

ACM0003

Large-scale Consolidated Methodology

Partial substitution of fossil fuels in cement or quicklime manufacture

Version 08.0

Sectoral scope(s):04



United Nations
Framework Convention on
Climate Change

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1. Introduction

1. The following table describes the key elements of the methodology:

Table 1. Methodology key elements

Typical projects	Partial replacement of fossil fuels in an existing clinker or quicklime production facility by less-carbon-intensive fossil fuel or alternative fuel (e.g. wastes or biomass)
Type of GHG emissions mitigation action	(a) Fuel switch; (b) Renewable energy; (c) GHG emission avoidance by preventing disposal or uncontrolled burning of biomass residues

2. Scope, applicability, and entry into force

2.1. Scope

2. This methodology comprises of replacing fossil fuels in existing clinker or quicklime production by alternative fuels, which could be fossil fuels with lower carbon emissions, waste or biomass.

2.2. Applicability

3. The methodology is applicable to project activities in the cement or quicklime industry where fossil fuel(s) used in an existing clinker or quicklime production facility are partially replaced by less carbon intensive fossil fuel(s) and/or alternative fuel(s).
4. The following conditions shall apply:
 - (a) A significant investment is required to enable the use of the alternative fuel(s) and/or the less carbon intensive fossil fuel(s);
 - (b) During the last three years prior to the start of the project activity, no alternative fuels have been used in the project plant;
 - (c) The CO₂ emissions reduction relates to CO₂ emissions generated from fuel combustion only and is unrelated to the CO₂ emissions from decarbonisation of raw materials (i.e. CaCO₃ and MgCO₃ bearing minerals);
 - (d) The methodology is applicable only for installed capacity (expressed in tonnes clinker/year or tonnes quicklime/year) that exists by the time of validation of the project activity.
5. In case of project activities using biomass residues or renewable biomass, the following applicability conditions apply:
 - (a) The biomass is not chemically processed (e.g. esterification to produce biodiesel, production of alcohols from biomass, etc.) prior to combustion in the project plant but it may be processed mechanically or be dried at the project site. Moreover, any preparation of the biomass, occurring before use in the project activity, does

- not cause other significant GHG emissions (such as, for example, methane emissions from anaerobic treatment of waste water or from char coal production);
 - (b) The biomass used by the project facility is stored under aerobic conditions.
6. If the land area is severely degraded, land degradation can be demonstrated using one or more of the following indicators:
- (a) Vegetation degradation, for example:
 - (i) Crown cover of pre-existing trees has decreased in the recent past for reasons other than sustainable harvesting activities;
 - (b) Soil degradation, for example:
 - (i) Soil erosion has increased in the recent past;
 - (ii) Soil organic matter content has decreased in the recent past;
 - (c) Anthropogenic influences, for example:
 - (i) There is a recent history of loss of soil and vegetation due to anthropogenic actions; and
 - (ii) Demonstration that there exist anthropogenic actions/activities that prevent possible occurrence of natural regeneration.
7. The methodology is not applicable to project activities that implement efficiency measures in production of clinker or quicklime, such as changing the configuration/number of pre-heaters.
8. Finally, this methodology is only applicable if F2 (the continuation of the current fuel mix) or F3 (a different fossil fuel mix portfolio) results to be the most plausible baseline scenario for the use of fuels in the cement or quicklime plant and if one or several of the following scenarios, as explained in the “Procedure for the selection of the most plausible baseline scenario and demonstration of additionality”, result to be the most plausible baseline scenario for the use of alternative fuels:
- (a) For the fate of any wastes originating from fossil sources: scenarios W1 and/or W3;
 - (b) For the fate of any biomass residues: scenarios B1, B2 and/or B3;
 - (c) For the fate of any renewable biomass: scenario R1.

2.3. Entry into force

9. The date of entry into force of the revision is the date of the publication of the EB 76 meeting report on 8 November 2013.

3. Normative references

10. This consolidated baseline and monitoring methodology is based on the following approved baseline and monitoring methodologies and proposed new methodologies:

- (a) “NM0040: Replacement of Fossil Fuel by Palm Kernel Shell biomass in the production of Portland cement”, prepared by Lafarge Asia;
 - (b) “NM0048-rev: Indocement’s Sustainable cement Production Project”, prepared by Indocement.
11. This methodology also refers to the latest approved versions of the following tools:
- (a) “Combined tool to identify the baseline scenario and demonstrate additionality”;
 - (b) The methodological tool “Emissions from solid waste disposal sites” if B2 is identified as the most plausible baseline scenario for the use of biomass residues;
 - (c) “Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion”;
 - (d) “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”;
 - (e) The methodological tool “Project and leakage emissions from transportation of freight”;
 - (f) The methodological tool “Upstream leakage emissions associated with fossil fuel use”;
 - (g) The methodological tool “Project emissions from cultivation of biomass”.
12. 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 please refer to <<http://cdm.unfccc.int/goto/MPappmeth>>.

3.1. Selected approach from paragraph 48 of the CDM modalities and procedures

13. “Emissions from a technology that represents an economically attractive course of action, taking into account barriers to investment”.

4. Definitions

14. The definitions contained in the Glossary of CDM terms shall apply.
15. For the purpose of this methodology, the following definitions apply:
- (a) **Biomass** - biomass refers to non-fossilized and biodegradable organic material originating from plants, animals and microorganisms. This shall also include products, by-products, residues and waste from agriculture, forestry and related industries as well as the non-fossilized and biodegradable organic fractions of industrial and municipal wastes. Biomass also includes gases and liquids recovered from the decomposition of non-fossilized and biodegradable organic material;
 - (b) **Biomass residues** - biomass residues are defined as biomass that is a by-product, residue or waste stream from agriculture, forestry and related industries.

This shall not include municipal waste or other wastes that contain fossilized and/or non-biodegradable material (small fractions of inert inorganic material like soil or sands may be included);

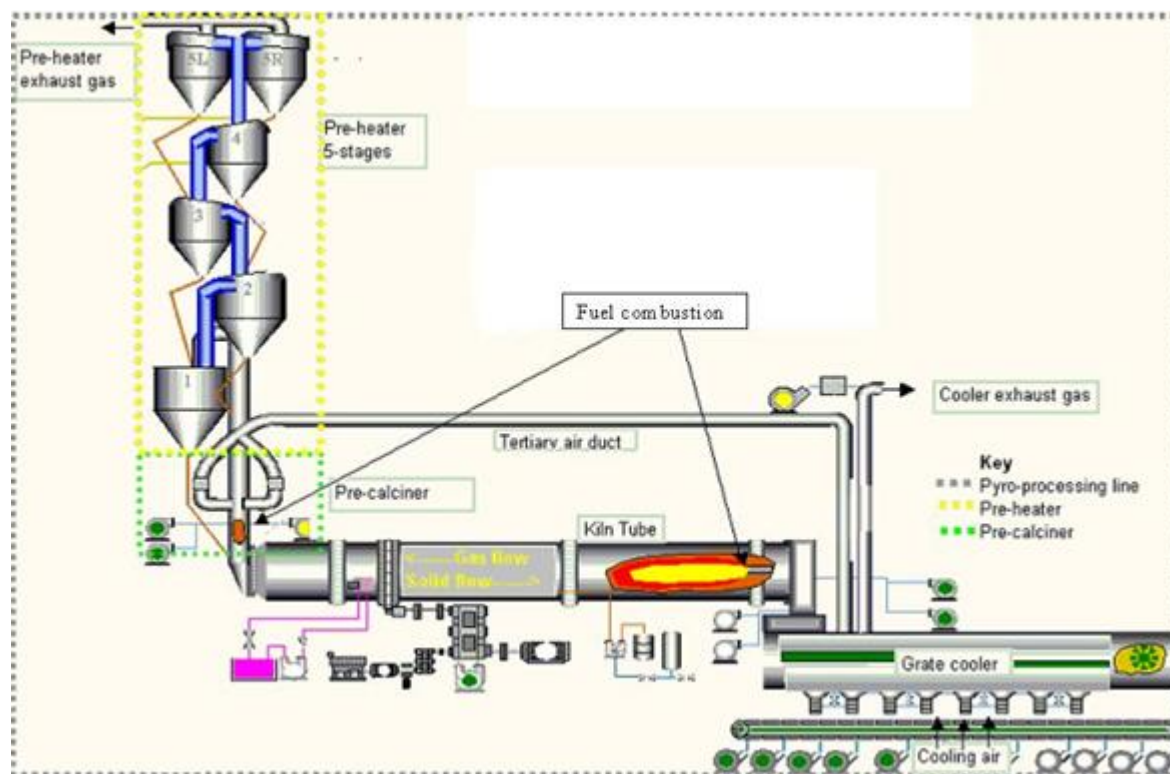
- (c) **Renewable biomass** - the latest approved definition by the Board applies;
 - (d) **Alternative fuels** - alternative fuels include the following fuel types:
 - (i) Wastes originating from fossil sources, such as tires, plastics, textiles from polymers, or rubber; and/or
 - (ii) Biomass residues; and/or
 - (iii) Renewable biomass from a dedicated plantation;
 - (e) **Less carbon intensive fossil fuel** - a less carbon intensive fossil fuel is a fossil fuel type that has not been used in the project plant during the last three years prior to the start of the project activity and that has a lower CO₂ emission factor on a net calorific value basis (t CO₂/GJ) than any fossil fuel type that has been used in the project plant during the last three years prior to the start of the project activity;
 - (f) **Clinker production** - the clinker production facility refers to the pyro-process that may include an integrated system encompassing several in line stages comprising of a multi stage pre-heater, followed by an inline pre-calciner, kiln tube and grate cooler as indicated in Figure 1. The fuel for clinker production is fired both in the pre-calciner and the kiln tube;
 - (g) **Fuel penalty** - a project specific fuel penalty is applied because the combustion of typically coarser biomass or other alternative fuels will reduce the heat transfer efficiency in the cement or quicklime manufacturing process. The use of alternative fuels will therefore require a greater heat input to produce the same quantity and quality of clinker or quicklime. The chemical content and ease of absorption into clinker or quicklime of all fuel ashes also differs, and this also contributes to the need for a project specific fuel penalty;
 - (h) **Quicklime production** - the quicklime production facility refers to the pyro-process that includes an integrated system encompassing several in line stages comprising of a pre-heater, a calcination kiln and a cooler, as indicated in Figure 2. Quicklime can also be produced in calcination kilns with a pre-heating zone and a cooling zone, as indicated in Figure 3. The fuel for quicklime production is fired in the calcination kiln;
 - (i) **Project plant** - is defined as the clinker/cement manufacturing facility or quicklime lime manufacturing facility where the project activity is implemented.
16. Note that in case of solid biomass for all the calculations in this methodology, quantity of biomass refers to the dry weight of biomass.

5. Baseline methodology

5.1. Project boundary

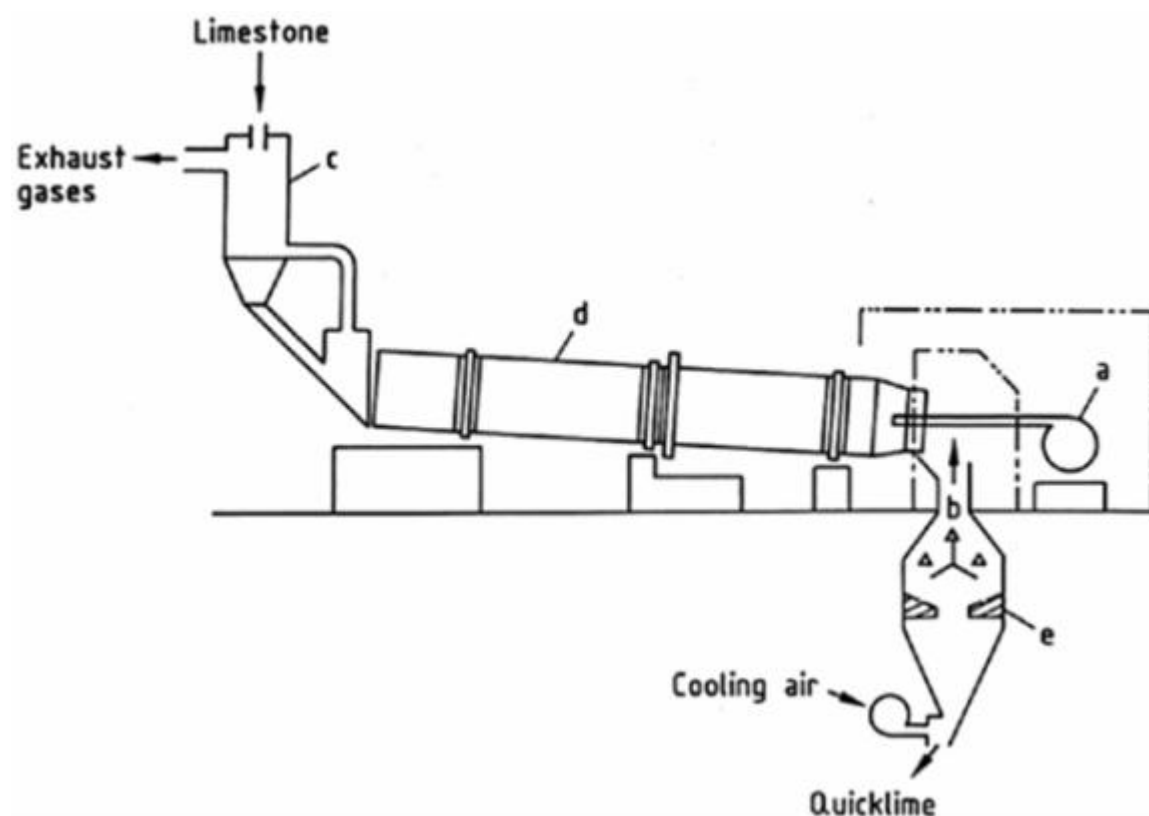
17. The physical project boundary covers all production processes related to clinker or quicklime production, including:
 - (a) The pre-heaters, if applicable, where the heat of exhaust gas is used to heat the inputs for clinker production;
 - (b) The pre-calciner, if applicable, where fuels are fired for the pre-calcination of the inputs for clinker production;
 - (c) The kiln tube, where fuels are fired and where the calcinations process of the inputs for clinker production takes place;
 - (d) The pre-heater or pre-heating zone, if applicable, where the heat of exhaust gas is used to heat the inputs for quicklime production;
 - (e) The calcination kiln where fuels are fired and where the calcination process of the inputs for quicklime production takes place;
 - (f) On-site storage and on-site transportation and drying of alternative fuels (if alternative fuels are used in the project activity);
 - (g) The vehicles used for transportation of alternative fuels to the project site;
 - (h) Where biomass residues are used, the project boundary includes the sites where the biomass residues would be dumped, left to decay or burnt in the absence of the project activity;
 - (i) Where renewable biomass is used in the project plant, the project boundary also includes the sites where the renewable biomass is cultivated.
18. The figure below shows a possible configuration of the pre-heaters, pre-calciner and kiln tube for clinker production.

Figure 1. Possible configuration of the pre-heaters, pre-calciner and kiln tube for clinker production



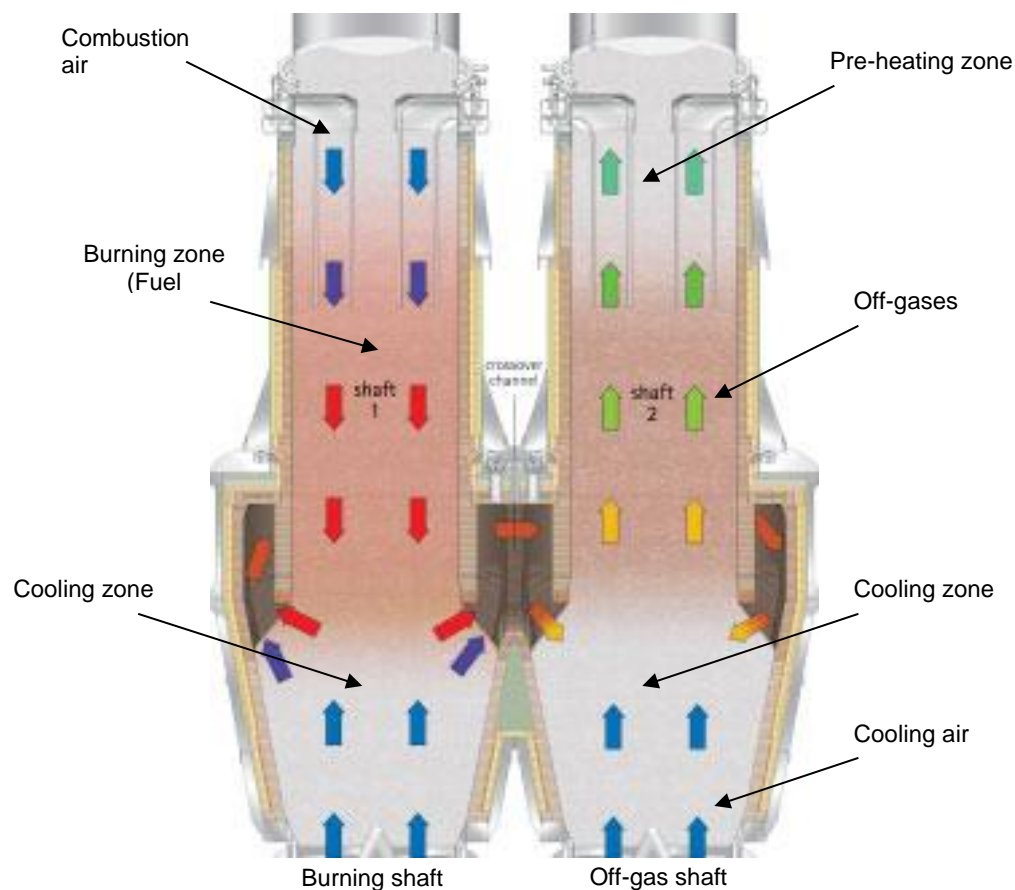
19. The figure below shows a possible configuration of the pre-heater and calcination kiln for quicklime production.

Figure 2. Possible configuration of the pre-heater and calcination kiln for quicklime production



20. The figure below shows a possible configuration of the calcination kiln with pre-heating zone for quicklime production.

Figure 3. Possible configuration of the calcination kiln with pre-heating zone for quicklime production



21. Emission sources and gases included in or excluded from the project boundary are described in Table 2.

Table 2. Emission sources included in or excluded from the project boundary

Source		Gas	Included	Justification/Explanation
Baseline	Emissions from fossil fuels displaced in the project plant ($BE_{FF,y}$)	CO ₂	Yes	Main emission source
		CH ₄	No	Minor source. Neglected for simplicity
		N ₂ O	No	Minor source. Neglected for simplicity
	Methane emissions avoided from preventing disposal or uncontrolled burning of biomass residues	CO ₂	No	It is assumed that CO ₂ emissions from surplus biomass residues do not lead to changes of carbon pools in the LULUCF sector
		CH ₄	Yes	Included if leakage can be ruled out
		N ₂ O	No	Minor source
Project activity	Emissions from the use of alternative fuels and/or less carbon intensive fossil fuels ($PE_{K,y}$)	CO ₂	Yes	Main emission source
		CH ₄	No	Minor source. Neglected for simplicity
		N ₂ O	No	Minor source. Neglected for simplicity
	Emissions from additional electricity and/or fossil fuel consumption as a result of the project activity ($PE_{FC,y}$ and $PE_{EC,y}$)	CO ₂	Yes	Can be a significant emission source
		CH ₄	No	Minor source. Neglected for simplicity
		N ₂ O	No	Minor source. Neglected for simplicity
	Emissions from combustion of fossil fuels for transportation of alternative fuels to the project plant ($PE_{T,y}$)	CO ₂	Yes	Can be a significant emission source
		CH ₄	No	Minor source. Neglected for simplicity
		N ₂ O	No	Minor source. Neglected for simplicity
	Emissions from the cultivation of renewable biomass at the dedicated plantation ($PE_{BC,y}$)	CO ₂	Yes	Can be a significant emission source, e.g. from combustion of fossil fuels
		CH ₄	Yes	Can be a significant emission source, e.g. in case of field burning of biomass
		N ₂ O	Yes	Can be a significant emission source, e.g. in the application of fertilizers

5.2. Procedure for the selection of the most plausible baseline scenario and demonstration of additionality

22. The baseline scenario is identified and additionality is assessed using the most recent approved version of the “Combined tool to identify the baseline scenario and demonstrate additionality”. This section highlights how specific sections of the tool are to be applied to this project context.

23. In applying Step 1a of the tool, the alternatives to be analysed for the fuel mix for cement or quicklime manufacturing may include, inter alia:
- (a) F1: The proposed project activity not undertaken as a CDM project activity (i.e. use of alternative fuels and/or less carbon intensive fossil fuels);
 - (b) F2: Continuation of current practice, i.e. a scenario in which the company continues cement or quicklime production using the existing technology, materials and fuel mix;
 - (c) F3: The continuation of using only fossil fuels and no alternative fuels, however, with a different fuel mix portfolio, taking into account relative prices of fuels available. The scenario(s) may be based on one fuel or different mixes of fuels;
 - (d) F4: The currently used fuels are partially substituted with alternative fuels and/or less carbon intensive fossil fuels other than those used in the CDM project activity and/or any other fuel types, without using the CDM. If relevant, develop different scenarios with different mixes of alternative fuels or less carbon intensive fuels and varying degrees of fuel-switch from traditional to alternative fuels or less carbon intensive fuels;
 - (e) F5: The construction and operation of a new cement or quicklime plant.
24. For each of these scenarios, project participants shall quantify the amount of fossil fuel(s) and alternative fuels that is expected to be used for clinker or quicklime production during the crediting period.
25. If the project activity uses alternative fuels, project participants should determine what would happen to the alternative fuels in the absence of the project activity:
26. Where **wastes originating from fossil sources** are used as the alternative fuel, the alternatives to be analysed may include, inter alia:
- (a) W1: Incineration of the waste in a waste incinerator without utilizing the energy from the incineration;
 - (b) W2: Incineration of the waste in a waste incinerator with use of the energy (e.g. for heat and/or electricity generation);
 - (c) W3: Disposal of the waste at a managed or unmanaged landfill;
 - (d) W4: The use of the waste at other facilities, for example other cement or quicklime plants or power plants, as a feedstock or for the generation of energy;
 - (e) W5: The recycling or reutilization of the waste;
 - (f) W6: The proposed project activity, not undertaken as a CDM project activity, i.e. the use of the waste in the project plant.
27. Where **biomass residues** are used as the alternative fuel, the alternatives to be analysed may include, inter alia:

-
- (a) B1: The biomass residues are dumped or left to decay under mainly aerobic conditions. This applies, for example, to dumping and decay of biomass residues on fields;
 - (b) B2: The biomass residues are dumped or left to decay under clearly anaerobic conditions. This applies, for example, to deep landfills with more than five meters. This does not apply to biomass residues that are stock-piled or left to decay on fields;
 - (c) B3: The biomass residues are burnt in an uncontrolled manner without utilizing them for energy purposes;
 - (d) B4: The biomass residues are sold to other consumers in the market and used by these consumers, such as for heat and/or electricity generation, for the generation of biofuels, as feedstock in processes (e.g. the pulp and paper industry), as fertilizer, etc.;
 - (e) B5: The biomass residues are used for other purposes at the project site, such as for heat and/or electricity generation, for the generation of biofuels, as feedstock in processes (e.g. the pulp and paper industry), as fertilizer, etc.;
 - (f) B6: The proposed project activity, not undertaken as a CDM project activity, i.e. the use of the biomass residue in the project plant.
28. Where **renewable biomass** from a new dedicated plantation is used as the alternative fuel, the alternatives to be analysed may include, inter alia:
- (a) R1: No establishment of a dedicated plantation and thus no generation of renewable biomass;
 - (b) R2: Establishment of a new dedicated plantation and sale of the renewable biomass from the plantation to other consumers in the market, which may use the renewable biomass for heat and/or electricity generation, for the generation of biofuels, as feedstock in processes (e.g. the pulp and paper industry), as fertilizer, etc.;
 - (c) R3: The proposed project activity, not undertaken as a CDM project activity, i.e. the establishment of a new dedicated plantation and use of the renewable biomass from that plantation in the project plant.
29. Where the project activity uses different types of wastes, biomass residues or renewable biomass, the baseline scenario should be identified for each type of waste, biomass residue or renewable biomass separately. Wastes, biomass residues or renewable biomass from different sources should be considered as a different type *k* of waste, biomass residue or renewable biomass. Similarly, wastes, biomass residues or renewable biomass with different uses in the absence of the project activity should be considered as a different type *k* of waste, biomass residues or renewable biomass.
30. Subsequently, all credible combinations of baseline scenarios should be identified and documented as part of Step 1 of the tool. These combinations should be considered in applying the following steps of the tool.
31. Project participants should document transparently in the CDM-PDD:

- (a) Which types and quantities of fuels have been used in the cement or quicklime plant in the most recent three years prior to the start of the project activity;
- (b) Which types and quantities of fossil fuels are supposed to be used under the project activity in the project plant and which of them are identified less carbon intensive fuels;
- (c) For each waste type, biomass residue type and renewable biomass type that is to be used in the project plant under the project activity: the type, the source and available quantities.

5.3. Project emissions

32. Project emissions include project emissions from the use of alternative fuels and/or less carbon intensive fossil fuels ($PE_{k,y}$), project emissions from additional electricity and/or fossil fuel consumption as a result of the project activity ($PE_{EC,y}$ and $PE_{FC,y}$), project emissions from combustion of fossil fuels for transportation of alternative fuels to the project plant ($PE_{T,y}$), and, if applicable, project emissions from the cultivation of renewable biomass at the dedicated plantation ($PE_{BC,y}$):

$$PE_y = PE_{k,y} + PE_{FC,y} + PE_{EC,y} + PE_{T,y} + PE_{BC,y} \quad \text{Equation (1)}$$

Where:

PE_y	=	Project emissions during the year y (t CO ₂ e)
$PE_{k,y}$	=	Project emissions from combustion of alternative fuels and/or less carbon intensive fossil fuels in the project plant in year y (t CO ₂)
$PE_{FC,y}$	=	Project emissions from additional fossil fuel combustion as a result of the project activity in year y (t CO ₂)
$PE_{EC,y}$	=	Project emissions from additional electricity consumption as a result of the project activity in year y (t CO ₂)
$PE_{T,y}$	=	CO ₂ emissions during the year y due to transport of alternative fuels to the project plant (t CO ₂)
$PE_{BC,y}$	=	Project emissions from the cultivation of renewable biomass at the dedicated plantation in year y (t CO ₂ e)

33. Project emissions are calculated in the following steps:
- (a) Step 1. Calculate project emissions from the use of alternative fuels and/or less carbon intensive fossil fuels;
 - (b) Step 2. Calculate project emissions from additional electricity and/or fossil fuel consumption as a result of the project activity;
 - (c) Step 3. Calculate project emissions from combustion of fossil fuels for transportation of alternative fuels to the project plant;
 - (d) Step 4. Calculate project emissions from the cultivation of renewable biomass at the dedicated plantation.

5.3.1. Step 1: Calculate project emissions from the use of alternative fuels and/or less carbon intensive fossil fuels

34. Project emissions from the use of alternative fuels and/or less carbon intensive fossil fuels in the project plant are calculated as follows:

$$PE_{k,y} = \sum_k FC_{PJ,k,y} \times NCV_{k,y} \times EF_{CO2,k,y} \quad \text{Equation (2)}$$

Where:

$PE_{k,y}$	=	Project emissions from combustion of alternative fuels and/or less carbon intensive fossil fuels in the project plant in year y (t CO ₂)
$FC_{PJ,k,y}$	=	Quantity of alternative fuel or less carbon intensive fossil fuel type k used in the project plant in year y (t)
$EF_{CO2,k,y}$	=	Carbon dioxide emissions factor for alternative or less carbon intensive fossil fuels type k in year y (t CO ₂ /GJ)
$NCV_{k,y}$	=	Net calorific value of the alternative or less carbon intensive fossil fuel type k in year y (GJ/t)
k	=	Alternative fuel types and less carbon intensive fossil fuel types used in the project plant in year y

5.3.2. Step 2: Calculate project emissions from additional electricity and/or fossil fuel consumption as a result of the project activity

35. The use of alternative fuels or less carbon intensive fossil fuels may result in additional fossil fuel and/or electricity consumption at the project site or off-site. This may include, inter alia, the following emission sources:
- (a) Drying or mechanical treatment of the fuels;
 - (b) On-site transportation of the fuels;
 - (c) Flue gas treatment required as a result of the project activity.
36. Project participants should identify in the CDM-PDD all relevant emission sources for additional fuel combustion and electricity generation and, if applicable, explain any changes in monitoring reports.
37. CO₂ emissions from on-site combustion of fossil fuels ($PE_{FC,y}$) should be calculated using the latest approved version of the “Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion”. For each fossil emission source j , the fuel consumption of each fuel type i ($FC_{i,j,y}$) should be monitored, consistent with the guidance in the tool.
38. CO₂ emissions from on-site electricity consumption ($PE_{EC,y}$) should be calculated using the latest approved version of the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”. Electricity consumption from each relevant source should be monitored and summed up to $EC_{PJ,y}$.

5.3.3. Step 3: Project emissions from combustion of fossil fuels for transportation of alternative fuels to the project plant

39. Project participants shall determine CO₂ emissions resulting from transportation of alternative fuels to the project plant. In many cases transportation is undertaken by vehicles. Project participants shall calculate these project emissions following the methodological tool “Project and leakage emissions from transportation of freight.”

5.3.4. Step 4: Calculate project emissions from the cultivation of renewable biomass at the dedicated plantation

40. Where renewable biomass from a dedicated plantation is used as alternative fuel, project emissions from the cultivation of the renewable biomass ($PE_{BC,y}$) shall be calculated according to the latest version of the methodological tool “Project emissions from cultivation of biomass”.

5.4. Baseline emissions

41. The project reduces CO₂ emissions by using alternative fuels and/or less carbon intensive fossil fuels in the pre-calcliner and the kiln for the production of clinker in cement manufacture or in the calcination kiln for the production of quicklime. If applicable, the project may also reduce CH₄ emissions from preventing disposal or uncontrolled burning of biomass residues. Baseline emissions are calculated as follows:

$$BE_y = BE_{FF,y} + BE_{CH_4,biomass,y} \quad \text{Equation (3)}$$

Where:

BE_y	=	Baseline emissions in year y (t CO ₂)
$BE_{FF,y}$	=	Baseline emission from fossil fuels displaced by alternative fuels or less carbon intensive fossil fuels in year y (t CO ₂)
$BE_{CH_4,biomass,y}$	=	Baseline methane emissions avoided during the year y from preventing disposal or uncontrolled burning of biomass residues (t CO ₂ e)

42. Baseline emissions are determined in the following steps:
- Step 1. Estimate the project specific fuel penalty;
 - Step 2. Calculate baseline emissions from the fossil fuels displaced by the alternative or less carbon intensive fuel(s);
 - Step 3. Calculate baseline emissions from decay, dumping or burning of biomass residues.

5.4.1. Step 1: Estimate the project specific fuel penalty

43. A project specific fuel penalty is applied because the combustion of typically coarser biomass or other alternative fuels will reduce the heat transfer efficiency in the cement or quicklime manufacturing process. The use of alternative fuels will therefore require a greater heat input to produce the same quantity and quality of clinker or quicklime. The

chemical content and ease of absorption into clinker or quicklime of all fuel ashes also differs, and this also contributes to the need for a project specific fuel penalty.

44. This project specific fuel penalty (FP_y) should be determined as follows:

$$FP_y = S_{PJ,k,y} \times P_{clinker/quicklime,y} \times \max(0, SEC_{clinker/quicklime,PJ,y} - SEC_{clinker/quicklime,BL}) \quad \text{Equation (4)}$$

Where:

FP_y	=	Fuel penalty in year y (GJ)
$S_{PJ,k,y}$	=	Share of the clinker or quicklime produced while project alternative or less carbon intensive fuel or biomass was used in year y (mass fraction)
$P_{clinker/quicklime,y}$	=	Production of clinker or quicklime in year y (t)
$SEC_{clinker/quicklime,PJ,y}$	=	Specific energy consumption of the project plant in year y (GJ/t clinker or GJ/t quicklime)
$SEC_{clinker/quicklime,BL}$	=	Specific energy consumption of the project plant in the absence of the project activity (GJ/t clinker or GJ/t quicklime)

45. The share of the clinker or quicklime produced while project alternative or less carbon intensive fuel or biomass was used in year y ($S_{PJ,k,y}$) may be used to account for periods, for example startup, in which no project fuels are used. It shall be determined as follows:

$$S_{PJ,k,y} = \frac{\sum_i (FC_{PJ,FP,i,y} \times NCV_{i,y}) + \sum_k (FC_{PJ,k,y} \times NCV_{k,y})}{\sum_i (FC_{PJ,i,y} \times NCV_{i,y}) + \sum_k (FC_{PJ,k,y} \times NCV_{k,y})} \quad \text{Equation (5)}$$

Where:

$S_{PJ,k,y}$	=	Share of the clinker or quicklime produced while project alternative or less carbon intensive fuel or biomass was used in year y (energy fraction)
$FC_{PJ,FP,i,y}$	=	Quantity of fossil fuel type i fired in the project plant while project alternative or less carbon intensive fuel or biomass were used in year y (t)
$FC_{PJ,i,y}$	=	Quantity of fossil fuel type i fired in the project plant in year y (t)
$NCV_{i,y}$	=	Net calorific value of the fossil fuel type i in year y (GJ/t)
$FC_{PJ,k,y}$	=	Quantity of alternative fuel or less carbon intensive fossil fuel type k used in the project plant in year y (t)

$NCV_{k,y}$	=	Net calorific value of the alternative or less carbon intensive fuel type k in year y (GJ/t)
k	=	Alternative fuel types and less carbon intensive fossil fuel types used in the project plant in year y
i	=	Fossil fuel types used in the project plant in year y that are not less carbon intensive fossil fuel types

46. The specific energy consumption in the project is calculated based on the quantity of all fuels used in the project plant and the quantity of clinker or quicklime produced in year y , as follows:

$$SEC_{clinker/quicklime,PJ,y} = \frac{\sum_i (FC_{PJ,i,y} \times NCV_{i,y}) + \sum_k (FC_{PJ,k,y} \times NCV_{k,y})}{P_{clinker/quicklime,y}} \quad \text{Equation (6)}$$

Where:

$SEC_{clinker/quicklime,PJ,y}$	=	Specific energy consumption of the project plant in year y (GJ/t clinker or GJ/t quicklime)
$FC_{PJ,i,y}$	=	Quantity of fossil fuel type i fired in the project plant in year y (t)
$NCV_{i,y}$	=	Net calorific value of the fossil fuel type i in year y (GJ/t)
$FC_{PJ,k,y}$	=	Quantity of alternative fuel or less carbon intensive fossil fuel type k used in the project plant in year y (t)
$NCV_{k,y}$	=	Net calorific value of the alternative or less carbon intensive fuel type k in year y (GJ/t)
$P_{clinker/quicklime,y}$	=	Production of clinker or quicklime in year y (t)
k	=	Alternative fuel types and less carbon intensive fossil fuel types used in the project plant in year y
i	=	Fossil fuel types used in the project plant in year y that are not less carbon intensive fossil fuel types

47. As a conservative approach, the specific energy consumption in the absence of the project activity is calculated as the average annual ratio of fuel input per clinker or quicklime production of the most recent three years prior to the start of the project activity, as follows:

$$SEC_{clinker/quicklime,BL} = \frac{\frac{HG_x}{P_{clinker/quicklime,x}} + \frac{HG_{x-1}}{P_{clinker/quicklime,x-1}} + \frac{HG_{x-2}}{P_{clinker/quicklime,x-2}}}{3} \quad \text{Equation (7)}$$

with

$$HG_x = \sum_i FC_{i,x} \times NCV_i \quad \text{Equation (8)}$$

Where:

$SEC_{clinker/quicklime,BL}$	=	Specific energy consumption of the project plant in the absence of the project activity (GJ/t clinker or GJ/t quicklime)
HG_x	=	Heat generated from fuel combustion in the project plant in the historical year x (GJ)
$FC_{i,x}$	=	Quantity of fossil fuel type i used in the project plant in year x (t)
NCV_i	=	Net calorific value of the fossil fuel type i (GJ/t)
$P_{clinker/quicklime,x}$	=	Production of clinker or quicklime in year x (t)
x	=	Year prior to the start of the project activity
i	=	Fossil fuel types used in the project plant in the last three years prior to the start of the project activity

5.4.2. Step 2: Calculate baseline emissions from the fossil fuels displaced by the alternative or less carbon intensive fuel(s)

48. Baseline emissions from displacement of fossil fuels are calculated as follows:

$$BE_{FF,y} = \left[\sum_k (FC_{PJ,k,y} \times NCV_{k,y}) - FP_y \right] \times EF_{CO_2,BL,y} \quad \text{Equation (9)}$$

Where:

$BE_{FF,y}$	=	Baseline emission from fossil fuels displaced by alternative fuels or less carbon intensive fossil fuels in year y (t CO ₂)
$FC_{PJ,k,y}$	=	Quantity of alternative fuel or less carbon intensive fossil fuel type k used in the project plant in year y (t)
$NCV_{k,y}$	=	Net calorific value of the alternative or less carbon intensive fuel type k in year y (GJ/t)
FP_y	=	Fuel penalty in year y (GJ)
$EF_{CO_2,BL,y}$	=	Carbon dioxide emissions factor for the fossil fuels displaced by the use of alternative fuels or less carbon intensive fossil fuels in the project plant in year y (t CO ₂ /GJ)
k	=	Alternative fuel types and less carbon intensive fossil fuel types used in the project plant in year y

49. The baseline emission factor ($EF_{CO_2,BL,y}$) is estimated as the lowest of the following CO₂ emission factors:

- (a) The weighted average CO₂ emission factor for the fossil fuel(s) consumed during the most recent three years before the start of the project activity, calculated as follows:

$$EF_{CO_2,BL,y} = \frac{\sum_i (FC_{i,x-2} + FC_{i,x-1} + FC_{i,x}) \times NCV_i \times EF_{CO_2,FF,i}}{\sum_i (FC_{i,x-2} + FC_{i,x-1} + FC_{i,x}) \times NCV_i} \quad \text{Equation (10)}$$

Where:

- $EF_{CO_2,BL,y}$ = Carbon dioxide emissions factor for the fossil fuels displaced by the use of alternative fuels or less carbon intensive fossil fuels in the project plant in year y (t CO₂/GJ)
- $FC_{i,x}$ = Quantity of fossil fuel type i used in the project plant in year x (t)
- NCV_i = Net calorific value of the fossil fuel type i (GJ/t)
- $EF_{CO_2,FF,i}$ = CO₂ emission factor for fossil fuel type i (t CO₂/GJ)
- x = Year prior to the start of the project activity
- i = Fossil fuel types used in the project plant in the last three years prior to the start of the project activity

- (b) The weighted average annual CO₂ emission factor of the fossil fuel(s) that are not less carbon intensive fossil fuels and that are used in the project plant in year y , calculated as follows:

$$EF_{CO_2,BL,y} = \frac{\sum_i FC_{PJ,i,y} \times NCV_{i,y} \times EF_{CO_2,FF,i,y}}{\sum_i FC_{PJ,i,y} \times NCV_{i,y}} \quad \text{Equation (11)}$$

Where:

- $EF_{CO_2,BL,y}$ = Carbon dioxide emissions factor for the fossil fuels displaced by the use of alternative fuels or less carbon intensive fossil fuels in the project plant in year y (t CO₂/GJ)
- $FC_{PJ,i,y}$ = Quantity of fossil fuel type i fired in the project plant in year y (t)
- $NCV_{i,y}$ = Net calorific value of the fossil fuel type i in year y (GJ/t)
- $EF_{CO_2,FF,i,y}$ = Carbon dioxide emission factor for fossil fuel type i in year y (t CO₂/GJ)
- i = Fossil fuel types used in the project plant in year y that are not less carbon intensive fossil fuel types

- (c) If F3 has been determined as the most likely baseline scenario: the weighted average annual CO₂ emission factor for the fossil fuel(s) that would have been consumed according to fuel mix determined in the “Procedure for the selection of the most plausible baseline scenario and demonstration of additionality” above, as follows:

$$EF_{CO2,BL,y} = \frac{\sum_i FC_{BL,F3,i,y} \times NCV_{i,y} \times EF_{CO2,i,y}}{\sum_i FC_{BL,F3,i,y} \times NCV_{i,y}} \quad \text{Equation (12)}$$

Where:

- $EF_{CO2,BL,y}$ = Carbon dioxide emissions factor for the fossil fuels displaced by the use of alternative fuels or less carbon intensive fossil fuels in the project plant in year y (t CO₂/GJ)
- $FC_{BL,F3,i,y}$ = Quantity of fossil fuel type i that would in the absence of the project activity be used in the project plant according to the selected baseline scenario F3 in year y (t)
- $NCV_{i,y}$ = Net calorific value of the fossil fuel type i in year y (GJ/t)
- $EF_{CO2,i,y}$ = Carbon dioxide emission factor for fossil fuel type i in year y (t CO₂/GJ)
- i = Fossil fuel types that are not less carbon intensive fossil fuel types and that would in the absence of the project activity be used in the project plant according to the selected baseline scenario F3 in year y

5.4.3. Step 3: Calculate baseline emissions from decay, dumping or burning of biomass residues

50. The calculation of baseline methane emissions from biomass residues dumped, left to decay or burnt in an uncontrolled manner without utilizing them for energy purposes depends on the applicable baseline scenario (B1, B2 or B3). Baseline emissions from decay, dumping or burning of biomass residues are calculated as follows:

$$BE_{CH4,biomass,y} = BE_{CH4,B1/B3,y} + BE_{CH4,B2,y} \quad \text{Equation (13)}$$

Where:

- $BE_{CH4,biomass,y}$ = Baseline methane emissions avoided during the year y from preventing disposal or uncontrolled burning of biomass residues (t CO₂e)
- $BE_{CH4,B1/B3,y}$ = Baseline methane emissions avoided during the year y from aerobic decay and/or uncontrolled burning of biomass residues (t CO₂e)
- $BE_{CH4,B2,y}$ = Baseline methane emissions avoided during the year y from anaerobic decay of biomass residues at a solid waste disposal site (t CO₂e)

5.4.3.1. Uncontrolled burning or aerobic decay of the biomass residues (cases B1 and B3)

51. If the most likely baseline scenario for the use of a biomass residue type k , used as alternative fuel in the project plant, is that the biomass residue would be dumped or left to decay under mainly aerobic conditions (B1) or burnt in an uncontrolled manner without

utilizing them for energy purposes (B3), baseline emissions are calculated assuming, for both scenarios viz., natural decay and uncontrolled burning, that the biomass residues would be burnt in an uncontrolled manner.

52. Baseline emissions avoided from aerobic decay and/or uncontrolled burning of biomass residues are calculated as follows:

$$BE_{CH_4,B1/B3,y} = GWP_{CH_4} \times \sum_k FC_{PJ,k,y} \times NCV_{k,y} \times EF_{burning,CH_4,k,y} \quad \text{Equation (14)}$$

Where:

$BE_{CH_4,B1/B3,y}$	=	Baseline methane emissions avoided during the year y from aerobic decay and/or uncontrolled burning of biomass residues (t CO ₂ e)
GWP_{CH_4}	=	Global Warming Potential of methane valid for the commitment period (t CO ₂ e/t CH ₄)
$FC_{PJ,k,y}$	=	Quantity of alternative fuel or less carbon intensive fossil fuel type k used in the project plant in year y (t)
$NCV_{k,y}$	=	Net calorific value of the alternative or less carbon intensive fuel type k in year y (GJ/t)
$EF_{burning,CH_4,k,y}$	=	CH ₄ emission factor for uncontrolled burning of the biomass residue type k during the year y (t CH ₄ /GJ)
k	=	Types of biomass residues used as alternative fuel in the project plant in year y for which the identified baseline scenario is B1 or B3

53. To determine the CH₄ emission factor, project participants may undertake measurements or use referenced default values. In the absence of more accurate information, it is recommended to use 0.0027 t CH₄ per tonne of biomass as default value for the product of NCV_k and $EF_{burning,CH_4,k,y}$ ¹.
54. The uncertainty of the CH₄ emission factor is in many cases relatively high. In order to reflect this and for the purpose of providing conservative estimates of emission reductions, a conservativeness factor must be applied to the CH₄ emission factor. The level of the conservativeness factor depends on the uncertainty range of the estimate for the CH₄ emission factor. The appropriate conservativeness factor from Table 3 below shall be chosen and multiplied with the estimate for the CH₄ emission factor. For example, if the default CH₄ emission factor of 0.0027 t CH₄/t biomass is used, the uncertainty can be deemed to be greater than 100% per cent, resulting in a conservativeness factor of 0.73. Thus, in this case, an emission factor of 0.001971 t CH₄/t biomass should be used.

¹ 2006 IPCC Guidelines, Volume 4, Table 2.5, default value for agricultural residues.

Table 3. Conservativeness factors

Estimated uncertainty range (%)	Assigned uncertainty band (%)	Conservativeness factor where lower values are more conservative
Less than or equal to 10	7	0.98
Greater than 10 and less than or equal to 30	20	0.94
Greater than 30 and less than or equal to 50	40	0.89
Greater than 50 and less than or equal to 100	75	0.82
Greater than 100	150	0.73

5.4.3.2. Anaerobic decay of the biomass residues (case B2)

55. If the most likely baseline scenario for the use of a biomass residue type k , used as alternative fuel in the project plant, is that the biomass residue would decay under clearly anaerobic conditions (case B2), project participants shall calculate baseline emissions using the latest approved version of the methodological tool “Emissions from solid waste disposal sites”. The variable $BE_{CH_4,SWDS,y}$ calculated by the tool then corresponds to $BE_{CH_4,B2,y}$ in this methodology. Use as waste quantities prevented from disposal ($W_{j,x}$) in the tool, those quantities of biomass residues ($BF_{PJ,k,y}$) for which B2 has been identified as the most plausible baseline scenario.

5.5. Leakage

56. For this type of project activity, leakage ($LE_{FF,upstream,y}$) has to be considered.
57. In case of project activities using (a) less carbon intensive fossil fuel(s), leakage may result from fuel extraction, processing, liquefaction, transportation, re-gasification and distribution of fossil fuels outside of the project boundary. This includes mainly fugitive CH_4 emissions and CO_2 emissions from associated fuel combustion and flaring.
58. Upstream leakage emission from fossil fuel use may result from fuel extraction, processing, liquefaction, transportation, re-gasification and distribution of fossil fuels outside of the project boundary. This shall be determined using the latest version of the methodological tool “Upstream leakage emissions associated with fossil fuel use”.
59. Where total net leakage effects from upstream emissions are negative ($LE_{FF,upstream,y} < 0$), project participants should assume $LE_{FF,upstream,y} = 0$.

5.6. Emission reductions

60. Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y \quad \text{Equation (15)}$$

Where:

$$\begin{aligned} ER_y &= \text{Emission reductions during the year } y \text{ (t CO}_2\text{/yr)} \\ BE_y &= \text{Baseline emissions during the year } y \text{ (t CO}_2\text{e/yr)} \\ PE_y &= \text{Project emissions during the year } y \text{ (t CO}_2\text{e/yr)} \end{aligned}$$

LE_y = Leakage emissions during the year y (t CO₂e/yr)

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

61. At the renewal of the crediting period, project participants should evaluate whether the project activity continues not to be the baseline scenario, i.e. whether it would have been implemented in the absence of the project activity. The procedure outlined under baseline scenario selection and demonstration of additionality above should be used for that purpose. Furthermore, all relevant data contained under “Data and parameters not monitored” should be updated.

5.8. Data and parameters not monitored

62. As applicable, all the provisions regarding data and parameters not monitored as contained in the tools referred to in this methodology shall be followed.

Data / Parameter table 1.

Data / Parameter:	FC_{i,x}, FC_{i,x-1} and FC_{i,x-2}
Data unit:	Mass or volume units
Description:	Quantity of fossil fuel of type i used in the project plant in year x , $x-1$ and $x-2$ where x is the year prior to the start of the project activity and i are the fossil fuel types used in the project plant in the last three years prior to the start of the project activity
Source of data:	Three years data from fuel consumption data logs at the project site
Measurement procedures (if any):	Use mass or volume meters. The consistency of metered fuel consumption quantities should be cross-checked by an annual energy balance that is based on purchased quantities and stock changes. Where the purchased fuel invoices can be identified specifically for the CDM project, the metered fuel consumption quantities should also be cross-checked with available purchase invoices from the financial records
Any comment:	-

Data / Parameter table 2.

Data / Parameter:	FC_{BL,F3,i,y}
Data unit:	Mass or volume unit
Description:	Quantity of fossil fuel type i that would in the absence of the project activity be used in the project plant according to the selected baseline scenario F3 in year y
Source of data:	Baseline scenario determination
Measurement procedures (if any):	-
Any comment:	Only applicable if F3 has been determined as the most likely baseline scenario

Data / Parameter table 3.

Data / Parameter:	$P_{\text{clinker/quicklime},x}$, $P_{\text{clinker/quicklime},x-1}$ and $P_{\text{clinker/quicklime},x-2}$
Data unit:	t
Description:	Production of clinker or quicklime in year x , $x-1$ and $x-2$ where x is the year prior to the start of the project activity
Source of data:	Three years data from production data logs at the project site
Measurement procedures (if any):	Use appropriate mass meters
Any comment:	-

Data / Parameter table 4.

Data / Parameter:	NCV_i										
Data unit:	GJ/mass or volume units										
Description:	Net calorific value of the fossil fuel type i where i are the fossil fuel types used in the project plant in the last three years prior to the start of the project activity										
Source of data:	<p>The following data sources may be used if the relevant conditions apply:</p> <table border="1"> <thead> <tr> <th>Data source</th><th>Conditions for using the data source</th></tr> </thead> <tbody> <tr> <td>(a) Values provided by the fuel supplier in invoices</td><td>This is the preferred source</td></tr> <tr> <td>(b) Measurements by the project participants</td><td>If (a) is not available</td></tr> <tr> <td>(c) Regional or national default values</td><td>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)</td></tr> <tr> <td>(d) IPCC default values at the lower limit of the uncertainty at a 95 per cent 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 (a) is not available</td></tr> </tbody> </table>	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 lower limit of the uncertainty at a 95 per cent 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
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 lower limit of the uncertainty at a 95 per cent 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										

Any comment:	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
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Data / Parameter table 5.

Data / Parameter:	EF_{CO₂,FF,i}										
Data unit:	t CO ₂ /GJ										
Description:	Weighted average CO ₂ emission factor for fossil fuel type / where / are the fossil fuel types used in the project plant in the last three years prior to the start of the project activity										
Source of data:	<p>The following data sources may be used:</p> <table border="1"> <thead> <tr> <th>Data source</th><th>Conditions for using the data source</th></tr> </thead> <tbody> <tr> <td>(a) Values provided by the fuel supplier in invoices</td><td>This is the preferred source</td></tr> <tr> <td>(b) Measurements by the project participants</td><td>If (a) is not available</td></tr> <tr> <td>(c) Regional or national default values</td><td>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)</td></tr> <tr> <td>(d) IPCC default values at the lower limit of the uncertainty at a 95 per cent confidence interval 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 (a) is not available</td></tr> </tbody> </table>	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 lower limit of the uncertainty at a 95 per cent 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
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 lower limit of the uncertainty at a 95 per cent 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										
Any comment:	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										

6. Monitoring methodology

63. The monitoring procedures are described in the tables below. As applicable, all the monitoring provisions contained in the tools referred to in this methodology shall be followed.

64. 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 practices.
65. 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 differently in the comments in the tables below.

6.1. Data and parameters monitored

Data / Parameter table 6.

Data / Parameter:	$FC_{PJ,k,y}$, $FC_{PJ,i,y}$ and $FC_{PJ,NG,y}$
Data unit:	Mass or volume units
Description:	Quantity of alternative fuel or less carbon intensive fossil fuel of type k ($FC_{PJ,k,y}$), fossil fuel of type i ($FC_{PJ,i,y}$), including any natural gas ($FC_{PJ,NG,y}$), used in the project plant in year y
Source of data:	Measurements
Measurement procedures (if any):	Use mass or volume meters. The consistency of metered fuel consumption quantities should be cross-checked by an annual energy balance that is based on purchased quantities and stock changes. Where the purchased fuel invoices can be identified specifically for the CDM project, the metered fuel consumption quantities should also be cross-checked with available purchase invoices from the financial records
Monitoring frequency:	Recorded continuously and aggregated at least annually
QA/QC procedures:	According to ISO 9000 or similar quality systems
Any comment:	-

Data / Parameter table 7.

Data / Parameter:	$EF_{CO_2,k,y}$ and $EF_{CO_2,FF,i,y}$
Data unit:	t CO ₂ /GJ
Description:	Weighted average CO ₂ emission factor for alternative or less carbon intensive fuels of type k ($EF_{CO_2,k,y}$) and for fossil fuel of type i ($EF_{CO_2,FF,i}$) in year y

Source of data:	<p>For fossil fuels and for wastes originating from fossil sources for which W3 has been identified as the most likely baseline scenario, the following data sources should be used:</p> <table border="1" data-bbox="632 465 1393 1171"> <thead> <tr> <th>Data source</th><th>Conditions for using the data source</th></tr> </thead> <tbody> <tr> <td>(a) Values provided by the fuel supplier in invoices</td><td>This is the preferred source</td></tr> <tr> <td>(b) Measurements by the project participants</td><td>If (a) is not available</td></tr> <tr> <td>(c) Regional or national default values</td><td>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)</td></tr> <tr> <td>(d) IPCC default values at the upper/lower limit² of the uncertainty at a 95 per cent confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories</td><td>If (a) is not available</td></tr> </tbody> </table> <p>$EF_{CO_2,k,y}$ is zero for the following alternative fuels:</p> <ul style="list-style-type: none"> • Wastes originating from fossil sources where W1 has been identified as the most plausible baseline scenario; • Biomass residues; • Renewable biomass³ 	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/lower limit ² of the uncertainty at a 95 per cent confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories	If (a) is not available
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/lower limit ² of the uncertainty at a 95 per cent confidence interval as provided in table 1.4 of Chapter1 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:	<p>For (a) and (b): the CO₂ emission factor should be obtained for each fuel delivery, from which weighted average annual values should be calculated.</p> <p>For (c): review appropriateness of the values annually.</p> <p>For (d): any future revision of the IPCC Guidelines should be taken into account</p>										

² To be conservative, choose the upper limit where project emissions are calculated and the lower limit where baseline emissions are calculated.

³ In case of waste originating from fossil sources and baseline scenario W1, the waste would also be combusted in the absence of the project activity, without displacing any fossil fuels. In case of biomass residues it is assumed that CO₂ emissions from surplus biomass residues do not lead to changes of carbon pools in the LULUCF sector and that the biomass residues are available in surplus. If this condition is not met any more during the crediting period, CO₂ emissions are taken into account by applying a leakage penalty (see leakage section). In case of renewable biomass, emissions from the cultivation of the biomass are estimated separately ($PE_{BC,y}$).

QA/QC procedures:	According to ISO 9000 or similar quality systems
Any comment:	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

Data / Parameter table 8.

Data / Parameter:	NCV _{k,y} , NCV _{i,y} and NCV _{NG,y}											
Data unit:	GJ/mass or volume units											
Description:	Weighted average net calorific value of the alternative or less carbon intensive fuel types <i>k</i> (NCV _{k,y}), fossil fuel types <i>i</i> (NCV _{i,y}), including natural gas (NCV _{NG,y}), in year <i>y</i>											
Source of data:	<div>The following data sources may be used if the relevant conditions apply:</div> <table><tr><th>Data source</th><th>Conditions for using the data source</th></tr><tr><td>(a) Values provided by the fuel supplier in invoices</td><td>This is the preferred source</td></tr><tr><td>(b) Measurements by the project participants</td><td>If (a) is not available</td></tr><tr><td>(c) Regional or national default values</td><td>If (a) is not available. These sources can only be used for liquid fossil fuels and should be based on well documented, reliable sources (such as national energy balances)</td></tr><tr><td>(d) IPCC default values at the upper limit of the uncertainty at a 95 per cent 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 (a) is not available. This source may only be used for fossil fuels</td></tr></table>		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 fossil 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 per cent 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. This source may only be used for fossil fuels
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 fossil 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 per cent 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. This source may only be used for fossil fuels											
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:	-

Data / Parameter table 9.

Data / Parameter:	PE_{FC,y}
Data unit:	t CO ₂
Description:	Project emissions $PE_{FC,y}$ from additional fossil fuel combustion as a result of the project activity in year y
Source of data:	As per the "Tool to calculate project or leakage CO ₂ emissions from fossil fuel combustion"
Measurement procedures (if any):	As per the "Tool to calculate project or leakage CO ₂ emissions from fossil fuel combustion"
Monitoring frequency:	As per the "Tool to calculate project or leakage CO ₂ emissions from fossil fuel combustion"
QA/QC procedures:	As per the "Tool to calculate project or leakage CO ₂ emissions from fossil fuel combustion"
Any comment:	-

Data / Parameter table 10.

Data / Parameter:	PE_{EC,y}
Data unit:	t CO ₂
Description:	Project emissions from additional electricity consumption as a result of the project activity in year y
Source of data:	As per the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption"
Measurement procedures (if any):	As per the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption"
Monitoring frequency:	As per the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption"
QA/QC procedures:	As per the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption"
Any comment:	-

Data / Parameter table 11.

Data / Parameter:	BE_{CH4,B2,y}
Data unit:	t CO ₂
Description:	Baseline methane emissions avoided during the year y from preventing disposal of biomass residues at a solid waste disposal site during the period from the start of the project activity to the end of the year y

Source of data:	As per the methodological tool “Emissions from solid waste disposal sites”
Measurement procedures (if any):	As per the methodological tool “Emissions from solid waste disposal sites”
Monitoring frequency:	As per the methodological tool “Emissions from solid waste disposal sites”
QA/QC procedures:	As per the methodological tool “Emissions from solid waste disposal sites”
Any comment:	-

Data / Parameter table 12.

Data / Parameter:	P_{clinker/quicklime,y}
Data unit:	t
Description:	Production of clinker or quicklime in year y
Source of data:	Production data logs at the project site
Measurement procedures (if any):	Weighing feeders
Monitoring frequency:	Recorded/calculated and reported monthly
QA/QC procedures:	According to ISO 9000 or similar quality systems
Any comment:	-

Data / Parameter table 13.

Data / Parameter:	EF_{CO₂,BL,y}
Data unit:	t CO ₂ /GJ
Description:	Carbon dioxide emissions factor for the fossil fuels displaced by the use of alternative fuels or less carbon intensive fossil fuels in the project plant
Source of data:	Calculated as follows as the lowest of the following CO ₂ emission factors: (a) The weighted average annual CO ₂ emission factor for the fossil fuel(s) consumed and monitored ex ante during the most recent three years before the start of the project activity; (b) The weighted average annual CO ₂ emission factor of the fossil fuel(s) consumed in the project plant in year y that are not less carbon intensive fossil fuels; (c) If F2 has been determined as the most likely baseline scenario: the weighted average annual CO ₂ emission factor for the fossil fuel(s) that would have been consumed according to fuel mix determined in the “Procedure for the selection of the most plausible baseline scenario and demonstration of additionality” above
Measurement procedures (if any):	-
Monitoring frequency:	Continuously, aggregated at least annually
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 14.

Data / Parameter:	$FC_{PJ,i,k,y}$
Data unit:	t
Description:	Quantity of fossil fuel type i fired in the project plant while project alternative or less carbon intensive fuel or biomass was used in year y
Source of data:	Measurements crossed with operation logs
Measurement procedures (if any):	Use mass or volume meters, crossed with operation logs showing when alternative or less carbon intensive fuel was used. The consistency of metered fuel consumption quantities should be cross-checked by an annual energy balance that is based on purchased quantities and stock changes. Where the purchased fuel invoices can be identified specifically for the CDM project, the metered fuel consumption quantities should also be cross-checked with available purchase invoices from the financial records
Monitoring frequency:	Recorded continuously and aggregated at least annually
QA/QC procedures:	-
Any comment:	As alternative to monitoring, the value of this parameter may be conservatively set to $FC_{PJ,i,y}$, assuming alternative or less carbon intensive fuel was used throughout the monitored period

Data / Parameter table 15.

Data / Parameter:	$EF_{\text{burning,CH}_4,k,y}$
Data unit:	t CH ₄ /GJ
Description:	CH ₄ emission factor for uncontrolled burning of the biomass residue type k during the year y
Source of data:	Undertake measurements or use referenced and reliable default values (e.g. IPCC)
Measurement procedures (if any):	-
Monitoring frequency:	Review of default values: annually. Measurements: once at the start of the project activity
QA/QC procedures:	Cross-check the results of any measurements with IPCC default values. If there is a significant difference, check the measurement method and increase the number of measurements in order to verify the results
Any comment:	Monitoring of this parameter for project emissions is only required if CH ₄ emissions from biomass combustion are included in the project boundary. Note that a conservative factor shall be applied, as specified in the baseline methodology

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Document information

<i>Version</i>	<i>Date</i>	<i>Description</i>
08.0	8 November 2013	<p>EB 76, Annex 8</p> <p>Revision to:</p> <ul style="list-style-type: none"> Remove leakage emissions related to the use of biomass residues; Streamline the methodology, referring to approved methodological tools; Introduce improvements to the concept of fuel penalty; Change the title from "Emissions reduction through partial substitution of fossil fuels with alternative fuels or less carbon intensive fuels in cement or quicklime manufacture" to "Partial substitution of fossil fuels in cement or quicklime manufacture".
07.4.1	2 March 2012	<p>EB 66, Annex 45</p> <p>Editorial amendment to change the title of the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site" to "Emissions from solid waste disposal sites".</p>
07.4.0	15 April 2011	<p>EB 60, Annex 3</p> <p>The amendment expands the applicability of the methodology to quicklime production.</p>
07.3	16 October 2009	<p>EB 50, Annex 9</p> <p>Editorial revision to correct the mistake in the applicability condition by adding "less" in front of carbon intensive fuel(s); and to correct parameters in equation 13, 14 and 15.</p>
07.2	02 August 2008	<p>EB 41, Paragraph 26(g)</p> <p>The title of the "Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site" changes to "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site".</p>
07.1	16 May 2008	<p>EB 39, Paragraph 22</p> <p>"Tool to calculate baseline, project and/or leakage emissions from electricity consumption" replaces the withdrawn "Tool to calculate project emissions from electricity consumption".</p>
07.0	30 November 2007	<p>EB 36, Annex 12</p> <p>Methodology is applicable to fuel switch in any part of the clinker production facility where combustion takes place by clearly defining the clinker production area.</p>
06.0	19 October 2007	<p>EB 35, Annex 4</p> <p>Expand the applicability to project activities that use biomass produced from dedicated plantations on land that was previously used for growing crops.</p>

<i>Version</i>	<i>Date</i>	<i>Description</i>
05.0	27 July 2007	<p>EB 33, Annex 7</p> <ul style="list-style-type: none"> • Expand the scope of the approved methodology; • Broadening of the applicability to project activities that use less carbon intensive fossil fuels in cement production than that used in the baseline; • Broadening of the applicability to project activities that use renewable biomass from dedicated plantations as an alternative fuel; • Improvement in the clarity and consistency, in particular with respect to the monitoring of the applicability conditions, consistent with ACM0006, AM0036 and other approved methodologies; • The use of approved tools to make it consistent with recently approved methodologies; • Neglecting very minor emission sources; • Modifying the equation for baseline methane emissions from avoided dumping of biomass residue to reflect the situation where only a part of the biomass residue available is in surplus and, therefore, would result in dumping leading to methane emissions.
04.0	21 July 2006	<p>EB 25, Annex 7</p> <ul style="list-style-type: none"> • Biomass residue types, where the preparation of biomass residue for use in the project plant may be associated with significant GHG emissions, are not eligible in the methodology; • Exclude from the methodology biomass residues, gases, liquids, or solids recovered from the decomposition of non-fossilized and biodegradable organic material.
03.0	12 May 2006	<p>EB 24, Annex 8</p> <p>Simplification of the procedure to estimate the moisture penalty for using alternative fuels in project scenario.</p>
02.0	24 February 2006	<p>EB 23, Annex 7</p> <ul style="list-style-type: none"> • Allow the use of FOD model for estimating the methane avoided from biomass which in absence of project would have been disposed land; • Clarify that the methodology is not applicable to projects where the biomass used in project activity is produced on land owned by the project proponents.

ACM0003

Large-scale Consolidated Methodology: Partial substitution of fossil fuels in cement or quicklime manufacture

Version 08.0

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01.0

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