Approved baseline and monitoring methodology AM0106

"Energy efficiency improvements of a lime production facility through installation of new kilns"

I. SOURCE, DEFINITIONS AND APPLICABILITY

Sources

This baseline and monitoring methodology is based on elements from the following proposed new methodology:

- NM0354 "Energy efficiency improvements of a lime production facility through installation of new kilns" prepared by Deloitte & Touché South Africa.

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

- "Combined tool to identify the baseline scenario and demonstrate additionality";
- "Tool to calculate the emission factor for an electricity system";
- "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion";
- "Tool to calculate baseline, project and/or leakage emissions from electricity consumption";
- "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period".

For more information regarding the proposed new methodologies and the tools as well as their consideration by the Executive Board (hereinafter referred to as the Board) of the clean development mechanism (CDM) please refer to <http://cdm.unfccc.int/goto/MPappmeth>.

Selected approach from paragraph 48 of the CDM modalities and procedures

"Existing actual or historical emissions, as applicable"

Definitions

For the purpose of this methodology, the following definitions apply:

Lime production facility. A lime production facility refers to a facility where lime is produced from limestone. The facility uses kilns which convert limestone into burnt lime. A facility can consist of more than one kiln.

Kiln. A kiln refers to a lime kiln. A lime kiln is used to produce burnt lime by the calcination of limestone (calcium carbonate). The reaction involves the addition of heat to limestone. The reaction forms burnt lime (calcium oxide) and carbon dioxide. The heat can be provided to the reaction by various fossil fuels.

Auxiliary equipment(s). Equipment(s) at the lime production facility associated with the operations of the kilns that are installed or removed or experiences changes in energy consumption as a result of the project activity. Typically, this would include the following equipment(s):

(a) Pre-heaters, heat exchangers, burners, air blowers, compressors, engines, filters, fans and coolers attached to the kiln;

(b) Coal mill and screens;

(c) Limestone crusher and screens;

(d) Transport of limestone on conveyor;

(e) Lime crushers and screens.

Applicability

This methodology applies to project activities that replace existing kilns by new energy efficient kilns in an existing lime production facility.

The methodology is applicable under the following conditions:

(a) The lime production facility is an existing facility and has operational history of at least three years prior to the start date of the CDM project activity. This methodology is not applicable to Greenfield projects;

(b) The existing kilns and the new kilns use same fossil fuel. This methodology is not applicable to project activities involving a fuel switch. However, the kilns and auxiliary equipment(s) can use electricity from grid;[1]

(c) The quality of lime produced in the project activity must be the same or better than the quality of the lime produced in the baseline. This shall be checked by comparing the quality of lime produced in the baseline with the quality of lime produced in the project activity. If the quality of the lime produced in the project activity is lower during a month of a crediting year due to the implementation of the CDM project activity, then the emission reduction for that crediting year shall not be claimed;

(d) The new energy efficient lime kilns shall improve energy efficiency and not combustion efficiency, according to the guidance provided by the Board (see EB 32 report paragraph 28);

(e) The project activity shall claim emission reductions only for the remaining lifetime of the baseline kiln(s) that are replaced by the CDM project activity, if shorter than the crediting period (i.e. this methodology is applicable up to the end of the lifetime of the existing kiln(s)). If more than one kiln in the baseline are replaced by the CDM project activity, emission reductions shall only be claimed for the duration corresponding to the shortest remaining lifetime of kilns that are replaced;[2] and

(f) The replaced kilns shall be decommissioned and not be used in another facility.

In addition, the applicability conditions included in the tools referred to above apply.

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1 In order to simplify the methodology, this condition allows that electricity can only be supplied by grid both in baseline and project situation. In case any project participants want to use electricity from other sources, they may propose a revision to this methodology. Such revision should provide clear guidance that the emission reductions are only claimed for the lower electricity consumption, but not for lower carbon intensity of the electricity.

2 For example, there are two kilns (kilns A and B) replaced by the CDM project activity. Kiln A has a remaining lifetime of ten years. Kiln B has a remaining lifetime of twenty years. Emission reductions can only be claimed up to the shortest lifetime of the replaced kilns which is kiln A in this case. As such, emission reductions can only be claimed up to the remaining lifetime of 10 years.

Finally, this methodology is only applicable if the most plausible baseline scenario, as identified per the section "Identification of the baseline scenario and demonstration of additionality" hereunder, is:

P1: Continuation of the operation of existing kilns.

II. BASELINE METHODOLOGY PROCEDURE

Project boundary

The **spatial extent** of the project boundary encompasses the project activity site where the new kilns are installed. The boundary includes the lime production facility. This encompasses the kilns and associated auxiliary equipment(s).

The project boundary also includes the electricity system to which the CDM project activity is connected as per the "Tool to calculate emission factor for an electricity system".

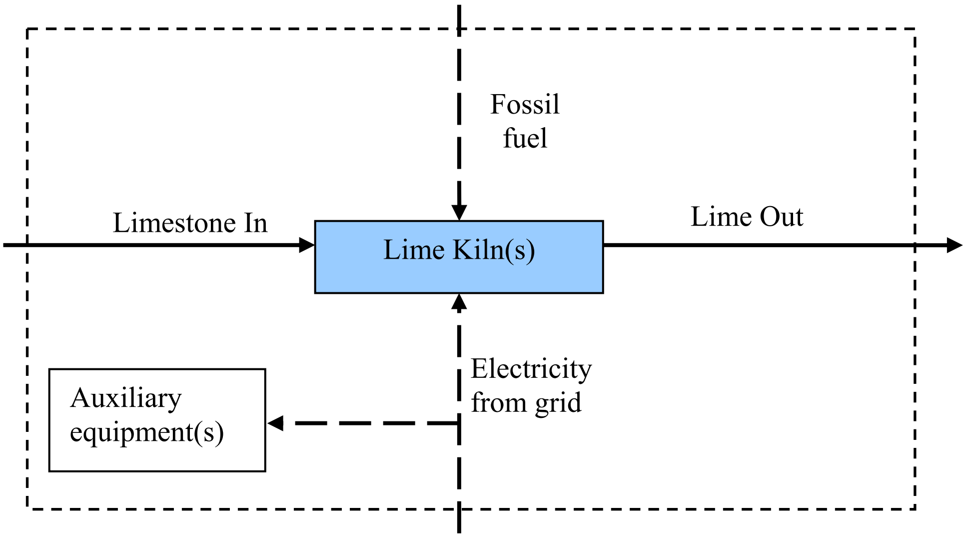

Figure 1: Diagram of the project boundary

The greenhouse gases included in or excluded from the project boundary are shown in Table 1.

Table 1: Emissions sources included in or excluded from the project boundary

	Source	Gas	Included?	Justification/Explanation
Baseline	Fossil fuel consumption in the kilns	CO_2	Yes	Main emission source
		CH_4	No	Excluded for simplification. This is conservative
		N_2O	No	Excluded for simplification. This is conservative
	Electricity consumption for auxiliary equipment(s) and in the kilns	CO_2	Yes	Main emission source
		CH_4	No	Excluded for simplification. This is conservative
		N_2O	No	Excluded for simplification. This is conservative
	CO_2 process emissions from the calcination of limestone	CO_2	Yes	The methodology does not allow for emission reductions generated from the calcination process itself. However, project participants are required to calculate the emissions from calcination of the limestone in the baseline for purposes of comparison with the process emissions in the project
		CH_4	No	Excluded for simplification as the amount is expected to be negligible
		N_2O	No	Excluded for simplification as the amount is expected to be negligible
Project activity	Fossil fuel consumption in the kilns	CO_2	Yes	Main emission source
		CH_4	No	Excluded for simplification as the amount is expected to be negligible
		N_2O	No	Excluded for simplification as the amount is expected to be negligible
	Electricity consumption for auxiliary equipment(s) and in the kilns	CO_2	Yes	Main emission source
		CH_4	No	Excluded for simplification as the amount is expected to be negligible
		N_2O	No	Excluded for simplification as the amount is expected to be negligible
	CO_2 process emissions from the calcination of limestone	CO_2	Yes	The methodology does not allow for emission reductions generated from the calcination process itself. However, project participants are required to calculate the emissions from calcination of the limestone in the project for purposes of comparison with the process emissions in the baseline
		CH_4	No	Excluded for simplification as the amount is expected to be negligible
		N_2O	No	Excluded for simplification as the amount is expected to be negligible

Selection of the baseline scenario and demonstration of additionality

The selection of the baseline scenario and the demonstration of additionality shall be conducted using the latest version of the “Combined tool to identify the baseline scenario and demonstrate additionality”. The following additional guidance shall be used when applying the tool.

When applying “Sub-step 1a” of the tool, alternative scenarios shall include all realistic and credible alternatives to the project activity that are consistent with current laws and regulations of the host country.

The following likely scenarios shall be assessed, inter alia:

P1: Continuation of the operation of existing kilns;

P2: Retrofit or modification of existing kilns to make them more energy efficient;

P3: Installation of new kilns of the technology of the existing kilns;

P4: Installation of new kilns of technologies other than that in the project activity and in existing kilns;

P5: Project activity not undertaken as a CDM project.

Step 3 of the tool, investment analysis, is mandatory regardless of the outcome of Step 2 of the tool. In applying Step 3, the project participants shall consider at least the following in the analysis:

(a) Investments related to the new kilns and/or retrofit to produce lime;

(b) Savings related to the decrease in fuel and electricity consumption. In case of the fuel saving, the project participants shall account the saving as the difference between the most inefficient kilns in the baseline and the project kilns;[3]

(c) Expenses related to the operation and maintenance of the lime kilns;

(d) Revenues related to the sale of lime and lime products produced in the project facility, including the increased productivity from the baseline, if applicable;

(e) Salvage value of the existing equipments.

Guidance to determine of the remaining lifetime of existing kilns

For this methodology, the technical lifetime of the lime kiln is 40 years. The remaining lifetime of the existing kilns shall be determined as the difference of the technical lifetime and the operational time.

Baseline emissions

The baseline emissions consist of fuel and electricity use and CO_2 emission from the calcination of limestone to produce lime. In general, following aspects are considered to determine the baseline emissions.

(a) Determine the specific fuel and specific electricity consumption of each kiln separately based on historical operation and compare it with the design values, choose the minimum among them. Based on the emission factor of the fuel and electricity, derive the emission factor;

(b) Use this emission factor for estimation of emission reductions for the quantity of lime eligible under the methodology;

(c) Determine the CO_2 emission from the calcination of limestone.

[3] This represents the real industrial practice as the efficient kilns will be operating along with the project kilns. For example, if there are two kilns in the baseline and only one of the kiln is replaced by the project kiln, then out of the two baseline kilns, efficient kiln would still be operating in the project scenario. Therefore, the saving of fuel would be from the replaced kiln (inefficient one in the baseline).

Below is the step-wise procedure to determine the baseline emission.

Step 1: Determine the amount of lime eligible for crediting and identify the existing kiln in which the lime would have been produced in the baseline

The CDM project activity shall not claim emission reductions above the historical production capacity as the baseline emission factors are based on existing specific fuel/electricity consumption value. Therefore, the project participants shall first determine the amount of lime production that are eligible for crediting.

The existing kilns at the lime production facility may have different specific fuel/electricity consumption. In the project case, it is difficult to determine the amount of lime that would be produced from each kiln. Therefore, to be conservative, it is assumed that the production takes place in the most efficient kiln first in the baseline.

Sub-step 1.1: Determine the amount of lime eligible for crediting in year y

$$P_{elig,y} = min\left(P_y, P_{MAX}\right) \quad \textbf{(1)}$$

Where:

$P_{elig,y}$	=	Amount of lime eligible for crediting in year *y* (ton of lime)
P_y	=	Amount of lime produced by the project facility in year *y* (ton of lime)
P_{MAX}	=	Maximum annual amount of lime that could be produced by all kilns of the lime producing facility in the baseline scenario (ton of lime)

$$P_{MAX} = P_{HIST,MAX,2MA} \times 6 \quad \textbf{(2)}$$

Where:

P_{MAX}	=	Maximum annual amount of lime that could be produced by all kilns of the lime producing facility in the baseline scenario (ton of lime)
$P_{HIST,MAX,2MA}$	=	Two months of highest reported lime production in the lime producing facility in the latest three years prior to the start date of the CDM project activity (ton of lime)

Sub-step 1.2: Allocate the amount of lime to each kiln k ($P_{k,y}$)

In case where the lime production facility has multiple kilns, the project participants shall determine in which kiln the lime would have been produced in the baseline. In all cases, the assumption is made that the lime would have been produced in the most efficient kiln in terms of fuel consumption until the installed capacity of the kiln is reached. Once the installed capacity of the kiln is reached then the remaining lime would have been produced in the second most efficient kiln until the capacity of this kiln is reached.

For example, a lime production facility has two kilns each with an installed capacity of 200,000 tons of lime per year.[4] The first kiln (kiln 1) has a coal consumption of 200 kg of coal per ton of lime and the second kiln (kiln 2) has a coal consumption of 100 kg of coal per ton of lime. In the project activity, 300,000 tons of lime is amount of lime eligible for crediting in year *y* ($P_{elig,y}$). In this case for the baseline, the first 200,000 tons of lime are assumed to be produced in Kiln 2 which has a coal consumption of 100 kg of coal per ton of lime. The remaining 100,000 tons of lime are assumed to be produced in Kiln 1

[4] In case the lime production capacity is provided in terms of tons per day, as a conservative approach this capacity should be multiplied by 365 days to get the annual figure.

which has a coal consumption of 200 kg per ton of lime. This reflects the real situation in a lime production facility as the most efficient kilns would be optimally utilised first. In addition, this is conservative.

Step 2: Determine the baseline emissions from fossil fuel combustion in kiln k in year y ($BE_{BL,FC,k,y}$)

Baseline emissions from fossil fuel combustion in kiln *k* are calculated based on the specific fuel combustion, amount of lime produced in year y allocated to kiln *k* and the CO_2 emission factor of the fuel, as follows:

$$BE_{BL,FC,k,y} = SFC_k \times P_{k,y} \times EF_{CO2,y} \tag{3}$$

Where:

$BE_{BL,FC,k,y}$	=	Baseline emissions from fossil fuel combustion in kiln *k* in the baseline in year *y* (tCO_2)
SFC_k	=	The specific fuel consumption of fuel combusted in kiln *k* in the baseline (GJ/ton of lime)
$P_{k,y}$	=	Amount of lime produced in year *y* allocated to kiln *k* (ton of lime)
$EF_{CO2,y}$	=	The weighted average CO_2 emission factor of fuel in year *y* (tCO_2/GJ)

Sub-step 2.1: Determine the specific fuel consumption of fuel combusted in kiln k in the baseline (SFC_k)

The specific fuel consumption of fuel combusted in kiln *k* in the baseline (SFC_k) is determined as follows:

$$SFC_k = min\left[\left(\frac{FC_{-1,k} \times NCV_{-1,k}}{P_{-1,k}}\right),\left(\frac{FC_{-2,k} \times NCV_{-2,k}}{P_{-2,k}}\right),\left(\frac{FC_{-3,k} \times NCV_{-3,k}}{P_{-3,k}}\right),SFC_{design,k}\right] \tag{4}$$

Where:

SFC_k	=	The specific fuel consumption of fuel combusted in kiln *k* in the baseline (GJ/ton of lime)
$FC_{-1,k}$, $FC_{-2,k}$, $FC_{-3,k}$	=	Amount of fuel consumed in kiln *k* in the years prior to the start date of the project activity (mass or volume unit) (-1 is one year prior, -2 is two year prior and -3 is three year prior)
$NCV_{-1,k}$, $NCV_{-2,k}$ $NCV_{-3,k}$	=	The weighted average net calorific value of the fuel in years prior to the start date of the project activity (GJ/mass or volume unit) (-1 is one year prior, -2 is two year prior and -3 is three year prior)
$P_{-1,k}$, $P_{-2,k}$, $P_{-3,k}$	=	Amount of lime produced in kiln *k* in y ears prior to the start date of the project activity (ton of lime) (-1 is one year prior, -2 is two year prior and -3 is three year prior)
$SFC_{design,k}$	=	Specific fuel consumption of the kiln *k* at the time of installation (manufacturer's value) (GJ/ton of lime)

Determination of specific fuel consumption of the kiln k at the time of installation ($SFC_{design,k}$)

Project participants shall obtain the specific fuel consumption value from manufacturer's specifications for kiln *k* at the time of installation and present this value to the DOE at the time of validation.

If the specific fuel consumption value at the time of installation of the kiln (design value) is not available, the project participants shall use the specific fuel consumption value of same type of kiln technology as the baseline kiln k provided by the manufacturers at the start of the CDM project activity or at the validation of the CDM project activity, whichever is earlier. The same type of kiln means that it shall be comparable in capacity (within +/-10% of capacity at installation) and shall have similar auxiliary equipment(s) (e.g. same number of pre-heaters). The project participants shall get the value from at least three manufacturers and use the lowest value among them.

Step 3: Determine the baseline emissions from electricity consumption in kiln k in year y ($BE_{EC,k,y}$)

Baseline emissions from electricity consumption in kiln *k* and auxiliary equipment(s) are calculated based on the specific electricity consumption, amount of lime produced in year y allocated to kiln *k* and the CO_2 emission factor of electricity from the grid as follows:

$$BE_{EC,k,y} = SEC_k \times P_{k,y} \times EF_{EL,y} \tag{5}$$

Where:

$BE_{EC,k,y}$	=	Baseline emissions from electricity consumption in kiln *k* and auxiliary equipment(s) in the baseline in year *y* (tCO_2)
SEC_k	=	The specific electricity consumption of kiln *k* and auxiliary equipment(s) in the baseline (MWh/ton of lime)
$P_{k,y}$	=	Amount of lime produced in year *y* allocated to kiln *k* (ton of lime), determined following sub-step 1.2
$EF_{EL,y}$	=	CO_2 emission factor of electricity from the grid in year *y* (tCO_2/MWh)

Sub-step 3.1: Determine the specific electricity consumption of kiln k and auxiliary equipment(s) in the baseline (SEC_k)

The specific electricity consumption of the kiln *k* and the auxiliary equipment(s) in the baseline (SEC_k) is determined as follows:

$$SEC_k = min\left[\left(\frac{EC_{-1,k}}{P_{-1,k}}\right),\left(\frac{EC_{-2,k}}{P_{-2,k}}\right),\left(\frac{EC_{-3,k}}{P_{-3,k}}\right),SEC_{design,k}\right] \tag{6}$$

Where:

SEC_k	=	The specific electricity consumption of kiln *k* and auxiliary equipment(s) in the baseline (MWh/ton of lime)
$EC_{-1,k}$, $EC_{-2,k}$ $EC_{-3,k}$	=	Amount of electricity consumed in kiln *k* in the years prior to the start date of the project activity (MWh) (-1 is one year prior, -2 is two year prior and -3 is three year prior)

$P_{-1,k}$ $P_{-2,k}$ $P_{-3,k}$	=	Amount of lime produced in kiln *k* in years prior to the start date of the project activity (ton of lime) (-1 is one year prior, -2 is two year prior and -3 is three year prior)
$SEC_{design,k}$	=	Specific electricity consumption of the kiln *k* and the auxiliary equipment(s) at the time of installation (manufacturer's value)

Determination of specific electricity consumption of the kiln k the auxiliary equipment(s) at the time of installation (manufacturer's value) ($SEC_{design,k}$)

Project participants shall obtain the specific electricity consumption value from manufacturer's specifications for kiln *k* and the auxiliary equipment(s) at the time of installation and present this value to the DOE at the time of validation.

If the specific electricity consumption value at the time of installation of the kiln (design value) is not available, the project participants shall use the specific electricity consumption value of same type of kiln technology as the baseline kiln *k* provided by the manufacturers at the start of the CDM project activity or at the validation of the CDM project activity, whichever is earlier. The same type of kiln means that it shall be comparable in capacity (within +/-10% of capacity at installation) and shall have similar auxiliary equipment(s) (e.g. same number of pre-heaters). The project participants shall get the value from at least three manufacturers and use the lowest value among them.

Sub-step 3.2: Determine the CO_2 emission factor of electricity from the grid in year y ($EF_{EL,y}$)

CO_2 emission factor of electricity from the grid in year *y* ($EF_{EL,y}$) is calculated in accordance with latest version of the "Tool to calculate the emission factor for an electricity system". Electricity consumption from sources other than the national electricity grid is not accounted for under this methodology.

In case the p*roject participants choose ex ante option to calculate the grid emission factor, they shall also choose the ex ante* option to calculate grid emission factor in project case while using the 'Tool to calculate baseline, project and/or leakage emissions from electricity consumption' and vice versa.

Step 4: Determine the baseline emissions from the calcination of limestone in year y

Emission reductions shall be claimed for reduction in fuel and electricity consumption, and not from reduction in the CO_2 emissions from calcination of raw materials (i.e. $CaCO_3$ and $MgCO_3$ bearing minerals). However, project participants are required to calculate the emissions resulting from decarbonisation of raw materials (i.e. $CaCO_3$ and $MgCO_3$ bearing minerals) in the baseline and the project. If there is a decrease in CO_2 emissions from the decarbonisation of the limestone then project participants do not need to account for the decrease. However, if emissions increase from the decarbonisation of limestone then the project participants must account for this increase in the emission reduction calculation.

$$BE_{calcin,y} = \min\left(BE_{calcin}, PE_{calcin,y}\right) \quad \textbf{(7)}$$

Where:

$BE_{calcin,y}$	=	Baseline emissions from the calcination of limestone in year *y* (tCO_2)
BE_{calcin}	=	Baseline emissions from the calcination of limestone (tCO_2)
$PE_{calcin,y}$	=	Project emissions from the calcination of limestone in year *y* (tCO_2)

Sub-step 4.1: Determine the baseline emissions from the calcination of the limestone

This methodology requires data from the **base year** to calculate the baseline emissions from the calcination of limestone. The base year is defined as the year prior to the start of the CDM project activity. If data is available for multiple years prior to the start of the CDM project activity, the average value of up to three years shall be taken.

The baseline emissions from the calcination of the limestone are calculated as follows:

$$BE_{calcin} = \frac{\left[0.785 \times \left(OutCaO + LKDCaO - InCaO\right) + 1.092 \times \left(OutMgO + LKDMgO - InMgO\right)\right]}{P_{BL}} \times P_y \qquad \textbf{(8)}$$

Where:

BE_{calcin}	=	Baseline emissions from the calcination of limestone (tCO_2)
0.785	=	Stoichiometric emission factor for CaO ($tCO_2/tCaO$)
1.092	=	Stoichiometric emission factor for MgO ($tCO_2/tMgO$)
InCaO	=	Baseline CaO content in the raw material (tCaO)
OutCaO	=	Baseline CaO content in the lime produced (tCaO)
InMgO	=	Baseline MgO content in the raw material (tMgO)
OutMgO	=	Baseline MgO content in the lime produced (tMgO)
LKDCaO	=	Baseline CaO content in the lime kiln dust (tCaO)
LKDMgO	=	Baseline MgO content in the lime kiln dust produced (tMgO)
P_{BL}	=	Amount of lime produced in the base year (ton of lime)
P_y	=	Amount of lime produced by the project facility in year *y* (ton of lime)

Step 5: Determine the baseline emissions for the production of lime

The baseline emissions shall be calculated as follows:

$$BE_y = \left[\sum_{k=1}^{m}\left(BE_{BL,FC,k,y} + BE_{BL,EC,k,y}\right)\right] + BE_{calcin,y} \qquad \textbf{(9)}$$

Where:

BE_y	=	Baseline emissions in year *y* (tCO_2)
$BE_{BL,FC,k,y}$	=	Baseline emissions from fossil fuel combustion in kiln *k* in the baseline in year *y* (tCO_2), calculated as per equation 3
$BE_{BL,EC,k,y}$	=	Baseline emissions from electricity consumption in kiln *k* and auxiliary equipment(s) in the baseline in year *y* (tCO_2), calculated as per equation 5
$BE_{calcin,y}$	=	Baseline emissions from the calcination of limestone in year *y* (tCO_2), calculated as per equation 7
M	=	Total number of kilns in the existing lime producing facility

Project emissions

Project emissions include emissions from the use of fossil fuel and electricity in the kilns and auxiliary equipment(s) and emissions from the calcination of limestone.

Project emissions are calculated as follows:

$$PE_y = \left[\sum_{k=1}^{n}\left(PE_{FC,k,y} + PE_{EC,k,y}\right)\right] + PE_{calcin,y} \quad \textbf{(10)}$$

Where:

PE_y	=	Project emissions in year *y* (tCO_2)
$PE_{FC,k,y}$	=	Project emissions from fossil fuel combustion in kiln *k* in year *y* (tCO_2)
$PE_{EC,k,y}$	=	Project emissions from electricity consumption in kiln *k* and auxiliary equipment(s) in year *y* (tCO_2)
$PE_{calcin,y}$	=	Project emissions from the calcination of limestone in year *y* (tCO_2)
n	=	Total number of kilns in the lime producing facility in year *y*

Determination of project emissions from fossil fuel combustion in kiln k

Project emissions from fossil fuel combustion in kiln *k* in year *y* ($PE_{FC,k,y}$) are calculated using the latest version of the 'Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion.'

Determination of project emissions from electricity consumption in kiln k and auxiliary equipment(s)

Project emissions from electricity consumption in kiln *k* and auxiliary equipment(s) in year *y* ($PE_{EC,k,y}$) are calculated using the latest version of the 'Tool to calculate baseline, project and/or leakage emissions from electricity consumption.'

Determination of project emissions from the calcination of limestone

The project emissions from the calcination of limestone are calculated as follows:

$$PE_{calcin,y} = \left[0.785 \times \left(OutCaO_y + LKDCaO_y - InCaO_y\right) + 1.092 \times \left(OutMgO_y + LKDMgO_y - InMgO_y\right)\right] \quad \textbf{(11)}$$

Where:

$PE_{calcin,y}$	=	Project emissions from the calcination of limestone in year *y* (tCO_2)
0.785	=	Stoichiometric emission factor for CaO ($tCO_2/tCaO$)
1.092	=	Stoichiometric emission factor for MgO ($tCO_2/tMgO$)
$InCaO_y$	=	CaO content in the raw material in year *y* (tCaO)
$OutCaO_y$	=	CaO content in the lime produced in year *y* (tCaO)
$InMgO_y$	=	MgO content in the raw material in year *y* (tMgO)
$OutMgO_y$	=	MgO content in the lime produced in year *y* (tMgO)
$LKDCaO_y$	=	CaO content in the lime kiln dust produced in year *y* (tCaO)
$LKDMgO_y$	=	MgO content in the lime kiln dust produced in year *y* (tMgO)

Leakage

No leakage is considered.

Emission reductions

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y \quad (12)$$

Where:

ER_y	=	Emission reductions in year y (tCO_2)
BE_y	=	Baseline emissions in year y (tCO_2)
PE_y	=	Project emissions in year y (tCO_2)

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

Refer to the latest approved version of the methodological tool "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period".

Data and parameters not monitored

In addition to the parameters listed in the tables below, the provisions on data and parameters not monitored in the tools referred to in this methodology apply.

The following data and parameters are included in this methodology, but do not need to be monitored during the crediting period:

Data / Parameter:	Quality of lime in the baseline
Data unit:	-
Description:	The quality of lime as measured by the available lime content and the reactivity of the lime
Source of data:	Historical data from on-site measurements in plant records or off-site laboratory tests. Tests conducted on batches to ensure that they meet customer specifications. If there is no historical data then a measurement campaign
Measurement procedures (if any):	At least one year of historical information must be used as a measurement of the quality of the lime. If data is available for multiple years prior to the start of the project activity, the average of up to three years shall be taken. This period must include at least three tests. If no historical data is available then a measurement campaign by an independent expert for one month prior to project start date must be conducted. The expert must prepare a report on the findings which contains a measurement of the quality of the lime in the baseline.
Any comment:	This parameter is required in order to comply with the following applicability condition: • The quality of lime produced in the project activity must be the same or better than the quality of the lime produced in the baseline

Data / Parameter:	$P_{HIST,MAX,2MA}$
Data unit:	ton of lime
Description:	Two months of highest reported lime production in the lime producing facility in the latest three years prior to the start date of the CDM project activity
Source of data:	Historical data from on-site measurements in plant records
Measurement procedures (if any):	Amount of lime produced from the lime producing facility shall be aggregated monthly for three years prior to the start date of the project activity. Amount of lime produced for two months which are highest among all months within this period of three years shall be taken as the value for $P_{HIST,MAX,2MA}$
Any comment:	Data from all months in three years prior to the start date of the project activity is required to calculate this parameter. In case, in any last three years, the production data for any month is not available, the data vintage shall be extended up to five years prior to the start date of the project activity

Data / Parameter:	$FC_{-1,k}$, $FC_{-2,k}$, $FC_{-3,k}$
Data unit:	mass or volume unit
Description:	Amount of fuel consumed in kiln *k* in the year prior to the start date of the project activity (-1 is one year prior, -2 is two year prior and -3 is three year prior)
Source of data:	Historical data from on-site measurements in plant records
Measurement procedures (if any):	Use either mass or volume meters
Any comment:	In case the kiln *k* did not operate during any of the latest three years, the data vintage shall be extended up to five years prior to the start date of the project activity to come up to at least three years value

Data / Parameter:	$P_{-1,k}$, $P_{-2,k}$, $P_{-3,k}$
Data unit:	ton of lime
Description:	Amount of lime produced in kiln *k* in years prior to the start date of the project activity (-1 is one year prior, -2 is two year prior and -3 is three year prior)
Source of data:	On-site measurements in plant records
Measurement procedures (if any):	Weigh bridge
Any comment:	In case the kiln *k* did not operate during any of the latest three years, the data vintage shall be extended up to five years prior to the start date of the project activity to come up to at least three years value

Data / Parameter:	$NCV_{-1,k}$, $NCV_{-2,k}$, $NCV_{-3,k}$
Data unit:	GJ/mass or volume unit
Description:	The weighted average net calorific value of the fuel in year prior to the start date of the project activity (-1 is one year prior, -2 is two year prior and -3 is three year prior)

<table>
<tr><td>Source of data:</td><td>The following data sources may be used if the relevant conditions apply:
<table>
<tr><th colspan="2">Data source</th><th>Conditions for using the data source</th></tr>
<tr><td>(a)</td><td>Values provided by the fuel supplier in invoices</td><td>This is the preferred source</td></tr>
<tr><td>(b)</td><td>Measurements by the project participants</td><td>If (a) is not available</td></tr>
<tr><td>(c)</td><td>Regional or national default values</td><td>If (b) 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)</td></tr>
<tr><td>(d)</td><td>IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories</td><td>If (c) is not available</td></tr>
</table></td></tr>
<tr><td>Measurement procedures (if any):</td><td>For (a) and (b): Measurements should be undertaken in line with national or international fuel standards</td></tr>
<tr><td>Any comment:</td><td>Note that for the NCV the same basis (pressure and temperature) should be used as for the fuel consumption.

In case the kiln k did not operate during any of the latest three years, the data vintage shall be extended up to five years prior to the start date of the project activity to come up to at least three years value</td></tr>
</table>

Data / Parameter:	$EC_{-1,k}$, $EC_{-2,k}$, $EC_{-3,k}$
Data unit:	MWh
Description:	Amount of electricity consumed in kiln *k* in the year prior to the start date of the project activity (-1 is one year prior, -2 is two year prior and -3 is three year prior)
Source of data:	Historical data from on-site measurements in plant records
Measurement procedures (if any):	Use electricity meters
Any comment:	In case the kiln *k* did not operate during any of the latest three years, the data vintage shall be extended up to five years prior to the start date of the project activity to come up to at least three years value

Data / Parameter:	InCaO
Data unit:	tCaO
Description:	Baseline CaO content in the raw material
Source of data:	On-site measurements in plant records. Historical data can be used. If not recorded historically then the results of a measurement campaign can be used

Measurement procedures (if any):	This parameter is calculated as the CaO content (%) of the raw material times the raw material quantity (Q_{rm})
Any comment:	The CaO content (%) may have been recorded in plant records. Use at least one year of historical data prior to the start of the CDM project activity. If data is available for multiple years prior to the start of the project activity, the average of up to three years shall be taken. If the CaO content has not been recorded, then the results from a measurement campaign conducted before the start date of the project must be used. The measurement campaign must be conducted for a month with the composition of a sample of the limestone tested daily. In addition, project participants are required to take into account any factors that could influence the CaO content of the limestone such as new body of limestone being mined etc. This must be accounted for in the calculation of the CaO content. The highest value must be applied as it will result in the lowest baseline emissions from calcination

Data / Parameter:	OutCaO
Data unit:	tCaO
Description:	Baseline CaO content in the lime produced
Source of data:	On-site measurements in plant records. Historical data can be used. If not recorded historically then the results of a measurement campaign can be used
Measurement procedures (if any):	This parameter is calculated as the CaO content (%) of the lime times the lime produced (Q_{lime})
Any comment:	The CaO content (%) may have been recorded in plant records. Use at least one year of historical data prior to the start of the CDM project activity. If data is available for multiple years prior to the start of the project activity, the average of up to three years shall be taken. If the CaO content has not been recorded, then the results from a measurement campaign conducted before the start date of the project must be used. The measurement campaign must be conducted for a month with the composition of a sample of the lime tested daily. In addition, project participants are required to take into account any factors that could influence the CaO content. This must be accounted for in the calculation of the CaO content. The lowest value must be applied as it will result in the lowest baseline emissions from calcination

Data / Parameter:	InMgO
Data unit:	tMgO
Description:	Baseline MgO content in the raw material
Source of data:	On-site measurements in plant records. Historical data can be used. If not recorded historically then the results of a measurement campaign can be used
Measurement procedures (if any):	This parameter is calculated as the MgO content (%) of the raw material times the raw material quantity (Q_{rm})

Any comment:	The MgO content (%) may have been recorded in plant records. Use at least one year of historical data prior to the start of the CDM project activity. If data is available for multiple years prior to the start of the project activity, the average of up to three years shall be taken. If the MgO content has not been recorded, then the results from a measurement campaign conducted before the start date of the project must be used. The measurement campaign must be conducted for a month with the composition of a sample of the limestone tested daily. In addition, project participants are required to take into account any factors that could influence the MgO content of the limestone such as new body of limestone being mined etc. This must be accounted for in the calculation of the MgO content. The highest value must be applied as it will result in the lowest baseline emissions from calcination

Data / Parameter:	OutMgO
Data unit:	tMgO
Description:	Baseline MgO content in the lime produced
Source of data:	On-site measurements in plant records. Historical data can be used. If not recorded historically then the results of a measurement campaign can be used
Measurement procedures (if any):	This parameter is calculated as the MgO content (%) of the lime times the lime produced (Q_{lime})
Any comment:	The MgO content (%) may have been recorded in plant records. Use at least one year of historical data prior to the start of the CDM project activity. If data is available for multiple years prior to the start of the project activity, the average of up to three years shall be taken. If the MgO content has not been recorded, then the results from a measurement campaign conducted before the start date of the project must be used. The measurement campaign must be conducted for a month with the composition of a sample of the lime tested daily. In addition, project participants are required to take into account any factors that could influence the MgO content. This must be accounted for in the calculation of the MgO content. The lowest value must be applied as it will result in the lowest baseline emissions from calcination

Data / Parameter:	Q_{rm}
Data unit:	Tons raw material
Description:	Quantity of limestone used in the baseline
Source of data:	On-site measurements in plant records
Measurement procedures (if any):	Weight meters
Any comment:	This parameter shall be based on historical records of the plant for the year prior to the start date of the CDM project activity. If data is available for multiple years, the average value of up to three years shall be taken

Data / Parameter:	Q_{lime}
Data unit:	Tons of lime
Description:	Quantity of lime produced in the baseline
Source of data:	On-site measurements in plant records

Measurement procedures (if any):	Weight meters
Any comment:	This parameter shall be based on historical records of the plant for the year prior to the start date of the CDM project activity. If data is available for multiple years, the average value of up to three years shall be taken

Data / Parameter:	LKDCaO
Data unit:	tCaO
Description:	Baseline CaO content in the lime kiln dust produced
Source of data:	On-site measurements in plant records. Historical data can be used. If not recorded historically then the results of a measurement campaign can be used
Measurement procedures (if any):	This parameter is calculated as the CaO content (%) of the lime kiln dust times the lime kiln dust produced (Q_{LKD})
Any comment:	The CaO content (%) may have been recorded in plant records. Use at least one year of historical data prior to the start of the CDM project activity. If data is available for multiple years prior to the start of the project activity, the average of up to three years shall be taken. If the CaO content and/or lime kiln dust quantity has not been recorded, then the results from a measurement campaign conducted before the start date of the project must be used. The measurement campaign must be conducted for a month with the composition of a sample of the lime kiln dust tested daily. In addition, project participants are required to take into account any factors that could influence the CaO content. This must be accounted for in the calculation of the CaO content

Data / Parameter:	LKDMgO
Data unit:	tMgO
Description:	Baseline MgO content in the lime kiln dust produced
Source of data:	On-site measurements in plant records. Historical data can be used. If not recorded historically then the results of a measurement campaign can be used
Measurement procedures (if any):	This parameter is calculated as the MgO content (%) of the lime kiln dust times the lime kiln dust produced (Q_{LKD})
Any comment:	The MgO content (%) may have been recorded in plant records. Use at least one year of historical data prior to the start of the CDM project activity. If data is available for multiple years prior to the start of the project activity, the average of up to three years shall be taken. If the MgO content and/or lime kiln dust quantity has not been recorded, then the results from a measurement campaign conducted before the start date of the project must be used. The measurement campaign must be conducted for a month with the composition of a sample of the lime kiln dust tested daily. In addition, project participants are required to take into account any factors that could influence the MgO content. This must be accounted for in the calculation of the MgO content

Data / Parameter:	Q_{LKD}
Data unit:	Tons lime kiln dust
Description:	Quantity of lime kiln dust produced in the base year
Source of data:	On-site measurements in plant records or measurement campaign. Alternatively project participants can also use default value of share of lime produced as 2%. In that case, the quantity of the lime kiln dust produced shall be 2% multiplied by the amount of lime produced in the base year (P_{BL})
Measurement procedures (if any):	Weight meters
Any comment:	This parameter shall be based on historical records of the plant for the year prior to the start date of the CDM project activity. If data is available for multiple years, the average value of up to three years shall be taken. If no data is available then the results from a measurement campaign conducted before the start date of the project must be used. The measurement campaign must be conducted for a month

Data / Parameter:	P_{BL}
Data unit:	ton of lime
Description:	Amount of lime produced in the base year
Source of data:	On-site measurements in plant records
Measurement procedures (if any):	Weight meters
Any comment:	Use at least one year of historical data prior to the start of the CDM project activity. If data is available for multiple years prior to the start of the project activity, the average of up to three years shall be taken

III. MONITORING METHODOLOGY

All data collected as part of monitoring should be archived electronically and be kept at least for two years after the end of the last crediting period. One hundred per cent of the data should be monitored if not indicated otherwise in the tables below. All measurements should be conducted with calibrated measurement equipment according to relevant industry standards.

Describe and specify in the CDM-PDD all monitoring procedures, including the type of measurement instrumentation used, the responsibilities for monitoring and QA/QC procedures that will be applied. Where the methodology provides different options (e.g. use of default values or on-site measurements), specify which option will be used. All meters and instruments should be calibrated regularly as per industry standards.

In addition, the monitoring provisions in the tools referred to in this methodology apply.

Data and parameters monitored

The following data and parameters are included in this methodology and need to be monitored during the crediting period:

Data / Parameter:	Quality of lime in the project
Data unit:	-
Description:	The quality of lime as measured by the available lime content and the reactivity of the lime
Source of data:	The quality of the lime is measured in the project activity by conducting tests on the available lime content and the reactivity of the lime
Measurement procedures (if any):	These tests must be conducted by an independent laboratory every three months and by the internal laboratory every month
Monitoring frequency:	These tests must be conducted by an independent laboratory every three months and by the internal laboratory every month
QA/QC procedures:	-
Any comment:	This monitored parameter is required in order to comply with the following applicability condition: • The quality of lime produced in the project activity must be the same or better than the quality of the lime produced in the baseline. The quality of the lime produced in the project activity shall be compared with the quality of lime produced in the baseline. If the quality of the lime produced in the project activity is lower during a month of a crediting year due to the implementation of the CDM project activity, then the emission reduction for that crediting year shall not be claimed

Data / Parameter:	$InCaO_y$
Data unit:	tCaO
Description:	CaO content in the raw material in year *y*
Source of data:	On-site measurement in plant records
Measurement procedures (if any):	This parameter is calculated as the CaO content (%) of the raw material times the raw material quantity ($Q_{rm,y}$) used in the project facility in year *y*. This will be calculated and measured as part of normal operations
Monitoring frequency:	Daily and aggregated annually
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	$OutCaO_y$
Data unit:	tCaO
Description:	CaO content in lime produced in year *y*
Source of data:	On-site measurement in plant records
Measurement procedures (if any):	This parameter is calculated as the CaO content (%) of the lime times the lime quantity (P_y) produced by the project facility in year *y*. This will be calculated and measured as part of normal operations
Monitoring frequency:	Daily and aggregated annually
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	$InMgO_y$
Data unit:	tMgO
Description:	MgO content in the raw material in year *y*
Source of data:	On-site measurement in plant records
Measurement procedures (if any):	This parameter is calculated as the MgO content (%) of the raw material times the raw material quantity ($Q_{rm,y}$) used in the project facility in year *y*. This will be calculated and measured as part of normal operations
Monitoring frequency:	Daily and aggregated annually
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	$OutMgO_y$
Data unit:	tMgO
Description:	MgO content in lime produced in year *y*
Source of data:	On-site measurement in plant records
Measurement procedures (if any):	This parameter is calculated as the MgO content (%) of the lime times the lime quantity (P_y) produced by the project facility in year *y*. This will be calculated and measured as part of normal operations
Monitoring frequency:	Daily and aggregated annually
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	$Q_{rm,y}$
Data unit:	Tons limestone
Description:	Quantity of limestone used in year *y*
Source of data:	On-site measurements in plant records
Measurement procedures (if any):	Weight meter
Monitoring frequency:	Daily and aggregated annually
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	P_y
Data unit:	ton of lime
Description:	Amount of lime produced by the project facility in year *y* (ton of lime)
Source of data:	On-site measurements in plant records
Measurement procedures (if any):	Weight meter
Monitoring frequency:	Daily and aggregated annually
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	$LKDCaO_y$
Data unit:	tCaO
Description:	CaO content in lime kiln dust produced in year *y*
Source of data:	On-site measurement in plant records
Measurement procedures (if any):	This parameter is calculated as the CaO content (%) of the lime kiln dust times the lime kiln dust quantity ($Q_{LKD,y}$) produced by the project facility in year *y*. This will be calculated and measured as part of normal operations
Monitoring frequency:	Daily and aggregated annually
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	$LKDMgO_y$
Data unit:	tMgO
Description:	MgO content in lime kiln dust produced in year *y*
Source of data:	On-site measurement in plant records
Measurement procedures (if any):	This parameter is calculated as the MgO content (%) of the lime kiln dust times the lime kiln dust quantity ($Q_{LKD,y}$) produced by the project facility in year *y*. This will be calculated and measured as part of normal operations
Monitoring frequency:	Daily and aggregated annually
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	$Q_{LKD,y}$
Data unit:	Tons lime kiln dust
Description:	Quantity of lime kiln dust produced in year *y*
Source of data:	On-site measurements in plant records
Measurement procedures (if any):	Weight meter
Monitoring frequency:	Daily and aggregated annually
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	$EF_{CO2,y}$
Data unit:	tCO_2/GJ
Description:	The weighted average CO_2 emission factor of fuel in year *y*

Source of data:	The following data sources may be used if the relevant conditions apply: <table><tr><th>Data source</th><th></th><th>Conditions for using the data source</th></tr><tr><td>(a)</td><td>Values provided by the fuel supplier in invoices</td><td>This is the preferred source</td></tr><tr><td>(b)</td><td>Measurements by the project participants</td><td>If (a) is not available</td></tr><tr><td>(c)</td><td>Regional or national default values</td><td>If (b) 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).</td></tr><tr><td>(d)</td><td>IPCC default values at the lower limit of the uncertainty at a 95% confidence level as provided in Table 1.4 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories</td><td>If (c) is not available</td></tr></table>
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 CO_2 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:	For (a): if the fuel supplier does not 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

IV. REFERENCES AND ANY OTHER INFORMATION

Not applicable.

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History of the document

Version	Date	Nature of revision(s)
02.0.0	13 September 2012	EB 69, Annex 15 Revision to: • Remove the restriction for application under a programme of activities (PoA) in line with the decision at EB 68 stating that all approved methodologies are eligible for application in a PoA. (EB 68, para. 97)
01.0.0	20 July 2012	EB 68, Annex 5 Initial adoption.
Decision Class: Regulatory **Document Type**: Standard **Business Function**: Methodology		