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

CONTENTS

SECTION A. General description of project activity

A.1 Title of the project activity:

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Emission reduction through partial substitution of fossil fuel with alternative fuels like agricultural by-products & Municipal Solid Waste (MSW) in the manufacturing of portland cement at Vikram Cement (VC), Neemuch (MP), India.

Version 05

08/08/2007

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A.2. Description of the project activity:

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The purpose of the project activity at Vikram Cement is to reduce the CO_2 emission in the cement production by using the alternative fuels like agricultural by-products, & Municipal Solid Waste (MSW) as refuse derived fuel (RDF), which is low green house gas emitting fuel.

The project activity involves partial replacement of the fossil fuels used in the kiln system for clinker formation by the alternative fuels. Conventionally fossil fuels namely coal, lignite and pet coke, are used in the kiln as thermal energy source to the raw meal, so that it can be converted as clinker. Some portion of these fossil fuels will be replaced by the use of alternative fuels like agriculture by- product i.e. soya husk and sarso husk, MSW etc. The use of agricultural by-products, Tyre & MSW as an alternative source of thermal energy during the manufacture of cement clinker shall result in significant saving on non-renewable fossil fuel.

Clinker manufacturing is the most energy intensive process. The process starts from quarrying, pre-processing (grinding) and pyro-processing of the raw meal, latter being highly energy intensive process. In the pyro-processing, substantial quantity of heat is required to make chemical changes in the raw meal. In most of the plants in India heating is done by major fossil fuels like coal, pet coke, lignite. The project activity aims to utilize the agriculture by- product and MSW in cement manufacturing, which is presently not in use, so increasing the quantity of coal (fossil fuel, non renewable source) for the other more important applications therefore reducing net CO_2 emissions from clinker formation. Utilisation of these alternative fuels would require retrofitting of the existing facility & installation of fuel processing equipments. The project activity is not common because it is not a financially viable option in cement manufacturing. Traditionally, the agriculture by- product is disposed by burning in open atmosphere and fetches no value. Utilization of the same makes the relationship more strong between VC and local population, as this is the avenue for increased employment in area. The project activity helps in effective disposal of wastes by using it as alternative fuel.

In the vicinity of VC, there are mainly Soya and Sarso husk, agricultural by-products available in plenty. VC has signed contract with Jaipur Municipal Corporation (JMC) for MSW, having estimated daily capacity of 1000 MT. The JMC will supply minimum 350 Tonnes per day (TPD) MSW to VC. VC is in discussion with other municipal corporation for the MSW supply. VC also utilizes Pet coke, which is a by-product from petroleum processing industries (refineries). Pet coke has limited availability and has other important application in aluminium and power sector. The use of alternative by- products is preferred over fossil fuel (petcoke & coal) and MSW due to following reasons:

- Agriculture by-products are climate neutral, e.g. the CO_2 generated by its combustion is sequestered by agriculture crops.
- Surplus agricultural by products are often wasted, as there is hardly any other application of the same.
- Utilization of these agricultural by-products helps prevent uncontrolled burning of the same in the area.
- Ensures proper waste utilization of MSW in the cement process. (Ash is mixed with clinker in the process)
- The avoidance of Methane generation due to MSW dumping on lands.
- Proper and environment friendly utilization of available heat energy stored in the alternative by products in cement industries due to very high temperature in the calciner and kiln.

The project would generate employment opportunities in the biomass supply chain – i.e. the collecting, sorting, processing and transportation of biomass. The project would be a source for employment for skilled and unskilled workers of the rural region and therefore will contribute to social well being of the people. The project will help uplifting the standard of living of farmers in nearby regions by making available an added source of revenue for their agricultural by-products, which were earlier burnt in open grounds and fetched no value.

A.3. Project participants:

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Name of Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
India (host)	Vikram Cement (VC) (Private entity)	No

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

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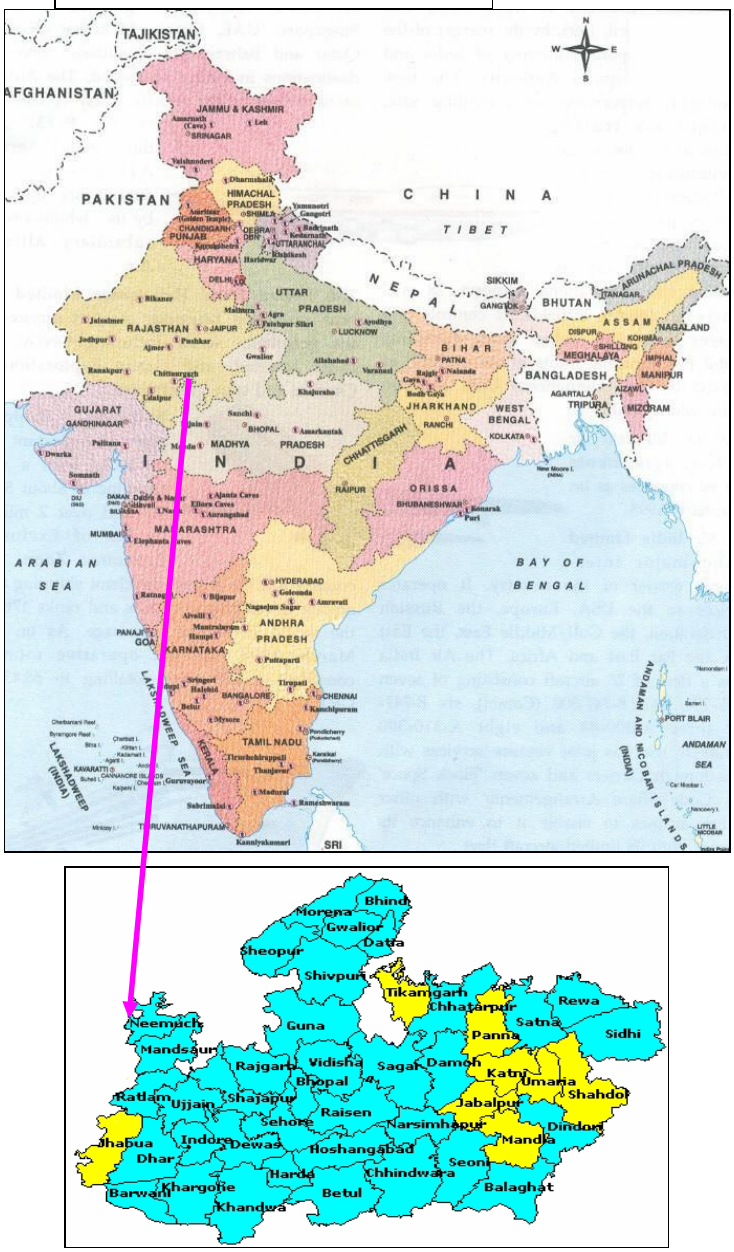
Fig 1: Location of activity site



A.4.1.1. Host Party(ies):

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India

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

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Madhya Pradesh

A.4.1.3. City/Town/Community etc:

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Neemuch

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

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VC is located at P.O. Khor; Distt. Neemuch (MP). VC Site lies between the parallels of latitude 24° 15' North, and the meridians of longitude 74° 45' East. The location of proposed project activity is at Vikram Cement, Khor, Distt. Neemuch, Madhya Pradesh.

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

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The project activity is cement sector specific. The project activity may principally be categorized in Category 4: Manufacturing Industries according to accreditation of operational entities.

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

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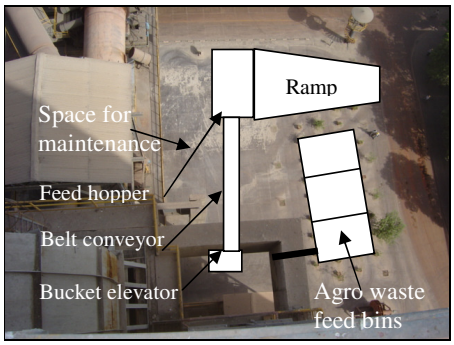
Technology used for fuel feeding: Technology to be employed is the development of the process with help of KHD Humboldt Wedag technology services, Germany. This technology will include the additional fuel feeding system along with the existing one. This new alternative fuel feeding system incorporates technologies for collection and preparation of the fuel with the necessary conveyors and feed hoppers for fuel feed. Agricultural by-product & MSW from the area will be collected and transported to VC. Alternative fuels will be unloaded from trucks at the clinker yard into a drop hopper. A screw conveyor will discharge this hopper material. Further on, the agricultural by-product will be transported pneumatically and fed directly into 3 feed bins of capacity approximately 240 m^3 each. Alternative by-product will be fed at constant rate by speed of the screw conveyor with frequency-controlled motor into the bucket elevator. A schematic sketch is shown here:

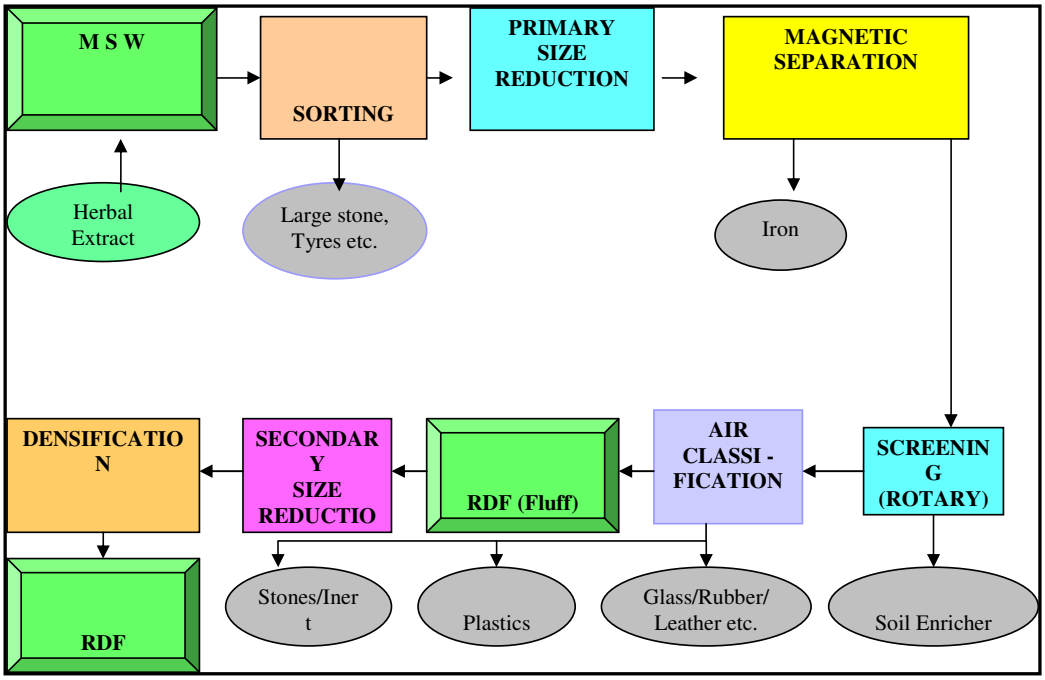
Figure 2: Scheduled retrofitting in the existing equipment



With this arrangement, 300 t/d of alternative fuels can be utilized. Here, double flap chute will be installed through which material will be fed to calciner in required quantity. This feeding system is centrally controlled and is monitored regularly.

Technology used for alternative fuel preparation: The proposed fuels for project activity are biomass residue and MSW. The project proponent is getting biomass residue directly from the villagers. There is no fuel preparation required for the biomass residue to use in the kiln. Second alternate fuel i.e. MSW is prepared at the landfill site of municipal corporation JMC. MSW processing unit will be set up at the landfill site and it will be made into pellets. By the method of segregation / screening different non combustible materials like iron, sand, stone etc. are removed from collected municipal waste. Excess moisture is removed by drying. The isolated combustible component is compacted to obtain Refuse Derived Fuel (RDF) in the form of pellets. These pellets will be brought to Vikram site and fed through the feeding system. The RDF preparation process is shown below:

Figure 3: RDF preparation from MSW



The Expected composition of MSW is:

Table 1: Expected composition of MSW

MSW Composition (in %)	MSW composition (in %)
Organic Fraction/Bio-mass	35.00
Woody Bio-mass	15.00
Paper	5.00
Rags/Textiles	5.00
Plastic	0.05
Rubber etc	4.85
Glass	0.05
Metals	0.05

Stones	20.00
Sand/Earth etc	15.00
Total	**100.00**

MSW & RDF storages facility: In the Jaipur site MSW will be transported from the designated collection sites in the city and directly fed to the MSW segregation system. In case of any problem in the system it will be stored for less than 2 days in the concrete flooring in the Jaipur site. After the separation of the required (useful) material the inert and other waste will be disposed on the designated site where the MSW was dumped before the project activity.
The RDF is produced in the fluffy form. The RDF will be stored in cement bags and transported in the closed trucks from Jaipur to the cement plant site.

Alternative fuel storage: The project proponent has proposed two type of alternate fuel. The biomass residue is stored near the fuel feeding location in a concrete floored and covered shed. The maximum retention time for the storage is 5-6 days. All the alternate fuels will be stored in a concrete floor with proper covered shed.

The availability and transportation distance for the alternate fuel: The alternative fuel (Agriculture residue) is available in near by area. The approximate diameter for the availability is 50 km. The main alternative fuel RDF will be transported from the Jaipur, which is 400 km from the Vikram cement site. The project activity will replace the fossil fuel, which were being transported from the 800 km distance from the Vikram cement.

Description about the environmental aspects of the technology: The technology used for fuel preparation is a partially imported technology and equipped with all environmental safety provisions. As the project will not use any hazardous chemicals (only sewage MSW) in the kiln therefore there will not be any environmental and health hazards with the application of the technology.
While using the technology for fuel feeding and MSW use in the kiln the project proponent has already taken proper care. The bag filters are already installed at various joints in the belts to avoid any dust emissions. All the exhausts are equipped with the environmental friendly equipments. The technology used is environmentally safe and sound. The project proponent is a proactive organisation for environment and will ensure environmentally safe operation of the technology.

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

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Table 2: Estimated emission reduction

Years	Annual estimation of emission reductions in tonnes of CO_2 e
2007-08 (1st June to 31st March)	42107
2008-09	62276
2009-10	71990
2010-11	80079
2011-12	86871
2012-13	92624
2013-14	97545
2014-15	101798
2015-16	105511
2016-17	108789
2017-18 (1st April to 31st May)	18132
Total estimated reductions (tonnes CO_2 equ.)	**867722**
Total no of Crediting Years	10 years
Annual average over the crediting period of estimated reductions (tonnes of CO_2 e)	**86772**

A.4.5. Public funding of the project activity:

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The project activity has received no public funding.

SECTION B. Application of a baseline and monitoring methodology

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

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Main Methodology

Title: **"Emission reduction through partial substitution of fossil fuels with alternative fuels in cement manufacture"**

Reference: ACM0003 Version 04, www.unfccc.org

Supporting Methodology

Consolidated methodology for grid-connected electricity generation from renewable sources --- Version 6

Additionality tool

Tool for the demonstration and assessment of additionality (ver 3)

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

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Approved Baseline methodology "Emission reduction through partial substitution of fossil fuels with alternative fuels in cement manufacture" (Approved consolidated methodology ACM0003 ver 04) is appropriate for VC's project activity because all the applicability conditions of this methodology match with VC project.

The applicability of methodology is justified as following

Fossil fuel(s) used in cement manufacture are partially replaced by the following alternative fuels:
(a) Wastes originating from fossil sources, such as tires, plastics, textiles from polymers, or rubber;
(b) Biomass residues where they are available in surplus and would in the absence of the project activity be dumped or left to decay or burned in an uncontrolled manner without utilizing them for energy purposes;

Proposed project activity at VC will partially replace the fossil fuel by alternative fuels like agriculture by-products, MSW etc. in the cement manufacturing. The agriculture by-products are biomass residue and available in near by villages. MSW will be purchased from JMC and contains some part of plastic and rubber. MSW used in VC will contain biomass waste. In absence of the project activity biomass residues were burnt because of no use in any other application and the MSW was dumped in landfill site.

The agriculture by-products are available in excess quantity in the vicinity of VC. VC has proposed to use:

1. 2870 ton of biomass residue per year[1].
2. 36225 ton of RDF per year

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

The project activity is using biomass residues like agriculture residues and for the preparation and drying only small quantities of electricity is used. There is no other process is involved for the fuel preparation of biomass residue.

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

For the estimation of CO_2 emissions reduction, the reduced emission due to fuel burning requirements is taken into account. The reduction in CO_2 emissions of clinkerisation process due to use of alternative fuels is not taken into account based on guidelines of methodology (Please see the emission reduction calculation for details).

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

The project activity has no impact on the increase in production and there are no plans to estimate emission reduction based on production increase in future. The emission reduction calculations are based on the installed clinker production capacity of the line three of VC.

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

The alternative fuels are available in abundance in the project activity site. The VC has proposed the use of MSW derived RDF[2] and agricultural residue. There is no established use of MSW in any process or

[1] The VC will use Soya husk and Sarso husk only as biomass residue; because they don't have any other useful application. The minimum availability of Sayabin husk is 60 MT per day for 6 months (10800 ton, Oct to March) and Sarso husk is 175 MT/day (15750 ton, Feb to Apr). The quantity used in project activity is around 2880 Ton, which is 10% of excess available.

operation. Cement industries are trying to use MSW derived fuel RDF in the kiln. MSW are easily available in excessive quantity. For ensuring the availability of agricultural residue (used in project activity) VC has carried out the agriculture residue assessment survey to insure the 1.5 times surplus availability of the same.

The VC's project activity fulfils all the applicability conditions described in the approved methodology.

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

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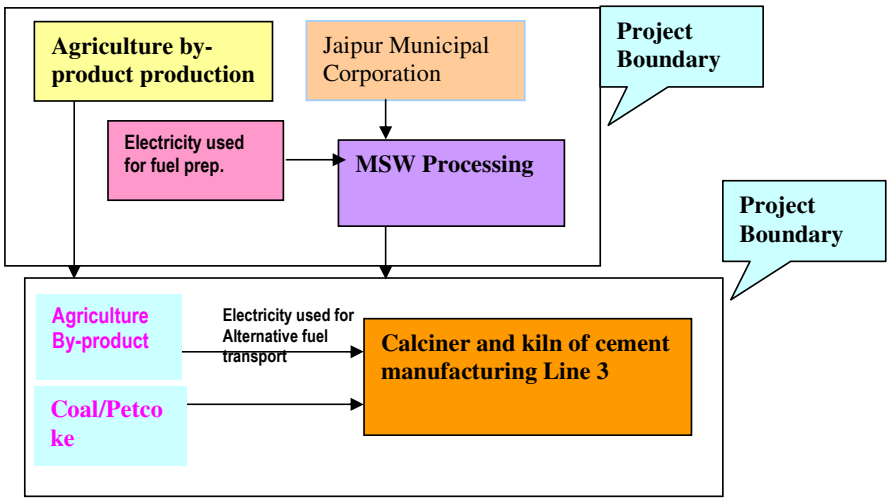
The project boundary covers the point of alternate fuel supply to the point of clinker produced in line 3. In the existing system, pet coke & coal are used as main fuel in the kiln for clinker burning. In the proposed system alternative fuel (Biomass & MSW derived fuel RDF) is burned in the kiln along with fossil fuels and clinker is produced in the kiln. Hence the kiln system is taken as boundary where the project proponent has a full control. Hence, project boundary is considered within these terminal points.

Flow chart and project boundary is illustrated in the following diagram:

Project boundary



Emissions sources included in or excluded from the project boundary

	Source	Gas	Included?	Justification / Explanation

[2] The MSW availability in Jaipur Municipal Corporation is in tune of 1000 MT/day. (Ref: Report of MSW assessment from Jaipur Municipal Corporation). The project proponent will use 350 TPD, which is only 35% of the available.

Baseline	Emissions from burning of fossil fuel	CO_2	Yes	The main emission from combustion of fossil fuel in absence of project activity
		CH_4	No	Not relevant due to higher temperature in the kiln.
		N_2O	No	Not relevant due to higher temperature in the kiln.
	Emissions from burning of alternative fuel in absence of project activity	CO_2	Yes	The main emission from combustion of fuel in absence of project activity
		CH_4	No	Not considered in the methodology.
		N_2O	No	Not considered in the methodology.
	Emissions from landfilling of alternate fuel	CO_2	No	Conservative estimation; not included in the methodology.
		CH_4	Yes	The main CH_4 emissions will takes place in landfilling.
		N_2O	No	Conservative estimation; not included in the methodology.
Project Activity	Emissions from burning of alternative fuel	CO_2	Yes	The main emission from combustion of non renewable alternative fuels
		CH_4	No	Not relevant due to higher temperature in the kiln.
		N_2O	No	Not relevant due to higher temperature in the kiln.
	Emissions from transportation and preparation of alternative fuel.	CO_2	Yes	The emissions from the burning of fuel used in transportation. The emissions due to use of electricity and fuel used in alternative fuel preparation is also included.
		CH_4	Yes	The emissions from the burning of fuel used in transportation.
		N_2O	Yes	The emissions from the burning of fuel used in transportation.

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

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Baseline scenario selection

Define alternative scenario for the fuel mix

Baseline scenario 1: Continuation of current practice scenario

The VC was using the coal and petcoke in the cement manufacturing process before the project activity. The fuel feeding and clinker manufacturing system in the VC was only capable to use fossil fuel. The VC fuel consumption mix before the activity was as below:

Table 3: Fuel mix in the VC before the project activity

Year	April 2005 - March 2006
Petcoke used (ton)	102312
% Petcoke used	75%
Imported Coal used (ton)	27414
% Imported Coal used	20%
Indian Coal used (ton)	6951
% Indian coal used	5%

In the absence of the project activity the VC plant will consume the same fuel mix as in baseline scenario. The fuel mix projections in the crediting period are shown in table 4.

Table 4: Expected fossil fuel use in Vikram Cement during the crediting period

Year	Petcoke (Tons)		Imp Coal (Tons)		Indian Coal (Tons)	
2007-08	102312	75%	27414	20%	6951	5%
2008-09	102312	75%	27414	20%	6951	5%
2009-10	102312	75%	27414	20%	6951	5%
2010-11	102312	75%	27414	20%	6951	5%
2011-12	102312	75%	27414	20%	6951	5%
2012-13	102312	75%	27414	20%	6951	5%
2013-14	102312	75%	27414	20%	6951	5%
2014-15	102312	75%	27414	20%	6951	5%
2015-16	102312	75%	27414	20%	6951	5%
2016-17	102312	75%	27414	20%	6951	5%

Baseline scenario 2: Using the average fuel mix used in the cement industries in India

Across the cement industries in India the fossil fuels are the common practice. Mainly coal is used for the cement manufacturing process with the lignite and petcoke. There is no legal obligation for cement industries in India as in European Union to use alternate fuels in cement kilns. According to the Cement Statistics 2005[3] the average fuel mix in the cement industry in India is discussed below:

Table 5: Fossil fuel mix in the Indian cement industry

[3] Cement statistics 2005, published by cement manufacturing association, India

(Quantities in Million tones)

Year	Coal	% Coal used	Lignite	% Lignite used	Petcoke	% Petcoke used
1998-99	12.47	98.7	0.16	1.3	0	0.0
1999-00	13.6	88.2	0.05	0.3	1.77	11.5
2000-01	13.05	96.9	0.05	0.4	0.37	2.7
2001-02	12.82	93.0	0.08	0.6	0.88	6.4
2002-03	14.17	92.9	0	0.0	1.09	7.1
2003-04	14.2	90.3	0.11	0.7	1.41	9.0
2004-05	14.95	85.	0.76	4.3	1.87	10.7

Cement manufacturing is highly energy intensive and cement industries always trying to reduce the fuel cost. The national average fuel mix in the country will reflect the economic fuel mix in the cement manufacturing. The second baseline scenario for the VC can be the use of the fuel mix as per the nation average in the cement industries in absence of project activity. Based on national average fuel mix the VC fuel mix in the crediting period will be as below in table 6:

Table 6: Expected fuel mix in VC during the crediting period based on national fuel mix

(Quantities in tones)

Year	Coal		Petcoke		Lignite	
2007-08	129271	85%	16182	4.3%	6569	10.7%
2008-09	129271	85%	16182	4.3%	6569	10.7%
2009-10	129271	85%	16182	4.3%	6569	10.7%
2010-11	129271	85%	16182	4.3%	6569	10.7%
2011-12	129271	85%	16182	4.3%	6569	10.7%
2012-13	129271	85%	16182	4.3%	6569	10.7%
2013-14	129271	85%	16182	4.3%	6569	10.7%
2014-15	129271	85%	16182	4.3%	6569	10.7%
2015-16	129271	85%	16182	4.3%	6569	10.7%
2016-17	129271	85%	16182	4.3%	6569	10.7%

Baseline scenario 3: Scenario in which traditional fuels are partially substituted with alternative fuels (i.e. the proposed CDM project activity).

As discussed above, the scenario in which the cement plants would partially substitute traditional fuels with alternative fuels is one of the most unlikely scenarios due to several reasons. With the heavy capital investment VC has introduced the replacement of fossil fuels with the alternative fuels, including the agricultural by products.

This project is VC's voluntary initiative for green house gas reduction through utilization of alternative fuels by taking into account relevant policies and regulations. There is no regulation or policies to use the alternative fuels in the cement manufacturing. Though the Ministry of Non-conventional Energy Sources, Government of India promotes renewable energy projects, it does not enforce cement industries to use biomass in cement kilns. The premier cement industry organisations in India, such as Cement Manufacturers Association (CMA) and National Council for Cement and Building Materials (NCCBM) have also not made it compulsory for cement industries in India to use biomass fuel in cement kilns. The project proponent has proposed to implement the project over and above the national and sectoral requirements.

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

Table 7 (a): Expected Fossil fuel percentage in the project activity

Year	Petcoke	Indian Coal
2007-08	92.9%	7.1%
2008-09	57%	4%
2009-10	57%	4%
2010-11	57%	4%
2011-12	57%	4%
2012-13	57%	4%
2013-14	57%	4%
2014-15	57%	4%
2015-16	57%	4%
2016-17	57%	4%

Table 7 (b): Fossil fuel and alternative fuel proportion during the project period[4]

Year	Petcoke	Imp Coal	Indian Coal	RDF	Biomass residue
2007-08	57%	15%	4%	23%	2%
2008-09	57%	15%	4%	23%	2%
2009-10	57%	15%	4%	23%	2%
2010-11	57%	15%	4%	23%	2%

[4] Percent are weight percentage

2011-12	57%	15%	4%	23%	2%
2012-13	57%	15%	4%	23%	2%
2013-14	57%	15%	4%	23%	2%
2014-15	57%	15%	4%	23%	2%
2015-16	57%	15%	4%	23%	2%
2016-17	57%	15%	4%	23%	2%

In India there are no regulations for the use of alternate fuels in the kiln. The applicable regulations from the pollution control board are air emission norms. All baseline scenario discussed are meeting all the relevant policies and regulations of the host country.

Baseline scenario selection

Option 2: Select baseline scenario through barriers analysis

Table 8: Barrier analysis

Alternative scenario	**Investment barriers**	**Technological barriers**	**Barriers due to prevailing practices**	**Other barriers**
Scenario 1	No initial capital investment required. In the absence of the project activity this is a most likely scenario.	No technological barriers. The plant will operate with this scenario in absence of the project activity.	This is the prevailing practice. No barriers.	No
Scenario 2	No initial capital investment. This scenario describes the different fossil fuel mix. This may require to some additional investment for making different contacts with the fuel supplier.	No technological barriers.	There will not be any barrier due to prevailing practice because this is only a different fossil fuel mix.	No

Scenario 3	Huge capital investment	A number of trials are required for the project activity.	The mindset of operators is a problem. They are not familiar with the alternate fuel feeding. This scenario will face the barriers due to prevailing scenario.	

Based on above barrier analysis the scenario 1 is most likely scenario in the absence of project activity. Scenario one i.e. continuation of current practices is selected as a baseline scenario.
The parameters and data source for the baseline scenario estimation is given in the table 9 below:

Table 9: Parameters required for baseline scenario

S. No.	Parameter	Data Source
1	Clinker production	Manufacturing plant (VC)
2	Fossil fuel consumption	Manufacturing plant (VC)
3	Fuel mix in baseline	Calculated
4	Fossil fuel consumption in other cement plants (National average)	CMA[5] data
5	Fuel mix (National average)	Calculated

The fuel mix and corresponding emissions from the baseline scenario 1 and 2 will be calculated annually and the lowest between all will be taken as baseline for the calculation of emission reduction.

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): >>

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

Sub-step1a. Define alternatives to the project activity:

[5] CMA stands for cement manufacturers association, India

All realistic alternative scenarios have been developed in the baseline scenario selection. The alternatives are:
Baseline scenario 1: Continuation of current practice scenario
Baseline scenario 2: Using the average fuel mix used in the cement industries in India
Baseline scenario 3: Scenario in which traditional fuels are partially substituted with alternative fuels (i.e. the proposed CDM project activity).

Sub-step 1b. Enforcement of applicable laws and regulations:
The regulatory framework, which may be applicable to this project activity, is the environmental regulations on air emissions and the project is meeting all the compliances of environment in this regards.

Step 2. Investment analysis

Sub-step 2a. Determine appropriate analysis method
The project activity is the partial replacement of fossil fuels by alternative fuels is generating revenues other than the CDM revenue so the option 1, can not be used for the project analysis.
Option 2 of analysis is the comparison method. It is difficult to estimate the cost and results from the continuation of current practices (Alternative 1) and the different fossil fuel mix for (alternative 2). It is practically very difficult to apply this option in a transparent and conservative manner for the VCs project activity.
The third option of the analysis is applied for the project activity.

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

According to additionality tool sub step 2 b option 3, Point 4 (c) A company internal benchmark (weighted average capital cost of the company) if there is only one potential project developer (e.g. when the project activity upgrades an existing process). The project developers shall demonstrate that this benchmark has been consistently used in the past, i.e. that project activities under similar conditions developed by the same company used the same benchmark is used as a benchmark for the project activity. The project proponent is the only promoter of the activity and the internal benchmark (12%) is used consistently in all the cement manufacturing units controlled by the project proponent, For the benchmark analysis internal benchmark 12%, is used, The internal rate of return (IRR) is calculated for the alternative fuel project.

Gelöscht: ¶

Gelöscht: the indicator opted is the minimum risk free returns of reserve bank of India (RBI) i.e.

Gelöscht: 6%.

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

The calculations for different options are available as a separate attachment to the PDD. The summary of IRR is given below.

Table 10: IRR Analysis

Particulars	**Value**
Investment for the project	INR 244.85 Million
Cost of fuels Imp Coal Ind Coal Petcoke Biomass residue RDF (INR 615/ton processing cost including the electricity consumption [ref: in-house estimation and from invited quotation] also and INR 600/ton transportation cost [ref: in-house estimation]) Electricity (Cement plant site at Neemuch)	 Rs 2361.5/ton Rs 2474.1/ton Rs 3268.7/ton Rs 1200/ton Rs 1215/ton Rs 4.06/kWh
IRR for the project activity without CDM	5.59%
IRR of the project with CDM	13.69%

This shows that any project should yield returns more than 12%, to consider it for implementation. The IRR calculations of project shows that the IRR of the project is below minimum internal benchmark of 12%. It improves to 13.69 with CDM funds availed against CERs, which is more than internal benchmark. Any project should yield returns more than 12% for the implementation.

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

Sensitivity Analysis

Sensitivity analysis is conducted based on the fuel price variations in two fuels biomass residue and MSW. The fuel prices in the IRR calculations are taken as base (100%) and the variation in the IRR with increasing and decreasing fuel prices are calculated and explained in the following table:

Gelöscht: The prevailing average rate of risk-free interest on bank deposit in India is 6[6]% [Reference: RBI, Table 74: Structure of Interest Rates, page no 129] (Internal financial benchmark). Though this benchmark is lower than the opportunity cost bench mark (IRR of 12%, this is the second benchmark of Vikram for all commercial project) as an environment friendly organization Vikram Industries group companies can take up any environment friendly project, which has an IRR above 6%.¶ ¶

Gelöscht: 6

Gelöscht: rate

Gelöscht: risk-free return (

Gelöscht: 6

Gelöscht:)

Gelöscht: minimum rate of risk free return

Table 11: Sensitivity Analysis for change in fuel prices

Without CDM revenue

Alternative fuel →

	106	***103***	***100***	***97***	***94***
106	6.27%	6.72%	7.16%	7.59%	8.02%
103	5.48%	5.94%	6.39%	6.84%	7.28%
100	4.64%	5.12%	**5.59%**	6.05%	6.51%
97	3.75%	4.26%	4.75%	5.23%	5.71%
94	2.79%	3.34%	3.86%	4.37%	4.87%

With CDM revenue

Alternative fuel →

	106	***103***	***100***	***97***	***94***
106	14.22%	14.66%	15.10%	15.53%	15.96%
103	13.51%	13.96%	14.40%	14.85%	15.28%
100	12.75%	13.23%	**13.69%**	14.14%	14.59%
97	11.95%	12.45%	12.94%	13.41%	13.87%
94	11.09%	11.63%	12.15%	12.65%	13.12%

Therefore in spite of sensitivity analysis on the basis of realistic deviations in assumptions, the IRR of project activity remains less attractive than the financial benchmark (12%) of project proponent.

Step 3. Barrier analysis

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

(a) Prevent the implementation of this type of project activity; and

(b) Do not prevent the implementation of at least one of the alternatives through the following sub-steps

All the barriers that prevail for the project activity are detailed in Sub-step 3a.

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

VC's initiative of reducing the GHG emissions in cement manufacturing has been facing several barriers as outlined below:

Investment Barrier

The project activity has a high upfront cost (more than INR 300 million), which is attributed to the in-house 'Equipment Cost on site', 'erection and commissioning cost' associated with the alternative fuel

use in cement manufacturing. VC is investing in the infrastructure of project activity implementation in order to ensure proper and effective utilization of alternative fuels. Furthermore to overcome the technical issues and to get the confidence in the smooth process and quality, they have to incurs, a significant cost for maintenance.

Besides all these direct expenses, Vikram Cement is also shouldering the additional transaction costs such as preparing documents, supporting CDM initiatives and developing and maintaining M&V protocol to fulfil CDM requirements. All these additional expenses have created a considerable amount of financial burdens on VC. They could have avoided such expenses and increased their profit margin by increasing their production instead of taking the initiative of producing clinker with the use of alternative fuels. However with the goal of obtaining carbon revenues from the reduction of fossil fuel usage and its associated greenhouse gas (GHG) emissions, VC took the decision of taking the investment risks and to invest in the CDM project activity after computing the proposed carbon financing.
Note: Production loss is estimated that 80 hrs will take for alignment of the alternative fuel feeding system with the existing cement manufacturing system. The realisation is 500 INR/ton of clinker. The production capacity is 125ton/hr. It will account for 50 Million INR

Technological Barrier

The technology used for the MSW to RDF conversion is first time used in Indian cement sector[7]. Before the starting of the project activity project proponent is predicting some technical barriers. The main technological barriers are:

1. Proper feeding of fuel: This is very important requirement for the good quality clinker manufacturing. The flowing of alternative fuel may not as smooth as fossil fuel. The alternative fuel has more affinity to moisture; it makes fuel flowing difficult.
2. Change in raw meal composition: The alternate fuel is having different characteristics against the conventional fossil fuels. There will be change in raw meal composition to meet the relevant clinker quality standard.
3. Process disturbance: Due to different type of alternate fuels the disturbance in process is most likely to happen.
4. Non-uniformity of Alternate Fuel: As the biomass residue will not be processed, fineness cannot be maintained which may lead to more retention time in the calciner to burn completely.

Barriers due to prevailing practice: The project activity is first of its kind in India. Based on CMA data for the fuel used; there is no cement plant in the India using the RDF. The Grasim industries limited – cement division south has registered project for alternative fuel and MSW use and that is the same group

[7] In India there is no cement plant using MSW as alternative fuel.

company plant and has not started using MSW. Therefore the project activity will be first to use MSW and faces the prevailing practice barrier.

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

It has been observed in Sub-step 3a that the project activity has its associated barriers to successful implementation. In a broader sense, these barriers can be categorised as below:

- Investment barrier and
- Technological barrier

The other realistic alternatives available with Vikram Cement in absence of the project activity are evaluated above.

Step 4. Common practice analysis

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

As already indicated in analysis that the use of alternate fuels is most uncommon practice in Indian cement industry due to several reasons, there is less likelihood of getting such examples. The project is not a common practice in Indian Cement industry. Based on the CMA[8] data currently no cement industry is using the alternative fuel. The Vikram Cement is one of the few cement companies, which has started the use of the alternate fuels.

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

It is evident that due to investment and technical barrier the project activity has less likelihood to happen. There is no incentive available from any association to use the alternative fuels in cement industry. Vikram Cement is one of the first cement industries to start the project activity (MSW use). Therefore the project activity is not common practice and no similar projects currently implemented in India.

This section establishes that the proposed project activity would not occur without CDM funds for abatement of GHG. Therefore, the project activity 'is additional' since the financially and barrier additionality is established and essentially the activity reduces anthropogenic emissions of GHG's below the level that would have occurred in the absence of the registered CDM project activity.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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The following equations will be applied for the emission reduction:

[8] Cement Statistics 2005, Cement manufacturing association, India

1. Project emissions:

1. Calculate project heat input from alternative fuels

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

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

Where:

HI_{AF} = heat input from alternative fuels (TJ/yr)

Q_{AF} = quantity of each alternative fuel (tonnes/yr)

HV_{AF} = lower heating value of the alternative fuel(s) used (TJ/tonne fuel).

Step 2. Estimate project specific moisture "penalty"

This project specific penalty should be determined as follows:

$$\mathbf{MP_y = C_{Pr,\,y} \times (HC_{AF} - HC_{FF})} \quad \textbf{(2)}$$

Where:

MP_y = moisture penalty (TJ/yr) for year y

$C_{Pr,y}$ = is the clinker production for year y

$HC_{AF,y}$ = is the specific fuel consumption on project case (TJ/tClinker) in year y

HC_{FF} = is the specific fuel consumption in the baseline when only fossil fuel is used, in TJ/tClinker.

$$HC_{FF} = \frac{(\sum Q_{FF,\mathrm{Pr}} \times HV_{FF}) + HI_{AF}}{C_{\mathrm{Pr}}} \quad \textbf{(3)}$$

Where:

$Q_{FF,pr}$ = is the quantity of fossil fuel used in the project case;

HV_{FF} = is the lower heating value of the fossil fuel used (TJ/tonne);

HI_{AF} = is heat input from alternative fuels (TJ/yr) in project case;

C_{Pr} = is the production of clinker in the project case; and

$$HC_{AF} = \frac{(\sum Q_{FF,Ba} \times HV_{FF})}{C_{Bl}} \quad \textbf{(4)}$$

Where:

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

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

$$AF_{GHG} = \sum (Q_{AF} \times HV_{AF} \times EF_{AF}) \quad \textbf{(5)}$$

Where:
AF_{GHG} = GHG emissions from alternative fuels (tCO_2e/yr)
Q_{AF} = monitored alternative fuels input in clinker production (tonnes/yr).
HV_{AF} = heating value(s) of the alternative fuel(s) used (TJ/tonne fuel).
EF_{AF} = emission factor(s) of alternative fuel(s) used (tCO_2e/TJ).

Step 4. Calculate GHG emissions due to on-site transportation and drying of alternative fuels

$$OT_{GHG} = (FD \times FD\_HV \times VEF_D) + OF_{AF} \times (VEF\_CO_2 + VEF\_CH_4 \times GWP\_CH_4 / 1000 + VEF\_N_2O \times GWP\_N_2O / 1000) \quad \textbf{(6)}$$

Where:
OT_{GHG} = GHG emissions from drying and preparation of alternative fuels (tCO_2e/yr)
FD = fuel used for drying alternative fuels (t/yr),
FD_HV = heating value of the fuel used for drying (TJ/t fuel), and
VEF_D = emission factor of the fuel used for drying (tCO_2/TJ)
EF_{ED} = emission factor of the electricity used for transportation /drying of alternative fuels (tCO_2/MWh)
OF_{AF} = transportation fuel used for alternative fuels on-site during the year (t/yr),
VEF_CO_2 = CO_2 emission factor for the transportation fuel ($tCO_2/tonne$),
VEF_CH_4 = CH_4 emission factor for the transportation fuel (kg CH_4/tonne),
VEF_N_2O = N_2O emission factor for the transportation fuel (kg N_2O/tonne),
GWP_CH_4 = global warming potential for CH_4 (21),
GWP_N_2O = global warming potential for N_2O (310),

Step 5. Calculate emission savings from reduction of on-site transport of fossil fuels

$$OT\_GHG_{FF} = OF_{FF} \times EF_{T\,CO2e} \quad \textbf{(7)}$$

Where:
$OT\text{-}GHG_{FF}$ = emissions from reduction of on-site transport of fossil fuels (tCO_{2e})
OF_{FF} = fuel saving from on-site transportation of fossil fuels (t/yr)

$EF_{T\ CO2e}$ = emission factor of fuel used for transportation (tCO_2e/t fuel),

2. Baseline emissions

1. Calculate the baseline GHG emissions from the fossil fuel(s) displaced by the alternative fuel(s)

$$FF_{GHG} = [(Q_{AF} \times HV_{AF}) - MP_{TOTAL}] \times EF_{FF} \quad \textbf{(8)}$$

Where:

FF_{GHG} = GHG emissions from fossil fuels displaced by the alternatives (tCO_2/yr)

$Q_{AF} * HV_{AF}$ = total actual heat provided by all alternative fuels (TJ/yr)

MP_{total} = total moisture penalty (TJ/yr)

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

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

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

3. Leakage emissions

1. Calculate CH4 emissions due to biomass that would be burned in the absence of the project.

$$BB_{CH4} = Q_{AF\text{-}B} * BCF * CH_4F * CH4/C * GWP\_CH_4 \quad \textbf{(9)}$$

Where:

BB_{CH4} = GHG emissions due to burning of biomass that is used as alternative fuel (tCO2e/yr)

$Q_{AF\text{-}B}$ = amount of biomass used as alternative fuel that would have been burned in the open field in the absence of the project (t/yr)

BCF = carbon fraction of the biomass fuel (tC/t biomass) estimated on basis of default values,

CH_4F = fraction of the carbon released as CH4 in open air burning (expressed as a fraction),

CH_4/C = mass conversion factor for carbon to methane (16 tCH4/12 tC), and

GWP_CH_4 = global warming potential of methane (21).

2. Calculate the CH4 emissions due to anaerobic decomposition of wastes in landfills.

$$LW_{CH4,y} = \varphi * \frac{16}{12} * F * DOC_f * MCF * \sum_{x=1}^{y} \sum_{j=A}^{D} QAFL_{j,x} * DOC_j * (1 - \exp(-k_j) * \exp(-k_j (y - x) * NFL * GWP_{CH4})) \quad \textbf{(10)}$$

Where:

$LW_{CH4,y}$ = Baseline GHG emissions due to anaerobic decomposition of biomass residues in landfills during the year y (tCO_{2e}/yr)

$QAFL_{j,x}$ = amount of biomass residues of type j used as alternative fuel that would be landfilled in the absence of the project in the year x (t/yr)

φ = is model correction factor (default 0.9) to correct for the model-uncertainties

F = is fraction of methane in the landfill gas

DOCj = is per cent of degradable organic carbon (by weight) in the biomass type j

DOCf = is fraction of DOC dissimilated to landfill gas

MCF = is Methane Correction Factor (fraction)

kj = is decay rate for the biomass residue stream type j

j = is biomass residue type distinguished into the biomass residue categories (from A to D)

x = is year during the crediting period: x runs from the first year of the first crediting period (x=1) to the year for which emissions are calculated (x=y)

y = is year for which LFG emissions are calculated

NFL = is the non-flared portion of the landfill gas produced (%)

GWP_{CH4} = Global warming potential valid for the relevant commitment period

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

The emissions from transportation should be calculated as follows:

$LK_{trans} = LK_{AF} - LK_{FF}$ **(11)**

$LK_{AF} = (Q_{AF}/CT_{AF}) * DAF * EFCO2e/1000$ **(12)**

$LK_{FF} = (Q_{FF}/CT_{FF}) * D_{FF} * EF_{CO2e}/1000$ **(13)**

Where:

LK_{trans} = leakage from transport of alternative fuel less leakage due to reduced transport of fossil fuels (tCO_2/yr)

LK_{AF} = leakage resulting from transport of alternative fuel (tCO_2/yr)

LK_{FF} = leakage due to reduced transport of fossil fuels (tCO_2/yr)

Q_{AF} = quantity of alternative fuels (tonnes)

CT_{AF} = average truck capacity (tonnes/truck)

D_{AF} = average round-trip distance between the alternative fuels supply sites and the cement plant sites (km/truck or ship)

Q_{FF} = quantity of fossil fuel (tonnes) that is reduced due to consumption of alternative fuels.

CT_{FF} = average truck or ship capacity (tonnes/truck or ship)

D_{FF} = average round-trip distance between the fossil fuels supply sites and the cement plant sites (km/truck or ship)

EF_{CO2e} = emission factor from fuel use due to transportation (kg CO_{2e}/km) estimated as:

$$EF_{CO2e} = EFT_{CO2} + (EF_{T\,CH4} * 21) + (EF_{T\,N2O} * 310) \quad \textbf{(14)}$$

Where:

$EF_{T\,CO2}$ = emission factor of CO_2 in transport (kg CO_2/km)

$EF_{T\,CH4}$ = emission factor of CH_4 in transport (kg CH_4/km)

$EF_{T\,N2O}$ = emission factor of N_2O in transport (kg N_2O/km)

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

4. Calculate emissions from off-site preparation of alternative fuels

The GHG emissions generated during the preparation of alternative fuels outside the project site are estimated as follows:

$$GHG_{PAFO} = FD_{AFO} * HV_{FDAFO} * EF_{FDAFO} + PD_{AFO} * EF_{pO} \quad \textbf{(15)}$$

Where:

GHG_{PAFO} = GHG emissions that could be generated during the preparation of alternative fuels outside the project site (tCO_2/yr)

FD_{AFO} = fuel used in drying of alternative fuels outside the project site (t/yr)

HV_{FDAFO} = heating value of fuel used for drying alternative fuels outside the project site (TJ /tonne)

EF_{FDAFO} = emission factor for the fuel used for drying of alternative fuels outside the project site (tCO_2/TJ)

PDAFO = power consumption in drying the alternative fuels (MWh/yr) outside the project site

EF_{pO} = CO_2 emission factor due to power generation outside the project where the drying of alternative fuels takes place, determined according to the methodology presented in AM0002 (tCO_2/MWh).

4. Emission reductions

Emission reductions by the project activity

Total emission reductions are given by the following formula

$AF_{ER} = FF_{GHG} - AF_{GHG} - OT_{GHG} - LK_{trans} + OT\_GHG_{FF} + BB_{CH4} + LW_{CH4} - GHG_{PAFO}$ **(16)**

Where:

FF_{GHG} = GHG emissions from fossil fuels displaced by the alternatives (tCO_2/yr)

AF_{GHG} = GHG emissions from alternative fuels (tCO_{2e}/yr)

OT_{GHG} = GHG emissions from on-site transport and drying of alternative fuels (tCO_{2e}/yr)

LK_{trans} = leakage from transport of alternative fuel less leakage due to reduced transport of fossil fuels (tCO_2/yr)

$OT\text{-}GHG_{FF}$ = emissions from reduction of on-site transport of fossil fuels (tCO_{2e})

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

LW_{CH4} = baseline GHG emissions due to anaerobic decomposition of biomass wastes in landfills (tCO_{2e}/yr)

GHG_{PAFO} = GHG emissions that could be generated during the preparation of alternative fuels outside the project site (tCO_2/yr)

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

(Copy this table for each data and parameter)

Data / Parameter:	**EF_{AF}**
Data unit:	tCO_2/TJ
Description:	Emission factor of alternative fuel
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories, volume 2, chapter 2, page 2.17,
Value applied:	91.7
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data Archived: Entire Crediting Period + 2 years IPCC default value.
Any comment:	No

Data / Parameter:	**Mp**
Data unit:	MJ/tonne/10% alt fuel share
Description:	Moisture penalty
Source of data used:	Lab experiment
Value applied:	20.9
Justification of the choice of data or description of measurement methods	The data will be received from lab. Recording frequency: Once before the starting of project activity. Data Archived: Entire Crediting Period + 2 years

and procedures actually applied :	
Any comment:	No

Data / Parameter:	**EF_{FF}**
Data unit:	tCO_2/TJ
Description:	Emission factor of fossil fuel
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories, volume 2, chapter 2, page 2.18,
Value applied:	Imported coal: 98.3 Indian coal: 94.6 Petcoke: 97.5 Lignite: 100
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data Archived: Entire Crediting Period + 2 years IPCC default value.
Any comment:	For each of the fossil fuels consumed: (i) In the year prior to the validation, (ii) During the project activity, (iii) In the baseline scenario

Data / Parameter:	**VEF_{CO2}**
Data unit:	g/km
Description:	CO_2 Emission factor for transport vehicles (truck)
Source of data used:	ACM0003 ver 04, reference notes
Value applied:	1097
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data Archived: entire crediting period + 2 years. Value is as per UNFCCC guidance.
Any comment:	Reference notes

Data / Parameter:	**VEF_{CH4}**
Data unit:	g/km
Description:	CH_4 Emission factor for transport vehicles (truck)
Source of data used:	ACM0003 ver 04, reference notes
Value applied:	0.06

Justification of the choice of data or description of measurement methods and procedures actually applied :	Data Archived: Entire Crediting Period + 2 years. Value is as per UNFCCC guidance.
Any comment:	Reference notes

Data / Parameter:	**VEF_{N2O}**
Data unit:	g/km
Description:	N_2O Emission factor for transport vehicles (truck)
Source of data used:	ACM0003 ver 04, reference notes
Value applied:	0.031
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data Archived: Entire Crediting Period + 2 years Value is as per UNFCCC guidance.
Any comment:	Reference notes

Data / Parameter:	**EF_{TCO2e}**
Data unit:	g/km
Description:	Emission factor from fuel use due to transportation (g CO_{2e}/km)
Source of data used:	ACM0003 ver 04, reference notes
Value applied:	1097
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data Archived: entire crediting period+ 2 years Value is as per UNFCCC guidance.
Any comment:	Reference notes

Data / Parameter:	**$Q_{AF-D/B}$**
Data unit:	Tonnes/ year
Description:	Biomass residues which would have been burnt in absence of project activity
Source of data used:	Estimated and 100% biomass residues have been considered on conservative basis.
Value applied:	100%
Justification of the choice of data or	Data Archived: entire crediting period + 2 years

description of measurement methods and procedures actually applied :	
Any comment:	Conservative assumption

Data / Parameter:	**BCF**
Data unit:	Tonnes C per tonnes of biomass
Description:	Carbon fraction of the biomass residue
Source of data used:	IPCC default value
Value applied:	0.39
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data Archived: entire crediting period + 2 years
Any comment:	Conservative assumption

Data / Parameter:	**CH_4F**
Data unit:	No unit
Description:	Carbon released as CH4 in open air burning
Source of data used:	IPCC default value
Value applied:	0.005
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data Archived: entire crediting period + 2 years. The value is IPCC default value
Any comment:	Conservative assumption

Data / Parameter:	**MCF**
Data unit:	No unit
Description:	Methane conversion factor
Source of data used:	IPCC default value
Value applied:	1
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data Archived: entire crediting period + 2 years. The value is IPCC default value

Any comment:	

Data / Parameter:	**DOC_j**
Data unit:	tC/tonnes of biomass
Description:	Degradable organic carbon content of the biomass residue
Source of data used:	IPCC default value
Value applied:	0.3
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data Archived: 2 years after the end of crediting period. The value is IPCC default value
Any comment:	Default = 0.3

Data / Parameter:	**DOC_F**
Data unit:	No unit
Description:	Portion of DOC that is converted to landfill gas
Source of data used:	IPCC default value
Value applied:	0.77
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data Archived: Entire Crediting Period + 2 years. The value is IPCC default value
Any comment:	Default = 0.77

Data / Parameter:	**NFL**
Data unit:	No unit
Description:	Landfill gas portion that is flared
Source of data used:	Default value
Value applied:	100
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data Archived: Entire Crediting Period + 2 years.
Any comment:	

Data / Parameter:	**D_{AF}**

Data unit:	Km/truck
Description:	Average distance of transport of alternative fuels
Source of data used:	Road atlas, transporters
Value applied:	400
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data Archived: Entire Crediting Period + 2 years.
Any comment:	

Data / Parameter:	**EF_{CO2e}**
Data unit:	Kg CO_{2e}/km
Description:	Emission factors
Source of data used:	ACM0003 ver 03 reference notes
Value applied:	1.10787
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data Archived: Entire Crediting Period + 2 years.
Any comment:	Reference notes

Data / Parameter:	**EF_{ADO}**
Data unit:	T CO_2/TJ
Description:	Emission factor for the fuel used for drying of alternative fuels outside the project site.
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories, volume 2, chapter 2, page 2.18,
Value applied:	Not used presently
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data Archived: 2 years after the end of crediting period.
Any comment:	

Data / Parameter:	**EF_{PO}**
Data unit:	tCO_2/MWh

Description:	Emission factor for the power generation outside the project site where drying of alternative fuel takes place.
Source of data used:	Central electricity authority
Value applied:	0.75
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data Archived: 2 years after the end of crediting period.
Any comment:	Electricity consumption associated with Jaipur site i.e. MSW processing plant (Northern region grid of India)

Data / Parameter:	EF_{ED}
Data unit:	tCO_2/TJ, for electricity (tCO_2/MWh)
Description:	Emission factor for the power generation outside the project site used for the onsite transportation of alternative fuels
Source of data to be used:	ACM0002 ver 06, reference notes. For electricity CEA data is used.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.89
Description of measurement methods and procedures to be applied:	Calculated Data Archived: Entire Crediting Period + 2 years
QA/QC procedures to be applied:	Calculated value, no procedure required.
Any comment:	Electricity is used as energy source for on-site transportation of alternative fuels. Electricity consumption associated with VC site (Western region grid of India)

Data / Parameter:	**OF_{FF}**
Data unit:	Ton/year
Description:	Fuel saving from on-site transportation of fossil fuel
Source of data used:	Plant
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures	The value considered as 0 for the entire crediting period. Data Archived: 2 years after the end of crediting period.

actually applied :	
Any comment:	Conservative assumption.

B.6.3 Ex-ante calculation of emission reductions:

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The following equations will be applied for the emission reduction:

1. Project emissions:

1. Calculate project heat input from alternative fuels

$$HI_{AF} = \sum Q_{AF} \times HV_{AF}$$

HI_{AF} = 564.76 TJ

Q_{AF} =

Biomass residue consumption	Tonnes	2870
MSW (RDF consumption)	Tonnes	36225

HV_{AF} =

Biomass residue	TJ/ton	0.0125
RDF	TJ/ton	0.0146

Step 2. Estimate project specific moisture "penalty"

MP_y = $C_{Pr,y}$ x (HC_{AF} – HC_{FF})

Where:

MP_y = 21.63 TJ

$C_{Pr,y}$ = 1035000

$HC_{AF,y}$ = 693 KCal/kg of Clinker

= 0.002897 TJ/tClinker

HC_{FF} = 688 KCal/kg of Clinker

= 0.002876 TJ/tClinker.

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

$$AF_{GHG} = \sum (Q_{AF} \times HV_{AF} \times EF_{AF})$$

Where:

AF_{GHG} = 7420 tCO_2e/yr

Q_{AF} =

Biomass residue consumption	Tonnes	2870
MSW (RDF consumption)	Tonnes	36225

HV_{AF} =

Biomass residue	TJ/ton	0.0125
RDF	TJ/ton	0.0146

EF_{AF} = MSW = 91.7 tCO_2e/TJ, Biomass residue= 0

Step 4. Calculate GHG emissions due to on-site transportation and drying of alternative fuels

$$OT_{GHG} = (FD \times FD\_HV \times VEF_D) + OF_{AF} \times (VEF\_CO_2 + VEF\_CH_4 \times GWP\_CH_4 / 1000 + VEF\_N_2O \times GWP\_N_2O / 1000)$$

Where:

Years	**OTGHG**
2007-08 (1st June to 31st March)	1462
2008-09	1754
2009-10	1754
2010-11	1754
2011-12	1754
2012-13	1754
2013-14	1754
2014-15	1754
2015-16	1754
2016-17	1754
2017-18 (1st April to 31st May)	292

FD = 0 t/yr

FD_HV = NA TJ/t fuel

VEF_D = NA tCO_2/TJ

EF_{ED} = 0.89 tCO_2/MWh – Western region grid of India (The emission factor is taken from the Central Electricity Authority data and ACM0002 ver 06 is used for calculating the factor)
Electricity used = 1964844 kWh (Taken from technical specification of technology supplier)
OF_{AF} = NA t/yr
VEF_CO_2 = NA tCO_2/tonne
VEF_CH_4 = NA kg CH_4/tonne
VEF_N_2O = NA kg N_2O/tonne
GWP_CH_4 = 21
GWP_N_2O = 310

Step 5. Calculate emission savings from reduction of on-site transport of fossil fuels

$$OT\_GHG_{FF} = OF_{FF} \times EF_{T\,CO2e}$$

Where:
$OT\text{-}GHG_{FF}$ = 0 tCO_{2e}
OF_{FF} = NA t/yr
$EF_{T\,CO2e}$ = NA tCO_2e/t fuel

2. Baseline emissions

1. Calculate the baseline GHG emissions from the fossil fuel(s) displaced by the alternative fuel(s)

$$FF_{GHG} = [(Q_{AF} \times HV_{AF}) - MP_{TOTAL}] \times EF_{FF}$$

Where:

Years	FFGHG
2007-08 (1st June to 31st March)	43054
2008-09	51664
2009-10	51664
2010-11	51664
2011-12	51664
2012-13	51664
2013-14	51664
2014-15	51664
2015-16	51664
2016-17	51664
2017-18 (1st April to 31st May)	8611

$Q_{AF} * HV_{AF}$ = 564.76 TJ/yr

MP_{total} = 21.63 TJ/yr
EF_{FF} = 95.12 tCO_2/TJ

3. Leakage emissions

1. Calculate CH4 emissions due to biomass that would be burned in the absence of the project.

$BB_{CH4} = Q_{AF-B} * BCF * CH_4F * CH4/C * GWP\_CH_4$

Years	BB_{CH4}
2007-08 (1st June to 31st March)	131
2008-09	157
2009-10	157
2010-11	157
2011-12	157
2012-13	157
2013-14	157
2014-15	157
2015-16	157
2016-17	157
2017-18 (1st April to 31st May)	26

Q_{AF-B} = 2870 t/yr
BCF = 0.39
CH_4F = 0.005
CH_4/C = 16 tCH4/12 tC
GWP_CH_4 = 21.

2. Calculate the CH4 emissions due to anaerobic decomposition of wastes in landfills.

$$LW_{CH4,y} = \varphi * \frac{16}{12} * F * DOC_f * MCF *$$
$$\sum_{x=1}^{y} \sum_{j=A}^{D} QAFL_{j,x} * DOC_j * (1 - \exp(-k_j) * \exp(-k_j (y - x) * NFL * GWP_{CH4}$$

Where:

Years	$LW_{CH4, y}$
2007-08 (1st June to 31st March)	11917
2008-09	26048
2009-10	35762
2010-11	43851
2011-12	50643
2012-13	56396
2013-14	61317
2014-15	65570
2015-16	69283
2016-17	72561
2017-18 (1st April to 31st May)	12094

$QAFL_{j,x}$ =

Paper and textiles	11550.00
Food waste/ organic	40425.00
Wood and straw waste	17325.00
Inert material	46200.00

φ = default 0.9

F = 0.5

DOCj =

Paper and textiles	40
Food waste/ organic	15
Wood and straw waste	30
Inert material	0

DOCf = 0.77

MCF = 1 (fraction)

kj =

Waste stream	***Decay-rate (kj)***
Paper and textiles	0.023

Food waste/ organic	0.231
Wood and straw waste	0.023
Inert material	0

NFL = 100%

GWP_{CH4} = 21

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

The emissions from transportation should be calculated as follows:

$LK_{trans} = LK_{AF} - LK_{FF}$

$LK_{AF} = (Q_{AF}/CT_{AF}) * DAF * EFCO_2e/1000$

$LK_{FF} = (Q_{FF}/CT_{FF}) * D_{FF} * EF_{CO2e}/1000$

Alternative fuels (Q_{AF})	Ton	39095
Average truck capacity for alternative fuel (CT_{AF})	Ton/truck	8
Average distance for transport of alternative fuels (D_{AF})	Km/truck	400
Emission factor	kg CO2/km	1.10787
Quantity of fossil fuel which is reduced due to consumption of alternative fuels (RQ_{FF})	Ton	17539.1
Average truck capacity for transport of Q_{FF} (CT_{FF})	Tonnes / truck	15
Average distance for transport of Q_{FF}	Km/truck	800
Leakage resulting from transport of alternative fuels (tCO2/yr) LK_{AF}	tCO2/yr	2166
leakage due to reduced transport of fossil fuel (LK_{FF})	tCO2/yr	1036
Leakage from transport of alternative fuel less leakage due to reduced transport of fossil fuel (Lktrans)	***tCO2/yr***	***1129***

Years	LKTrans
2007-08 (1st June to 31st March)	941
2008-09	1129
2009-10	1129
2010-11	1129
2011-12	1129
2012-13	1129

2013-14	1129
2014-15	1129
2015-16	1129
2016-17	1129
2017-18 (1st April to 31st May)	188

4. Calculate emissions from off-site preparation of alternative fuels

The GHG emissions generated during the preparation of alternative fuels outside the project site are estimated as follows:

$GHG_{PAFO} = FD_{AFO} * HV_{FDAFO} * EF_{FDAFO}+PD_{AFO}*EF_{pO}$ **(15)**

Power consumption of drying the alternative fuels outside the project site (PD_{ADO}) (The quantity of electricity is taken from the technical specification of technology supplier)	KWh	7009848
Emission factor for power generation outside the project site where drying of the alternative fuels takes place (EFpO) (The emission factor is taken from the Central Electricity Authority data and ACM0002 ver 06 is used for calculating the factor)	kg CO2/kwh	0.75 (Northern region grid of India)
Fuel used for any drying of alternative fuels outside the project site (FD_{AFO})	Ton, Kg or Litre	0
Heating value for fuel used for drying of alternative fuels outside the project site (HV_{FDADO})	TJ or Tcal/unit of fuel	0
Emission factor for the fuel used for drying of alternative fuels outside the project site (EF_{ADO})	TCO_2/TJ	0
Emissions from offsite preparation of alternative fuel GHG_{PAFO}	***ton CO2/yr***	***5290***

Years	GHG_{PAFO}

2007-08 (1st June to 31st March)	4408
2008-09	5290
2009-10	5290
2010-11	5290
2011-12	5290
2012-13	5290
2013-14	5290
2014-15	5290
2015-16	5290
2016-17	5290
2017-18 (1st April to 31st May)	882

4. Emission reductions

Emission reductions by the project activity

Total emission reductions are given by the following formula

$AF_{ER} = FF_{GHG} - AF_{GHG} - OT_{GHG} - LK_{trans} + OT\_GHG_{FF} + BB_{CH4} + LW_{CH4} - GHG_{PAFO}$ **(16)**

Year	**AF_{GHG}**	**OT_{GHG}**	**BB_{CH4}**	**LW_{CH4}**	**LK_{Trans}**	**GHG_{PAFO}**	**FF_{GHG}**	**Emission reduction**
2007-08 (1st June to 31st March)	6184	1462	131	11917	941	4408	43054	42107

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

>>

Years	**AF_{GHG}**	**OT_{GHG}**	**BB_{CH4}**	**LW_{CH4}**	**LK_{Trans}**	**GHG_{PAFO}**	**FF_{GHG}**	**Emission reduction**
2007-08 (1st June to 31st March)	6184	1462	131	11917	941	4408	43054	42107

2008-09	7420	1754	157	26048	1129	5290	51664	62276
2009-10	7420	1754	157	35762	1129	5290	51664	71990
2010-11	7420	1754	157	43851	1129	5290	51664	80079
2011-12	7420	1754	157	50643	1129	5290	51664	86871
2012-13	7420	1754	157	56396	1129	5290	51664	92624
2013-14	7420	1754	157	61317	1129	5290	51664	97545
2014-15	7420	1754	157	65570	1129	5290	51664	101798
2015-16	7420	1754	157	69283	1129	5290	51664	105511
2016-17	7420	1754	157	72561	1129	5290	51664	108789
2017-18 (1st April to 31st May)	1237	292	26	12094	188	882	8611	18132
Total	**74201**	**17540**	**1570**	**505442**	**11290**	**52900**	**516641**	**867722**

Year	**Estimation of project activity emission reductions (tonnes of CO_2 e)**	**Estimation of baseline emission reductions (tonnes of CO_2 e)**	**Estimation of leakage (tonnes of CO_2 e)**	**Estimation of emission reductions (tonnes of CO_2 e)**
2007-08 (1st June to 31st March)	7646	43054	-6699	42107
2008-09	9174	51664	-19786	62276
2009-10	9174	51664	-29500	71990
2010-11	9174	51664	-37589	80079
2011-12	9174	51664	-44381	86871
2012-13	9174	51664	-50134	92624
2013-14	9174	51664	-55055	97545
2014-15	9174	51664	-59308	101798
2015-16	9174	51664	-63021	105511
2016-17	9174	51664	-66299	108789

2017-18 (1st April to 31st May)	1529	8611	-11050	18132
Total (tones of CO2 e)	**91741**	**516641**	**-442822**	**867722**

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

B.7.1 Data and parameters monitored:

(Copy this table for each data and parameter)

Data / Parameter:	**C_{Pr}**
Data unit:	Ton
Description:	Clinker production
Source of data to be used:	Manufacturing plant
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1035000
Description of measurement methods and procedures to be applied:	Instrument used: Weighing feeders 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:	Clinker is calculated based on the raw meal consumption and raw meal to clinker conversion factor. The project proponent has in house procedure for periodic verification of the factor and calibration of the weighing feeders.

Data / Parameter:	**Q_{AF}**		
Data unit:	Ton		
Description:	Fuel type		
Source of data to be used:	Manufacturing plant		
Value of data applied for the purpose of calculating expected emission reductions in	Biomass residue consumption	Tonnes	2870
	MSW (RDF consumption)	Tonnes	36225

section B.5	
Description of measurement methods and procedures to be applied:	Instrument used: Weighing bridge Data Archived: 2 years after the end of crediting period Monitoring frequency: Recorded continuously and reported monthly and adjusted according to stock change
QA/QC procedures to be applied:	Instrument should be calibrated regularly according to manufacturer's guidelines.
Any comment:	No

Data / Parameter:	**HV_{AF}**
Data unit:	TJ/Tonnes
Description:	Fuel heating value
Source of data to be used:	Manufacturing plant
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Biomass residue: TJ/ton 0.0125 RDF: TJ/ton 0.0146
Description of measurement methods and procedures to be applied:	Instrument used: Bomb calorimeter Data Archived: 2 years after the end of crediting period Monitoring frequency: Monthly
QA/QC procedures to be applied:	Instrument should be calibrated regularly according to manufacturer's guidelines.
Any comment:	Measure in Kcal/kg and converted in TJ/ton

Data / Parameter:	**Q_{FF}**
Data unit:	Ton
Description:	Fuel type
Source of data to be used:	Manufacturing plant
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Lowest of the three factors is used.
Description of measurement methods and procedures to be applied:	Instrument used: Scale Data Archived: 2 years after the end of crediting period Monitoring frequency: recorded continuously reported monthly.
QA/QC procedures to	Instrument should be calibrated regularly according to manufacturer's

be applied:	guidelines.
Any comment:	No

Data / Parameter:	**HV_{FF}**
Data unit:	TJ/Tonnes
Description:	Fuel heating value
Source of data to be used:	Manufacturing plant
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Imp Coal: Kcal/kg 6602 Ind Coal: Kcal/kg 5742 Petcoke: Kcal/kg 8120
Description of measurement methods and procedures to be applied:	Instrument used: Bomb calorimeter Data Archived: 2 years after the end of crediting period Monitoring frequency: Monthly
QA/QC procedures to be applied:	Instrument should be calibrated regularly according to manufacturer's guidelines.
Any comment:	No

Data / Parameter:	**CT_{AF}**
Data unit:	Tonnes/truck
Description:	Average truck capacity for transport of alternative fuels
Source of data to be used:	Manufacturing plant
Value of data applied for the purpose of calculating expected emission reductions in section B.5	8
Description of measurement methods and procedures to be applied:	Instrument used: Weighing feeders Data Archived: 2 years after the end of crediting period Monitoring frequency: Calculated monthly
QA/QC procedures to be applied:	Instrument should be calibrated regularly according to manufacturer's guidelines.
Any comment:	

Data / Parameter:	**PD_{ADO}**
Data unit:	kWh
Description:	Power consumption of drying the alternative fuels outside the project site

Source of data to be used:	Fuel preparation plant
Value of data applied for the purpose of calculating expected emission reductions in section B.5	7009848
Description of measurement methods and procedures to be applied:	Instrument used: Electronic meter Data Archived: 2 years after the end of crediting period Monitoring: Continuously and reported monthly.
QA/QC procedures to be applied:	Instrument should be calibrated regularly according to manufacturer's guidelines.
Any comment:	

Data / Parameter:	**RQ_{FF}**
Data unit:	Ton
Description:	Fossil fuels which is reduced due to consumption of alternative fuels
Source of data to be used:	Calculated from the alternative fuel consumption in the plant
Value of data applied for the purpose of calculating expected emission reductions in section B.5	17539.1
Description of measurement methods and procedures to be applied:	Calculated Data Archived: 2 years after the end of crediting period
QA/QC procedures to be applied:	Calculated value, no procedure required.
Any comment:	

Data / Parameter:	**$QAFL_{j,x}$**
Data unit:	Ton
Description:	Biomass residue that would have been landfilled without project
Source of data to be used:	Estimated from the quantity and quality of MSW used
Value of data applied for the purpose of calculating expected emission reductions in section B.5	The detailed calculations are presented in annex 4 monitoring plan.

Description of measurement methods and procedures to be applied:	Estimated Data Archived: 2 years after the end of crediting period
QA/QC procedures to be applied:	Estimated based on quantity and quality of MSW used. The QA/QC procedure for MSW is required.
Any comment:	

Data / Parameter:	**HI_{AF}**
Data unit:	TJ/year
Description:	Alternative fuel heat input
Source of data to be used:	Calculated from the alternative fuel consumption in the plant
Value of data applied for the purpose of calculating expected emission reductions in section B.5	564.76
Description of measurement methods and procedures to be applied:	Calculated Data Archived: 2 years after the end of crediting period
QA/QC procedures to be applied:	Calculated value, no procedure required.
Any comment:	

Data / Parameter:	**S_{AF}**
Data unit:	%
Description:	Share of heat input from alternative fuels
Source of data to be used:	Calculated from the alternative fuel and fossil fuel consumption in the plant
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Value is not used in the estimated emission reduction.
Description of measurement methods and procedures to be applied:	Calculated Data Archived: 2 years after the end of crediting period
QA/QC procedures to be applied:	Calculated value, no procedure required.
Any comment:	

Data / Parameter:	OF_{AF}
Data unit:	Kwh/yr
Description:	Transportation fuel (electricity) used for alternative fuels on-site during the year (t/yr),
Source of data to be used:	Manufacturing Plant
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1964844 KWh
Description of measurement methods and procedures to be applied:	Instrument used: Energy Meter Data Archived: Entire Crediting Period + 2 years Monitoring frequency: Recorded continuously and reported monthly
QA/QC procedures to be applied:	Instrument should be calibrated regularly according to manufacturer's guidelines.
Any comment:	Electricity is used as energy source for on-site transportation of alternative fuels

Data / Parameter:	OT_{GHG}
Data unit:	tCO_2e/yr
Description:	GHG emissions due to on-site transportation of alternative fuels
Source of data to be used:	Manufacturing plant
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1754
Description of measurement methods and procedures to be applied:	Calculated Data Archived: 2 years after the end of crediting period
QA/QC procedures to be applied:	Calculated value, no procedure required.
Any comment:	Electricity is used as energy source for on-site transportation of alternative fuels

Data / Parameter:	**CT_{FF}**
Data unit:	Tonnes/truck
Description:	Average truck capacity for transport Q_{FF}
Source of data to be used:	Transporter, Plant

Value of data applied for the purpose of calculating expected emission reductions in section B.5	15
Description of measurement methods and procedures to be applied:	Data Archived: Entire Crediting Period + 2 years The data will be collected from the transporters, transporting the fossil fuel.
QA/QC procedures to be applied:	The data taken will be from third party. No procedure required.
Any comment:	

Data / Parameter:	**D_{FF}**
Data unit:	Km/truck
Description:	Average distance for transport Q_{FF}
Source of data to be used:	Transporter, Plant
Value of data applied for the purpose of calculating expected emission reductions in section B.5	800
Description of measurement methods and procedures to be applied:	Data Archived: Entire Crediting Period + 2 years The data will be collected from the transporters, transporting the fossil fuel. Monitoring frequency: Monthly
QA/QC procedures to be applied:	The data taken will be from third party. No procedure required.
Any comment:	

Data / Parameter:	**Availability**
Data unit:	Ton
Description:	Alternative fuel used by other
Source of data to be used:	Biomass assessment report, plant
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not used in calculation
Description of measurement methods and procedures to be	Data Archived: Entire Crediting Period + 2 years The report will be generated from third party or internally based on surveys,

applied:	published data.
QA/QC procedures to be applied:	No procedure required.
Any comment:	Yearly report will be prepared.

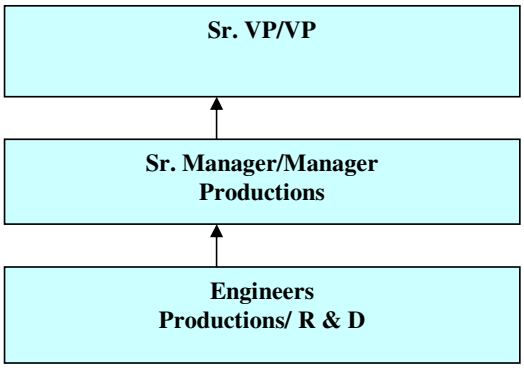
Data / Parameter:	**Availability**
Data unit:	Ton
Description:	Alternative fuel reserve available in the region
Source of data to be used:	Biomass assessment report, plant
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not used in calculation
Description of measurement methods and procedures to be applied:	Data Archived: Entire Crediting Period + 2 years The report will be generated from third party or internally based on surveys, published data.
QA/QC procedures to be applied:	No procedure required.
Any comment:	Yearly report will be prepared.

B.7.2 Description of the monitoring plan:

>>

Emission monitoring and calculation procedure will follow the following organisational structure.

Organisational structure for monitoring plan



Monitoring and calculation activities and responsibility

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 should be as per section B of PDD.
Review	All received data is reviewed by the engineers in the production/R & D.
Data compilation	All the data is compiled and stored in R & D department.
Emission calculation	Emission reduction calculations will be done annual based on the data collected. Engineers of production/ R & D department will do the calculations
Review	Sr. Manager/ Manager, Production will review the calculation.
Emission data review	Final calculations is reviewed and approved by VP/EVP R & D.
Record keeping	All calculation and data record will be kept with the Production/ R & D.

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)

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The baseline study of the project activity will be completed after necessary baseline calculation.

Baseline completion date: 12/12/2006.

The baseline study is presently determined by the person referred in annex 1 of the PDD.

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:

>>
24/12/2004

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

>>
20 years, 0 months.

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

C.2.1. Renewable crediting period

Not applicable

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

>>

C.2.1.2. Length of the first crediting period:

>>

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>> The crediting period of the activity will start only after registration of the project activity. For the CER estimation purposes date 01/06/2007 is considered.

C.2.2.2. Length:

>> 10 years 0 months

SECTION D. Environmental impacts

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

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The Ministry of Environment and Forests (MoEF), Government of India, under the Environment Impact Assessment Notification vide S.O. 60(E) dated 27/01/94 has listed a set of industrial activities in Schedule I[9] of the notification which for setting up new projects or modernization/ expansion will require environmental clearance and will have to conduct an Environment Impact Assessment (EIA) study. This project is not for the expansion or modernisation; the project under consideration does not require any EIA to be conducted.

Article 12 of the Kyoto Protocol requires that a CDM project activity contribute to the sustainable development of the host country. Assessing the project activity's positive and negative impacts on the local environment and on society is thus a key element for each CDM project.

The VC's CDM project activity ensures maximum global and local benefits in relation to certain environmental and social issues and is a small step towards sustainable development. The project activity does not have any significant negative environmental impact at the site. The GHG emission reduction from project activity benefits the global environment.

SL. NO.	ENVIRONMENTAL IMPACTS & BENEFITS	REMARKS
A	CATEGORY: ENVIRONMENTAL – RESOURCE CONSERVATION	
1	**Coal / Petcoke conservation:** The project activity reduces the use of fossil fuel in cement manufacturing and reduces an equivalent amount of coal / petcoke consumption per unit of cement produced that would have been required to cater to the baseline project option. "Coal is a finite natural resource" used as fuel to generate power and for other production processes. Since this project activity reduces its use positively contributes towards conservation of coal and making coal available for other important applications.	The project activity is a step towards coal/ petcoke conservation.

[9] http://envfor.nic.in/legis/legis.html#H

B	CATEGORY: ENVIRONMENTAL – AIR QUALITY	
1 2	**Global** By reducing the fossil fuel use in cement manufacturing, the project activity reduces net CO_2 emissions in atmosphere. **Local (Ambient)** Alternate fuel utilization by the project activity eliminates all the negative environmental impacts like air pollution caused due to emissions from alternative fuel dumped in the vicinity of the municipal corporation. The project involves transportation & handling of alternative fuels where there are chances of fugitive emission at unloading and feeding points.	The project activity reduces emission of CO_2 -a global entity. To control air pollution, the plant is equipped with Electro Static Precipitator (ESP) attached to kiln, raw grinding mill and also has bag filters installed to upkeep a clean environment. According to Central Pollution Control Board, the plant is required to meet the legal stack emission limit of 150 mg/Nm^3 and the plant's stack emission levels are well under the limit: around 50-70 mg/Nm^3 All care is taken to minimize fugitive emissions from alternative fuel handling through effective environmental programme. The alternative fuel is brought from in closed covered trucks to avoid any spillage.

C	CATEGORY: ENVIRONMENTAL –WATER	
1	The project activity utilizes alternative fuels and eliminates all the negative environmental impacts like water pollution caused due to sanitary landfill leaching and dumping in the vicinity of municipal corporation. **The project activity does not contribute to water pollution.**	The project activity contributes positive impacts to the water environment.

D	CATEGORY: ENVIRONMENTAL – LAND	
1	Alternative fuel disposal is one of the major environmental aspects of the municipal corporations in India. By utilizing large volumes of waste, the project activity eliminates all the negative environmental impacts related to MSW disposal on soil/land. Land requirement for MSW disposal is minimized. There is no possible soil or land pollution arising due to project activity.	The project activity leads to positive impact on Land environment.
E	CATEGORY: ENVIRONMENTAL – NOISE GENERATION	
1	**The project activity does not contribute to noise pollution.**	-
F	CATEGORY: SOCIAL	
1	**Employment:** The project activity creates opportunity for employment of semi-skilled, unskilled, engaged in various activities. The project activity site is within the premises and there is no human displacement. Therefore no rehabilitation programme was needed.	The project is expected to bring positive changes in the life style and quality of life.
2	**Capacity Building** The project activity indirectly encourages development of waste management infrastructure and associated value chain between two different types of industries mutually befitting each other's operation. Thus the external activity of the project links two sectors of industries and expedites similar proactive actions from industries to find avenues and opportunities for economical exchange of waste products and decrease cost of waste management.	The project is expected to bridge two types of industries for mutual benefiting.

Explanation of other environmental impacts may arise due to project activity:

S. No.	Environmental impacts	Comments
	Dust pollution due to agricultural by product at VC site	The transportation of alternate fuel in the VC site will be by closed belt conveyor. There will

		not be any dust pollution. And in the mean time at every transfer point the bag filters are installed for arresting the dust pollution. The dust quantities in the stack are monitored continuously and crosschecked by state pollution control board.
	Stake gas analysis with respect to combustion RDF and agricultural	This is regulatory requirement for every cement plant. In every six month the pollution control board is monitoring the stack emission. The cement plant is fulfilling all regulator requirements and will continue the same in future also with the use of RDF and agriculture fuels.
	Odour, health problem related to MSW/RDF handling and combustion of RDF in kiln	The MSW processing plant is outside the city limits of Jaipur municipal corporation and nearby the MSW dumping yard of the Jaipur. The project activity will reduce the Odour and health related problem by utilizing it in the best possible way.
	Proper control mechanism for environmental pollution	The project proponent has already obtained the consents and has the proper mechanism for the control of pollution from the application of alternative fuels.
	Segregation of biodegradable and non biodegradable waste procedure of MSW at Jaipur site	The system which is expected is the imported system and have inbuilt procedure of segregation of the waste. The waste will be segregated mechanically and inert materials will be dumped into dump yard.
	Disposal of non biodegradable and by-product of RDF process	The non-biodegradable part will be dumped into the MSW dump yards, which was used earlier for dumping of MSW.
	Leaching of land at Jaipur site due to MSW handling	The process is mechanism and there will not be any storage for more than 2 days. There will not be any leaching during this process.
	Fly, insect nuisance at Jaipur site	The site is nearby the MSW disposal site. The project activity will reduce the fly insect in the application area.

	Applicable legislation	The project proponent has obtained all necessary consents from applicable regulatory bodies.
	Methane emission from MSW storage at Jaipur site	The storage will not be more than 2 days. There is no methane expected in two days.
	Additional fertilizer requirement or used of agri by product other than project activity	For the availability of alternate fuels, "Biomass Assessment Study" in the nearby areas of VC plant has been carried out. Availability of biomass is 605818 MT/year in which 521960 MT/year and 12332 MT/year is domestic sector and industrial sector consumption respectively. Total planned predicted requirement of biomass for project activity is 2870 MT/year while grand availability of biomass residue is 71526 MT/year. VC will use Soya husk and Sarso husk only as biomass residue, because they don't have any other useful application. The minimum availability of Soya husk is 60 MT per day for 6 (six) months in year (10800 MT for the period October to March of year) and Sarso husk is 175 MT/day for 3 (three) months in year (15750 MT, for the period February to April). The quantity used in project activity is around 2870 MT per year, which is around 10 per cent of surplus biomass availability. Thus, availability of alternate fuel is more than 1.5 times the total expected consumption of biomass per year. This is fulfilling the applicability criteria of ACM0003/Version 04. According to above calculation it is clear that there will not be biomass shortage for purpose of fertilizer. According to above analysis the situation of additional fertilization i.e., application of additional synthetic fertilizers arising in the nearby rural areas in near future is unexpected and same has not been considered in the approved methodology ACM0003 ver 04 as

		well.

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:

>>

Project activity does not lead to any significant negative impact. Neither does the host country require EIA study to be conducted for this kind of projects. As stated above project activities not included under Schedule I of Environment Impact Assessment Notification of MoEF for environmental clearance of new projects or modification of old ones needn't conduct the EIA.

SECTION E. Stakeholders' comments

>>

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

>>

The project activity of VC is at their cement plant in Neemuch. The project activity will use eco- friendly biomass as fuel.

Various stakeholders identified for the project are as under.

- Elected body of representatives administering the local area (village Panchayat)
- Employees of Vikram cement Neemuch and MSW processing plant at Jaipur
- Central & State Pollution Control Board
- Ministry of Environment & Forest (MoEF), Government of India
- Consultants
- Equipment Suppliers
- Municipal Corporations of city of Jaipur

Stakeholders list includes the government and non-government parties, which are involved in the project at various stages. At the appropriate stage of the project development, stakeholders/ relevant bodies were involved to get the project clearance.

Vikram cement has communicated to the local population for the project activity. Vikram cement has written letter to '*Gram Pradhan*' of the village and govt. official of the village. The personnel of Vikram corporate office have discussed the project with the central pollution control board (CPCB). The Vikram Cement has discussed the project with state pollution control board.

The Success of the project activity depends upon the quality clinker production and supply of alternate fuels. Hence local population is one of the key stakeholders of the project activity.

Local population comprises of the local people in and around the project area. The roles of the local people are as a beneficiary of the project. The project activity has created employment opportunity to local manpower near the plant site. Since, the project has environmental benefits at the project area and has provided good direct employment opportunities the local populace has positive opinions about the project.

The employee's support is very important for successful implementation of any project. The project proponent has taken views from the employees about the technical aspects and other environmental and health related aspects of implementing of the project activity. The employees were happy to see the unique type of project implantation in there cement plant.

State pollution control board (SPCB) has prescribed standards of environmental compliance and monitors the adherence to the standards. Every six month the pollution control board is checking the

emissions from the cement industry. The VC is fulfilling all the emission norms imposed by SPCB. The project activity reduces the environmental impacts on the local ambient quality and meets all the statutory requirements.

The project is being implemented at existing facility of Vikram cement thus project does not require any displacement of the local population. This implies that the project will not cause any adverse social impacts on the local population but helps in improving the quality of life for them.
Further the adverse heath impacts caused from quarrying of materials on the mining persons, nearby habitats and eco-system would therefore be avoided. Hence, with minimization of natural resources depletion the project activity achieves environmental restoration for future generation as well as increased health prosperity of present generation.

E.2. Summary of the comments received:

>>
VC has received comments from the local '*Gram Pradhan*' mentioning that the project is good for the nearby area. Similar comment was received from the government officials.
VC has received environmental clearance from pollution control board also. The project activity is environment friendly activity and creates business opportunity. The project activity has provided the proper waste utilisation system in developing country like India. The project proponent has not received any negative comment from any stakeholder.
The environment and health related issues were discussed in various interviews with the stakeholders. There is no negative comment is received in this process. The Gram Pradhan has also discussed the health and environmental related issues with the village population and finally given the letter. The letter received from the Gram panchayat on 13th September 2006 is submitted to DoE.

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

>>
There are no negative comments received from any stakeholders for the project activity.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Vikram cement
Street/P.O.Box:	Vikram Nagar, P.O. Khor
Building:	Vikram Cement Factory
City:	Neemuch
State/Region:	Madhya Pradesh
Postfix/ZIP:	458470
Country:	India
Telephone:	07420-230108/230566
FAX:	07420-235524
E-Mail:	
URL:	www.adityabirla.com
Represented by:	Unit head
Title:	Sr. Executive President
Salutation:	Mr.
Last Name:	Gupta
Middle Name:	M
First Name:	R
Department:	Plant head
Mobile:	91 94253 28083
Direct FAX:	
Direct tel:	
Personal E-Mail:	rmgupta@adityabirla.com

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no funding available from any annex 1 country.

Annex 3

BASELINE INFORMATION

The project activity is the partial replacement of fossil fuel use with the alternative fuels like agricultural by product and MSW. The baseline scenario for the project activity will be continuation of current practices.

According to the methodology:

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

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

The baseline fossil fuel consumption for the baseline year is presented in the table with the average emission factor of all three baseline scenario (according to the point three above). The average baseline emission factor will be calculated annually and the lowest of all three scenarios will be used for emission reduction calculations. The baseline emission factor for the project activity is a variable emission factor which is the lowest of the three factors discussed above. There are three baseline scenarios:

1. Continuation of current practices: The value of this baseline scenario is based on the data before commissioning, which will be fixed in entire crediting period.
2. Average fuel mix in Indian Cement Industry: This baseline scenario will be calculated after every financial year based on the data published by CMA.
3. Project activity scenario: The emission factor from fossil fuel consumption in project scenario will be calculated every year.

The lowest value of the three will be considered for the emission reduction calculations.

Scenario 1	Fossil fuel used (Q_{FF})	Tonne	
	Imp Coal	tones	27414
	Ind Coal	tones	6951
	Petcoke	tones	102312
	Heat value of fossil fuel (HV_{FF})	TJ/ton	0.0322

Gelöscht: , average fossil fuel mix of the Indian cement industry

Formatiert: Block, Zeilenabstand: Mehrere 1,25 ze

Formatiert: Schriftart: 11 pt

Gelöscht: baseline

	Imp Coal	Kcal/kg	6602
	Ind Coal	Kcal/kg	5742
	Petcoke	Kcal/kg	8120
	Emission factor (EF_{FF})	TCO2/TJ	97.528
	Imported Coal		98.3
	Indian Coal		94.60
	Petcoke		97.50

Scenario 2

Fuel	% fuel used	Calorific value	Emission factor	Average emission factor
Coal	85	0.0240	94.6	
Lignite	4.3	0.0098	100.0	
Petcoke	10.7	0.0339	97.5	**95.12**

Scenario 3

Fuel	% fossil fuel used	Calorific value	Emission factor	Average emission factor
Imp Coal	0.0	0.0276	98.3	
Indian Coal	7.1	0.02400156	94.6	
Petcoke	92.9	0.0339	97.5	**97.35**

Electricity emission factor[10]

(Reference: Ministry of Power, Central Electricity Authority, CO2 Baseline Database for the Indian Power Sector, Version 1.1, December 2006)

	Combined Margin in tCO2/MWh (incl. Imports)				
	2000-01	2001-02	2002-03	2003-04	2004-05
North	0.76	0.76	0.77	0.76	0.75
East	1.06	1.05	1.04	1.05	1.04
South	0.86	0.85	0.85	0.86	0.85
West	0.88	0.89	0.88	0.88	0.89
North-East	0.39	0.38	0.39	0.36	0.45
India	0.85	0.86	0.85	0.86	0.86

[10] http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm

Annex 4

MONITORING INFORMATION

Monitoring Plan

Sr. no.	Data description	Procedure for monitoring the parameter	Traceability of calibration method/ standard	Tag no OR equipment serial no of instrument	Service & Tech def. Of instru and measuring	Make of instrument	Location of instrument	Calibration Method	Least Count and range of instrument	Uncertainty	Linkage with system management, ISO doc number
1	Raw Meal consumption	Raw meal supplied at Kiln inlet is measured by Solid Flow Meter. This raw meal is then converted into clinker. The weighment of clinker is calculated by	Office of Standard Weights & Measurement Control, MP (Inspector of Weight & Measurement, Indore.) Loss in weight of kiln feed system is checked	SFF H29 SFF H30	Service: Weight measurement Tech. Def.: Solid Flow Meter	Make: Jenson & Nicolson Or meter having similar specification Solid Flow Meter	At the inlet of the VC-III Kiln	Calibration method as described in the ISO document.	+/-0.5% 0 - 325TPH	As per ISO procedure INT-SP-02	ISO Doc number: INT-WI-28 INT-WI-30 INT-SP-01

Sr. no.	Data description	Procedure for monitoring the parameter	Traceability of calibration method/ standard	Tag no OR equipment serial no of instrument	Service & Tech def. Of instru and measuring	Make of instrument	Location of instrument	Calibration Method	Least Count and range of instrument	Uncertainty	Linkage with system management, ISO doc number
		NCCBM factor.	through "Microcount" controller and the procedure is inbuilt and the programmed in the chip.								
2	Quantity of Alternative fuel used (RDF and agricultural waste)	Quantity of alternative fuel used at VC site is measured by Weigh Feeder.	Test weight as supplied by Transweigh, supplier of weigh feeder system.	300WF1 300WF2 300WF3	Service: Weight measurement Tech. Def.: Weigh feeder	Transweigh Or weigh feeder having similar specification	At Jaipur site, at VC alternate fuel feeding system site.	Standard test and weight measurement and also as suggested by the supplier.	+/-0.5% 0 - 15 TPH	As per ISO procedure INT-SP-02	ISO Doc number: INT-WI-06

Sr. no.	Data description	Procedure for monitoring the parameter	Traceability of calibration method/ standard	Tag no OR equipment serial no of instrument	Service & Tech def. Of instru and measuring	Make of instrument	Location of instrument	Calibration Method	Least Count and range of instrument	Uncertainty	Linkage with system management, ISO doc number
3	Heat value of alternative fuel (RDF and agricultural waste)	By Bomb Calorimeter with standard procedure as given by the OEM.	By Benzoic acid powder/ tablet test. Make: Merc GR grade.	Sl.No.1815	Service: Temperature measurement Tech. Def.: Calorimeter	Toshniwal Instrument & Engg. Co. Or calorimeter having similar specification	QC equipment lab at VC	As given in standard manual by OEM	Upto 10,000 Kcal	As per the manual	ISO Doc.No. QCD-WI-05

Sr. no.	Data description	Procedure for monitoring the parameter	Traceability of calibration method/ standard	Tag no OR equipment serial no of instrument	Service & Tech def. Of instru and measuring	Make of instrument	Location of instrument	Calibration Method	Least Count and range of instrument	Uncertainty	Linkage with system management, ISO doc number
4	Weight of Fossil fuel quantity used in project activity (coal/ petcoke)	Coal measurement at Poldos with Load Cell and Loss of weight with the help of test weight.	Office of Standard Weights & Measurement Control, MP (Inspector of Weight & Measurement, Indore.)	3 Poldos with nos. S64, S65 & S66	Service: Solid Flow rate measurement Tech. Def.: Poldos	Krupp Polysius Or Poldos having similar specification	VC Line-III	Through standard weight	0 - 20 TPH	As per ISO procedure INT-SP-02	ISO Doc number: INT-WI-33 INT-SP-01
5	Heating value of fossil fuel (coal/ pet coke)	By Bomb Calorimeter with standard procedure as given by the	By Benzoic acid powder/ tablet test. Make: Merc GR grade.	Sl.No.1815	Service: Temperature measurement Tech. Def.:	Toshniwal Instrument & Engg. Co. Or	QC equipment lab at VC	As given in standard manual by OEM	Upto 10,000 Kcal	As per the manual	ISO Doc.No. QCD-WI-05

Sr. no.	Data description	Procedure for monitoring the parameter	Traceability of calibration method/ standard	Tag no OR equipment serial no of instrument	Service & Tech def. Of instru and measuring	Make of instrument	Location of instrument	Calibration Method	Least Count and range of instrument	Uncertainty	Linkage with system management, ISO doc number
		OEM.			Calorimeter	Calorimeter having similar specification					
6	Quantity of fuel used for transportation	The transportation will be done by the transporter, as it is given on the contract basis. One payloader and one gravel for	-	-	-	-	-	-	-	-	-

Sr. no.	Data description	Procedure for monitoring the parameter	Traceability of calibration method/ standard	Tag no OR equipment serial no of instrument	Service & Tech def. Of instru and measuring	Make of instrument	Location of instrument	Calibration Method	Least Count and range of instrument	Uncertainty	Linkage with system management, ISO doc number
		12 hours each will be used at Jaipur Site									
7	Electricity used for processing of alternative fuels at Jaipur site	With the help of Energy Meters. At Jaipur 50 kWh/MT of power will be used.	At Jaipur 50 kWh/MT of electrical energy will be used	300FH1. M01/ 300FF1.M 01 X 2 Nos & all other equipment as mentioned in the drawing	Service: Electrical energy measurement Tech. Def: Energy Meter	As supplied by Droppspat , supplier of the Alternate fuel Plant	Motor for Pre-Shredder/ Fine Shredder	As per the standard by OEM	315Kw / 210 Kw X 2 nos, 415 V	-	-
8	Average	There will be	-	-	-	-	-	-	-	-	-

Sr. no.	Data description	Procedure for monitoring the parameter	Traceability of calibration method/ standard	Tag no OR equipment serial no of instrument	Service & Tech def. Of instru and measuring	Make of instrument	Location of instrument	Calibration Method	Least Count and range of instrument	Uncertainty	Linkage with system management, ISO doc number
	truck capacity for transport of alternative fuel (RDF and agricultural waste)	9 tons capacity trucks will be used for transportation.									
9	Electricity consumption of conveying the alternative fuels on the VC project site	With the help of Energy Meters. At VC 12 kWh/MT of electrical energy will be used for	The standard for electronic test & Development center traceable to National Std. Of NPL, Delhi for	PCC-19F	Service: Electrical energy measurement Tech. Def.: Energy Meter	Enercon / Ducati Or energy meter having similar specification	Line-III CCR Sub-station at VC site	Digital Calibration software is in built in the energy meter.	100 kWH - 900 kWH +/- 0.25%	+/- 1 digit	-

Sr. no.	Data description	Procedure for monitoring the parameter	Traceability of calibration method/ standard	Tag no OR equipment serial no of instrument	Service & Tech def. Of instru and measuring	Make of instrument	Location of instrument	Calibration Method	Least Count and range of instrument	Uncertainty	Linkage with system management, ISO doc number
		conveying alternate fuel	Enercon make & For DUCATI make they follow the standard of FLUKE 5500A								

The monitoring plan for the project is based on ACM0003 methodology and discussed in section D. All the parameters are monitored as per the frequency of monitoring and recording. Based on the formulae described in the methodology; emission reductions are calculated and presented in the table below.

Emission Reduction Calculation

Available as separate attachment

IRR analysis

Available as separate attachment

Appendix i

Abbreviation

CDM	Clean development mechanism
CER	Certified emission reduction
CMA	Cement manufacturers association
CO_2	Carbon dioxide
Distt	District
EIA	Environment impact assessment
Equ	Equivalent
Gcal	Giga calories (10^9 calories)
GHG	Greenhouse gas
IPCC	Inter governmental panel on climate change
IRR	Internal Rate of Return
Km	Kilometer
KWh	Kilo watt hour
MNES	Ministry of Non-conventional Energy Source
MoEF	Ministry of Environment & Forest
MTPA	Million tonne per annum
PDD	Project design document
p.a.	Per annum

INR	Indian rupees
Sp	Specific
UNFCCC	United Nations Framework Convention on Climate Change
VC	Vikram cement

Appendix ii

References

Sl. No.	Particulars of the references
1	Kyoto Protocol to the United Nations Framework Convention on Climate Change
2	Website of United Nations Framework Convention on Climate Change (UNFCCC), http://unfccc.int
3	Cement Statistics 2005, Cement Manufacturers Association (CMA)
4	Revised 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual
5	Information received by technology supplier
6	www.ceaindia.nic

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