Draft consolidated baseline methodology ACM00XX

"Consolidated baseline methodology for grid-connected electricity generation from biomass residues"

Sources

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

- AM0004: "Grid-connected Biomass Power-Generation that avoids uncontrolled burning of biomass" which is based on the A.T. Biopower Rice Husk Power Project in Thailand whose Baseline study, Monitoring and Verification Plan and Project Design Document were prepared by Mitsubishi Securities;
- AM0015: "Bagasse-based cogeneration connected to an electricity grid" which is based on the Vale do Rosário Bagasse Cogeneration project in Brazil, whose baseline study, monitoring and verification plan and project design document were prepared by Econergy International Corporation;
- NM0050: "Ratchasima SPP Expansion Project in Thailand" whose baseline study, monitoring and verification plan and project design document were prepared by Agrinergy Limited;
- NM0081: "Trupán biomass cogeneration project in Chile" whose baseline study, monitoring and verification plan and project design document were prepared by Celulosa Arauco y Constitutción S.A;
- NM0098: "Nobrecel Fossil-to-Biomass Fuel Switch Project in Brazil", whose baseline study, monitoring and verification plan and project design document were prepared by Nobrecel S.A.Celulose e Papel.

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

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

Selected approach from paragraph 48 of the CDM modalities and procedures

"Existing actual or historical emissions, as applicable"

or

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

Applicability

This consolidated methodology covers a number of different project types for power generation with biomass residues. Where a combination of project activity and baseline scenario is not covered by this methodology, project participants are encouraged to submit proposals for revision or further amendment of this consolidated methodology.

This methodology is applicable to grid-connected and *biomass residue* fired electricity generation project activities, including cogeneration plants.

The project activity may include:

- the installation of a new biomass power generation plant at a site where currently no power generation occurs (**greenfield power projects**); or
- the installation of a new biomass power generation unit, which is operated next to existing power generation capacity fired with either fossil fuels or the same type of biomass residue as in the project plant (**power capacity expansion projects**); or
- the improvement of energy efficiency of an existing power generation plant (**energy efficiency improvement projects**), e.g. by retrofitting the existing plant or by installing a new plant that replaces the existing plant; or
- the replacement of fossil fuels by biomass in an existing power plant (**fuel switch projects**).

The project activity may be based on the operation of a power generation unit located in an agro-industrial plant generating the biomass residues or as an independent plant supplied by biomass residues coming from the nearby area or a market.

For this specific methodology, *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.

The methodology is applicable under the following conditions:

- No other biomass types than *biomass residues*, as defined above, are used in the project plant and these biomass residues are the predominant fuel used in the project plant (some fossil fuels may be co-fired);
- For projects that use biomass residues from a production process (e.g. production of sugar or wood panel boards), the implementation of the project shall not result in an increase of the processing capacity of raw input (e.g. sugar, rice, logs, etc.) or in other substantial changes (e.g. product change) in this process;
- The biomass used by the project facility should not be stored for more than one year;
- No significant energy quantities, except from transportation of the biomass, are required to prepare the biomass residues for fuel combustion, i.e. projects that process the biomass residues prior to combustion (e.g. esterification of waste oils) are not eligible under this methodology.

It is further noted that the methodology is only applicable for the combinations of project activities and baseline scenarios identified in Table 1 below.

This baseline methodology shall be used in conjunction with the approved consolidated monitoring ACM00XX “Consolidated monitoring methodology for grid-connected electricity generation from biomass residues”.

Identification of the baseline scenario

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

Realistic and credible alternatives should be separately determined regarding:

- how **power** would be generated in the absence of the CDM project activity;
- what would happen to the **biomass** in the absence of the project activity; and
- in case of cogeneration projects: how the **heat**[1] would be generated in the absence of the project activity.

For **power** generation, the realistic and credible alternatives may include, *inter alia*:

P1 The proposed project activity not undertaken as a CDM project activity

P2 The proposed project activity (installation of a power plant), fired with the same type of biomass but with a lower electrical energy efficiency[2] (e.g. an efficiency that is common practice in the relevant industry sector)

P3 The generation of power in an existing plant, on-site or nearby the project site, using only fossil fuels

P4 The generation of power in existing and/or new grid-connected power plants

P5 The continuation of power generation in an existing power plant, fired with the same type of biomass as in the project activity, and implementation of the project activity, not undertaken as a CDM project activity, at the end of the lifetime of the existing plant

If the proposed project activity is the **cogeneration** of power and heat, project participants shall define the most plausible baseline scenario for the generation of heat. For **heat** generation, realistic and credible alternative(s) may include, *inter alia*:

H1 The proposed project activity not undertaken as a CDM project activity

H2 The proposed project activity (installation of a cogeneration power plant), fired with the same type of biomass but with a different thermal energy efficiency[2] (e.g. an efficiency that is common practice in the relevant industry sector)

H3 The generation of heat in an existing cogeneration plant, on-site or nearby the project site, using only fossil fuels

H4 The generation of heat in boilers using the same type of biomass residues

H5 The continuation of heat generation in an existing cogeneration plant, fired with the same type of biomass as in the project activity, and implementation of the project activity, not undertaken as a

[1] In the context of this methodology, "heat" refers to heat that is utilized (e.g. steam for processes) and not to waste heat.

[2] In the context of this methodology, "electrical energy efficiency" is defined as the net quantity of electricity produced per quantity of fuel fired (both in energy units). In case of cogeneration plants, the "thermal efficiency" is defined as the quantity of heat generated per quantity of fuel fired (both in energy units).

CDM project activity, at the end of the lifetime of the existing plant
H6 The generation of heat in boilers using fossil fuels
H7 The use of heat from external sources, such as district heat
H8 Other heat generation technologies (e.g. heat pumps or solar energy)

For the use of **biomass**, the realistic and credible alternative(s) may include, *inter alia*:

B1 The biomass is dumped or left to decay or burned in an uncontrolled manner without utilizing it for energy purposes
B2 The biomass is used for heat and/or electricity generation at the project site
B3 The biomass is used for power generation, including cogeneration, in other existing or new grid-connected power plants[3]
B4 The biomass is used for heat generation in other existing or new boilers at other sites[4]
B5 The biomass is used for other energy purposes, such as the generation of biofuels
B6 The biomass is used for non-energy purposes

Where the project activity uses different types of biomass residues, the baseline scenario should be identified for each type of biomass residue separately.

This methodology is only applicable to the specific combinations of types of baseline scenarios as illustrated in Table 1 below.

[3] For example, this may be a likely scenario where the biomass has prior to the project implementation been sold in a market and where electricity generation with that biomass type is common practice in the respective region.
[4] For example, this may be a likely scenario where the biomass has prior to the project implementation been sold in a market and where heat generation with that biomass type is common practice in the respective region.

Table 1: Combinations of project types and baseline scenarios applicable to this methodology

Scenario	Project type	Baseline scenario: Power	Baseline scenario: Biomass	Baseline scenario: Heat (if relevant)	Description of the situation
1	Greenfield power projects	P4	B3	H6 or H7 or H8[5]	The project activity involves the installation of a new power plant at a site where currently no power generation occurs. The power generated by the project plant is fed into the grid or would in the absence of the project activity be purchased from the grid. The biomass would in the absence of the project activity be used in power plants at other sites. This may apply, for example, if the biomass is purchased from a market or would be sold to a market in the absence of the project activity and if power generation is the main use of biomass in the country/region. In case of cogeneration plants, the heat would in the absence of the project activity be generated in boilers fired with fossil fuels, or by other means not involving the biomass. This may apply, for example, where prior to the project implementation heat has been generated in boilers using fossil fuels.
2			B1	H6 or H7 or H8[5]	The project activity involves the installation of a new power plant at a site where currently no power generation occurs. The power generated by the project plant is fed into the grid or would in the absence of the project activity be purchased from the grid. The biomass would in the absence of the project activity be dumped or left to decay or burned in an uncontrolled manner without utilizing it for energy purposes. In case of cogeneration plants, the heat would in the absence of the project activity be generated in boilers fired with fossil fuels, or by other means not involving the biomass. This may apply, for example, where prior to the project implementation heat has been generated in boilers using fossil fuels.

[5] Note that procedures to calculate baseline emissions are only provided for option H6. As a simple and conservative assumption, project participants may still use this methodology for options H7 and H8 assuming conservatively that baseline emissions from heat generation are zero.

		Baseline scenario			
3			B1 and B2	H4	The project activity involves the installation of a new cogeneration plant at a site where currently no power generation occurs. The power generated by the project plant is fed into the grid or would in the absence of the project activity be purchased from the grid. The biomass would in the absence of the project activity (a) be used for heat generation in boilers at the project site and (b) be dumped or left to decay or burned in an uncontrolled manner without utilizing it for energy purposes. This may apply, for example, where the quantity of biomass that was not needed for heat generation was dumped, left to decay or burned in an uncontrolled manner prior to the project implementation

Scenario	Project type	Baseline scenario			Description of the situation
		Power	Biomass	Heat (if relevant)	
4	Greenfield power project	P2 and P4	B2	H2	The project activity involves the installation of a new power plant at a site where currently no power generation occurs. In the absence of the project activity, a new biomass power plant (in the following referred to as "reference plant") would be installed instead of the project activity at the same site and with the same thermal firing capacity but with a lower electric efficiency as the project plant (e.g. by using a low-pressure boiler instead of a high-pressure boiler). The same type and quantity of biomass as in the project plant would be used in the reference plant. Consequently, the power generated by the project plant would in the absence of the project activity be generated (a) in the reference plant and – since power generation is larger in the project plant than in the reference plant – (b) partly in power plants in the grid. In the case of cogeneration plants, the project plant should be of backpressure type[6]. The heat generated by the project plant would in the absence of the project activity be generated in the reference plant (the heat generated per biomass input in the project plant is smaller or the same compared to the reference plant).
5	Power capacity expansion projects	P3 and P4	B1	NA	The project activity involves the installation of a new biomass power plant at a site where an existing fossil fuel fired power plant (no cogeneration plant) is also being operated. The power generated by the project plant (a) would in the absence of the project activity be generated in the existing fossil fuel fired plant and may partly (b) be fed into the grid or be purchased from the grid in the absence of the project activity. The biomass is only used in the project plant and would in the absence of the project activity be dumped or left to decay or burned in an uncontrolled manner without utilizing it for energy purposes.

[6] Backpressure type cogeneration plants are defined as cogeneration plants where the relation between electricity and heat generation is fairly constant and cannot be influenced significantly by the operators of the plant. This applies, for example, to backpressure steam turbines. For other plant configurations (e.g. steam turbines with heat extraction points), this methodology is not applicable. Project participants would need to apply or propose a different methodology.

		Baseline scenario			
6			B3	NA	The project activity involves the installation of a new biomass power plant at a site where an existing fossil fuel fired power plant (no cogeneration plant) is also being operated. The power generated by the project plant (a) would in the absence of the project activity be generated in the existing fossil fuel fired plant and may partly (b) be fed into the grid or be purchased from the grid in the absence of the project activity. The biomass is only used in the project plant and would in the absence of the project activity be used in power plants at other sites. This may apply, for example, if the biomass is purchased from a market or would be sold to a market in the absence of the project activity and if power generation is the main use of biomass in the country/region.

Scenario	Project type	Baseline scenario			Description of the situation
		Power	Biomass	Heat (if relevant)	
7	Power capacity expansion projects	P3 and P4	B1	H3	The project activity involves the installation of a new biomass cogeneration plant at a site where an existing fossil fuel fired cogeneration plant is also being operated. The power generated by the project plant (a) would in the absence of the project activity be generated in the existing fossil fuel fired plant and may partly (b) be fed into the grid or be purchased from the grid in the absence of the project activity. The heat generated by the project plant would in the absence of the project activity be generated in the existing fossil fuel fired cogeneration plant (the thermal efficiency of the project plant and the existing fossil fuel fired cogeneration plant is similar, i.e. the difference is less than 5%). The biomass is only used in the project plant and would in the absence of the project activity be dumped or left to decay or burned in an uncontrolled manner without utilizing it for energy purposes.
8			B3	H3	The project activity involves the installation of a new biomass cogeneration plant at a site where an existing fossil fuel fired cogeneration plant is also being operated. The power generated by the project plant (a) would in the absence of the project activity be generated in the existing fossil fuel fired plant and may partly (b) be fed into the grid or be purchased from the grid in the absence of the project activity. The heat generated by the project plant would in the absence of the project activity be generated in the existing fossil fuel fired cogeneration plant (the thermal efficiency of the project plant and the existing fossil fuel fired cogeneration plant is similar, i.e. the difference is less than 5%). The biomass is only used in the project plant would in the absence of the project activity be used in power plants at other sites. This may apply, for example, if the biomass is purchased from a market or would be sold to a market in the absence of the project activity and if power generation is the main use of biomass in the country/region.

		Baseline scenario			
9		P4	B3	NA	The project activity involves the installation of a new power unit, which is operated next to (an) existing biomass power generation unit(s). The existing unit(s) are only fired with biomass and continue to operate after the installation of the new power unit. The power generated by the new power unit is fed into the grid or would in the absence of the project activity be purchased from the grid. The biomass would in the absence of the project activity be used in power plants at other sites. This may apply, for example, if the biomass is purchased from a market or would be sold to a market in the absence of the project activity and if power generation is the main use of biomass in the country/region.

Scenario	Project type	Baseline scenario			Description of the situation
		Power	Biomass	Heat (if relevant)	
10	Power capacity expansion projects	P4	B1	H6 or H7 or H8[5]	The project activity involves the installation of a new power unit, which is operated next to (an) existing biomass power generation unit(s). The existing unit(s) are only fired with biomass and continue to operate after the installation of the new power unit. The power generated by the new power unit is fed into the grid or would in the absence of the project activity be purchased from the grid. The biomass would in the absence of the project activity be dumped or left to decay or burned in an uncontrolled manner without utilizing it for energy purposes. In case of cogeneration plants, the heat would in the absence of the project activity be generated in on-site boilers fired with fossil fuels, or by other means not involving the biomass. This may apply, for example, where prior to the project implementation heat has been generated in boilers using fossil fuels.
11		P4 and P5	B2	H5	The project activity involves the installation of a new power unit, which is operated next to (an) existing biomass power generation unit(s). The existing unit(s) are only fired with biomass and continue to operate after the installation of the new power unit. The efficiency of electricity generation is higher in the new power unit than in the existing unit(s). The biomass would in the absence of the project activity be used in the existing power plant(s) at the project site. Consequently, the power generated by the new power unit would in the absence of the project activity be generated (a) in the existing plant(s) and – since power generation is more efficient in the project plant than in the existing plant(s) – (b) partly in power plants in the grid. In case of cogeneration plants, the project plant should be of backpressure[6] type. The heat generated by the project plant would in the absence of the project activity be generated in the existing unit(s) (the heat generated per biomass input in the project plant is smaller or the same compared to the existing unit(s)).

		Baseline scenario			
12		P4	B2	H4	The project activity involves the installation of a new cogeneration unit, which is operated next to (an) existing biomass power generation unit(s). The existing unit(s) are only fired with biomass and continue to operate after the installation of the new power unit. The power generated by the new power unit is fed into the grid or would in the absence of the project activity be purchased from the grid. The biomass would in the absence of the project activity be used for heat generation in boilers at the project site. This may apply, for example, where the biomass has been used for heat generation in boilers at the project site prior to the project implementation.

Scenario	Project type	Baseline scenario			Description of the situation
		Power	Biomass	Heat (if relevant)	
13	Power capacity expansion project	P2 and P4	B2	H2	The project activity involves the installation of a new power unit, which is operated next to (an) existing biomass power generation unit(s). The existing unit(s) are only fired with biomass and continue to operate after the installation of the new power unit. In the absence of the project activity, a new biomass power unit (in the following referred to as "reference plant") would be installed instead of the project activity at the same site and with the same thermal firing capacity but with a lower electric efficiency as the project plant (e.g. by using of a low-pressure boiler instead of a high-pressure boiler). The same type and quantity of biomass as in the project plant would be used in the reference plant. Consequently, the power generated by the project plant would in the absence of the project activity be generated (a) in the reference plant and – since power generation is larger in the project plant than in the reference plant – (b) partly in power plants in the grid. In case of cogeneration plants, the project plant should be of backpressure[6] type. The heat generated by the project plant would in the absence of the project activity be generated in the reference plant (the heat generated per biomass input in the project plant is smaller or the same compared to the reference plant).
14	Energy efficiency projects	P4 and P5	B2	H5	The project activity involves the improvement of energy efficiency of an existing biomass power plant by retrofit or replacement of the existing biomass power plant. The retrofit or replacement increases the power generation capacity, while the thermal biomass firing capacity is maintained. In the absence of the project activity, the existing power plant would continue to operate without significant changes, until it would need to be replaced at the end of its technical lifetime. The same type and quantity of biomass as in the project plant would be used. Consequently, the power generated by the project plant would in the absence of the project activity be generated (a) in the same plant (without project implementation) and – since power generation is larger due to the energy efficiency improvements – (b) partly in power plants in the grid. In case of cogeneration plants, the heat generated by the project plant would in the absence of the project activity be generated in the same plant (the heat generated per biomass input is smaller or the same after the implementation of the project activity).

		Baseline scenario			
15	Fuel switch project	P3	B1	H3	The project activity involves the partial or complete fuel switch from fossil fuels to biomass at an existing power plant at the project site. The biomass is not used in any other facilities at the project site for power or heat generation and would in the absence of the project activity be dumped or left to decay or burned in an uncontrolled manner without utilizing it for energy purposes. The power and, in case of cogeneration plants, heat generated by the project plant would in the absence of the project activity be generated in the same plant, only using fossil fuels.

NA = not applicable

Project boundary

For the purpose of determining GHG emissions of the **project activity**, project participants shall include the following emissions sources:

- CO_2 emissions from on-site fuel consumption of fossil fuels, co-fired in the biomass power plant; and
- CO_2 emissions from off-site transportation of biomass that is combusted in the project plant.

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

- CO_2 emissions from fossil fuel fired power plants connected to the electricity system; and
- CO_2 emissions from fossil fuel based heat generation that is displaced through the project activity.

Where the most likely baseline scenario for the biomass is that the biomass would be dumped or left to decay or burned in an uncontrolled manner without utilizing it for energy purposes (case B1), project participants may decide whether to include CH_4 emissions in the project boundary. In this case, CH_4 emissions should be estimated in a conservative manner using emission factors for the uncontrolled burning of biomass. Project participants shall either include CH_4 emissions from both project and baseline emissions or exclude them in both cases, and document their choice in the CDM-PDD.

The **spatial extent** of the project boundary encompasses the power plant at the project site, the means for transportation of biomass to the project site (e.g. vehicles), and all power plants connected physically to the electricity system that the CDM project power plant is connected to. The spatial extent of the project electricity system, including issues related to the calculation of the build margin (BM) and operating margin (OM), is further defined in the "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (ACM0002).

Table 2 illustrates which emissions sources are included and which are excluded from the project boundary for determination of both baseline and project emissions.

Table 2: Overview on emissions sources included in or excluded from the project boundary

	Source	Gas		Justification / Explanation
Baseline	Grid electricity generation	CO_2	Included	Main emission source
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is conservative.
	Heat generation	CO_2	Included	Main emission source
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is conservative.
	Uncontrolled burning or decay of surplus biomass	CO_2	Excluded	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	To be decided by project participants	Project participants may decide to include this emission source, where case B1 has been identified as the most likely baseline scenario.[a]
		N_2O	Excluded	Excluded for simplification. This is conservative. Note also that emissions from natural decay of biomass are not included in GHG inventories as anthropogenic sources.[a]
Project Activity	On-site fossil fuel consumption due to the project activity (stationary or mobile)	CO_2	Included	May be an important emission source
		CH_4	Excluded	Excluded for simplification. This emission source is assumed to be very small.[c]
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small.[c]
	Off-site transportation of biomass	CO_2	Included	May be an important emission source
		CH_4	Excluded	Excluded for simplification. This emission source is assumed to be very small.[c]
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small.[c]
	Combustion of biomass for electricity and / or heat generation	CO_2	Excluded	It is assumed that CO_2 emissions from surplus biomass do not lead to changes of carbon pools in the LULUCF sector.
		CH_4	Included or excluded	This emission source must be included if CH_4 emissions from uncontrolled burning or decay of biomass in the baseline scenario are included.[b]
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be small.
	Biomass storage	CO_2	Excluded	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	Excluded	Excluded for simplification. Since biomass is stored for not longer than one year, this emission source is assumed to be small.
		N_2O	Excluded	Excluded for simplification. This emissions source is assumed to be very small.

Notes to the table:

a. Note that the emission factors for CH_4 and N_2O emissions from uncontrolled burning or decay of dumped biomass are highly uncertain and depend on many site-specific factors. Quantification is difficult and may increase transaction costs significantly. Note also that CH_4 and N_2O emissions from the natural decay or uncontrolled burning are in some cases (e.g. natural decay of forest residues) not anthropogenic sources of emissions included in Annex A of the Kyoto Protocol and should not be included in the calculation of baseline emissions pursuant to paragraph 44 of the modalities and procedures for the CDM.

b. Default CH_4 emissions from combustion of biomass are provided in the Reference Manual of the Revised 1996 IPCC Guidelines (Table 1-7 on page 1.35).

c. CH_4 and N_2O emission factors depend significantly on the technology (e.g. vehicle type) and may be difficult to determine for project participants. Exclusion of this emission source is not a conservative assumption; however, it appears reasonable, since CH_4 and N_2O from on-site use of fossil fuels and transportation are expected to be very small compared to overall emission reductions, and since it simplifies the determination of emission reductions significantly.

Emission Reductions

The project activity mainly reduces CO_2 emissions through substitution of power and heat generation with fossil fuels by energy generation with biomass. The emission reduction ER_y by the project activity during a given year y is the difference between the emission reductions through substitution of electricity generation with fossil fuels ($ER_{electricity,y}$), the emission reductions through substitution of heat generation with fossil fuels ($ER_{heat,y}$), project emissions (PE_y), emissions due to leakage (L_y) and, where this emission source is included in the project boundary and relevant, baseline emissions due to the natural decay or burning of anthropogenic sources of biomass ($BE_{biomass,y}$), as follows:

$$ER_y = ER_{heat,y} + ER_{electricity,y} + BE_{biomass,y} - PE_y - L_y \quad \textbf{(1)}$$

where:

ER_y	are the emissions reductions of the project activity during the year y in tons of CO_2,
$ER_{electricity,y}$	are the emission reductions due to displacement of electricity during the year y in tons of CO_2,
$ER_{heat,y}$	are the emission reductions due to displacement of heat during the year y in tons of CO_2,
$BE_{biomass,y}$	are the baseline emissions due to natural decay or burning of anthropogenic sources of biomass during the year y in tons of CO_2 equivalents,
PE_y	are the project emissions during the year y in tons of CO_2, and
L_y	are the leakage emissions during the year y in tons of CO_2.

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

Project emissions

Project emissions include CO_2 emissions from transportation of biomass to the project site (PET_y) and CO_2 emissions from on-site consumption of fossil fuels due to the project activity ($PEFF_y$) and, where this emission source is included in the project boundary and relevant, CH_4 emissions from the combustion of biomass ($PE_{Biomass,CH4,y}$):

$$PE_y = PET_y + PEFF_{CO2,y} + GWP_{CH4} \cdot PE_{Biomass,CH4,y} \tag{2}$$

where:

PET_y	are the CO_2 emissions during the year y due to transport of the biomass to the project plant in tons of CO_2,
$PEFF_{CO2,y}$	are the CO_2 emissions during the year y due to fossil fuels co-fired by the generation facility in tons of CO_2,
GWP_{CH4}	is the Global Warming Potential for methane valid for the relevant commitment period,
$PE_{Biomass,CH4,y}$	are the CH_4 emissions from the combustion of biomass during the year y.

a) Carbon dioxide emissions from combustion of fossil fuels for transportation of biomass to the project plant (PET_y)

In cases where the biomass is not generated directly at the project site, project participants shall determine CO_2 emissions resulting from transportation of the biomass to the project plant. In many cases transportation is undertaken by vehicles.

Project participants may choose between two different approaches to determine emissions: an approach based on distance and vehicle type (option 1) or on fuel consumption (option 2).

<u>Option 1:</u>
Emissions are calculated on the basis of distance and the number of trips (or the average truck load):

$$PET_y = N_y \cdot AVD_y \cdot EF_{km,CO2} \tag{3}$$

or

$$PET_y = \frac{\sum_i BF_{i,y}}{TL_y} \cdot AVD_y \cdot EF_{km,CO2} \tag{4}$$

where:

N_y	is the number of truck trips during the period y.
AVD_y	is the average return trip distance between the biomass fuel supply sites and the site of the project plant in kilometers (km),
$EF_{km,CO2}$	is the average CO_2 emission factor for the trucks measured in t CO_2/km, and
$BF_{i,y}$	is the quantity of biomass type *i* used as fuel in the project plant during the year *y* in a volume or mass unit,
TL_y	is the average truck load of the trucks used measured in tons or volume of biomass,

<u>Option 2:</u>
Emissions are calculated based on the actual quantity of fossil fuels consumed for transportation.

$$PET_y = \sum_i F_{Trans,i,y} \cdot COEF_{CO2,i} \qquad \textbf{(5)}$$

where:

$F_{Trans,i,y}$	is the fuel consumption of fuel type *i* during the year *y*,
$COEF_{CO2,i}$	is the CO_2 emission factor of the fuel type *i*,

b) Carbon dioxide emissions from on-site consumption of fossil fuels (*$PEFF_y$*)

The proper and efficient operation of the biomass power plant may require using some fossil fuels, e.g. for start-ups or during winter operation (when biomass humidity is too high). Project participants may also co-fire fossil fuels to a limited extent in order to enhance the economic performance of the plant.[7] The calculation of these emissions depends on the scenario from Table 1 that has been identified.

<u>*Scenarios 1 to 14*</u>

CO_2 emissions from combustion of respective fuels are calculated as follows:

$$PEFF_y = \sum_i FF_{project\ plant,i,y} \cdot COEF_{CO2,i} \qquad \textbf{(6)}$$

where:

$FF_{project\ plant,i,,y}$	is the quantity of fossil fuel type *i* combusted in the biomass power plant during the year *y*, and
$COEF_{CO2,i}$	is the CO_2 emission factor of the fuel type *i*.

<u>*Scenario 15*</u>

Where scenario 15 applies, emission reductions are calculated based on the quantity of electricity that is generated by firing the biomass and $PEFF_y = 0$.

[7] Note the applicability conditions of this methodology.

c) Methane emissions from combustion of biomass ($PE_{Biomass,CH4,y}$)

If this source has been included in the project boundary, emissions are calculated as follows:

$$PE_{Biomass,CH4,y} = EF_{CH4} \cdot \sum_{i} BF_{i,y} \cdot NCV_i \qquad (7)$$

where:

$BF_{i,y}$	is the quantity of biomass type *i* used as fuel in the project plant during the year *y* in a volume or mass unit,
NCV_i	is the net calorific value of the biomass type i in terajoules (TJ) per mass or volume of biomass,
EF_{CH4}	CH_4 emission factor for the combustion of biomass in the project plant tons CH_4 per TJ.

To determine the CH_4 emission factor, project participants may conduct measurements at the plant site or use default values, such as provided in the Reference Manual of the Revised 1996 IPCC Guidelines (e.g. Table 1-7 on page 1.35 or Table 1-16 on page 1.54). The uncertainty of the CH_4 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 CH_4 emission factor. The level of the conservativeness factor depends on the uncertainty range of the estimate for the CH_4 emission factor. Project participants shall select the appropriate conservativeness factor from Table 3 below and shall multiply the estimate for the CH_4 emission factor with the conservativeness factor.

For example, where wood is burned in industrial stoker boilers and the IPCC default CH_4 emission factor of 15 kg/TJ, as provided in Table 1-16 of the Reference Manual of the 1996 Revised IPCC Guidelines, is used, the uncertainty can be deemed to be greater than 100%, resulting in a conservativeness factor of 1.37. Thus, in this case a CH_4 emission factor of 21.55 kg/TJ should be used.

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

Emission reductions due to displacement of electricity

Emission reductions due to the displacement of electricity are relevant for all scenarios from Table 1 above and are calculated by multiplying the net quantity of increased electricity generated with biomass as a result of the project activity (EG_y) with the CO_2 baseline emission factor for the electricity displaced due to the project ($EF_{electricity,y}$), as follows:

$$ER_{electricity,y} = EG_y \cdot EF_{electricity,y} \quad \textbf{(8)}$$

where:

$ER_{electricity,y}$	are the emission reductions due to displacement of electricity during the year *y* in tons of CO_2,
EG_y	is the net quantity of increased electricity generation as a result of the project activity (incremental to baseline generation) during the year *y* in MWh,
$EF_{electricity,y}$	is the CO_2 emission factor for the electricity displaced due to the project activity during the year *y* in tons CO_2/MWh.

Step 1: Determination of $EF_{electricity,y}$

The determination of the emission factor for displacement of electricity $EF_{electricity,y}$ depends on the type of project activity and the baseline scenario identified and should be determined as follows for the different scenarios identified in Table 1 above:

Scenarios 1, 2, 3, 4, 9, 10, 11, 12, 13 and 14

The project activity displaces electricity from other grid-connected sources (P4) or from less efficient plants fired with the same type of biomass (P2). Apart from co-firing fossil fuels in the project plant, where relevant, electricity is not generated with fossil fuels at the project site. The emission factor for the displacement of electricity should correspond to the grid emission factor ($EF_{electricity,y} = EF_{grid,y}$) and $EF_{grid,y}$ shall be determined as follows:

- If the power generation capacity of the biomass power plant is of more than 15 MW, $EF_{grid,y}$ should be calculated as a combined margin (CM), following the guidance in the section “Baselines” in the “Consolidated baseline methodology for grid-connected electricity generation from renewable sources” (ACM0002).
- If the power generation capacity of the biomass power plant is less or equal to 15 MW, project participants may alternatively use the average CO_2 emission factor of the electricity system, as referred to in option (d) in step 1 of the baseline determination in ACM0002.

Scenarios 5, 6, 7 and 8

The project activity displaces electricity in a captive power plant (P3) and may partly also displace electricity from the grid (P4). The emission factor for the displacement of electricity should reflect the emissions intensity of the captive power plant and the grid, taking into account an appropriate allocation between displacement of captive power and displacement of electricity from the grid. $EF_{electricity,y}$ shall be determined as follows[8]:

$$EF_{electricity,y} = \begin{cases} \alpha \cdot EF_{CP} + (1-\alpha) \cdot EF_{grid,y} & where\ 0 < \alpha < 1 \\ EF_{CP} & where\ \alpha \geq 1 \\ EF_{grid,y} & where\ \alpha \leq 0 \end{cases} \quad \textbf{(9)}$$

$$\text{with} \quad \alpha = \frac{\frac{EG_{CP,historic,3y}}{3} - EG_{CP,y}}{EG_{project\ plant,y}} \quad \textbf{(10)}$$

where:

$EF_{electricity,y}$	is the CO_2 emission factor for the electricity displaced due to the project activity during the year y in tons CO_2/MWh.
$EF_{grid,y}$	is the CO_2 emission factor for electricity displaced in the grid during the year y in tons CO_2/MWh,
EF_{CP}	is the CO_2 emission factor for electricity displaced in the captive power plant identified as baseline plant (P3) in tons CO_2/MWh,
$EG_{CP,y}$	is the net quantity of electricity generated in captive power plant identified as baseline plant (P3) during the year y in MWh,
$EG_{CP,historic,3y}$	is the net quantity of electricity generated during the three most recent years in the captive power plant identified as baseline plant (P3) in MWh,
$EG_{project\ plant,y}$	is the net quantity of electricity generated in the project plant during the year y in MWh,

The emission factor for captive power generation ($EF_{CP,y}$) is determined based on the historical performance of the plant in the most recent three years, by dividing CO_2 emissions from power generation with fossil fuels during the most recent three years by the overall electricity generation during the most recent three years, as follows:

$$EF_{CP} = \frac{\sum_i FF_{CP,historic,3y,i} \cdot COEF_{CO2,i}}{EG_{CP,historic,3y}} \quad \textbf{(11)}$$

where:

EF_{CP}	is the CO_2 emission factor for electricity displaced in the captive power plant identified as baseline plant (P3) in tons CO_2/MWh,
$FF_{CP,historic,3y,i}$	is the quantity of fossil fuel type i combusted during the most recent three years in the captive power plant,
$COEF_{CO2,i}$	is the CO_2 emission factor of the fuel type i,

[8] This approach aims at identifying the quantities of electricity that replace captive power generation and grid electricity. For example, if electricity demand at the project site increases over time, the captive power plant may continue to produce the same quantity of electricity as prior to the project implementation in order to meet the increased demand. In this case, in the absence of the project activity additional electricity would have been purchased from the grid and consequently the biomass power generation replaces grid electricity.

$EG_{CP,historic,3y}$ is the net quantity of electricity generated during the three most recent years in the captive power plant identified as baseline plant (P3) in MWh,

Scenario 15

The project activity displaces fossil fuel based electricity generation in the project plant. The emission factor for the displacement of electricity should be based on the historical performance of the plant and be calculated ex-ante with equation (11) above ($EF_{electricity,y} = EF_{CP}$), assuming that the efficiency of electricity generation does not change significantly as a result of substitution of fossil fuels with biomass and assuming that the composition of fossil fuels fired during the most recent three years would be similar during the crediting period.

Step 2: Determination of EG_y

The determination of EG_y depends on the type of project activity and the baseline scenario identified and should be determined as follows for the different scenarios identified in Table 1 above:

Scenario 2, 3, 5 and 7

Where scenarios 2, 3, 5 or 7 apply, EG_y corresponds to the net quantity of electricity generation in the project plant ($EG_y = EG_{project\ plant,y}$).

Scenario 10 and 12

Where scenarios 10 or 12 apply, EG_y corresponds to the lower value between (a) the net quantity of electricity generated in the new power unit that is installed as part of the project activity and (b) the difference between the total net electricity generation by the new power unit and the existing power unit(s) and the historical generation of the existing power unit(s), based on the three most recent years, as follows[9]:

$$EG_y = EG_{total,y} - \frac{EG_{historic,3yr}}{3} \quad \textbf{(12)}$$

where:

EG_y	is the net quantity of increased electricity generation as a result of the project activity (incremental to baseline generation) during the year y in MWh,
$EG_{total,y}$	is the net quantity of electricity generated in all power units fired with the same type of biomass at the project site, including the new power unit installed as part of the project activity and any previously existing units, during the year y in MWh,
$EG_{historic,3yr}$	is the net quantity of electricity generated during the most recent three years in all power plants fired with the same type of biomass at the project in MWh,

Scenarios 1, 4, 6, 8, 9, 11 and 13

For the scenarios 1, 6, 8, 4, 9 and 11, EG_y is determined as the difference between the electricity generation in the project plant and the quantity of electricity that would be generated by other power plant(s) using the same quantity of biomass that is fired in the project plant, as follows:

$$EG_y = EG_{project\ plant,y} - \varepsilon_{el,other\ plant(s)} \cdot \sum_i BF_{i,y} \cdot NCV_i \quad \textbf{(13)}$$

where:

EG_y	is the net quantity of increased electricity generation as a result of the project activity (incremental to baseline generation) during the year y in MWh,
$EG_{project\ plant,y}$	is the net quantity of electricity generated in the project plant during the year y in MWh,

[9] This provision aims at ensuring that biomass is not diverted from the existing power plants to the new power generation unit. In that case, baseline scenario B2 would apply instead of scenario B1.

$\varepsilon_{el,other\ plant(s)}$ is the average net energy efficiency of electricity generation in (the) other power plant(s) that would use the biomass fired in the project plant in the absence of the project activity, expressed in $MWh_{el}/TJ_{biomass}$
$BF_{i,y}$ is the quantity of biomass type *i* used as fuel in the project plant during the year *y* in a volume or mass unit, and
NCV_i is the net calorific value of the biomass type i in terajoules (TJ) per mass or volume of biomass.

For the scenarios 9 and 13 from Table 1, EG_y is determined as the difference between

- the lower value between (a) the net quantity of electricity generated in the new power unit that is installed as part of the project activity and (b) the difference between the total net electricity generation by the new power unit and the existing power unit(s) and the historical generation of the existing power unit(s), based on the three most recent years, and
- the quantity of electricity that could be generated by other power plant(s) using the same quantity of biomass that is fired in the project plant,

as follows[9]:

$$EG_y = MIN\left\{\begin{matrix} EG_{project\ plant,y} \\ EG_{total,y} - \frac{EG_{historic,3yr}}{3} \end{matrix}\right\} - \varepsilon_{el,other\ plant(s)} \cdot \sum_i BF_{i,y} \cdot NCV_i \quad \textbf{(14)}$$

where:

EG_y is the net quantity of increased electricity generation as a result of the project activity (incremental to baseline generation) during the year *y* in MWh,
$EG_{project\ plant,y}$ is the net quantity of electricity generated in the project plant during the year *y* in MWh,
$\varepsilon_{el,other\ plant(s)}$ is the average net energy efficiency of electricity generation in (the) other power plant(s) that would use the biomass fired in the project plant in the absence of the project activity, expressed in $MWh_{el}/TJ_{biomass}$
$EG_{total,y}$ is the net quantity of electricity generated in all power units fired with the same type of biomass at the project site, including the new power unit installed as part of the project activity and any previously existing units, during the year *y* in MWh,
$EG_{historic,3yr}$ is the net quantity of electricity generated during the most recent three years in all power plants fired with the same type of biomass at the project in MWh,
$BF_{i,y}$ is the quantity of biomass type *i* used as fuel in the project plant during the year *y* in a volume or mass unit, and
NCV_i is the net calorific value of the biomass type i in terajoules (TJ) per mass or volume of biomass.

Where scenarios 4 or 13 apply, $\varepsilon_{el,other\ plant(s)}$ corresponds to the average net efficiency of electricity generation in the "reference plant" ($\varepsilon_{el,reference\ plant}$) that would be installed in the absence of the CDM project activity. $\varepsilon_{el,reference\ plant}$ should represent the efficiency of electricity generation in commonly installed new biomass power plants in the respective industry sector in the country or region. Project participants should choose the efficiency in a conservative manner, document relevant sources of information (relevant studies, measurements and/or expert judgments) and justify their choice in the CDM-PDD.

Where scenarios 1, 6, 8 or 9 apply and where the project activity is power generation with (without) cogeneration, $\varepsilon_{el,other\ plant(s)}$ should reflect the average net efficiency of electricity generation in power plants in the grid with (without) cogeneration that fire the same type of biomass ($\varepsilon_{el,grid\ plant(s)}$). Project participants should determine $\varepsilon_{el,grid\ plant(s)}$ in a conservative manner based on statistics, surveys, relevant studies, measurements and/or expert judgements, and justify their choice of estimation approach in the CDM-PDD.

Where scenario 11 applies, $\varepsilon_{el,other\ plant(s)}$ corresponds to the average net efficiency of electricity generation in the existing power plant(s) fired with the same type of biomass at the project site ($\varepsilon_{el,existing\ plant(s)}$). To determine $\varepsilon_{el,existing\ plant(s)}$, project participants shall measure the net efficiency of electricity generation prior to project implementation in all existing plant(s). In case of several plant(s), the average efficiency should be determined by weighting the individual efficiencies with the historic electricity generation from the most recent three years. Emission reductions shall only be accounted as long as the existing plant(s) is/are still operating.

Scenario 14

Where scenario 14 applies, EG_y is determined based on the net efficiency of electricity generation in the project plant prior to project implementation $\varepsilon_{el,pre\ project}$ and the net efficiency of electricity generation in the project plant after project implementation $\varepsilon_{el,project\ plant,y}$, as follows:

$$EG_y = EG_{project\ plant,y} \cdot \left(1 - \frac{\varepsilon_{el,pre\ project}}{\varepsilon_{el,project\ plant,y}}\right) \qquad \textbf{(15)}$$

where:

EG_y	is the net quantity of increased electricity generation as a result of the project activity (incremental to baseline generation) during the year *y* in MWh,
$EG_{project\ plant,y}$	is the net quantity of electricity generated in the project plant during the year *y* in MWh,
$\varepsilon_{el,pre\ project}$	is the net efficiency of electricity generation in the project plant prior to project implementation, expressed in $MWh_{el}/TJ_{biomass}$
$\varepsilon_{el,project\ plant,y}$	is average net energy efficiency of electricity generation in the project plant, expressed in $MWh_{heat}/TJ_{biomass}$.

To determine $\varepsilon_{el,pre\ project}$, project participants shall measure the net efficiency of electricity generation prior to project implementation and use, as a conservative approach, the higher value between the measured efficiency and the manufacturer's information on the efficiency of the plant. Project participants shall regularly measure $\varepsilon_{el,project\ plant,y}$ as part of monitoring.

Emission reductions are accounted until the plant or the respective equipment would need to be replaced or respectively retrofitted in the absence of the project activity. From that point of time, a different baseline shall apply. It is assumed that at that point of time the existing plant or equipment would be replaced by a technology with the same or similar performance as the technology installed as part of the project activity. For example, where the project activity involves the replacement of a low-pressure boiler by a high-pressure boiler, emission reductions are only accounted until the existing low-pressure boiler would need to be replaced in the absence of the project activity. As a simplification, it is assumed that the low-pressure boiler would, at the end of its technical lifetime, be replaced by a high pressure boiler with approximately the same efficiency as in the project plant.

In order to estimate the point in time when the existing equipment would need to be replaced in the absence of the project activity, project participants may take the following approaches into account:

(a) The typical average technical lifetime of the type of equipment may be determined and documented, taking into account common practices in the sector and country, e.g. based on industry surveys, statistics, technical literature, etc.
(b) The practices of the responsible company regarding replacement schedules may be evaluated and documented, e.g. based on historical replacement records for similar equipment.

The point in time when the existing equipment would need to be replaced in the absence of the project activity should be chosen in conservative manner, i.e. the earliest point in time should be chosen in cases where only a time frame can be estimated.

Scenario 15

Where scenario 15 applies, EG_y is determined based on the fraction of biomass that has been used in the project plant, taking into account all biomass types *k* and fossil fuel type *i* fired in the project plant during a year, as follows:

$$EG_y = EG_{project\ plant,y} \cdot \frac{\sum_{k} BF_{k,y} \cdot NCV_k}{\sum_{k} BF_{k,y} \cdot NCV_k + \sum_{i} FF_{i,y} \cdot NCV_i} \qquad \textbf{(16)}$$

where:

EG_y	is the net quantity of increased electricity generation as a result of the project activity (incremental to baseline generation) during the year *y* in MWh,
$EG_{project\ plant,y}$	is the net quantity of electricity generated in the project plant during the year *y* in MWh,
$BF_{k,y}$	is the quantity of biomass type *k* fired in the project plant during the year y in a volume or mass unit
NCV_k	is the net calorific value of the biomass type *k* (per volume or mass)
$FF_{i,y}$	is the quantity of fossil fuel type *i* fired in the project plant during the year y in a volume or mass unit

General guidance for all scenarios

In determining the *net* quantities of electricity generation or the *net* efficiency of electricity generation, project participants shall subtract the quantity of electricity required for the operation of the power plant (in both the baseline and project cases).

For this methodology, it is assumed that transmission and distribution losses in the electricity grid are not influenced significantly by the project activity. They are therefore neglected.

Emission reductions or increases due to displacement of heat

In case of cogeneration plants, project participants shall determine the emission reductions or increases due to displacement of heat ($ER_{heat,y}$). The determination of $ER_{heat,y}$ depends on the type of project activity and the most likely baseline scenario and should be determined as follows for the different scenarios identified in Table 1 above:

Scenario 1, 3, 7, 8 and 15

Where scenario 1, 3, 7, 8 or 15 apply, $ER_{heat,y}$ = 0.[10]

Scenario 2 and 10

If the identified baseline scenario is the use of heat from external sources (H7) or other heat generation technologies (H8) emissions due to the displacement of heat are assumed as zero ($ER_{heat,y}$ = 0) as a conservative approach.[11]

If the identified baseline scenario is the generation of heat in boilers using fossil fuels (H6), baseline emissions are calculated by multiplying the savings of fossil fuels with the emission factor of these fuels.

Savings of fossil fuels are determined by dividing the generated heat by the net calorific value of the fuel and the efficiency of the boiler that would be used in the absence of the project activity, as follows for the different scenarios[9]:

[10] In case of scenario 1, the heat would in the absence of the project activity be generated in boilers using fossil fuels (or by other means involving fossil fuels) at the project site and the biomass would be combusted in power plants, including cogeneration plants, at other sites. This involves two different substitution effects:
(a) Fossil fuels are saved at the project site due to the displacement of heat generated from fossil fuels.
(b) The project activity diverts biomass from other (cogeneration) power plants to the project activity. This may indirectly increase the use of fossil fuels for heat generation elsewhere.
These two substitution effects may be of different size, depending on a number of factors, including the performance of the project plant, the fossil-fuel fired boiler as well as the other power plants, and the carbon intensity of the fuels used. As a simplification, it is assumed that the two effects are of similar magnitude and that ER_{heat} = 0.
In case of scenarios 7, 8 and 15, the quantity of heat generated by the project plant displaces heat generation in the existing fossil fuel fired cogeneration plant. However, the associated emission reductions are already accounted in the calculation of emission reductions from electricity generation.

[11] Project participants are encouraged to submit proposals for further amendment of this methodology in order to reflect respective emission reductions from the displacement of heat.

Scenario 2: $$ER_{heat,y} = \frac{Q_y \cdot COEF_i}{\varepsilon_{boiler} \cdot NCV_i} \quad \textbf{(17)}$$

Scenario 10: $$ER_{heat,y} = MIN\left\{\begin{matrix} Q_y \\ \left(Q_{total,y} - \frac{Q_{historic,3yr}}{3}\right)\end{matrix}\right\} \cdot \frac{COEF_i}{\varepsilon_{boiler} \cdot NCV_i} \quad \textbf{(18)}$$

where:

$ER_{heat,y}$	are the emission reductions due to displacement of heat during the year y in tons of CO_2,
Q_y	is the net quantity of heat generated in the cogeneration project plant during the year y in GJ,
$Q_{total,y}$	is the net quantity of heat generated in all cogeneration units fired with the same type of biomass at the project site, including the cogeneration unit installed as part of the project activity and any previously existing units, during the year *y* in MWh,
$Q_{historic,3yr}$	is the net quantity of heat generated during the most recent three years in all cogeneration plants fired with the same type of biomass at the project in MWh,
ε_{boiler}	is the energy efficiency of the boiler that would be used in the absence of the project activity,
NCV_i	is the net calorific value of the fuel type *i* displaced due to the project activity in GJ per volume or mass unit, and
$COEF_i$	is the CO_2 emission factor of the fossil fuel type *i* fired in the boiler in the absence of the project activity in tons CO_2 / mass or volume unit of the fuel.

Scenarios 4, 11, 12, 13 and 14

In case of scenarios 4, 11, 13 and 14, heat and electricity would in the absence of the project activity be generated in a similar cogeneration plant but with a different configuration, i.e. the efficiency of electricity generation is lower than in the project plant. The efficiency of heat generation, i.e. the heat generated per quantity of biomass fired, may differ between the project plant and the plant in the baseline scenario (the "reference plant" in case of scenarios 4 and 13, the existing plant(s) in case of scenario 11, the project plant prior to the implementation of the project activity in case of scenario 14). Where the efficiency of heat generation is smaller in the project plant than in the baseline scenario, i.e. where

$\varepsilon_{th,project\ plant} < \varepsilon_{th,reference\ plant}$ (in case of scenario 4 or 13), or
$\varepsilon_{th,project\ plant} < \varepsilon_{th,existing\ plant(s)}$ (in case of scenario 11), or
$\varepsilon_{th,project\ plant} < \varepsilon_{th,pre\ project}$ (in case of scenario 14),

the quantity of heat generated in the project plant is smaller than the quantity of heat that would be generated in the absence of the project activity. This implies that the project implementation involves additional heat generation from other sources or a longer operation of the project plant. This may result in an increase in GHG emissions.

Similar considerations apply to scenario 12, where the heat would be generated in biomass-fired boilers in the absence of the project activity. Although the cogeneration process as a whole is more efficient than separate generation of electricity and heat, a cogeneration plant usually produces less heat per biomass fired than a boiler ($\varepsilon_{th,project\ plant} < \varepsilon_{boiler}$). As a consequence, the project plant will in most cases produce less heat than would be produced in the boilers in the absence of the project activity if the same amount of biomass is used in both cases. This implies, as for scenarios 4, 11, 13 and 14, that the project implementation involves additional heat generation from other sources or increased operation of the project plant.

To address this substitution effect for all scenarios (4, 11, 12, 13 and 14), project participants may either

- demonstrate that the thermal efficiency in the project plant is larger or similar compared with the thermal efficiency of the plant considered in baseline scenario and then assume $ER_{heat,y} = 0$, or, if this is not the case,
- account for any increases in CO_2 emissions, as described in the following.

This increased level of heat generation as a result of the project activity may be generated by different means, such as

(a) additional biomass being fired in the project plant, i.e. leading to a higher load factor than in the absence of the project activity;
(b) increasing or initiating heat generation in boilers fired with the same type of biomass;
(c) co-firing fossil fuels in the project plant, e.g. in cases where the supply of biomass is limited;
(d) increasing or initiating heat generation in boilers fired with fossil fuels.

Project participants shall identify how additional heat is generated in the context of the project activity, as follows:

- In the absence of any boilers and of any fossil fuel consumption for power or heat generation at the project site, option (a) shall apply.
- Where biomass boilers fired with the same type of biomass are operated and no fossil fuels are used for power or heat generation at the project site, option (b) shall apply.
- Where fossil-fuels are co-fired in the project plant but not in any boilers, option (c) shall apply.
- Where fossil fuels are fired in boilers, option (d) shall apply.

In the case of (a), the additional heat generation can be assumed not to involve additional emissions and $ER_{heat,y} = 0$. In case of (b), emission reductions due to displacement of heat can be estimated as well estimated as zero as a simplified assumption ($ER_{heat,y} = 0$). In case of (c), increases in CO_2 emissions are considered as project emissions and accounted with equation (6) above. In case of (d), project participants shall account for CO_2 emissions from increased combustion of fossil fuels in the boiler(s) due to the project activity, as follows for the different scenarios:

Scenarios 4 and 13:
$$ER_{heat,y} = \frac{Q_y \cdot COEF_i}{\varepsilon_{boiler} \cdot NCV_i} \cdot \left(1 - \frac{\varepsilon_{th,reference\ plant}}{\varepsilon_{th,project\ plant}}\right) \quad \textbf{(19)}$$

Scenario 11:
$$ER_{heat,y} = \frac{Q_y \cdot COEF_i}{\varepsilon_{boiler} \cdot NCV_i} \cdot \left(1 - \frac{\varepsilon_{th,existing\ plant(s)}}{\varepsilon_{th,project\ plant}}\right) \quad \textbf{(20)}$$

Scenario 12:
$$ER_{heat,y} = \frac{Q_y \cdot COEF_i}{\varepsilon_{boiler} \cdot NCV_i} \cdot \left(1 - \frac{\varepsilon_{boiler}}{\varepsilon_{th,project\ plant}}\right) \quad \textbf{(21)}$$

Scenario 13:
$$ER_{heat,y} = \frac{Q_y \cdot COEF_i}{\varepsilon_{boiler} \cdot NCV_i} \cdot \left(1 - \frac{\varepsilon_{th,reference\ plant}}{\varepsilon_{th,project\ plant}}\right) \quad \textbf{(22)}$$

where:

$ER_{heat,y}$	are the baseline emissions due to displacement of heat during the year y in tons of CO_2,
Q_y	is the net quantity of heat generated in the cogeneration project plant during the year y in GJ,
ε_{boiler}	is the energy efficiency of the boiler that is used during the project activity to generate heat next to the cogeneration power plant,
$\varepsilon_{th,reference\ plant}$	is average net energy efficiency of heat generation in the reference plant that would use the biomass fired in the project plant in the absence of the project activity, expressed in $MWh_{heat}/TJ_{biomass}$,
$\varepsilon_{th,pre\ project}$	is the net efficiency of heat generation in the project plant prior to project implementation, expressed in $MWh_{el}/TJ_{biomass}$,
$\varepsilon_{th,existing\ plant(s)}$	is average net energy efficiency of heat generation in the existing cogeneration plant(s), expressed in $MWh_{heat}/TJ_{biomass}$,
$\varepsilon_{th,project\ plant}$	is average net energy efficiency of heat generation in the project cogeneration plant, expressed in $MWh_{heat}/TJ_{biomass}$,
NCV_i	is the net calorific value of the fuel type *i* displaced due to the project activity in GJ per volume or mass unit, and
$COEF_i$	is the CO_2 emission factor of the fossil fuel type *i* displaced due to the project activity in tons CO_2 / mass or volume unit of the fuel.

Note that the emission reductions calculated here are negative.

$\varepsilon_{th,reference\ plant}$ should represent the efficiency of heat generation in commonly installed new biomass cogeneration power plants in the respective industry sector in the country or region. Project participants should choose the efficiency in a conservative manner, document relevant sources of information (relevant studies, measurements and/or expert judgements) and justify their choice in the PDD.

To determine $\varepsilon_{th,pre\ project}$, project participants shall measure the net efficiency of heat generation prior to project implementation and use, as a conservative approach, the higher value between the measured efficiency and the manufacturer's information on the efficiency of the plant.

To determine $\varepsilon_{th,existing\ plant(s)}$, project participants shall measure the net efficiency of heat generation prior to project implementation in all existing cogeneration plant(s). In case of several plant(s), the average efficiency should be determined by weighting the individual efficiencies with the historic electricity generation from the most recent three years. Emission reductions shall only be accounted as long as the existing plant(s) is/are still operating.

General guidance for all scenarios

Where the thermal efficiency of the project cogeneration plant or of any other boilers involved in the project activity is required to calculate emissions, project participants shall conduct regular measurements of these efficiencies as part of monitoring.

To estimate the energy efficiency of boilers involved in the baseline scenario, project participants may choose between the following two options:

<u>Option 1</u>

Use the highest value among the following two values as a conservative approach:

1. Measured efficiency prior to project implementation;
2. Manufacturer's information on efficiency of the existing boilers.

<u>Option 2</u>

Assume a boiler efficiency of 100% based on the net calorific values as a conservative approach.

Baseline emissions due to natural decay or uncontrolled burning of anthropogenic sources of biomass

Where the biomass would have been burned in an uncontrolled manner or would have decayed in the absence of the project activity and where this emission source is anthropogenic, project participants may decide to account associated emissions from methane. For the calculation of these emissions, this methodology assumes that the biomass would have been burned in an uncontrolled manner for both baseline scenarios, natural decay or uncontrolled burning.

<u>Scenarios 1, 4, 6, 8, 9. 11, 12, 13 and 14</u>

$BE_{Biomass,y} = 0$.

<u>Scenarios 2, 3, 5, 7, 10 and 15</u>

Baseline emissions due to the natural decay or uncontrolled burning of anthropogenic sources of biomass ($BE_{Biomass,y}$) are calculated by multiplying the quantity of biomass that would not be used in the absence of the project activity with the net calorific value and an appropriate emission factor, as follows for the different scenarios:

Scenarios 2, 5, 7, 10 and 15: $$BE_{Biomass,y} = GWP_{CH4} \cdot \sum_i BF_{i,y} \cdot NCV_i \cdot EF_{burning,CH4,i} \quad \textbf{(23)}$$

Scenario 3: $$BE_{Biomass,y} = GWP_{CH4} \cdot \left[\sum_i BF_{i,y} \cdot NCV - \frac{Q_y}{\varepsilon_{boiler}} \right] \cdot EF_{burning,CH4,i} \quad \textbf{(24)}$$

where:

$BE_{Biomass,y}$	are the baseline emissions due to natural decay or burning of anthropogenic sources of biomass during the year *y* in tons of CO_2 equivalents,
GWP_{CH4}	is the Global Warming Potential for methane valid for the relevant commitment period,
$BF_{i,y}$	is the quantity of biomass type *i* used as fuel in the project plant during the year *y* in a volume or mass unit,
NCV_i	is the net calorific value of the biomass type i in terajoules (TJ) per mass or volume of biomass,
Q_y	is the net quantity of heat generated in the cogeneration project plant during the year y in

GJ,

ε_{boiler} is the energy efficiency of the boiler that would be used in the absence of the project activity,

$EF_{burning,CH4,i}$ is the CH_4 emission factor for uncontrolled burning of the biomass type *i* in tons CH_4 per TJ.

To determine the CH_4 emission factor, project participants may undertake measurements or use referenced default values. The uncertainty of the CH_4 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 CH_4 emission factor. The level of the conservativeness factor depends on the uncertainty range of the estimate for the CH_4 emission factor. Project participants shall select the appropriate conservativeness factor from Table 4 below and shall multiply the estimate for the CH_4 emission factor with the conservativeness factor.

For example, if the default CH_4 emission factor of 300 kg/TJ for combustion of biomass in agriculture or forestry, as provided in Table 1-7 of the Reference Manual of the 1996 Revised IPCC Guidelines, the uncertainty is deemed to be greater than 100%, resulting in a conservativeness factor of 0.73. Thus, in this case an CH_4 emission factor of 219 kg/TJ should be used.

Table 4. 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

Additionality

The additionality of the project activity shall be demonstrated and assessed using the latest version of the ***"Tool for the demonstration and assessment of additionality"*** *agreed by the CDM Executive Board, available at the UNFCCC CDM web site*[12].

Leakage

The main potential source of leakage for this project activity is an increase in emissions from fossil fuel combustion due to diversion of biomass from other uses to the project plant as a result of the project activity. Changes in carbon pools in the LULUCF sector are expected to be insignificant since this methodology is limited to biomass *residues*, as defined in the applicability conditions above.

Where the most likely baseline scenario is the use of the biomass for energy generation (scenarios 1, 4, 6, 8, 9, 11, 12, 13 and 14), the diversion of biomass to the project activity is already considered in the calculation of baseline reductions. In this case, leakage effects do not need to be addressed.

Where the most likely baseline scenario is that the biomass is dumped or left to decay or burned in an uncontrolled manner without utilizing it for energy purposes (scenarios 2, 3, 5, 7, 10 and 15), project participants shall demonstrate that the use of the biomass residues does not result in increased fossil fuel consumption elsewhere. For this purpose, project participants shall assess as part of the monitoring the supply situation for the types of biomass used in the project plant. The following options may be used to demonstrate that the biomass used in the plant did not increase fossil fuel consumption elsewhere:

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

L_1 Demonstrate that at the sites where the project activity is supplied from with biomass, the biomass has not been collected or utilized (e.g. as energy carrier, fertilizer or feedstock) but has been left for decay or uncontrolled 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 no market has emerged for the biomass considered or by showing that it would not be feasible to utilize the biomass residues for any purposes (e.g. due to the remote location where the biomass is generated).

This approach is applicable to situations where project participants use only biomass residues from specific sites and do not purchase biomass from or sell biomass to a market.

L_2 Demonstrate that there is an abundant surplus of the biomass in the region of the project activity which is not utilized. For this purpose, demonstrate that the quantity of available biomass in the region is at least 25% larger than the quantity of biomass that is utilized (e.g. for energy generation or as feedstock), including the project plant.

L_3 Demonstrate that suppliers of the biomass in the region of the project activity are not able to sell all of their biomass. For this purpose, project participants shall demonstrate that the ultimate supplier of biomass (who supplies the project) and a representative sample of biomass suppliers in the region had a surplus of biomass (e.g. at the end of the period during which biomass is sold), which they could not sell and which is not utilized.

Where project participants wish to use approaches L_2 or L_3 to assess leakage effects, they shall clearly define the geographical boundary of the region and document it in the 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 is 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, for which project participants can not demonstrate with one of the approaches above that the use of the biomass 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 is substituted by the most carbon intensive fuel in the country.

If for a certain type of biomass *i* used in the project activity, leakage effects cannot be ruled out with one of the approaches above, leakage effects for the year *y* shall be calculated as follows:

Scenarios 2, 5, 7, 10 and 15: $$L_y = COEF_{CO2,j} \cdot \sum_i BF_{i,y} \cdot NCV_i \quad \textbf{(25)}$$

Scenario 3: $$L_y = COEF_{CO2,j} \cdot \sum_i BF_{i,y} \cdot NCV_i - \frac{Q_y}{\varepsilon_{boiler}} \quad \textbf{(26)}$$

where:

L_y	are the leakage emissions during the year y in tons of CO_2,
$COEF_{CO2,j}$	is the CO_2 emission coefficient (per an energy unit) of the most carbon intensive fuel used in the country,
$BF_{i,y}$	is the quantity of biomass type *i* used as fuel in the project plant during the year *y* in a volume or mass unit,
i	are the types of biomass for which leakage effects could not be ruled out with one of the approaches L_1, L_2 or L_3 above,
NCV_i	is the net calorific value of the biomass type i (per volume or mass).
Q_y	is the net quantity of heat generated in the cogeneration project plant during the year y in GJ,
ε_{boiler}	is the energy efficiency of the boiler that would be used in the absence of the project activity,

In the case that negative overall emission reductions arise in a year through application of the leakage penalty, CERs are not issued to project participants for the year concerned and in subsequent years, until emission reductions from subsequent years have compensated the quantity of negative emission reductions from the year concerned. (For example: if negative emission reductions of 30 tCO_2e occur in the year t and positive emission reductions of 100 tCO_2e occur in the year t+1, only 70 CERs are issued for the year t+1.)

Draft consolidated monitoring methodology ACM00XX

"Consolidated monitoring methodology for grid-connected electricity generation from biomass residues"

Sources

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

- AM0004: "Grid-connected Biomass Power-Generation that avoids uncontrolled burning of biomass" which is based on the A.T. Biopower Rice Husk Power Project in Thailand whose Baseline study, Monitoring and Verification Plan and Project Design Document were prepared by Mitsubishi Securities;
- AM0015: "Bagasse-based cogeneration connected to an electricity grid" which is based on the Vale do Rosário Bagasse Cogeneration project in Brazil, whose baseline study, monitoring and verification plan and project design document were prepared by Econergy International Corporation;
- NM0050: "Ratchasima SPP Expansion Project in Thailand" whose baseline study, monitoring and verification plan and project design document were prepared by Agrinergy Limited;
- NM0081: "Trupán biomass cogeneration project in Chile" whose baseline study, monitoring and verification plan and project design document were prepared by Celulosa Arauco y Constitutción S.A;
- NM0098: "Nobrecel Fossil-to-Biomass Fuel Switch Project in Brazil", whose baseline study, monitoring and verification plan and project design document were prepared by Nobrecel S.A.Celulose e Papel.

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

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

Applicability

This monitoring methodology shall be used in conjunction with the approved consolidated baseline methodology ACM00XX (Consolidated baseline methodology for grid-connected electricity generation from biomass residues). The same applicability conditions as in baseline ACM00XX apply.

Monitoring Methodology

The monitoring methodology requires monitoring of the following:
- Electricity generation from the proposed project activity;

- Data needed to recalculate the operating margin emission factor, if needed, based on the choice of the method to determine the operating margin (OM), consistent with “Consolidated baseline methodology for grid-connected electricity generation from renewable sources” (ACM0002);
- Data needed to recalculate the build margin emission factor, if needed, consistent with “Consolidated baseline methodology for grid-connected electricity generation from renewable sources” (ACM0002);
- Data needed to calculate, if applicable, carbon dioxide emissions from fuel combustion due to co-firing fossil fuels used in the project plant or in boilers operated next to the project plant or in boilers used in the absence of the project activity;
- Where applicable, data needed to calculate methane emissions from natural decay or burning of biomass in the absence of the project activity;
- Where applicable, data needed to calculate carbon dioxide emissions from the transportation of biomass to the project plant;
- Where applicable, data needed to calculate methane emissions from the combustion of biomass in the project plant;
- Where applicable, data needed to calculate leakage effects from fossil fuel consumption outside the project boundary;

All data collected as part of monitoring should be archived electronically and be kept at least for 2 years after the end of the last crediting period. 100% of the data should be monitored if not indicated differently in the comments in the tables below.

Project emissions parameters

The following table illustrates the data to be collected or used in order to monitor emissions from the project activity.
Project participants should establish a system to monitor the amount of all types of biomass combusted (1). If the amount of biomass combusted is estimated from the amount of biomass delivered to the project site, a procedure should be established to undertake an energy balance for the verification period, considering the stocks of biomass at the beginning and end of each verification period. On-site fossil fuel consumption for the operation of the biomass power plant (10) should be metered through mass or volume (flow) meters, or with an energy balance over the verification period, considering stocks at the beginning and at the end of each verification period. Where possible, project participants should cross-check these estimates with fuel purchase receipts.

The methane emission factor for combustion of biomass in the project plant (3) may be measured or default values may be used. Monitoring of this parameter is only required where this emission source is included in the project boundary. For the default values or the measurements, project participants should also determine and document the uncertainty range of the measurement and apply the respective conservativeness factors, as described in the baseline methodology.

Off-site CO_2 emission due to transportation of biomass can be either calculated based on the distance traveled by trucks (4, 5, 6, 7) or on the basis of actual fuel consumption (8, 9).

ID number	Data Type	Data variable	Data unit	Measured (m) calculated (c) estimated (e)	Recording frequency	Applicable scenarios	Comments
1. $BF_{i,,y}$	Mass or volume	Quantity of biomass type *i* combusted in the project plant during the year *y*	mass or volume unit	m	Continuously, prepare annually an energy balance	All if CH_4 emissions are included in the project boundary)	The quantity of biomass combusted should be collected separately for all types of biomass. Monitoring of this parameter for project emissions is only required if CH_4 emissions from biomass combustion are included in the project boundary or if biomass is transported to the project site and corresponding CO2 emissions are calculated with equation (3) in the baseline methodology.

ID number	Data Type	Data variable	Data unit	Measured (m) calculated (c) estimated (e)	Recording frequency	Applicable scenarios	Comments
2. NCV_i	Net calorific value	Net calorific value of biomass or fossil fuel type i	GJ / mass or volume unit	m or c	Annually		The net calorific value should be determined separately for all types of biomass. Net calorific values should be based on measurements or reliable local or national data. Monitoring of this parameter for project emissions is only required if CH_4 emissions from biomass combustion are included in the project boundary.
3. EF_{CH4}	Emission factor	Methane emission factor for combustion of biomass in the project plant	kg CH_4 / TJ	m or e	Annually		Monitoring of this parameter for project emissions is only required if CH_4 emissions from biomass combustion are included in the project boundary and if measurements are undertaken to determine the emission factor.
4. AVD_y	Distance	Average return trip distance between biomass fuel supply sites and the project site	km	m	Continuously		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.
5. N_y	Number	Number of truck trips for the transportation of biomass	-	m	Continuously		Project participants have to monitor either this parameter or the average truck load TL_y.
6. TL_y	Mass or volume	Average truck load of the trucks used for transportation of biomass	mass unit or volume unit	m	Regularly		Project participants have to monitor either the number of truck trips N_y or this parameter.

ID number	Data Type	Data variable	Data unit	Measured (m) calculated (c) estimated (e)	Recording frequency	Applicable scenarios	Comments
7. $EF_{km,CO2}$	Emission factor	Average CO_2 emission factor for transportation of biomass with trucks	t CO_2/km	c	Annually		Local or national data should be preferred. Default values from the IPCC may be used alternatively and should be chosen in a conservative manner.
8. $F_{Trans,i,y}$	Mass or volume	Fuel consumption of fuel type i used for transportation of biomass	mass or volume unit	m	Continuously		
9. $COEF_{CO2,i}$	Emission factors	CO_2 emission factor for the fuel type i	t CO_2 / mass or volume unit	m or c	Annually		These emission factors are applied to fuel consumption for transportation (8) and on-site fuel consumption (10). Measurements or local / national data should be preferred. Default values from the IPCC may be used alternatively.
10. $FF_{project\ plant,i,y}$	Mass or volume	On-site fossil fuel consumption of fuel type i for co-firing in the project plant	mass or volume unit	m	Continuously		

Baseline emission parameters

Note that data required to calculate the emissions factor for displacement of electricity ($EF_{grid,,y}$) is contained in the "Consolidated monitoring methodology for zero-emission grid-connected electricity generation from renewable sources" (ACM0002). Next to the parameters listed in the table below, project participants shall monitor in addition all baseline emission parameters included in ACM0002.

ID number	Data Type	Data variable	Data unit	Measured (m) calculated (c) estimated (e)	Recording frequency	Applicable scenarios	Comment
11. $EG_{project\ plant,y}$	Electricity quantity	Net quantity of electricity generated in the project plant during the year y	MWh	m	Continuously	All	
12. $EG_{CP,y}$	Electricity quantity	Net quantity of electricity generated in the captive power plant during the year y	MWh	m	Continuously	5, 6, 7, 8	
13. $EG_{total,y}$	Electricity quantity	Total quantity of electricity generated at the project site (including the project plant and any other plants existing at the start of the project activity)	MWh	m and c	Continuously	9, 10, 12, 13	

ID number	Data Type	Data variable	Data unit	Measured (m) calculated (c) estimated (e)	Recording frequency	Applicable scenarios	Comment
14. Q_y	Heat quantity	Net quantity of heat generated from firing biomass in the project plant	GJ	m	Continuously	2, (3), 4, 10, 11, 12, 13, 14	Only relevant for cogeneration project activities. Project participants should calculate the net heat generation and subtract any condensate return. In case of scenarios 3, monitoring of this parameter for project emissions is only required, if CH_4 emissions due to natural decay or uncontrolled burning are included in the project boundary.
15. $Q_{total,y}$	Heat quantity	Net quantity of heat generated at the project site (including the project plant and any other plants existing at the start of the project activity)	GJ	m	Continuously	10	Only relevant for cogeneration project activities. Project participants should calculate the net heat generation and subtract any condensate return.
16. NCV_i	Net calorific value	Net calorific value of the fossil fuel types i co-fired in the project plant	GJ / mass or volume unit	m or c	Annually	15	Measured or local / national data should be preferred. Default values from the IPCC may be used alternatively.
17. $BF_{i,,y}$	Mass or volume	Quantity of biomass type *i* combusted in the project plant during the year *y*	mass or volume unit	m	Continuously, prepare annually an energy balance	1, (2), (3), 4, (5), 6, (7), 8, 9, (10), 11, 13, (15)	The quantity of biomass combusted should be collected separately for all types of biomass. In case of scenarios 2, 3, 5, 7, 10 and 15, monitoring of this parameter for project emissions is only required, if CH_4 emissions due to natural decay or uncontrolled burning are included in the project boundary.

ID number	Data Type	Data variable	Data unit	Measured (m) calculated (c) estimated (e)	Recording frequency	Applicable scenarios	Comment
18. NCV_i	Net calorific value	Net calorific value of biomass or fossil fuel type i	GJ / mass or volume unit	m or c	Annually	1, (2), (3), 4, (5), 6, (7), 8, 9, (10), 11, 13, (15)	The net calorific value should be determined separately for all types of biomass. Net calorific values should be based on measurements or reliable local or national data. In case of scenarios 2, 3, 5, 7, 10 and 15, monitoring of this parameter for project emissions is only required, if CH_4 emissions due to natural decay or uncontrolled burning are included in the project boundary.
19. $FF_{project\ plant,i,y}$	Mass or volume	On-site fossil fuel consumption of fuel type i for co-firing in the project plant	mass or volume unit	m	Continuously	15	
20. $\varepsilon_{el,project\ plant,y}$	Electric energy efficiency	Average net energy efficiency of electricity generation in the project plant	-	c	Quarterly	14	The efficiency should be calculated based on the electricity generation during the year y and the sum of all biomass types *i* used during the year *y*, as follows: $\varepsilon_{el,project\ plant,y} = \frac{EG_{project\ plant,y}}{\sum_i NCV_i \cdot BF_{i,y}}$
21. $\varepsilon_{th,project\ plant,y}$	Thermal energy efficiency	Average net energy efficiency of heat generation in the project plant	-	c	Quarterly	14	The efficiency should be calculated based on the heat generation during the year *y* and the sum of all fuel types *i* used during the year *y*, as follows: $\varepsilon_{th,project\ plant,y} = \frac{Q_y}{\sum_i NCV_i \cdot BF_{i,y}}$

ID number	Data Type	Data variable	Data unit	Measured (m) calculated (c) estimated (e)	Recording frequency	Applicable scenarios	Comment
22. ε_{boiler}	Thermal energy efficiency	Average net energy efficiency of heat generation in the boiler that is operated next to the project plant	-	m	Quarterly	4, 11, 12, 13, 14	

Leakage

Monitoring of leakage effects is only required where the most likely baseline scenario is that the biomass is dumped for decay or burned in an uncontrolled manner without utilizing it for energy purposes (scenarios 2, 3, 5, 7, 10 and 15).

The methodology accounts only for leakage effects due to increases in fossil fuel consumption outside the project boundary as a result of diversion of biomass from other users to the project. Parameters that need to be collected during monitoring to determine leakage effects are listed in the table below.

ID number	Data Type	Data variable	Data unit	Measured (m) calculated (c) estimated (e)	Recording frequency	Comment
23. $BF_{i,y}$	Mass or volume	Quantity of biomass type i for which leakage could not be ruled out using one of the approaches in the baseline methodology	Mass or volume unit	m	Annually	See approach B_1 in the baseline methodology.
24. $COEF_{CO2,j}$	Emission factor	CO_2 emission factor of the most carbon intensive fuel in the calculation of the combined margin with methodology ACM0002	t CO_2 / mass or volume unit	m or c	Annually	Measured or local / national data should be preferred. Default values from the IPCC may be used alternatively.
25.	Volume or mass	Amount of biomass of type i fired in all grid-connected power plants in the region / country	Volume or mass unit	m or c	Annually	Only applicable to approach B_2. Project participants should use official data (dispatch center, statistics, relevant publications, etc.)

ID number	Data Type	Data variable	Data unit	Measured (m) calculated (c) estimated (e)	Recording frequency	Comment
26.	Volume or mass	Quantity of biomass of type i that is available in surplus in the the region / country	Volume or mass unit	m or c	Annually	Only applicable to approach B_{2}. Project participants should use official data (statistics, relevant publications, etc.) or prepare an own survey. The quantity of surplus supply is the difference between available biomass and biomass used for other purposes than gird-connected electricity generation.
27.	Volume or mass	Quantity of biomass of type i that could not be sold or is not utilized at a representative sample group of biomass suppliers	Volume or mass unit	m or c	Annually	Only applicable to approach B_{3}.

Quality Control (QC) and Quality Assurance (QA) Procedures

All measurements should use calibrated measurement equipment that is maintained regularly and checked for its functioning. QA/QC procedures for the parameters to be monitored are illustrated in the following table.

Note: Some QA/QC procedures are taken from the underlying methodologies, some have been added.

Data	Uncertainty Level of Data (High/Medium/Low)	Are QA/QC procedures planned for these data?	Outline explanation how QA/QC procedures are planned
3.	High	Yes	Compare any measurement results with the range of default emission factors.
1., 17., 23.	Low	Yes	Any direct measurements with mass or volume meters at the plant site should be cross-checked with an annual energy balance that is based on purchased quantities and stock changes.
2., 18.	Low	Yes	Check consistency of measurements and local / national data with default values by the IPCC. If the values differ significantly from IPCC default values, possibly collect additional information or conduct measurements.
7., 9., 16., 24.	Low	Yes	Check consistency of measurements and local / national data with default values by the IPCC. If the values differ significantly from IPCC default values, possibly collect additional information or conduct measurements
4.	Low	Yes	Check consistency of distance records provided by the truckers by comparing recorded distances with other information from other sources (e.g. maps).
5.	Low	Yes	Check consistency of the number of truck trips with the quantity of biomass combusted, e.g. by the relation with previous years.
6.	Low	No	
8.	Low	Yes	If project participants determine CO_2 emissions from transportation based on fuel consumption, this estimate should be cross-checked with a simple calculation based on the distance approach.
10., 19.	Low	Yes	The consistency of metered fuel consumption quantities should be checked with purchase receipts.

Data	Uncertainty Level of Data (High/Medium/Low)	Are QA/QC procedures planned for these data?	Outline explanation how QA/QC procedures are planned
11., 12., 13.	Low	Yes	The consistency of metered net electricity generation should be cross-checked with receipts from sales (if available) and the quantity of biomass fired (e.g. check whether the electricity generation divided by the quantity of biomass fired results in a reasonable efficiency that is comparable to previous years).
14., 15.	Low	Yes	The consistency of metered net heat generation should be cross-checked with receipts from sales (if available) and the quantity of biomass fired (e.g. check whether the net heat generation divided by the quantity of biomass fired results in a reasonable thermal efficiency that is comparable to previous years).
20., 21., 22.	Low	Yes	Check consistency with manufacturers information or the efficiency of comparable boilers.
23., 25., 26., 27.	Medium	Yes	Where possible, supplementary data sources and expert judgments should be used to support the findings.