:	N_y
Data unit:	Count
Description:	Number of truck trips during the year *y*
Source of data to be used:	$\frac{\sum_k AF_{T,k,y}}{TL_y}$

Value of data applied for the purpose of calculating expected emission reductions in section B.5

Year	N_y
01/03/2012 to 28/02/2013	1349
01/03/2013 to 28/02/2014	1758
01/03/2014 to 28/02/2015	2776
01/03/2015 to 29/02/2016	4396

	01/03/2016 to 28/02/2017	6217	
	01/03/2017 to 28/02/2018	7438	
	01/03/2018 to 28/02/2019	8040	
Description of measurement methods and procedures to be applied:	Aggregated from $AF_{T,k,y}$ and TL_y		
QA/QC procedures to be applied:	Check of the consistency of the number of truck trips with the quantity of biomass combusted, e.g. by the relation with previous years		
Any comment:	-		

Data / Parameter:	$AVD_{k,y}$
Data unit:	km
Description:	Average round trip distance from the Jatropha plantations and biomass residues collection points to the SOCOCIM Industries cement plant during the year *y*
Source of data to be used:	Transportation data logs
Value of data applied for the purpose of calculating expected emission reductions in section B.5	300
Description of measurement methods and procedures to be applied:	Continuously monitored
QA/QC procedures to be applied:	Check consistency of distance records provided by the truckers by comparing recorded distances with other sources (e.g. maps).
Any comment:	The average transportation distance is conservatively taken as 300km as the radius of biomass collection is expected at 150km maximum.

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:	Calculate CO_2 emissions from fuel consumption by multiplying with appropriate net calorific values and CO_2 emission factors. For net calorific values and CO_2 emission factors, use reliable national default values or, if not available, (country-specific) IPCC default values. Alternatively, choose emission factors applicable for the truck types used from the literature in a conservative manner (i.e. the higher end within a plausible range).
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.001135
Description of	This measurement will be done at least annually following a well described

measurement methods and procedures to be applied:	procedure
QA/QC procedures to be applied:	Cross-check measurement results with emission factors referred to in the literature.
Any comment:	-

Data / Parameter:	$AF_{T,k,y}$
Data unit:	Tons
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 project participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	**Year** / $AF_{T,k,y}$ 01/03/2012 to 28/02/2013: 13,490 01/03/2013 to 28/02/2014: 17,579 01/03/2014 to 28/02/2015: 27,764 01/03/2015 to 29/02/2016: 43,956 01/03/2016 to 28/02/2017: 62,170 01/03/2017 to 28/02/2018: 74,384 01/03/2018 to 28/02/2019: 80,400
Description of measurement methods and procedures to be applied:	A weighing bridge will be used.Recorded continuously and reported monthly and adjusted according to stock change
QA/QC procedures to be applied:	According to ISO 9000 or similar quality systems
Any comment:	-

Data / Parameter:	TLy
Data unit:	Tons
Description:	Average truck load of the trucks used during the year y
Source of data to be used:	Transportation data logs.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	10
Description of measurement methods and procedures to be applied:	Monitored continuously
QA/QC procedures to be applied:	-
Any comment:	Applicable if Option 1 is chosen to estimate CO2 emissions from transportation.

	Project participants have to monitor either the number of truck trips Ny or this parameter

Data / Parameter:	$FC_{plantation,y}$
Data unit:	Tons
Description:	Quantity of diesel used in the project plantations during year *y*
Source of data to be used:	Measurements in the project plantations
Value of data applied for the purpose of calculating expected emission reductions in section B.5	**Year** / $FC_{plantation,y}$ 01/03/2012 to 28/02/2013: 327.71 01/03/2013 to 28/02/2014: 394.34 01/03/2014 to 28/02/2015: 394.34 01/03/2015 to 29/02/2016: 329.51 01/03/2016 to 28/02/2017: 0.00 01/03/2017 to 28/02/2018: 0.00 01/03/2018 to 28/02/2019: 0.00
Description of measurement methods and procedures to be applied:	A flow meter totalizer will be utilized for continuous monitoring. The consistency of metered diesel consumption quantities will be crosschecked by an annual mass balance that is based on quantities provided to the plantations and stock changes. The purchased diesel invoices from the financial records will be used to cross-check the metered diesel consumption quantities.
QA/QC procedures to be applied:	Instrument will be calibrated regularly according to manufacturer's guidelines.
Any comment:	The value applied ex-ante is a conservative estimation based on measurements performed during the pilot plantation phase at Pout (150 L/ha planted (one-time).

Data / Parameter:	$NCV_{diesel,y}$
Data unit:	GJ/ton
Description:	Weighted average net calorific value of diesel during year y.
Source of data to be used:	Values provided by the fuel supplier in invoices
Value of data applied for the purpose of calculating expected emission reductions in section B.5	43.3
Description of measurement methods and procedures to be applied:	Measurements are undertaken in line with international fuel standards.
QA/QC procedures to be applied:	According to ISO 9001 or similar quality systems Data Archived: Entire Crediting Period + 2 years
Any comment:	The NCV will be obtained for each diesel delivery, from which weighted average annual values should be calculated

Data / Parameter:	$EF_{CO2,diesel,y}$
Data unit:	tCO_2/GJ
Description:	Weighted average CO_2 emission factor for diesel during year *y*
Source of data to be used:	Measurements by the project participants or use of the IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.0748
Description of measurement methods and procedures to be applied:	In case during year y SOCOCIM Industries can undertake the measurement locally in line with international fuel standards, the measurement will be the option otherwise the IPCC guidelines will be used.
QA/QC procedures to be applied:	According to ISO 9001 or similar quality systems Data Archived: Entire Crediting Period + 2 years
Any comment:	If measurements are made, the CO_2 emission factor will be determined for each diesel delivery, from which weighted average annual values should be calculated. If the IPCC values are used then any future revision of the IPCC Guidelines will be taken into account.

Data / Parameter:	Gasoil density
Data unit:	ton / Liter
Description:	Density of the gasoil used for the transportation vehicles in the project activity
Source of data to be used:	Values provided by an independent laboratory after measurements on SOCOCIM fuel delivery batch
Value of data applied for the purpose of calculating expected emission reductions in section B.5:	0.0008763
Description of measurement methods and procedures to be applied:	This is the preferred source. It will be updated annually by the consolidate average from the supplier.
QA/QC procedures to be applied:	-
Any comment:	-

Data / Parameter:	$EF_{CO2,BL,y}$
Data unit:	tCO_2/GJ
Description:	Carbon dioxide emissions factor for the coal displaced by the use of Jatropha and biomass residues in the SOCOCIM Industries cement 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 F3 has been determined as the most likely baseline scenario: the weighted average annual CO2 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:	0.0864
Description of measurement methods and procedures to be applied:	Continuously, aggregated at least annually In case during year y SOCOCIM Industries can undertake the measurement locally in line with international fuel standards, the measurement will be the option otherwise the IPCC guidelines will be used.
QA/QC procedures to be applied:	-
Any comment:	-

Data / Parameter:	$F_{ON,y}$
Data unit:	tons of nitrogen per year
Description:	Amount of organic fertilizer nitrogen from animal manure, sewage, compost or other organic amendments applied at the dedicated plantation during the year *y*
Source of data to be used:	On-site records and measurements
Value of data applied for the purpose of calculating expected emission reductions in section B.5:	**Year** / **$F_{ON,y}$** 01/03/2012 to 28/02/2013 — 11,219 01/03/2013 to 28/02/2014 — 13,500 01/03/2014 to 28/02/2015 — 13,500 01/03/2015 to 29/02/2016 — 11,281 01/03/2016 to 28/02/2017 — 0,000 01/03/2017 to 28/02/2018 — 0,000 01/03/2018 to 28/02/2019 — 0,000
Description of measurement methods and procedures to be applied:	Where applicable, measure the quantities and nitrogen content of any animal manure, sewage, compost or other organic amendments applied as fertilizers to the dedicated plantation. Quantities of organic fertilizer: Continuously Nitrogen content: Regularly by sample measurements
QA/QC procedures to be applied:	-
Any comment:	Only initial manual incorporation of a very small quantity of organic fertilizer is foreseen (150 kg of organic fertilizer per ha, based on vegetal waste compost nearby each young plant)

Data / Parameter:	$F_{SN,f,y}$
Data unit:	kg fertilizer/year
Description:	Amount of synthetic fertilizer of type *f* applied in year *y*
Source of data to be used:	On-site records by project participants
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:	Continuously
QA/QC procedures to be applied:	Cross-check records of applied quantities with purchase receipts
Any comment:	No synthetic fertilizers are foreseen to be used in the Project activity

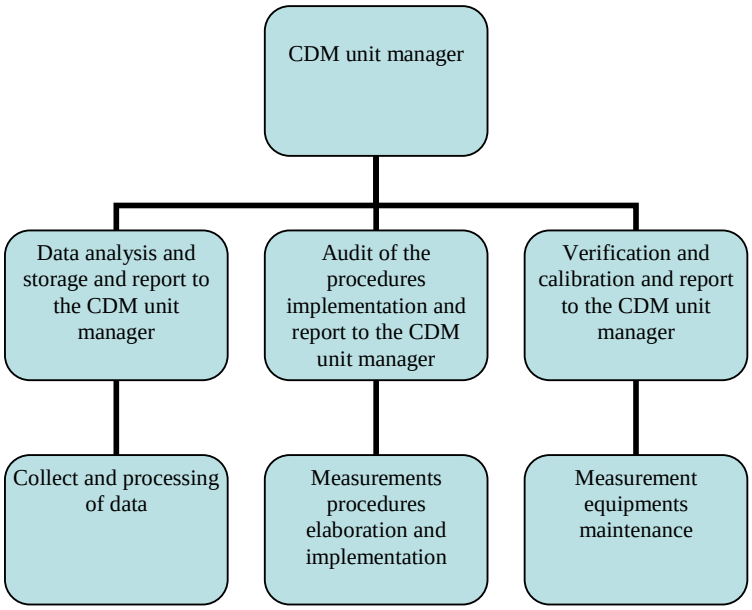
Data / Parameter:	$FC_{utilized,y}$
Data unit:	Tons
Description:	Quantity of biomass residues of type *k* that are utilized (e.g. for energy generation or as feedstock) in the defined geographical region (region covering a radius of 150 km around the project activity)
Source of data to be used:	Surveys 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:	Annually
QA/QC procedures to be applied:	-
Any comment:	Monitoring of this parameter is applicable if approach L_2 is used to rule out leakage. The biomass supply and demand will be monitored if new markets have emerged and leakage will be ignored only if there is an abundant surplus of biomass (availability 25% higher than utilization). Otherwise, a leakage penalty will be applied to the type of biomass residues for which it cannot be demonstrated that its use by the project does not result in leakage.

Data / Parameter:	$FC_{available,y}$
Data unit:	Tons

Description:	Quantity of available biomass residues of type *k* in the region (region covering a radius of 150 km around the project activity)
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:	Annually
QA/QC proceduresv:	-
Any comment:	Monitoring of this parameter is applicable if approach L_2 is used to rule out leakage The biomass supply and demand will be monitored if new markets have emerged and leakage will be ignored only if there is an abundant surplus of biomass (availability 25% higher than utilization). Otherwise, a leakage penalty will be applied to the type of biomass residues for which it cannot be demonstrated that its use by the project does not result in leakage.

B.7.2 Description of the monitoring plan:

Emission monitoring and calculation procedure will follow the following organizational structure:



Monitoring and calculation activities	Procedure and responsibility
Data source and collection	Data is taken from the purchase, materials and accounting system. Most of the data is available in ISO 9001 quality management system.
Frequency	Monitoring frequency will be set as per ACM0003.
Review	All received data is reviewed by the department in charge of the monitoring of the cement plant parameters.
Data compilation	All the data is compiled and stored in CDM unit.
Emission calculation	Emission reduction calculations will be done annually based on the data collected. Engineers of production/ R & D department will do the calculations.
Review	The manager of the CDM unit will review the calculation and elaborate the monitoring report.
Emission data review	Final draft of the monitoring report is reviewed and approved by the cement plant manager.
Record keeping	All calculation and data record will be kept within the CDM unit for all the crediting period and two years after the crediting period.

Please refer to Annex 4 for detailed monitoring procedures.

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

Baseline study and monitoring methodology completion date: 25 November 2010

Responsible persons:

- Moctar DIAW for SOCOCIM Industries (see Annex 1)
- Aurélie Lepage and Alexandre Dunod for ecosur afrique

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

01/07/2007; as determined above in section B.5 in accordance with the *Glossary of CDM terms.*

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

Lifespan of Jatropha plantations: approximately 50 years (600 months). The equipment to be installed in the cement plant will have a lifetime above 25 years (300 months). The existing kiln lines n°3 and n°4 will be kept operational for more than 25 years (300 months) from now.

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:

01/03/2012, or on the date of registration of the CDM project, whichever is the latest.

C.2.1.2. Length of the first crediting period:

7 years (84 months)

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Not applicable.

C.2.2.2. Length:

Not applicable.

SECTION D. Environmental impacts

SOCOCIM Industries as a cement manufacturer has to meet all environmental laws and regulations which are applicable in Senegal for the exploitation of its quarries and the operation of its cement plant. Since the takeover of SOCOCIM Industries in 1999 by the French cement group VICAT, major investment programs have been carried out to reduce its environmental impact on the air (NOx, sulfur and dusts), the soils, and the water resources. SOCOCIM Industries management has also made special efforts to reduce impacts of cement plant on the inhabitants of Rufisque (dust, noise, security, vegetation regeneration, creation of artificial lakes, etc.) through a continuous dialogue with local authorities and trade unions.

An action program for environment is under implementation. This program has been validated end 2007 by the Senegalese government and the Prefect of Rufisque, as representative of the government, is ensuring quarterly field visits to check its progress and report it to the Ministry. The SOCOCIM Industries action program is covering in particular the following components:

- reduction of cement dusts on the soil through concrete flooring,
- green spaces and plantations,
- watering of transport lanes,
- purchase of a special vacuum cleaning truck for dust collection,
- improvement of truck parking,
- new access road to reduce traffic in Rufisque town,
- creation of 3 artificial lakes,
- dust control investment in cement workshops,

- installation of electro filters and bag filters on furnace chimneys,
- installation of new production lines with higher energy efficiency and reduced air pollution and noise.

The project activity will generate important additional benefits on the environment at local level through the regeneration of about 11,000 ha of eroded marginal soils and its associated benefits.

The additional incomes generated in the rural areas by this Jatropha culture will limit the over exploitation of existing soils used for food and cash crops and cattle grazing. Indeed, the "green belts" made from dedicated Jatropha plantations will contribute to restore local environment in areas severely touched by climate change.

At cement plant level, the project activity will result in a major reduction of greenhouse gas (about 2million CO_2 tons over 21 years) issued from coal combustion taking into account the fact that its consumption will be reduced thanks to the use of alternative fuels (approximately 40% substitution rate).

More generally this project activity is playing a pioneer role in the new Senegalese government environment and energy policy [78] to demonstrate that it is possible to use widely local renewable resources while reducing dependence on energy imports. The project activity, with the CDM incentive, will contribute to convince other industries that such conversions are feasible and interesting for the country as well as for the developers.

The following table summarizes the different impacts of the project activity. As it appears, the negative impacts are limited and can be alleviated by relevant initiatives.

A detailed Environmental Impact Analysis on the cultivation of 11,000 ha of Jatropha has been carried out in 2009 at the request of the Ministry of Environment[79]. See D.2 for details on its results.

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

Jatropha plantations

	Negative impact	No significant impact	Positive impact
Biodiversity			Jatropha plantation will be carried out on poor land, with little or no fauna and flora.
GHG emissions			Very positive thanks to carbon storage (Jatropha trees and fruits)
Rainwater retention			Better assimilation and retention of rainwater in the ground water
Soil quality			The soil quality will be improved with Jatropha plantations

[78] As explained and justified previously, the project activity is strongly supported by the Senegalese government taking into account the fact that it is fully in line with its new policy on energy and environment.

[79] See Document 11: *« Projet de Cultures Industrielles Jatropha pour une utilisation de bio combustibles en substitution au charbon importé à SOCOCIM INDUSTRIES, **Evaluation Environnementale Stratégique**, (EES)* » Mme Gertrude COULIBALY & Al Assane SENE, Janvier 2010.

Toxicity		Jatropha leaves and latex are toxic for humans and animals if eaten. But no impact on the environment.	
Visual impact			Poor land will be revegetalised on a sustainable basis
Water consumption		No existing irrigation system deviation	
Water pollution		No chemicals used for the culture (only organic fertilizers, pesticides…)	

In accordance with the Senegalese legislation (Law n°2001-01 dated 15th January 2001 related to the Environment Code – Section I : Classified installations for environment protection), an environmental impact study has to be carried out for each plantation over 1,000 hectares, and an environmental analysis will be carried out for smaller plantations.

Jatropha storage

	Negative impact	No significant impact	Positive impact
Fire	The risk is real. No storage of big quantities; fruits will be isolated and widely spread out.		
GHG emissions		No GHG emissions since the storage will avoid fermentation	
Odor		The Jatropha fruits doesn't smell if not fermented	
Toxicity		Jatropha fruits are toxic for humans and animals if eaten. But no impact on the environment.	
Visual impact		Existing storage centers (used for groundnuts for example) will be used in priority.	
Water pollution		Little leakage since the storage areas will be covered during rainy season. Anyway, leakage is non toxic.	

Transport scheme

	Negative impact	No significant impact	Positive impact
GHG emissions	GHG emissions due to heavy load trucks		
Noise	Additional noise along the roads due to heavy load trucks		
Traffic	Increase of traffic,	Return trips of cement deliveries will	

	especially close to the cement plant, due to Jatropha deliveries.	be used to transport Jatropha fruits to the cement plant, reducing significantly the impact of transport.	

In order to reduce transport, Jatropha plantation sites will be chosen preferentially in the proximity of the cement plant.

The above table doesn't take into account the positive impacts related to the transport of smaller quantities of coal to the cement plant: extraction of coal (South Africa), train or heavy load truck transportation to harbor, transport by ship to Dakar, heavy load truck to Rufisque cement plant.

Cement plant

	Negative impact	**No significant impact**	**Positive impact**
CO_2 emissions			Very positive thanks to substitution to fossil fuels
VOC emissions			Jatropha fruits contain less volatile matter than charcoal
Electric energy consumption			Less charcoal grinding thanks to the use of Jatropha fruits
Fire		The Jatropha storage in the cement plant is not more likely to burn than the coal storage. The cement plant will apply to the Jatropha storage the existing self ignition prevention procedures.	
Noise		No additional noise in the cement plant	
Odor		The Jatropha fruits doesn't smell if not fermented	
SO_2 emissions			Reduction of SO_2 emissions
Visual impact		Not significant (storage and feeding systems will be integrated in existing buildings)	
Water pollution		The leakages of the Jatropha storage will be treated the same way as the more pollutant leakages of the coal storage	

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:

In compliance with government rules and regulations related to the Environment, a Strategic Environmental Assessment (SEA)[80] of this Jatropha industrial cultures project, whose plantations are scheduled in a radius of 150 km around SOCOCIM factory in Rufisque, has been carried out in 2009 by

[80] See Documents 19 and 19a: *Final Strategic Environmental Assessment on Jatropha cultivation Jan 2010 and English translation of its Introduction and Conclusion*.

an independent consultant. It aimed at (i) identifying clearly, what in the project activities is likely to cause an environmental impact so as to determine the potential significant effects on the environment, (ii) envisaging measures to avoid, reduce and, as much as possible, compensate any significant negative impact in the implementation of the project on the environment, (iii) proposing a mechanism for the monitoring of impacts of program's measures so as to be able to take corrective actions.

The methodology used in the framework of this study was based on a participatory approach, in consultation with all the stakeholders and partners concerned by the project, namely SOCOCIM, producers' organizations, pubic technical services, (central, decentralized), local communities and some potential beneficiaries. Furthermore, the study has singled out an approach hinged on: (i) collection and analysis of the projects documents and other strategic and planning documents; and (ii) meetings with institutional stakeholders mainly concerned by the project. Moreover, the consultant formed his judgment based on the operational policy of the World Bank relating to the environmental assessment procedures (O.P.4.01) as well as policies and legal documents in Senegal that are relevant to the project.

The conclusions of the SEA are:

"In the light of the overall negligible aspect of the negative impacts and the importance of the positive effects that could be engendered by the project in its intervention zones and on the basis of the impact assessment, one can infer that the social environmental feasibility of the project is still very appreciable in terms of sustainability. In fact, this project sponsored by SOCOCIM Industries has several environmental and social gains which make its peculiarity. On the one hand, it is likely to increase the country's energy independence, in compliance with the Senegalese government policy which aims at diversifying the energy sources.

Furthermore, the project allows a very significant increase of income for poor populations mainly in these intervention zones. This impact which we have called induced effect is therefore particularly important in the current context of the country where the agricultural economy is faced with many constraints among which the degradation of lands (Jatropha culture could help in the regeneration and/or recovery of degraded lands). Finally, this is a project whose aim is to produce energy by using renewable sources of energy, therefore whose direct emissions are null.

In a nutshell, the project is really like a structuring program for a balanced and sustainable socio economic development for Senegal, in the sense that it will contribute to the implementation of a true promotion strategy of the "*pourghère*" plant which help mainly in the reduction of plant cover pressure, environment protection, foreign currency saving in imports of petroleum products, an improvement of income of the populations living in the production sites, in particular the young, the unemployed, etc.
It is also structuring, technically, economically as the area necessary for the culture of jatropha (11,000 ha of land) can be easily mobilized on a radius of 150 km around the factory located in Rufisque. This possibility justifies several factors analyzed in this document. "

The SEA recommendations are:
"In the prospect of optimization of the positive impact of the project and with a view of minimizing residual negative impacts which the project might engender, it seems necessary to (i) strengthen the involvement of populations so as to ensure that the most vulnerable social groups are not excluded from the project mainly new opportunities created by the project, (ii) involve stakeholders from the agricultural sector in the formulation and the implementation of the project activities, their access to

information, so as to ensure their social responsibility in the implementation/ execution; (iii) increase food security by minimizing social risk associated with the project."

On 25th January 2010, a technical Committee placed under the Ministry of Environment, Directorate of Environment and Listed Establishments, has approved the SEA report through a letter[81] dated 29th January 2010 signed by the Director of Environment and Listed Establishments.

SECTION E. Stakeholders' comments

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

SOCOCIM Industries, right from the beginning of the activity, has conducted an in-depth dialogue with local stakeholders through meetings, presentations, field visits, interviews, etc. at all levels of the Senegalese society. In particular the following local stakeholders were associated:

- Local rural communities within the perimeter of the project,
- Mayors and representatives of related towns (Rufisque, Bargny…), regions, communities and villages
- Traditional and religious authorities of the region,
- Senior officers from relevant Ministries (environment, industry, energy, biofuels, local communities, interior),
- Experts from national agriculture and forestry research institutes (ISRA, IRD, PROGEDE…),
- NGO organizations (ENDA, CONGAD…),
- International cooperation organizations involved in rural development (AFD, GTZ, USAID…).

In addition, the project was visited on 14th December 2007 by the President of Senegal, his Excellence Maître Abdoulaye Wade, who strongly supports with his government [82] the development of local bioenergy and considers SOCOCIM's Jatropha project as an example of its new sustainable energy policy.

To facilitate the dialogue with local stakeholders, SOCOCIM Industries has developed different tools to present the project activity to the local stakeholders: PowerPoint presentations, video, theatre play, presentation of samples of Jatropha fruits, visits of the Jatropha nursery and experimental plantations, articles in the local papers.

On 11th July 2008 from 9 am to 14 pm, a large stakeholder consultation meeting was jointly organized by the "*Comité National sur les Changements Climatiques*" upon request of the DNA of Senegal and SOCOCIM Industries.

The aim of this meeting was to provide detailed information on the proposed CDM activity and to obtain questions, comments and recommendations on the implementation of this project activity. The meeting was attended by 84 participants including two regional governors (Kaolack and Fatick) and two senior

[81] See Document 19b and 19c: *SEA Government validation letter* and *English translation*, dated 29th January 2010.
[82] See Document o2a and 02b: Letters of support to the Jatropha project from Senior Minister of Interior dated 26th September 2007 and Minister of Local Communities dated 6th June 2009.

representatives of the governors of Saint Louis and Dakar, four prefects (Fatick, Bambey, Diourbel, Nioro du Rip) and four representatives of prefects (Kaffrine, Mbour, Mbacké and Thiès), nine Presidents of Rural Communities (Diender, Réfane, Pire Goureye, Taïba Niassene, Nbiebel, Mont Rolland, Gawane, Ngaye Khome, and Niakhene), farm owners, representatives of agricultural and development research institutes, NGO representatives active in rural development, representatives of local and national financial institutions, senior officers of ministries, representatives of embassies and journalists from the press, radio and TV.

The stakeholder consultation meeting was introduced by Mr Aly LO, President of the "*Association Nationale des Conseils Ruraux du Sénégal*", Mrs Codou MAR DIOP from Ministry of Environment, Mr Marc LEISING Managing Director of SOCOCIM Industries and Mr Moctar DIAW Director of Environment at SOCOCIM Industries. Following these introductory speeches, various contributions were submitted to the organizers by the participants through comments, recommendations and questions.

The comments by participants have been laid down on special sheets and collected by organizers to provide later, if necessary, clarifications on some of the points raised during the presentations. A detailed report of the meeting with all presentations, questions and answers and the written comments of participants has been established complemented by a CD recording of the stakeholder consultation. All these documents (see list in Annex 5) are available for the designated operational entity experts.

E.2.	**Summary of the comments received:**

Globally, the comments of the participants were the following:

- The participants welcome the SOCOCIM Industries initiative as the first private company in Senegal to enter into the CDM process,
- The participants recognize the opportunity and pertinence of this Jatropha project in a world environment facing a critical energy crisis particularly severe for developing countries like Senegal where rising oil imports are weakening the economy,
- The participants, and in particular, the representatives of rural populations (governors, prefects and presidents of rural communities) have stressed the positive impact of the project on local development through the cultivation of new surfaces uncultivated so far due to their degradation,
- The participants expect that this project will play a catalyst role for other private developers in the rural sector,
- Several participants have stressed the importance of a rapid project implementation to improve rural incomes in related regions.

Regarding the questions and preoccupations raised by participants, they were mainly related to:

- The relation between the SOCOCIM Jatropha project and the national biofuel program,
- The mode and organization of the partnership between SOCOCIM Industries and Jatropha producers as well as the role of local communities in the institutional framework which will be set up,

- The need to raise awareness amid local populations through sessions of the « *Conseils Départementaux de Développement* » (CDD) and of the « *Conseils Régionaux de Développement*" (CRD),
- The motivation of producers to start this new culture taking into account its anticipated price,
- The arbitration mode between soil allocation for food crops and bioenergy,
- The limitation to a 150 km radius for Jatropha cultivation for SOCOCIM,
- The eligibility criteria of Jatropha producers according to the "Cultivation Charter" prepared by SOCOCIM,
- The need to closely associate the agricultural research center ISRA in the selection of Jatropha seeds and to avoid contamination by other crops,
- The reason why forestry was not taken into account in the PDD,
- The status of financing of the whole project and the possibility to use local banking,
- The impact of the project on cement prices.

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

Detailed answers to the above questions were given by Mr Mbaye DIAGNE of the "*Comité National sur les Changements Climatiques"* and Mr Marc LEISING and Moctar DIAW of SOCOCIM Industries.

The main answers were the following:

- SOCOCIM Industries has already established contacts with the ministry in charge of local communities, the ministry of agriculture and the ministry of renewable energy and biofuels. Drafts partnership agreements are under preparation with these entities as well as with the "*Programme National Biocarburants*", in order to ensure that this Jatropha project is in synergy with the national Jatropha development policy,
- SOCOCIM Industries prepares the implementation of a relevant structure which will play as an interface with all entities involved in Jatropha: producers, donors, institutional and socio-economic partners. The framework of this structure is illustrated in the project presentation. The rural communities being the legal entities in charge of soil allocations, SOCOCIM Industries will establish close relations with them for the selection of allocated surfaces, the organization of populations and socio-professional entities and all other actors involved in agriculture,
- Other meetings with local stakeholders are planned at regional levels in the prefectures and rural communities preselected for Jatropha cultivation in association with the "*Conseils Régionaux et Départementaux de Développement*",
- SOCOCIM Industries confirmed that the Jatropha cultivation must provide additional incomes to rural populations. This additional income by hectare is presently estimated in average at 60% of the income provided by groundnut cultivation. The comparison is about the same for tomato growers in the Senegal valley,
- The Cultivation Charter applicable to Jatropha producers selling to SOCOCIM industries ("*Charte applicable aux producteurs de jatropha approvisionnant en exclusivité la cimenterie de Rufisque*") is necessary to ensure CDM additionality and avoid diversion from food cultivation and deforestation,

- The 150 km maximum radius for Jatropha dedicated cultivation is defined to limit transport costs and CO_2 emissions,
- The forestry project component will need another CDM methodology. The project activity follows the ACM0003 approved methodology,
- Project financing is open to donors and local financing institutions. Project financial closure has not yet been reached,
- Cement price of SOCOCIM is the lowest of the sub-region. The CDM activity, through the sale of CER, will contribute to its stabilization and reduce energy imports.

Following a question from a participant regarding the Jatropha production during the first years, SOCOCIM Industries agreed to revise downward its estimates on the Jatropha substitution to reflect this transitional period.

SOCOCIM Industries confirmed at the end of the meeting that, by using the dedicated forms filled by participants during the meeting (available on request), it will remain in contact with them and will reply by mail to their questions and interrogations.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	SOCOCIM Industries
Street/P.O.Box:	B.P. 29
City:	RUFISQUE
State/Region:	Région de Dakar
Postfix/ZIP:	
Country:	Senegal
Telephone:	00 221 33 839 88 88
FAX:	00 221 33 836 09 81
URL:	
Represented by:	Moctar DIAW
Title:	Environmental Director
Salutation:	Mr.
Last Name:	DIAW
First Name:	Moctar
Department:	
Mobile:	00 221 77 639 90 56
Direct FAX:	00 221 33 836 09 81
Direct tel:	00 221 33 839 88 84
Personal E-Mail:	m.diaw@sococim.sn

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding is involved in the project activity.

Annex 3

BASELINE INFORMATION

No additional information.

Annex 4

MONITORING INFORMATION

- **Sustainable development indicators**

As required by the Strategic Environmental Assessment and described in its chapter 7 "Plan cadre de gestion environnementale et sociale" (Socio-Environmental Management Framework), the following sustainable development indicators will be set up and monitored. The collection and archiving of relevant data will be ensured by the responsible bodies specified for each indicator; consolidation will be done by SOCOCIM Industries and provided to the verifying DOE.

Indicators	Monitoring method	Responsible	Frequency
Waters - Pollution - Eutrophication - Sedimentation - Hydrology	- Inputs utilization procedure watch - Underground and surface waters control near production units - Surface water utilization activities watch - Erosion control measures watch - Water courses and bodies' turbidity control - Sedimentation attenuation measures control	Regional monitoring committee & Independent Consultant, if necessary	Bi-monthly
		Hydraulic Services DRECC	Bi-monthly
Soils - Erosion/ draining - Pollution/degradation	- Salinity prevention measures assessment - Visual assessment of soils erosion control measures	Regional monitoring committee & Independent Consultant, if necessary	Bi-monthly
		DRECC	Bi-monthly
Vegetation/fauna - Degradation rate - Reforesting rate	- Visual assessment of vegetation degradation - Visual assessment of reforesting/replanting measures - Deforesting activities control - Sensitive areas watch and control - Fauna aggressions control	Regional monitoring committee & Independent Consultant, if necessary	Monthly
		DRECC Forestry Services	Bi-monthly
Human environment - Life conditions - Socio-economic activities - Space occupancy - Hygiene and health - Pollution and noises	- Private lands/agricultural fields occupancy control - Historical heritage and sacred sites respect - Control of effects on production sources	Regional monitoring committee & Independent Consultant, if necessary	Monthly
		Technical Services	Bi-monthly
	Verification: - Of the existence of disease vectors and the apparition of water-related diseases - Of various diseases related to the projects (STD/HIV/AIDS,etc.) - Of the respect of on-site hygiene measures - Waste management practices watch	Independent Consultant if necessary	Monthly
		Environmental Focal Point PDMAS Technical Services	Start, mid-term and end of construction

These mandatory indicators will be completed by:

- The annual and cumulated surfaces of poor land rehabilitated through Jatropha plantations;
- The yearly yields of Jatropha fruits per ha;
- The number of persons employed by the Jatropha plantations;
- The incomes distributed upstream to the rural population through the purchase of Jatropha fruits to cooperatives and farmers.

This monitoring will be carried by the operator of the production unit and will be characterized by an environmental monitoring report of the Monitoring Committee comprising regional services (ANCAR, MPD DREEC, DRDR, Brigade Hygiene, and Department of Livestock). This report must state the residual impacts and measures to be implemented to correct them, evaluate their effectiveness.

- **Day-to-day data measuring and reporting procedures**

The accounting procedures for raw materials, intermediate products, finished products and energy consumption in each sector of production of cement SOCOCIM Industries involve the following sources:

- *Electric meters of the factory supplying plant and all motor feeders and workshops of the factory,*
- *Fuels and materials feeders, weight bridge and flow-meters,*

Electricity consumptions

The electric meter readings are done by the electrical service. The meter reading materials and fuels are made by the production services sector.

Frequency:

- The factory supplying plant production meter reading is done on a daily basis at 7:30.
- Motors and workshops electricity meters are read on a monthly basis on the first day of each month.

The electricity reading cards are stored on computer records in a database at the electrical service. They are validated by the Head of Electrical Service.

Fuels and materials production data

In order to know the real situation of the plant operation, two reports are written each month. They are the “production workshops performance report” and the "operation report". Both reports enable to know the operational performances of production workshops and a cumulative analysis is done for performance monitoring, production ratios (kWh/ton), yields and average flows for each workshop. With these data, the plant can know if the workshops had satisfying performances and if the machines have turned to their rated capacity.

Energy balance of the plant

Each end of month, the electrical service sends the monthly electricity reading information to the Chief Industrial Officer. This balance is obtained after operation of two main data:

• The consumption (kWh), obtained through the monthly statement provided. It gives the amount of energy consumed at each workshop during the month. The "production facilities performance chart" includes all data to calculate then the consumption (kWh/ton) at each workshop (quarry, crushing, raw, kilns, cement grinding, bagging ...).

• The tonnage record per workshop, which includes the necessary information about the amount of material consumed during the month. Thus, information on stocks at the beginning and end of the month for each workshop is shown in the "operation table". The cumulative flow is shown in the table and gives the total amount of material output per workshop.

These two points are used to calculate the kWh/ton for each workshop: this corresponds to the energy balance. This review is a good indicator to determine the effectiveness of a particular plant. Indeed, the lower the value expressed in kWh/ton, the better its efficiency. When an abnormality is detected in a workshop, the sector responsible is alerted for intervention and determination of the cause of this discrepancy.

Materials balance

The material balance is a factor that indicates the amount of material consumed in each workshop and its actual energy value. This balance is obtained after operation of:

• The tonnage record per workshop cited above (stocks beginning and end of month, cumulative flow);

• Hours of operation per workshop indicated in the “production facilities performance chart”.

The operating hours for a particular plant as well as the quantity of material used during the month enable to calculate the average throughput per workshop. This is equivalent to the performance of the workshop and corresponds to the material balance for the particular unit. This mass balances are consolidated in the "Operation Report" of the plant, gathering all relevant information about the consumption of materials, inputs and outputs as well as hours of operation of workshops involved.

Fuel balance

The “production facilities performance chart” also provides information on the amount of biomass, fuels and waste oils consumed during the month. Thus can be found in the table the equivalent in NCV, kcal/kg and kg/t of the amount of fuel used in the month.

The values of these different fuel consumptions (Fuel Balance) and the materials tonnage record allow determining the specific consumption (thermies/ton) per workshop. The "production workshops performance report" (kWh/ton or th/ton) is obtained from the specific consumption per workshop.

- **Calibration and control procedures**

The regular calibration of all instruments of the cement plant related to production data (feeding measuring equipment, weighting bridges, etc.) is ensured under the existing Quality System certified ISO 9001 and the CE-NF Standard labeling for all cement sold by SOCOCIM Industries. For instruments out of the cement plant, regular calibration will be ensured under National Trade Regulations and survey conducted by SOCOCIM. Metrology audits of all instruments and working equipment in relation with quality product are regularly carried out internally and with outside specialized services in agreement with the prevailing referential for Certification.

Cement plant electrical devices

The checks and calibrations of measuring equipment are carried out by staff of electrical service. They relate to the electrical equipment which may have a direct impact on product quality and production performances.

The list of production equipments under control (and frequency) by the electrical service is contained in Table ELEC.P01.A1 of the quality manual. This control occurs during outages, untimely and on-demand from manufacturing.

This list is drawn up by the electricity department in collaboration with the Head of Maintenance and the Quality Manager. It is validated by the Plant Manager. It is distributed by the Quality Manager. It is modified by the Head of Manufacturing in case of changes in manufacturing process or changes in the type of material.

The verification of proper operation order and the calibration of production equipment are made by the electrical service staff following the manufacturer's instructions set out in Table ELEC.P01.A1 (replacement of sensors, lever shift ...).

Such checks and calibrations are mastered and adapted to the wear of equipment for which it must be ensured that it remains in conformity with the desired operating conditions. A "life" form (ELEC.P01.A3) is attached to each production equipment under control. These forms allow monitoring of controls and are stored in a binder kept in electrical service department.

An annual schedule of calibration estimate (ELEC.P01.A2) is displayed in the service. The dates may change depending on production requirements (breakdowns, availability of workshops ...). The table includes forecast dates of action for each piece of equipment. The electrical service staff also writes on the form the completion time and date for each control and calibration.

Calibration instructions for each equipment are designed according to the manufacturer's provisions and kept in the binder. The forms also bear the status of equipment before and after each calibration.

Raw materials and fuels

Monitoring and recording of the weight of the products received is done the same way that shipments under instruction EXP.I04. Quality checks are conducted under the guidelines contained in the statement "Controls of raw materials and fuels (LAB.I06), defining in particular the actions to take in case of drift of supplies. Each product is subject to a "Specifications and control raw materials and fuels (LAB.I06.01) form. Records of such inspections shall be filed and archived by computer in a database managed by the Laboratory Manager using specific software in the laboratory.

Thanks to this software, all test results are daily edited on documents (such as LAB.I02.A1 and LAB.I03.A1) including checks of clinker and cement grinding. These documents are validated by endorsement by the Laboratory Manager. If the product is not conform, it is treated following the procedure and form MNGT.P08 and a non-conformity/corrective action is established (MNGT.P08.01). These documents are filed and archived in the laboratory by the Laboratory Manager.

- **Emergency procedures**

SOCOCIM Industries has its own Security Department with fire fighting installations based on a dedicated water network and a 650 m^3 water tank. The cement plant has its Internal Operation Plan regularly tested and a Management System is operational based on three objectives: Quality, Security and Environment, which are aimed at obtaining certifications ISO 14001 in 2010 and OHSAS 18001 for Security in 2011, after ISO 9001 which was obtained in 2009.

Annex 5

LIST OF THE DOCUMENTS RELATED TO THE STAKEHOLDER CONSULTATION

STAKEHOLDER CONSULTATION HELD ON JULY 11, 2008 IN DAKAR

Report on the consultation of the stakeholders of the project « Partial Substitution of Coal by Jatropha Fruits and Biomass Residues in the Production of Portland Cement » held on July 11, 2008 in Dakar by the "*Comité National Sur Les Changements Climatiques* (COMNAC)" and SOCOCIM Industries

Annex 5.A:	Participant attendance sheet
Annex 5.B:	Speech of the representative of the Minister of Environment
Annex 5.C:	Presentation of COMNAC and the Designated National Authority by the President of "*Comité National sur les Changements Climatiques"*
Annex 5.D:	Speech of the Managing Director of SOCOCIM Industries
Annexes 5.E & F:	Presentation of the Jatropha project of SOCOCIM Industries by the Director of Environment of SOCOCIM Industries
Annex 5.G:	Charter applicable to Jatropha producers supplying in exclusivity the Rufisque cement plant of SOCOCIM Industries
Annex 5.H:	Minutes of questions and comments by participants
Annex 5.I:	Form used for questions and comments
Annex 5.J:	Press book = DVD video reporting + photos + articles « Q*uotidien le Soleil* » and economic newsletter «sustainable development and private sector in Senegal »

All these documents, partly in French, are available upon request from SOCOCIM Industries.

Annex 6

Technical presentation of Jatropha Fruits feeding installations at SOCOCIM Industries Cement Plant in Rufisque, Senegal

For each of the kilns, n°3 and n°4, the facility includes mainly the following points:

- Reception: Container lorry (static or drifting soil or dump truck) supplying Jatropha fruit and/or other biomasses in a pit.
- Storage hall: Jatropha fruit and other biomasses are stored in a storage hall. The hall has a volume of about 1,700 m^3. An overhead travelling crane moves Jatropha fruits and other biomasses in the storage hall pit.
- Biomass workshop: In the biomass workshop, a small silo is fed by the overhead travelling crane mentioned above. Jatropha fruits and other biomasses are brought in on a weighting system by an endless screw, a magnetic separator and a sieve. This instrument weighs the desired quantity, and then through a pneumatic line, Jatropha fruit and other biomasses are hauled directly into the burner of the pre-calcination facility of the kiln. Also included in the mechanical equipment are other transport facilities and the installation of filters.
- Electricity installation: In the electrical room are the supervisory units of the biomass workshop: control system, lighting system, overhead travelling crane system, and security system.

ATEX:	The facility is in line with ATEX standards in force.
Security:	The facility is also in line with standards in force related to security.
Security of people:	The facility is indeed designed for people's security to be specially secured in the unloading and access zones of the automatic overhead travelling crane.
Fire Protection:	Jatropha fruit and other biomasses are stored in the closed storage hall. Entrance gates are locked. The hall has a fire protection warning system, as well as a temperature and carbon monoxide (CO) monitoring system.
Emissions:	Lorry trucks cause noise. The contaminated air of the facility goes through a bag house filter and a silencer before being thrown outside.
Quantity:	The facility can convey to the kiln a maximum of 8t/h of Jatropha fruit or other biomasses. This represents about 20 and 25 lorry trucks per day for the two kilns.

Further details are available upon request.

Cost of the facilities

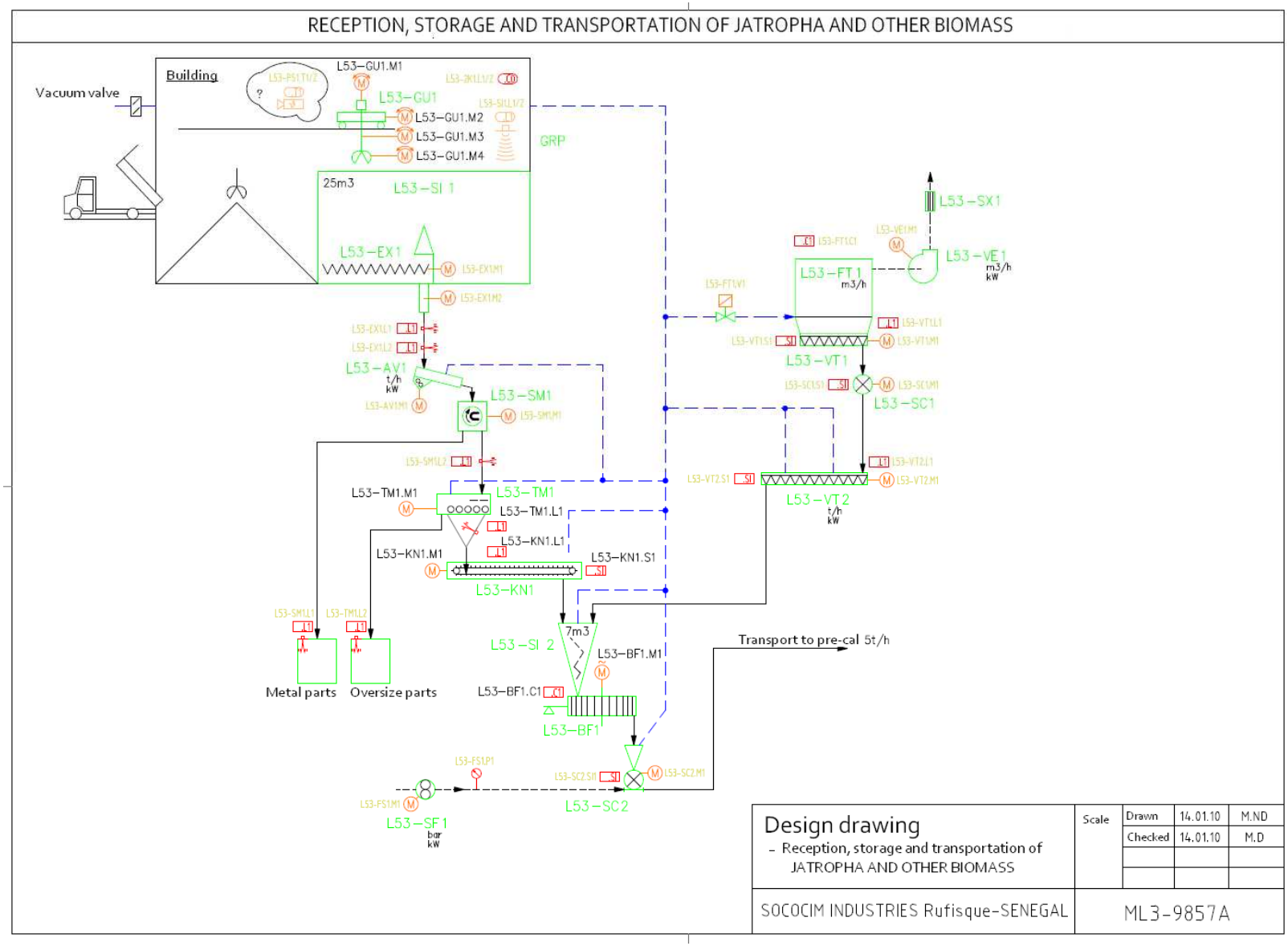
The cost of the biomass feeding facilities is based on tenders and project implementations of WIRTECH Company which has built several facilities of the same type in cement plants, among which the one of the VICAT group in Reuchenette, Switzerland.

For each of these two biomass feeding lines

Civil engineering works:	1,132,650 EUR
Mechanical Equipment:	1,472,000 EUR
Electrical Equipment:	576,450 EUR

Total Investment cost of biomass feeding line per kiln: 3,181,100 EUR; i.e. **6,362,200 EUR for the two biomass feeding lines of the CDM Jatropha project**.

See detailed drawing on next page.


RECEPTION, STORAGE AND TRANSPORTATION OF JATROPHA AND OTHER BIOMASS
Building
Vacuum valve
L53-GU1.M1
L53-GU1
L53-GU1.M2
L53-GU1.M3
L53-GU1.M4
GRP
25m3
L53-SI 1
L53-EX1
L53-AV1
L53-SM1
L53-SX1
L53-VE1
L53-FT1
m3/h
L53-VT1
L53-SC1
L53-VT2
L53-TM1.M1
L53-TM1
L53-TM1.L1
L53-KN1.M1
L53-KN1.L1
L53-KN1.S1
L53-KN1
7m3
L53-SI 2
L53-BF1.M1
L53-BF1.C1
L53-BF1
Transport to pre-cal 5t/h
Metal parts
Oversize parts
L53-SC2
L53-SF1
bar
kW
Design drawing
- Reception, storage and transportation of JATROPHA AND OTHER BIOMASS
Scale
Drawn 14.01.10 M.ND
Checked 14.01.10 M.D
SOCOCIM INDUSTRIES Rufisque-SENEGAL
ML3-9857A

Annex 7

Synoptic layouts of clinker kiln lines n°3 and n°4 before and after the project activity

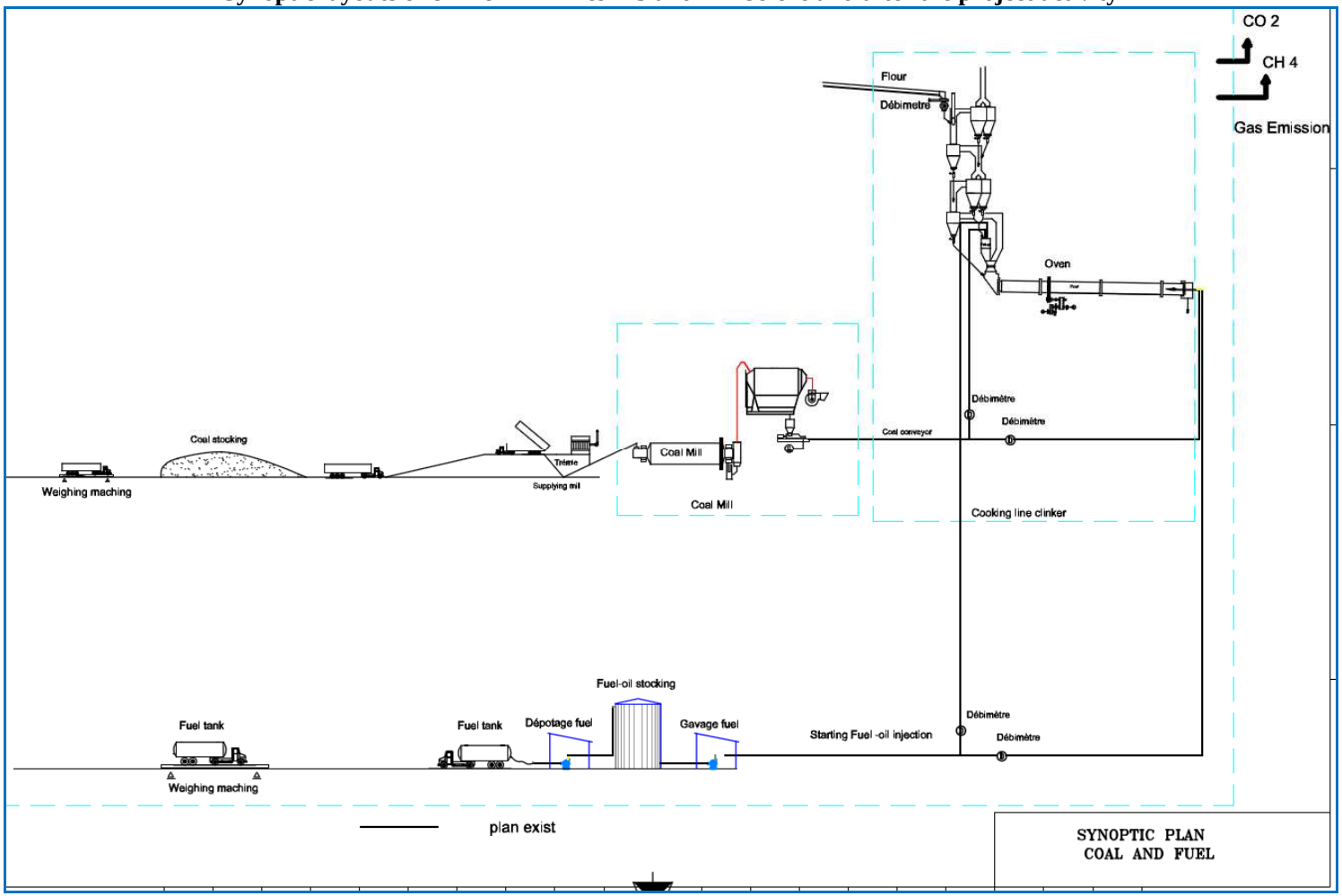


Figure 11: *Layout of cement plant in CDM reference scenario*

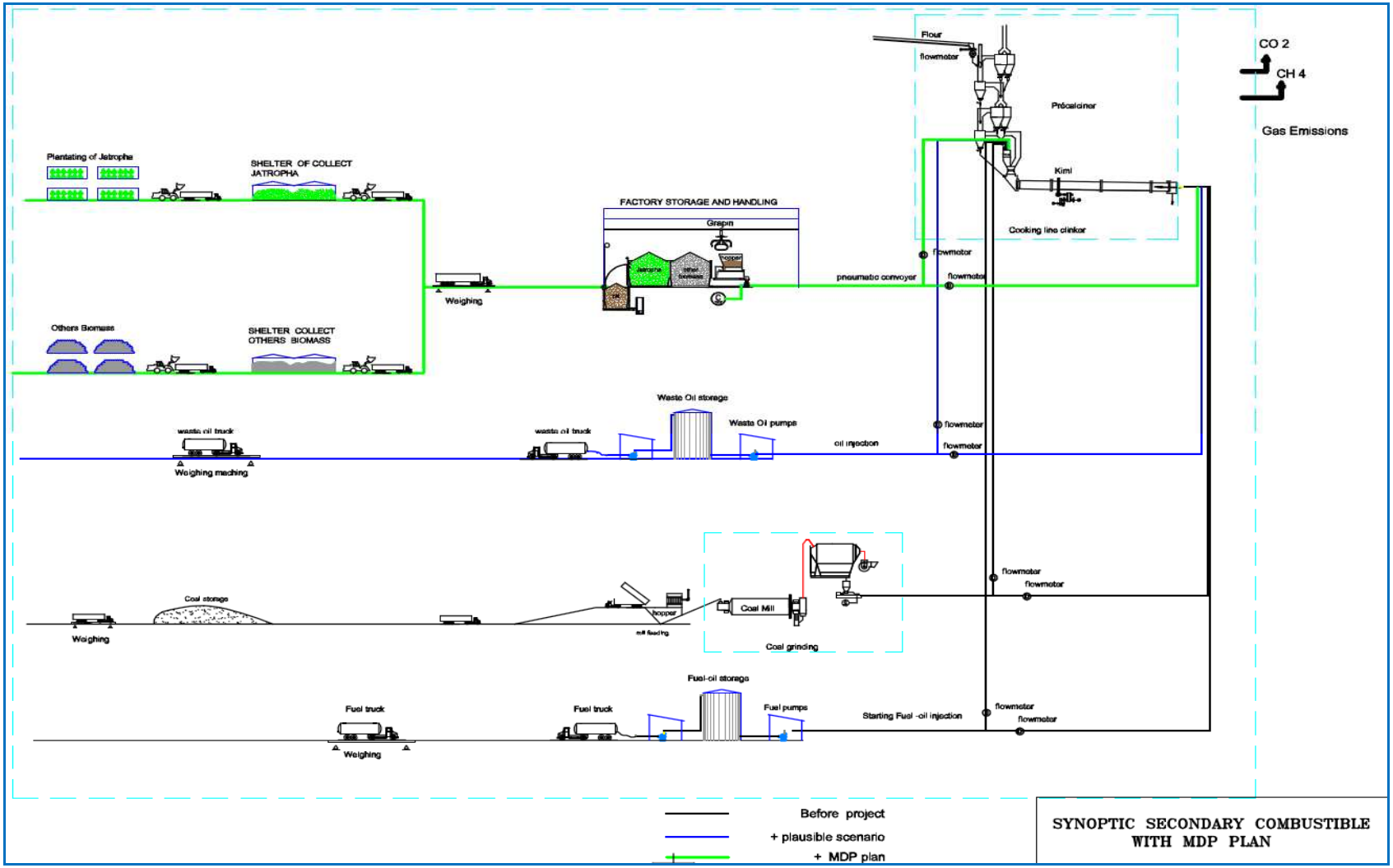


Figure 12: *Layout of cement plant in CDM project activity scenario*

Annex 8

List of documents referenced in this PDD

01-Cultivation chart for Jatropha suppliers 2008-06-30.doc
02a- Letter Minister of Local Communities supporting Jatropha Sococim project 2008-06-06.pdf
02b- Letter of Senior Minister of Interior supporting Jatropha Sococim project 2007-09-26.pdf
03-Partnership agreement INP-SOCOCIM.pdf
03a-Partnership Letter INP-SOCOCIM 2010-03-09.jpg
03b-Partnership Letter INP-SOCOCIM (English) 2010-03-09.doc
04-List and maps of Seccos.xls
05-List of equipments in kilns 3 and 4 before project activity.zip
06-Government decree on management of waste oils 2007-10-05.pdf
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