**CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 02 - in effect as of: 1 July 2004)**

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**Annexes**



**Enclosures**

## SECTION A. General description of project activity

### A.1 Title of the project activity:

>> Optimum utilisation of clinker by PPC production at Binani Cement Limited, Rajasthan.

Version 01

Date: 01/11/2005

### A.2. Description of the project activity:

>> Binani cement Ltd is one of the progressive private sector cement manufacturing company. Binani Cement plant was commissioned in July 1997 with a capacity of 1.65 million tones[1]. The present capacity of plant is 2 million TPA; which is a result of optimisation of the present equipment capacities and energy efficiency activities completed in 2002-03. The Binani Cement's project on "Optimum utilisation of clinker by PPC production" is one of major step towards sustainable development.

The project activity entails a reduction of the clinker content by producing the Portland Pozzolana Cement (PPC) thereby replacing an equivalent amount of clinker at Binani Cement's cement manufacturing units at Binanigram, Rajasthan.

Clinker is one of the most important raw materials for cement production. Clinker manufacturing includes:

1. Pre-processing (grinding) and
2. Pyro-processing of the raw meal

The clinker manufacturing process is an energy intensive process. The project activity aims to optimally utilize the clinker in PPC manufacturing. The reduction of clinker percent in the PPC by the project activity would conserve natural resources like limestone and coal fuel used to meet the process, thermal and electrical energy requirements of pre-processing and pyro-processing of cement manufacturing. The project activity would therefore reduce direct onsite emissions from clinkerisation and direct off-site emissions due to power generation at the thermal power plants per unit of cement produced.

The project activity started (fly ash blending) in the year 2003-04 with 26.64 % additive in the PPC production. This percentage additive was more than the highest fly-ash blending percentage (25.09%) of the region before project activity implementation (base year 2002-03). Binani Cement proposes to further increase the additive % in PPC over the next 10 years crediting period. The implementation of the project activity required Binani cement to develop more infrastructure to blend the additives in PPC and overcome the barriers related to availability of additives required, technical aspects related use of PPC product and market resistance.

The project activity contributes to sustainable development at the local, regional and global levels in the following ways:

[1] www.binani.com

**Direct and indirect reduction of GHG emissions**

Clinker production from raw meal is the main source of $CO_2$ emission in cement production. Project activity reduces the clinker percent in cement production by use of fly ash (alternative waste material from coal based power plants) and results in direct and indirect GHG emission reductions.

**Industrial waste utilization**

Project activity uses fly ash for the PPC manufacturing, which is an industrial waste of power plants. Disposal of fly ash is one of the major environmental problems of the coal based thermal power plants. The project activity facilitates fly ash utilization and reduces the environmental degradation due to coal fired thermal power plants. Fly ash utilisation in PPC manufacturing also reduces:

***Land pollution:*** In normal practice fly ash is dumped on the landfills, which creates land pollution in long run. Project activity reduces the burden of the ever-increasing volume of waste in landfills as well as utilise it properly.

***Water contamination:*** Project activity reduces problems arising from landfill leaching, by reducing the fly ash in the landfill sites.

Further, the project indirectly encourages development of waste management infrastructure and associated value chains between two different types of industries mutually support each other's operation. Thus, the external activities of the project links two sectors of industries and expedites similar proactive action from industries to find avenues and opportunities for exchange of waste products and decrease cost of waste management.

**Thermal and electrical energy conservation**

The project activity reduces specific thermal and electrical energy consumption for PPC production and conserves the energy. Indian economy is highly dependent on "Coal – a finite natural resource" as fuel to generate power and heat for production processes. Since, the project activity reduces coal based thermal and electrical energy demand, it positively contributes towards conservation of coal, a non-renewable natural resource and making coal available for other important applications. The savings in electrical energy demand would also means savings in electricity lost during transmission and distribution.

**Resource Conservation**

The project activity conserves the resources in following way:

1. Reduces the quantum of limestone required per unit of PPC produced
2. Reduces the coal used per unit of PPC production

This resource conservation helps in sustainable development by the ways of

1. Reducing quarry mining for lime extraction
2. Reducing associated fugitive dust emissions
3. Reducing land destruction and erosions arising from such activities.

4. Reducing adverse heath impacts caused from quarrying of materials on the mining persons, nearby habitats and ecosystem.

Therefore, the project activity contribute to improvement of environmental issues in terms of reduction of carbon emissions, limestone resource conservation, coal conservation, decreased environmental destruction and enhanced restoration, economical and social prosperity by opening avenues for investment in waste management.

**A.3. Project participants:**

>>

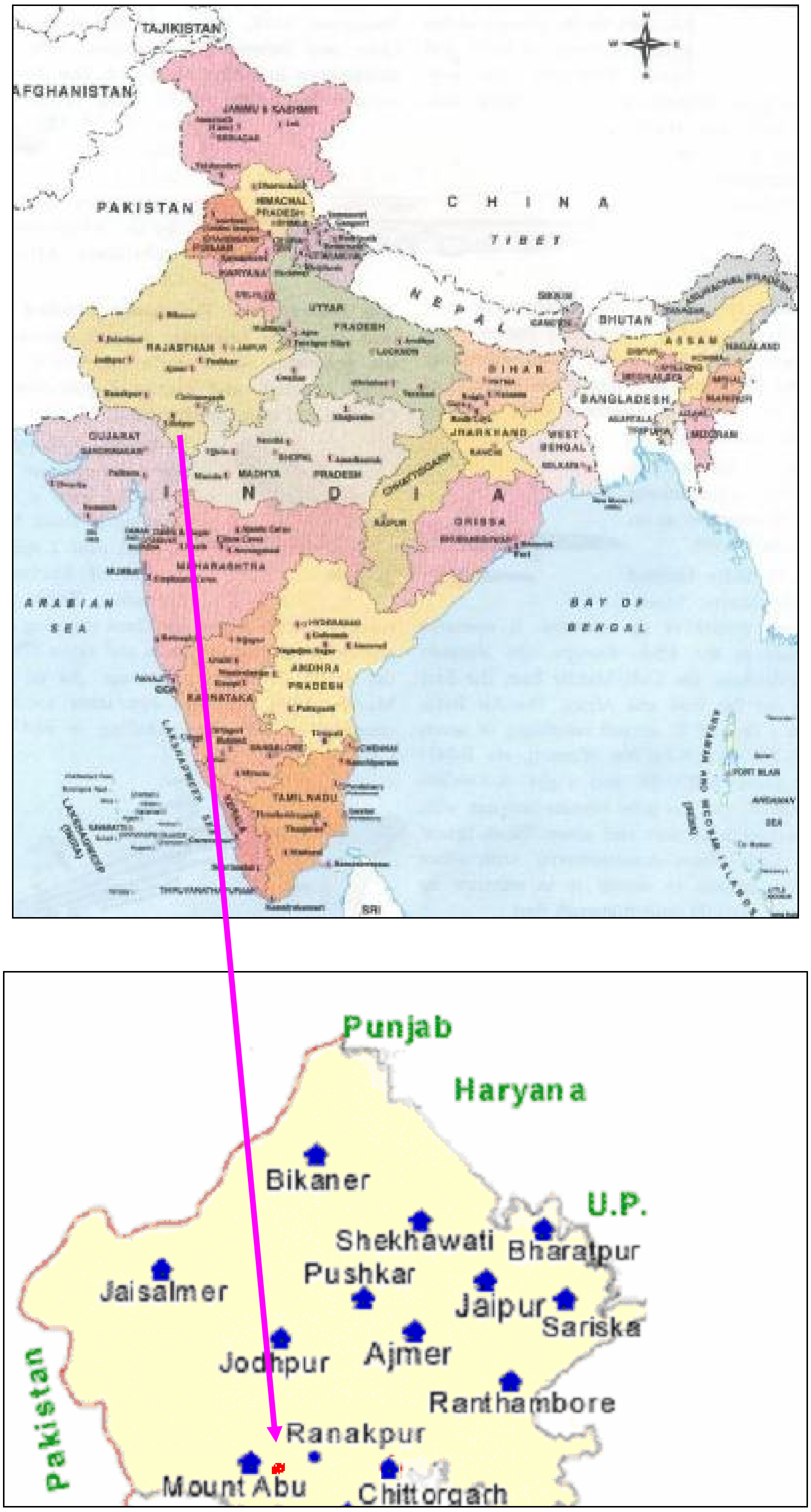
| Name of Party involved ((host) indicates a host Party) | Private and/or public entity(ies) project participants(as applicable) | Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No) |
|---|---|---|
| India | ***Private entity:*** Binani cement Limited, P.O. Binanigram 307025, Tehsil: Pindwara, Dist. Sirohi Rajasthan<br>***Public entity***: Ministry of environmental and forest (MoEF) | No |

**A.4. Technical description of the project activity:**

**A.4.1. Location of the project activity:**

>> The project activity location is shown in the map below:

**Location of project activity site**



**A.4.1.1. Host Party(ies):**

>> India

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

>> Rajasthan

**A.4.1.3. City/Town/Community etc:**

>> Binanigram, Tehsile: Pindwara, District: Sirohi

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

>> Binani Cement is strategically located at Binanigram, district Sirohi in state of Rajasthan. The site is advantageous for its easy accessibility to limestone mines from the Aravalli range of Pindwara belts. The plant is located near NH-14 (Ahmedabad-Delhi) highway. The coordinates of the site are as follows:

Latitude: 24°48’-24°51’

Longitude: 73°4’-73°9’

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

>> The project activity is a cement sector specific project activity. The project activity may principally be categorized in scope 4: Manufacturing Industries as per the scope of the project activities enlisted in the ‘list of sectoral scopes with approved methodologies’ for accreditation of operational entities.

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

>> The project activity includes the following sub systems:

1. Feeding of fly ash from power plant to fly ash silo.
2. Fly ash handling and feeding system to cement mill
3. Fly ash mixing and Portland Pozzolona Cement (PPC) storage silo
4. Modification in the existing cement mill circuit

Fly ash is transported from power plant to fly ash silo through tankers having inbuilt unloading pneumatic facility.

Fly ash feeding system to cement mill consists 2 stages:

1. Fly ash is extracted from the silo and fed to weighing bin though control valves.
2. From weighing bin to outlet of cement mill no. 1 through air slides.

The quantity of fly ash is controlled by the solid flow meter at the mill outlet. Fly ash is mixed with clinker and transported through elevator and feed to Sepex separator for required fineness. The accuracy of weighing and feeding system is +/- 3 %. Bag dust collectors are installed for arresting of dust.

The technology adopted is simple and environmentally safe. Bag dust collectors are provided at top of the fly-ash silo to vent out transport air during unloading of fly-ash from tankers and also aeration air, which is provided at bottom of the silo. The project proponent modified the cement mill circuit for the fly ash blending and preparation of the blended cement.

**A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed CDM project activity, including why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances:**

>> The project activity would reduce the clinker percent in PPC produced. Since clinker manufacturing process results in process emissions, emissions related to thermal and electrical energy consumption, the project activity with reduction in clinker content will reduce direct on-site emissions from calcinations reduced clinker production and reduced thermal energy consumption and direct off-site emissions at the thermal power plants due to reduced electrical energy consumption.

Though the Ministry of Environment and Forest (MoEF), Ministry of Power (MoP) and Ministry of Non conventional Energy Sources (MNES) in India encourages energy conservation, there is no compulsion for cement industries to reduce their specific energy consumption to a prescribed standard. Nor do the Department of Industries/ the Bureau of Indian Standards/ Cement Manufacturers Association/ National Council for Building Materials have imposed any directives towards reduction in clinker content in cement manufacturing. The project proponent has implemented the project activity over and above the national or sectoral requirements. The GHG reductions achieved by the project activity are additional to those directed by the governmental policies and regulations. The other "additionality" criteria of the project activity are dealt with in section B.

The GHG performance of Binani Cement in absence of the CDM project activity would be in line with the only OPC production, which was the case in base year. The baseline carbon emission factor of the system boundary as per the proposed baseline methodology was estimated as 0.7081 t$CO_2$/t PPC and the baseline emissions for the same production plan would be 6,297,249 tonnes of $CO_2$ emissions over a crediting period of 10 years (details have been provided in Section B and E).

However, Binani Cement decided to produce PPC cement and market it by making additional efforts in the direction of overcoming the stiff resistance by the consumers and government bodies. With CDM project activity implementation the GHG performance of Binani Cement over 10 years of crediting period would be of the order of 6,105,038 tonnes of $CO_2$ emissions and the $CO_2$ emission reductions would amount to 192,211 tonnes.

**A.4.4.1. Estimated amount of emission reductions over the chosen crediting period:**

>> Crediting period of 10 years has been chosen for the project activity

**Table 1: Emission reductions of the project activity**

| Years | Annual estimation of emission reductions in tonnes of $CO_2$ e |
|---|---|
| 2003-2004 | 3688 |
| 2004-2005 | 6895 |
| 2005-2006 | 13846 |
| 2006-2007 | 17628 |
| 2007-2008 | 19390 |
| 2008-2009 | 21326 |
| 2009-2010 | 23560 |
| 2010-2011 | 26027 |
| 2011-2012 | 285052 |
| 2012-2013 | 31349 |
| **Total estimated reductions** (tonnes of $CO_2$ e) | **192211** |
| **Total number of crediting years** | 10 |
| **Annual average over the crediting period of estimated reductions (**(tonnes of $CO_2$ e) | **19221** |

**A.4.5. Public funding of the project activity:**

>> No public funding from parties included in Annex – I are available to the project.

## SECTION B. Application of a baseline methodology

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

>> **Title**: Consolidated Baseline methodology for increasing the Blend in cement production

(ACM0005)

**Reference**: UNFCCC website

**Approach:** Existing actual or historical emissions, as applicable; [as per 48 (a) of CP 7/17]

#### B.1.1. Justification of the choice of the methodology and why it is applicable to the project activity:

>> This methodology is applicable to projects that increase the share of additives (i.e. reduce the share of clinker) in the production of cement types beyond current practices in the country. Binani Cement project activity increases the share of additive in PPC beyond current practices in the region and Binani Cement's project activity meets all the applicability conditions of the consolidated methodology. The same has been discussed herein.

The applicability of methodology is justified as following

There is no shortage of additives to prevent leakage related to the lack of blending materials. Project participants should demonstrate that there is no alternative allocation or use for the additional amount of additives used in the project activity. If the surplus availability of additives is not substantiated the project emissions reductions (ERs) will be discounted.

The project activity uses fly ash (as additive) a waste generated in thermal power plants. Fly ash is available abundantly in the thermal power plants. Binani Cement takes fly ash from Sabarmati thermal power plant, Gandhi Nagar thermal power plant, Torrent power station where surplus fly ash is available.

This methodology is applicable to domestically sold output of the project activity plant and excludes export of blended cement types

Binani Cement does not export PPC and all the output of the project activity are sold in domestic market only.

Adequate data are available on cement types in the market

Adequate data on cement types in the market is available through reports published by Cement Manufacturers Association, India.

The Binani Cement's project activity fulfils all the applicability conditions described in the consolidated methodology. Hence the consolidated baseline methodology for increasing the blend in cement production is appropriate for Binani Cement's project activity.

**B.2. Description of how the methodology is applied in the context of the project activity:**

>> The methodology is based on a systematic, step-wise approach that is applied as under for selecting an appropriate region for the project activity hosting plant, identifying the alternatives available to the project proponent, determining the benchmark for baseline emissions, establishing additionality of the project activity and estimating the emission reductions resulting from the project activity:

**Selection of the region for the project activity hosting plants**

The methodology requires the project proponent to determine the region for the project activity hosting plant by selecting an appropriate geographic boundary where the project plant is physically situated and catering their PPC production.

Binani Cement plant is located in Rajasthan and catering mainly to Rajasthan, Gujarat & Haryana. The other small markets for Binani Cement are Delhi, Punjab, UP, J & K, Uttaranchal, Chhatisgarh etc. The market break up for the Binani Cement in the base year (2002-2003) is given in the table below:

| Table B-1: Selection of market for the project activity hosting plant considering their sales | |
|---|---|
| **Parameters** | **Base Year (2002-2003)** |
| Total PPC Despatch ('000MT) | 348.55 (100%) |
| **Sales in other states** | |
| Rajasthan | 144.26 (41.39%)[2] |
| Gujarat | 105.30 (30.21%) |
| Haryana | 43.6 (12.51%) |
| Delhi | 17.43 (5%) |
| Punjab | 15.58 (4.47%) |
| UP | 19.73 (5.66%) |
| J & K | 1.08(0.31%) |
| Uttaranchal | 0.77(0.22%) |
| Himanchal Pradesh | 0.03(0.01%) |
| Chandigarh | 0.07(0.02%) |

[2] % of the cement catered in different markets.

| | |
|---|---|
| Internal consumption | 0.07(0.2%) |

The project proponent is required to select the region for the baseline calculation in which the project activity plant is supplying at least 75% of their blended cement production. As per the methodology, the national market can be chosen by default; however the geographic boundary of India being very large, the key parameters affecting the percentage of additive blending vary widely in cement manufacturing units across the country depending on the local scenarios (like fly ash availability, customers' perception and market acceptability etc). As a result measures like increased additive blending in cement production, undertaken in different cement manufacturing units all over India are not exposed to similar economic and market circumstances. Therefore the project proponent has considered the geographic extent of the states where the project plant caters their cement production in order to arrive at the region for the project activity hosting plant.

Table B.1 above clearly establishes that primarily the project activity hosting plant cater their cement production mainly to Rajasthan (41.39%), Gujarat (30.21%) & Haryana (12.51%) states.

Therefore considering both the aspects of location and primary market of the project activity hosting plant, the geographic boundary of the Rajasthan, Gujarat & Haryana has been considered as the region for the project activity hosting plant. The following plants come under the region of project activity cement plant.

| **Table B-2: Plants catering to the markets as that of the project activity hosting** plant | |
|---|---|
| **Name of Plants** | **Cluster**[3] |
| **Binani Cement Limited** | |
| **Rajasthan** | |
| ACC Lakheri | Chanderia |
| Birla cement | Chanderia |
| Chittor cement | Chanderia |
| Mangalam Cement | Chanderia |
| Neershree cement | Chanderia |
| Aditya cement | Chanderia |
| JK Nimbahera | Chanderia |
| JK Mangrol | North Rajasthan |
| Lakshmi | North Rajasthan |
| JK Udaipur Udyog | North Rajasthan |
| Ambuja Rajasthan | North Rajasthan |

[3] The cement industries in India have been classified into clusters taking into consideration the geographical aggregation of the cement plants India. This concept of 'clusterisation' has been further elaborated in the economic considerations.

| | |
|---|---|
| Shree Cement | North Rajasthan |
| Binani | North Rajasthan |
| Shiram cement | Chanderia |
| **Gujarat** | |
| Sikka | Gujarat |
| Saurashtra Cement | Gujarat |
| Gujarat siddhi cement | Gujarat |
| Porbander | Gujarat |
| L & T Gujarat | Gujarat |
| Jafarabad | Gujarat |
| Magdalla | Gujarat |
| Gajambuja | Gujarat |
| Ambuja Kodinar | Gujarat |
| **Haryana** | |
| Charkhi Dadri | Others |

As per the methodology, the region selected for the project activity hosting plant needs to satisfy the following conditions:

*i) "at least 75% of project activity plant's cement production is sold (percentage of domestic sales only)"*

In the year 2002-2003, Binani Cement plant sold 348549 MT of PPC in the domestic market which included a sale of 293165 MT in the states included in the selected region. Therefore around 84.1% (>75%) of the cement of Binani Cement plant was sold in the selected region in the year 2002-2003.

Therefore the region selected for the Binani cement plant satisfies the above condition.

ii) *"includes at least 5 other plants with the required published data"*

The region selected for Binani Cement plant includes twenty four (24>5) plants.

Therefore the region selected for Binani Cement plant satisfies the above condition.

iii) *"the production in the region is at least four times the project activity plant's output"*

The total PPC production in the region is 4264409 MT; which is more than six (6.5>4) times of the cement production of the project activity plant.

Therefore the region selected for the project activity hosting plant is justified.

**Identification of the alternatives**

As per the methodology, the project proponent is required to identify all the realistic and credible alternatives or production scenarios for the relevant cement type (i.e. PPC) that were available to them in absence of the project activity and that are consistent with current rules and regulations. These alternatives would provide output or services comparable with the project activity.

Binani Cement has identified the following alternatives to the project activity:

Alternative 1: Continuation of the existing practice of cement (PPC) production
Alternative 2: Implementation of the project activity not undertaken as a CDM project activity
Alternative 3: Implementation of cement (PPC) production practice as in other manufacturing plants in the region using similar input/raw materials, and facing similar economic, market and technical circumstances.

**Alternative 1: Continuation of the existing practice of cement (PPC) production**

In absence of the project activity, Binani Cement may propose to continue the PPC production with "the mass percentage of clinker in the relevant cement type produced in the proposed project activity plant before the implementation of the CDM project activity."

Alternative-1 is in compliance with all applicable legal and regulatory compliances and may be the baseline alternative. Since the Alternative-1 is the status quo and does not face barriers that would prevent its implementation (as per Step 3: Barrier Analysis of the "Tool for the demonstration and assessment of additionality") it is considered as one of the most probable baseline scenario.

The mass percentage of clinker in the relevant cement type produced in the proposed project activity plant before the implementation of the CDM project activity has been determined as per the guidance provided in point (iii) of the 'Baseline emissions' section of the consolidated baseline methodology. Please refer to Bench mark determination and Baseline emission calculations given below.

**Alternative 2: Implementation of the project activity not undertaken as a CDM project activity**

Binani Cement may propose to produce PPC with a lower clinker percentage as in the project activity scenario.

Alternative-2 is also in compliance with all applicable legal and regulatory compliances and may be the baseline alternative.

However this alternative would have faced the barriers as that of the project activity under consideration (all these barriers are detailed in "Barrier Analysis" in Section-B.3 given below). Hence without the CDM revenue which would actually supplement the financial burdens associated with the R&D and promotional activities of the PPC produced, this alternative would not be a feasible option for Binani Cement.

**Alternative 3: Implementation of cement (PPC) production practice as in other manufacturing plants in the region using similar input/raw materials, and facing similar economic, market and technical circumstances.**

In absence of the project activity, Binani Cement may produce PPC with a clinker percentage, which was the common prevailing practice in other cement manufacturing plants in the southern region using similar input/raw materials, and facing similar economic, market and technical circumstances.

The region for the project activity hosting plant has already been determined above and all the plants supplying PPC in the region have been identified.

The methodology requires the project proponent to determine the common prevailing clinker percentage in PPC in other cement manufacturing plants in the region "using similar input/raw materials, and facing similar economic, market and technical circumstances."

Each of these considerations has been dealt with below:

Similar input/raw materials

The project activity entails an increase in additive blending in PPC production in the cement manufacturing unit of Binani Cement. The basic raw materials for PPC production are limestone and different calcareous materials (like clay, shale, sand and iron ore containing calcium, silica, alumina and iron oxides) along with gypsum and other pozzolana additives (like fly ash). The primary raw materials used in PPC production are same for all the cement manufacturing units producing PPC. In cement manufacturing the quality of raw material is very important. Good quality raw material helps in production of very good quality clinker, which gives the flexibility to add more quantity of blending materials. The plants already started the CDM project before the project activity years are excluded from the baseline calculation. Some plants in the region are using good quality limestone from the mines which are far from the cement manufacturing plant; those plants are not considered in the baseline calculations.

Similar market circumstances

Indian cement market is divided in 22 major markets. The Binani Cement plant is in North Rajasthan cluster and caters to the Ahmedabad, Surat, Jaipur and Delhi markets.

**Table B.3 Main markets of different cluster**

| Sr. No. | Market \ Cluster | Satna | Bilaspur | Gulbarga | Chandrapur | Chanderia | Nalgonda | Yerraguntla | Gujarat | HP + Punjab | Orissa | North Rajasthan. | TN + Kerala | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | Ahmedabad | | | | | | | | M | | | M | | |
| 2. | Mumbai | | | M | O | | | | M | | | | | |
| 3. | Pune | | | M | O | | O | | | | | | | |
| 4. | Surat | | | | | | | | M | | | M | | |
| 5. | Nagpur | | M | | M | | | | | | | | | |
| 6. | Hyderabad | | | O | O | | M | | | | | | | |
| 7. | Bangalore | | | M | O | | O | M | | | | | | |
| 8. | Chennai | | | | | | O | M | | | | | M | |
| 9. | Cochin | | | | | | M | O | | | | | M | |
| 10. | Vizag | | O | | | | M | | | | | | | |
| 11. | Trivandrum | | | | | | | O | | | | | M | |
| 12. | Raipur | | M | | | | | | | | | | | |

| Sr. No. | Cluster / Market | Satna | Bilaspur | Gulbarga | Chandrapur | Chanderia | Nalgonda | Yerraguntla | Gujarat | HP + Punjab | Orissa | North Rajasthan. | TN + Kerala | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13. | Patna | M | O | | | | | | | | O | | | M |
| 14. | Calcutta | | M | | | | | | | | O | | | M |
| 15. | Guwahati | M | M | | | | | | | | O | | | M |
| 16. | Bhubaneshwar | | O | | | | | | | | M | | | O |
| 17. | Jamshedpur | | M | | | | | | | | O | | | M |
| 18. | Bhopal | M | O | | | | | | | | | | | |
| 19. | Lucknow | M | | | | | | | | | | | | M |
| 20. | Delhi | O | | | | M | | | | | | M | | |
| 21. | Jaipur | | | | | M | | | | | | M | | |
| 22. | Amritsar | | | | | M | | | | M | | | | |

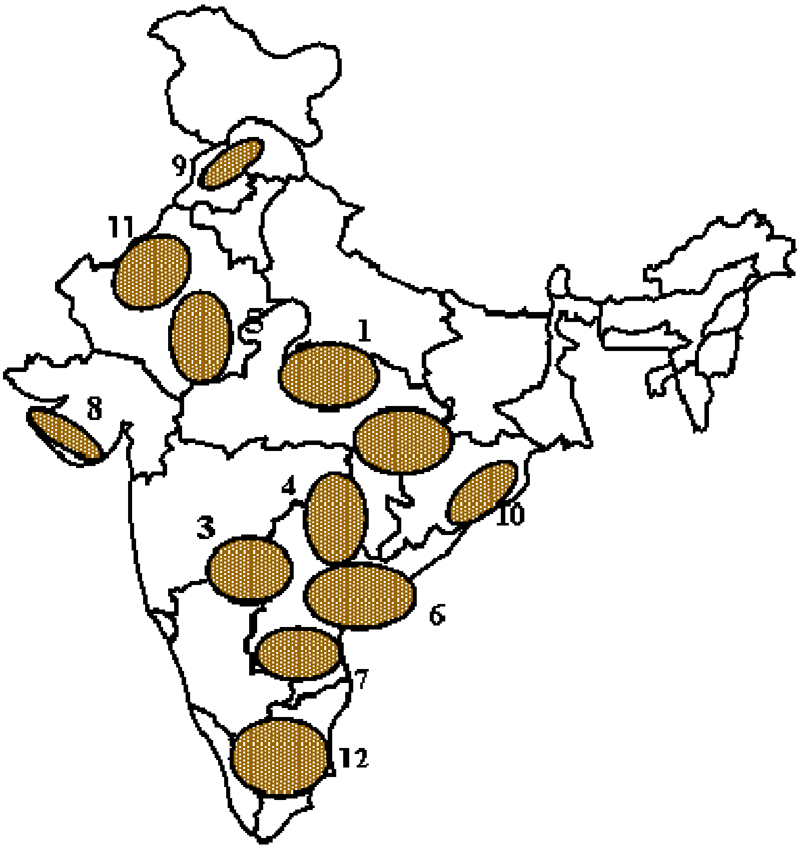
The cement manufacturing plants in the Gujarat and Chanderia clusters of the selected region are sharing major markets with North Rajasthan cluster (Chanderia catering to Delhi & Jaipur and Gujart Cluster catering to Ahemdabad & Surat markets common to North Rajasthan cluster). Therefore the market circumstances of all the plants in Gujarat, Chanderia and North Rajasthan clusters of the selected region are similar including that of the project activity hosting plant.

Similar economic circumstances

Since all the plants in the Gujarat, North Rajasthan & Chanderia clusters in the selected region have similar market circumstances, the project proponent is required to conduct a comparison in the 'economic circumstances' amongst the cement plants of Gujarat, North Rajasthan & Chanderia cluster based on the parameters like cost of raw material (lime), energy (fuel and electricity) and fly ash (which would include transportation/ purchase/ handling costs).

The availability and cost of the limestone is one of the most important factors among all the other factors, which influence the economical considerations. This factor has played a major role in the cement plant locations and has resulted in geographical aggregation or clusterisation of the cement plants in and around the limestone reserves of India. The cement industries have been classified into several clusters taking into consideration this geographical aggregation of the cement plants in India.

Figure B-1: Map of India illustrates the geographic location of the cement clusters




| | |
|---|---|
| 1 | Satna |
| 2 | Bilaspur |
| 3 | Gulbarga |
| 4 | Chandrapur |
| 5 | Chanderia |
| 6 | Nalgonda |
| 7 | Yerraguntla |
| 8 | Gujarat |
| 9 | Himachal Pradesh-Punjab |
| 10 | Orissa |
| 11 | North Rajasthan |
| 12 | Tamil Nadu + Kerala group |

The project activity has been undertaken at the manufacturing unit of Binani Cement, which falls under the North Rajasthan cluster.
The cement plants in the same cluster will have similar economic circumstances due to similar proximities to the required quality of limestone, coal reserves, gypsum and fly ash and similar locational advantages whereas the cement plants in different clusters will differ with respect to the above parameters and therefore will have varied economic circumstances in terms of fair price of cement based on cost of input raw material and operational cost. Based on cost of input raw material and operation costs ONE report has

published the fair price of cement. The Table B-4 provides a comparison of the economic circumstances of the Gujarat, North Rajasthan & Chanderia cluster.

**Table B.4 Fair price of cement based on average cost basis**

| | **Sr. No.** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Markets >>>** | Ahmedabad | Mumbai | Pune | Surat | Nagpur | Hyderabad | Bangalore | Chennai | Cochin | Vizag | Trivandrum |
| Sr. No. | **Cluster** | | | | | | | | | | | |
| 1 | Satna | | | | | | | | | | | |
| 2 | Bilaspur | | | | | 150 | | | | | 168 | |
| 3 | Gulbarga | | 180 | 165 | | | 150 | 171 | | | | |
| 4 | Chandrapur | | 172 | 168 | | 137 | 141 | 183 | | | | |
| 5 | Chanderia | | | | | | | | | | | |
| 6 | Nalgonda | | | 182 | | | 156 | 181 | 173 | 195 | 162 | |
| 7 | Yerraguntla | | | | | | | 197 | 192 | 218 | | 230 |
| 8 | Gujarat | 175 | 193 | | 188 | | | | | | | |
| 9 | Himachal Pradesh-Punjab | | | | | | | | | | | |
| 10 | Orissa | | | | | | | | | | | |
| 11 | North Rajasthan | 163 | | | 171 | | | | | | | |
| 12 | Tamil Nadu + Kerala group | | | | | | | | 181 | 181 | | 190 |
| 13 | Others | | | | | | | 177 | | | | |
| | *Minimum* | *163* | *172* | *165* | *171* | *137* | *141* | *171* | *173* | *181* | *162* | *190* |
| | *Maximum* | *175* | *193* | *182* | *188* | *150* | *156* | *197* | *192* | *218* | *168* | *230* |

| | **Sr. No.** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **20** | **21** | **22** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Markets >>>** | Raipur | Patna | Calcutta | Guwahati | Bhubaneshwar | Jamshedpur | Bhopal | Lucknow | Delhi | Jaipur | Amritsar |
| Sr. No. | **Cluster** | | | | | | | | | | | |
| 1 | Satna | | 169 | | 210 | | | 163 | 164 | 171 | | |
| 2 | Bilaspur | 140 | 173 | 175 | 200 | 160 | 158 | 174 | | | | |
| 3 | Gulbarga | | | | | | | | | | | |
| 4 | Chandrapur | | | | | | | | | | | |
| 5 | Chanderia | | | | | | | | | 135 | 136 | 151 |

| | Sr. No. | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Markets >>>** | Raipur | Patna | Calcutta | Guwahati | Bhubaneshwar | Jamshedpur | Bhopal | Lucknow | Delhi | Jaipur | Amritsar |
| 6 | Nalgonda | | | | | | | | | | | |
| 7 | Yerraguntla | | | | | | | | | | | |
| 8 | Gujarat | | | | | | | | | | | |
| 9 | Himachal Pradesh-Punjab | | | | | | | | | | | 146 |
| 10 | Orissa | | 159 | 165 | 192 | 154 | 143 | | | | | |
| 11 | North Rajasthan | | | | | | | | | 169 | 171 | |
| 12 | Tamil Nadu + Kerala group | | | | | | | | | | | |
| 13 | Others | | 150 | 159 | 181 | 162 | 131 | | 145 | | | |
| | *Minimum* | *140* | *150* | *159* | *181* | *154* | *131* | *163* | *145* | *135* | *136* | *146* |
| | *Maximum* | *140* | *173* | *175* | *210* | *162* | *158* | *174* | *164* | *171* | *171* | *151* |

The above table clearly establishes that the fair prices for different markets are different. The table below shows the fair prices of the clusters in the selected region with the common markets.

**Table B.5: Fair price of cement from different clusters to different markets**

| Cluster/Market | Ahemdabad | Surat | Delhi | Jaipur |
|---|---|---|---|---|
| **Chanderia** | | | 135 (-34) | 136 (-35) |

| | | | | |
|---|---|---|---|---|
| **North Rajasthan** | 163 | 171 | 169 | 171 |
| **Gujarat** | 175 (+12[4]) | 188 (+17) | | |

[4] Values in brackets shows the price variations with respect to prices in North Rajasthan cluster. Posive sign indicates the higher prices and negative sign shows the less prices with respect to North Rajasthan cluster.

The above table reflects that the average cost in the chanderia cluster is very low as compared with the North Rajasthan cluster. At the same time the fair prices in the Gujarat cluster is high. The plants in chanderia clusters are having more margins on the products and they can sell the product at lower cost; so the plants in chanderia cluster are not considered in the baseline emission calculations. The Plants having less than 5% PPC productions out of there total productions are also not facing the market barriers because of very less quantities. So these plants are not considered in the baseline calculations.
Thus considering all the above mentioned key economic parameters, it is established that the cement plants in the North Rajasthan and Gujarat cluster would have similar economic circumstances.

Similar technical circumstances
The project proponent is required to compare the 'technical circumstances' of the cement plants in North Rajasthan and Gujarat cluster with regards the availability and use of the basic technology for the three distinct phases of the cement manufacturing process viz.- Raw material preparation, Clinker production (including clinker grinding) and Cement manufacturing. Most of the cement plants in India manufacture cement through dry process. Thus the basic technology adopted by Indian cement industries in the dry process is similar.
It can be inferred from the above discussions that the identified cement plants in North Rajasthan and Gujarat cluster would produce PPC with 'similar input/ raw materials' under 'similar market, economic and technical circumstances' and would therefore be considered for estimating the common prevailing clinker percentage in PPC.
Since the Alternative-3 is the prevailing practice and does not face barriers that would prevent its implementation (as per Step 3: Barrier Analysis of the "Tool for the demonstration and assessment of additionality") it is considered as one of the most probable baseline scenario.
The mass percentage of clinker in the PPC produced in the proposed project activity plant as per the practices in other manufacturing plants in the North Rajasthan and Gujarat cluster has been determined as per the guidance provided in point (i) and point (ii) of the 'Baseline emissions' section of the consolidated baseline methodology. Please refer to Benchmark determination and Baseline emission calculations given below.

**Benchmark determination and Baseline emission calculations:**
The mass percentage of clinker in PPC has been calculated for Alternative 1 and Alternative 3 as per the guidance provided in the consolidated baseline methodology and is tabulated below in Table B-6.

| Sl. No | Condition | Mass percentage of clinker in PPC (Tonne of clinker / Tonne of PPC ) | The lowest value among the following is to be selected as benchmark for baseline emissions. |
|---|---|---|---|

| | | | |
|---|---|---|---|
| | **Alternative 3:** | | |
| 1 | The average (weighted by production) mass percentage of clinker for the 5 highest blend cement brands for PPC in the North Rajasthan and Gujarat cluster | 0.7705 | ✘ |
| 2 | The production weighted average mass percentage of clinker in the top 20% (in terms of share of additives) of the total production of the PPC in the North Rajasthan and Gujarat cluster | 0.7541 | ✘ |
| | **Alternative 1:** | | |
| 3 | The mass percentage of clinker in PPC produced in Binani Cement before the implementation of the CDM project activity during the year 2002-2003. | 0.7511 | ✔ |

It is reflected from the above table that the baseline option 3 has the lowest mass percentage of clinker in cement, so this will be the benchmark baseline scenario. Since the baseline is dynamic, an increasing endogenous trend of 2% increase in additive over the percentage of additive at the start of the project activity has been incorporated.

**Estimating the emission reduction resulting from the project activity**

The emission reduction resulting from the project activity is estimated as a difference between the baseline emissions, project emissions and leakage.

Baseline Emissions

As per the methodology,

*"The baseline emissions are a function of two factors:*

i. *the percentage of additives and the related electricity consumption that is taken as the baseline benchmark; and*
ii. *the $CO_2$ emissions per tonne of clinker in the Binani Cement project activity plants, which in turn depends on*
   (a) *Quantity and carbon intensity of the fuels used in clinker making;*
   (b) *Quantity and carbon intensity of electricity;*
   (c) *$CO_2$ emissions from calcinations."*

For detailed calculations of baseline emissions in the base year 2002-2003, please refer to Enclosure 1: Calculation of Baseline Emission Factor and Enclosure 4: Emission Reductions.

Since Binani cement plant meets its partial electricity requirement from the Rajasthan state grid, which has substantial electricity imports from the state grids in the Northern Region, the baseline grid emission factor is determined for the Northern Regional grid according to Approved Consolidated Methodology ACM0002.

Since this methodology is restricted to increase in percentage of blend only and not to efficiency improvements or fuel switching, in case

(i) the emissions per tonne of clinker during the crediting period are less than baseline, the baseline value is substituted by the project activity value

(ii) the emissions per tonne of clinker are higher during the crediting period than the baseline, it could be due to declining efficiency or fuel switch or some other reason. Under such circumstances the baseline value is used and in case negative emission reductions arise in a year, ERs are not issue until emission reductions from subsequent years have compensated the negative quantum.

Project Emissions

The project emissions resulting after the implementation of the project activity is also calculated as per the guidance provided in ACM0005 for each of the years of the proposed crediting period (2003-2013).
For detailed calculations of project activity emission factors and the project activity emissions in the crediting period 2003-2013, please refer to Enclosure 2: Calculation of Project activity Emission Factor and Enclosure 4: Emission Reductions.

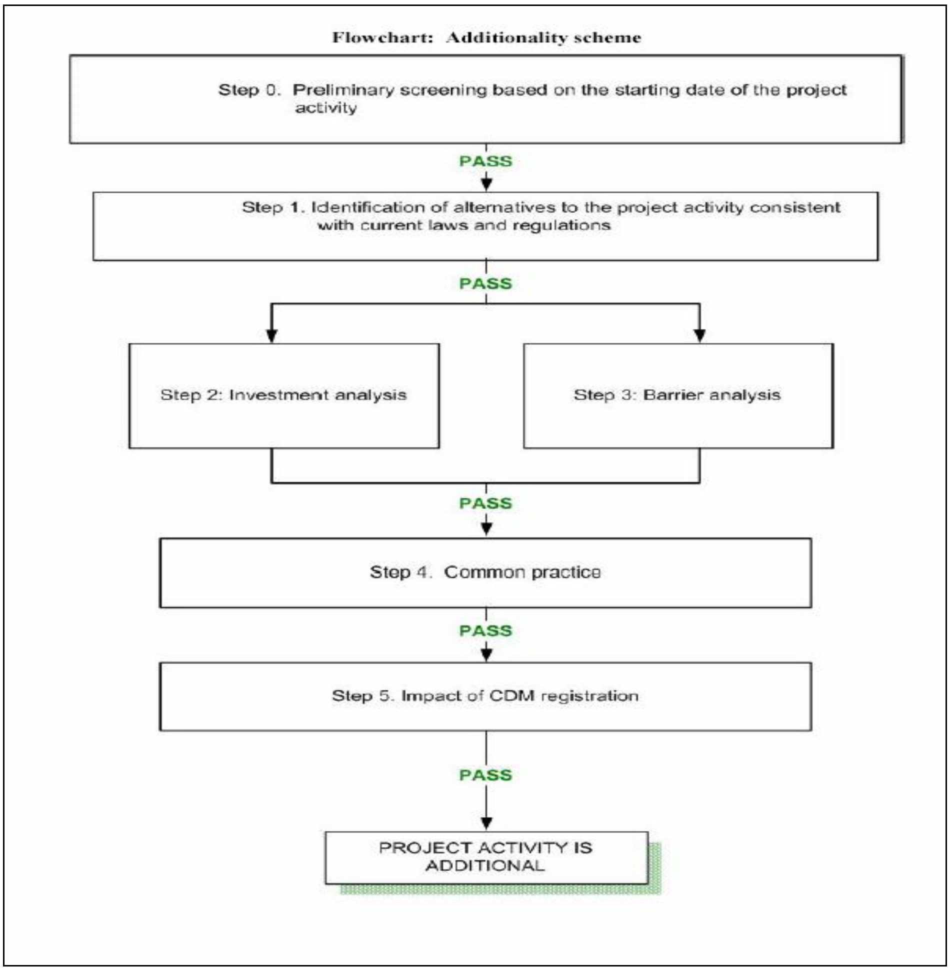
Leakage

The project proponent is also required to account for any leakage which may be attributed to the project activity. Any transport related emissions for the delivery of additional additives would be included in the emissions related to the project activity as leakage. Reduction of clinker percentage in PPC results in reduced limestone and coal consumption per ton of PPC produced. Therefore there is a decrease in transportation of limestone and coal required per ton of PPC produced due to the implementation of the project activity, leading to a reduction in associated transportation emissions. However as conservative simplification, emission reductions from transport of raw materials for clinker production are not taken into consideration.
For detailed calculations of emissions due to leakage in the crediting period 2003-2013, please refer to Enclosure 3: Leakage

**B.3. 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:**

>> As per the decision 17/cp.7 para 43, a CDM project activity is additional if anthropogenic emissions of greenhouse gases by sources are reduced below those that would have occurred in absence of the registered CDM project activity. The methodology requires the project proponent to determine its additionality based

on the "Tool for the demonstration and assessment of additionality", agreed by the CDM Executive Board at its sixteenth meeting.
The flowchart presented in below provides a step-by-step approach to establish additionality of the project activity.




The additionality of the project activity has been described below:

As per the selected methodology, the project proponent is required to establish that the GHG reductions due to project activity are additional to those that would have occurred in absence of the project activity as per the 'Tool for the demonstration and assessment of additionality' Annex-1 to EB 16 Report.

### Step 0. Preliminary Screening based on the starting date of the project activity

Binani cement wishes to have the crediting period starting prior to the registration of their project activity. Binani cement is therefore required to
(a) Provide evidence that the starting date of the CDM project activity falls between 1 January 2000 and the date of the registration of a first CDM project activity, bearing in mind that only CDM project activities

submitted for registration before 31 December 2005 may claim for a crediting period starting before the date of registration; and

(b) Provide evidence that the incentive from the CDM was seriously considered in the decision to proceed with the project activity.

Binani Cement's management took the decision of implementing the project activity in spite the associated project risk with the consideration that the CDM revenue stream would be made available based on actual reduction. The management approval note of the project activity would be provide as evidence to support that CDM was seriously considered in the decision to proceed with the project activity.

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

In sub-step 1a and 1b, Binani cement is required to identify the realistic and credible alternative(s) that were available to them and that would provide output or services comparable with the project activity. These alternatives are required to be in compliance with all applicable legal and regulatory requirements.

Sub-step1a- Define alternatives to the project activity

Binani cement identified the following alternatives to the project activity:

Alternative 1: Continuation of the existing practice of cement (PPC) production

Alternative 2: Implementation of the project activity not undertaken as a CDM project activity

Alternative 3: Implementation of cement (PPC) production practice as in other manufacturing plants in the region using similar input/raw materials, and facing similar economic, market and technical circumstances

Please refer to Section B.2 for details on the alternatives.

Sub-step1b- Enforcement of applicable laws and regulations

In India, PPC product is required to satisfy the specifications of the Bureau of Indian Standards as laid down in IS: 1489 (Part 1). As per this specification, the percentage of pozzolanic material (i.e. fly ash) in PPC must fall between the ranges of 15% to 35%. All the above alternatives would meet this requirement.

Fly ash is being used as the major additive in the production of PPC. The quantum of fly ash generated in thermal power plants is huge and fly ash disposal has always been a matter of environmental concern. In absence of the project activity, the fly ash would have been dumped in landfill or low land.

There is no legal binding on Binani cement to implement the project activity. In India it is not mandatory for to use higher additives in cement manufacturing. There is no policy, which promotes use of higher percentage of additives and would be adequate to stimulate implementation of the project activity in absence of CDM. The implementation of the project activity was a voluntary step undertaken by Binani cement with no direct or indirect mandate by law or promotional policies to foster development of widespread CDM projects like optimal utilization of clinker.

The project proponent is required to conduct

**Step 2. Investment analysis OR**
**Step 3. Barrier analysis**

Binani cement proceeds to establish the project activity additionality by conducting 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**

Binani cement's initiative of reducing the clinker consumption in the PPC produced by using a higher additive percentage has been facing several barriers as outlined below:

**Investment Barrier**

The project activity had an high upfront cost which is attributed to the in-house 'Research & Development Cost', 'Equipment Cost on site' and 'Market Promotional Cost associated with increasing market acceptability of the product' etc. For instance, Binani cement has invested in the infrastructure of project activity implementation in order to ensure proper and uniform blending. Furthermore to overcome the market resistances and to get the confidence of the customers, they have been incurring, since the implementation of the project activity, a significant cost for various promotional activities. These promotional activities were a part of the project activity implementation and operation and would be conducted throughout the 10 year crediting period.
Besides all these direct expenses, Binani 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 Binani cement. They could have avoided such expenses and increased their profit margin by increasing their production instead of taking the initiative of producing PPC with higher additive percentage. However with the goal of obtaining carbon revenues from the reduction of clinker usage and its associated greenhouse gas (GHG) emissions, Binani cement took the decision of taking the investment risks and to invest in the CDM project activity after computing the proposed carbon financing.

**Technological Barrier**

There are technical barriers related to use of PPC with higher additive %. An increase in the additive % in the PPC produced results in a change in the product mix. The masons and builders require special training and guidance in order to use PPC as building material. The training and guidance include measures to be adopted to ensure equal durability and workability of OPC and PPC. Due to poor awareness levels on use and preparation of PPC for building and other benefits, the product acceptability levels of PPC with higher additive % are also very low. These technical barriers related to use of PPC with higher additive % further heightens the poor market acceptability of the product. It may however be noted that the PPC with a higher additive% would be providing an equivalent service to that of PPC with lower additive % as per the BIS standards, Binani cement had taken some initiatives in this direction to conduct awareness and training programmes as measures under the project activity implementation.

Generally PPC manufacturers use low percentage of additive in manufacturing of blended cement. In the project activity, Binani cement uses high additive percent of additives and proposes to increase. It is noted that the use of fly ash for the manufacture of PPC depends on the quality of fly ash, clinker and by adding high flyash percent (the CDM project activity) in PPC increases the efforts to adhere the required quality standards of PPC by manifold. Any higher addition of fly-ash would cause fall in strength properties on 1 day, 3 day and 28 day basis.

In order to optimise the clinker quantum per ton of PPC, Binani cement conducted Research & Development (R&D) and numerous trials & experiments with varying percentage of flyash addition and with varying clinker qualities to examine and has ascertained their impact on each other as well as their combined final impact on the strength properties of PPC manufactured. Binani cement also carried out numerous trials with varying fineness of PPC cement with numerous permutation- combinations of different flyash percentage additions and different clinker qualities

**Market barrier due to poor acceptance of the PPC produced**

The resistance in the acceptability of the PPC produced is the major barrier of the project activity at Binani cement. The reasons behind this non-acceptability are furnished below:

**Consumer perception of PPC**

The various consumer perceptions were as follows:

a) Non-acceptance of PPC in Government Departments and Projects - The Central Public Works Department (CPWD) imposed a ban on use of blended cement for bridges and other prestigious concrete works/constructions
b) “PPC is ash mixed cement” propagated by the competitors and perceived by general public
c) Serious doubts about strength and durability in the mind of technocrats, builders and entire hierarchy of consumers
d) The darker colour of PPC and the colour variations in them are mistakenly attributed to impurity. For example, PPC is generally of darker colour as compared with OPC because of the carbon present in flyash. Dissatisfaction due to blackish material leaching and floating on the surface of concrete / mortar

All these misconceptions have resulted in a lower market share of PPC thereby discouraging the cement manufacturing units all over India to produce more PPC. In spite of all such prevailing market resistances, Binani cement continued the production of PPC and has put their whole-hearted efforts to further increase the additive percentage in the PPC in order to improve the GHG performance during cement production.

**Resistance from utilisation of higher percentage of additives in PPC production**

With such a background of 'consumer resistances' resulting in 'poor market acceptability of PPC' as discussed above, a higher percentage of additives in PPC worsened the scenario. However with the objective of increasing the additive percentage in PPC production, Binani Cement has implemented the project activity.

Indian cement market, being controlled by a number of players, is highly susceptible to the negative propaganda by the competitors against the launching of a new kind of product mix. With various misconceptions created by the competitors in the mind of the consumers, only quality assurance of the product mix can not get the confidence of the consumers. However, instead of succumbing to such market resistances by producing PPC with lower additive percentage, Binani Cement has put their consistent efforts in designing a product mix which would optimise the clinker percentage in PPC by addition of higher additives and enhance market acceptability. A lot of Research & Development (R&D) activities have been carried out by an in-house team of technical experts in order to produce PPC with a higher additive percentage that would satisfy the code requirements as per the relevant Indian Standard (IS 1489(Part 1):1991) and get the confidence of its consumers.

**Sub-step 3 b. Show that the identified barriers would not prevent a wide spread implementation of at least one of the alternatives (excepted 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
- Technological barrier and
- Market barrier

The other realistic alternatives available with Binani cement in absence of the project activity are evaluated with respect to these barriers.

So far as market and technological barriers are concerned, Alternative 1 and Alternative 3 would not have faced all the market related resistances and technological awareness problems that are evident for the project activity (i.e. Alternative 2). No upfront investment would be required for the Alternative options 1 and 3. No expenses would need to be incurred in order to train the masons and the builders for using the product mix manufactured as per Alternative 1 and 3. Hence Binani cement would not have faced any obstacles in adopting either of the Alternatives 1 and 3.

**Step 4. Common practice analysis**

The project proponent is further required to conduct the common practice analysis as a credibility check to complement the barrier analysis (Step 3). The project proponent is required to identify and discuss the existing common practice through the following sub-steps:

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

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

From Step 3: Barrier Analysis it may be concluded that Alternative 1 and Alternative 3 would not have faced obstacles to implementation. However Alternative 2 faced all the barriers to implementation as detailed in Sub-step 3a. The common practice scenario discussed below further substantiates that Alternative 2 faces barriers to implementation and is therefore not a widespread proposition for cement plants under similar socio-economic environment in India.

All the cement plants in the region selected for the project activity hosting plant were producing the similar cement with mass percent of clinker below that of project activity plant before implementation of the project activity.

This further proves that the risk associated with the project activity is so high that the cement plants in the included in the region are reluctant to take up an initiative like this. Hence Binani cement's initiative is a pioneering effort which would not have occurred in absence of the CDM project activity.

**Step 5. Impact of CDM registration**

The benefits and incentives expected due to approval and registration of the project activity as a CDM activity will certainly improve the sustainability of the project activity and thus its consideration before implementation helps to overcome the identified barriers, which enables the project activity to be undertaken. Each of them especially barriers associated to market uncertainties and customer resistance could result in project failure resulting in financial losses. However, with goal of obtaining the proposed carbon financing for the project Binani cement's management took a corporate decision to invest

- in overcoming the barriers facing project implementation
- in the other CDM project activities through equity
- in additional transaction costs such as preparing documents, supporting CDM initiatives and developing and maintaining M&V protocol to fulfil CDM requirements.

It is ascertained that the project activity would not have occurred in the absence of the CDM simply because no sufficient financial, policy, or other incentives exist locally to foster its development in India and without the proposed carbon financing for the project the Binani cement would not have taken the investment risks in order to implement the project activity. In such an event the BAU baseline option is continued with release of carbon dioxide emissions.

**B.4. Description of how the definition of the project boundary related to the baseline methodology selected is applied to the project activity:**

>> The project activity would affect the GHG emissions at all the three distinct stages of cement manufacturing. Therefore *the project boundary includes*

*- the clinker & cement production plant*

*- Power generation in the grid connected to Binani cement*

*- Onsite power generation which includes Captive coal based Thermal Power plant at Binani cement*

*The project boundary defined above takes into account the following emission sources*

• *Direct emissions at the cement plant due to fuel combustion for:*

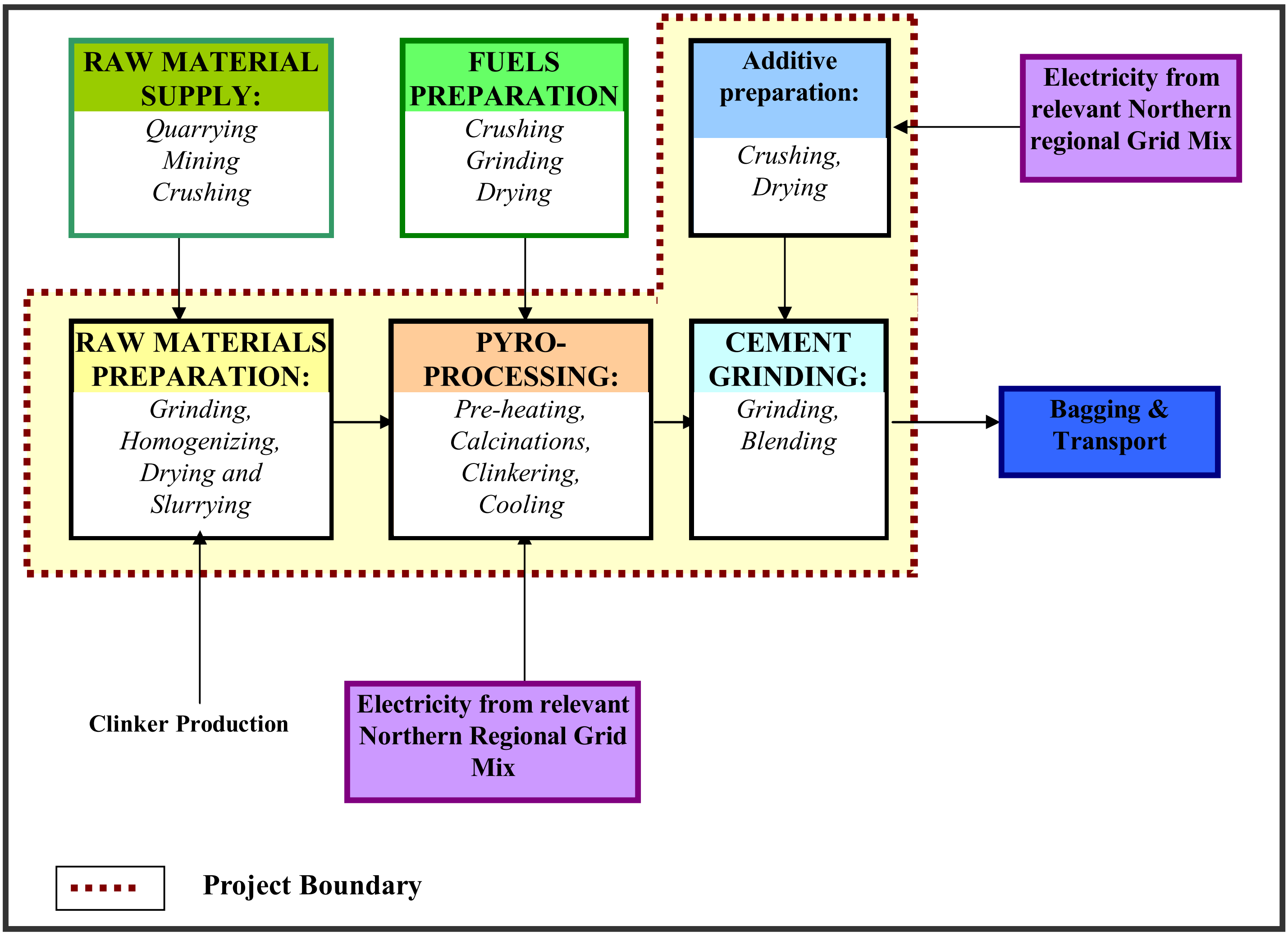
  - *Firing the kiln (including supplemental fuels used in the precalciner);*
  - *Processing (including drying) of solid fuels, raw materials, and additives;*
  - *On-site generation of electricity (if applicable).*

• *Direct emissions due to calcination of limestone (i.e. calcium carbonate and magnesium carbonate, if present in the raw meal).*

• *Indirect emissions from fossil fuel combustion in power plants in the grid due to electricity use at the cement plant, including electricity consumption for:*

  - *Crushing and grinding the raw materials used for clinker production;*
  - *Driving the kiln and kiln fans;*
  - *Finish grinding of cement;*
  - *Processing of additives."*

The diagrammatic representation of the cement process and the project boundary is illustrated below which includes all anthropogenic emissions by sources of GHG under control of the project proponent which are significant and reasonably attributable to the project activity.



Transport related emissions for the delivery of additional additives have been included in the emissions related to the project activity as leakage. Emissions reductions from transport of raw materials for clinker production are not taken into account as a conservative simplification.

**B.5. Details of baseline information, including the date of completion of the baseline study and the name of person (s)/entity (ies) determining the baseline:**

>>

**Date of completing the final draft of this baseline selection:** 01/11/2005

**Name of person/entity determining the baseline:** Binani cement along with guidance from their consultants

## 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:

>> 31/01/2003

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

>> 25 y 0 m

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

#### C.2.1. Renewable crediting period

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

>>

##### C.2.1.2. Length of the first crediting period:

>>

#### C.2.2. Fixed crediting period:

##### C.2.2.1. Starting date:

>> 01/04/2003

##### C.2.2.2. Length:

>> 10 y 0 m

## SECTION D. Application of a monitoring methodology and plan

### D.1. Name and reference of approved monitoring methodology applied to the project activity:

>> **Title:** Consolidated monitoring methodology for increasing the Blend in cement production (ACM0005)

**Approach:** Existing actual or historical emissions, as applicable; [as per 48 (a) of CP 7/17]

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

>> This methodology is applicable to projects that increase the share of additives (i.e. reduce the share of clinker) in the production of cement types beyond current practices in the region/country. Binani cement's project activity increases the share of additives in PPC beyond current practices in the region and Binani cement's project activity meets all the applicability conditions of the consolidated methodology, Hence the consolidated monitoring methodology for increasing the blend in cement production is appropriate for Binani cement's project activity.

The applicability conditions of methodology are already discussed in Section B.1.1.

**D.2. 1. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario**

**D.2.1.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:**

| ID number *(Please use numbers to ease cross-referencing to D.3)* | Data variable | Source of data | Data unit | Measured (m), calculated (c) or estimated (e) | Recording frequency | Proportion of data to be monitored | How will the data be archived? (electronic/ paper) | Comment |
|---|---|---|---|---|---|---|---|---|
| 1.1 | $InCao_y$ | Plant Records | % | M,C | Daily | 100% | Electronic | Will be calculated / measured as part of normal operations |
| 1.2 | $OutCao_y$ | Plant Records | % | M,C | Daily | 100% | Electronic | Will be calculated /measured as part of normal operations |
| 1.3 | $InMgo_y$ | Plant Records | % | M,C | Daily | 100% | Electronic | Will be calculated/ measured as part of normal operations |
| 1.4 | $OutMgo_y$ | Plant Records | % | M,C | Daily | 100% | Electronic | Will be calculated/ measured as part of normal operations |
| 1.5 | Quantity of clinker raw material | Plant Records | Kilo Tonnes | M | Annually | 100% | Electronic | |
| 1.6 | $CLNK_y$ | Plant Records | Kilo Tonnes of clinker | M | Annually | 100% | Electronic | |

| ID number *(Please use numbers to ease cross-referencing to D.3)* | Data variable | Source of data | Data unit | Measured (m), calculated (c) or estimated (e) | Recording frequency | Proportion of data to be monitored | How will the data be archived? (electronic/ paper) | Comment |
|---|---|---|---|---|---|---|---|---|
| 1.7 | $FF_{i\_y}$ | Plant Records | tonnes of fuel i | M | Annually | 100% | Electronic | |
| 1.8 | $EFF_i$ | IPCC | $tCO_2$/tonne of fuel i | C/M | Annually | 100% | Electronic | |
| 1.9 | $PELE_{grid\_CLNK,y}$ | Plant Records | MWh | M | Monthly | 100% | Electronic | |
| 1.10 | $EF_{grid\_BSL}$ | - | tCO2/MWh | C | Annually | 100% | Electronic | |
| 1.11 | $PELE_{sg\_CLNK,y}$ | Plant Records | MWh | M | Monthly | 100% | Electronic | |
| 1.12 | $EF_{sg\_y}$ | Plant Records/IPCC | tCO2/MWh | C | Monthly | 100% | Electronic | |
| 1.13 | $ADD_{,y}$ Quantity of additives | Plant Records | Kilo Tonnes | M | Monthly | 100% | Electronic | |
| 1.14 | $PELE_{grid\_BC,y}$ | Plant Records | MWh | M | Monthly | 100% | Electronic | |
| 1.15 | $PELE_{sg\_BC,y}$ | Plant Records | MWh | M | Monthly | 100% | Electronic | |
| 1.16 | $PELE_{grid\_ADD,}$ | Plant Records | MWh | M | Monthly | 100% | Electronic | |

| ID number *(Please use numbers to ease cross-referencing to D.3)* | Data variable | Source of data | Data unit | Measured (m), calculated (c) or estimated (e) | Recording frequency | Proportion of data to be monitored | How will the data be archived? (electronic/ paper) | Comment |
|---|---|---|---|---|---|---|---|---|
| 1.17 | $PELE_{sg\_ADD,BS L}$ | Plant Records | MWh | M | Monthly | 100% | Electronic | |
| 1.18 | $F_{i,j,y}$ | Plant records | tonnes of fuel I | M | Monthly | 100% | Electronic | |
| 1.19 | $COEF_{I,j,,y}$ | IPCC / Plant Records | $tCO_2$/tonne of fuel i | C/M | Annually | 100% | Electronic | |
| 1.20 | $GEN_{I,y}$ | Plant Records | MWh | M | Annually | 100% | Electronic | |
| 1.21 | $PE_{calcin,y}$ | Plant Records | $tCO_2$/tonne of clinker | C | Annually | 100% | Electronic | |
| 1.22 | $PE_{fossil\_fuel,y}$ | Plant Records | $tCO_2$/tonne of clinker | C | Annually | 100% | Electronic | |
| 1.23 | $PE_{ele\_grid\_CLNK,y}$ | Plant Records | $tCO_2$/tonne of clinker | C | Annually | 100% | Electronic | |
| 1.24 | $PE_{ele\_sg\_CLNK,y}$ | Plant Records | $tCO_2$/tonne of clinker | C | Annually | 100% | Electronic | |
| 1.25 | $PE_{ele\_grid\_BC,y}$ | Plant Records | $tCO_2$/tonne of blended cement | C | Annually | 100% | Electronic | |
| 1.26 | PE | Plant Records | $tCO_2$/tonne | C | Annually | 100% | Electronic | |

| ID number *(Please use numbers to ease cross-referencing to D.3)* | Data variable | Source of data | Data unit | Measured (m), calculated (c) or estimated (e) | Recording frequency | Proportion of data to be monitored | How will the data be archived? (electronic/ paper) | Comment |
|---|---|---|---|---|---|---|---|---|
| | $_{ele\_sg\_BC,y}$ | | of blended cement | | | | | |
| 1.27 | $PE_{ele\_grid\_ADD,y}$ | Plant Records | $tCO_2$/tonne of blended cement | C | Annually | 100% | Electronic | |
| 1.28 | $PE_{ele\_sg\_ADD,y}$ | Plant Records | $tCO_2$/tonne of blended cement | C | Annually | 100% | Electronic | |
| 1.29 | $PE_{blend,y}$ | Plant Records | Tonne of clinker/ tonne of blended cement | C | Annually | 100% | Electronic | |

**D.2.1.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of $CO_2$ equ.)**

>> $PE_{BC,y}$ are estimated as below. In the project activity plant emissions are determined per unit of clinker or per unit of BC accounting for

- Emissions from calcinations of limestone;
- Emissions from combustion of fossil fuel and electricity for clinker production and processing of raw material;
- Emissions from electricity used for additives preparation and grinding of cement.

In determining the emissions reduction there are 3 possibilities:

(i) Emissions per tonne of clinker during the crediting period are less than baseline emissions per tonne of clinker ($PE_{Clinker,y} < BE_{Clinker}$); or

(ii) Baseline and year y emissions per tonne of clinker are equal ($PE_{Clinker,y} = BE_{Clinker}$); or

(iii) Emissions per tonne of clinker in year y are greater than the baseline emissions per tonne of clinker ($PE_{Clinker,y} > BE_{Clinker}$).

As this methodology is restricted to increase in percentage of blend only and not to efficiency improvements, in case (i), the baseline value is substituted for the project activity value. That is, if emissions per tonne of clinker are lower during the crediting period, then the lower value is taken. The choice of the lower value aims at avoiding potential perverse incentives for project participants to increase the energy intensity of clinker production as a result of the project activity (e.g. by switching from less carbon-intensive energy sources to more carbon intensive energy sources).

In case (iii) the emissions per tonne of clinker are higher during the crediting period than the baseline. This could be due to declining efficiency or a fuel switch or some other reason. In this case, there is a possibility that project activity emissions exceed the baseline emissions for some years in the crediting period. In this case, the project does not get new credits for emissions reduction till the net balance for the project is positive. In the case that negative overall emission reductions arise in a year, ERs are not issued to project participants for the year concerned and in subsequent years, until emission reductions from subsequent years have compensated the quantity of negative emission reductions from the year concerned.

$$\mathbf{PE_{BC,y} = [PE_{clinker,y} * P_{Blend,y}] + PE_{ele\_ADD\_BC,y}} \quad (1)$$

Where:

$PE_{BC,y}$ = $CO_2$ emissions per tonne of BC in the project activity plant in year y ($tCO_2$/tonne BC)

$PE_{clinker,y}$ = $CO_2$ emissions per tonne of clinker in the project activity plant in year y (t $CO_2$/tonne clinker) and defined below

$P_{Blend,y}$ = Share of clinker per tonne of BC in year y (tonne of clinker/tonne of BC)

$PE_{ele\_AD,D\_BC,y}$ = Electricity emissions for BC grinding and preparation of additives in year y (tCO2/tonne of BC)

$CO_2$ per tonne of clinker in the project activity plant in year y is calculated as below:

**$PE_{clinker,y} = PE_{calcin,y} + PE_{fossil\_fuel,y} + PE_{ele\_grid\_CLNK,y} + PE_{ele\_sg\_CLNK,y}$** **(1.1)**

Where:

$PE_{clinker,y}$ = Emissions of $CO_2$ per tonne of clinker in the project activity plant in year y (t $CO_2$/tonne clinker)

$PE_{calcin,y}$ = Emissions per tonne of clinker due to calcinations of calcium carbonate and magnesium carbonate in year y (t $CO_2$/tonne clinker)

$PE_{fossil\_fuel,y}$ = Emissions per tonne of clinker due to combustion of fossil fuels for clinker production in year y (t $CO_2$/tonne clinker)

$PE_{ele\_grid\_CLNK,y}$ = Grid electricity emissions for clinker production per tonne of clinker in year y (t $CO_2$/tonne clinker)

$PE_{ele\_sg\_CLNK,y}$ = Emissions from self-generated electricity per tonne of clinker production in year y (t $CO_2$/tonne clinker)

**$PE_{calcin,y} = 0.785*(OutCaO_y - InCaO_y) + 1.092*(OutMgO_y - InMgO_y) / [CLNK_y * 1000]$** **(1.1.1)**

Where:

$PE_{calcin,y}$ = Emissions from the calcinations of limestone ($tCO_2$/tonne clinker)

0.785 = Stoichiometric emission factor for CaO ($tCO_2$/t CaO)

1.092 = Stoichiometric emission factor for MgO ($tCO_2$/t MgO)

$InCaO_{,y}$ = CaO content (%) of the raw material * raw material quantity (tonnes)

$OutCaO_{,y}$ = CaO content (%) of the clinker * clinker produced (tonnes)

$InMgO_{,y}$ = MgO content (%) of the raw material * raw material quantity (tonnes)

$OutMgO_{,y}$ = MgO content (%) of the clinker * clinker produced (tonnes)

**$PE_{fossil\_fuel,y} = [\sum FF_{i\_,y} * EFF_i] / CLNK_{,y} * 1000$** **(1.1.2)**

Where:

$FF_{i\_,y}$ = Fossil fuel of type i consumed for clinker production in year y (tonnes of fuel i)

$EFF_i$ = Emission factor for fossil fuel i ($tCO_2$/tonne of fuel)

$CLNK_y$ = Annual production of clinker in year y (kilotonnes of clinker)

**$PE_{ele\_grid\_CLNK,y}$ = [ $PELE_{grid\_CLNK,y}$ * $EF_{grid\_y}$] / [$CLNK_y$* 1000]** **(1.1.3)**

Where:

$PELE_{grid\_CLNK,y}$ = Grid electricity for clinker production in year y (MWh)

$EF_{grid\_y}$ = Grid emission factor in year y(t $CO_2$/MWh)

$CLNK_y$ = Annual production of clinker in year y (kilotonnes of clinker)

**$PE_{elec\_sg\_CLNK,y}$ = [$PELE_{sg\_CLNK\ ,y}$* $EF_{sg\_y}$] /[$CLNK_y$ * 1000]** **(1.1.4)**

Where:

$PELE_{sg\_CLNK,y}$ = Self generation of electricity for clinker production in year y (MWh)

$EF_{sg\_y}$ = Emission factor for self generated electricity in year y (t $CO_2$/MWh)

$CLNK_y$ = Annual production of clinker in year y (kilotonnes of clinker)

**$PE_{ele\_ADD\_BC,y}$ = $PE_{ele\_grid\_BC,y}$ + $PE_{ele\_sg\_BC,y}$ + $PE_{ele\_grid\_ADD,y}$ + $PE_{ele\_sg\_ADD,y}$** **(1.2)**

Where:

$PE_{ele\_grid\_BC}$ = Grid electricity emissions for BC grinding in year y ($tCO_2$/tonneof BC)

$PE_{ele\_sg\_BC}$ = Emissions from self generated electricity for BC grinding in year y ($tCO_2$/tonne of BC)

$PE_{ele\_grid\_ADD}$ = Grid electricity emissions for additive preparation in year y ($tCO_2$/tonne of BC)

$PE_{ele\_sg\_ADD}$ = Emissions from self generated electricity additive preparation in year y ($tCO_2$/tonne of BC)

**$PE_{ele\_grid\_BC,y}$ = [ $PELE_{grid\_BC,y}$ * $EF_{grid\_BSL,y}$] /[$BC_y$* 1000]** **(1.2.1)**

Where :

$PELE_{grid\_BC,y}$ = Baseline grid electricity for grinding BC (MWh)

$EF_{grid\_y}$ = Grid emission factor in year y (t $CO_2$/MWh)

$BC_y$ = Annual production of BC in year y (kilotonnes of BC)

$$PE_{elec\_sg\_BC,y} = [PELE_{sg\_BC,y} * EF_{sg\_y}] / [BC_y * 1000] \qquad (1.2.2)$$

Where:

$PELE_{sg\_BC,y}$ = Self generated electricity for grinding BC in year y (MWh)

$EF_{sg\_y}$ = Emission factor for self generated electricity in year y (t $CO_2$/MWh)

$BC_y$ = Annual production of BC in year y (kilotonnes of BC)

$$PE_{ele\_grid\_ADD} = [ PELE_{grid\_ADD} * EF_{grid\_y}] / [ADD_y * 1000] \qquad (1.2.3)$$

Where:

$PELE_{grid\_ADD}$ = Grid electricity for grinding additives (MWh)

$EF_{grid\_y}$ = Grid emission factor in year y (t $CO_2$/MWh)

$ADD_y$ = Annual consumption of additives in year y (kilotonnes of additives)

$$PE_{elec\_sg\_ADD,y} = [PELE_{sg\_ADD,y} * EF_{sg\_y}] / [ADD_y * 1000] \qquad (1.2.4)$$

Where :

$PELE_{sg\_ADD,y}$ = Self generation electricity for grinding additives (MWh)

$EF_{sg\_y}$ = Emission factor for self generated electricity in year y (t $CO_2$/MWh)

$ADD_y$ = Annual consumption of additives in year y (kilotonnes of additives)

**D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :**

| ID number *(Please use numbers to ease cross-referencing to table D.3)* | Data variable | Source of data | Data unit | Measured (m), calculated (c), estimated (e), | Recording frequency | Proportion of data to be monitored | How will the data be archived? (electronic/ paper) | Comment |
|---|---|---|---|---|---|---|---|---|
| 2.1 | $InCaO_{BSL}$ | Plant Records | % | M,C | Daily | 100% | Electronic | Will be calculated / measured as part of normal operations |
| 2.2 | $OutCaO_{BSL}$ | Plant Records | % | M,C | Daily | 100% | Electronic | Will be calculated /measured as part of normal operations |
| 2.3 | $InMgO_{BSL}$ | Plant Records | % | M,C | Daily | 100% | Electronic | Will be calculated/ measured as part of normal operations |
| 2.4 | $OutMgO_{BSL}$ | Plant Records | % | M,C | Daily | 100% | Electronic | Will be calculated/ measured as part of normal operations |
| 2.5 | Quantity of clinker raw material | Plant Records | Kilo Tonnes | M | Annually | 100% | Electronic | |
| 2.6 | $CLNK_{BSL}$ | Plant Records | Kilo Tonnes of clinker | M | Annually | 100% | Electronic | |

| ID number *(Please use numbers to ease cross-referencing to table D.3)* | Data variable | Source of data | Data unit | Measured (m), calculated (c), estimated (e), | Recording frequency | Proportion of data to be monitored | How will the data be archived? (electronic/ paper) | Comment |
|---|---|---|---|---|---|---|---|---|
| 2.7 | $FF_{i\_BSL}$ | Plant Records | tonnes of fuel i | M | Annually | 100% | Electronic | |
| 2.8 | $EFF_i$ | IPCC | $tCO_2$/tonne of fuel i | C/M | Annually | 100% | Electronic | |
| 2.9 | $BELE_{grid\_CLNK,BSL}$ | Plant Records | MWh | M | Annually | 100% | Electronic | |
| 2.10 | $EF_{grid\_BSL}$ | - | $tCO_2$/MWh | C | Once at the beginning of the crediting period | 100% | Electronic | ACM002 would be used to determine electricity emission. Please refer to ID number 2.30 to 2.34 |
| 2.11 | $BELE_{sg\_CLNK,BSL}$ | Plant Records | MWh | M | Annually | 100% | Electronic | |
| 2.12 | $EF_{sg\_BSL}$ | Plant Records/IPCC | $tCO_2$/MWh | C | Annually | 100% | Electronic | |
| 2.13 | $ADD_{,BSL}$ Quantity of additives | Plant Records | Kilo Tonnes | M | Annually | 100% | Electronic | |

| ID number *(Please use numbers to ease cross-referencing to table D.3)* | Data variable | Source of data | Data unit | Measured (m), calculated (c), estimated (e), | Recording frequency | Proportion of data to be monitored | How will the data be archived? (electronic/ paper) | Comment |
|---|---|---|---|---|---|---|---|---|
| 2.14 | $BELE_{grid\_BC,BS L}$ | Plant Records | MWh | M | Annually | 100% | Electronic | |
| 2.15 | $BELE_{sg\_BC,BS L}$ | Plant Records | MWh | M | Annually | 100% | Electronic | |
| 2.16 | $BELE_{grid\_ADD,}$ | Plant Records | MWh | M | Annually | 100% | Electronic | |
| 2.17 | $BELE_{sg\_ADD,BS L}$ | Plant Records | MWh | M | Annually | 100% | Electronic | |
| 2.18 | $F_{i,j,BSL}$ | Plant records | tonnes of fuel i | M | Annually | 100% | Electronic | |
| 2.19 | $COEF_{I,j,BSL}$ | IPCC / Plant Records | $tCO_2$/tonne of fuel i | C/M | Annually | 100% | Electronic | |
| 2.20 | $GEN_{I,BSL}$ | Plant Records | MWh | M | Annually | 100% | Electronic | |
| 2.21 | $BE_{calcin,BS L}$ | Plant Records | $tCO_2$/tonne of clinker | C | Annually | 100% | Electronic | |
| 2.22 | $BE_{fossil\_fuel,BS L}$ | Plant Records | $tCO_2$/tonne of clinker | C | Annually | 100% | Electronic | |
| 2.23 | $BE_{ele\_grid\_CLNK,BS L}$ | Plant Records | $tCO_2$/tonne of clinker | C | Annually | 100% | Electronic | |

| ID number *(Please use numbers to ease cross-referencing to table D.3)* | Data variable | Source of data | Data unit | Measured (m), calculated (c), estimated (e), | Recording frequency | Proportion of data to be monitored | How will the data be archived? (electronic/ paper) | Comment |
|---|---|---|---|---|---|---|---|---|
| 2.24 | $BE_{ele\_sg\_CLNK,BSL}$ | Plant Records | $tCO_2$/tonne of clinker | C | Annually | 100% | Electronic | |
| 2.25 | $BE_{ele\_grid\_BC,BSL}$ | Plant Records | $tCO_2$/tonne of blended cement | C | Annually | 100% | Electronic | |
| 2.26 | $BE_{ele\_sg\_BC,BSL}$ | Plant Records | $tCO_2$/tonne of blended cement | C | Annually | 100% | Electronic | |
| 2.27 | $BE_{ele\_grid\_ADD,BSL}$ | Plant Records | $tCO_2$/tonne of blended cement | C | Annually | 100% | Electronic | |
| 2.28 | $BE_{ele\_sg\_ADD,BSL}$ | Plant Records | $tCO_2$/tonne of blended cement | C | Annually | 100% | Electronic | |
| 2.29 | $B_{blend,y}$ | Plant Records | Tonne of clinker/ tonne of blended cement | C | Annually | 100% | Electronic | |
| $EF_{grid\_BSL}$ | | | | | | | | |

| ID number *(Please use numbers to ease cross-referencing to table D.3)* | Data variable | Source of data | Data unit | Measured (m), calculated (c), estimated (e), | Recording frequency | Proportion of data to be monitored | How will the data be archived? (electronic/ paper) | Comment |
|---|---|---|---|---|---|---|---|---|
| 2.30 | $EF_{OM, y}$ | Published data from electricity board | $tCO_2/MWh$ | C | Once at the beginning of the crediting period | 100% | Electronic | Calculated as Step 1 of ACM0002 |
| 2.31 | $EF_{BM, y}$ | Published data from electricity board | $tCO_2/MWh$ | C | Once at the beginning of the crediting period | 100% | Electronic | Calculated as Step 2 of ACM0002 |
| 2.32 | $F_{i,y}$ | Published data from electricity board | Tonnes | C | Once at the beginning of the crediting period | 100% | Electronic | Calculated based on the Total power generation, Average Net Calorific Value of the fuel used and the Designed |

| ID number *(Please use numbers to ease cross-referencing to table D.3)* | Data variable | Source of data | Data unit | Measured (m), calculated (c), estimated (e), | Recording frequency | Proportion of data to be monitored | How will the data be archived? (electronic/ paper) | Comment |
|---|---|---|---|---|---|---|---|---|
| 2.33 | $COEF_i$ | IPCC/local | $tCO_2$/ton of fuel | Standard / calculated | Once at the beginning of the crediting period | 100% | Electronic | Calculated based on the IPCC default value of the Emission Factor, Net Calorific Value and Oxidation Factor of the Fuel used by the power plants of the state grid |
| 2.34 | $GEN_{j,y}$ | Published data from electricity board | MWh / annum | M | Once at the beginning of the crediting period | 100% | Electronic | Obtained from authentic and latest local statistics |

**D.2.1.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of $CO_2$ equ.)**

>> The formulae used for estimation of the anthropogenic emissions by sources of greenhouse gases of the baseline scenario are as under

$$\mathbf{BE_{BC,y} = [BE_{clinker} * B_{Blend,y}] + BE_{ele\_ADD\_BC}} \quad \textbf{(2)}$$

Where:

$BE_{BC,y}$ = Baseline $CO_2$ emissions per tonne of blended cement type (BC) ($tCO_2$/tonne BC)

$BE_{clinker}$ = $CO_2$ emissions per tonne of clinker in the baseline in the project activity plant (t $CO_2$/tonne clinker) and defined below

$B_{Blend,y}$ = Baseline benchmark of share of clinker per tonne of BC updated for year y (tonne of clinker/tonne of BC)

$BE_{ele\_ADD\_BC}$ = Baseline electricity emissions for BC grinding and preparation of additives ($tCO_2$/tonne of BC)

$CO_2$ per tonne of clinker in the project activity plant in the baseline is calculated as below:

$$\mathbf{BE_{clinker} = BE_{calcin} + BE_{fossil\_fuel} + BE_{ele\_grid\_CLNK} + BE_{ele\_sg\_CLNK}} \quad \textbf{(2.1)}$$

Where:

$BE_{clinker}$ = Baseline emissions of $CO_2$ per tonne of clinker in the project activity plant ($tCO_2$/tonne clinker)

$BE_{calcin}$ = Baseline emissions per tonne of clinker due to calcinations of calcium carbonate and magnesium carbonate (t $CO_2$/tonne clinker)

$BE_{fossil\_fuel}$ = Baseline emissions per tonne of clinker due to combustion of fossil fuels for clinker production (t $CO_2$/tonne clinker)

$BE_{ele\_grid\_CLNK}$ = Baseline grid electricity emissions for clinker production per tonne of clinker (t $CO_2$/tonne clinker)

$BE_{ele\_sg\_CLNK}$ = Baseline emissions from self generated electricity for clinker production per tonne of clinker (t $CO_2$/tonne clinker)

$$\mathbf{BE_{calcin} = [0.785*(OutCaO - InCaO) + 1.092*(OutMgO - InMgO)] / [CLNK_{BSL} * 1000]} \quad \textbf{(2.1.1)}$$

Where:

$BE_{calcin}$ = Emissions from the calcinations of limestone ($tCO_2$/tonne clinker)

0.785 = Stoichiometric emission factor for CaO ($tCO_2$/t CaO)

1.092 = Stoichiometric emission factor for MgO ($tCO_2$/t MgO)

InCaO = CaO content (%) of the raw material * raw material quantity (tonnes)

OutCaO = CaO content (%) of the clinker * clinker produced (tonnes)

InMgO = MgO content (%) of the raw material * raw material quantity (tonnes)

OutMgO = MgO content (%) of the clinker * clinker produced (tonnes)

$CLNK_{BSL}$ = Annual production of clinker in the base year (kilotonnes of clinker)

$$\mathbf{BE_{fossil\_fuel} = [\sum FF_{i\_BSL} * EFF_i] / [CLNK_{BSL} * 1000]} \quad \textbf{(2.1.2)}$$

Where:

$FF_{i\_BSL}$ = Fossil fuel of type i consumed for clinker production in the baseline (tones of fuel i)

$EFF_i$ = Emission factor for fossil fuel i (t $CO_2$/tonne of fuel)

$CLNK_{BSL}$ = Annual production of clinker in the base year (kilotonnes of clinker)

**$BE_{ele\_grid\_CLNK}$ = [ $BELE_{grid\_CLNK}$ * $EF_{grid\_BSL}$] /$CLNK_{BSL}$* 1000** **(2.1.3)**

Where:

$BELE_{grid\_CLNK}$ = Baseline grid electricity for clinker production (MWh)

$EF_{grid\_BSL}$ = Baseline grid emission factor (t $CO_2$/MWh)

$CLNK_{BSL}$ = Annual production of clinker in the base year (kilotonnes of clinker)

With reference to ACM0002 baseline emissions are estimated as under

**Calculation of electricity baseline emission factor**

The electricity baseline emission factor ($EF_y$) is calculated as a combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) factors according to the following three steps. Calculations for this combined margin must be based on data from an official source (where available) and made publicly available.

***Step 1: Calculate the Operating Margin emission factor(s)***

Out of the four methods mentioned in ACM0002, simple OM approach has been chosen for calculations since the low-cost/must run resources constitute less than 50% of the total grid generation in the state grid mix. Simple OM factor is calculated as under.

$EF_{OM, simple, y}$ is calculated as the average of the most recent three years

$$EF_{OM,simple,y} = \sum_{i,j} F_{i,j,y} \times COEF_{i,j} / \sum_{j} GEN_{j,y} \qquad \textbf{E.1}$$

Where

$COEF_{i,j}$ - is the $CO_2$ emission coefficient of fuel i (t $CO_2$ / mass or volume unit of the fuel), calculated as given below and

$GEN_{j,y}$ - is the electricity (MWh) delivered to the grid by source j

$F_{i,j,y}$ - is the amount of fuel i (in a mass or volume unit) consumed by relevant power sources j in year(s) y, calculated as given below

j - refers to the power sources delivering electricity to the grid, not including low-operating cost and must-run power plants, and including imports from the grid

The Fuel Consumption $F_{i,j,y}$ is obtained as

$$\sum_i F_{i,j,y} = \left( \sum_j GEN_{j,y} \times 860 \Big/ NCV_i \times E_{i,j} \right)$$ **E.2**

Where

$GEN_{j,y}$ - is the electricity (MWh) delivered to the grid by source j

$NCV_i$ - is the net calorific value (energy content) per mass or volume unit of a fuel i

$E_{i,j}$ - is the efficiency (%) of the power plants by source j

The $CO_2$ emission coefficient $COEF_i$ is obtained as

$$COEF_i = NCV_i \times EF_{CO_2,i} \times OXID_i$$ **E.3**

Where

$NCV_i$ -is the net calorific value (energy content) per mass or volume unit of a fuel i

$EFCO_{2,i}$ -is the $CO_2$ emission factor per unit of energy of the fuel i

$OXID_i$ -is the oxidation factor of the fuel

***Step 2: Calculation of the Build Margin emission factor ($EF_{BM,y}$)***

It is calculated as the generation-weighted average emission factor (t $CO_2$/MWh) of a sample of power plants m of grid, as follows:

$$EF_{BM,y} = \sum_{i,m} F_{i,m,y} \times COEF_{i,m} / \sum_{m} GEN_{m,y} \qquad \textbf{E.4}$$

Where

$F_{i,m,y}$, $COEF_{i,m}$ and $GEN_{m,y}$ - are analogous to the variables described for the simple OM method above for plants m.

Considered calculations for the Build Margin emission factor $EF_{BM,y}$ as ex ante based on the most recent information available on plants already built for sample group m of state grid at the time of PDD submission. The sample group m consists of the 20 % of power plants supplying electricity to grid that have been built most recently, since it comprises of larger annual power generation. (Refer Enclosure- 10)

Further, none of the power plant capacity additions in the sample group have been registered as CDM project activities.

***Step 3: Calculate the electricity baseline emission factor ($EF_y$)***

It is calculated as the weighted average of the Operating Margin emission factor ($EF_{OM,simple,y}$) and the Build Margin emission factor ($EF_{BM,y}$):

$$EF_y = W_{OM} \times EF_{OM,Simple,y} + W_{BM} \times EF_{BM,y} \qquad \textbf{E.5}$$

where the weights $w_{OM}$ and $w_{BM}$, by default, are 50% (i.e., $W_{OM} = W_{BM} = 0.5$), and $EF_{OM, Simple, y}$ and $EF_{BM, y}$ are calculated as described in Steps 1 and 2 above and are expressed in t $CO_2$/MWh.

$$BE_y = EF_y \times EG_y \quad \textbf{E.6}$$

Where

$BE_y$ - are the baseline emissions due to displacement of electricity during the year y in tons of $CO_2$

$EG_y$- is the net quantity of electricity generated by the project activity during the year y in MWh, and

$EF_y$- is the $CO_2$ baseline emission factor for the electricity displaced due to the project activity in during the year y in tons $CO_2$/MWh.

$$\mathbf{BE_{elec\_sg\_CLNK} = [BELE_{sg\_CLNK} * EF_{sg\_BSL}] / [CLNK_{BSL} * 1000]} \quad \textbf{(2.1.4)}$$

Where:

$BELE_{sg\_CLNK}$ = Baseline self generation of electricity for clinker production (MWh)
$EF_{sg\_BSL}$ = Baseline electricity self generation emission factor (t $CO_2$/MWh)
$CLNK_{BSL}$ = Annual production of clinker in the base year (kilotonnes of clinker)

$$\mathbf{BE_{ele\_ADD\_BC} = BE_{ele\_grid\_BC} + BE_{ele\_sg\_BC} + BE_{ele\_grid\_ADD} + BE_{ele\_sg\_ADD}} \quad \textbf{(2.2)}$$

Where:

$BE_{ele\_grid\_BC}$ = Baseline grid electricity emissions for BC grinding (t$CO_2$/tonne of BC)
$BE_{ele\_sg\_BC}$ = Baseline self generated electricity emissions for BC grinding (t$CO_2$/tonne of BC)
$BE_{ele\_grid\_ADD}$ = Baseline grid electricity emissions for additive preparation (t$CO_2$/tonne of BC)
$BE_{ele\_sg\_ADD}$ = Baseline self generated electricity emissions for additive preparation (t$CO_2$/tonne of BC)

$$\mathbf{BE_{ele\_grid\_BC} = [\ BELE_{grid\_BC} * EF_{grid\_BSL}] / [BC_{BSL} * 1000]} \quad \textbf{(2.2.1)}$$

Where:

$BELE_{grid\_BC}$ = Baseline grid electricity for grinding BC (MWh)

$EF_{grid\_BSL}$ = Baseline grid emission factor (t $CO_2$/MWh)

$BC_{BSL}$ = Annual production of BC in the base year (kilotonnes of BC)

$$BE_{elec\_sg\_BC} = [BELE_{sg\_BC} * EF_{sg\_BSL}] / [BC_{BSL} * 1000] \quad (2.2.2)$$

Where:

$BELE_{sg\_BC}$ = Baseline self generation electricity for grinding BC (MWh)

$EF_{sg\_BSL}$ = Baseline electricity self generation emission factor (t $CO_2$/MWh)

$BC_{BSL}$ = Annual production of BC in the base year (kilotonnes of BC)

$$BE_{ele\_grid\_ADD} = [ BELE_{grid\_ADD} * EF_{grid\_BSL}] /[ADD_{BSL} * 1000] \quad (2.2.3)$$

Where:

$BELE_{grid\_ADD}$ = Baseline grid electricity for grinding additives (MWh)

$EF_{grid\_BSL}$ = Baseline grid emission factor (t $CO_2$/MWh)

$ADD_{BSL}$ = Annual consumption of additives in the base year (kilotonnes of additives)

$$BE_{elec\_sg\_ADD} = [BELE_{sg\_ADD} * EF_{sg\_BSL}] / [ADD_{BSL} * 1000] \quad (2.2.4)$$

Where:

$BELE_{sg\_BC}$ = Baseline self generation electricity for grinding additives (MWh)

$EF_{sg\_BSL}$ = Baseline electricity self generation emission factor (t $CO_2$/MWh)

$ADD_{BSL}$ = Annual consumption of additives in the base year (kilotonnes of additives)

**D. 2.2. Option 2: Direct monitoring of emission reductions from the project activity (values should be consistent with those in section E).**

Not applicable.

| D.2.2.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived: | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ID number *(Please use numbers to ease cross-referencing to table D.3)* | Data variable | Source of data | Data unit | Measured (m), calculated (c), estimated (e), | Recording frequency | Proportion of data to be monitored | How will the data be archived? (electronic/ paper) | Comment |
| | | | | | | | | |
| | | | | | | | | |

**D.2.2.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of $CO_2$ equ.):**

>> Not applicable

**D.2.3. Treatment of leakage in the monitoring plan**

**D.2.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity**

| ID number *(Please use numbers to ease cross-referencing to table D.3)* | Data variable | Source of data | Data unit | Measured (m), calculated (c) or estimated (e) | Recording frequency | Proportion of data to be monitored | How will the data be archived? (electronic/ paper) | Comment |
|---|---|---|---|---|---|---|---|---|
| 3.1 | Fuel consumption for the vehicle per | Plant Records | Kg of fuel / Kilometer | C | Annually | 100% | Electronic | |

| ID number *(Please use numbers to ease cross-referencing to table D.3)* | Data variable | Source of data | Data unit | Measured (m), calculated (c) or estimated (e) | Recording frequency | Proportion of data to be monitored | How will the data be archived? (electronic/ paper) | Comment |
|---|---|---|---|---|---|---|---|---|
| | kilometre | | | | | | | |
| 3.2 | Distance between the source of additive and project activity plant | Plant Records | Km | M | Per Trip | 100% | Electronic | |
| 3.3 | Quantity of additive carried in one trip per vehicle | Plant Records | Tonnes of additive / Vehicle | M | Per Trip | 100% | Electronic | |
| 3.4 | Emission factor for transport fuel | IPCC | Kg $CO_2$/Kg of fuel | E | Annually | 100% | Electronic | |
| 3.5 | Electricity consumption for conveyor system for additives | Plant Records | MWh | M | Monthly | 100% | Electronic | |
| 3.6 | Grid electricity emission factor | National Grid / Plant Data | tonnes of $CO_2$/MWh | C | Annually | 100% | Electronic | |

| ID number *(Please use numbers to ease cross-referencing to table D.3)* | Data variable | Source of data | Data unit | Measured (m), calculated (c) or estimated (e) | Recording frequency | Proportion of data to be monitored | How will the data be archived? (electronic/ paper) | Comment |
|---|---|---|---|---|---|---|---|---|
| 3.7 | Tonnes of additives in year y / total additional additives used in year | Plant Records | Tonnes of fly ash | M/C | Annually | 100% | Electronic | |

**D.2.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of $CO_2$ equ.)**

>> Emissions due to fuel use for the transport of raw materials (e.g. iron ore, gypsum), coal (or other fuels) and additives (blending materials) from offsite locations to the project plant will change due to the implementation of the project. The transport related emissions for raw materials and fuels are likely to decrease. To keep the methodology conservative – this change shall not be included. In the project activity, emissions due to transportation of additives will increase. These emissions will be accounted as leakage. Transport related emissions related for additives per tonne of additive are calculated as below.

$$L_{add\_trans} = [(TF_{cons} * D_{add\_source} * TEF) + (ELE_{conveyor\_ADD} * EF_{grid})] * 1/Q_{add} * 1/1000 \quad (3)$$

Where:

$L_{add\_trans}$ = Transport related emissions per tonne of additives (t $CO_2$/tonne of additive)

$TF_{cons}$ = Fuel consumption for the vehicle per kilometre (kg of fuel/kilometre)

$D_{add\_source}$ = Distance between the source of additive and the project activity plant (km)

TEF = Emission factor for transport fuel (kg $CO_2$/kg of fuel)

$ELE_{conveyor\_ADD}$ = Electricity consumption for conveyor system for additives (MWh)

$EF_{grid}$ = Grid electricity emission factor (tonnes of $CO_2$/MWh)

$Q_{add}$ = Quantity of additive carried in one trip per vehicle (tonnes of additive)

And leakage emissions per tonne of BC due to additional additives are determined by

$$\mathbf{L_y = L_{add\_trans} * [B_{blend,y} - P_{blend,y}] * BC_y} \qquad \mathbf{(3.1)}$$

Where:

$L_y$ = Leakage emissions for transport of additives (kilotonnes of $CO_2$)

$BC_y$ = Production of BC in year y (kilotonnes of BC)

Another possible leakage is due to the diversion of additives from existing uses. The PPs shall demonstrate that additional amounts of additives used are surplus. If the PPs do not substantiate x tonnes of additives are surplus, the project emissions reductions are reduced by the factor α, which is defined as:

$$\alpha_y = \text{x tonnes of additives in year y / total additional additives used in year y} \qquad \mathbf{(4)}$$

**D.2.4. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of $CO_2$ equ.)**

>> The project activity mainly reduces $CO_2$ emissions through substitution of clinker in cement by blending materials. Emissions reductions in year y are the difference in the $CO_2$ emissions per tonne of BC in the baseline and in the project activity multiplied by the production of BC in year y. The emissions reductions are discounted for the percentage of additives for which surplus availability is not substantiated.

**Emission reductions by the project activity**

$$\mathbf{ER_y = \{ [BE_{BC,y} - PE_{BC,y}] * BC_y + L_y \} * (1 - \alpha_y)} \qquad \mathbf{(5)}$$

$ER_y$ = Emissions reductions in year y due to project activity (thousand tonnes of $CO_2$)

$BE_{BC,y}$ = Baseline emissions per tonne of BC (t $CO_2$/tonnes of BC)

$PE_{BC,y}$ = Project emissions per tonne of BC in year y (t $CO_2$/tonnes of BC)

$BC_y$ = BC production in year y (thousand tonnes)

$L_y$ = Leakage emissions for transport of additives (kilotonnes of $CO_2$)

$\alpha_y$ = x tonnes of additives in year y / total additional additives used in year y

**D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored**

| Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)* | Uncertainty level of data (High/Medium/Low) | Explain QA/QC procedures planned for these data, or why such procedures are not necessary. |
|---|---|---|
| 1.1 | Low | ISO 9001 or similar quality system |
| 1.2 | Low | -Do- |
| 1.3 | Low | -Do- |
| 1.4 | Low | -Do- |
| 1.5 | Low | -Do- |
| 1.6 | Low | -Do- |
| 1.7 | Low | -Do- |
| 1.8 | Low | IPCC values would be used |
| 1.9 | Low | ISO 9001 or similar quality system |
| 1.10 | Low | - |
| 1.11 | Low | ISO 9001 or similar quality system |
| 1.12 | Low | IPCC values would be used |
| 1.13 | Low | ISO 9001 or similar quality system |
| 1.14 | Low | -Do- |
| 1.15 | Low | -Do- |
| 1.16 | Low | -Do- |
| 1.17 | Low | -Do- |
| 1.18 | Low | -Do- |

| Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)* | Uncertainty level of data (High/Medium/Low) | Explain QA/QC procedures planned for these data, or why such procedures are not necessary. |
|---|---|---|
| 1.19 | Low | IPCC values would be used |
| 1.20 | Low | ISO 9001 or similar quality system |
| 1.21 | Low | -Do- |
| 1.22 | Low | -Do- |
| 1.23 | Low | -Do- |
| 1.24 | Low | -Do- |
| 1.25 | Low | -Do- |
| 1.26 | Low | -Do- |
| 1.27 | Low | -Do- |
| 1.28 | Low | -Do- |
| 1.29 | Low | -Do- |
| 2.1 | Low | ISO 9001 or similar quality system |
| 2.2 | Low | -Do- |
| 2.3 | Low | -Do- |
| 2.4 | Low | -Do- |
| 2.5 | Low | -Do- |
| 2.6 | Low | -Do- |
| 2.7 | Low | -Do- |
| 2.8 | Low | IPCC values would be used |
| 2.9 | Low | ISO 9001 or similar quality system |
| 2.10 | Low | - |
| 2.11 | Low | ISO 9001 or similar quality system |
| 2.12 | Low | IPCC values would be used |

| Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)* | Uncertainty level of data (High/Medium/Low) | Explain QA/QC procedures planned for these data, or why such procedures are not necessary. |
|---|---|---|
| 2.13 | Low | ISO 9001 or similar quality system |
| 2.14 | Low | -Do- |
| 2.15 | Low | -Do- |
| 2.16 | Low | -Do- |
| 2.17 | Low | -Do- |
| 2.18 | Low | -Do- |
| 2.19 | Low | IPCC values would be used |
| 2.20 | Low | ISO 9001 or similar quality system |
| 2.21 | Low | -Do- |
| 2.22 | Low | -Do- |
| 2.23 | Low | -Do- |
| 2.24 | Low | -Do- |
| 2.25 | Low | -Do- |
| 2.26 | Low | -Do- |
| 2.27 | Low | -Do- |
| 2.28 | Low | -Do- |
| 2.29 | Low | -Do- |
| 3.1 | Low | -Do- |
| 3.2 | Low | -Do- |
| 3.3 | Low | IPCC values would be used |
| 3.4 | Low | ISO 9001 or similar quality system |
| 3.5 | Low | -Do- |
| 3.7 | Low | -Do- |

**D.4 Please describe the operational and management structure that the project operator will implement in order to monitor emission reductions and any leakage effects, generated by the project activity**

>> Binani cement has implemented an operational and management structure in order to monitor emission reductions and any leakage effects, generated by the project activity.

Binani cement has formed a CDM team/committee comprising of persons from relevant departments, which will be responsible for monitoring of all the parameters mentioned in this section. The CDM team also comprises of a special group of operators who are assigned the responsibility of monitoring of different parameters and record keeping. On a weekly basis, the monitoring reports are reviewed and discussed by the seniors CDM team members/managers. In case of any irregularity observed by any of the CDM team member, it is informed to the concerned person for necessary actions. On monthly basis, these reports are forwarded at the management level.

**D.5 Name of person/entity determining the monitoring methodology:**

>> Binani cement along with guidance from their consultants

## SECTION E. Estimation of GHG emissions by sources

### E.1. Estimate of GHG emissions by sources:

>>
Please refer Annex-3 of PDD for detailed calculations.

| Sl. No. | Operating Years | Project Emission Factor (tones of $CO_2$ / tPPC) | Project Emission (tones of $CO_2$) |
|---|---|---|---|
| 1. | 2003-2004 | 0.6990 | 333584 |
| 2. | 2004-2005 | 0.6913 | 444137 |
| 3. | 2005-2006 | 0.6769 | 478375 |
| 4. | 2006-2007 | 0.6689 | 519993 |
| 5. | 2007-2008 | 0.6644 | 568144 |
| 6. | 2008-2009 | 0.6599 | 620726 |
| 7. | 2009-2010 | 0.6554 | 678142 |
| 8. | 2010-2011 | 0.6509 | 740835 |
| 9. | 2011-2012 | 0.6465 | 809409 |
| 10. | 2012-2013 | 0.6420 | 884153 |
| | | | **6,077,498** |

### E.2. Estimated leakage:

>> The emission due to fuel use for the transport of Fly ash additive from offsite locations (Thermal power plants) to the project plant has been considered. There is no conveying system for additive transportation at offsite location. Please refer Annex-3 of PDD for detailed calculations.

| Sl. No. | Operating Years | Leakage (tones of $CO_2$) |
|---|---|---|
| 1. | 2003-2004 | 655 |
| 2. | 2004-2005 | 1072 |
| 3. | 2005-2006 | 1984 |
| 4. | 2006-2007 | 2506 |
| 5. | 2007-2008 | 2758 |
| 6. | 2008-2009 | 3036 |
| 7. | 2009-2010 | 3342 |
| 8. | 2010-2011 | 3679 |
| 9. | 2011-2012 | 4050 |
| 10. | 2012-2013 | 4458 |
| | **Total** | **27540** |

**E.3. The sum of E.1 and E.2 representing the project activity emissions:**

>> Net emissions by project activity (E1+E2) are over the 10-year crediting period.

| Sl. No. | Operating Years | Total Project Activity emissions (tones of $CO_2$) |
|---|---|---|
| 1. | 2003-2004 | 334239 |
| 2. | 2004-2005 | 445209 |
| 3. | 2005-2006 | 480359 |
| 4. | 2006-2007 | 522499 |
| 5. | 2007-2008 | 570902 |
| 6. | 2008-2009 | 623762 |
| 7. | 2009-2010 | 681484 |
| 8. | 2010-2011 | 744514 |
| 9. | 2011-2012 | 813459 |
| 10. | 2012-2013 | 888611 |
| | **Total** | **6105038** |

**E.4. Estimated anthropogenic emissions by sources of greenhouse gases of the baseline:**

>>

| Sl. No. | Operating Years | Baseline Emission Factor (tones of $CO_2$ / tPPC) | Baseline Emissions (tones of $CO_2$) |
|---|---|---|---|
| 1. | 2003-2004 | 0.7081 | 337927 |
| 2. | 2004-2005 | 0.7037 | 452104 |
| 3. | 2005-2006 | 0.6993 | 494205 |
| 4. | 2006-2007 | 0.6948 | 540127 |
| 5. | 2007-2008 | 0.6903 | 590292 |
| 6. | 2008-2009 | 0.6858 | 645088 |
| 7. | 2009-2010 | 0.6814 | 705044 |
| 8. | 2010-2011 | 0.6770 | 770541 |
| 9. | 2011-2012 | 0.6725 | 841961 |
| 10. | 2012-2013 | 0.6880 | 919960 |
| | **Total** | | **6297249** |

**E.5. Difference between E.4 and E.3 representing the emission reductions of the project activity:**

>>

| Years | Annual estimation of emission reductions in tonnes of $CO_2$ e |
|---|---|
| 2003-2004 | 3688 |
| 2004-2005 | 6895 |
| 2005-2006 | 13846 |
| 2006-2007 | 17628 |
| 2007-2008 | 19390 |
| 2008-2009 | 21326 |
| 2009-2010 | 23560 |
| 2010-2011 | 26027 |
| 2011-2012 | 285052 |
| 2012-2013 | 31349 |
| **Total estimated reductions** (tonnes of $CO_2$ e) | **192211** |
| **Total number of crediting years** | 10 |
| **Annual average over the crediting period of estimated reductions (**(tonnes of $CO_2$ e) | **19221** |

**E.6. Table providing values obtained when applying formulae above:**

>>

| Years | Estimation of Project activity Emission reductions (tonnes of CO2 e) | Estimation of baseline emission reductions (tonnes of CO2 e) | Estimation of leakage (tonnes of CO2 e) | Estimation of emission reductions in tonnes of $CO_2$ e |
|---|---|---|---|---|
| 2003-2004 | 333584 | 337927 | 655 | 3688 |
| 2004-2005 | 444137 | 452104 | 1072 | 6895 |
| 2005-2006 | 478375 | 494205 | 1984 | 13846 |
| 2006-2007 | 519993 | 540127 | 2506 | 17628 |
| 2007-2008 | 568144 | 590292 | 2758 | 19390 |
| 2008-2009 | 620726 | 645088 | 3036 | 21326 |
| 2009-2010 | 678142 | 705044 | 3342 | 23560 |

| Years | Estimation of Project activity Emission reductions (tonnes of CO2 e) | Estimation of baseline emission reductions (tonnes of CO2 e) | Estimation of leakage (tonnes of CO2 e) | Estimation of emission reductions in tonnes of $CO_2$ e |
|---|---|---|---|---|
| 2010-2011 | 740835 | 770541 | 3679 | 26027 |
| 2011-2012 | 809409 | 841961 | 4050 | 285052 |
| 2012-2013 | 884153 | 919960 | 4458 | 31349 |
| **Total estimated reductions** (tonnes of $CO_2$ e) | **6,077,498** | **6297249** | **27540** | **192211** |

Please refer to Enclosure – 4 of PDD for detailed calculations.

## SECTION F. Environmental impacts

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

>> 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[5] 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. However, the project under consideration does not require any EIA to be conducted, as the activity is not included in Schedule I.

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 CDM project activity developed by Binani cement ensures maximum global and local benefits with respect to certain environmental & social issues and contributes marginally towards sustainable development. The project activity - to utilize pollutant - fly ash in cement manufacturing and thereby reducing clinker content per tonne of cement produced leads to many positive Environmental Impacts.

The reduction in clinker content per tonne of cement reduces environmental impacts related to clinkerisation, fly ash disposal and also conserves natural resources like limestone & non-renewable coal. The GHG emission reductions from project activity benefits the global environment and the local environment is benefited (due to the project activity) by natural resource conservation, good ambient quality maintenance etc.

Binani cement being an ISO 14001, OHSAS 18001 organisation has specialized environmental management systems & consistent evaluation of the impacts, key parameters have ensured that the company meets the environmental targets. The project activity is one such voluntary measure, which has positive long-term environmental impact. The nature of the impacts that are evident during the operational phase is discussed in detail given below. The environmental impact during the construction phase is regarded as temporary or short term and hence does not affect the environment significantly.

The Binani cement'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 reductions from project activity benefit the global environment.

| SL. NO. | ENVIRONMENTAL IMPACTS & BENEFITS | REMARKS |
|---|---|---|

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

| A | CATEGORY: ENVIRONMENTAL – RESOURCE CONSERVATION | |
|---|---|---|
| 1<br><br><br>2 | **Limestone conservation:**<br>The project activity reduces the quantum of limestone required per unit of cement produced.<br>**Coal / Petcoke conservation:**<br>The project activity reduces specific electrical & thermal energy consumption for cement production and conserves the energy.<br>By reducing the specific thermal energy, the project activity 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. By reducing the specific electrical energy, the project activity reduces an equivalent amount of coal consumption at the thermal power plants that would have been required in absence of project activity. The reduced electrical energy demand would also include the electricity loss during transmission and distribution.<br>"Coal is a finite natural resource" used as fuel to generate power and for production processes. Since this project activity reduces its thermal energy demand it positively contributes towards conservation of coal and making coal available for other important applications. | The project activity is a step towards limestone and coal/ petcoke conservation. |
| B | CATEGORY: ENVIRONMENTAL – AIR QUALITY | |

| | | |
|---|---|---|
| 1<br><br>2 | **Global**<br>By reducing the clinker content of the cement, the project activity reduces $CO_2$ emissions due to reduced manufacture of clinker required per unit of cement produced in the baseline. The $CO_2$ emissions reductions include emissions from the calcinations process, fuel combustion in clinkerisation.<br>**Local (Ambient )**<br>Fly ash utilization by the project activity eliminates all the negative environmental impacts like air pollution caused due to fugitive emissions from fly ash dumped in the vicinity of the thermal power plants. Reduction in thermal energy consumption invariably reduces air pollution (caused by the SPM emissions from fuel combustion in the Pyro-processing).<br>The project involves transportation & handling of fly ash where there are chances of fugitive dust emission at unloading and feeding points. | The project activity reduces emission of $CO_2$ -a global entity.<br><br>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 fly ash handling through effective environmental programme like installing dust collectors at fly ash handling area, providing nose mask to the workers etc. The fly ash is brought from power plant in closed covered tankers to avoid any spillage. |

| C | CATEGORY: ENVIRONMENTAL –WATER | |
|---|---|---|
| 1 | The project activity utilizes fly ash and eliminates all the negative environmental impacts like water pollution caused due to sanitary landfill leaching and fly ash dumping in the vicinity of the thermal power plants.<br>**The project activity does not contribute to water pollution.** | The project activity contributes positive impacts to the water environment. |

| D | CATEGORY: ENVIRONMENTAL – LAND | |
|---|---|---|
| 1<br><br><br><br><br>2 | Reduction in specific limestone and coal consumption/ demand further reduces quarry/coal mining; raw material extraction, which leads to loss of biodiversity, land destruction and erosions arising from such activities.<br><br>Fly ash disposal is one of the major environmental aspect of the thermal power plants in India. By utilizing large volumes of thermal power plant's fly-ash waste, the project activity eliminates all the negative environmental impacts related to fly ash disposal on soil/land. Land requirement for fly ash disposal is minimized.<br>**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<br><br><br><br><br><br><br><br>2 | **Mining Risks:**<br>Quarry mining of limestone experiences landslides and destruction in the history of mining. Thus by less consumption of limestone with reduced clinker production the project activity would indirectly reduce chances of landslides and landscape destruction at mining sites. The adverse heath impacts caused from quarrying of materials on the mining persons, nearby habitats and ecosystem, would therefore be avoided.<br>**Employment:**<br>The project activity creates opportunity for employment of semi-skilled, unskilled, engaged in various activities.<br>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 and reduce mining risks. |
| 3 | **Capacity Building**<br>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 type of industries for mutual benefiting. |
| G | CATEGORY: ECOLOGY | |
| 1 | By fly ash utilization, the project activity has a beneficial impact on the flora, fauna in the vicinity of the thermal power plants. | - |

Thus above tables clearly purports that the project activity has excellent environmental benefits in terms of reduction of carbon emissions, limestone resource conservation, coal / petcoke conservation, decreased environmental destruction and enhanced restoration, economical and social prosperity by opening avenues for investment in waste, etc

**F.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 G. Stakeholders' comments

>>

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

>> Stakeholder consultation is a important matter for an esteemed organisation, where comments on the project activity are invited from identified stakeholders with a view to maintain transparency in the activities of the project promoter and also assist to comply with applicable regulations. Representatives of Binani cement have already identified the relevant stakeholders and they have been consulting with them looking for their comments and approvals for the project activity. The necessary consultation is the form of the oral and written documents. The Binani cement has communicated to identified stakeholders about the project activity and ask for the comments on the activity. This is a continuous process from the project proponent.

The project activity occurred at Binani cement's cement plant in Binanigram, Rajasthan. The project activity will reduce the use of thermal energy *i.e.* fossil fuel.

The various stakeholders identified for the project are as under.

- Elected body of representatives administering the local area (village Panchayat)
- Central & State Pollution Control Board
- Ministry of Environment & Forest (MoEF), Government of India
- PPC cement users/consumers
- Local population
- Consultants
- Equipment Suppliers

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.

### G.2. Summary of the comments received:

**>> Stakeholders Involvement**

The Success of the project activity depends upon the acceptance and usage level of PPC by consumers, masons, engineers, architects, dealers and builders. Hence they form the key stakeholders of the project activity. Binani Cement also plans to increase the PPC production during the credit period, hence the importance levels of this stakeholders increases manifold. Binani cement appraises the consumers, masons, dealers, architects about its PPC product- benefits, technical reliability, & the latest development in the PPC scenario by conducting various seminars, training, awareness programmes, on-field testing & experiments and most importantly having one to one meeting.

Local population comprises of the local people in and around the project area and also people around thermal power plant, which provides fly ash. The roles of the local people are as a beneficiary of the project. The project activity also includes creates employment opportunity to local manpower near the plant site. Since, the project has environmental benefits at the project area and the thermal power plant's locality and has provided good direct employment opportunities the local populace has positive opinions about the project

RSPCB has prescribed standards of environmental compliance and monitors the adherence to the standards. The cement plant received the Consent to Establish (or No Objection Certificate (NOC)) and the Consent to Operate from RSPCB during the commissioning of the plant. The project activity reduces the environmental impacts on the local ambient quality and meets all the statutory requirements. Binani cement submits an annual Environmental Statement to RPCB and also describes the Environmental aspects of the plant in its annual report .As discussed in chapter F, the project activity has many positive environmental impacts and does not violate the environmental norms.

The project is being implemented at existing facility of Binani 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 ecosystem, 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.

The Government of India, through Ministry of Environment and Forests (MoEF), has been promoting waste minimization projects like "Fly Ash Utilization" and "Energy Conservation" to reduce much increasing burden of industrial waste on the society as a whole. The project activity is in line with their promotional activities with regard to environmental improvements.

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

>> The relevant comments and important clauses mentioned in the project documents were considered while preparation of CDM PDD. The Binani cement representatives met with the various stakeholders for appraisal and support. They were commended for their voluntary action toward environmental development and saving quarry mines from further destruction as well as industrial waste minimization and bringing out ultimate way of waste disposal by adding reuse value to it.

Annex 1

## CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

| | |
|---|---|
| Organization: | Binani cement |
| Street/P.O.Box: | Binanigram |
| Building: | |
| City: | Sirohi |
| State/Region: | Rajasthan |
| Postfix/ZIP: | 307025 |
| Country: | India |
| Telephone: | 02971-228280 |
| FAX: | 02971225020 |
| E-Mail: | |
| URL: | |
| Represented by: | |
| Title: | Vice President (Production) |
| Salutation: | Mr. |
| Last Name: | Lal |
| Middle Name: | |
| First Name: | Darshan |
| Department: | Production |
| Mobile: | |
| Direct FAX: | |
| Direct tel: | |
| Personal E-Mail: | Bgrintak_ip1@sancharnet.in |

Annex 2

**INFORMATION REGARDING PUBLIC FUNDING**

No public funding for the project is available.

Annex 3

## BASELINE INFORMATION

Please see enclosure 1-4 in the project design document.

## Annex 4

## MONITORING PLAN

Binani Cement's project activity is of clinker content reduction in PPC production. The monitoring and verification system mainly comprise of Raw material, PPC production along with fly ash and clinker used for this purpose. Key parameters related to quality of cement are also monitored to ensure 'equivalence of service'. The key parameters related to quality of the product delivered are governed by country's specifications and standards, Binani Cement too has a monitoring plan to ensure the product meets the 'Indian Standard – Portland-Pozzolana Cement – Specification (IS 1489(Part 1): 1991;

Further, the project activity has employed the state of art monitoring and control equipment that will measure, record, report, monitor and control various key parameters like total cement & clinker produced, material flow rate, operating conditions and parameters of the material movement and conversion processes.

The instrumentation and control system is the key aspect for salubrious functioning of any monitoring and verification system of a CDM project activity. Taking these issues into considerations, Binani Cement has designed adequate and apt instruments for the project activity, to control and monitor various operating parameters for safe, effective & efficient operations like raw material processing, kiln, grinding and mixing.

The instrumentation system comprises of microprocessor-based instruments like weigh feeders etc. (of reputed makes) that adheres the required specifications and of best accuracy levels. The instruments are calibrated (by reputed third parties) and marked at regular intervals ensuring the accuracy of measurements always. The calibration frequency too is a part of the monitoring and verification parameters.

**Project boundary and GHG sources**

Binani Cement has state-of- the-art Central Control Room (CCR) which monitors various process parameters (including the parameters required to be monitored for the project activity) continuously. The project system comprising of the raw material transportation system, Pre Calcination, Kiln, Grinding, Electrostatic precipitator and the ash disposal system.

The project boundary covers the point of supply of raw material to the point of finished goods dispatch where the project proponent has a full control. Hence, project boundary is considered within these terminal points.

**GHG emissions sources of the project**

**Direct on-site emissions**

In the project activity, clinker is substituted by additives (like fly ash) and therefore itself does-not emits no direct GHG.

**Indirect on-site emissions**

The indirect on site GHG source is the consumption of energy and the emission of GHGs involved in the construction of the cement blending equipment. Considering the life cycle assessment of the total power generated and the emissions to be avoided in the life span of 25 years, emissions from the above-mentioned source is too small and hence neglected.

**Direct off site emissions**

Direct off site emission is due to the fly ash transportation from thermal power plants to the facility site and have been considered in the leakage due to transportation.

**In-Direct off-site emissions**

This includes emissions during the manufacturing process of parts, supplies and machinery required for building the project (i.e. electromechanical equipment, etc.). But these emissions are outside the control of the project and excluded;

**Project parameters affecting emission reduction claims**

**Monitoring**

The CDM mechanism stands on the quantification of emission reduction and keeping the track of the emissions reduced. The project activity reduces the carbon dioxide whereas an apt monitoring system ensures this reduction is quantified and helps maintaining the required level. The monitoring system brings about the flaws (if any are identified) in the system and opens up always, opportunities for amelioration.

## ENCLOSURE 1

| Sr.No | Particulars of the references |
|---|---|
| | ***Kyoto Protocol / UNFCCC Related*** |
| 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. | UNFCCC Decision 17/CP.7: Modalities and procedures for a clean development mechanism as defined in article 12 of the Kyoto Protocol. |
| 4. | UNFCCC document, Clean Development Mechanism-Project Design Document (CDM-PDD) version 02 |
| 5. | ACM002, www.unfccc.int |
| 6. | Further Clarification on Methodological Issues, EB 10 Report, Annex 1, http://unfccc.int |
| 7. | Annex 2: Amendment to Appendix B of the Simplified Modalities and Procedures for Small-Scale CDM Project Activities, EB 12 Report. http://unfccc.int |
| | ***Baseline Related*** |
| 8. | Report of the working group on cement industry, X-Five year Plan (2002-2007), Government of India, Planning Comission, February, 2000. |
| 9. | India Cement Sector - The Untold Story Part II ; by India Infoline<br>- Overview of the industry; 15th July, 2003<br>- Annexure 9 – Types of cement; 12th August, 2003 |
| 10. | Cement Industry Data, by Cement Manufacturers' Association, Annual report 2001,2002,2003-March 2004 |
| 11. | Module – 1: Estimation of Fair Prices of Cement, May 2001; by The credit rating information services of India Limited. |
| 12. | Module – 2:Current Demand Supply Scenario, May 2001; by The credit rating information services of India Limited |
| 13. | Module – 3:Trends in Cement Prices, May 2001; by The credit rating information services of India Limited |
| 14. | Map of India: Annual Rainfall - |

| Sr.No | Particulars of the references |
|---|---|
| | **http://education.vsnl.com/rmcguwahati/normalannual.gif** |
| 15. | An initial view on methodologies for Emission Baselines: Cement Case Study; June 2000, OECD and IEA Information Paper; by Jane Ellis, Organisation for Economic Co-operation and Development, Paris. |
| 16. | 'India's cement Industry: Productivity, Energy Efficiency and Carbon Emissions, July 1999 by Katja Schumacher and Jayant Sathaye, Environmental Energy Technologies Division, Ernest Orlando Lawrence Berkeley National Laboratory |
| 17. | IPCC-Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (There is no year for this document)<br>- $CO_2$ Emissions From Industry; Cement production; Figure 3.1:Decision Tree for Estimation of $CO_2$emissions from cement production<br>- $CO_2$ Emissions From Stationary Combustion of Fossil Fuels |
| 18. | Website of Department of Energy, Government of Rajasthan - **http://www.rajenergy.com** |
| 19. | 'Anthropogenic Emissions from Energy Activities in India: Generation and Source Characterization' by Moti L. Mittal and C. Sharma |
| 20. | Cement Production, Conversion Factor Data, Energy Consumption Data of cement plants in North Rajasthan Cluster, 2002-2003, NCCBM |
| 21 | http://mnes.nic.in/baselinepdfs/annexure2a.pdf |
| 22. | Report on Indian Cement Industry, ICRA, March 2004 |
| | ***Project Related*** |
| 23. | Various project related information / documents / data received from Binani Cement's cement manufacturing units, Sirohi, Rajasthan |
| 24. | Various project related information / documents / data on Environmental Impacts received from Binani Cement's cement manufacturing units, Sirohi, Rajasthan |
| 25. | Various project related information / documents on Stakeholders comments received from Binani Cement's cement manufacturing units, Sirohi, Rajasthan |
| 26. | Binani's project report |

## ENCLOSURE 2

## ABBRIVIATIONS

| | |
|---|---|
| **%** | Percentage |
| **BAU** | Business As Usual |
| **BM** | Build Margin |
| **$CaCO_3$** | Calcium Carbonate |
| **CaO** | Calcium Oxide |
| **CAS** | Country Assistance Strategy |
| **CCR** | Central Control Room |
| **CDM** | Clean Development Mechanism |
| **CEA** | Central Electricity Authority |
| **CM** | Combined Margin |
| **CMA** | Cement Manufacturer Association of India |
| **$CO_2$** | Carbon di-oxide |
| **COP** | Cost of production |
| **CPWD** | Central Public Works Department |
| **$EF_{Coal}$** | Emission Factor of Coal |
| **$EF_{Diesel}$** | Emission Factor of Diesel |
| **$EF_{Fuel}$** | Emission Factor of Fuel |
| **Equ** | Equivalent |
| **GHG** | Greenhouse Gas |
| **HP** | Himachal Pradesh |
| **IPCC** | Intra-governmental Panel for Climate Change |
| **IS** | Indian Standards |
| **Kg** | Kilo Gram |
| **Km** | Kilo meter |
| **kWh** | Kilo Watt Hour |
| **M** | Major Proportion of Supply in Clusters |
| **$M^3$** | Cubic Meter |
| **$MgCO_3$** | Magnesium Carbonate |
| **MgO** | Magnesium Oxide |

| | |
|---|---|
| **MoEF** | Ministry of Environment & Forest |
| **MoP** | Ministry of Power |
| **MU** | Million Units |
| **MVP** | Monitoring Verification and Protocol |
| **MW** | Mega Watts |
| **NCBM** | National Council for Building and Materials |
| **O** | Other Clusters supplying to the Market |
| **OM** | Operating Margin |
| **OPC** | Ordinary Portland Cement |
| **PFC** | Portland Blast Furnace Slag Cement |
| **PFD** | Process Flow Diagrams |
| **PPC** | Portland Pozzolona Cement |
| **RVPN** | Rajasthan Rajya Vidyut Prasaran Nigam |
| **SPM** | Suspended Particulate Matter |
| **STEC** | Specific Thermal Energy Consumption in kcal/t clinker |
| **$tCO_2$** | Tones of Carbon Di Oxide |
| **TJ** | Trillion Joules |
| **TPH** | Tones Per Hour |
| **UNFCCC** | United Nations Framework Convention on Climate Change |

## Enclosure 1

## Project Activity Emissions

| Parameter | Unit | 2003-04 |
|---|---|---|
| **Emissions of $CO_2$ per tonne of clinker in the project activity plant ($tCO_2$/tonne clinker)-PE $_{clinker,y}$** | | |
| **Emissions per tonne of clinker due to calcinations of calcium carbonate and magnesium carbonate in year y (tCO2/tonne clinker)-PE calcin,y** | | |
| Quantity of raw mix | Tonnes | 3036048 |
| Quantity of clinker produced | Tonnes | 1997400 |
| CaO content (%) of raw mix | % | 0 |
| MgO content (%) of raw mix | % | 0 |
| CaO content (%) of Clinker | % | 65.1 |
| MgO content (%) of Clinker | % | 2.09 |
| Emissions from the calcinations of limestone(tCO2/tonne clinker) PE $_{calcin,y}$ | tCO2/tclinker | 0.53386 |
| **Emissions per tonne of clinker due to combustion of fossil fuels for clinker production in year y (tCO2/tonne clinker)-PE fossil_fuel,y** | | |
| Quantity of coal consumed-FF_,y | Tonnes | 224467.10 |
| Net calorific value of coal Fuel(IPCC) | TJ/KiloTonnes | 27.26 |
| Carbon Emission factor of coal(IPCC) | tCO2/TJ | 96.07 |
| Emission factor of coal – EFF | tCO2/Ton of fuel | 2.62 |
| Quantity of lignite consumed-FF_,y | Tonnes | 5993.15 |
| Net calorific value of lignite Fuel(IPCC) | TJ/KiloTonnes | 18.85 |
| Carbon Emission factor of lignite (IPCC) | tCO2/TJ | 101.20 |
| Emission factor of lignite- EFF | tCO2/Ton of | 1.91 |

| | | |
|---|---|---|
| | fuel | |
| Emissions per tonne of clinker due to combustion of fossil fuels for clinker production-PE $_{fossil\_fuel,y}$ | tCO2/tclinker | 0.300013 |
| **Grid electricity emissions for clinker production per tonnne of clinker in year y - PE ele_grid_CLNK, y (tCO2/tonne clinker)** | | |
| Grid Electricity for clinker production in year y -PELE$_{grid_CLNK,y}$ | MWh | 18513.71 |
| Grid Emission Factor in year y- EF$_{grid_y}$ | tCO2/MWh | 0.752 |
| Grid electricity emissions for clinker production per tonnne of clinker PE $_{ele\_grid\_CLNK,y}$ | tCO2/tonne clinker | 0.006970 |
| **Emissions from self generated electricity per tonne of clinker production in year y -PE $_{ele\_sg\_CLNK,y}$-(tCO2/tonne clinker)** | | |
| Generation of Electricity by Thermal captive power plant for clinker production in year y-PELE$_{sg_CLNK_CPP,y}$ | MWh | 82488.51 |
| CPP Emission Factor in year y - EFsg_CPP_y | tCO2/MWh | 1.33 |
| Self generated electricity emissions for clinker production per tonnne of clinker PE $_{ele\_sg\_CLNK,y}$ | tCO2/tonne of clinker | 0.054926 |
| **Emissions of CO2 per tonne of clinker in the project activity in year y (tCO2/tonne clinker)-PE $_{clinker,y}$** | **tCO2/tonne of clinker** | **0.895767** |
| **Electricity Emissions for BC grinding and preparation of additives in year y ($tCO_2$/tonne BC)-PE $_{ele\_ADD\_BC,y}$** | | |
| Annual production of BC in year y –Bcy | kilotonnes of BC | 477.231 |
| **Grid electricity emissions for BC grinding in a year y PE $_{ele\_grid\_BC,y}$ -(tCO2/tonne of BC)** | | |
| Northern Grid Electricity for grinding BC in year y -PELEgrid_BC,y | MWh | 2267.00 |
| Northern Grid Emission Factor in year y- EFgrid_y | tCO2/MWh | 0.752 |
| Northern grid electricity emissions for BC grinding in year y (tCO2/tonne of BC) PE $_{ele\_grid\_BC,y}$ | tCO2/tonne of BC | 0.003572 |
| **Emissions from self generated electricity for BC grinding in year y PE $_{ele\_sg\_BC,y}$** | | |
| Generation of Electricity by CPP for BC grinding in year y-PELEsg_BC,y | MWh | 13720.20 |
| Self generated electricity emissions for BC grinding in year y (tCO2/tonne of BC) PE $_{ele\_sg\_BC,y}$ | tCO2/tonne of BC | 0.038237 |
| **Grid electricity emissions for additive preparation in year y PE $_{ele\_grid\_ADD,y}$** | | |

| | | | |
|---|---|---|---|
| Grid electricity emissions for additive preparation in year y PE ele_grid_ADD,y | tCO2/tonne of BC | 0 | No grinding of additive |
| **Emissions from Self generated electricity additive preparation in year y PE ele_sg_ADD,y** | | | |
| Emissions from Self generated electricity additive preparation in year y PE ele_sg_ADD,y | tCO2 / tonne of BC | 0 | No grinding of additive |
| **Electricity Emissions for BC grinding and preparation of additives in year y PE ele_ADD_BC,y** | **tCO2 / tonne of BC** | **0.041809** | |

## Enclosure 2

### Leakage Emissions

| Parameter | Unit | 2003-04 | 2004-05 | 2005-06 | 2006-07 | 2007-08 | 2008-09 | 2009-10 | 2010-11 | 2011-12 | 2012-13 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Quantity of Flyash procured from GEB Gandhi nagar | Tonnes | 35950 | 75619 | 83181 | 91499 | 100648 | 110713 | 121785 | 133963 | 147359 | 148000 |
| Quantity of Flyash procured from torrent power AEC, Sabarmati | Tonnes | 55038 | 53794 | 59173 | 65091 | 71600 | 78760 | 86636 | 95299 | 104829 | 105000 |
| Quantity of Flyash procured from Surathgarh Thermal power plant | Tonnes | 4118 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Quantity of Flyash procured from GEC Wanabori | Tonnes | | 4071 | 4478 | 4926 | 5419 | 5961 | 6557 | 7212 | 7934 | 8000 |
| Total quantity of Fly ash procured | Tonnes | 95107 | 133484 | 146832 | 161516 | 177667 | 195434 | 214977 | 236475 | 260123 | 261000 |
| Fuel consumption for the Vehicle per kilometre-TFcons | Kilimeter/kg of fuel | 2.8 | 2.8 | 2.8 | 2.8 | 2.8 | 2.8 | 2.8 | 2.8 | 2.8 | 2.8 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Distance between the source of additive(GEB Gandhinagar) and the project activity plant-Dadd_source | kilometre | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 |
| Distance between the source of additive(Torrent power AEC, Sabarmati) and the project activity plant-Dadd_source | kilometre | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 |
| Distance between the source of additive(Surathgarh thermal power plant)and the project activity plant-Dadd_source | kilometre | 670 | 670 | 670 | 670 | 670 | 670 | 670 | 670 | 670 | 670 |
| Distance between the source of additive(GEC, Wanabori)and the project activity plant-Dadd_source | kilometre | 350 | 350 | 350 | 350 | 350 | 350 | 350 | 350 | 350 | 350 |
| Net calorific value of Diesel Fuel(IPCC) | TJ/KiloTonnes | 43.33 | 43.33 | 43.33 | 43.33 | 43.33 | 43.33 | 43.33 | 43.33 | 43.33 | 43.33 |
| Carbon Emission factor of Diesel fuel (IPCC) | tCO2/TJ | 74.07 | 74.07 | 74.07 | 74.07 | 74.07 | 74.07 | 74.07 | 74.07 | 74.07 | 74.07 |
| Emission factor for transport fuel(Diesel)-TEF | kg CO2/ kg of fuel | 3.21 | 3.21 | 3.21 | 3.21 | 3.21 | 3.21 | 3.21 | 3.21 | 3.21 | 3.21 |
| Electricity consumption for the conveyor system for additives-ELEconveyor_ADD | MWh | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Grid electricity emission factor EFgrid | tCO2/MWh | 0.752 | 0.752 | 0.752 | 0.752 | 0.752 | 0.752 | 0.752 | 0.752 | 0.752 | 0.752 |
| Quantity of additive carried in one trip per vehicle - Qadd | Tonnes of Additive | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Transport related emissions per tonne of additives-Ladd_trans | tCO2/tonne of additive | 0.10954 | 0.10336 | 0.10336 | 0.10336 | 0.10336 | 0.10336 | 0.10336 | 0.10336 | 0.10336 | 0.10337 |
| Production of BC in year y -BCy | kilotonnes of BC | 477.23 | 642.47 | 706.71 | 777.39 | 855.12 | 940.64 | 1034.7 | 1138.17 | 1251.99 | 1377.19 |
| Baseline benchmark of share of clinker per tonne of BC updated for year y -B blend,y | tonne of clinker /tonne of BC | 0.746 | 0.741 | 0.736 | 0.731 | 0.726 | 0.721 | 0.716 | 0.711 | 0.706 | 0.701 |
| Share of clinker per tonne of BC in year y -P blend,y | tonne of clinker /tonne of BC | 0.7336 | 0.725 | 0.709 | 0.7 | 0.695 | 0.69 | 0.685 | 0.68 | 0.675 | 0.67 |
| Leakage emissions for transport of additives-Ly | kilotonnes of CO2 | 0.655 | 1.072 | 1.984 | 2.506 | 2.758 | 3.036 | 3.342 | 3.679 | 4.050 | 4.458 |

## Enclosure 3

| **Parameter** | **Unit** | **2002-2003** |
|---|---|---|
| **Baseline Emissions of $CO_2$ per tonne of clinker in the project activity ($tCO_2$/tonne clinker)-BE clinker** | | |
| **Baseline Emissions per tonne of clinker due to calcinations of calcium carbonate and magnesium carbonate (tCO2/tonne clinker)- BE calcin** | | |
| Quantity of raw mix | Tonnes | 2915824 |
| Quantity of clinker produced | Tonnes | 1918305 |
| CaO content (%) of raw mix | % | 0 |
| MgO content (%) of raw mix | % | 0 |
| CaO content (%) of Clinker | % | 65.1 |
| MgO content (%) of Clinker | % | 2.09 |
| Baseline Emissions from the calcinations of limestone(tCO2/tonne clinker) BE calcin | tCO2/tclinker | 0.53386 |
| **Baseline Emissions per tonne of clinker due to combustion of fossil fuels for clinker production (tCO2/tonne clinker)-BE fossil_fuel** | | |
| Quantity of coal consumed-$FF_{,BSL}$ | Tonnes | 215585.00 |
| Net calorific value of coal Fuel(IPCC) | TJ/KiloTonnes | 27.26 |

| | | |
|---|---|---|
| Carbon Emission factor of coal(IPCC) | tCO2/TJ | 96.07 |
| Emission factor of coal – EFF | tCO2/Ton of fuel | 2.62 |
| Quantity of lignite consumed-FF_,BSL | Tonnes | 5756.00 |
| Net calorific value of lignite Fuel(IPCC) | TJ/KiloTonnes | 18.85 |
| Carbon Emission factor of Lignite(IPCC) | tCO2/TJ | 101.20 |
| Emission factor of lignite – EFF | tCO2/Ton of fuel | 1.91 |
| Baseline Emissions per tonne of clinker due to combustion of fossil fuels for clinker production-BE fossil_fuel | tCO2/tclinker | 0.300022 |
| **Baseline grid electricity emissions for clinker production per tonnne of clinker- BE ele_grid_CLNK -(tCO2/tonne clinker)** | | |
| Baseline grid electricity for clinker production -BELE$_{grid_CLNK}$ | MWh | 17781.12 |
| Baseline grid emission Factor for state grid - EF$_{grid_BSL}$ | $tCO_2$/MWh | 0.752 |
| Baseline grid electricity emissions for clinker production per tonnne of clinker BE ele_grid_CLNK | $tCO_2$/tonne clinker | 0.006970 |
| **Baseline Emissions from Self generated electricity for clinker production per tonne of clinker -BE ele_sg_CLNK-(tCO2/tonne clinker)** | | |
| Baseline generation of Electricity by thermal captive power plant for clinker production - BELE$_{sg_CLNK_CPP}$ | MWh | 79224.46 |
| CPP Emission Factor in year y - EF$_{sg_CPP_BSL}$ | $tCO_2$/MWh | 1.33 |
| Self generated electricity emissions for clinker production per tonnne of clinker BE ele_sg_CLNK,y | $tCO_2$/tonne of clinker | 0.054928 |
| **Baseline Emissions of $CO_2$ per tonne of clinker in the project activity ($tCO_2$/tonne clinker)-BE clinker** | **$tCO_2$/tonne of clinker** | **0.895778** |
| **Baseline Electricity Emissions for BC grinding and preparation of additives ($tCO_2$/tonne BC)-BE ele_ADD_BC** | | |
| Annual production of BC in base year –BC$_{BSL}$ | kilotonnes of BC | 348.549 |
| **Baseline grid electricity emissions for BC grinding in BE ele_grid_BC -(tCO2/tonne of BC)** | | |

| | | | |
|---|---|---|---|
| Baseline Grid Electricity for grinding BC -BELEgrid_BC | MWh | 2076.40 | |
| Baseline Grid Emission Factor for northern grid - EFgrid_BSL | tCO2/MWh | 0.752 | |
| Baseline Grid electricity emissions for BC grinding (tCO2/tonne of BC) BE ele_grid_BC | tCO2/tonne of BC | 0.004480 | |
| **Baseline self generated electricity emissions for BC grinding BE ele_sg_BC** | | | |
| Baseline generation of Electricity by CPP (Thermal power) for BC grinding - BELEsg_CPP_BC | MWh | 9251.40 | |
| Baseline Self generated electricity emissions for BC grinding (tCO2/tonne of BC) BE ele_sg_BC | tCO2/tonne of BC | 0.035302 | |
| **Baseline Grid electricity emissions for additive preparation BE ele_grid_ADD** | | | |
| Baseline grid electricity emissions for additive preparation BE ele_grid_ADD | tCO2/tonne of BC | 0 | No grinding of additive |
| **Baseline emissions from Self generated electricity additive preparation BE ele_sg_ADD** | | | |
| Emissions from Self generated electricity additive preparation BE ele_sg_ADD | tCO2 / tonne of BC | 0 | No grinding of additive |
| **Baseline electricity Emissions for BC grinding and preparation of additives BE ele_ADD_BC** | | | |
| **Baseline electricity Emissions for BC grinding and preparation of additives BE ele_ADD_BC** | **tCO2 / tonne of BC** | **0.0397815** | |

## Enclosure 4

| **Emission Reduction Calculations** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Parameters** | **Unit** | **2002-2003 Baseline year** | **2003-04** | **2004-05** | **2005-06** | **2006-07** | **2007-08** | **2008-09** | **2009-10** | **2010-11** | **2011-12** | **2012-13** |
| Production of BC in year y | Tonnes | 348549 | 477231 | 642467 | 706714 | 777385 | 855124 | 940636 | 1034700 | 1138170 | 1251987 | 1377185 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Baseline benchmark of share of clinker per tonne of BC updated for year y -B blend,y | tonne of clinker /tonne of BC | 0.7511 | 0.7461 | 0.7411 | 0.7362 | 0.7312 | 0.7262 | 0.7212 | 0.7163 | 0.7113 | 0.7063 | 0.7013 |
| Share of clinker per tonne of BC in year y -P blend,y | tonne of clinker /tonne of BC | - | 0.7336 | 0.725 | 0.709 | 0.7 | 0.695 | 0.69 | 0.685 | 0.68 | 0.675 | 0.67 |
| Baseline Emissions of CO2 per tonne of clinker in the project activity –BE clinker | tCO2/tonne of clinker | 0.8958 | - | - | - | - | - | - | - | - | | - |
| Emissions of CO2 per tonne of clinker in the project activity in year y-PE clinker,y | tCO2/tonne of clinker | - | 0.8958 | 0.8958 | 0.8958 | 0.8958 | 0.8958 | 0.8958 | 0.8958 | 0.8958 | 0.8958 | 0.8958 |
| Conservative Baseline Emissions of CO2 per tonne of clinker in the project activity -BE clinker | | | 0.8958 | 0.8958 | 0.8958 | 0.8958 | 0.8958 | 0.8958 | 0.8958 | 0.8958 | 0.8958 | 0.8958 |
| Baseline electricity Emissions for BC grinding and preparation of additives BE ele_ADD_BC | tCO2 / tonne of BC | 0.0398 | | | - | - | - | - | - | - | | - |
| Electricity Emissions for BC grinding and preparation of additives in year y PE ele_ADD_BC,y | tCO2 / tonne of BC | - | 0.0418 | 0.0418 | 0.0418 | 0.0418 | 0.0418 | 0.0418 | 0.0418 | 0.0418 | 0.0418 | 0.0418 |
| Conservative Baseline electricity Emissions for BC grinding and preparation of | | | 0.0398 | 0.0398 | 0.0398 | 0.0398 | 0.0398 | 0.0398 | 0.0398 | 0.0398 | 0.0398 | 0.0398 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Additives Beele_ADD_BC | | | | | | | | | | | | |
| Baseline CO2 emissions per tonne of BC type-BE BC,y | tCO2 / tonne of BC | - | 0.7081 | 0.7037 | 0.6993 | 0.6948 | 0.6903 | 0.6858 | 0.6814 | 0.6770 | 0.6725 | 0.6680 |
| CO2 emissions per tonne of BC in the project activity plant in year y PE BC,y | tCO2 / tonne of BC | - | 0.6990 | 0.6913 | 0.6769 | 0.6689 | 0.6644 | 0.6599 | 0.6554 | 0.6509 | 0.6465 | 0.6420 |
| **Emissions reductions in year y due to project activity** | **tCO2** | | **3688** | **6895** | **13846** | **17628** | **19390** | **21326** | **23560** | **26027** | **28502** | **31349** |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Baseline emissions | tCO2 | | 337927 | 452104 | 494205 | 540127 | 590292 | 645088 | 705044 | 770541 | 841961 | 919960 |
| Project emissions | tCO2 | | 333584 | 444137 | 478375 | 519993 | 568144 | 620726 | 678142 | 740835 | 809409 | 884153 |
| Leakage | tCO2 | | 655 | 1072 | 1984 | 2506 | 2758 | 3036 | 3342 | 3679 | 4050 | 4458 |
| | | | **334239** | **445209** | **480359** | **522499** | **570902** | **623762** | **681484** | **744514** | **813459** | **888611** |
| | | | 3688 | 6895 | 13846 | 17628 | 19390 | 21326 | 23560 | 26027 | 28502 | 31349 |

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