Approved baseline and monitoring methodology AM0042

"Grid-connected electricity generation using biomass from newly developed dedicated plantations"

I. SOURCE AND APPLICABILITY

Source

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

- NM0133-rev "Grid-connected electricity generation using biomass from newly developed dedicated plantations," prepared by Mitsubishi UFJ Securities.

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

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

Selected approach from paragraph 48 of the CDM modalities and procedures

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

Definitions

The following definitions apply for this methodology:

- **Biomass** is 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.

- **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 waste that contains fossilized and/or non-biodegradable material (small fractions of inert inorganic material like soil or sands may be included).

Note that, in case of solid biomass, for all the calculations in this methodology, the quantity of biomass refers to the dry weight of the biomass.

Applicability

The methodology is applicable under the following conditions:

- The project activity involves the installation of a new grid-connected power plant that is mainly fired with renewable biomass from a dedicated plantation (fossil fuels or other types of biomass may be co-fired);
- Prior to the implementation of the project activity, no power was generated at the project site (i.e. the project plant does not substitute or amend any existing power generation at the project site);
- The geographic and system boundaries for the relevant electricity grid can be clearly identified and information on the characteristics of the grid is available;
- Biomass used by the project facility is not stored for more than one year;
- The dedicated plantation must be newly established as part of the project activity for the purpose of supplying biomass exclusively to the project;
- The biomass from the plantation 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;
- The site preparation does not cause longer-term net emissions from soil carbon. Carbon stocks in soil organic matter, litter and deadwood can be expected to decrease more due to soil erosion and human intervention or increase less in the absence of the project activity;
- The land area of the dedicated plantation will be planted by direct planting and/or seeding;
- After harvest, regeneration will occur either by direct planting or natural sprouting;
- Grazing will not occur within the plantation;
- No irrigation is undertaken for the biomass plantations;
- The land area where the dedicated plantation will be established is, prior to project implementation, severely degraded and in absence of the project activity would have not been used for any other agricultural or forestry activity. The land degradation can be demonstrated using one or more of the following indicators:

  (a) Vegetation degradation, e.g.

  - Crown cover of pre-existing trees has decreased in the recent past for reasons other than sustainable harvesting activities;

  (b) Soil degradation, e.g.

  - Soil erosion has increased in the recent past;
  - Soil organic matter content has decreased in the recent past.

(c) Anthropogenic influences, e.g.

- There is a recent history of loss of soil and vegetation due to anthropogenic actions; and
- Demonstration that there exist anthropogenic actions/activities that prevent possible occurrence of natural regeneration.

Furthermore, this methodology is only applicable if the most plausible baseline scenarios are:

- For power generation, electricity generated by the project would have been generated by existing and/or new power plants in the grid; and
- For the use of biomass residues, If biomass residues are co-fired in the project plant case B1, B2, B3, B4 and/or B5. If case B5 is the most plausible scenario, the methodology is only applicable if:
  (a) The plant where the biomass residues would be used as feedstock in the absence of the project activity can be clearly identified throughout the crediting periods; and
  (b) The fuels used as substitutes for the biomass residues at the plant, referred in (a) above, can be monitored by project participants.

II. BASELINE METHODOLOGY

Project boundary

The physical delineation of the project boundary is the physical extent of the project site, where electricity generating activity occurs and the geographic boundaries of the dedicated plantation. In addition, the project boundary is extended to include emissions from the biomass transportation to the power generation site. The project boundary also includes the power plants connected physically to the electricity system that the CDM project power plant is connected to. Please refer to “Tool to calculate emission factor for an electricity system” for further details of the project boundary with respect to the electricity grid.

Project emissions include:

- CO_2 emissions from co-firing fuels in the project plant other than biomass from the dedicated plantation or biomass residues;
- CO_2 emissions from combustion of fossil fuels at the site of the project plant, other than fossil fuels co-fired in the project plant, that are attributable to the project activity;
- CO_2 emissions from the consumption of electricity at the site of the project plant that is attributable to the project activity (e.g. for mechanical processing of the biomass);
- CO_2 emissions from off-site transportation of biomass used to fuel the project plant;
- CH_4 emissions from combustion of biomass in the power plant.

If the complete land area of the dedicated plantation is included in the project boundary of one or several registered A/R CDM project activities, no further emission sources need to be included in the project boundary.[1] Otherwise, the following project emission sources related to the production of the biomass shall also be considered:

- CO_2 emissions from fossil fuel consumption during agricultural operations;
- GHG emissions from the production of fertilizer that is used at the plantation;
- N_2O emissions from the application of fertilizer at the plantation;
- CH_4 and N_2O emissions from the field burning of biomass.

For the purpose of determining the baseline emissions, project participants shall include the following emission sources:

- CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity.

[1] The Board, at its 25th meeting, agreed that the emissions associated with A/R activity should be accounted for in the A/R CDM project activity. In general all project activities using biomass for energy should account for emissions associated with production of biomass. However, in the case that it can be demonstrated that for a project activity using biomass for energy, which uses biomass originating from a registered A/R project activity (i.e. through contractual agreement for procurement of biomass) it need not account for emissions related to biomass production.

Table 1: Summary of gases and sources included in the project boundary, and justification/explanation where gases and sources are not included

	Source	Gas	Included?	Justification / Explanation
Baseline	Grid electricity generation	CO_2	Yes	
		CH_4	No	Excluded for simplification. This is conservative
		N_2O	No	
Project Activity	On-site fuel consumption	CO_2	Yes	
		CH_4	No	Excluded for simplification. This emission source is assumed to be small
		N_2O	No	Excluded for simplification. This emission source is assumed to be small
	Combustion of biomass for electricity (and heat) generation	CO_2	No	It is assumed that CO_2 emissions from surplus biomass do not lead to changes in carbon pools
		CH_4	Yes	
		N_2O	No	Excluded for simplification. This emission source is assumed to be small
	Off-site fossil fuel combustion for transportation of biomass to the project plant	CO_2	Yes	
		CH_4	No	Excluded for simplification. This emission source is assumed to be small
		N_2O	No	Excluded for simplification. This emission source is assumed to be small
	Electricity consumption at the project site	CO_2	Yes	
		CH_4	No	Excluded for simplification. This emission source is assumed to be small
		N_2O	No	Excluded for simplification. This emission source is assumed to be small
	Fuel consumption in agriculture operations	CO_2	Yes[2]	
		CH_4	No	Excluded for simplification. This emission source is assumed to be small [6]
		N_2O	No	Excluded for simplification. This emission source is assumed to be small [6]
Project Activity	Fertilizer production	CO_2	Yes[2]	
		CH_4	Yes[2]	
		N_2O	Yes[2]	
	Fertilizer application	N_2O	Yes[2]	
	Field burning of biomass	CO_2	No	CO_2 emissions from biomass burning are assumed not lead to changes in carbon pools
		CH_4	Yes[2]	
		N_2O	Yes[2]	

[2] This emission source does not need to be included in the project boundary, if the complete land area of the dedicated plantation is included in the project boundary of one or several registered CDM A/R project activities.

Procedure for the selection of the most plausible baseline scenario

The baseline scenario is determined through the following steps:

(1) Identification of realistic and credible alternative scenarios that are consistent with applicable laws and regulations;

(2) Identify barriers and assess which alternative scenarios are not prevented by these barriers;

(3) If there is still more than one alternative scenario remaining, project participants may either identify the alternative scenario with the lowest emissions (i.e. the most conservative) as the baseline scenario or may conduct an investment analysis.

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

Project participants are to identify all realistic and credible alternatives to the project activity that are consistent with current laws and regulations. Alternatives include, but are not limited to, the following scenarios:

- The project carried out without the CDM;
- Other comparable projects that are fuelled by renewable sources;
- Other comparable projects that are fuelled by fossil fuels;
- The generation of power in existing and / or new grid-connected power plants.

The alternatives to the project activity shall be in compliance with all applicable legal and regulatory requirements - taking into account EB decisions with respect to national and/or sectoral policies and regulations in determining a baseline scenario[3] - even if these laws and regulations have objectives other than GHG reductions, e.g. to mitigate local air pollution.

If an alternative does not comply with all applicable legislation and regulations, then show that, based on an examination of current practice in the country or region in which the law or regulation applies, those applicable legal or regulatory requirements are systematically not enforced and that non-compliance with those requirements is widespread in the country. If this cannot be shown, then eliminate the alternative from further consideration.

If the project will co-fire biomass residues, realistic and credible alternatives should be separately determined for what would happen to the biomass residues in the absence of the project activity. The alternatives (including combinations) to be analyzed for use of biomass residues may include, inter alia:

[3] Annex 3 of the 22nd EB meeting report: "Clarifications on the treatment of national and/or sectoral policies and regulations (paragraph 45(e)) of the CDM Modalities and Procedures) in determining a baseline scenario (version 2)".

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
B2: The biomass residues are dumped or left to decay under clearly anaerobic conditions. This applies, for example, to deep landfills with more than 5 meters. This does not apply to biomass residues that are stock-piled[4] or left to decay on fields
B3: The biomass residues are burnt in an uncontrolled manner without utilizing them for energy purposes
B4: The biomass residues are sold to other consumers in the market and the predominant use of the biomass residues in the region/country is for energy purposes (heat and/or power generation)
B5: The biomass residues are used as feedstock in a process (e.g. in the pulp and paper industry)
B6: The biomass residues are used as fertilizer
B7: The proposed project activity not undertaken as a CDM project activity (use of the biomass residues in the project plant)
B8: Any other use of the biomass residues

Where different types or sources of biomass residues are used in the project activity, the most plausible baseline scenario for the use of biomass residues should be determined for each type and source of biomass separately. The respective biomass residue types, quantities and sources should be documented transparently in the draft CDM-PDD.

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

Establish a complete list of barriers that would prevent alternative scenarios to occur in the absence of the CDM, using the guidance in Step 3 of the latest version of the “Tool for the demonstration and assessment of additionality”.

Since the proposed project activity not being registered as a CDM project activity shall be one of the considered alternatives, any barrier that may prevent the project activity to occur shall be included in that list. Show which alternatives are prevented by at least one of the barriers previously identified and eliminate those alternatives from further consideration. All alternatives shall be compared to the same set of barriers.

If there is only one scenario alternative that is not prevented by any barrier, then this scenario alternative is identified as the baseline scenario.

Where more than one credible and plausible alternative remains, project participants shall, as a conservative assumption, use the alternative baseline scenario that results in the lowest baseline emissions as the most likely baseline scenario, or conduct an investment analysis (Step 3).

Step 3. Investments analysis (optional)

Conduct an investment analysis, consistent with the guidance in Step 2 of the latest version of the “Tool for the demonstration and assessment of additionality”. The economically most attractive alternative is deemed as the most plausible baseline scenario.

[4] Further work is undertaken to investigate to which extent and in which cases methane emissions may occur from stock-piling biomass residues. Subject to further insights on this issue, the methodology may be revised.

The above steps should be conducted taking into account relevant national and/or sectoral policies and circumstances. In doing so, the latest CDM EB guidance on the treatment of national and/or sectoral policies and regulations in determining a baseline scenario shall be adhered to.

Additionality

This methodology uses the latest version of the "Tool for demonstration and assessment of additionality" that is available on the UNFCCC web site.

Baseline emissions

Baseline emissions are CO_2 emissions from the displacement of electricity generation in grid-connected fossil fuel fired power plants. Baseline emissions are calculated as follows:

$$BE_y = EG_{PJ,y} \cdot EF_{grid,y} \tag{1}$$

Where:

BE_y = Baseline emissions in year *y* (tCO_2/yr)

$EG_{PJ,y}$ = Net quantity of electricity generated in the project plant in the year *y* (MWh/yr)

$EF_{grid,y}$ = Grid emission factor in year *y*, monitored and calculated according to the latest approved version of the "Tool to calculate the emission factor for an electricity system" (tCO_2/MWh)

Project Emissions

Total project emissions are given as follows:

$$PE_y = PE_{FC,on-site,y} + PE_{EC,y} + PE_{TP,y} + PE_{BF,y} + PE_{FC,PL,y} + PE_{FP,y} + PE_{FA,y} + PE_{BB,y} \tag{2}$$

Where:

PE_y = Project emissions in year *y* (tCO_2/yr)

$PE_{FC,on-site,y}$ = Project emissions in year *y* from co-firing fossil fuels in the project plant and/or from other fossil fuel combustion that occurs at the site of the project plant and that is attributable to the project activity (tCO_2/yr)

$PE_{EC,y}$ = Project emissions from electricity consumption at the site of the project plant that is attributable to the project activity (e.g. for mechanical processing of the biomass) in year *y* (tCO_2/yr)

$PE_{TP,y}$ = Project emissions related to transportation of the biomass from the dedicated project plantation and/or biomass residues to the power plant in year *y* (tCO_2/yr)

$PE_{BF,y}$ = Project emissions from combustion of the renewable biomass from the dedicated project plantation and biomass residues in the project plant in year *y* (tCO_2e/yr)

$PE_{FC,PL,y}$ = Project emissions related to fossil fuel consumption at the plantation during agricultural operations in year *y* (tCO_2/yr)

$PE_{FP,y}$ = Project emissions related to the production of synthetic fertilizer that is used at the dedicated plantation in year *y* (tCO_2e/yr)

$PE_{FA,y}$ = Project emissions related to the application of fertilizers at the plantation in year *y* (tCO_2e/yr)

$PE_{BB,y}$ = Project emissions arising from field burning of biomass at the plantation site (tCO_2e/yr)

a) CO_2 emissions from fuel combustion ($PE_{FC,on\text{-}site,y}$)

This emission source should include CO_2 emissions from all fuel consumption that occurs at the site of the project plant and that is attributable to the project activity. This includes:

- Fossil fuels co-fired in the project plant;
- Biomass co-fired in the project plant other than the biomass from the dedicated plantation or biomass residues;
- Fuel consumption for mechanical preparation or drying of the biomass.

CO_2 emissions from firing biomass from the dedicated plantation and/or biomass residues should not be included. Emissions shall be calculated as follows:

$$PE_{FC,on-site,y} = \sum_i FC_{on-site,i,y} \cdot NCV_i \cdot EF_{CO2,FF,i} \quad (3)$$

Where:

$PE_{FC,on\text{-}site,y}$	=	Project emissions in year *y* from co-firing fossil fuels in the project plant and/or from other fossil fuel combustion that occurs at the site of the project plant and that is attributable to the project activity (tCO_2/yr)
$FC_{on\text{-}site,i,y}$	=	Amount fuel type *i* that is (a) co-fired in the project plant and/or is (b) combusted at the site of the project plant and attributable to the project activity, during the year *y* (mass or volume unit)[5]
NCV_i	=	Net calorific value of fuel type *i* (GJ / mass or volume unit)
$EF_{CO2,FF,i}$	=	CO_2 emission factor of fuel type *i* (tCO_2/GJ)
i	=	Fossil fuels or biomass fuel types other than the biomass from the dedicated plantation or biomass residues

b) CO_2 emissions from on-site electricity consumption ($PE_{EC,y}$)

CO_2 emissions from on-site electricity consumption ($PE_{EC,y}$) are calculated by multiplying the electricity consumption by an appropriate grid emission factor, as follows:

$$PE_{EC,y} = EC_{PJ,y} \cdot EF_{grid,y} \quad (4)$$

Where:

$PE_{EC,y}$	=	Project emissions from electricity consumption at the site of the project plant that is attributable to the project activity (e.g. for mechanical processing of the biomass) in year *y* (tCO_2/yr)
$EC_{PJ,y}$	=	On-site electricity consumption attributable to the project activity during the year *y* (MWh)
$EF_{grid,y}$	=	Grid emission factor in year *y*, monitored and calculated according to the latest approved version of "Tool to calculate the emission factor for an electricity system" (tCO_2/MWh)

[5] Preferably use a mass unit for solid fuels and a volume unit for liquid and gaseous fuels.

c) CO_2 emissions from fossil fuel combustion due to transportation of biomass from the plantation site(s) to the site of the project plant ($PE_{TP,y}$)

This emission source includes CO_2 emissions from the transportation of biomass from the dedicated plantation site(s) and biomass residues from their source of generation to the project plant. Emissions may be calculated either based on information on the number of trips, the return trip distance and CO_2 emission factors of the vehicles (Option 1) or based on data on the actual fuel consumption of vehicles (Option 2).

Where the biomass is obtained from different sources with different distances and/or transported in different types of vehicles, emissions should be calculated separately for the different distances and vehicles types.

<u>Option 1:</u>

Emissions are calculated on the basis of distance and the number of trips (or the average truck load):

$$PE_{TP,y} = N_y \cdot AVD_y \cdot EF_{km,CO2} \qquad \textbf{(5)}$$

or

$$PE_{TP,y} = \frac{\sum_j BF_{PJ,j,y}}{TL_y} \cdot AVD_y \cdot EF_{km,CO2,y} \qquad \textbf{(6)}$$

Where:

$PE_{TP,y}$	=	Project emissions related to transportation of the biomass from the dedicated project plantation and/or biomass residues from their source of generation to the power plant in year *y* (tCO_2/yr)
N_y	=	Number of truck trips during the year *y*
AVD_y	=	Average return trip distance (from and to) between the source of the biomass and the site of the project plant during the year *y* (km),
$EF_{km,CO2,y}$	=	Average CO_2 emission factor for the trucks measured during the year y (tCO_2/km)
$BF_{PJ,j,y}$	=	Quantity of biomass type *j* fired in the project plant in the year *y* (tons of dry matter or liter)[6]
TL_y	=	Average truck load of the trucks used (tons or liter)
j	=	All types of renewable biomass from the dedicated project plantation and types of biomass residues that are fired in the project plant

<u>Option 2:</u>

Emissions are calculated based on the actual quantity of fossil fuels consumed for transportation.

$$PE_{TP,y} = \sum_i FC_{TR,i,y} \cdot NCV_i \cdot EF_{CO2,FF,i} \qquad \textbf{(7)}$$

[6] Use tons of dry matter for solid biomass residues and liter for liquid biomass residues.

Where:

$PE_{CO2,TR,y}$ = CO_2 emissions from off-site transportation of biomass residues to the project site (tCO_2/yr)
$FC_{TR,i,y}$ = Fuel consumption of fuel type *i* used in trucks for transportation of biomass during the year *y* (mass or volume unit)[5]
NCV_i = Net calorific value of fuel type *i* (GJ / mass or volume unit)
$EF_{CO2,FF,i}$ = CO_2 emission factor for fossil fuel type *i* (tCO_2/GJ)

d) CH_4 emissions from combustion of biomass ($PE_{BF,y}$)

CH_4 emissions are associated with the combustion of biomass fired in the project plant. This is calculated as follows:

$$PE_{BF,y} = GWP_{CH4} \cdot \sum_j \left(BF_{PJ,j,y} \cdot NCV_j \cdot EF_{CH4,BF,j}\right) \quad \textbf{(8)}$$

Where:

$PE_{BF,y}$ = Project emissions from combustion of the renewable biomass from the dedicated project plantation and biomass residues in the project plant in year *y* (tCO_2e/yr)
GWP_{CH4} = Global Warming Potential of methane valid for the commitment period (tCO_2e/tCH_4)
$BF_{PJ,j,y}$ = Quantity of biomass type *j* fired in the project plant in the year *y* (tons of dry matter or liter)[6]
NCV_j = Net calorific value of biomass fuel type *j* (GJ/ton of dry matter or GJ/liter)
$EF_{CH4,BF,j}$ = CH_4 emission factor for the combustion of biomass type *j* in the project plant (tCH_4/GJ)
j = All types of renewable biomass from the dedicated project plantation and types of biomass residues that are fired in the project plant

To determine the CH_4 emission factor, project participants may conduct measurements at the plant site or use IPCC default values, as provided in Table 2 below. The uncertainty of the CH_4 emission factor in many cases is 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 CH_4 emission factor. The level of the conservativeness factor depends on the uncertainty range of the CH_4 emission factor estimate . Appropriate conservativeness factors from Table 3 below shall be chosen and shall be multiplied with the estimated CH_4 emission factor.

For example, where the default CH_4 emission factor of 30 kg/TJ from Table 2 below is used, for which the uncertainty is estimated to be 300%, and the conservativeness factor for the uncertainty is 1.37 (from Table 3). Thus, in this case a CH_4 emission factor of (30*1.37=) 41.1 kg/TJ should be used.

Table 2. Default CH_4 emission factors for combustion of biomass residues[7]

	Default emission factor (kg CH_4 / TJ)	Assumed uncertainty
Wood waste	30	300%
Sulphite lyes (Black Liquor)	3	300%
Other solid biomass residues	30	300%
Liquid biomass residues	3	300%

[7] Values are based on the 2006 IPCC Guidelines, Volume 2, Chapter 2, Tables 2.2 to 2.6.

Table 3. Conservativeness factors

Estimated uncertainty range (%)	Assigned uncertainty band (%)	Conservativeness factor where higher values are more conservative
Less than or equal to 10	7	1.02
Greater than 10 and less than or equal to 30	20	1.06
Greater than 30 and less than or equal to 50	40	1.12
Greater than 50 and less than or equal to 100	75	1.21
Greater than 100	150	1.37

e) CO_2 emissions from fossil fuel consumption during agricultural operations ($PE_{FC,PL,y}$)

CO_2 emissions associated with fossil fuel consumption at the plantation are calculated as follows:

$$PE_{FC,PL,y} = \sum_i FC_{PL,i,y} \cdot NCV_i \cdot EF_{CO_2,FF,i} \quad \textbf{(9)}$$

Where:

$PE_{FC,PL,y}$	=	Project emissions related to fossil fuel consumption at the plantation during agricultural operations in year y (tCO_2/yr)
$FC_{PL,i,y}$	=	Amount of fuel type i that is combusted at the dedicated plantation during the year y (mass or volume unit)[5]
NCV_i	=	Net calorific value of fuel type i (GJ / mass or volume unit)
$EF_{CO2,FF,i}$	=	CO_2 emission factor of fuel type i (tCO_2/GJ)
i	=	Fuel types used for combustion at the dedicated plantation

f) Emissions from the production of synthetic fertilizer that is used at the plantation ($PE_{FP,y}$)

The GHG emissions from the production of synthetic fertilizer are estimated for each synthetic fertilizer type *f* by multiplying an emission factor with the monitored quantity of fertilizer applied at the plantation during the year *y*, as follows:

$$PE_{FP,y} = \sum_f \left(EF_{CO2e,FP,f} \cdot F_{SF,f,y} \right) \quad \textbf{(10)}$$

Where:

$PE_{FP,y}$	=	Project emissions related to the production of synthetic fertilizer that is used at the dedicated plantation in year y (tCO_2e/yr)
$EF_{CO2e,FP,f}$	=	Emission factor for GHG emissions associated with the production of fertilizer type *f* (tCO_2e/kg fertilizer)
$F_{SF,f,y}$	=	Amount of synthetic fertilizer of type *f* applied in year *y* (kg fertilizer/yr)
f	=	Types of synthetic fertilizers applied at the dedicated plantation

g) N_2O emissions from application of fertilizers at the plantation ($PE_{FA,y}$)

N_2O emissions are associated with the application of both organic and synthetic fertilizers, and are emitted through direct soil emissions and indirect emissions from atmospheric deposition and leaching and run-off. Emissions are calculated as follows.

$$PE_{FA,y} = GWP_{N_2O} \cdot \frac{44}{28} \cdot \left(PE_{N_2O-N,dir,y} + PE_{N_2O-N,ind,y}\right) \tag{11}$$

Where:

$PE_{FA,y}$	=	Project emissions related to the application of fertilizers at the dedicated plantation in year y (tCO_2e/yr)
GWP_{N2O}	=	Global Warming Potential of nitrous oxide valid for the commitment period (tCO_2e/tN_2O)
$PE_{N2O-N,dir,y}$	=	Direct N_2O-N emissions as a result of nitrogen application at the dedicated plantation during the year y (tN_2O-N/yr)
$PE_{N2O-N,ind,y}$	=	Indirect N_2O-N emissions as a result of nitrogen application at the dedicated plantation during the year y (tN_2O-N/yr)

<u>Direct soil N_2O emissions</u>

$$PE_{N2O-N,dir,y} = EF_{N2O-N,dir} \cdot \left(F_{ON,y} + F_{SN,y}\right) \tag{12}$$

Where:

$PE_{N2O-N,dir,y}$	=	Direct N_2O-N emissions as a result of nitrogen application at the dedicated plantation during the year y (tN_2O-N/yr)
$EF_{N2O-N,dir}$	=	Emission factor for direct nitrous oxide emissions from N inputs (kg N_2O-N/kg N)
$F_{ON,y}$	=	Amount of organic fertilizer nitrogen from animal manure, sewage, compost or other organic amendments applied at the dedicated plantation during the year y (t N/yr)
$F_{SN,y}$	=	Amount of synthetic fertilizer nitrogen applied at the dedicated plantation during the year y (t N/yr)

<u>Indirect N_2O emissions</u>

Note: This source of emission is not to be accounted for in the case of a woody plantation.

Indirect N_2O emissions comprise N_2O emissions due to atmospheric decomposition of N volatilized from the plantation and N_2O emissions from leaching/run-off:

$$PE_{N2O-N,ind,y} = PE_{N2O-N,ind,ATD,y} + PE_{N2O-N,ind,L,y} \tag{13}$$

Where:

$PE_{N2O-N,ind,y}$	=	Indirect N_2O-N emissions as a result of nitrogen application at the dedicated plantation during the year y (tN_2O-N/yr)
$PE_{N2O-N,ind,ATD,y}$	=	Indirect N_2O-N emissions due to atmospheric deposition of volatilized N, as a result of nitrogen application at the dedicated plantation during the year y (tN_2O-N/yr)
$PE_{N2O-N,ind,L,y}$	=	Indirect N_2O-N emissions due to leaching/run-off, as a result of nitrogen application at the dedicated plantation during the year y (tN_2O-N/yr)

Indirect N_2O emissions due to atmospheric decomposition are calculated as follows:

$$PE_{N2O-N,ind,ATD,y} = \left(F_{SN,y} \cdot Frac_{GASF} + F_{ON,y} \cdot Frac_{GASM}\right) \cdot EF_{N2O-N,ATD} \quad \textbf{(14)}$$

Where:

$PE_{N2O\text{-}N,ind,ATD,y}$	=	Indirect N_2O-N emissions due to atmospheric deposition of volatilized N, as a result of nitrogen application at the dedicated plantation during the year *y* (tN_2O-N/yr)
$F_{SN,y}$	=	Amount of synthetic fertilizer nitrogen applied at the dedicated plantation during the year *y* (t N/yr)
$Frac_{GASF}$	=	Fraction of synthetic fertilizer N that volatilizes as NH_3 and NO_X (kg N volatilized / kg N applied)
$F_{ON,y}$	=	Amount of organic fertilizer nitrogen from animal manure, sewage, compost or other organic amendments applied at the dedicated plantation during the year *y* (t N/yr)
$Frac_{GASM}$	=	Fraction of organic N fertilizer that volatilizes as NH_3 and NO_X (kg N volatilized / kg N applied)
$EF_{N2O\text{-}N,ATD}$	=	Emission factor for atmospheric deposition of N on soils and water surfaces (t N_2O-N / t N volatilized)

Indirect N_2O emissions due to leaching and runoff are calculated as follows:

$$PE_{N2O-N,ind,L,y} = \left(F_{SN,y} + F_{ON,y}\right) \cdot Frac_{LEACH} \cdot EF_{N2O-N,L} \quad \textbf{(15)}$$

Where:

$PE_{N2O\text{-}N,ind,L,y}$	=	Indirect N_2O-N emissions due to leaching/run-off, as a result of nitrogen application at the dedicated plantation during the year *y* (tN_2O-N/yr)
$F_{SN,y}$	=	Amount of synthetic fertilizer nitrogen applied at the dedicated plantation during the year *y* (t N/yr)
$F_{ON,y}$	=	Amount of organic fertilizer nitrogen from animal manure, sewage, compost or other organic amendments applied at the dedicated plantation during the year *y* (t N/yr)
$Frac_{LEACH}$	=	Fraction of synthetic and organic fertilizer N that is lost through leaching and runoff (kg N leached and runoff / kg N applied)
$EF_{N2O\text{-}N,L}$	=	Emission factor for N_2O emissions from N leaching and runoff (t N_2O-N / t N leached and runoff)

h) CH_4 and N_2O emissions from the field burning of biomass

Biomass may be burnt at the start of the project activity (for land clearance) or regularly during the crediting period (e.g. after harvest). In these cases, CH_4 and N_2O emissions should be calculated for each time that field burning is occurring, as follows:

$$PE_{BB,y} = A_B \cdot M_B \cdot C_f \cdot \left(EF_{N2O,BB} \cdot GWP_{N2O} + EF_{CH4,BB} \cdot GWP_{CH4}\right) \quad \textbf{(16)}$$

Where:

$PE_{BB,y}$	=	Project emissions arising from field burning of biomass at the plantation site (tCO_2e/yr)
A_B	=	Area burned (ha)
M_B	=	Average mass of biomass available for burning on the area (t dry matter/ha)

C_f = Combustion factor, accounting for the proportion of fuel that is actually burnt (dimensionless)
$EF_{N2O,BB}$ = N_2O emission factor for field burning of biomass (tN_2O/tonne of dry matter)
GWP_{N2O} = Global Warming Potential of nitrous oxide valid for the commitment period (tCO_2e/tN_2O)
$EF_{CH4,BB}$ = CH_4 emission factor for field burning of biomass (tCH_4/tonne of dry matter)
GWP_{CH4} = Global Warming Potential of methane valid for the commitment period (tCO_2e/tCH_4)

Leakage

An important potential source of leakage for this project activity is an increase in emissions from fossil fuel combustion or other sources due to diversion of biomass ***residues*** from other uses to the project plant as a result of the project activity.

If biomass residues are co-fired in the project plant, project participants shall demonstrate that the use of the biomass residues does not result in increased use of fossil fuels or other GHG emissions elsewhere. For this purpose, project participants shall assess as part of the monitoring the supply situation for each type of biomass residue *k* used in the project plant. Table 6 below outlines the options that may be used to demonstrate that the biomass residues used in the plant did not increase fossil fuel consumption or other GHG emissions elsewhere.

Which approach should be used depends on the most plausible baseline scenario for the use of the biomass residues. Where scenarios B1, B2 or B3 apply, use approaches L_1, L_2 and/or L_3. Where scenario B4 applies, use approaches L_2 or L_3. Where scenario B5 applies, use approach L_4.

Table 6: Approaches to rule out leakage

L_1	Demonstrate that at the sites where the project activity is supplied from with biomass residues, the biomass residues have not been collected or utilized (e.g. as fuel, fertilizer or feedstock) but have been dumped and left to decay, land-filled or burnt without energy generation (e.g. field burning) prior to the implementation of the project activity. Demonstrate that this practice would continue in the absence of the CDM project activity, e.g. by showing that in the monitored period no market has emerged for the biomass residues considered or by showing that it would still not be feasible to utilize the biomass residues for any purposes (e.g. due to the remote location where the biomass residue is generated)
L_2	Demonstrate that there is an abundant surplus of the in the region of the project activity which is not utilized. For this purpose, demonstrate that the quantity of available biomass residues of type *k* in the region is at least 25% larger than the quantity of biomass residues of type *k* that are utilized (e.g. for energy generation or as feedstock), including the project plant
L_3	Demonstrate that suppliers of the type of biomass residue in the region of the project activity are not able to sell all of their biomass residues. For this purpose, project participants shall demonstrate that the ultimate supplier of the biomass residue (who supplies the project) and a representative sample of suppliers of the same type of biomass residue in the region had a surplus of biomass residues (e.g. at the end of the period during which biomass residues are sold), which they could not sell and which are not utilized

L_4	Identify the consumer that would use the biomass residue in the absence of the project activity (e.g. the former consumer). Demonstrate that this consumer has substituted the biomass residue diverted to the project with other types of biomass residues (and not with fossil fuels or other types of biomass than biomass residues[8]) by showing that the former user only fires biomass residues for which leakage can be ruled out using approaches L_2 or L_3. Provide credible evidence and document the types and amounts of biomass residues used by the former user as replacement for the biomass residue fired in the project activity and apply approaches L_2 or L_3 to these types of biomass residues. Demonstrate that the substitution of the biomass residues used in the project activity with other types of biomass residues does not require a significant additional energy input except for the transportation of the biomass residues

Where project participants wish to use approaches L_2, L_3 or L_4 to assess leakage effects, they shall clearly define the geographical boundary of the region and document it in the draft CDM-PDD. In defining the geographical boundary of the region, project participants should take the usual distances for biomass transports into account, i.e. if biomass residues are transported up to 50 km, the region may cover a radius of 50 km around the project activity. In any case, the region should cover a radius around the project activity of at least 20 km but not more than 200 km. Once defined, the region should not be changed during the crediting period(s).

Project participants shall apply a leakage penalty to the quantity of biomass residues, for which project participants cannot demonstrate with one of the approaches above that the use of the biomass residue does not result in leakage. The leakage penalty aims at adjusting emission reductions for leakage effects in a conservative manner, assuming that this quantity of biomass residues is substituted by the most carbon intensive fuel in the country.
If for a certain biomass residue type *k* used in the project leakage effects cannot be ruled out with one of the approaches above, leakage effects for the year *y* shall be calculated as follows:

$$LE_y = EF_{CO2,LE} \cdot \sum_n BF_{LE,n,y} \cdot NCV_n \quad \textbf{(17)}$$

Where:

LE_y	=	Leakage emissions during the year *y* (tCO_2/yr)
$EF_{CO2,LE}$	=	CO_2 emission factor of the most carbon intensive fuel used in the country (tCO_2/GJ)
$BF_{LE,n,y}$	=	Quantity of biomass residue type *n* used for heat generation as a result of the project activity during the year *y* and for which leakage can not be ruled out using one of the approaches L_1, L_2, L_3 or L_4 (tons of dry matter or liter)[6]
NCV_n	=	Net calorific value of the biomass residue type *n* (GJ/ton of dry matter or GJ/liter)
n	=	Biomass residue type *n* for which leakage can not be ruled out using one of the approaches L_1, L_2, L_3 or L_4

In case of approaches L_1, $BF_{LE,n,y}$ corresponds to the quantity of biomass residue type *n* that is obtained from the relevant source or sources.

[8] The generation of other types of biomass than biomass residues may be involved with significant GHG emissions, for example, from cultivation or harvesting.

In case of approaches L_2 or L_3, $BF_{LE,n,y}$ corresponds to the quantity of biomass residue type *k* used in the project plant as a result of the project activity during the year *y* ($BF_{LE,n,y} = BF_{PJ,k,y}$, where $n=k$).

In case of approach L_4, $\left(BF_{LE,n,y} \cdot NCV_n\right)$ corresponds to the lower value of

(a) The quantity of fuel types *m*, expressed in energy quantities, that are used by the former user of the biomass residue type *k* and for which leakage can not be ruled out because the fuels used are either (i) fuels types other than biomass residues (e.g. fossil fuels or biomass types other than biomass residues) or (ii) are biomass residues but leakage can not be ruled out for those types of biomass residues with approaches L_2 or L_3; as follows:

$$BF_{LE,n,y} \cdot NCV_n = \sum_m FC_{former\ user,m,y} \cdot NCV_m \quad \textbf{(18)}$$

Where:

$BF_{LE,n,y}$	=	Quantity of biomass residue type *n* used for heat generation as a result of the project activity during the year *y* and for which leakage can not be ruled out using approach L_4 (tons of dry matter or liter)[6]
NCV_n	=	Net calorific value of the biomass residue type *n* (GJ/ton of dry matter or GJ/liter)
n	=	Biomass residue type *n* for which leakage can not be ruled out using approach L_4
$FC_{former\ user,m,y}$	=	Quantity of fuel type *m* used by the former user of the biomass residue type *n* during the year *y* (mass or volume unit)[5]
NVC_m		Net calorific value of fuel type *m* (GJ/ton of dry matter or GJ/liter)
m	=	Fuel type *m*, being either (i) a fuel type other than a biomass residue (e.g. fossil fuel or biomass other than biomass residues) or (ii) a biomass residues for which leakage can not be ruled out with approaches L_2 or L_3

(b) The quantity of biomass residue type *k*, expressed in energy quantities, used in the project plant during the year *y* ($BF_{LE,n,y} = BF_{PJ,k,y}$, where $n=k$).

Emission reductions

The emission reductions (ER_y) are calculated as:

$$ER_y = BE_y - PE_y - LE_y \quad \textbf{(19)}$$

Where:

ER_y	=	Emission reductions in year *y* (tCO_2/yr)
BE_y	=	Baseline emissions in year *y* (tCO_2/yr)
PE_y	=	Project emissions in year *y* (tCO_2/yr)
LE_y	=	Leakage emissions in year *y* (tCO_2/yr)

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

Consistent with guidance by the Executive Board, project participants shall assess the continued validity of the baseline and update the baseline.

In order to assess the continued validity of the baseline, project participants should apply the procedure to determine the most plausible baseline scenario, as outlined above. The crediting period may only be renewed if the application of the procedure results in that the baseline scenarios for power generation and, if applicable, the use of biomass residues, as determined in the draft CDM-PDD, still apply.

The following data shall be updated at the renewal of the crediting period, based on any future revision or amendment of the 2006 IPCC Guidelines:

- Emissions factor for direct N_2O emissions from N inputs ($EF_{N2O\text{-}N,dir}$);
- Emissions factor for atmospheric deposition of N on soils and water surfaces ($EF_{N2O,ATD}$);
- Emissions factor for N_2O emissions from N leaching and runoff ($EF_{N2O\text{-}N,L}$);
- Fraction of organic N fertilizer that volatilizes as NH_3 and NO_X ($Frac_{GASM}$);
- Fraction of synthetic and organic fertilizer N that is lost through leaching and runoff ($Frac_{LEACH}$);
- Fraction of synthetic fertilizer N that volatilizes as NH_3 and NO_X ($Frac_{GASF}$)N_2O emission factor for field burning of biomass ($EF_{N2O,BB}$);
- CH_4 emission factor for field burning of biomass ($EF_{CH4,BB}$).

Data and parameters not monitored

Parameter:	$EF_{N2O\text{-}N,dir}$
Data unit:	kg N_2O-N / kg N input
Description:	Emissions factor for direct N_2O emissions from N inputs
Source of data:	2006 IPCC Guidelines, Vol. 4, Ch. 11. Table 11.1
Value to be applied:	0.01
Any comment:	

Parameter:	$EF_{N2O,ATD}$
Data unit:	t N_2O-N / t N volatilized
Description:	Emissions factor for atmospheric deposition of N on soils and water surfaces
Source of data:	2006 IPCC Guidelines, Vol. 4, Ch. 11. Table 11.3
Value to be applied:	0.01
Any comment:	

Parameter:	$EF_{N2O\text{-}N,L}$
Data unit:	t N_2O-N / t N leached and runoff
Description:	Emissions factor for N_2O emissions from N leaching and runoff
Source of data:	2006 IPCC Guidelines, Vol. 4, Ch. 11. Table 11.3
Value to be applied:	0.0075
Any comment:	

Parameter:	$Frac_{GASM}$
Data unit:	kg N volatilized / kg N applied
Description:	Fraction of organic N fertilizer that volatilizes as NH_3 and NO_X
Source of data:	2006 IPCC Guidelines, Vol. 4, Ch. 11. Table 11.3
Value to be applied:	0.2
Any comment:	

Parameter:	$Frac_{LEACH}$
Data unit:	kg N leached and runoff / kg N applied
Description:	Fraction of synthetic and organic fertilizer N that is lost through leaching and runoff
Source of data:	2006 IPCC Guidelines, Vol. 4, Ch. 11. Table 11.3
Value to be applied:	0.3
Any comment:	

Parameter:	$Frac_{GASF}$
Data unit:	kg N volatilized / kg N applied
Description:	Fraction of synthetic fertilizer N that volatilizes as NH_3 and NO_X
Source of data:	2006 IPCC Guidelines, Vol. 4, Ch. 11. Table 11.3
Value to be applied:	0.1
Any comment:	

Parameter:	$EF_{N2O,BB}$
Data unit:	t N_2O / ton of dry matter of biomass
Description:	N_2O emission factor for field burning of biomass
Source of data:	Select the most suitable value to the type of biomass from the 2006 IPCC Guidelines, Vol. 4, Ch. 2, Table 2.5
Measurement procedures (if any):	
Any comment:	

Parameter:	$EF_{CH4,BB}$
Data unit:	t CH_4 / ton of dry matter of biomass
Description:	CH_4 emission factor for field burning of biomass
Source of data:	Select the most suitable value to the type of biomass from the 2006 IPCC Guidelines, Vol. 4, Ch. 2, Table 2.5
Measurement procedures (if any):	
Any comment:	

III. MONITORING METHODOLOGY

Monitoring procedures

Describe and specify in the draft 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.

Data and parameters monitored

Data / Parameter:	$EG_{PJ,y}$
Data unit:	MWh/yr
Description:	Net quantity of electricity generated in the project plant in year *y*
Source of data:	Electricity meter
Measurement procedures (if any):	
Monitoring frequency:	continuous
QA/QC procedures:	Metered net electricity generation should be cross-checked with receipts from sales (if available) and the quantity of fuels fired (e.g. check whether the electricity generation divided by the energy quantity of all fuels fired results in a reasonable efficiency that is comparable to previous years)
Any comment:	

Data / Parameter:	$EF_{grid,y}$
Data unit:	tCO_2/MWh
Description:	Grid electricity emissions factor
Source of data:	As per the latest approved version of “Tool to calculate the emission factor for an electricity system”
Measurement procedures (if any):	
Monitoring frequency:	Either once at the start of the project activity or updated annually, consistent with guidance in “Tool to calculate the emission factor for an electricity system”
QA/QC procedures:	Apply procedures in “Tool to calculate the emission factor for an electricity system”
Any comment:	All data and parameters to determine the grid electricity emission factor, as required by “Tool to calculate the emission factor for an electricity system”, shall be included in the monitoring plan

Data / Parameter:	$EF_{CO2,FF,i}$
Data unit:	tCO_2/GJ
Description:	Carbon dioxide emissions factor of fuel type *i*
Source of data:	Either conduct measurements or use accurate and reliable local or national data where available. Where such data is not available, use IPCC default emission factors (country-specific, if available) if they are deemed to reasonably represent local circumstances. Choose the value in a conservative manner and justify the choice
Measurement procedures (if any):	Measurements shall be carried out at reputed laboratories and according to relevant international standards
Monitoring frequency:	In case of measurements: At least every six months, taking at least three samples for each measurement. In case of other data sources: Review the appropriateness of the data annually
QA/QC procedures:	Check consistency of measurements and local / national data with default values by the IPCC. If the values differ significantly from IPCC default values, collect additional information or conduct additional measurements
Any comment:	

Data / Parameter:	$BF_{PJ,j,y}$
Data unit:	tons of dry matter or liter
Description:	Quantity of biomass type *j* fired in the project plant in the year *y* (tons of dry matter or liter)
Source of data:	On-site measurements
Measurement procedures (if any):	Use weight or volume meters. Adjust for the moisture content in order to determine the quantity of dry biomass. The quantity shall be crosschecked with the quantity of electricity generated and any fuel purchase receipts (if available).
Monitoring frequency:	Continuously, aggregated at least annually
QA/QC procedures:	Cross-check the measurements by establishing an annual energy balance that is based on purchased quantities and stock changes. Also cross check with fuel purchase receipts and the quantity of electricity generation
Any comment:	The quantity of biomass combusted should be collected separately for all types of biomass

Data / Parameter:	Moisture content of the biomass
Data unit:	% Water content
Description:	Moisture content of each biomass type *j*
Source of data:	On-site measurements
Measurement procedures (if any):	
Monitoring frequency:	The moisture content should be monitored for each batch of biomass of homogeneous quality. The weighted average should be calculated for each monitoring period and used in the calculations
QA/QC procedures:	
Any comment:	In case of dry biomass, monitoring of this parameter is not necessary

Data / Parameter:	NCV_i, NCV_j
Data unit:	GJ / mass or volume unit (use a dry matter basis for biomass)
Description:	Net calorific value of fuel type *i* or *j*
Source of data:	Biomass: Measurements Fossil fuels: Either conduct measurements or use accurate and reliable local or national data where available. Where such data is not available, use IPCC default net calorific values (country-specific, if available) if they are deemed to reasonably represent local circumstances. Choose the values in a conservative manner and justify the choice
Measurement procedures (if any):	Measurements shall be carried out at reputed laboratories and according to relevant international standards. Measure the NCV of biomass based on the dry matter
Monitoring frequency:	In case of measurements: At least every six months, taking at least three samples for each measurement. In case of other data sources: Review the appropriateness of the data annually
QA/QC procedures:	Check the consistency of the measurements by comparing the measurement results with measurements from previous years, relevant data sources (e.g. values in the literature, values used in the national GHG inventory) and default values by the IPCC. If the measurement results differ significantly from previous measurements or other relevant data sources, conduct additional measurements
Any comment:	

Data / Parameter:	$EC_{PJ,y}$
Data unit:	tCO_2/yr
Description:	On-site electricity consumption attributable to the project activity during the year *y*
Source of data:	On-site measurements
Measurement procedures (if any):	Electricity meters
Monitoring frequency:	Continuously, aggregated at least annually
QA/QC procedures:	Cross-check measurement results with invoices for purchased electricity if available
Any comment:	

Data / Parameter:	$FC_{on\text{-}site,i,y}$
Data unit:	mass or volume unit[5]
Description:	Amount fuel type *i* that is (a) co-fired in the project plant and/or is (b) combusted at the site of the project plant and attributable to the project activity, during the year *y*
Source of data:	Measurements
Measurement procedures (if any):	
Monitoring frequency:	Continuous
QA/QC procedures:	Metered fuel consumption quantities should be cross-checked with fuel purchase receipts
Any comment:	

Data / Parameter:	N_y
Data unit:	-
Description:	Number of truck trips during the year *y*
Source of data:	On-site measurements
Measurement procedures (if any):	-
Monitoring frequency:	Continuously
QA/QC procedures:	Check consistency of the number of truck trips with the quantity of biomass combusted.
Any comment:	Project participants have to monitor either this parameter or the average truck load TL_y.

Data / Parameter:	AVD_y
Data unit:	km
Description:	Average return trip distance (from and to) between the source of the biomass and the site of the project plant during the year *y*
Source of data:	Records by project participants on the origin of the biomass
Measurement procedures (if any):	
Monitoring frequency:	Regularly
QA/QC procedures:	Check consistency of distance records provided by the truckers by comparing recorded distances with other information from other sources (e.g. maps).
Any comment:	If biomass is supplied from different sites, this parameter should correspond to the mean value of km traveled by trucks that supply the biomass plant

Data / Parameter:	$EF_{km,CO2,y}$
Data unit:	tCO_2/km
Description:	Average CO_2 emission factor per km for the trucks during the year *y*
Source of data:	Conduct sample measurements of the fuel type, fuel consumption and distance traveled for all truck types. Calculate CO_2 emissions from fuel consumption by multiplying with appropriate net calorific values and CO_2 emission factors. For net calorific values and CO_2 emission factors, use reliable national default values or, if not available, (country-specific) IPCC default values. Alternatively, choose emission factors applicable for the truck types used from the literature in a conservative manner (i.e. the higher end within a plausible range)
Measurement procedures (if any):	
Monitoring frequency:	At least annually
QA/QC procedures:	Cross-check measurement results with emission factors referred to in the literature
Any comment:	

Data / Parameter:	TL_y
Data unit:	tons or liter (consistent with the unit chosen for the biomass)
Description:	Average truck load of the trucks used
Source of data:	On-site measurements
Measurement procedures (if any):	Determined by averaging the weights of each truck carrying biomass to the project plant
Monitoring frequency:	Continuously, aggregated annually
QA/QC procedures:	-
Any comment:	Project participants have to monitor either the number of truck trips N_y or this parameter.

Data / Parameter:	$FC_{TR,i,y}$
Data unit:	Mass or volume unit[5]
Description:	Fuel consumption of fuel type *i* used in trucks for transportation of biomass during the year *y*
Source of data:	Fuel purchase receipts or fuel consumptions meters in the trucks
Measurement procedures (if any):	
Monitoring frequency:	Continuously, aggregated annually
QA/QC procedures:	Cross-check the resulting CO_2 emissions for plausibility with a simple calculation based on the distance approach (option 1).
Any comment:	This parameter only needs to be monitored if option 2 is chosen to estimate CO_2 emissions from transportation.

Data / Parameter:	$EF_{CH4,BF,j}$
Data unit:	tCH_4/GJ
Description:	CH_4 emission factor for the combustion of biomass type *j* in the project plant
Source of data:	On-site measurements or default values, as provided in Table 2.
Measurement procedures (if any):	The CH_4 emission factor may be determined based on a stack gas analysis using calibrated analyzers.
Monitoring frequency:	At least quarterly, taking at least three samples per measurement
QA/QC procedures:	Check the consistency of the measurements by comparing the measurement results with measurements from previous years, relevant data sources (e.g. values in the literature, values used in the national GHG inventory) and default values by the IPCC. If the measurement results differ significantly from previous measurements or other relevant data sources, conduct additional measurements.
Any comment:	Note that a conservative factor shall be applied, as specified in the baseline methodology.

Data / Parameter:	$FC_{PL,i,y}$
Data unit:	Mass or volume unit[5]
Description:	Amount of fuel type *i* that is combusted at the dedicated plantation during the year *y*
Source of data:	Measurements
Measurement procedures (if any):	
Monitoring frequency:	Continuously
QA/QC procedures:	Metered fuel consumption quantities should be cross-checked with purchase receipts.
Any comment:	

Data / Parameter:	$F_{SF,f,y}$
Data unit:	kg fertilizer/year
Description:	Amount of synthetic fertilizer of type *f* applied in year *y*
Source of data:	On-site records by project participants
Measurement procedures (if any):	
Monitoring frequency:	Continuously
QA/QC procedures:	Cross-check records of applied quantities with purchase receipts
Any comment:	

Data / Parameter:	$EF_{CO2e,FP,f}$
Data unit:	tCO_2e/kg fertilizer
Description:	Emissions factor for GHG emissions associated with the production of fertilizer type *f*
Source of data:	Select values from Wood and Cowie (2004) and/or other more recent peer-reviewed publications that have at least the same scope in a conservative manner (i.e. use the highest value presented for the type of fertilizer). Document the choice.
Measurement procedures (if any):	
Monitoring frequency:	Annually
QA/QC procedures:	
Any comment:	

Data / Parameter:	$F_{ON,y}$
Data unit:	tons of nitrogen per year
Description:	Amount of organic fertilizer nitrogen from animal manure, sewage, compost or other organic amendments applied at the dedicated plantation during the year *y*
Source of data:	On-site records and measurements
Measurement procedures (if any):	Where applicable, measure the quantities and nitrogen content of any animal manure, sewage, compost or other organic amendments applied as fertilizers to the dedicated plantation.
Monitoring frequency:	Quantities of organic fertilizer: Continuously Nitrogen content: Regularly by sample measurements
QA/QC procedures:	
Any comment:	

Data / Parameter:	$F_{SN,y}$
Data unit:	tons of nitrogen per year
Description:	Amount of synthetic fertilizer nitrogen applied at the dedicated plantation during the year *y*
Source of data:	Determine $F_{SN,y}$ based on the types and quantities of fertilizers applied ($F_{SF,f,y}$) and manufacturers information on the nitrogen content of each fertilizer
Measurement procedures (if any):	-
Monitoring frequency:	Continuously
QA/QC procedures:	
Any comment:	

Data / Parameter:	A_B
Data unit:	hectares
Description:	Area burnt
Source of data:	Records by project participants
Measurement procedures (if any):	
Monitoring frequency:	Each time field burning takes place
QA/QC procedures:	
Any comment:	

Data / Parameter:	M_B
Data unit:	ton dry matter per hectare
Description:	Average mass of biomass available for burning on the area
Source of data:	Sample measurements by project participants
Measurement procedures (if any):	
Monitoring frequency:	Each time field burning takes place
QA/QC procedures:	
Any comment:	

Data / Parameter:	C_f
Data unit:	-
Description:	Combustion factor, accounting for the proportion of fuel that is actually burnt
Source of data:	Sample measurements by project participants or assume a default value of 1
Measurement procedures (if any):	Measure the remaining biomass after field burning (if any)
Monitoring frequency:	Each time field burning takes place
QA/QC procedures:	
Any comment:	

Data / Parameter:	$EF_{CO2,LE}$
Data unit:	tCO_2/GJ
Description:	CO_2 emission factor of the most carbon intensive fuel used in the country
Source of data:	Identify the most carbon intensive fuel type from the national communication, other literature sources (e.g. IEA). Possibly consult with the national agency responsible for the national communication / GHG inventory. If available, use national default values for the CO_2 emission factor. Otherwise, IPCC default values may be used
Measurement procedures (if any):	
Monitoring frequency:	Annually
QA/QC procedures:	
Any comment:	

Data / Parameter:	**-**
Data unit:	-
Description:	Demonstration that the biomass residue type k from a specific source would continue not to be collected or utilized, e.g. by an assessment whether a market has emerged for that type of biomass residue (if yes, leakage is assumed not be ruled out) or by showing that it would still not be feasible to utilize the biomass residues for any purposes
Source of data:	Information from the site where the biomass is generated
Measurement procedures (if any):	
Monitoring frequency:	Annually
QA/QC procedures:	
Any comment:	Monitoring of this parameter is applicable if approach L_1 is used to rule out leakage

Data / Parameter:	-
Data unit:	Tons
Description:	Quantity of biomass residues of type *k* or *m* that are utilized (e.g. for energy generation or as feedstock) in the defined geographical region
Source of data:	Surveys or statistics
Measurement procedures (if any):	
Monitoring frequency:	Annually
QA/QC procedures:	
Any comment:	Monitoring of this parameter is applicable if approach L_2 is used to rule out leakage or if approach L_4 is used in combination with approach L_2 to rule out leakage for the substituted biomass residue type *m*

Data / Parameter:	-
Data unit:	Tons
Description:	Quantity of available biomass residues of type *k* or *m* in the region
Source of data:	Surveys or statistics
Measurement procedures (if any):	
Monitoring frequency:	Annually
QA/QC procedures:	
Any comment:	Monitoring of this parameter is applicable if approach L_2 is used to rule out leakage or if approach L_4 is used in combination with approach L_2 to rule out leakage for the substituted biomass residue type *m*

Data / Parameter:	-
Data unit:	
Description:	Availability of a surplus of biomass residue type *k* or *m* (which can not be sold or utilized) at the ultimate supplier to the project (or, in case of L_4, the former user of the biomass residue type *k*) and a representative sample of other suppliers in the defined geographical region
Source of data:	Surveys
Measurement procedures (if any):	
Monitoring frequency:	Annually
QA/QC procedures:	
Any comment:	Monitoring of this parameter is applicable if approach L_3 is used to rule out leakage or if approach L_4 is used in combination with approach L_3 to rule out leakage for the substituted biomass residue type *m*

IV. REFERENCES AND ANY OTHER INFORMATION

Wood, S. and Cowie, A., *A Review of Greenhouse Gas Emission Factors for Fertilizer Production*, IEA Bioenergy Task 38, June 2004 (http://www.joanneum.at/iea-bioenergy-task38/publications/GHG_Emission_Fertilizer%20Production_July2004.pdf)

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History of the document

Version	Date	Nature of revision(s)
02.1	EB 55, Annex 15 30 July 2010	Editorial revision to: • Revise the monitoring procedure of the biomass moisture content so that the parameter can be monitored for each batch of biomass, rather than continuously.
02	EB 35, Para 24, 19 October 2007	Revision to incorporate the use of the “Tool to calculate the emission factor for an electricity system”
01	EB 27, Annex 3, 1 November 2006	Initial adoption
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