Revision to the approved consolidated baseline methodology ACM0005

"Consolidated Baseline Methodology for-Increasing the Blend in Cement Production"

Sources

This consolidated baseline methodology is based on elements from the following proposed new methodologies:

- NM0045-rev2: "Birla Corporation Limited: CDM Project for "Optimal Utilization of Clinker", whose project design document, and baseline study, monitoring and verification plans were developed by Birla Corporation Limited;
- NM0047-rev: "Indocement's Sustainable Cement Production Project Blended Cement Component", whose project design document, and baseline study, monitoring and verification plans were developed by PT. Indocement Tunggal Perkasa;
- NM0095: "ACC New Wadi Blended Cement Project", whose project design document, and baseline study, monitoring and verification plans were developed by Agrinergy Ltd.;
- NM0106: "Baseline methodology for optimization of clinker use in the cement industry through investment in grinding technology", whose project design document, and baseline study, monitoring and verification plans were developed by Ecosecurities Ldt.

For more information regarding the proposals and its consideration by the Executive Board please refer to http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html. This methodology also refers to the "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (ACM0002) and the "Tool for the demonstration and assessment of additionality".

Applicability

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. Additives are defined as materials blended with clinker to produce blended cement types and include fly ash, gypsum, slag, etc. The methodology is applicable under the following conditions:

- There is no shortage of additives 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 as outlined below.
- This methodology is applicable to domestically sold output of the project activity plant and excludes export of blended cement.
- Adequate data are available on cement types in the market.

This baseline methodology shall be used in conjunction with the approved consolidated monitoring methodology "Consolidated Monitoring Methodology for Increasing the Blend in Cement Production" (ACM0005).

Project activity

The project activity is the increase in the share of blending materials used in the production of cement (i.e. a reduction of the amount of clinker per tonne of blended cement). The project activity accounts only for GHG emission reductions associated with the increased level of blending – other measures such as energy efficiency improvements should be considered as a separate project activity.

In order to estimate emission reductions in a conservative manner and to reflect the endogenous trends in the level of blending in the region, a benchmark approach is used to calculate emission reductions. The benchmark is defined in the "Baseline" section.

Approach

"Existing actual or historical emissions, as applicable".

Project Boundary

The project boundary includes the cement production plant, any onsite power generation (if applicable), and the power generation in the grid (if applicable).

Project participants shall account for 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 power grid or plant from which the cement plant purchases electricity and its losses will be considered in determining indirect emissions. Any transport related emissions for the delivery of additional additives will be 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.

Gases included: CO_2 only. Changes in CH_4 and N_2O emissions from combustion processes are considered to be negligible and excluded because the differences in the baseline and project activity are not substantial. This assumption simplifies the methodology and is conservative.

Identification of the baseline scenario

Project participants shall identify the most plausible baseline scenario among all realistic and credible alternatives(s). Steps 2 and/or 3 of the latest approved version of the "tool for the determination and assessment of additionality" should be used to assess which of these alternatives should be excluded from further consideration (e.g. alternatives where barriers are prohibitive or which are clearly economically unattractive). Where more than one credible and plausible alternative remains, project participants shall, as a conservative assumption, use the alternative baseline scenario that results in the lowest baseline emissions as the most likely baseline scenario.

In doing so, project proponents (PPs) shall consider all realistic and credible production scenarios for the relevant cement type that are consistent with current rules and regulations, including the existing practice of cement production, the proposed project activity, and practices in other manufacturing plants in the region using similar input/raw materials, and facing similar economic, market and technical circumstances. If only two scenarios, i.e. the existing practice of cement production and the proposed project activity, are realistic and credible alternatives, the most likely baseline scenario can be identified with the latest version of the "Tool for the demonstration and assessment of additionality".

Additionality

The additionality of the project activity shall be demonstrated and assessed using the latest version of the "Tool for the demonstration and assessment of additionality" agreed by the CDM Executive Board, which is available on the UNFCCC CDM web site[1].

In applying the latest version of the "Tool for the demonstration and assessment of additionality", where project proponents use the barrier analysis, they must demonstrate that there exist real and demonstrable barriers to the increase in the additive blend. Such barriers may include, among others:

Technological barriers, inter alia:

- A substantial research effort is required to enable the increase in blending.
- Lack of infrastructure for implementation of the technology.

Institutional barriers to project activity implementation, for example, lack of access to financing.

Market acceptability barriers, inter alia:

- Perception that high additive blended cement is of inferior quality.
- Lack of awareness of customers on the use high additive blended cement.

Project participants shall demonstrate that the identified barriers prevent potential project proponents from carrying out the proposed project activity if it is not registered as a CDM activity. The PP shall provide transparent and documented evidence as illustrated in the "Tool for the demonstration and assessment of additionality". The evidence should be substantiated through independent surveys and independent stakeholder interviews.

Baseline emissions

The benchmark for baseline emissions is defined as the lowest value among the following:

(i) The average (weighted by production) mass percentage of clinker for the 5 highest blend cement brands for the relevant cement type in the region; If the region comprises of less than 5 blend cement brands, the national market should be used as the default region; or

(ii) The production weighted average mass percentage of clinker in the top 20% (in terms of share of additives) of the total production of the blended cement type in the region. If 20% falls on part capacity of a plant, that plant is included in the calculations; or

(iii) 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, if applicable (For Greenfield project activity this option may be excluded).

[1] Please refer to: < http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html>

For (i) and (ii) above, the project proponents can choose between 2 options – either (1) to update the benchmark annually and incorporate only an increasing trend (a decreasing trend would require the baseline to remain constant); or (2) the benchmark incorporates a trend increase, specified ex-ante, in the share of additives in blended cement type based on general market trend or a minimum of an annual 2% increase in additives. For example, if the additives percentage is 15% at the start of the project activity (year 1), for the second year of the crediting period, the percentage of additives increases to 15.3% and is 15.6% for year 3 and so on, for the baseline.

For option (iii) the highest percentage of additives used over the 3 most recent years and the highest percentage of additives is selected and an increasing trend of a minimum of 2% increase in additives over the percentage of additives at the start of the project activity is incorporated up to the limit of the regulatory/product norm in the region/national market.

At the renewal of the crediting period, the benchmark is recalculated. The basis (between the 3 options) of the benchmark may change from the option selected during the first crediting period.

To determine the benchmark for option (i) and (ii), statistically significant random sampling is done for the high blend brands in the relevant cement type in the region. In other words, for the cement type under consideration and for high blend brands in the region, random and statistically significant samples are selected and analyzed for the percentage of clinker by an independent laboratory. The sampling of the relevant type of blended cement type produced in the region should exclude cement plants or output from cement plants that have registered blended cement CDM project activities. If reliable and up to date annual data are available from reputable and verifiable external sources (for example, industry manufacturers association or government agencies), these may be used to determine the benchmark.

The "Region" for the benchmark calculation needs to be clearly determined and justified by project participants. The default is the national market but PPs can define a geographic region as the area where each of the following conditions are met: (i) at least 75% of project activity plant's cement production is sold (percentage of domestic sales only); (ii) includes at least 5 other plants with the required published data; and (iii) the production in the region is at least four times the project activity plant's output. Only domestically sold output is considered and any export of cement produced by the project activity plant are excluded in the estimation of emission reductions.

The baseline emissions are a function of two factors:

- the percentage of additives and the related electricity consumption that is taken as the baseline benchmark; and
- the CO_2 emissions per tonne of clinker in the project activity plant, which in turn depends on
    - Quantity and carbon intensity of the fuels used in clinker making;
    - Quantity and carbon intensity of electricity;
    - CO_2 emissions from calcinations.

Baseline emissions per tonne of blended cement type (BC) are determined below. BC is defined as distinct products with different uses that have different additives and different additive to clinker ratios (for example, Portland Pozzolana Cement or Portland Blast Furnace Slag). Consumption of fuel and electricity in the production of clinker and blended cement type are monitored for at least one year prior to the start of the CDM project activity. If monitored data to determine specific energy consumption by type of fuels is available for two or three years prior to the start of the project activity, the average may be taken in determining baseline emissions.

The values to be used in the formulae below relating to clinker production, fossil fuel consumption and electricity consumption shall be obtained by monitoring the operation of the plant before the project activity is implemented.

$$BE_{BC,y} = [BE_{clinker} * B_{Blend,y}] + BE_{ele\_ADD\_BC} \quad \textbf{(1)}$$

where:

$BE_{BC,y}$	=	Baseline CO_2 emissions per tonne of blended cement type (BC) (t CO_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 (tCO2/tonne of BC)

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

$$BE_{clinker} = BE_{calcin} + BE_{fossil\_fuel} + BE_{ele\_grid\_CLNK} + BE_{ele\_sg\_CLNK} \quad \textbf{(1.1)}$$

where:

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

$$BE_{calcin} = [0.785*(OutCaO - InCaO) + 1.092*(OutMgO - InMgO)] / [CLNK_{BSL} * 1000] \quad \textbf{(1.1.1)}$$

where:

BE_{calcin}	=	Emissions from the calcinations of limestone (tCO2/tonne clinker)
0.785	=	Stoichiometric emission factor for CaO (tCO2/t CaO)
1.092	=	Stoichiometric emission factor for MgO (tCO2/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)

$$BE_{fossil\_fuel} = [\sum FF_{i\_BSL} * EFF_i] / [CLNK_{BSL} * 1000] \quad \textbf{(1.1.2)}$$

FF_{i_BSL}	=	Fossil fuel of type i consumed for clinker production in the baseline (tonnes 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 **(1.1.3)**

$BELE_{grid\_CLNK}$ = 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)

$BE_{elec\_sg\_CLNK}$ = [$BELE_{sg\_CLNK}$ * EF_{sg_BSL}] /[$CLNK_{BSL}$ * 1000] **(1.1.4)**

$BELE_{sg\_CLNK}$ = 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)

$BE_{ele\_ADD\_BC}$ = $BE_{ele\_grid\_BC}$ + $BE_{ele\_sg\_BC}$ + $BE_{ele\_grid\_ADD}$ + $BE_{ele\_sg\_ADD}$ **(1.2)**

where:

$BE_{ele\_grid\_BC}$ = Baseline grid electricity emissions for BC grinding (tCO2/tonne of BC)
$BE_{ele\_sg\_BC}$ = Baseline self generated electricity emissions for BC grinding (tCO2/tonne of BC)
$BE_{ele\_grid\_ADD}$ = Baseline grid electricity emissions for additive preparation (tCO2/tonne of BC)
$BE_{ele\_sg\_ADD}$ = Baseline self generated electricity emissions for additive preparation (tCO2/tonne of BC)

$BE_{ele\_grid\_BC}$ = [$BELE_{grid\_BC}$ * EF_{grid_BSL}] /[BC_{BSL}* 1000] **(1.2.1)**

$BELE_{grid\_BC}$ = 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] **(1.2.2)**

$BELE_{sg\_BC}$ = 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}] /[BC_{BSL}* 1000] **(1.2.3)**

$BELE_{grid\_ADD}$ = Baseline grid electricity for grinding additives (MWh)
EF_{grid_BSL} = Baseline grid emission factor (t CO_2/MWh)

$BE_{elec\_sg\_ADD}$ = [$BELE_{sg\_ADD}$ * EF_{sg_BSL}] / [BC_{BSL}* 1000] **(1.2.4)**

$BELE_{sg\_BC}$ = Baseline self generation electricity for grinding additives (MWh)
EF_{sg_BSL} = Baseline electricity self generation emission factor (t CO_2/MWh)

Leakage

Emissions due to fuel use for the transport of raw materials (e.g. limestone, 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 for additives are calculated as below.

$$L_{add\_trans} = [(TF_{cons} * D_{add\_source} * TEF)* 1/Q_{add}*1/1000 + (ELE_{conveyor\_ADD} * EF_{grid})*1/ADD_y] \quad \textbf{(2)}$$

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)
$ELE_{conveyor\_ADD}$	=	Annual 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)
ADD_y	=	Annual consumption of additives in year y. (t of additives)

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

$$L_y = L_{add\_trans} * [A_{blend,y} – P_{blend,y}] * BC_y \quad \textbf{(2.1)}$$

where:

L_y	=	Leakage emissions for transport of additives (kilotonnes of CO_2)
BC_y	=	Production of BC in year y (kilotonnes of BC)
$A_{blend,y}$	=	Baseline benchmark share of additives per tonne of BC updated for year y (tonne of additives/tonne of BC)
$P_{blend,y}$	=	Share of additives per tonne of BC in year y (tonne of additives/tonne 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 used in the project activity are surplus, the project emissions reductions are reduced by the factor α, which is defined as:

$$\alpha_y = \text{x tonnes of additives in year y / total additional additives used in year y} \quad \textbf{(3)}$$

Emission Reductions

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.

$$ER_y = \{ \; [BE_{BC,y} - PE_{BC,y}] * BC_y + L_y \; \} * (1 - \alpha_y) \qquad \textbf{(4)}$$

where:

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)

Project Activity Emissions

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

(i) Emissions from calcinations of limestone;
(ii) Emissions from combustion of fossil fuel and electricity for clinker production and processing of raw material;
(iii) 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 or fuel switching, in case (i), the baseline value is substituted by the project activity value. That is, if emissions per tonne of clinker are lower during the crediting period, then the lower value is taken for the baseline. The choice of the lower value aims at avoiding potential perverse incentives for project participants to increase the emissions 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 overall negative 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. (For example: if negative emission reductions of 30 tCO_2e occur in the year t and positive emission reductions of 100 tCO_2e occur in the year t+1, 0 CERs are issued for year t and only 70 CERs are issued for the year t+1.)

$$PE_{BC,y} = [PE_{clinker,y} * P_{Blend,y}] + PE_{ele\_ADD\_BC,y} \qquad \textbf{(5)}$$

where:

$PE_{BC,y}$ = CO_2 emissions per tonne of BC in the project activity plant in year y(t CO_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:

$$PE_{clinker,y} = PE_{calcin,y} + PE_{fossil\_fuel,y} + PE_{ele\_grid\_CLNK,y} + PE_{ele\_sg\_CLNK,y} \quad \textbf{(5.1)}$$

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)

$$PE_{calcin,y} = 0.785*(OutCaO_y - InCaO_y) + 1.092*(OutMgO_y - InMgO_y) / [CLNK_y * 1000] \quad \textbf{(5.1.1)}$$

where:

$PE_{calcin,y}$ = Emissions from the calcinations of limestone (tCO2/tonne clinker)
0.785 = Stoichiometric emission factor for CaO (tCO2/t CaO)
1.092 = Stoichiometric emission factor for MgO (tCO2/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)

$$PE_{fossil\_fuel,\,y} = [\sum FF_{i\_,y} * EFF_i] / CLNK_{,y} * 1000 \quad \textbf{(5.1.2)}$$

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 (tCO2/tonne of fuel)
$CLNK_y$ = Annual production of clinker in year y (kilotonnes of clinker)

$$PE_{ele\_grid\_CLNK,y} = [PELE_{grid\_CLNK,y} * EF_{grid\_y}] / [CLNK_y * 1000] \quad \textbf{(5.1.3)}$$

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)

$$PE_{elec\_sg\_CLNK,y} = [PELE_{sg\_CLNK,y} * EF_{sg\_y}] / [CLNK_y * 1000] \qquad \textbf{(5.1.4)}$$

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)

$$PE_{ele\_ADD\_BC,y} = PE_{ele\_grid\_BC,y} + PE_{ele\_sg\_BC,y} + PE_{ele\_grid\_ADD,y} + PE_{ele\_sg\_ADD,y} \qquad \textbf{(5.2)}$$

where:

$PE_{ele\_grid\_BC}$ = Grid electricity emissions for BC grinding in year y (tCO2/tonne of BC)
$PE_{ele\_sg\_BC}$ = Emissions from self generated electricity for BC grinding in year y (tCO2/tonne of BC)
$PE_{ele\_grid\_ADD}$ = Grid electricity emissions for additive preparation in year y (tCO2/tonne of BC)
$PE_{ele\_sg\_ADD}$ = Emissions from self generated electricity additive preparation in year y (tCO2/tonne of BC)

$$PE_{ele\_grid\_BC,y} = [PELE_{grid\_BC,y} * EF_{grid\_BSL,y}] / [BC_y * 1000] \qquad \textbf{(5.2.1)}$$

$PELE_{grid\_BC,y}$ = 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)

$$PE_{elec\_sg\_BC,y} = [PELE_{sg\_BC,y} * EF_{sg\_y}] / [BC_y * 1000] \qquad \textbf{(5.2.2)}$$

$PELE_{sg\_BC,y}$ = 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)

$$PE_{ele\_grid\_ADD} = [PELE_{grid\_ADD} * EF_{grid\_y}] / [BC_y * 1000] \qquad \textbf{(5.2.3)}$$

$BELE_{grid\_ADD}$ = Baseline grid electricity for grinding additives (MWh)
EF_{grid_y} = Grid emission factor in year y(t CO_2/MWh)

$$PE_{elec\_sg\_ADD,y} = [PELE_{sg\_ADD,y} * EF_{sg\_y}] / [BC_y * 1000] \qquad \textbf{(5.2.4)}$$

$PELE_{sg\_ADD,y}$ = Baseline self generation electricity for grinding additives (MWh)
EF_{sg_y} = Emission factor for self generated electricity in year y (t CO_2/MWh)

All fuel uses are expressed in net calorific values (NCV) or lower heating value (LHV). All units use the metric system, unless specified otherwise. In determining emission coefficients, emission factors or net calorific values in this methodology, guidance by the 2000 IPCC Good Practice Guidance should be followed where appropriate. Project participants may either conduct regular measurements or they may use accurate and reliable local or national data where available. Where such data is not available, IPCC default emission factors (country-specific, if available) may be used if they are deemed to reasonably represent local circumstances. All values should be chosen in a conservative manner and the choice should be justified.

Electricity Emission Factor

For the calculation of the specific emissions from power generation from the grid

($EF_{grid\_BSL\ or\ y}$) the approved consolidated baseline methodology ACM0002 is applied. [2]

For cement plants that self-generate power, the average annual emission factor of the self-generated power can be substituted by the emission factor calculated below.
The emission factor for self generation ($EF_{sg,y}$) is calculated as the generation-weighted average emissions per electricity unit (tCO_2/MWh) of all self-generating sources in the project boundary serving the system.

$$EF_{sg,y} = \frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_{j} GEN_{j,y}} \qquad \textbf{(6)}$$

where:

$F_{i,j,y}$ = amount of fuel i (in a mass or volume unit) consumed by relevant power sources j in year(s) y,
j = *on-site* power sources,
$COEF_{i,j\,y}$ = CO_2 emission coefficient of fuel i (tCO_2 / mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant power sources j and the percent oxidation of the fuel in year(s) y, and
$GEN_{j,y}$ = electricity (MWh) generated by the source j.

The CO_2 emission coefficient $COEF_i$ is obtained as:

$$COEF_i = NCV_i \cdot EF_{CO2,i} \cdot OXID_i \qquad \textbf{(7)}$$

where:

NCV_i = net calorific value (energy content) per mass or volume unit of a fuel i,
$OXID_i$ = oxidation factor of the fuel (see page 1.29 in the 1996 Revised IPCC Guidelines for default values),
$EF_{CO2,i}$ = CO_2 emission factor per unit of energy of the fuel i.

[2] Please refer to: < http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html >

Revision to the approved consolidated monitoring methodology ACM0005

"Consolidated Monitoring Methodology for Increasing the Blend in Cement Production"

Sources

This consolidated baseline methodology is based on elements from the following proposed new methodologies:

- NM0045-rev2: "Birla Corporation Limited: CDM Project for "Optimal Utilization of Clinker", whose project design document, and baseline study, monitoring and verification plans were developed by Birla Corporation Limited;
- NM0047-rev: "Indocement's Sustainable Cement Production Project Blended Cement Component", whose project design document, and baseline study, monitoring and verification plans were developed by PT. Indocement Tunggal Perkasa;
- NM0095: "ACC New Wadi Blended Cement Project", whose project design document, and baseline study, monitoring and verification plans were developed by Agrinergy Ltd.;
- NM0106: "Baseline methodology for optimization of clinker use in the cement industry through investment in grinding technology", whose project design document, and baseline study, monitoring and verification plans were developed by Ecosecurities Ldt.

For more information regarding the proposals and its consideration by the Executive Board please refer to <http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html>

Applicability

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. Additives are defined as materials blended with clinker to produce blended cement types and include flyash, gypsum, slag, etc. The methodology is applicable under the following conditions:

- There is no shortage of additives 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 as outlined below.
- This methodology is applicable to domestically sold output of the project activity plant and excludes export of blended cement types.
- Adequate data are available on cement types in the market.

Project emissions are those arising from the production of clinker and the processing of additives, subject to the actual additive blend achieved.

This monitoring methodology shall be used in conjunction with the approved consolidated baseline methodology "Consolidated Baseline Methodology for Increasing the Blend in Cement Production" (ACM0005).

Data to monitor emissions from the project activity

ID number	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.	$InCaO_y$	Plant records	%	M,C	Daily	100%	Electronic	Will be calculated/measured as part of normal operations
2.	$OutCaO_y$	Plant records	%	M,C	Daily	100%	Electronic	Will be calculated/measured as part of normal operations
3.	$InMgO_y$	Plant records	%	M,C	Daily	100%	Electronic	Will be calculated/measured as part of normal operations
4.	$OutMgO_y$	Plant records	%	M,C	Daily	100%	Electronic	Will be calculated/measured as part of normal operations
5.	Quantity of clinker raw material	Plant records	Kilo tonnes	M	Annually	100%	Electronic	
6.	$CLNK_y$	Plant records	Kilo tonnes of clinker	M	Annually	100%	Electronic	
7.	FF_{i_y}	Plant records	Tonnes of fuel i	M	Annually	100%	Electronic	
8.	EFF_i	IPCC/ Plant records	tCO2/tonne of fuel i	C/M	Annually	100%	Electronic	IPCC factors for determining CO_2 coefficient
9.	$PELE_{grid\_CLNK,y}$	Plant records	MWh	M	Monthly	100%	Electronic	

ID number	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
10.	EF_{grid_BSL}	See comment	t CO_2/MWh	C	Annually	100%	Electronic	ACM0002 will be used to determine electricity emissions
11.	$PELE_{sg\_CLNK,y}$	Plant records	MWh	M	Monthly	100%	Electronic	
12.	EF_{sg_y}	Plant records/IPCC	t CO_2/MWh	C	Monthly	100%	Electronic	IPCC factors for determining CO_2 coefficient
13.	ADD_y Quantity of additives	Plant records	Kilo tonnes	M	Monthly	100%	Electronic	
14.	$PELE_{grid\_BC,y}$	Plant records	MWh	M	Monthly	100%	Electronic	
15.	$PELE_{sg\_BC,y}$	Plant records	MWh	M	Monthly	100%	Electronic	
16.	$PELE_{grid\_ADD}$	Plant records	MWh	M	Monthly	100%	Electronic	
17.	$PELE_{sg\_ADD,y}$	Plant records	MWh	M	Monthly	100%	Electronic	
18.	$F_{i\ ,j,\ y}$	Plant records	Tonnes of fuel i	M	Monthly	100%	Electronic	
19.	$COEF_{i,j\ y}$	IPCC/ Plant records	tCO2/tonne of fuel i	C/M	Annually	100%	Electronic	
20.	$GEN_{j,y}$	Plant records	MWh	M	Annually	100%	Electronic	
21.	$PE_{calcin,y}$	Plant records	t CO_2/tonne clinker	C	Annually	100%	Electronic	

ID number	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
22.	$PE_{fossil\_fuel,y}$	Plant records	t CO_2/tonne clinker	C	Annually	100%	Electronic	
23.	$PE_{ele\_grid\_CLNK,y}$	Plant records	t CO_2/tonne clinker	C	Annually	100%	Electronic	
24.	$PE_{ele\_sg\_CLNK,y}$	Plant records	t CO_2/tonne clinker	C	Annually	100%	Electronic	
25.	$PE_{ele\_grid\_BC,y}$	Plant records	t CO_2/tonne blended cement	C	Annually	100%	Electronic	
26.	$PE_{ele\_sg\_BC,y}$	Plant records	t CO_2/tonne blended cement	C	Annually	100%	Electronic	
27.	$PE_{ele\_grid\_ADD,y}$	Plant records	t CO_2/tonne blended cement	C	Annually	100%	Electronic	
28.	$PE_{ele\_sg\_ADD,y}$	Plant records	t CO_2/tonne blended cement	C	Annually	100%	Electronic	
29.	$P_{blend,y}$	Plant records	Tonne of clinker/tonne of blended cement	C	Annually	100%	Electronic	

Baseline emissions

ID number	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
1.	$InCaO_{BSL}$	Plant records	%	M,C	Daily	100%	Electronic	Will be calculated/measured as part of normal operations
2.	$OutCaO_{BSL}$	Plant records	%	M,C	Daily	100%	Electronic	Will be calculated/measured as part of normal operations
3.	$InMgO_{BSL}$	Plant records	%	M,C	Daily	100%	Electronic	Will be calculated/measured as part of normal operations
4.	$OutMgO_{BSL}$	Plant records	%	M,C	Daily	100%	Electronic	Will be calculated/measured as part of normal operations
5.	Quantity of clinker raw material	Plant records	Kilo tonnes	M	Annually	100%	Electronic	
6.	$CLNK_{BSL}$	Plant records	Kilo tonnes of clinker	M	Annually	100%	Electronic	
7.	$FF_{i\_,BSL}$	Plant records	Tonnes of fuel	M	Annually	100%	Electronic	
8.	EFF_i	IPCC/ Plant records	tCO2/tonne of fuel i	C/M	Annually	100%	Electronic	
9.	$BELE_{grid\_CLNK,BSL}$	Plant records	MWh	M	Annually	100%	Electronic	
10.	EF_{grid_BSL}	See comments	t CO_2/MWh	C	Annually	100%	Electronic	ACM0002 will be used to determine electricity emissions

ID number	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
11.	$BELE_{sg\_CLNK,BSL}$	Plant records	MWh	M	Annually	100%	Electronic	
12.	EF_{sg_BSL}	Plant records	t CO_2/MWh	C	Annually	100%	Electronic	
13.	ADD_{BSL} Quantity of additives	Plant records	Kilo tonnes	M	Annually	100%	Electronic	
14.	$BELE_{grid\_BC,BSL}$	Plant records	MWh	M	Annually	100%	Electronic	
15.	$BELE_{sg\_BC,BSL}$	Plant records	MWh	M	Annually	100%	Electronic	
16.	$BELE_{grid\_ADD}$	Plant records	MWh	M	Annually	100%	Electronic	
17.	$BELE_{sg\_ADD,BSL}$	Plant records	MWh	M	Annually	100%	Electronic	
18.	$F_{i\ ,j,\ BSL}$	Plant records	Tonnes of fuel i	M	Annually	100%	Electronic	
19.	$COEF_{i,j\ BSL}$	IPCC/ Plant records	tCO2/tonne of fuel i	C/M		100%	Electronic	
20.	$GEN_{j,BSL}$	Plant records	MWh	M	Annually	100%	Electronic	
21.	$BE_{calcin,BSL}$	Plant records	t CO_2/tonne clinker	C	Annually	100%	Electronic	
22.	$BE_{fossil\_fuel,BSL}$	Plant records	t CO_2/tonne clinker	C	Annually	100%	Electronic	
23.	$BE_{ele\_grid\_CLNK,BSL}$	Plant records	t CO_2/tonne clinker	C	Annually	100%	Electronic	

ID number	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
24.	$BE_{ele\_sg\_CLNK,BSL}$	Plant records	t CO_2/tonne clinker	C	Annually	100%	Electronic	
25.	$BE_{ele\_grid\_BC,BSL}$	Plant records	t CO_2/tonne blended cement	C	Annually	100%	Electronic	
26.	$BE_{ele\_sg\_BC,BSL}$	Plant records	t CO_2/tonne blended cement	C	Annually	100%	Electronic	
27.	$BE_{ele\_grid\_ADD,BSL}$	Plant records	t CO_2/tonne blended cement	C	Annually	100%	Electronic	
28.	$BE_{ele\_sg\_ADD,BSL}$	Plant records	t CO_2/tonne blended cement	C	Annually	100%	Electronic	
29.	$A_{blend,y}$	Plant records	Tonne of additives/tonne of blended cement	C	Annually	100%	Electronic	

Leakage

ID number	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.	TF_{cons}	Plant records	kg of fuel/kilometre	C	Annually	100%	Electronic	
2.	D_{add_source}	Plant records	km	M	Per trip	100%	Electronic	
3.	TEF	IPCC	kg CO_2/kg of fuel	E	Annually	100%	Electronic	
4.	Q_{add}	Plant records	Tonnes of additive /vehicle	M	Per trip	100%	Electronic	
5.	$ELE_{conveyor\_ADD}$	Plant records	MWh	M	Monthly	100%	Electronic	
6.	EF_{grid}	National grid/plant data (if onsite generation)	Tonnes of CO_2/MWh	C	Annually	100%	Electronic	
7.	α_y	Plant records	Tonnes of additive	M/C	Annually	100%	Electronic	

Quality control (QC) and quality assurance (QA)

Data	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
Table B.2.1 ID numbers1-29	Low-Medium	These data will be collected as part of normal plant level operations. QA/QC requirements consist of cross –checking these with other internal company reports. Local data and where applicable IPCC data will be used. Independent agency verification will also be used.
Table B.2.3 ID numbers1-29	Low-Medium	These data will be collected as part of normal plant level operations. QA/QC requirements consist of cross –checking these with other internal company reports. Local data and where applicable IPCC data will be used. Independent agency verification will also be used.
Table B.4.1 ID numbers 1-7	Low	Round trip distance will be cross-checked with evidence of origin and map references. Truck capacity and Fuel consumption data will originate from vehicle manufacturers and transporters.