Approved consolidated baseline and monitoring methodology ACM0015

"Consolidated baseline and monitoring methodology for project activities using alternative raw materials that do not contain carbonates for clinker manufacturing in cement kilns"

I. SOURCE AND APPLICABILITY

Source

This methodology is based on the project activities:

- NM0163 "Use of calcined ashes and fluorite for clinker production in the Cement Plant of Huichapan, Mexico", whose baseline and monitoring methodology and project design document were prepared by MGM International.
- NM0123-rev "Methodology for use of non-carbonated calcium sources in the raw mix for cement processing" proposed by Lafarge Brasil, whose baseline study was prepared by Lafarge Brasil and ICF Consulting.

For more information regarding the proposal and its consideration by the Executive Board please refer to cases NM0163 and NM0123-rev on http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html

This methodology also refers to the latest version of the "Tool for the demonstration and assessment of additionality" and ACM0002: "Consolidated baseline methodology for grid-connected electricity generation from renewable sources".

Please refer to http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html.

This methodology also refers to the latest approved versions of the following tools:

- Tool to calculate the emission factor for an electricity system;
- Tool for the demonstration and assessment of additionality.

Selected approach from paragraph 48 of the CDM modalities and procedures

"Actual or historical emissions, as applicable"

Definitions

Alternative raw materials that do not contain carbonates for clinker manufacturing (AMC) are defined as any mineral or synthetic substances or compounds that do not contain carbonates in its chemical composition; are obtained from mining, transformation or as by-products of other industrial processes; and chemically react with raw materials commonly used for clinker production. These alternative raw materials could include, among others: waste ash from fuel combustion in thermal power plants, blast furnace slag, gypsum, anhydrite, and fluorite etc. that are not used in normal production conditions.

Raw materials are a general designation for input material to the cement kiln for the purpose of production of clinker.

Applicability

This methodology is applicable to project activities that use alternative raw materials that do not contain carbonates (AMC) in cement kilns for the production of clinker. The AMC partially or fully substitutes raw materials that contain calcium and/or magnesium carbonates (e.g. limestone) and that would otherwise be used in the kilns.

This methodology is applicable under the following additional conditions:

- Use of alternative materials shall increase neither the capacity of clinker production nor the lifetime of equipment;
- The methodology is applicable to existing as well as to greenfield plants;
- Type and quality of produced clinker remain the same in both baseline and project case;
- Alternative raw materials have never been used in the clinker manufacturing facility prior to the implementation of the project activity;
- The quantity of AMC available shall be at least 1.5 times the quantity required for meeting the demand of all existing users, including other uses than in the cement industry, consuming the same AMC in the project area, i.e. the total quantity required for the project as well as other users of the alternative raw materials. Project area in this context is defined as the area defined by a radius of 200 km around the project activity including at least the ten cement plants nearest to the plant of the project activity;
- There is sufficient historical information about the clinker manufacturing facility, the raw materials used, and energy performance of the kiln.

This methodology is not applicable for the following activities:

- Energy efficiency initiatives for improvements in process equipment (up-grade towers, grinding separators, burners, expert control systems, etc.);
- Fuel switching.

The quantity of clinker used for manufacturing new varieties of cement following project implementation is excluded from calculation of emissions, since these new varieties do not belong to the common-practice cement category.

Project boundary

The spatial extent of project boundary includes all process units related to the manufacturing of clinker in the cement kiln, from reception of raw materials and fuel to the delivery of clinker to the cooler.

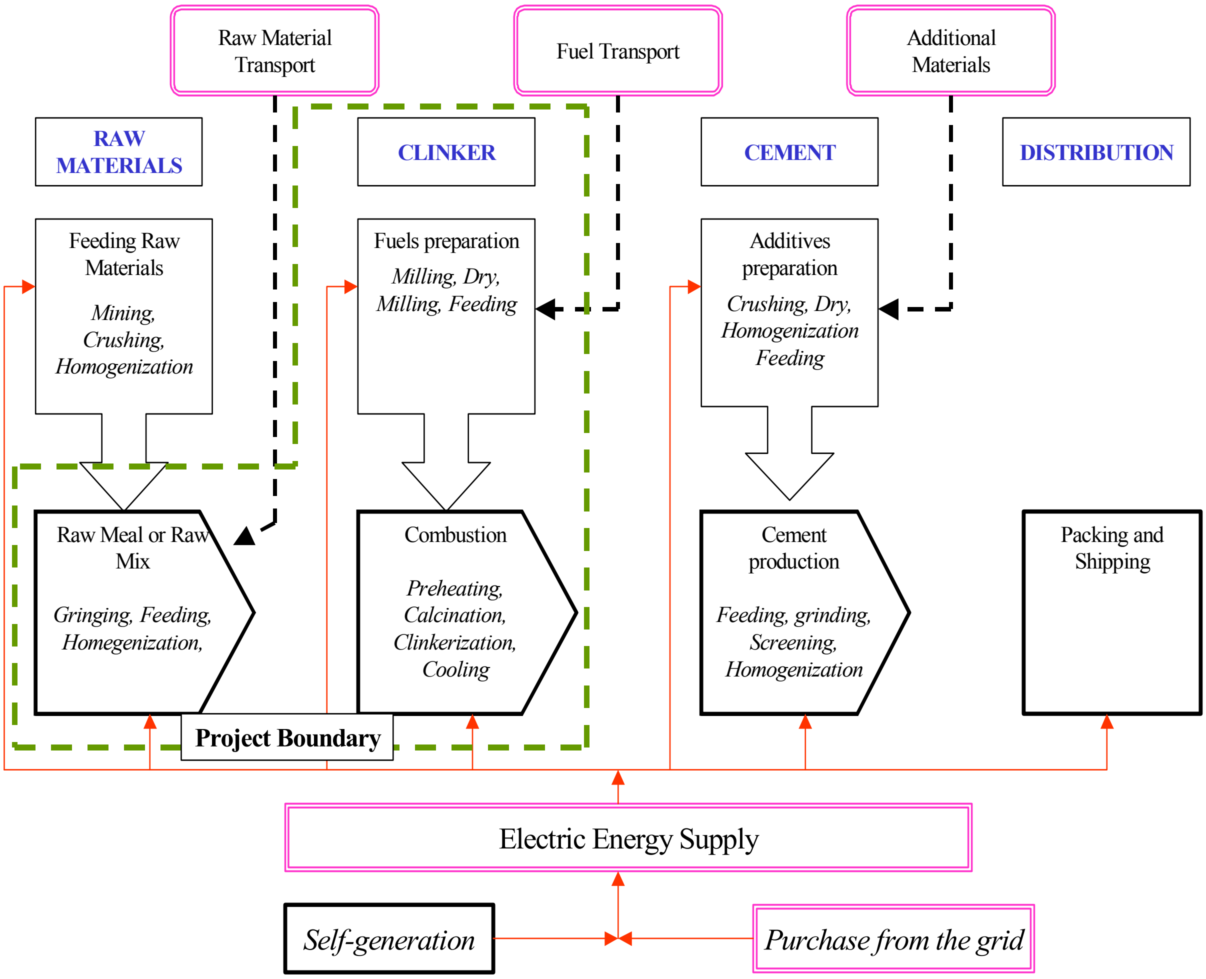
Transportation of raw materials, alternative raw materials, fuels and electricity generation sources are excluded from the project boundary and accounted as leakage. Emissions generated from transportation and electricity consumption in cement production, and potential effects due to a higher consumption of clinker when manufacturing the different kinds of cement will also be accounted as leakage.

Table 1: Gases and sources included in the project boundary

Source		Gas	Included?	Explanation
Baseline	Calcination of raw materials in the kiln	CO_2	Yes	Direct emission from clinker kiln. It includes effects for By-pass and Clinker Kiln Dust productions systems.
		CH_4	No	Emissions negligible, excluded for simplification
		N_2O	No	Emissions negligible, excluded for simplification
	Use of fuels in the kiln, including main burner and pre-calcinator (fossil, alternative fossil and non-fossil)	CO_2	Yes	Direct emissions from clinker kiln.
		CH_4	No	Emissions negligible, excluded for simplification
		N_2O	No	Emissions negligible, excluded for simplification
	Use of fuel for the preparation of alternative raw materials and fuels (e.g. drying of materials or fuels using external dryers)	CO_2	Yes	Only if there exists an additional consumption of fuel during the preparation of raw materials or fuel, for example, drying of materials using burners.
		CH_4	No	Emissions negligible, excluded for simplification
		N_2O	No	Emissions negligible, excluded for simplification
	Use of electricity (grid and self generated) for the preparation of raw materials and fuels, and for the operation of equipments related to the kiln (engines, compressors, fans, etc.)	CO_2	Yes	Changes in feeding system and preparation of materials.
		CH_4	No	Emissions negligible, excluded for simplification
		N_2O	No	Emissions negligible, excluded for simplification
Project Activity	Calcination of raw materials	CO_2	Yes	Direct emission from clinker kiln. It includes effects for By-pass and Clinker Kiln Dust productions systems.
		CH_4	No	Emissions negligible, excluded for simplification
		N_2O	No	Emissions negligible, excluded for simplification
	Use of fuels in the kiln, including main	CO_2	Yes	Direct emission from clinker kiln.
		CH_4	No	Emissions negligible, excluded for simplification

Source		Gas	Included?	Explanation
	burner and pre-calcinator (fossil, alternative fossil and non-fossil)	N_2O	No	Emissions negligible, excluded for simplification
	Use of fuel for the preparation of alternative raw materials and fuels (e.g. drying of materials or fuels using external dryers)	CO_2	Yes	Only if the new material would have a fuel consumption specific component for the adaptation of material, for instance, drying.
		CH_4	No	Emissions negligible, excluded for simplification
		N_2O	No	Emissions negligible, excluded for simplification
	Use of electricity (grid and self generated) for the preparation of raw materials and fuels, and for the operation of equipments related to the kiln (engines, compressors, fans, etc.)	CO_2	Yes	Changes in feeding system and preparation of materials.
		CH_4	No	Emissions negligible, excluded for simplification
		N_2O	No	Emissions negligible, excluded for simplification

The green dotted line in the figure below represents the project boundary:



Procedure for the identification of the most plausible baseline scenario

Step 1. Identification of alternative scenarios to the proposed CDM project activity that are consistent with current laws and regulations

Identify all realistic and credible alternatives to the project activity that are consistent with current laws and regulations. In doing so, project participants shall consider all realistic and credible production scenarios for the relevant clinker type that are consistent with current rules and regulations, including the existing practice of clinker production, the proposed project activity not undertaken as a CDM project activity and practices in other manufacturing plants in the region[1] using similar input/raw materials, and facing similar economic, market and technical circumstances.

[1] Region in this context is defined as the geographic area defined by a radius of 200 km around the project activity including at least the ten cement plants nearest to the plant of the project activity.

At least, the following scenarios have to be considered:

- The continuation of the current practice, i.e. a scenario in which the company continues cement production using the existing technology, fuel materials and raw materials. In case of greenfield projects, a scenario where the company uses raw materials from carbonated sources;
- A scenario in which traditional raw materials, limestone and clay, are partially substituted by AMC at a different rate than that of the project scenario. If relevant, develop different scenarios varying the degrees of different raw materials. These scenarios should reflect all relevant policies and regulations
- The proposed project activity not undertaken as a CDM project.

The alternatives should go through one of the following analysis:

Step 2. Barrier analysis to eliminate alternatives to the project activity that face prohibitive barriers

Establish a complete list of barriers that would prevent alternative scenarios in the absence of the CDM, using the guidance in step 3 (barrier test) of the latest version of the "*Tool for the demonstration and assessment of additionality*".

Show which alternatives are prevented by at least one of the barriers previously identified and eliminate those alternatives from further consideration. All alternatives shall be evaluated for a common set of barriers.

If there is only one alternative that is not prevented by any barrier then this alternative is identified as the baseline scenario. Where more than one credible and plausible alternative remains, as a conservative assumption, use the alternative baseline scenario that results in the lowest baseline emissions as the most likely baseline scenario, or conduct an investment analysis (Step 3).

Step 3. Investment analysis

Conduct an investment analysis, consistent with the guidance in step 2 of the latest version of the "Tool for the demonstration and assessment of additionality". The economically most attractive combination of alternatives is deemed as the most plausible baseline scenario.

The following additional instructions should be followed:

- Calculate the financial costs (e.g. capital and variable costs) and account cost savings due to net energy gains, if any, from project activity.
- A sensitivity analysis should be performed to assess the robustness of the selection of the most likely future scenario to reasonable variations in critical assumptions and to establish that the project is not the baseline. The financial indicator is calculated conservatively if assumptions tend to make the CDM project's indicators more attractive and the alternatives' indicators less attractive.
- The baseline scenario should take into account relevant national/local and sectoral policies and circumstances, and the proponent should demonstrate that the key factors, assumptions and parameters of the baseline scenario are conservative

This methodology is applicable only if the most likely baseline scenario is the continuation of the production practice using current processes.

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 website.[2]

If the investment analysis is chosen project participants shall demonstrate that the use of non-carbonated calcium sources in the region or country is non-profitable using the net present value (NPV) analysis and explicitly state the following parameters:

- Investment requirements for raw materials switching;
- A discount rate appropriate to the country and sector;
- Current price and projected price (variable costs) of non-carbonated calcium source;
- Revenues due to the substitution of limestone and clay by non-carbonated calcium source;
- Lifetime of the project, equal to the remaining lifetime of the existing equipment(s);
- Cost savings accounting fuel consumption reduction due to energy gains of a non-occurrence of some chemical reactions that were expected in the regular way of clinker processing.

The project is additional if the NPV of the project activity is negative.

If the barriers analysis is chosen, the project participants shall demonstrate that the use of non-carbonated calcium sources in the region or country is the "first of its kind" and no project activity of this type is currently operational in the host country or region ("region" is also defined here as the geographic area defined by a radius of 200 km around the project activity including at least the ten cement plants nearest to the plant of the project activity). Project participants shall demonstrate that the identified barrier prevent the implementation of the proposed project activity and can only be overcome by registering the project as a CDM project activity. If the project participant faces other barriers than being the "first of its kind", they should use step 2 (investment analysis) by monetized these barriers and including them in the investment analysis.

Baseline emissions

Baseline emissions are calculated as follows:

$$BE_y = BE_{Calcin} + BE_{FC\_Calcin} + BE_{Dust} + BE_{FC\_Dry} + BE_{Elec\_Grid} + BE_{Elec\_SG} \quad \textbf{(1)}$$

Where:

BE_y	=	Baseline emissions for the year y (tCO_2).
BE_{Calcin}	=	Baseline CO_2 emissions from calcination of calcium carbonate and magnesium carbonate (tCO_2).

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

BE_{FC_Calcin}	=	Baseline CO_2 emissions factor for combustion of fuels in clinker production (tCO_2).
BE_{Dust}	=	Baseline CO_2 emissions factor due to discarded dust from bypass and dedusting units (CDK) system (tCO_2).
BE_{FC_Dry}	=	Baseline CO_2 emissions factor due to fuel consumption for drying of raw materials or fuel preparation (tCO_2).
BE_{Elec_Grid}	=	Baseline CO_2 emissions factor for the grid electricity consumption for clinker production (tCO_2).
BE_{Elec_SG}	=	Baseline CO_2 emissions for self-generated electricity used for clinker production (tCO_2).

Each one of the above baseline emission components shall be calculated as follows:

(a) Baseline CO_2 emissions from Calcination of carbonates (BE_{Calcin}):

For estimation of CO_2 emissions resulting from calcination, only the proportion of calcium oxides and magnesium oxides present in the produced clinker will be considered. Measured values of CaO and MgO contents, corrected for the non-carbonate sources (for example, deducting any calcium that comes from use of calcium silicates or fly ash used as raw materials) shall be used. CO_2 emissions from calcination with correction for non-carbonate sources shall be determined as follows:

$$BE_{Calcin} = \frac{CLNK_y}{CLNK_{BSL}} \cdot \Big(0.785 \cdot \left(CaO_{CLNK,BSL} \cdot CLNK_{BSL} - CaO_{RM,BSL} \cdot RM_{BSL} \right) + $$

$$+1.092 \cdot \left(MgO_{CLNK,BSL} \cdot CLNK_{BSL} - MgO_{RM,BSL} \cdot RM_{BSL} \right) \Big) \quad \mathbf{(2)}$$

Where:

BE_{Calcin}	=	Baseline CO_2 emissions from calcination of calcium carbonate and magnesium carbonate (tCO_2).
0.785	=	Stoichiometric emission factor for CaO (tCO_2/tonnes of CaO).
1.092	=	Stoichiometric emission factor for MgO (tCO_2/tonnes of MgO).
$CaO_{RM,BSL}$	=	Non-carbonated CaO content in the raw materials in the baseline (tonnes of CaO/tonnes of raw material). These non-carbonated sources must be different from the non-carbonated materials used in the project activity.
$CaO_{CLNK,BSL}$	=	CaO content in the clinker produced in the baseline (tonnes of CaO/tonnes of clinker).
$MgO_{RM,BSL}$	=	Non-carbonated MgO content in the raw materials in the baseline (tonnes of MgO/tonnes of raw material). These non-carbonated sources must be different from the non-carbonated materials used in the project activity.
$MgO_{CLNK,BSL}$	=	MgO content in the clinker produced in the baseline (tonnes of MgO/tonnes of raw material).
RM_{BSL}	=	Annual consumption of raw materials in the baseline (tonnes).

$CLNK_{BSL}$ = Annual production of clinker in the baseline (tonnes).

$CLNK_y$ = Annual production of clinker in the year y (tonnes).

Guidance for greenfield projects

For greenfield projects, where data is not available for baseline non-carbonate CaO and MgO, the fraction of non-carbonate CaO and MgO shall be based on sampling using one of the following approaches:

Option 1: Lab analysis based on the raw material sample obtained in the region in the baseline scenario

Under this Option, samples, to obtain the values for Non-carbonate CaO and MgO are taken from the clinker production line (which may be owned by the same owner) with the lowest CO_2 emission in the region. The clinker production line sampled should use the same raw materials (limestone and clay) that is commonly used in the region and as in the identified baseline scenario and produces the same type and quality of clinker as done by the project activity. "Region" is defined as the geographic area defined by a radius of 200 km around the project activity including at least the ten cement plants nearest to the plant of the project activity.

The historical information during the year previous to project implementation (previous to the proposed project implementation, at least twelve monthly measurements) shall be used if available. Alternatively, the ex post monitoring is carried out. The size and frequency of sampling for this lab analysis should be statistically significant with a maximum uncertainty range of 20% at a 95% confidence level. Possible impurities in the raw materials should be monitored and reported so as to guarantee that the difference in mass can be attributed to CO_2 emissions only, or corrected otherwise.

The analysis of the samples is as per established standards.

Option 2: Lab analysis based on the sample obtained through authorized information

The non-carbonate content is estimated as the average of value from clinker production lines whose performance are among the top 5 or the top 20% and which has been put into operation most recently in the defined region. The non-carbonate CaO and MgO for each clinker production line is based on sampling procedure as defined above. "Region" is defined as the geographic area defined by a radius of 200 km around the project activity including at least the ten cement plants nearest to the plant of the project activity. The properties of the clinker production lines are based on the recently published information provided by authorized or official documents.

The lab analysis shall be carried out by an or independent authorized entity. It shall be ensured that the composition of the sample of raw materials taken for each clinker production line is the same as that identified in the baseline scenario. The size and frequency of sampling for each production line should be statistically significant with a maximum uncertainty range of 20% at a 95% confidence level. Possible impurities in the raw materials should be monitored and reported so as to guarantee that the difference in mass can be attributed to CO_2 emissions only, or corrected otherwise. The values are established before the project implementation and will not be changed during the crediting period.

(b) Baseline CO_2 emissions from combustion of fuels in the kiln for calcination (BE_{FC_Calcin}):

In order to calculate the CO_2 emissions related to fuel consumption, the historical kiln energy consumption performance values shall be used.

$$BE_{FC\_Calcin} = SKC_{BSL} \cdot \frac{\sum \left(FC_{i,Calcin,y} \cdot NCV_i \cdot EF_{CO2,i} \right)}{\sum \left(FC_{i,Calcin,y} \cdot NCV_i \right)} \cdot CLNK_y \tag{3}$$

Where:

BE_{FC_Calcin}	=	Baseline CO_2 emissions factor for combustion of fuels in clinker production (tCO_2)
SKC_{BSL}	=	Specific Kiln Calorific Consumption for the baseline scenario (GJ/tonnes of clinker)
$FC_{i,Calcin,y}$	=	Fuel type *i* consumed for calcination in clinker production during the year *y* (mass or volume units)
$EF_{CO2,i}$	=	CO_2 emission factor for fuel type *i* (tCO_2/GJ)
$CLNK_y$	=	Annual production of clinker in the year y (tonnes)
NCV_i	=	Net calorific value of the fuel type *i* (GJ/mass or volume units)

In order to ensure that emission reductions for fuel switching measures, if any, undertaken during the project activity are not claimed, the types of fuel used during project activity are used to estimate BE_{FC_Calcin}[3].

(c) Baseline emissions due to discarded dust from bypass and dedusting units (CDK) system (BE_{Dust}):

If there is a discarded dust from the bypass and dedusting unit (CDK), the baseline emissions due to discarded dust shall be determined as follows:

$$BE_{Dust} = \frac{\left\{ \left(BE_{Calcin} \cdot ByPass \right) + \frac{BE_{Calcin} \cdot d}{\left[BE_{Calcin}(1-d)+1 \right]} \cdot CKD_{BSL} \right\}}{CLNK_{BSL}} \cdot CLNK_y \tag{4}$$

Where:

BE_{Dust}	=	Baseline CO_2 emissions factor due to discarded dust from bypass and dedusting units (CDK) system (tCO_2)
BE_{Calcin}	=	Baseline CO_2 emissions from calcination of calcium carbonate and magnesium carbonate (tCO_2)
ByPass	=	Annual production of Bypass dust leaving kiln system (tonnes)
CKD_{BSL}	=	Annual production of CKD dust leaving kiln system in the baseline (tonnes)
d	=	CKD calcination rate (released CO_2 expressed as a fraction of the total carbonate CO_2 in the raw materials)

[3] In this way, fuel switching is not precluded from the project activity but it is assumed that this fuel switching would have occurred anyway in the baseline, and thus no emission reductions are accounted for in this case.

$CLNK_{BSL}$ = Annual production of clinker in the baseline (tonnes)

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

(d) Baseline emissions from fuel consumption for drying of raw material or fuel preparation (BE_{FC_Dry}):

$$BE_{FC\_Dry} = \frac{\sum \left(FC_{Dry,i} \cdot EF_{CO2,i} \cdot NCV_i \right)}{CLNK_{BSL}} \cdot CLNK_y \qquad \textbf{(5)}$$

Where:

BE_{FC_Dry} = Baseline CO_2 emissions factor due to fuel consumption for drying of raw materials or fuel preparation (tCO_2).

$FC_{Dry,i}$ = Fossil fuel 'i' consumed for drying raw materials or fuel preparation in the baseline (tonnes).

$EF_{CO2,i}$ = CO_2 emission factor for fuel type *i* (tCO_2/GJ).

NCV_i = Net calorific value of the fuel type *i* (GJ/mass or volume units).

$CLNK_{BSL}$ = Annual production of clinker in the baseline (tonnes).

$CLNK_y$ = Annual production of clinker in the year y (tonnes).

(e) Baseline emissions from grid electricity consumption for clinker production (BE_{Elec_Grid}):

$$BE_{Elec\_Grid} = \frac{\left(EC_{RM,Grid} + EC_{Feed,Grid} + EC_{KO,Grid} \right) \cdot EF_{CO2,Elec\_Grid}}{CLNK_{BSL}} \cdot CLNK_y \qquad \textbf{(6)}$$

Where:

BE_{Elec_Grid} = Baseline CO_2 emissions factor for the grid electricity consumption for clinker production (tCO_2).

$EC_{RM,Grid}$ = Baseline grid electricity consumption for raw materials grinding (MWh).

$EC_{Feed,Grid}$ = Baseline grid electricity consumption for fuel feeding (MWh).

$EC_{KO,Grid}$ = Baseline grid electricity consumption for kiln operation (MWh).

$EF_{CO2,Elec\_Grid}$ = CO_2 emission factor of the grid (t CO_2/MWh).

$CLNK_{BSL}$ = Annual production of clinker in the baseline (tonnes).

$CLNK_y$ = Annual production of clinker in the year y (tonnes).

CO_2 emission factor of the grid ($EF_{CO2,Elec\_Grid}$) shall be calculated in accordance with the procedures and guidelines provided in latest version of the approved "Tool to calculate the emission factor for an electricity system".

(f) Baseline emissions from self-generation of electricity for clinker production (BE_{Elec_SG}):

$$BE_{Elec\_SG} = \frac{\left(EC_{RM,SG} + EC_{Feed,SG} + EC_{KO,SG}\right) \cdot EF_{CO2,Elec\_SG}}{CLNK_{BSL}} \cdot CLNK_y \quad \textbf{(7)}$$

Where:

BE_{Elec_SG}	=	Baseline CO_2 emissions for self-generated electricity used for clinker production (tCO_2).
$EC_{RM,SG}$	=	Baseline self-generated electricity consumed for raw materials grinding (MWh).
$EC_{Feed,SG}$	=	Baseline self-generated electricity consumed for fuel feeding (MWh).
$EC_{KO,SG}$	=	Baseline self-generated electricity consumed for kiln operation (MWh).
$EF_{CO2,Elec\_SG}$	=	CO_2 emission factor of self generated electricity (tCO_2/MWh).
$CLNK_{BSL}$	=	Annual production of clinker in the baseline (tonnes).
$CLNK_y$	=	Annual production of clinker in the year y (tonnes).

CO_2 emission factor for self-generated electricity ($EF_{CO2,Elec\_SG}$) shall be determined as the generation-weighted average emissions per electricity unit (tCO_2/MWh) of all self-generating sources in the project boundary serving the facility.

$$EF_{CO2,Elec\_SG} = \frac{\sum_{i,j} F_{i,j} \cdot COEF_i}{\sum_j GEN_j} \quad \textbf{(8)}$$

Where:

$EF_{CO2,Elec\_SG}$	=	CO_2 emission factor of self generated electricity (tCO_2/MWh)
$F_{i,j}$	=	Amount of fuel i consumed by relevant power sources *j* (mass or volume units)
j	=	*On-site* power sources
$COEF_i$	=	CO_2 emission coefficient of fuel *i* (tCO_2/mass or volume units)
GEN_j	=	Electricity generated by the source j (MWh)

The CO_2 emission coefficient $COEF_i$ is obtained as:

$$COEF_i = NCV_i \cdot EF_{CO_2,i} \cdot OXID_i \quad \textbf{(9)}$$

Where:

$COEF_i$	=	CO_2 emission coefficient of fuel *i* (tCO_2/mass or volume units).
NCV_i	=	Net calorific value of the fuel type *i* (GJ/mass or volume units).
$OXID_i$	=	Oxidation factor of the fuel *i* (see Table 1-4 in the 2006 IPCC Guidelines, Vol. 2, page 1.25, for default values).
$EF_{CO2,i}$	=	CO_2 emission factor for fuel type *i* (tCO_2/GJ).

Project Emissions

Similar to the baseline emissions, project activity emissions shall be expressed as CO_2 emission factor per ton of clinker produced, as follows:

$$PE_y = PE_{Calcin,y} + PE_{FC\_Calcin,y} + PE_{Dust,y} + PE_{FC\_Dry,y} + PE_{Elec\_Grid,y} + PE_{Elec\_SG,y} \quad \textbf{(10)}$$

Where:

PE_y	=	Project emissions in the year y (tCO_2).
$PE_{Calcin,y}$	=	Project CO_2 emissions from calcination of calcium carbonate and magnesium carbonate in the year y (tCO_2).
$PE_{FC\_Calcin,y}$	=	Project CO_2 emissions factor for combustion of fuels in clinker production in the year y (tCO_2).
$PE_{Dust,y}$	=	Project CO_2 emissions factor due to discarded dust from bypass and dedusting units (CDK) system in the year y (tCO_2).
$PE_{FC\_Dry,y}$	=	Project CO_2 emissions factor due to fuel consumption for drying of raw material or fuel preparation in the year y (tCO_2).
$PE_{Elec\_Grid,y}$	=	Project CO_2 emissions factor for the grid electricity consumption for clinker production in the year y (tCO_2).
$PE_{Elec\_SG,y}$	=	Project CO_2 emissions for self-generated electricity used for clinker production in the year y ($t\ CO_2$).

(a) Project emissions from Calcination of carbonates ($PE_{Calcin,y}$):

For estimation of CO_2 emissions resulting from calcination, only the proportion of calcium oxides and magnesium oxides present in the produced clinker will be considered. Measured values of CaO and MgO contents, corrected for the non-carbonate sources (for example, deducting any calcium that comes from use of calcium silicates or fly ash used as raw materials) shall be used. CO_2 emissions from calcination with correction for non-carbonate sources shall be determined as follows:

$$PE_{Calcin,y} = 0.785 \cdot \left(CaO_{CLNK,y} \cdot CLNK_y - CaO_{RM,y} \cdot RM_y\right) + \\ + 1.092 \cdot \left(MgO_{CLNK,y} \cdot CLNK_y - MgO_{RM,y} \cdot RM_y\right) \quad \textbf{(11)}$$

Where:

$PE_{Calcin,y}$	=	Project CO_2 emissions from calcination of calcium carbonate and magnesium carbonate in the year y (tCO_2).
0.785	=	Stoichiometric emission factor for CaO (tCO_2/tonnes of CaO).
1.092	=	Stoichiometric emission factor for MgO (tCO_2/tonnes of MgO).
$CaO_{RM,y}$	=	Non-carbonated CaO content in the raw materials in the year y (tonnes of CaO/tonnes of raw material).
$CaO_{CLNK,y}$	=	CaO content in the clinker produced in the year y (tonnes of CaO/tonnes of clinker).
$MgO_{RM,y}$	=	Non-carbonated MgO content in the raw materials in the year y (tonnes of MgO/tonnes of raw material).
$MgO_{CLNK,y}$	=	Product of the MgO content in the clinker produced in the year y (tonnes of MgO/tonnes of clinker).
RM_y	=	Annual consumption of raw materials in the year y (tonnes).

$CLNK_y$ = Annual production of clinker in the year y (tonnes).

(b) Project emissions from combustion of fuels in the kiln for calcination ($PE_{FC\_Calcin,y}$):

$$PE_{FC\_Calcin,y} = SKC_y \cdot \frac{\sum\left(FC_{i,Calcin,y} \cdot NCV_i \cdot EF_{CO2,i}\right)}{\sum\left(FC_{i,Calcin,y} \cdot NCV_i\right)} \cdot CLNK_y \qquad \textbf{(12)}$$

Where:

$PE_{FC\_Calcin,y}$	=	Project CO_2 emissions factor for combustion of fuels in clinker production in the year *y* (tCO_2).
SKC_y	=	Specific Kiln Calorific Consumption for the year y (GJ/tonnes of clinker).
$FC_{i,Calcin,y}$	=	Fuel type *i* consumed for calcination in clinker production during the year *y* (mass or volume units).
$EF_{CO2,i}$	=	CO_2 emission factor for fuel type *i* (tCO_2/GJ).
$CLNK_y$	=	Annual production of clinker in the year y (tonnes).
NCV_i	=	Net calorific value of the fuel type *i* (GJ/mass or volume units).

Procedure to ensure that emission reductions are claimed only for the alternative materials used

As this methodology is restricted to the use of new alternative material for clinker manufacturing and not to efficiency improvement measures that could take place at the same time as the project activity, the following procedure shall be used to ensure the emission reductions from project activity are claimed only for the alternative materials used. Diagram 1.1 below, gives a graphic description of comparative procedure for project emission calculation. The procedures is based on comparison of the actual kiln energy performance in the year "y" ($SKC_{y,measured}$) with the baseline kiln energy performance (SKC_{BSL}) and the expected value with the project activity (SKC_{ex}). SKC_{ex} shall be estimated by means of industrial samples that follow an ex-ante monitoring procedure described in Annex to this methodology. The following rule (also explained in the diagram 1.1) apply for assigning value to SKC_y in equation 2.2:

(i) If $SKC_{y,measured} \geq SKC_{BSL}$ then $SKC_y = SKC_{y,measured}$

(ii) If $SKC_{y,measured} < SKC_{BSL}$

a) If $\%AMC_y$ falls out of "*$\%AMC_{ex}$ optimal range*", then

<u>$SKC_y = SKC_{BSL}$</u>

b) If $\%AMC_y$ falls between the "*$\%AMC_{ex}$ optimal range*" and

a. $SKC_{y,measured}$ falls between "*SKC_{ex} optimal range*", respectively, then

<u>$SKC_y = SKC_{y,measured}$</u>

b. If $SKC_{y,measured}$ is lower than any value of the interval "*SKC_{ex} optimal range*", SKC_y shall be calculated as follows:

$SKC_y = \overline{SKC_j}$ ("j" runs from 1 to "y-1" years following project implementation)

This average shall exclude SKC_j values that were higher than SKC_{BSL}, i.e. allowed SKC_j values fall within the following range:

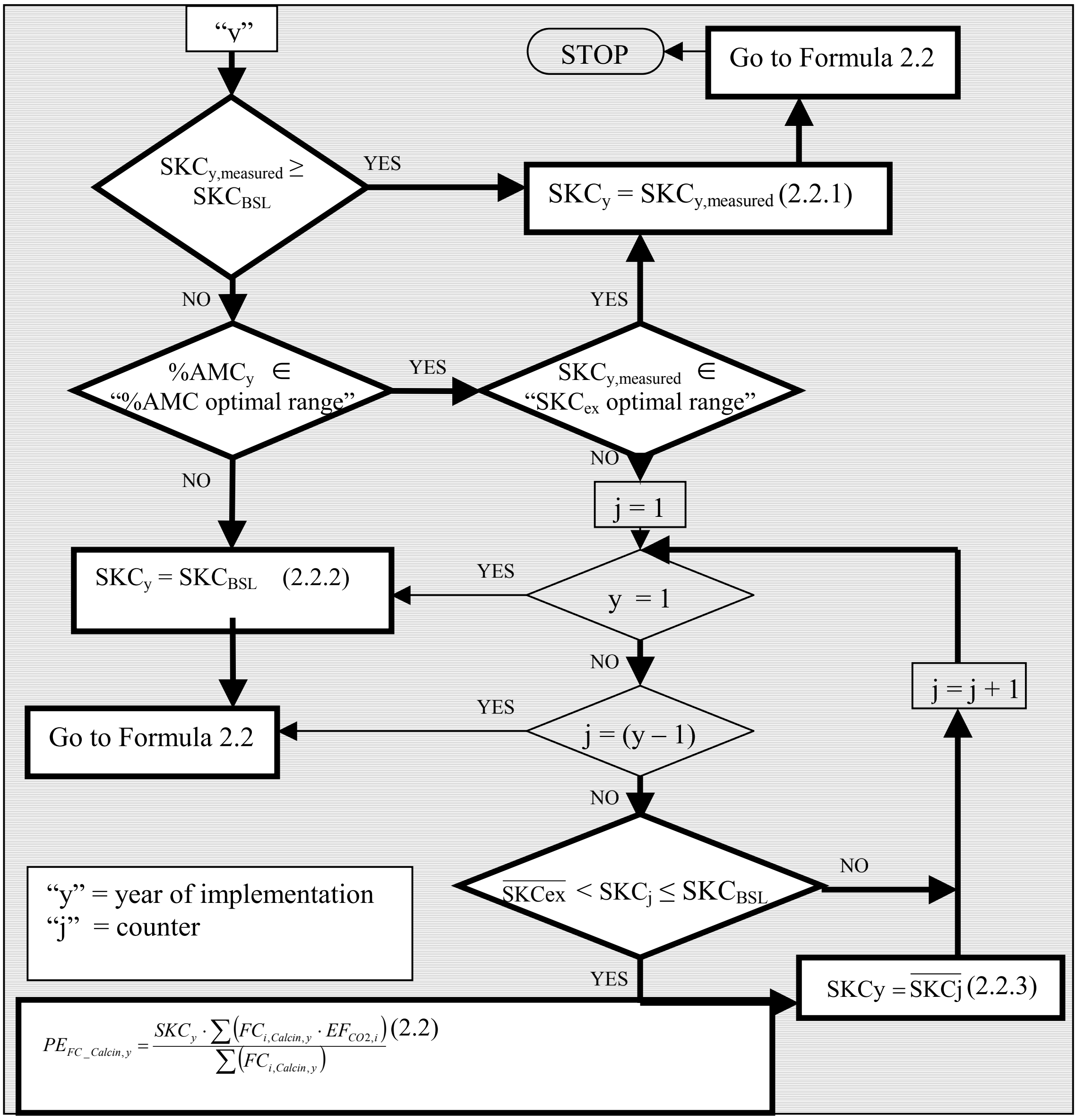
$$\overline{SKC_{ex}} < SKC_j \leq SKC_{BSL}$$

Where:

SKC_y	=	Specific Kiln Calorific Consumption for the year "y" (GJ/tonnes of clinker).
$SKC_{y,measured}$	=	Specific Kiln Calorific Consumption measured in the year "y" (GJ/tonne clinker).
SKC_{BSL}	=	Specific Kiln Calorific Consumption for the baseline scenario (GJ/tonnes of clinker).
$\overline{SKC_{ex}}$	=	Arithmetic mean of Specific Kiln Calorific Consumption during ex-ante monitoring (GJ/tonne clinker). See Annex 1.
SKC_{ex} *optimal range*	=	Interval of 95% of confidence for specific kiln calorific consumption during ex-ante monitoring (GJ/tonne clinker). See Annex 1.
$\overline{SKC_j}$	=	Average of specific kiln calorific consumption following project activity prior to the year "y". Label "j" is a counter that runs from 1 to "y-1". (GJ/tonne clinker). If y = 1, $\overline{SKC_j} = SKC_{BSL}$
$FC_{i,Calcin,y}$	=	Fuel type *i* consumed for calcination in clinker production during the year *y* (mass or volume units).
$EF_{CO2,i}$	=	CO_2 emission factor for fuel type *i* (tCO_2/GJ).
$\%AMC_y$	=	Percentage of Alternative Materials in the raw materials production in the year "y" due to project activity implementation. The %AMC could be %SO3 or %(SO3 and CaF2) or Lime Saturation Factor (LSF) or raw materials particle size (fineness).
$\overline{\%AMC_{ex}}$	=	Arithmetic mean of %AMC in the raw materials during ex-ante monitoring. See Annex 1.
$\%AMC_{ex}$ *optimal range*	=	Interval of 95% of confidence for AMC content in the raw materials during ex-ante monitoring. See Annex 1.

In case (ii) the project proponents shall demonstrate that the higher energy performance is only due to the utilization of alternative materials. To do so, the project proponents have to compare the actual specific kiln calorific consumption ($SKC_{y,measured}$) for the year "y" with the results of the ex-ante monitoring at the beginning of the project implementation (SKC_{ex}) (See Diagram 1.1). This ex-ante monitoring procedure is explained in Annex 1. The main purpose of this ex-ante monitoring procedure is to develop an industrial testing procedure (where kiln operational variables are under total control) that shows the highest specific consumption reduction ("optimum") that is possible to achieve during project implementation. The optimum values will only be used as reference.

Diagram 1.1 "Flowchart of comparative procedure for Project Emissions in the year "y"



(c) Project emissions due to discarded dust from bypass and dedusting units (CDK) system ($PE_{Dust,y}$):

If there is a discarded dust from the bypass and dedusting unit (CDK), the emissions due to discarded dust shall be determined as follows:

$$PE_{Dust,y} = \left(PE_{Calcin,y} \cdot ByPass\right) + \frac{PE_{Calcin,y} \cdot d_y}{\left[PE_{Calcin,y} \cdot (1 - d_y) + 1\right]} \cdot CKD_y \qquad \textbf{(13)}$$

Where:

$PE_{Dust,y}$ = Project CO_2 emissions factor due to discarded dust from bypass and dedusting units (CDK) system in the year *y* (tCO_2).

$PE_{Calcin,y}$ = Project CO_2 emissions from calcination of calcium carbonate and magnesium carbonate in the year *y* (tCO_2).
ByPass = Annual production of Bypass dust leaving kiln system (tonnes)
CKD_y = Annual production of CKD dust leaving kiln system (tonnes)
d_y = CKD calcination rate (released CO_2 expressed as a fraction of the total carbonate CO_2 in the raw materials)

(d) Project emissions from fuel consumption for drying of raw material or fuel preparation ($PE_{FC\_Dry,y}$):

$$PE_{FC\_Dry,y} = \sum \left(FC_{Dry\_Addl,i,y} \cdot EF_{CO2,i} \cdot NCV_i \right) \quad (14)$$

Where:
$PE_{FC\_Dry,y}$ = Project CO_2 emissions factor due to fuel consumption for drying of raw material or fuel preparation in the year *y* (tCO_2).
$FC_{Dry\_Addl,I,y}$ = Fossil fuel 'i' consumed for drying raw materials or fuel preparation in the year 'y' (mass or volume units).
$EF_{CO2,i}$ = CO_2 emission factor for fuel type *i* (tCO_2/GJ).
NCV_i = Net calorific value of the fuel type *i* (GJ/mass or volume units).

(e) Project emissions from grid electricity consumption for clinker production ($PE_{Elec\_Grid,y}$):

$$PE_{Elec\_Grid,y} = \left(EC_{RM,Grid,y} + EC_{Feed,Grid,y} + EC_{KO,Grid,y} \right) \cdot EF_{CO2,Elec\_Grid,y} \quad (15)$$

Where:
$PE_{Elec\_Grid,y}$ = Project CO_2 emissions factor for the grid electricity consumption for clinker production in the year *y* (tCO_2).
$EC_{RM,Grid,y}$ = Grid electricity consumption for raw materials grinding (MWh).
$EC_{Feed,Grid,y}$ = Grid electricity consumption for fuel feeding (MWh).
$EC_{KO,Grid,y}$ = Grid electricity consumption for kiln operation (MWh).
$EF_{CO2,Elec\_Grid,y}$ = CO_2 emission factor of the grid (tCO_2/MWh).

CO_2 emission factor of the grid ($EF_{CO2,Elec\_Grid,y}$) shall be calculated in accordance with the procedures and guidelines provided in latest version of the approved "Tool to calculate the emission factor for an electricity system".

As this methodology is restricted to the use of new alternative raw materials only for clinker manufacturing and not for any reduction in electricity energy consumption for raw materials or kiln operations, the project CO_2 emissions from grid electricity consumption ($PE_{Elec\_grid,y}$) from the grid shall base on the following considerations. The value of $EC_{RM,Grid,y}$ and $EC_{KO\_Grid,y}$ shall be as follows.

$$EC_{RM,Grid,y} = \min\left(EC_{RM,Grid,y} \text{ , } EC_{RM,Grid} \right)$$

$$EC_{KO,Grid,y} = \min\left(EC_{KO,Grid,y} \text{ , } EC_{KO,Grid} \right) \quad (16)$$

(f) Project emissions from self-generation of electricity for clinker production ($PE_{Elec\_SG,y}$):

$$PE_{Elec\_SG,y} = \left(EC_{RM.SG,y} + EC_{Feed,SG,y} + EC_{KO,SG,y}\right) \cdot EF_{CO2,Elec\_SG} \quad \textbf{(17)}$$

Where:

$PE_{Elec\_SG,y}$	=	Project CO_2 emissions for self-generated electricity used for clinker production in the year *y* (t CO_2).
$EC_{RM,SG,y}$	=	Self-generated electricity consumed for raw materials grinding (MWh).
$EC_{Feed,SG,y}$	=	Self-generated electricity consumed for fuel feeding (MWh).
$EC_{KO,SG,y}$	=	Self-generated electricity consumed for kiln operation (MWh).
$EF_{CO2,Elec\_SG,y}$	=	CO_2 emission factor of self generated electricity (tCO_2/MWh).

The value of $EC_{RM,SG,y}$ and $EC_{KO\_SG,y}$ is calculated as:

$$EC_{RM,SG,y} = \min\left(EC_{RM,SG,y}\ ,\ EC_{RM,Grid}\right)$$

$$EC_{KO,SG,y} = \min\left(EC_{KO,SG,y}\ ,\ EC_{KO,Grid}\right) \quad \textbf{(18)}$$

CO_2 emission factor for self-generated electricity ($EF_{CO2,Elec\_SG,y}$) shall be determined as the generation-weighted average emissions per electricity unit (tCO_2/MWh) of all self-generating sources in the project boundary serving the facility.

$$EF_{CO2,Elec\_SG,y} = \frac{\sum_{i,j} F_{i,j} \cdot COEF_i}{\sum_{j} GEN_j} \quad \textbf{(19)}$$

Where:

$EF_{CO2,Elec\_SG,y}$	=	CO_2 emission factor of self generated electricity (tCO_2/MWh).
$F_{i,j}$	=	Amount of fuel i consumed by relevant power sources j (mass or volume units).
j	=	*On-site* power sources.
$COEF_i$	=	CO_2 emission coefficient of fuel *i* (tCO_2/mass or volume units).
GEN_j	=	Electricity generated by the source *j* (MWh).

The CO_2 emission coefficient $COEF_i$ is obtained as:

$$COEF_i = NCV_i \cdot EF_{CO_2,i} \cdot OXID_i \quad \textbf{(20)}$$

Where:

$COEF_i$	=	CO_2 emission coefficient of fuel *i* (tCO_2/mass or volume units).
NCV_i	=	Net calorific value of the fuel type *i* (GJ/mass or volume units).
$OXID_i$	=	Oxidation factor of the fuel *i* (see Table 1-4 in the 2006 IPCC Guidelines, Vol. 2, page 1.25, for default values).
$EF_{CO2,i}$	=	CO_2 emission factor for fuel type *i* (tCO_2/GJ).

Leakage

The following emission sources shall be considered as leakage under this methodology:

- Any incremental increase in transportation of clinker raw material (limestone, clay and iron ore), fuels (fossil fuels and alternative fuels) and new alternative materials (blast furnace slag, fly ash, waste ash from fuel combustion in thermal power plants, gypsum and others) from offsite locations to the project plant site. Any decrease in transport-related emissions for existing clinker raw materials and fuels change shall not be accounted;
- Emissions due to transport of alternative raw materials will be accounted as leakage;
- Emissions from grid electricity consumption for conveyor system for alternative materials;
- Electricity consumption in cement raw material grinding, preparation and feeding for blended cement manufacture, due to indirect effects of the change of clinker conditions in cement production (i.e., the clinker could be harder to grind; therefore, the cement grinding needs more electricity consumption in order to produce the same quality of common-practice blended cement);
- Changes in clinker proportion in cement manufacture due to the same effects of the potential changes in the physical and mineralogical condition of clinker, in common-practice blended cement production (i.e. the proponents could need more or less clinker in order to produce the same quality of common-practice blended cement).

Another possible leakage is due to the diversion of alternative raw materials from existing uses. The project proponents shall demonstrate that the quantities of alternative raw materials used in the project are surplus. For this purpose the project participants need to conduct a survey to demonstrate that the alternative raw materials are available in the region by at least 1.5 times the demand for the same alternative raw materials from all existing users including the project plant. Otherwise, this methodology is not applicable.

The leakage from the project activity is expressed as

$$LE_y = LE_{trans,y} + LE_{Elec\_Conv,y} + LE_{ele\_cto,y} + LE_{Cto,y} \quad \textbf{(21)}$$

Where:

LE_y	=	CO_2 emissions due to leakage during the year *y* (tCO_2).
$LE_{trans,y}$	=	CO_2 leakage due to transportation of new materials during the year *y* (tCO_2).
$LE_{Elec\_Conv,y}$	=	CO_2 emissions from electricity consumption for conveyor systems for alternative materials during the year *y* (tCO_2).
$LE_{ele\_cto,y}$	=	CO_2 leakage due to additional electricity consumption in blended cements grinding during the year *y* (tCO_2).
$LE_{Cto,y}$	=	CO_2 leakage due to lower clinker consumption in blended cements during the year *y* (tCO_2).

(a) Leakage due to transportation of new alternative raw materials (LE_{trans}):

Transport-related emissions for alternative raw materials shall be determined as follows:

$$LE_{Trans,y} = \frac{\lfloor FC_{Trans,i} \cdot Dist \cdot NCV_i \cdot EF_{CO2,i} \rfloor}{(Q_{Trip} \cdot 1000)} \cdot ALTM_y \quad \textbf{(22)}$$

Where:

$LE_{trans,y}$	=	CO_2 leakage due to transportation of new materials during the year *y* (tCO_2).
$FC_{Trans,i}$	=	Fuel consumption of the vehicle per kilometer (mass or volume unit of fuel/kilometer).
Dist	=	Distance between the source of fuel and the project activity plant (km).
$EF_{CO2,i}$	=	CO_2 emission factor for fuel type *i* (tCO_2/GJ).
Q_{trip}	=	Quantity of alternative materials carried in one trip per vehicle (tonnes).
$ALTM_y$	=	Annual consumption of alternative materials in raw materials in year y (tonnes).
NCV_i	=	Net calorific value of the fuel type *i* (GJ/mass or volume units).

(b) Leakage from electricity consumption for conveyors system ($LE_{ElecConv,y}$):

$$LE_{Elec\_Conv,y} = EC_{Conv,y} \cdot EF_{CO2,Elec\_Grid,y} \quad \textbf{(23)}$$

Where:

$LE_{Elec\_Conv,y}$	=	CO_2 emissions from electricity consumption for conveyor systems for alternative materials during the year *y* (tCO_2).
$EC_{Conv,y}$	=	Electricity consumed for conveyors during the year *y* (MWh).
$EF_{CO2,Elec\_Grid,y}$	=	CO_2 emission factor of the grid electricity during the year *y* (tCO_2/MWh).

CO_2 emission factor of the grid ($EF_{CO2,Elec\_Grid,y}$) shall be calculated in accordance with the procedures and guidelines provided in latest version of the approved "*Tool to calculate the emission factor for an electricity system*".

(c) Leakage calculation due to change in electricity consumption in cement grinding and production

Since changes in electricity consumption in cement grinding and production cannot be determined precisely due to the new conditions of the clinker (for instance, harder to grind), for the purpose of calculating leakage in a conservative way, only the higher consumption is considered according to:

$$LE_{ele\_cto,y} = \sum \left[EC_{Cto,y} - EC_{Cto,BSL} \right] \cdot EF_{CO2,Elec\_Grid,y} \quad \textbf{(24)}$$

Where:

$LE_{ele\_cto,y}$	=	CO_2 leakage due to additional electricity consumption in blended cements grinding during the year *y* (tCO_2).
$EC_{Cto,BSL}$	=	Baseline electricity consumption for cement grinding (MWh).
$EC_{Cto,y}$	=	Electricity consumption for cement grinding in year "y" (MWh).
$EF_{CO2,Elec\_grid,y}$	=	Electricity grid emission factor (tCO_2/MWh).

If $LE_{ele\_cto,y} < 0$, conservatively LE_{ele_cto} shall be taken as zero.

(d) Leakage calculation of a potential higher consumption of clinker in cement production

Leakage shall be quantified due to a potential higher consumption of clinker in cement production, according to the clinker factor of the project activity, as follows:

$$LE_{Cto,y} = \sum CTO_{m,y} \cdot \left(P_{blend,y} - B_{blend}\right) \cdot \frac{PE_y}{CLNK_y} \quad \textbf{(25)}$$

If $LE_{Cto,y} < 0$, conservatively $LE_{Cto,y}$ shall be taken as zero.

Where:

$LE_{Cto,y}$	=	CO_2 emissions due to higher consumption of clinker in Portland-type common-practice blended cement (tCO_2).
$PE_{CLINKER,y}$	=	Emissions of CO_2 per tonne of clinker in the project activity plant in year "y" (tCO_2/tonnes of clinker).
$CTO_{m,y}$	=	Annual production of common-practice blended cement by type "m" in year "y" (tonnes).
B_{blend}	=	Baseline average percentage of clinker in common-practice Blended Cement based on the total blended cement production of the last three years prior to project implementation (tonnes of clinker/tonnes of blended cement).
$P_{blend,y}$	=	Percentage of clinker in common-practice Blended Cement in year "y" (tonnes of clinker/tonnes of blended cement).
$CLNK_y$	=	Annual production of clinker in the year y (tonnes).

Common-practice blended cement is defined as the types of cements that have been produced in the cement plant prior to project implementation. Blended cement is defined as a product with different uses that has gypsum and/or different additives and different clinker ratios (for example, limestone, pozzolana, blast furnace slag, silica flume, fly ash and others). The domestic and export types of cement are included if they are common-practice blended cement.

In accordance with these definitions, for the identification of the baseline percentage of clinker considered in common-practice cement production (B_{blend}), the project proponents shall monitor the annual weighted percentage of clinker consumed in the total of blended cement produced for three (3) years before implementing the project activity. To do this, the project proponents shall monitor the total clinker consumption and total cement produced by each blended cement type ("m") every year of the three (3)-year period before implementing the project activity. The definition of each blended cement type ("m") must be in accordance with the respective regulatory cement norm of the cement market where the common-practice cement product has been commercialized.

The percentage of clinker in common-practice cement production (B_{blend}) is calculated as follows:

$$B_{blend} = AVERAGE(\Sigma CLNK_{BSL\_CNSM,m} / \Sigma\, CTO_{BSL,m}) \quad \textbf{(26)}$$

Where:

B_{blend}	=	Baseline average percentage of clinker in common-practice Blended Cement based on the total blended cement production of the last three years prior to project implementation (tonnes of clinker/tonnes of blended cement).
$CLNK_{BSL\_CNSM,m}$	=	Annual clinker consumption in each blended cement type "m" in the last three years prior to project implementation (tonnes of clinker).
$CTO_{BSL,m}$	=	Annual blended cement type "m" production in the last three years prior to project implementation (tonnes of blended cement).

For the identification of the percentage of clinker in common-practice blended cement production in the year "y" following project implementation ($P_{blend,y}$), the project proponents shall monitor the total amount of clinker consumed and total blended cement production in the year “y” for each cement type “m” defined in the baseline as blended cement of common-practice (see formula 3.4).

The percentage of clinker in common-practice cement production ($P_{blend,y}$) in the year ”y” is calculated as follows:

$$P_{blend,y} = AVERAGE(\Sigma CLNK_{CONSM,m,y} / \Sigma CTO_{m,y}) \quad \textbf{(27)}$$

Where:

$P_{blend,y}$	=	Percentage of clinker in common-practice blended cement in the year “y” (tonnes of clinker/tonnes of blended cement).
$CLNK_{CONSM,m,y}$	=	Annual consumption of clinker of each common-practice blended cement type “m” in the year “y” (tonnes of clinker).
$CTO_{m,y}$	=	Annual production of common-practice blended cement by type “m*”* in the year “y” (tonnes).

Emission reductions

Quantification of CO_2 emission reductions for year “y” following project implementation shall be calculated as follows:

$$ER_y = BE_y - PE_y - LE_y \quad \textbf{(28)}$$

Where:

ER_y	=	Emission reductions in year “y” due to project activity (tCO_2).
BE_y	=	Baseline emissions of CO_2 in the project activity plant (tCO_2/tonnes of clinker).
PE_y	=	Emissions of CO_2 in the project activity plant in year “y” (tCO_2/tonnes of clinker).
LE_y	=	CO_2 emissions due to leakage (tCO_2).

The total annual consumption of clinker in type “*m”* of common-practice blended cement production in year “y” (tonnes of clinker) must be determined according to the procedure of (d) of Leakage section above.

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

The procedure to select the baseline scenario, as outlined in the tool mentioned above, should be applied to assess whether the chosen baseline scenario is still valid taking in account new data. For determining the CO_2 emissions from calcination of carbonates in the baseline scenario, project proponents shall follow the guidance for “greenfield projects” as described above.

Data and parameters not monitored

Data / Parameter:	*ByPass*
Data unit:	tonnes
Description:	Annual production of bypass dust leaving kiln system
Source of data:	It is determined base on historical data for previous 3 years as part of production control procedures
Measurement procedures (if any):	Weighfeeders/ Weighbridge at previous 3 years
Monitoring frequency:	Monthly (Recorded)

QA/QC procedures:	These data will be collected as part of normal plant level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	$CaO_{CLNK, BSL}$
Data unit:	tonnes of CaO/tonnes of clinker
Description:	CaO content in the clinker produced in the baseline
Source of data:	It is determined base on historical data for previous at least 3 years, as part of laboratory quality control procedure
Measurement procedures (if any):	Sampling of at least 3 years preceding the start of the project activity.
Monitoring frequency:	Monthly (Recorded)
QA/QC procedures:	These data will be collected as part of normal plant level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	$CaO_{RM, BSL}$
Data unit:	tonnes
Description:	Non-carbonated CaO content in the raw materials in the baseline (tonnes of CaO/tonnes of raw material). These non-carbonated sources must be different from the non-carbonated materials used in the project activity.
Source of data:	It is determined based on historical data for at least 3 years preceding the start of the project activity. The data is based on laboratory quality control procedures.
Measurement procedures (if any):	Sampling. Historical data of the previous 3 years plant records
Monitoring frequency:	Monthly (Recorded)
QA/QC procedures:	These data will be collected as part of normal plant level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	CKD_{BSL}
Data unit:	tonnes
Description:	Annual production of CKD dust leaving kiln system in the baseline.
Source of data:	It is determined base on historical data for at least 3 years preceding the start of the project activity. The data is sourced from production control procedures.
Measurement procedures (if any):	Weighfeeders/ Weighbridge at previous 3 years
Monitoring frequency:	Monthly (Recorded)
QA/QC procedures:	These data will be collected as part of normal plant level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	$CLNK_{BSL}$
Data unit:	tonnes
Description:	Annual production of clinker in the baseline
Source of data:	It is determined base on historical data for at least 3 years preceding the start of the project activity. The data is sourced from inventories control procedures
Measurement procedures (if any):	Weighfeeders/Stockpile control at previous 3 years
Monitoring frequency:	Monthly (Recorded)
QA/QC procedures:	These data will be collected as part of normal plant level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	$CLNK_{BSL\_CNSM,m}$
Data unit:	tonnes of clinker
Description:	Annual clinker consumption in each blended cement type “m” in the last three years prior to project implementation
Source of data:	It is determined base on historical data for previous 3 year as part of production control procedures
Measurement procedures (if any):	Weighfeeders/field instruments at previous 3 year
Monitoring frequency:	Monthly
QA/QC procedures:	These data will be collected as part of normal logistic level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	$CTO_{BSL,m}$
Data unit:	tonnes
Description:	Annual blended cement type “m” production in the last three years prior to project implementation
Source of data:	It is determined base on historical data for previous 3 year as part of production control procedures
Measurement procedures (if any):	Weighfeeders/field instruments at previous 3 year
Monitoring frequency:	Monthly
QA/QC procedures:	These data will be collected as part of normal logistic level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	*d*
Data unit:	fraction
Description:	CKD calcination rate (released CO_2 expressed as a fraction of the total carbonate CO_2 in the raw materials).
Source of data:	It is determined base on historical data for at least 3 years preceding the start of the project activity. The data is sourced from inventories control procedures
Measurement procedures (if any):	Sampling at previous 3 years
Monitoring frequency:	Monthly (Recorded)
QA/QC procedures:	These data will be collected as part of normal plant level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	It could be estimated

Data / Parameter:	$EC_{Cto,BSL}$
Data unit:	MWh
Description:	Baseline electricity consumption for cement grinding
Source of data:	It is determined base on historical data for at least 3 years preceding the start of the project activity. The data is sourced from production control procedures.
Measurement procedures (if any):	Field instruments at previous 3 year
Monitoring frequency:	Annually
QA/QC procedures:	These data will be collected as part of normal logistic level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	$EC_{Feed,Grid}$
Data unit:	MWh
Description:	Baseline grid electricity consumption for fuel feeding
Source of data:	It is determined base on historical data for at least 3 years preceding the start of the project activity. The data is sourced from production control procedures.
Measurement procedures (if any):	Field instruments at previous 3 years
Monitoring frequency:	Monthly (Recorded)
QA/QC procedures:	These data will be collected as part of normal plant level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	$EC_{RM,Grid}$
Data unit:	MWh
Description:	Baseline grid electricity consumption due to raw materials grinding
Source of data:	It is determined base on historical data for at least 3 years preceding the start of the project activity. The data is sourced from production control procedures.
Measurement procedures (if any):	Field instruments at previous 3 years
Monitoring frequency:	Monthly (Recorded)
QA/QC procedures:	These data will be collected as part of normal plant level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	$EC_{Feed,SG}$

Data unit:	MWh
Description:	Baseline self-generated electricity consumption due to fuel feeding
Source of data:	It is determined base on historical data for at least 3 years preceding the start of the project activity. The data is sourced from production control procedures.
Measurement procedures (if any):	Field instruments at previous 3 years
Monitoring frequency:	Monthly
QA/QC procedures:	These data will be collected as part of normal plant level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	$EC_{KO,SG}$
Data unit:	MWh
Description:	Baseline self-generated electricity consumption due to kiln operation
Source of data:	It is determined base on historical data for at least 3 years preceding the start of the project activity. The data is sourced from production control procedures.
Measurement procedures (if any):	Field instruments at previous 3 years
Monitoring frequency:	Monthly
QA/QC procedures:	These data will be collected as part of normal plant level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	$EC_{KO,Grid}$
Data unit:	MWh
Description:	Baseline grid electricity consumption due to kiln operation
Source of data:	It is determined base on historical data for at least 3 years preceding the start of the project activity. The data is sourced from production control procedures.
Measurement procedures (if any):	Field instruments at previous 3 years
Monitoring frequency:	Monthly (Recorded)
QA/QC procedures:	These data will be collected as part of normal plant level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	$EC_{RM,SG}$
Data unit:	MWh
Description:	Baseline self-generated electricity consumption due to raw materials grinding
Source of data:	It is determined base on historical data for at least 3 years preceding the start of the project activity. The data is sourced from production control procedures.
Measurement procedures (if any):	Field instruments at previous 3 years
Monitoring frequency:	Monthly
QA/QC procedures:	These data will be collected as part of normal plant level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	$MgO_{CLNK, BSL}$
Data unit:	tonnes of MgO/tonnes of raw material
Description:	MgO content in the clinker produced in the baseline
Source of data:	It is determined base on historical data for at least 3 years preceding the start of the project activity. The data is based on laboratory quality control procedures.
Measurement procedures (if any):	Sampling at previous 3 years.
Monitoring frequency:	Monthly (Recorded)
QA/QC procedures:	These data will be collected as part of normal plant level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	$MgO_{RM,BSL}$
Data unit:	tonnes of MgO/tonnes of raw material
Description:	Non-carbonated MgO content in the raw materials in the baseline. These non-carbonated sources must be different from the non-carbonated materials used in the project activity.
Source of data:	It is determined base on historical data for at least 3 years preceding the start of the project activity. The data is based on laboratory quality control procedures.
Measurement procedures (if any):	Sampling. Historical data at previous 3 years
Monitoring frequency:	Monthly (Recorded)
QA/QC procedures:	These data will be collected as part of normal plant level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	RM_{BSL}
Data unit:	tonnes
Description:	Annual consumption of raw materials in the base year
Source of data:	It is determined base on historical data for at least 3 years preceding the start of the project activity. The data is based on inventories.
Measurement procedures (if any):	Weighfeeders/ Weighbridge/Stockpile control at previous 3 years
Monitoring frequency:	Monthly (Recorded)
QA/QC procedures:	These data will be collected as part of normal plant level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	SKC_{BSL}
Data unit:	GJ/tonnes
Description:	Specific Kiln Calorific Consumption for the baseline scenario
Source of data:	Calculated as part of energy efficiency evaluation in baseline (at least three previous year)
Measurement procedures (if any):	Historical data of the Plant records
Monitoring frequency:	Monthly (Recorded)

QA/QC procedures:	These data will be calculated as part of normal plant level operations for energy performance evaluation. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	The specific fuel consumption of a kiln is arguably the most important operating parameter

Data / Parameter:	$FC_{Dry,i}$
Data unit:	tonnes
Description:	Fossil fuel 'i' consumed for drying raw materials or fuel preparation in the baseline
Source of data:	It is determined base on historical data for at least 3 years preceding the start of the project activity. The data is sourced from production control procedures.
Measurement procedures (if any):	Weighfeeders/ Weighbridge/Stockpile control at previous year
Monitoring frequency:	Monthly (Recorded)
QA/QC procedures:	These data will be collected as part of normal plant level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

III. MONITORING METHODOLOGY

Monitoring procedures

Data and parameters monitored

Data / Parameter:	$\overline{SKC_{ex}}$
Data unit:	GJ/tonne clinker
Description:	Arithmetic mean of Specific Kiln Calorific Consumption during ex-ante monitoring. See Annex 1.
Source of data:	Calculated as part of ex-ante monitoring procedure
Measurement procedures (if any):	Ex-ante monitoring procedure record
Monitoring frequency:	Monthly
QA/QC procedures:	QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	$\overline{\%AMCex}$
Data unit:	%
Description:	Arithmetic mean of %AMC in the raw materials during ex-ante monitoring. See Annex 1.
Source of data:	Result data of ex-ante monitoring procedure
Measurement procedures (if any):	Ex-ante monitoring procedure record
Monitoring frequency:	Monthly
QA/QC procedures:	QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	

Data / Parameter:	$\%AMC_{ex}$ *optimal range*
Data unit:	% (interval)
Description:	Interval of 95% of confidence for AMC content in the raw materials during ex-ante monitoring. See Annex 1.
Source of data:	Result data of ex-ante monitoring procedure
Measurement procedures (if any):	Ex-ante monitoring procedure record
Monitoring frequency:	Monthly
QA/QC procedures:	QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	SKC_{ex} *optimal range*
Data unit:	GJ/tonne clinker
Description:	Interval of 95% of confidence for specific kiln calorific consumption during ex-ante monitoring (GJ/tonne clinker). See Annex 1.
Source of data:	Result data of ex-ante monitoring procedure
Measurement procedures (if any):	Ex-ante monitoring procedure record
Monitoring frequency:	Monthly
QA/QC procedures:	QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	$\overline{SKC_j}$
Data unit:	GJ/tonne clinker
Description:	Average of specific kiln calorific consumption following project activity prior to the year “y”. Label “j” is a counter that runs from 1 to “y-1”. If y = 1, $\overline{\mathrm{SKC}_j} = \mathrm{SKC}_{BSL}$
Source of data:	Calculated as part of energy efficiency evaluation for project activity
Measurement procedures (if any):	Plant records
Monitoring frequency:	Annually
QA/QC procedures:	These data will be collected as part of normal plant level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	$\%AMC_y$
Data unit:	%
Description:	Percentage of Alternative Materials in the raw materials production in the year “y” due to project activity implementation. The %AMC could be %SO3 or %(SO3 and CaF2) or Lime Saturation Factor (LSF) or raw materials particle size (fineness).
Source of data:	It will be measured as part of laboratory quality control procedure for project activity
Measurement procedures (if any):	Sampling
Monitoring frequency:	Monthly
QA/QC procedures:	These data will be collected as part of normal plant level operations. QA/QC requirements according to ISO 9000 or similar quality systems

Any comment:	---

Data / Parameter:	$ALTM_y$
Data unit:	Tonne alternative materials
Description:	Annual consumption of alternative materials in raw materials in year y
Source of data:	It will be registered as part of inventories control
Measurement procedures (if any):	Weighbridge/Stockpile control data
Monitoring frequency:	Per trip
QA/QC procedures:	These data will be collected as part of normal logistic level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	$ByPass_y$
Data unit:	tonnes
Description:	Annual production of Bypass dust leaving kiln system in year “y”
Source of data:	It will be measured as part of normal operations
Measurement procedures (if any):	Weighfeeders/ Weighbridge
Monitoring frequency:	Monthly
QA/QC procedures:	These data will be collected as part of normal plant level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	$CaO_{CLINK,y}$
Data unit:	tonnes of CaO/tonnes of clinker).
Description:	CaO content in the clinker produced in the year y
Source of data:	It will be measured as part of laboratory quality control procedure
Measurement procedures (if any):	Sampling
Monitoring frequency:	Monthly
QA/QC procedures:	These data will be collected as part of normal plant level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	$CaO_{RM,y}$
Data unit:	tonnes of CaO/tonnes of raw material
Description:	Non-carbonated CaO content in the raw materials in the year y
Source of data:	It will be measured as part of laboratory quality control procedure
Measurement procedures (if any):	Sampling
Monitoring frequency:	Monthly
QA/QC procedures:	These data will be collected as part of normal plant level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	CKD_y
Data unit:	tonnes
Description:	Annual production of CKD dust leaving kiln system
Source of data:	It will be measured as part of normal operations
Measurement procedures (if any):	Weighfeeders/ Weighbridge
Monitoring frequency:	Monthly
QA/QC procedures:	These data will be collected as part of normal plant level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	$CLNK_{CONSM,m,y}$
Data unit:	tonnes of clinker
Description:	Annual consumption of clinker in each common-practice blended cement type “m” in the year “y”
Source of data:	It will be measured with field instruments and checked with production control procedures
Measurement procedures (if any):	Weighfeeders / Stock piles control
Monitoring frequency:	Monthly
QA/QC procedures:	These data will be collected as part of normal plant level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	$CLNK_y$
Data unit:	tonnes
Description:	Annual production of clinker in the year y
Source of data:	It will be measured with field instruments and checked with inventories control procedure
Measurement procedures (if any):	Weighfeeders /Stockpile control
Monitoring frequency:	Monthly
QA/QC procedures:	These data will be collected as part of normal plant level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	$CTO_{m,y}$
Data unit:	tonnes
Description:	Annual production of common-practice blended cement by type m in year y.
Source of data:	It will be determined as part of production control procedures
Measurement procedures (if any):	Weighfeeders/field instruments
Monitoring frequency:	Monthly
QA/QC procedures:	These data will be collected as part of normal logistic level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	*Daily $CLNK_{ex}$*
Data unit:	Tonne of clinker produced/day
Description:	Daily clinker production in 30 days of continuous operation
Source of data:	It will be measured as part ex-ante monitoring procedure through field instruments
Measurement procedures (if any):	Weighfeeders. Ex-ante monitoring procedure record
Monitoring frequency:	Daily
QA/QC procedures:	QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	*Daily SKC_{ex}*
Data unit:	GJ/tonne clinker produced/day
Description:	Daily Specific Kiln Calorific Consumption in each 30 day of ex-ante monitoring
Source of data:	Calculated as part of ex-ante monitoring procedure
Measurement procedures (if any):	Ex-ante monitoring procedure record
Monitoring frequency:	Daily
QA/QC procedures:	QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	*Daily $\%AMC_{ex}$*
Data unit:	%
Description:	Daily percentage of alternative material composition in clinker production due to the implementation of project activity in 30 days of continuous operation. The %AMC could be $\%SO_3$ or $\%(SO_3$ and $CaF_2)$ or Lime Saturation Factor (LSF) or raw materials particle size (fineness)
Source of data:	It will be measured as part of ex-ante monitoring data
Measurement procedures (if any):	Sampling
Monitoring frequency:	Hour
QA/QC procedures:	QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	*Daily $FF_{ex\ i}$*
Data unit:	tonne fuel/day
Description:	Daily consumption of fuel type i 30 days of continuous operation
Source of data:	It will be measured as part ex-ante monitoring procedure through weighfeeders
Measurement procedures (if any):	Weighfeeders. Ex-ante monitoring procedure record
Monitoring frequency:	Daily
QA/QC procedures:	QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	d_y
Data unit:	fraction
Description:	CKD calcination rate (released CO_2 expressed as a fraction of the total carbonate CO_2 in the raw materials).
Source of data:	It will be measured as part of normal operations
Measurement procedures (if any):	Sampling
Monitoring frequency:	Monthly
QA/QC procedures:	These data will be collected as part of normal plant level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	This parameter could be estimated

Data / Parameter:	*Dist*
Data unit:	km
Description:	Distance between the source of fuel and the project activity plant
Source of data:	It will be registered on logistic department as part of inventories control
Measurement procedures (if any):	Logistic records or purchased tickets
Monitoring frequency:	Per trip
QA/QC procedures:	These data will be collected as part of normal logistic level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	EC_{Conv},y
Data unit:	MWh
Description:	Annual Electricity consumption for conveyor system for alternative materials
Source of data:	It will be measured with field instruments and checked with production control procedures
Measurement procedures (if any):	Field instruments
Monitoring frequency:	Monthly
QA/QC procedures:	These data will be collected as part of normal logistic level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	$EC_{Cto, y}$
Data unit:	MWh
Description:	Electricity consumption for cement grinding in year “y”
Source of data:	It will be determined as part of production control procedures
Measurement procedures (if any):	Field instruments
Monitoring frequency:	Annually
QA/QC procedures:	These data will be collected as part of normal logistic level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	$EC_{Feed,Grid,y}$
Data unit:	MWh
Description:	Grid electricity consumption for fuel feeding
Source of data:	It will be measured with field instruments and checked with production control procedures
Measurement procedures (if any):	Field/automatic instruments
Monitoring frequency:	Monthly
QA/QC procedures:	These data will be collected as part of normal plant level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	$EC_{Feed,SG,y}$
Data unit:	MWh
Description:	Self-generated electricity consumed for fuel feeding
Source of data:	It will be measured with field instruments and checked with production control procedures
Measurement procedures (if any):	Field/automatic instruments
Monitoring frequency:	Monthly
QA/QC procedures:	These data will be collected as part of normal plant level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	$EC_{KO,Grid,y}$
Data unit:	MWh
Description:	Grid electricity consumption for kiln operation (MWh).
Source of data:	It will be measured with field instruments and checked with production control procedures
Measurement procedures (if any):	Field/automatic instruments
Monitoring frequency:	Monthly
QA/QC procedures:	These data will be collected as part of normal plant level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	$EC_{KO,SG,y}$
Data unit:	MWh
Description:	Self-generated electricity consumed for kiln operation
Source of data:	It will be measured with field instruments and checked with production control procedures
Measurement procedures (if any):	Field/automatic instruments
Monitoring frequency:	Monthly
QA/QC procedures:	These data will be collected as part of normal plant level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	$EC_{RM,Grid,y}$
Data unit:	MWh
Description:	Grid electricity consumption for raw materials grinding
Source of data:	It will be measured with field instruments and checked with production control procedures
Measurement procedures (if any):	Field/automatic instruments
Monitoring frequency:	Monthly
QA/QC procedures:	These data will be collected as part of normal plant level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	$EC_{RM,SG,y}$
Data unit:	MWh
Description:	Self-generated electricity consumed for raw materials grinding
Source of data:	It will be measured with field instruments and checked with production control procedures
Measurement procedures (if any):	Field/automatic instruments
Monitoring frequency:	Monthly
QA/QC procedures:	These data will be collected as part of normal plant level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	$EF_{CO2,Elec\_Grid,y}$ and $EF_{CO2,Elec\_Grid}$
Data unit:	tCO_2/MWh
Description:	CO_2 emission factor of the grid
Source of data:	Calculated as per the "Tool to calculate the emission factor for an electricity system"
Measurement procedures (if any):	---
Monitoring frequency:	---
QA/QC procedures:	---
Any comment:	---

Data / Parameter:	$FC_{Dry\_addl,i,y}$
Data unit:	mass or volume units
Description:	Fossil fuel 'i' consumed for drying raw materials or fuel preparation in the year 'y'
Source of data:	It will be measured with field instruments and checked with inventories control procedure
Measurement procedures (if any):	Weighfeeders/ Weighbridge/Stockpile control
Monitoring frequency:	Monthly
QA/QC procedures:	These data will be collected as part of normal plant level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	$FC_{i,Calcin,y}$
Data unit:	mass or volume units
Description:	Fuel type *i* consumed for calcination in clinker production during the year *y*
Source of data:	It will be measured with field instruments and checked with inventories control procedure
Measurement procedures (if any):	Weighfeeders /Stockpile control
Monitoring frequency:	Monthly
QA/QC procedures:	These data will be collected as part of normal plant level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	$FC_{Trans,i}$
Data unit:	mass or volume unit of fuel/kilometer
Description:	Fuel consumption of the vehicle per kilometer
Source of data:	Estimated as part of fuel consumption evaluation of logistic department or data from external suppliers
Measurement procedures (if any):	Logistic registered data or third part
Monitoring frequency:	Annually
QA/QC procedures:	These data will be collected as part of normal logistic level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	GEN_j
Data unit:	MWh
Description:	Electricity (MWh) generated by the source *j*
Source of data:	It will be measured with field instruments and checked with inventories control for self generation
Measurement procedures (if any):	Field /automatic instruments
Monitoring frequency:	Monthly
QA/QC procedures:	These data will be collected as part of normal plant level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	$F_{i,j,y}$
Data unit:	mass or volume units
Description:	Amount of fuel i consumed by relevant power sources *j*
Source of data:	It will be measured with field instruments and checked with inventories control for self power generation
Measurement procedures (if any):	Weighfeeders/ Weighbridge/Stockpile control
Monitoring frequency:	Monthly
QA/QC procedures:	These data will be collected as part of normal plant level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	$MgO_{CLNK,y}$
Data unit:	tonnes of MgO/tonnes of clinker
Description:	Product of the MgO content in the clinker produced in the year y
Source of data:	It will be measured as part of laboratory quality control procedure
Measurement procedures (if any):	Sampling
Monitoring frequency:	Monthly
QA/QC procedures:	These data will be collected as part of normal plant level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	$MgO_{RM,y}$
Data unit:	tonnes of MgO/tonnes of raw material
Description:	Non-carbonated MgO content in the raw materials in the year y
Source of data:	It will be measured as part of laboratory quality control procedure
Measurement procedures (if any):	Sampling
Monitoring frequency:	Monthly
QA/QC procedures:	These data will be collected as part of normal plant level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	RM_y
Data unit:	tonnes
Description:	Annual consumption of raw materials in the year y
Source of data:	It will be measured with field instruments and checked with inventories control procedure
Measurement procedures (if any):	Weighfeeders/ Weighbridge/Stockpile control
Monitoring frequency:	Monthly
QA/QC procedures:	These data will be collected as part of normal plant level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	SKC_y
Data unit:	GJ/tonnes of clinker
Description:	Specific Kiln Calorific Consumption for the year y
Source of data:	Calculated as part of project emission results
Measurement procedures (if any):	Plant records
Monitoring frequency:	Monthly
QA/QC procedures:	QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	$SKC_{y,measured}$
Data unit:	GJ/tonnes of clinker
Description:	Specific Kiln Calorific Consumption measured in the year "y"
Source of data:	Calculated as part of energy efficiency evaluation in year "y"
Measurement procedures (if any):	Plant records
Monitoring frequency:	Monthly
QA/QC procedures:	These data will be collected as part of normal plant level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	Q_{trip}
Data unit:	tonnes
Description:	Quantity of alternative materials carried in one trip per vehicle
Source of data:	It will be registered on logistic department as part of inventories control
Measurement procedures (if any):	Weighbridge data and purchase receipts
Monitoring frequency:	Per trip
QA/QC procedures:	These data will be collected as part of normal logistic level operations. QA/QC requirements according to ISO 9000 or similar quality systems
Any comment:	---

Data / Parameter:	$EF_{CO2,i}$
Data unit:	tCO_2/GJ
Description:	CO_2 emission factor for the fossil fuel type *i*
Source of data:	The following data sources may be used if the relevant conditions apply:

Data source	**Conditions for using the data source**
a. Values provided by the fuel supplier in invoices	This is the preferred source.
b. Measurements by the project participants	If a) is not available
c. Regional or national default values	If a) is not available These sources can only be used for liquid fuels and should be based on well documented, reliable sources (such as national energy balances).
d. IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories	If a) is not available

Measurement procedures (if any):	For a) and b): Measurements should be undertaken in line with national or international fuel standards. For a): If the fuel supplier does provide the NCV value and the CO_2 emission factor on the invoice and these two values are based on measurements for this specific fuel, this CO_2 factor should be used. If another source for the CO_2 emission factor is used or no CO_2 emission factor is provided, options b), c) or d) should be used.
Monitoring frequency:	For a) and b): The emission factor should be obtained for each fuel delivery, from which weighted average annual values should be calculated For c): Review appropriateness of the values annually For d): Any future revision of the IPCC Guidelines should be taken into account
QA/QC procedures:	---
Any comment:	---

Data / Parameter:	NCV_i
Data unit:	GJ/mass or volume units
Description:	Weighted average net calorific value for fuel type *i*
Source of data:	The following data sources may be used if the relevant conditions apply:

Data source	**Conditions for using the data source**
a) Values provided by the fuel supplier in invoices	This is the preferred source
b) Measurements by the project participants	If a) is not available
c) Regional or national default values	If a) is not available These sources can only be used for liquid fuels and should be based on well documented, reliable sources (such as national energy balances).
d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories	If a) is not available

Measurement procedures (if any):	For a) and b): Measurements should be undertaken in line with national or international fuel standards.
Monitoring frequency:	For a) and b): The NCV should be obtained for each fuel delivery, from which weighted average annual values should be calculated For c): Review appropriateness of the values annually For d): Any future revision of the IPCC Guidelines should be taken into account

QA/QC procedures:	Verify if the values under a), b) and c) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values fall below this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in a), b) or c) should have ISO17025 accreditation or justify that they can comply with similar quality standards.
Any comment:	Note that for the NCV the same basis (pressure and temperature) should be used as for the fuel consumption.

Data / Parameter:	$OXID_i$
Data unit:	fraction
Description:	Oxidation factor of the fuel *i*
Source of data:	Refer to the Table 1-4 in the 2006 IPCC Guidelines, Vol. 2, page 1.25, for default values.
Measurement procedures (if any):	---
Monitoring frequency:	---
QA/QC procedures:	---
Any comment:	---

-.-.-.-.-

Annex 1

Procedure for ex ante determination of Specific Kiln Calorific Consumption

Title: Procedure for ex-ante monitoring to be implemented at the beginning of the project implementation

1. Objective

The main purpose of this ex-ante monitoring is to develop an industrial testing procedure (where kiln operational variables are under total control) that shows the highest specific consumption reduction that is possible to be achieved during project implementation.

2. Development

2.1 Laboratory research and Protocol of sampling definition

2.1.1 Develop a burnability analysis of raw materials(1) in order to identify the theoretical "optimum-range" of concentration of new raw materials and the design of the raw materials that would permit the reduction of energy consumption for clinker preparation

2.1.2 The outputs of the burnability analysis are the "Free Lime vs. Concentration of alternative materials (%AMC)" and "Free Lime vs. Temperature" graphics.

2.1.3 Design the Industrial testing Protocol. The Protocol must follow all the Plant procedures for quality control (QC) and quality assurance (QA) in order to guarantee the representative sampling in terms of size, frequency, chemical and physical analysis with its respective quality index control (2). The Protocol has to define the equipment involved, all material specifications and requirements of data records. The Protocol for ex-ante monitoring shall consider the following points

2.2. Initial operational adjustments and production of new raw materials

2.2.1 Develop a program for total consumption of the inventory of raw materials produced for clinker manufacturing prior to project implementation and replacement with the new raw material according to a laboratory design.

2.2.2 Develop operational adjustments and stabilization of operating conditions. The period of time for 2.2. And 2.3 could be adjustable according to the particular operating conditions of each cement plant.

2.3. The operational transitional process

2.3.1 Start the kiln operation with the new design of raw materials according burnability test results (project activity)

2.3.2 Daily follow-up of the operational data obtained and recording the global results. The principal records of the Plant during the monitoring procedure are:

- Concentration of alternative material (%AMC) in the raw materials feeding, The %AMC could be %SO3 or %(SO3 and CaF2) or Lime Saturation Factor (LSF) or raw materials particle size (fineness)
- Fuel consumption with its LHV
- Total clinker production
- The main operational variables of the kiln as indicators of general conditions of operations

2.4. Kiln operation under total control of the operational variables

2.4.1 Guarantee the stabilization and operation at as regular operational conditions as possible – 30-day of continuous operation (3)

2.4.2 Follow up the same daily data of the operational transitional process parameters defined above. The objective is to seek a repetition of the previous month values.

2.4.3 Register the "optimal range" with 95% of statistical confidence level of the 30 –day samples of the concentration of alternative material used (AMC) in the raw materials and the specific consumption in the kiln (SKCex) during 30 days continuous operational samples.

2.4.4 Make the final report with the analysis of the results and carry out the analysis to show that these results have been proved to be with the theoretical research and quality control, as well as with quality assurance procedures.(4)

3. Results

3.1 Obtain and record the following data:

Daily SKC_{ex}	=	Daily Specific Kiln Calorificfic Consumption in each 30-day period of ex-ante monitoring (GJ/tonne clinker / day). Daily $SKC_{ex\text{-}ante} = \Sigma$ (Daily FF_{ex} i * LHV_{ex}i) / Daily $CLNK_{ex}$ (3.1)
Daily $\%AMC_{ex}$	=	Daily percentage of alternative material composition in clinker production due to the implementation of project activity in 30 days of continuous operation The %AMC could be %SO3 or %(SO3 and CaF2) or Lime Saturation Factor (LSF) or raw materials particle size (fineness)
Daily FF_{ex} i	=	Daily consumption of fuel type i 30 days of continuous operation (tonne fuel/day)
LHV_{ex}i	=	Daily low heating value of fuel type i in 30 days of continuous operation (GJ / tonne fuel /day)
Daily$CLNK_{ex}$	=	Daily clinker production in 30 days of continuous operation (tonne clinker /day)
$\overline{SKC_{ex}}$	=	Arithmetic mean of Specific Kiln Calorific Consumption during each day of 30 days of continuous operation (GJ/tonne clinker)
$\overline{\%AMC_{ex}}$	=	Arithmetic mean of %AMC in the raw materials during ex-ante monitoring
σ		Standard deviation of 30 days of continuous operation
$1.96\frac{\sigma}{\sqrt{30}}$	=	Interval of 95% of confidence of 30 samples in ex-ante monitoring
"$\%AMC_{ex}$ optimal range"	$\overline{\%AMCex} \pm 1.96\frac{\sigma}{\sqrt{30}}$	Interval of 95% of confidence for %AMC content in the raw materials during ex-ante monitoring
"SKC_{ex} optimal range"	$\overline{SKCex} \pm 1.96\frac{\sigma}{\sqrt{30}}$	Interval of 95% of confidence for specific kiln calorific consumption during ex-ante monitoring (GJ/tonne clinker)

4. References and Notes

(1) "Burnability" is the term used to describe how easily the clinker transformation happens and the behavior of the raw materials in the sintering process (clinker phases formation). The burnability analysis is a common procedure in Cement Industry and was developed by F.L.Smidth (Fundal 1979 and Theisen 1992) that helps to optimize the raw materials design, with regard to chemical and mineral composition and fineness of the material.

(2) The minimum quality control procedures are described in "The Cement Plant Operations Handbook 4th Edition", International Cement Review, 2005, Chapter 6.

(3) Thirty continuously days of sample (one month) is the minimum amount of daily average values that reflect the operational conditions and evaluate if the process complies with the minimum quality assurance specifications. Besides, the standard unit of time for Cement Industry is a month. Plant operational records are normally measured in this period of time (i.e. raw material inventories, fuel consumption and kiln energy performance)

(4) The consistency between industrial testing and the laboratory research results guarantees that project activity are related only by means of new alternative materials and not as the results of other energy efficiency measures or fuel switching options that may occur at the same time as the project implementation.

History of the document

Version	Date	Nature of revision
01	EB 36, Annex 15 30 November 2007	Initial adoption