Draft approved consolidated baseline methodology ACMXXXX

"Consolidated baseline methodology for grid-connected electricity generation from biomass residues"[1]

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.

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"

[1] Note that the Meth Panel intends to broaden the scope of this consolidated methodology, e.g. by including procedures for energy efficiency improvement projects. The Meth Panel intends to agree on a new version by September 2005.

Applicability

This methodology is applicable to grid-connected and *biomass residue* fired.

- electricity generation project activities that displace electricity generation in the electricity grid; and/or
- cogeneration project activities that displace electricity generation in the electricity grid and, where applicable, heat generation (steam, hot air, hot liquids, etc) with fossil fuels.

The project activity may include:

- the installation of a new power generation plant at a site where currently no power generation occurs ("power" **greenfield projects**); or
- the installation of a new power generation unit, which is operated next to existing power generation capacity fired with the same type of biomass residue as the project activity (**power expansion projects**).

This consolidated methodology is not yet applicable to project activities that:

- improve energy efficiency (**energy efficiency improvement projects**), e.g. by replacing a low-pressure boiler by a high-pressure boiler or by installing a new plant that replaces an existing plant, or
- replace fossil fuels by biomass in existing power plants (**fuel switch projects**); or
- introduce cogeneration of power and heat, where the currently only power is generated (**waste heat recovery projects**).

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 fossilised 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 amount 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.

This baseline methodology shall be used in conjunction with the approved consolidated monitoring ACMXXXX (Methodology for grid-connected electricity and / or heat generation from biomass project activities).

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 to determine and assess 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** that in the absence of the project activity; and
- in case of cogeneration projects: how the **heat** would be generated in the absence of the project activity.

For **power** generation, the realistic and credible alternative(s) may include, *inter alia*:

P1 The proposed project activity not undertaken as a CDM project activity
P2 The proposed project activity, implemented at a later point in time and not undertaken as a CDM project activity
P3 The proposed project activity (installation of a power plant), fired with the same type of biomass but with a lower electrical energy efficiency (e.g. an efficiency that is common practice in the relevant industry sector)
P4 The generation of power in a particular existing or new plant, on-site or off-site the project site, using other energy sources than biomass residues proposed to be used in the project activity, such as coal, diesel, natural gas, hydro, wind, other biomass types
P5 The generation of power in existing and/or new grid-connected power plants
P6 The continuation of power generation in an existing plant, 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 in addition 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, implemented at a later point in time and not undertaken as a CDM project activity
H3 The proposed project activity (installation of a cogeneration power plant), fired with the same type of biomass but with a lower thermal energy efficiency (e.g. an efficiency that is common practice in the relevant industry sector)
H4 The generation of heat in a particular existing or new cogeneration plant, on-site or off-site the project site, using other energy sources than biomass residues proposed to be used in the project activity, such as coal, diesel, natural gas, hydro, wind, other biomass types
H5 The generation of heat in boilers using the same type of biomass residues
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[2]

B4 The biomass is used for heat generation in other existing or new boilers at other sites[3]

B5 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.[4]

Table 1: Combinations of baseline scenarios applicable to this methodology

<table>
<tr><th rowspan="2">Scenario</th><th rowspan="2">Project type</th><th colspan="3">Baseline scenario</th></tr>
<tr><th>Power generation</th><th>Use of biomass</th><th>Heat generation (where relevant)</th></tr>
<tr><td>1</td><td rowspan="3">Power greenfield projects</td><td rowspan="2">P5</td><td>B3</td><td rowspan="2">H5, H6, H7, H8[5]</td></tr>
<tr><td>2</td><td>B1</td></tr>
<tr><td>3</td><td>P3</td><td>B2</td><td>H3</td></tr>
<tr><td>4</td><td rowspan="2">Power capacity expansion projects</td><td>P5</td><td>B3</td><td rowspan="2">H5, H6, H7, H8[5]</td></tr>
<tr><td>5</td><td>P3</td><td>B2</td></tr>
</table>

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, including stationary combustion from co-firing fossil fuels and mobile combustion from transportation of biomass; and

[2] 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.

[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 heat generation with that biomass type is common practice in the respective region.

[4] Note that the Meth Panel intends to increase the scope of the methodology, increasing the number of combinations that this methodology can be applied to.

[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 H5, H7 and H8 assuming that baseline emissions from heat generation are zero. Project participants are encouraged to submit new methodologies that contain procedures to calculate baseline emissions for these and other cases.

- 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 biomass is dumped or left to decay or burned in an uncontrolled manner without utilizing it for energy purposes is the most likely baseline scenario for the biomass (case B1), project proponents may decide to include CH_4 emissions from both the baseline scenario and the project activity. Where biomass is dumped or left to decay, CH_4 emissions should be estimated conservatively using emission factors for the uncontrolled burning of biomass.. Project participants shall either include CH_4 emissions from both project and baseline CH_4 emissions 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 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 LUCF 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 Reduction

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 baseline emissions though substitution of electricity generation with fossil fuels ($BE_{electricity,y}$), the baseline emissions though substitution of heat generation with fossil fuels ($BE_{heat,y}$), project emissions (PE_y), emissions due to leakage (L_y) and, where this emission source is included in the project boundary, baseline emissions due to the natural decay or burning of anthropogenic sources of biomass, as follows:

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

where:

ER_y are the emissions reductions of the project activity during the year y in tons of CO_2,
$BE_{electricity,y}$ are the baseline emissions due to displacement of electricity during the year y in tons of CO_2,
$BE_{heat,y}$ are the baseline emissions 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 activity

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, CH_4 emissions from the combustion of biomass:

$$PE_y = PET_y + PEFF_{CO2,y} + GWP_{CH4} \cdot PE_{Biomass,CH4,y} \quad \textbf{(2)}$$

where:

$PET_{,y}$	are the CO_2 emissions during the year *y* due to transport of the biomass to the generation facility in tons of CO_2,
$PEFF_{CO2,y}$	are the CO_2 emissions during the year *y* due to fossil fuel 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).

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

$$PET_y = N_y \cdot AVD_y \cdot EF_{km,CO2} \quad \textbf{(3)}$$

or

$$PET_y = \frac{\sum_i BF_{i,y}}{TL_y} \cdot AVD_y \cdot EF_{km,CO2} \quad \textbf{(4)}$$

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,

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

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

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 plant may require to use 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.[6] In addition, fossil fuels may be combusted for on-site transportation of biomass. CO_2 emissions from combustion of respective fuels are calculated as follows:

$$PEFF_y = \sum_i F_{on-site,i,y} \cdot COEF_{CO2,i} \quad \textbf{(6)}$$

where:

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

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

$$PE_{Biomass,CH4,y} = EF_{CH4} \cdot \sum_i BF_{i,y} \cdot NCV_i \quad \textbf{(7)}$$

[6] Note the applicability conditions of this methodology.

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

Baseline emissions due to displacement of electricity

For all applicable cases (1, 2, 3 and 4 in Table 1) the baseline emissions due to displacement of electricity are calculated by multiplying the net quantity of increased electricity generated 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:

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

where:

$BE_{electricity,y}$	are the baseline emissions due to displacement of electricity during the year y in tons of CO_2,
$EG_{,y}$	is the net quantity of increased electricity generated as a result of the project activity during the year y in MWh, and
$EF_{electricity,y}$	is the CO_2 baseline emission factor for the electricity displaced due to the project activity during the year y in tons CO_2/MWh.

$EF_{electricity,y}$ is assumed to be the same for all cases (1-5).

However, the determination of EG_y depends on the project activity and the most likely baseline scenario, as follows:

- Where case 2 applies (i.e. the biomass used by the project would have otherwise not been used for any purpose), EG_y corresponds to the net quantity of electricity generation in the project plant;

- For the cases 1, 3, 4, and 5, where the baseline scenario indicates that the biomass used by the project would otherwise be used to generate electricity at the project site or elsewhere, EG_y is determined as the difference between the electricity generation in the project plant 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:

$$EG_{baseline,y} = EG_{project\ plant,y} - \varepsilon_{other\ plant(s)} \cdot \sum_i BF_{i,y} \cdot NCV_i \quad (9)$$

where:

$EG_{baseline,y}$	is the net quantity of electricity that would have been generated in the baseline scenario during the year y in MWh, and
$EG_{project\ plant,y}$	is the net quantity of electricity generated in the project plant during the year y in MWh,
$\varepsilon_{other\ plant(s)}$	is the average net energy efficiency for electricity generation in the other 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,
NCV_i	is the net calorific value of the biomass type i in terajoules (TJ) per mass or volume of biomass,

Where case 3 applies, $\varepsilon_{other\ plant(s)}$ is the average net efficiency of the plant which has been determined as the most likely baseline scenario.

Where cases 1, 4, or 5 apply and where the project activity is power generation with (without) cogeneration, $\varepsilon_{other\ plant(s)}$ should reflect the average net efficiency of power plants in the grid with (without) cogeneration that fire the same type of biomass. Project participants should determine

$\varepsilon_{other\ plant(s)}$ in conservative manner based on statistics, surveys, relevant studies, measurements and/or expert judgements, and justify their choice of estimation approach in the CDM-PDD.

In determining the *net* quantities of electricity, project participants shall subtract the quantity of electricity required for the operation of the power plant.

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.

If the power generation capacity of the biomass power plant is of more than 15 MW, the CO_2 baseline emission factor ($EF_{electricity,y}$) 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 also 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.

Baseline emissions due to displacement of heat

If the identified baseline scenario is not the generation of heat in boilers using fossil fuels, as referred to as option (e) in the identification of the most likely baseline scenario above, under this methodology $BE_{heat,y} = 0$.[7]

If the identified baseline scenario is the generation of heat in boilers using fossil fuels, 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:

$$BE_{heat,y} = \frac{Q_y}{\varepsilon \cdot NCV_i} \cdot COEF_i \qquad \textbf{(10)}$$

where:

$BE_{heat,y}$	are the baseline emissions due to displacement of heat during the year y in tons of CO_2,
Q_y	is the <u>net</u> quantity of heat generated in the cogeneration plant during the year y in GJ,
E	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.

7 Project participants are encouraged to submit methodologies that estimate baseline emissions for other cases.

To estimate boiler efficiency, project participants may choose between the following two options:

Option 1

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.

Option 2

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

In determining the *net* quantity of heat generated in the biomass-based cogeneration plant (Q_y), project participants shall subtract the quantity of heat required for operation of the plant (e.g. required heat for a biogas reactor).

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.

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 with the net calorific value and an appropriate emission factor, as follows:

$$BE_{Biomass,y} = GWP_{CH4} \cdot \sum_i BF_{i,y} \cdot NCV_i \cdot EF_{burning,CH4,i} \qquad \textbf{(11)}$$

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,
$EF_{burning,CH4,i}$	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* [8].

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 users to the project 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 (cases B2 or B3, and respectively cases 1, 3, 4, or 5), 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 for decay or burned in an uncontrolled manner without utilizing it for energy purposes (case B1 and respectively case 2), project participants shall demonstrate that the use of renewable 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:

[8] 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 or to use the biomass residues for other purposes (e.g. due to the 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 surplus supply of biomass is twice as large as the biomass required to fuel all grid-connected electricity generating plants (including the project plant) using the same type of biomass. Note that in this calculation, the surplus supply is equivalent to the total quantity of available biomass minus the quantity of biomass used for other purposes than grid-connected electricity generation.

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 within 50 km of the project site 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 for energy generation.

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 calculation of the combined margin.

Leakage effects are then calculated as follows:

$$L_y = COEF_{CO2,j} \cdot \sum_i BN_i \cdot NCV_i \qquad \textbf{(12)}$$

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.
BN_i is the quantity of biomass type i that cannot be ruled out as a source of leakage in a volume or mass unit
NCV_i is the net calorific value of the biomass type i (per volume or mass)

For each type of biomass *i*, the quantity of biomass that cannot be ruled out as a source of leakage (BN_i) is determined as follows:

$$BN_i = BP_i - B_{1i} - B_{2i} - B_{3i} \tag{13}$$

where:

BP_i	is the total quantity of biomass type i consumed in the project plant in a volume or mass unit,
B_{1i}	is the quantity of biomass type i for which project participants could demonstrate that its use does not result in leakage, using approach B_1 above,
B_{2i}	is the quantity of biomass type i for which project participants could demonstrate that its use does not result in leakage, using approach B_2 above, and
B_{3i}	is the quantity of biomass type i for which project participants could demonstrate that its use does not result in leakage, using approach B_3 above.

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 approved consolidated monitoring methodology ACMXXXX

"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.

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 methodology is applicable to grid-connected and *biomass residue* fired.

- electricity generation project activities that displace electricity generation in the electricity grid; and/or
- cogeneration project activities that displace electricity generation in the electricity grid and, where applicable, heat generation (steam, hot air, hot liquids, etc) with fossil fuels.

The project activity may include:

- the installation of a new power generation plant at a site where currently no power generation occurs ("power" **greenfield projects**); or
- the installation of a new power generation unit, which is operated next to existing power generation capacity fired with the same type of biomass residue as the project activity (**power expansion projects**).

This consolidated methodology is not yet applicable to project activities that:

- improve energy efficiency (**energy efficiency improvement projects**), e.g. by replacing a low-pressure boiler by a high-pressure boiler or by installing a new plant that replaces an existing plant; or
- replace fossil fuels by biomass in existing power plants (**fuel switch projects**); or
- introduce cogeneration of power and heat, where the currently only power is generated (**waste heat recovery projects**).

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 fossilised 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 amount 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.

This monitoring methodology shall be used in conjunction with the approved consolidated baseline ACMXXXX (Methodology for grid-connected electricity and / or heat generation from biomass project activities).

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 fossil fuels used for heat generation 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;
- Data needed to calculate carbon dioxide emissions from the transportation of biomass to the project plant;
- Data needed to calculate carbon dioxide emissions from on-site stationary or mobile fossil fuel consumption due to the project activity;
- 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;

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 estimated (e.g. based on default values or expert judgments) or measured. Monitoring of this parameter is only required where this emission source is included in the project boundary and where project participants measure emissions. If measurements are undertaken, 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	Pro-portion of data monitored	How will data be archived? (electronic/ paper)	For how long is archived data kept?	Comments
1. $BF_{i,,y}$	Mass or volume	Quantity of biomass of type *i* com-busted in the project plant	mass or volume unit	M	Continuously, prepare annually an energy balance	100%	Electronic	During the crediting period	The quantity of biomass combusted should be collected separately for all types of biomass.
2. NCV_i	Net calorific value	Net calorific value of biomass fuel type i	GJ / mass or volume unit	m or c	Annually	100%	Electronic	During the crediting period	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.

ID number	Data Type	Data variable	Data unit	Measured (m) calculated (c) estimated (e)	Recording frequency	Pro-portion of data monitored	How will data be archived? (electronic/ paper)	For how long is archived data kept?	Comments
3. EF_{CH4}	Emission factor	Methane emission factor for combustion of biomass in the project plant	kg CH4 / TJ	m	Annually	100%	Electronic	During the crediting period	Monitoring only where applicable (see explanations above)
4. AVD_y	Distance	Average return trip distance between biomass fuel supply sites and the project site	km	m	Continuously	100%	Electronic	During the crediting period	If biomass is supplied from different sites, determined as 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	100%	Electronic	During the crediting period	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	100%	Electronic	During the crediting period	Project participants have to monitor either the number of truck trips N_y or this parameter.
7. $EF_{km,CO2}$	Emission factor	Average CO_2 emission factor for trans-portation of biomass with trucks	t CO_2/km	c	Annually	100%	Electronic	During the crediting period	Local or national data should be preferred. Default values from the IPCC may be used alternatively.

ID number	Data Type	Data variable	Data unit	Measured (m) calculated (c) estimated (e)	Recording frequency	Pro-portion of data monitored	How will data be archived? (electronic/ paper)	For how long is archived data kept?	Comments
8. $F_{Trans,i,y}$	Mass or volume	Fuel consumption of fuel type i used for transportation of biomass	mass or volume unit	c	Continuously	100%	Electronic	During the crediting period	
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	100%	Electronic	During the crediting period	These emission factors are applied to fuel consumption for transportation (8) and on-site fuel consumption (10) and used for the calculation of CO_2 baseline emissions from fossil fuel consumption for heat generation. Measurements or local / national data should be preferred. Default values from the IPCC may be used alternatively.
10. $F_{on\text{-}site,i,y}$	Mass or volume	On-site fossil fuel consumption of fuel type i for stationary or mobile use	mass or volume unit	m	Continuously	100%	Electronic	During the crediting period	

Baseline emission parameters

Note that data required to calculate the emissions factor for displacement of electricity ($EF_{electricity,y}$) 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, except the electricity generation of the project activity (*EGy*), which is included in the table below.

ID number	Data Type	Data variable	Data unit	Measured (m) calculated (c) estimated (e)	Recording frequency	Pro-portion of data monitored	How will data be archived? (electronic/ paper)	For how long is archived data kept?	Comment
11. EG_y	Electricity quantity	Net quantity of electricity generated in the project plant	MWh	m and c	Continuously	100%	Electronic	During the crediting period	Electricity used for the operation of the plant should be subtracted
12. Q_y	Heat quantity	Net quantity of heat generated from firing biomass in the project plant	GJ	m	Continuously	100%	Electronic	During the crediting period	Heat used for the operation of the plant should be subtracted.
13. NCV_i	Net calorific value	Net calorific value of the fossil fuel type i used in a boiler in the absence of the project activity	GJ / mass or volume unit	m or c	Annually	100%	Electronic	During the crediting period	Measured or local / national data should be preferred. Default values from the IPCC may be used alternatively.

ID number	Data Type	Data variable	Data unit	Measured (m) calculated (c) estimated (e)	Recording frequency	Pro-portion of data monitored	How will data be archived? (electronic/ paper)	For how long is archived data kept?	Comment
14. $\varepsilon_{other\ plant(s)}$	Other plant energy efficiency	Average net energy efficiency for electricity generation in the other plant(s) that would use the biomass fired in the project plant in the absence of the project activity, expressed in	MWh_{el}/ $TJ_{biomass}$	m or e	Annually	100%	Electronic	During the crediting period	Project participants should determine $\varepsilon_{other\ plant(s)}$ in conservative manner based on statistics, surveys, relevant studies, measurements and/or expert judgments, and justify their choice of estimation approach in the CDM-PDD.

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 (case B1 and respectively case 2).

The methodology accounts only for leakage effects due to increases in fossil fuel consumption outside the project boundary as a result of diversion o 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. Consistent with the baseline methodology, project participants have the parameters 1, 2, 15, 16, 17, 18, and, depending on the approach chosen, 19 and 20, or 21 to determine eventual leakage penalties.

ID number	Data Type	Data variable	Data unit	Measured (m) calculated (c) estimated (e)	Recording frequency	Pro-portion of data monitored	How will data be archived? (electronic/ paper)	For how long is archived data kept?	Comment
15. B_{1i}	Mass or volume	Quantity of biomass type i for which leakage could not be ruled out using approach B_1 in the baseline methodology	Mass or volume unit	m	Annually	100%	Electronic	During the crediting period	See approach B_1 in the baseline methodology.
16. B_{2i}	Mass or volume	Quantity of biomass type i for which leakage could not be ruled out using approach B_2 in the baseline methodology	Mass or volume unit	m	Annually	100%	Electronic	During the crediting period	See approach B_2 in the baseline methodology.

ID number	Data Type	Data variable	Data unit	Measured (m) calculated (c) estimated (e)	Recording frequency	Pro-portion of data monitored	How will data be archived? (electronic/ paper)	For how long is archived data kept?	Comment
17. B_{3i}	Mass or volume	Quantity of biomass type i for which leakage could not be ruled out using approach B_3 in the baseline methodology	Mass or volume unit	m	Annually	100%	Electronic	During the crediting period	See approach B_3 in the baseline methodology.
18. $COEF_{CO2,j}$	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	100%	Electronic	During the crediting period	Measured or local / national data should be preferred. Default values from the IPCC may be used alternatively.
19.	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	100%	Electronic	During the crediting period	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	Pro-portion of data monitored	How will data be archived? (electronic/ paper)	For how long is archived data kept?	Comment
20.	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	100%	Electronic	During the crediting period	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.
21.	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	100%	Electronic	During the crediting period	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.	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., 13.	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.
3., 7., 9., 18.	Low (CO_2) / Medium (CH_4)	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	**Maria: nothing to be included in this cell?? Kay**
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.	Low	Yes	The consistency of metered fuel consumption quantities should be checked with purchase receipts.
11.	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).

Data	Uncertainty Level of Data (High/Medium/Low)	Are QA/QC procedures planned for these data?	Outline explanation how QA/QC procedures are planned
12.	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).
14.	Low	Yes	Check consistency with manufacturers information or the efficiency of comparable boilers.
15., 16., 17., 19., 20., 21.	Medium	Yes	Where possible, supplementary data sources and expert judgments should be used to support the findings.