CDM-MP80-A04

Draft Large-scale Consolidated Methodology

ACM0018: Electricity generation from biomass in power-only plants

Version 05.0

Sectoral scope(s): 01 and 13

United Nations
Framework Convention on
Climate Change

COVER NOTE

1. Procedural background

1. At its 102nd meeting, the CDM Executive Board (the Board) requested the Methodologies Panel (MP) to revise the methodology "ACM0006: Electricity and heat generation from biomass" to address inconsistencies and ambiguities in the language used therein, and revise the methodologies "AM0036: Fuel switch from fossil fuels to biomass residues in heat generation equipment" and "ACM0018: Electricity generation from biomass in power-only plants" to ensure consistency across biomass methodologies.

2. Purpose

2. The purpose of this revision is to address inconsistencies and ambiguities in the language used in the methodology, and simplify the approach for the estimation of emission reductions.

3. Key issues and proposed solutions

3. The proposed revision aims to address inconsistencies and ambiguities in the language used and ensure consistency across biomass methodologies.

4. Further, the revision simplifies the approach for baseline and project emissions from avoided biomass decay/burning.

4. Impacts

5. The revision simplifies the methodology, facilitates its readability and improves its applicability by the project participants.

5. Subsequent work and timelines

6. The MP, at its 80th meeting, agreed on the draft revision of the methodology. After receiving public inputs on the document, the MP will continue working on the revision of the methodology, at its next meeting, for recommendation to the Board at a future meetingof the Board.

6. Recommendations to the Board

7. Not applicable (call for public inputs).

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1. Introduction

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

Table 1. Methodology key elements

Typical project(s)	Generation of power using biomass as fuel, in new biomass based power plants at sites where currently no power generation occurs (greenfield), replacement or installation of operation units next to existing power plants (capacity expansion projects), energy efficiency improvement projects or replacement of fossil fuel by biomass in existing power plants (fuel switch projects). The biomass based power generation may be combined with solar thermal power generation
Type of GHG emissions mitigation action	• Renewable energy; • Energy efficiency; • Fuel switch: Displacement of more GHG-intensive electricity generation in the grid or on-site. Avoidance of methane emissions from anaerobic decay of biomass

2. Scope, applicability, and entry into force

2.1. Scope

2. This methodology applies to project activities that generate power using biomass as fuel, optionally combining with solar thermal power generation. The project may be a Greenfield, capacity expansion or fuel switch project.

2.2. Applicability

3. This methodology is applicable to project activities that generate electricity in biomass (co-) fired power-only plants, optionally combining with electricity generation using solar thermal technology. The project activity may include the following activities or, where applicable, combinations of these activities:

(a) The installation of new biomass(co-)fired power-only plants at a site where currently no power generation occurs (Greenfield power projects);

(b) The installation of new biomass (co-)fired power-only plants, which replace or are operated next to existing power-only plants fired with fossil fuels and/or biomass (power capacity expansion projects);

(c) The improvement of energy efficiency of existing biomass (co-)fired power-only plants (energy efficiency improvement projects), which can also lead to a capacity expansion, for example by retrofitting the existing plant;

(d) The total or partial replacement of fossil fuels by biomass in an existing power-only plant or in a new power-only plant that would have been built in the absence of the project (fuel switch projects), for example by increasing the share of biomass use as compared to the baseline, by retrofitting an existing plant to use biomass, etc.;

(e) The installation of biomass (co-)fired power-only plants which include solar thermal power generation by sharing the power generation equipment between the biomass and solar components at a site where currently no power generation using solar thermal technology occurs (either as Greenfield or power capacity expansion project).

4. The methodology is applicable under the following conditions:

(a) Biomass used by the project facility is limited to biomass residues, biogas, RDF[1] and/or biomass from dedicated plantations;

(b) Fossil fuels may be co-fired in the project plant. However, the amount of fossil fuels co-fired shall not exceed 80 per cent of the total fuel fired (i.e. fossil fuels and biomass) on an energy basis;

(c) 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;

(d) The biomass used by the project facility should not be stored for more than one year;

(e) The biomass used by the project facility is not processed chemically or biologically (e.g. through esterification, fermentation, hydrolysis, pyrolysis, bio- or chemical-degradation, etc.) prior to combustion. Thermal degradation, drying and mechanical processing, such as shredding and pelletisation, are allowed;

(f) No power and heat plant operates at the project site during the crediting period;

(g) If any heat is generated for purposes other than power generation (e.g. heat which is produced in boilers or extracted from the header to feed thermal loads in the process) during the crediting period or was generated prior to the implementation of the project activity, by any on-site or off-site heat generation equipment connected to the project site, the following conditions should apply:

(i) The implementation of the project activity does not influence directly or indirectly the operation of the heat generation equipment, i.e. the heat generation equipment would operate in the same manner in the absence of the project activity;

(ii) The heat generation equipment does not influence directly or indirectly the operation of the project plant (e.g. no fuels are diverted from the heat generation equipment to the project plant); and

(iii) The amount of fuel used in the heat generation equipment can be monitored and clearly differentiated from any fuel used in the project activity;

[1] Refuse Derived Fuel (RDF) may be used in the project plant, but all carbon in the fuel, including carbon from biogenic sources, shall be considered as fossil fuel.

(h) In the case of fuel switch project activities, the use of biomass or the increase in the use of biomass as compared to the baseline scenario is technically not possible at the project site without a capital investment in:

(i) The retrofit or replacement of existing heat generators/boilers; or

(ii) The installation of new heat generators/boilers; or

(iii) A new dedicated biomass supply chain established for the purpose of the project (e.g. collecting and cleaning contaminated new sources of biomass that could otherwise not be used for energy purposes);

(iv) Equipment for preparation and feeding of biomass.

5. If biogas is used for power generation, the biogas must be generated by anaerobic digestion of wastewater, and:

(a) If the wastewater generation source is registered as a CDM project activity, the details of the wastewater project shall be included in the PDD, and emission reductions from biogas energy generation are claimed using this methodology;

(b) If the wastewater source is not a CDM project, the amount of biogas is lower than 50% of the total fuel fired on energy basis.

6. In the case biomass from dedicated plantations are used, the applicability conditions of ~~the methodological tool~~ “TOOL16: Project and leakage emissions from biomass” shall apply.

7. Finally, the methodology is only applicable if the baseline scenario, as identified per the “Procedure for the selection of the baseline scenario and demonstration of additionality” section hereunder, is:

(a) For power generation: Scenarios P2 to P7, or a combination of any of those scenarios.

2.3. Entry into force

8. The date of entry into force is the date of the publication of the EB ## meeting report on DD month YYYY.

2.4. Applicability of sectoral scopes

9. For validation and verification of CDM projects and programme of activities by a designated operational entity (DOE) using this methodology application of sectoral scope 01 is mandatory.

10. If emission reductions are claimed for preventing disposal and/or preventing uncontrolled burning of biomass residues in the baseline, then sectoral scope 13 apply.

3. Normative references

11. This consolidated baseline and monitoring methodology is based on elements from the following approved consolidated baseline and monitoring methodology:

(a) "ACM0006: Consolidated methodology for electricity and heat generation from biomass";

(b) "ACM0014: Treatment of wastewater";

(c) "NM0369: Baseline and monitoring methodology for electricity generation from biomass residues combined with solar thermal power-only plants".

12. This methodology also refers to the latest approved version of the following tool(s):

(a) "TOOL07: Tool to calculate the emission factor for an electricity system";

(b) "TOOL04: Emissions from solid waste disposal sites";

(c) "TOOL03: Tool to calculate project or leakage CO2 emissions from fossil fuel combustion";

(d) "TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation;

~~(e) "TOOL10: Tool to determine the remaining lifetime of equipment";~~

(f) "TOOL16: Project and leakage emissions from biomass";

(g) "TOOL11: Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period";

(h) "TOOL02: Combined tool to identify the baseline scenario and demonstrate additionality";

(i) "TOOL12: Project and leakage emissions from transportation of freight".

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

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

14. "Existing actual or historical emissions, as applicable";

and/or

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

4. Definitions

16. The definitions contained in the Glossary of CDM terms shall apply.

17. Furthermore, the following definitions apply:

(a) **Biomass** - non-fossilized and biodegradable organic material originating from plants, animals and micro-organisms including:

(i) Biomass residue;

(ii) The non-fossilized and biodegradable organic fractions of industrial and municipal wastes; and

(iii) The gases and liquids recovered from the decomposition of non-fossilized and biodegradable organic material;

(b) **Biomass residues** - non-fossilized and biodegradable organic material originating from plants, animals and micro-organisms which is a by-product, residue or waste stream from agriculture, forestry and related industries;

(c) **Cogeneration plant** - is a heat and power plant in which at least one heat engine simultaneously generates both heat and power;

(d) **Heat** - is defined as useful thermal energy that is generated in a heat generation facility (e.g. a boiler, a cogeneration plant, thermal solar panels, etc.) and transferred to a heat carrier (e.g. hot liquids, hot gases, steam, etc.) for utilization in thermal applications and processes, including power generation. ~~For the purposes of this methodology, heat does not include waste heat, i.e. heat that is transferred to the environment without utilization, for example, heat in flue gas, heat transferred to cooling towers or any other heat losses.~~ Note that heat refers to the net quantity of thermal energy that is transferred to a heat carrier at the heat generation facility. For example, in case of a boiler it refers to the difference of the enthalpy of the steam generated in the boiler and the enthalpy of the feed water ~~and~~ or, if applicable, any condensate return;

(e) **Power** - refers to electric power. Mechanical and other forms of power are not included under this methodology;

(f) **Power plant** - is an installation that generates electric power through the conversion of heat to ~~mechanical~~ power using a heat engine. The heat is produced in a heat generator, through the combustion of fuels, and ~~the~~ ~~electric power is generated in an electricity generator, coupled to the heat engine~~ is consumed in a heat engine (e.g. steam turbine) coupled to an electricity generator. ~~The power plant includes all the equipment necessary to generate electric power, including, inter alia, heat generators, heat engines, electricity generators, gear boxes and speed reducers, instrumentation and control equipment, cooling equipment, pumps, fans, and also the systems required for the preparation, storage and transportation of fuels. A common example of power plant is a steam cycle plant, in which heat is produced in boilers through the combustion of fuels, transferred to steam which then drives steam turbines. The steam turbines are coupled, normally via speed reducers, to electricity generators which in turn finally generate the electric power. The steam leaving the turbines is directed to condensers, so that its residual heat content is transferred to the atmosphere via a cooling towers system. In the case of several heat generators providing heat to one heat header and/or several heat engines receiving heat from one heat header, all equipment connected to the heat header should be considered as part of the power plant~~;

(g) **Power-only plant** - is a power plant to which the following conditions apply:

(i) All heat engines of the power plant produce only power and do not co-generate heat; and

(ii) The thermal energy (e.g. steam) produced in equipment of the power plant (e.g. a boiler) is only used in heat engines (e.g. turbines or motors) and not for other processes (e.g. heating purposes or as feedstock in processes). For example, in the case of a power plant with a steam header, this means that all steam supplied to the steam header must be used in turbines;

(h) **Power and heat plant** - ~~is a power plant which does not fulfill one or both conditions of a power-only plant~~ encompass two broad categories of power plants: cogeneration plants (as defined above) and plants in which heat and power are produced at the same installation although not in cogeneration mode, e.g. a common heat header supplies heat for both process heat and power generation;

(i) **An off-grid power plant** is a power plant which is located at a site that has no connection to the electricity grid. The power plant provides electricity only to identified consumers through dedicated distribution line(s) which are only served by power plants from the project site. The consumers are not connected to the grid and do not receive electricity from power plants other than the plants included in the project boundary;

(j) **Net quantity of electricity generation** - is the electricity generated by the power plant unit after exclusion of parasitic and auxiliary loads, i.e. the electricity consumed by the auxiliary equipment of the power plant unit (e.g. pumps, vans, flue gas treatment, control equipment, etc.) and equipment related to fuel handling and preparation;

(k) **Efficiency of electricity generation** - is defined as the net quantity of electricity generated per quantity of fuel fired in the relevant power plant (expressed in the same energy units). The average efficiency refers to the generation efficiency over a longer time period (e.g. one year) that includes different loads and operational modes, including start-ups.

5. Baseline methodology

5.1. Project boundary

18. The spatial extent of the project boundary encompasses:

(a) The project activity power-only plant(s);

(b) All other on-site power-only plants, whether fired with biomass, fossil fuels or a combination of both;

(c) All power plants connected physically to the electricity system (grid) that the project plant is connected to;

(d) If applicable, the means of transportation of biomass to the project site;

(e) If the feedstock is biomass residues, the site where the biomass residues would have been left for decay or dumped;

(f) If the feedstock is biomass produced in dedicated plantations, the geographic boundaries of the dedicated plantations;

(g) The wastewater treatment facilities used to treat the wastewater produced from the treatment of biomass;

(h) If biogas is included, the site of the anaerobic digester:

(i) If the biomass involve any type of processing prior to combustion such as drying, pelletization, shredding, briquetting, etc., two options can be considered. The biomass processing plant can be included in the project boundary and the primary source of the biomass is assessed according to the procedures described in the following section. Or else, the biomass processing plant is not included in the project boundary and then the processed biomass obtained from that plant should be considered as alternative B4 following the guidance in ~~the methodological tool~~ "TOOL16: Project and leakage emissions from biomass".

5.2. Project documentation

19. Explain in the CDM-PDD the specific situation of the project activity. For this purpose, project participants should document in the CDM-PDD:

(a) For each power plant that has been operated at the project site during the most recent three years prior to the start of the project activity: the type and capacity of the power plant, the types and quantities of fuels which have been used in the power plant during the most recent three years prior to the start of the project activity, and whether the plant continues operation after the start of the project activity;

(b) For each boiler or other heat generation equipment that has been operated at the project site during the most recent three years prior to the start of the project activity: the type and capacity of the equipment, the types and quantities of fuels which have been used in the equipment during the most recent three years prior to the start of the project activity, and whether the equipment continues operation after the start of the project activity;

(c) For each power plant installed under the project activity: the type and capacity of the power plant, and the types and quantities of fuels which are planned to be used;

(d) For each power plant that would be installed in the absence of the project activity: the type and capacity of the power plant and the types and quantities of fuels which would be used.

20. 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. Emission sources included in or excluded from the project boundary

Source		Gas	Included	Justification/Explanation
Baseline	Electricity generation	CO_2	Yes	Main emission source
		CH_4	No	Excluded for simplification. This is conservative
		N_2O	No	Excluded for simplification. This is conservative
	Uncontrolled burning or decay of surplus biomass residues	CO_2	No	It is assumed that CO_2 emissions from surplus biomass residues do not lead to changes of carbon pools in the LULUCF sector
		CH_4	Yes or No	Project participants may decide to include this emission source, where case B1, B2 or B3 has been identified as the most likely baseline scenario
		N_2O	No	Excluded for simplification. This is conservative. Note also that emissions from natural decay of biomass are not included in GHG inventories as anthropogenic sources
Project activity	On-site fossil fuel consumption	CO_2	Yes	May be an important emission source
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small
	On-site and off-site transportation and processing of biomass	CO_2	Yes	May be an important emission source
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small
	Combustion of biomass for electricity	CO_2	No	It is assumed that CO_2 emissions from surplus biomass do not lead to changes of carbon pools in the LULUCF sector
		CH_4	Yes or No	This emission source must be included if CH_4 emissions from uncontrolled burning or decay of biomass residues in the baseline scenario are included
		N_2O	No	Excluded for simplification. This emission source is assumed to be small

Source		Gas	Included	Justification/Explanation
	Cultivation of land to produce biomass feedstock	CO_2	Yes	This emission source shall be included in cases biomass from dedicated plantation is used
		CH_4	Yes	This emission source shall be included in cases biomass from dedicated plantation is used
		N_2O	Yes	This emission source shall be included in cases biomass from dedicated plantation is used
	Waste water from the treatment of biomass	CO_2	No	It is assumed that CO_2 emissions from surplus biomass residues do not lead to changes of carbon pools in the LULUCF sector
		CH_4	Yes	This emission source shall be included in cases where the waste water is treated (partly) under anaerobic conditions
		N_2O	No	Excluded for simplification. This emission source is assumed to be small

5.3. Procedure for the selection of the baseline scenario and demonstration of additionality

21. The selection of the baseline scenario and demonstration of additionality should be conducted by ~~applying the~~ following "TOOL02: Combined tool to identify the baseline scenario and demonstrate additionality".

5.3.1. Identification of alternative scenarios

22. The alternative scenarios ~~should~~shall be separately determined regarding:

(a) How electric power would be generated in the absence of the CDM project activity;

(b) If the CDM project activity uses biomass residues, what would happen to the biomass residues in the absence of the CDM project activity (B scenarios); and

(c) If the CDM project activity uses biogas from on-site wastewater, what would happen to the biogas in the absence of the CDM project activity (BG scenarios).

23. The alternative scenarios for electric power ~~should~~shall include, inter alia:

(a) P1: The proposed project activity not undertaken as a CDM project activity;

(b) P2: If applicable,[2] the continuation of power generation in existing power-only plants fired with biomass or fossil fuels, or a combination of both, at the project site. The existing power-only plants would operate at the same conditions (e.g. installed capacities, average load factors, or average energy efficiencies, fuel mixes, and

[2] This alternative is only applicable if there are existing power plants operating at the project site.

equipment configuration) as those observed in the most recent three years prior to the project activity;

(c) P3: If applicable,[2] the continuation of power generation in existing power-only plants fired with biomass or fossil fuels, or a combination of both, at the project site. The existing power-only plants would operate with different conditions from those observed in the most recent three years prior to the project activity;

(d) P4: If applicable,[2] the retrofitting of existing power-only plants fired with biomass or fossil fuels, or a combination of both, at the project site. The retrofitting may or may not include a change in fuel mix;

(e) P5: The generation of power in the grid;

(f) P6: The installation of new power-only plants fired with biomass or fossil fuels, or a combination of both, at the project site, using the same amount or less biomass than under scenario P1, both with and without solar thermal power generation, if applicable;[3]

(g) P7: The installation of new power-only plants fired with biomass or fossil fuels, or a combination of both, at the project site, using more biomass than under scenario P1, both with and without solar thermal power generation, if applicable;[3]

(h) P8: If applicable,[3] the installation of new solar thermal power-only plant without biomass utilisation.

24. When defining plausible and credible alternative scenarios for power generation, the guidance below should be strictly followed:

(a) For any of the alternative scenarios described above, all assumptions with respect to installed capacities, load factors, energy efficiencies, fuel mixes, and equipment configuration, should be clearly described and justified in the CDM-PDD. The justification for existing plants should be based on the existing conditions of the plants and the justification for new plants, or changes to existing plants, should be based on design parameters selected considering realistic and credible alternative design options;

(b) The whole electricity generation under the project scenario, at the project site, must be considered. Therefore, whenever the project activity involves an increase in installed power generation capacity, an increase in electricity generation, and/or a change in electricity demand as compared to the historical situation, the baseline scenario should be determined for the overall power generated under the project activity, possibly including a combination of the different scenarios described above. This is particularly relevant for cases in which existing power plants have operated at the project site prior to the implementation of the project activity;

(c) In cases where alternative scenarios include the installation of new power generation facilities at the project site other than the proposed project activity, the economically most attractive technology and fuel mix should be identified among those which provide the same service (i.e. the same power quantity), that are technologically available and that are in compliance with relevant regulations. The

[3] This alternative is only applicable if the project activity includes the utilization of solar thermal energy.

efficiency of the technology and the fuel type should be selected in a conservative manner, i.e. where several technologies and/or fuel types could be used and are similarly economically attractive, the least carbon intensive fuel type/the most efficient technology should be considered. Ensure that the selected technology represents at least the common practice for new power plants in the respective industry sector, in the country or region, excluding CDM registered projects;[4]

(d) If a power plant was already operated at the project site prior to the implementation of the project activity, it could be retired at the start of the project activity because it is replaced by the project plant, or it may initially be operated in parallel to the project plant and be retired at a future point in time (at the end of its lifetime). In such cases, the remaining technical lifetime of the existing equipment has to be determined and a baseline based on historical performance only applies until the existing power plant would have been replaced or retrofitted in the absence of the project activity. From that point of time, a different baseline shall apply. Project participants should determine the age and the average technical lifetime of any existing power plant, taking into account common practices in the sector and country. The average technical lifetime may be determined based on industry surveys, statistics, technical literature or the practices of the responsible company regarding replacement schedules, e.g. based on historical replacement records for similar equipment. The average technical lifetime 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, and should be documented and justified in the CDM-PDD;

(e) If the project activity supplies electricity partially or fully to (a) captive consumer(s), then alternatives considered for power generation should only include alternatives that can be implemented at the project site (e.g. P1, P2, P3, P4, P6, P7 or P8) or the purchase of electricity from the grid (P5) but not the generation of power in plants established by the project participants at other locations;

(f) If the project activity is the establishment of a greenfield power plant and supplies electricity only to the grid, then the alternatives considered for power generation should include only the scenarios P1 and P5. In this case, it can be considered that the electricity delivered by the project activity would have otherwise been generated by the operation of existing or new grid-connected power plants, established either by the project participants or by third parties.

25. When using biomass residues, the alternative scenarios of the biomass residues in absence of the project activity shall be determined following the guidance in ~~the methodological tool~~ "TOOL16: Project and leakage emissions from biomass";

26. In addition to the alternative scenarios provided in ~~the methodological tool~~ "TOOL16: Project and leakage emissions from biomass", the ~~alternative scenarios~~ project participants shall include scenario B5: The biomass residues are used for electricity generation in power-only plant configuration at the project site in new and/or existing power plants.

~~(a) B5: The biomass residues are used for electricity generation in power-only plant configuration at the project site in new and/or existing power plants.~~

[4] In case all similar plants are registered as CDM project activities, this assessment of common practice is not required.

27. In case the proposed project activity includes the use of biogas, the project shall consider the following baseline alternatives for the biogas:

(a) BG1: No biogas would be generated and wastewater would not be treated by anaerobic digestion;

(b) BG2: Biogas is captured and flared;

(c) BG3: Biogas is captured and used to produce electricity and/or thermal energy;

(d) BG4: Biogas is captured and used as feedstock or transportation fuel.

28. When defining plausible and credible alternative scenarios for the use of biogas, the guidance below should be followed:

(a) If scenario BG1 and BG2 are selected, no biogas shall be included in the baseline scenario of the proposed project activity;

(b) If scenario BG3 is selected, the same amount of biogas produced in the project shall be included in the baseline scenario. For the purpose of calculating the "Baseline Emissions" the biogas shall be considered a biomass residue;

(c) If scenario BG4 is selected, the methodology is not applicable;

(d) In case any emission reductions are claimed for the avoidance of methane in scenario BG1, the baseline scenario for and additionality of the biogas shall be determined in a separate biogas CDM project activity using methodology ACM0014 or AMS-III.H. In addition, all baseline, project and emissions not related to energy generation shall be accounted for in the biogas CDM project activity. Any incremental costs related to biogas energy generation in the project scenario shall be included in the biogas CDM PDD (e.g. costs of pipes, burner and control systems) and not in the proposed project activity under this methodology.

29. In case of scenario BG2 and BG3 any incremental costs related to biogas energy generation in the project scenario shall be included in the PDD of the proposed project activity using this methodology. In case the biogas is supplied by an existing CDM project activity its reference shall be included in the PDD. Any required changes to the existing CDM project activity (e.g. change in project emissions due to flare emissions, reduction of CERs due to energy supply to this methodology) shall be dealt with in the PDD of the existing CDM project activity.

30. ~~For the purpose of identifying relevant alternative scenarios, provide an overview of other technologies or practices that provide outputs or services with comparable quality, properties and application areas as the proposed CDM project activity and that have been implemented previously or are currently underway in the relevant geographical area. The relevant geographical area should in principle be the host country of the proposed CDM project activity. A region within the country could be the relevant geographical area if the framework conditions vary significantly within the country. However, the relevant geographical area should include preferably ten facilities (or projects) that provide outputs or services with comparable quality, properties and application areas as the proposed CDM project activity. If less than ten facilities (or projects) that provide outputs or services with comparable quality, properties and application areas as the proposed CDM project activity are found in the region/host country, the geographical area may be expanded to an area that covers if possible, ten such facilities (or projects). In cases where the above~~

~~described definition of geographical area is not suitable, the project proponents should provide an alternative definition of geographical area. Other registered CDM project activities are not to be included in this analysis. Provide relevant documentation to support the results of the analysis~~.

5.4. Emission reductions

31. Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y \quad \text{Equation (1)}$$

Where:

ER_y	=	Emissions reductions during year *y* (t CO_2)
BE_y	=	Baseline emissions during year *y* (t CO_2)
PE_y	=	Project emissions during year *y* (t CO_2)
LE_y	=	Leakage emissions during year *y* (t CO_2)

5.5. Baseline emissions

32. Baseline emissions may, where applicable, include the following emission sources:

(a) CO_2 emissions from fossil fuel power plants at the project site;

(b) CO_2 emissions from grid-connected fossil fuel power plants in the electricity system;

(c) CH_4 emissions from anaerobic decay of biomass residues and/or CH_4 emissions from uncontrolled burning of biomass residues without utilizing them for energy purposes.

33. Baseline emissions are calculated as follows:

$$BE_y = BE_{EL,y} + BE_{BR,y} \quad \text{Equation (2)}$$

Where:

BE_y	=	Baseline emissions during year *y* (t CO_2)
$BE_{EL,y}$	=	Baseline emissions due to generation of electricity in year *y* (t CO_2)
$BE_{BR,y}$	=	Baseline emissions due to uncontrolled burning or decay of biomass residues in year *y* (t CO_2e)

34. Baseline emissions are determined through the following steps:

5.5.1. Step 1: Determination of $BE_{EL,y}$

35. Baseline emissions from electricity generation are calculated based on the net quantity of electricity generated at the project site under the project scenario ($EG_{PJ,y}$) and a baseline

emission factor ($EF_{BL,EL,y}$) which expresses the weighted average CO_2 intensity of electricity generation in the baseline, as follows:

$$BE_{EL,y} = EG_{PJ,y} \times EF_{BL,EL,y} \quad \text{Equation (3)}$$

Where:

$BE_{EL,y}$	=	Baseline emissions due to generation of electricity in year *y* (t CO_2)
$EG_{PJ,y}$	=	Net quantity of electricity generated in all power plants which are located at the project site and included in the project boundary in year *y* (MWh)
$EF_{BL,EL,y}$	=	Emission factor for electricity generation in the baseline in year *y* (t CO_2/MWh)

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

5.5.1.1. Step 1.1: Determination of $EG_{PJ,y}$

37. The net quantity of electricity generated in all power plants which are located at the project site and included in the project boundary ($EG_{PJ,y}$) is determined as the difference between the gross electricity generation at the project site ($EG_{PJ,gross,y}$) and the auxiliary electricity consumption required for the operation of the power plants at the project site ($EG_{PJ,aux,y}$), as follows:

$$EG_{PJ,y} = EG_{PJ,gross,y} - EG_{PJ,aux,y} \quad \text{Equation (4)}$$

Where:

$EG_{PJ,y}$	=	Net quantity of electricity generated in all power plants which are located at the project site and included in the project boundary in year *y* (MWh)
$EG_{PJ,gross,y}$	=	Gross quantity of electricity generated in all power plants which are located at the project site and included in the project boundary in year *y* (MWh)
$EG_{PJ,aux,y}$	=	Total auxiliary electricity consumption required for the operation of the power plants at the project site (MWh)

38. $EG_{PJ,aux,y}$ shall include all electricity required on-site for the operation of equipment related to the preparation, processing, storage and transport of biomass (e.g. for mechanical treatment of the biomass, conveyor belts, driers, pelletization, shredding, briquetting processes, etc.) and electricity required for the operation of all power plants which are located at the project site and included in the project boundary (e.g. for pumps, fans, cooling towers, instrumentation and control, etc.).

5.5.1.2. Step 1.2: Determination of $EF_{BL,EL,y}$

39. The electricity generated under the project activity could be generated in the baseline in three different ways, depending on the baseline scenario and the particular situation of the project activity:

(a) Use of biomass residues at the project site. Electricity could be generated with biomass residues in power plants at the project site. This applies, for example, if

(i) The project activity is a replacement of an existing biomass residues fired power plant;

(ii) The project activity is a capacity expansion of an existing biomass residues fired power plant by installing a new biomass residues fired power plant that is operated next to the existing plant;

(iii) The project activity is a fuel switch project activity where some biomass residues have already been used prior to the implementation of the project activity;

and/or

(b) Use of fossil fuels at the project site. Electricity could be generated with fossil fuels in power plants at the project site. This applies, for example, if:

(i) The project activity is a fuel switch from fossil fuels to biomass residues;

(ii) In the baseline, a fossil fuel power plant would continue to operate at the project site in parallel with a new biomass residues power plant;

and/or

(c) Power generation in the electricity grid. Electricity could be generated by power plants in the electricity grid. This applies, for example, if

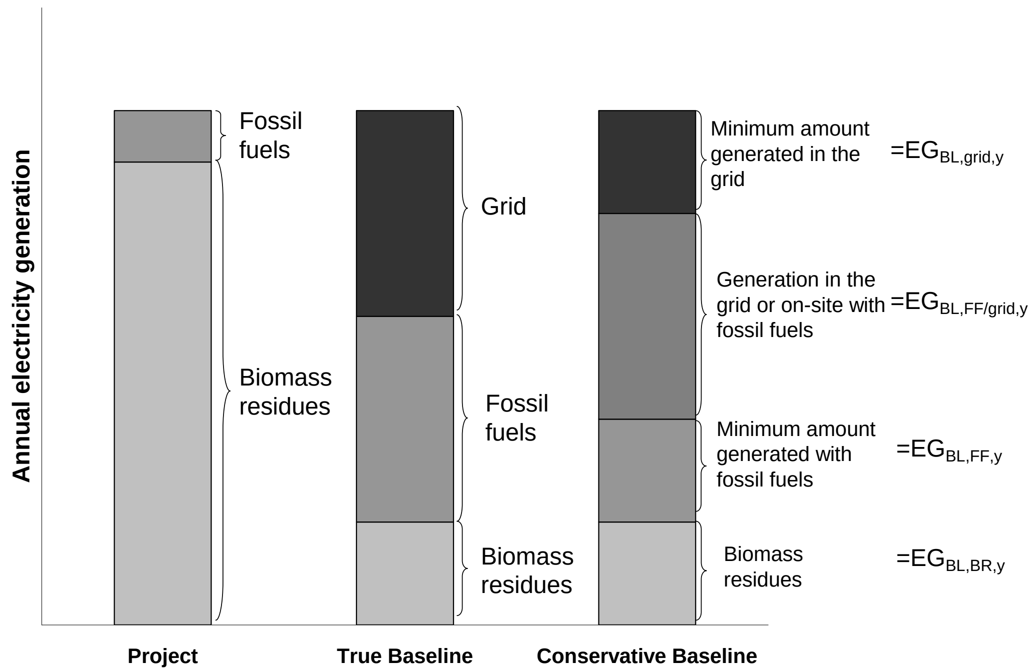
(i) The project activity exports all electricity to the grid and no electricity would be produced at the project site in the baseline;

(ii) The project activity results in an increase of the quantity of electricity produced by power plants included in the project boundary and this increased electricity is exported to the grid or would in the baseline be purchased from the grid.

40. For some project types, electricity would be generated in the baseline by a combination of these three ways. Therefore, $EF_{BL,EL,y}$ is a weighted average baseline emission factor: it is determined based on each of the three ways electricity could be generated (grid, biomass residues, fossil fuels), multiplied with its respective emission factor over the total amount of electricity produced in the baseline.

41. Figure 1 illustrates this general case. Under the project activity, electricity is generated with biomass residues and fossil fuels. This is illustrated in the bar labelled as “Project” in the figure. The bar labelled as “True Baseline” represents the scenario that would truly represent the mix of grid, biomass residues and fossil fuels based electricity that would be generated in the absence of the project activity.

Figure 1. Illustration of the determination of $EF_{BL,EL,y}$



42. In many situations, it is difficult to clearly determine the precise mix of grid, biomass residues and fossil fuels based electricity that would be generated in the absence of the project activity. If electricity can be generated in an on-site fossil fuel power plant or can be purchased from the grid, it is particularly challenging to determine how electricity would be generated in the baseline. For example, to what extent an existing coal power plant is dispatched and to what extent electricity is purchased from the grid can depend on the prices for electricity and coal which change over time.

43. For this reason, this methodology adopts a conservative approach and defines four different electricity quantities to be used for the calculation of the weighted average baseline emission factor $EF_{BL,EL,y}$. This is illustrated in the bar labelled “Conservative Baseline” in Figure 1. These four different electricity quantities are $EG_{BL,BR,y}$, $EG_{BL,grid,y}$, $EG_{BL,FF,y}$ and $EG_{BL,FF/grid,y}$:

(a) $EG_{BL,BR,y}$ corresponds to the amount of electricity that would be generated with biomass residues in power-only plants operated at the project site in the baseline;

(b) $EG_{BL,grid,y}$ corresponds to the amount of electricity for which it can be clearly identified that it would be generated in the electricity grid in the baseline. For example, the amount of electricity generated under the project activity that exceeds the amount that could be generated with the capacity of the baseline plants operated at the project site could only be generated in the grid in the baseline;

(c) $EG_{BL,FF,y}$ corresponds to the amount of electricity for which it can be clearly identified that it would be generated in the baseline with fossil fuels at the project site. For example, in the case of a co-fired boiler operated in the baseline, some fossil fuels may need to be fired for technical or operational reasons;

(d) $EG_{BL,FF/grid,y}$ corresponds to the amount of electricity that could be generated in the baseline either by power plants in the electricity grid or with fossil fuels at the site of the project activity. As it cannot be clearly identified which of these two options would be used in the baseline, the lower CO_2 emission factor between the grid emission factor and the emission factor of fossil fuel power plants operated at the site of the project activity is used for this amount of electricity.

44. Based on this approach, $EF_{BL,EL,y}$ is calculated as follows:

$$EF_{BL,EL,y} = \frac{EG_{BL,FF,y} \times EF_{BL,FF,y} + EG_{BL,grid,y} \times EF_{grid,CM,y} + EG_{BL,FF/grid,y} \times \mathrm{MIN}\left(EF_{BL,FF,y}, EF_{grid,CM,y}\right)}{EG_{BL,BR,y} + EG_{BL,FF,y} + EG_{BL,grid,y} + EG_{BL,FF/grid,y}} \quad \text{Equation (5)}$$

Where:

$EF_{BL,EL,y}$	=	Emission factor for electricity generation in the baseline in year *y* (t CO_2/MWh)
$EG_{BL,BR,y}$	=	Amount of electricity that would be generated with biomass residues in power-only plants operated at the project site in the baseline in year *y* (MWh)
$EG_{BL,FF,y}$	=	Minimum amount of electricity that would be generated with fossil fuels at the project site in the baseline in year *y* (MWh)
$EG_{BL,grid,y}$	=	Minimum amount of electricity that would be generated by power plants in the electricity grid in the baseline in year *y* (MWh)
$EG_{BL,FF/grid,y}$	=	Amount of electricity that could be generated in the baseline either by power plants in the electricity grid or by power plants at the project site using fossil fuels in year *y* (MWh)
$EF_{grid,CM,y}$	=	Combined margin CO_2 emission factor for grid-connected electricity generation in year *y* (t CO_2/MWh)
$EF_{BL,FF,y}$	=	CO_2 emission factor for electricity generation with fossil fuels in power plant(s) at the project site in the baseline in year *y* (t CO_2/MWh)

45. In the following, first the amounts of electricity generated from the various sources in the baseline ($EG_{BL,BR,y}$, $EG_{BL,grid,y}$, $EG_{BL,FF,y}$ and $EG_{BL,FF/grid,y}$) are determined, taking into account the project configuration and the baseline scenario. Therefore, different cases have to be considered. Then the emission factors ($EF_{grid,CM,y}$ and $EF_{BL,FF,y}$) are determined.

5.5.1.3. Step 1.3: Determination of $EG_{BL,BR,y}$

46. The amount of electricity that would be generated with biomass residues in power-only plants operated at the project site in the baseline ($EG_{BL,BR,y}$) should, in accordance with the baseline scenario and the historical situation before project implementation, be determined as follows:

(a) **Case 1: No power generation with biomass residues in the baseline:** If Scenario B5 does not apply to any biomass residue category (i.e. if no biomass residues would be used for electricity generation in power-only plants in the baseline), then: $EG_{BL,BR,y}$ = 0;

(e) **Case 2: Power generation with biomass residues in the baseline:** If Scenario B5 applies to all or parts of the biomass residues fired in the power plant(s) included in the project boundary (i.e. if all or parts of the biomass residues would be used in the baseline for electricity generation in power-only plants included in the baseline boundary), then $EG_{BL,BR,y}$ is calculated as follows:

$$EG_{BL,BR,y} = \frac{1}{3.6} \times \sum_{n} \sum_{p} \eta_{BL,BR,p} \times BR_{BL,n,p,y} \times NCV_{n,y}$$ Equation (6)

Where:

$EG_{BL,BR,y}$	=	Amount of electricity that would be generated with biomass residues in power-only plants operated at the project site in the baseline in year *y* (MWh)
$\eta_{BL,BR,p}$	=	Efficiency of electricity generation of baseline power plant *p* if fired only with biomass residues and not with fossil fuels (ratio)
$BR_{BL,n,p,y}$	=	Quantity of biomass residues of category *n* that would be fired in power-only plant *p* in the baseline in year *y* (tonnes on dry-basis)
$NCV_{n,y}$	=	Net calorific value of biomass residues of category *n* in year *y* (GJ/tonnes on dry-basis)
n	=	Biomass residues categories
p	=	Power-only plants at the site of the project activity that would (partly) use biomass residues to generate electricity in the baseline

5.5.1.3.1. Determination of $BR_{BL,n,p,y}$

47. Where case 2 above applies, $BR_{BL,n,p,y}$ has to be determined. The determination of $BR_{BL,n,p,y}$ shall be based on the monitored amounts of biomass residues used in power plants included in the project boundary. The biomass residue quantities used should be monitored separately for (a) each type of biomass residue (e.g. rice husks, sugarcane bagasse, empty fruit bunches, etc.) and each source (e.g. produced on-site, obtained from biomass residues suppliers, obtained from a biomass residues market, obtained from an identified biomass residues producer, etc.). Note that $BR_{BL,n,p,y}$ only includes those biomass residues categories which would also be used in the baseline for electricity generation in power-only plants (i.e. for which B5 or BG3 is the baseline scenario).

48. Where the whole amount of biomass residues of one particular type and from one particular source would be used in the baseline in only one clearly identifiable baseline power plant *p*, the monitored quantities of biomass residues used in the project ($BR_{PJ,n,y}$) can be directly allocated to their use in the baseline scenario ($BR_{BL,n,p,y}$). This allocation should be made consistently with above, as provided for the project activity in the CDM-PDD.

49. However, the following situations require particular attention:

(a) One biomass residue type from one particular source could be used in the baseline in two or more power plants *p* (and not only in one power plant) or in different boilers of that power plant. In this case, the use of this biomass residue type from this source has to be allocated to the different baseline power plants *p* or different boilers should they have a different efficiency;

(b) One biomass residue type from one particular source could have two different fates in the baseline scenario. For example: rice husks are obtained from one source but would in the baseline partly be dumped (B1) and partly be used for power generation at the project site (B5). This can apply, for example, if parts of one biomass residue type were already collected prior to the implementation of the project activity while another part was not needed and thus dumped, left to decay or burnt. In this case, it is necessary to allocate the biomass residue quantity used under the project to the following fates in the baseline scenario:

(i) Electricity generation in power-only plants at the project site (B5);

(ii) Dumping, leaving to decay or burning (B1, B2 and/or B3); or

(iii) Other fates (B4).

50. Where one of these situations arises, the project participants should specify and justify in the CDM-PDD in a transparent manner how the relevant allocations should be made and how $BR_{BL,n,p,y}$ should be determined for the relevant biomass residue category *n* and each power plant *p* based on the monitored quantities. The approaches used should be consistent with the identified baseline scenario and reflect the particular situation of the underlying project activity. In doing so, the following allocation rules should be adhered to:

(a) The sum of biomass residues used in the baseline in all power plants *p* shall correspond to the total amount of biomass residues which are used under the project activity and for which the baseline scenario is B5:

$$\sum_{n}\sum_{p} BR_{BL,n,p,y} = \sum_{n} BR_{PJ,n,y}$$ Equation (7)

Where:

$BR_{BL,n,p,y}$	=	Quantity of biomass residues of category *n* that would be fired in power-only plant *p* in the baseline in year *y* (tonnes on dry-basis)
$BR_{PJ,n,y}$	=	Quantity of biomass residues of category *n* used in power plants which are located at the project site and included in the project boundary in year *y* (tonnes on a dry-basis)
n	=	Biomass residues categories
p	=	Power-only plants at the site of the project activity that would (partly) use biomass residues to generate electricity in the baseline

(b) The allocation of biomass residue should be undertaken in a conservative manner. This means that in case of uncertainty an allocation rule should favour the option that results in lower emission reductions;

(c) If several biomass residue plants *p* or several boilers supplying one power plant would operate in the baseline and if it is technically feasible to use a biomass residue type in different power plants *p* or boilers, one of the following two approaches should be applied:

(i) Assume the most efficient operation mode which results in the greatest amount of electricity generation from biomass residues. For example, it should be assumed that first those biomass residues types, boilers and power plants *p* would be used that yield the highest efficiency of power generation, taking into account technical constraints, and that subsequently less efficient biomass residue types or equipment would be used;

(ii) Choose for the determination of $\eta_{BL,BR,p}$ below the same conservative default efficiency for all power plants *p* that would be operated in the baseline at the project. In this case, no allocation of biomass residues to different power plants is required;

(d) In the case a biomass residues type from one particular source has been used prior to the implementation of the project activity partly in power-only plants operated at the project site (scenario B5) and partly has been dumped, left to decay or burnt (scenarios B1, B2, B3) and if this situation would continue in the baseline scenario, then use, as a conservative approach to address the uncertainty associated with such an allocation, the maximum value among the following two approaches for the quantity of biomass residue allocated to scenario B5:

(i) The highest annual historical use of that biomass residue type from that source in power-only plants operated at the project site observed in the most recent three calendar years prior to the implementation of the project activity; and

(ii) In the case of projects that use biomass residues from an on-site production process (e.g. production of sugar cane or rice), calculated as follows:

$$BR_{PJ,n,B5,y} = P_y \times MAX\left\{\frac{BR_{n,power-only,x}}{P_x};\frac{BR_{n,power-only,x-1}}{P_{x-1}};\frac{BR_{n,power-only,x-2}}{P_{x-2}}\right\}$$

Equation (8)

Where:

$BR_{PJ,n,B5,y}$	=	Quantity of biomass residues of category *n* used in year *y* in power-only plants which are located at the project site and included in the project boundary and for which B5 is the baseline scenario (tonnes on dry-basis)
$BR_{n,power-only,x}$	=	Quantity of biomass residues of category *n* used in year *x* in power-only plants which were used at the project site prior to the implementation of the project activity (tonnes on dry-basis)

P_y	=	Quantity of the main product of the production process (e.g. sugar cane, rice) produced in year *y* from plants operated at the project site
P_x	=	Quantity of the main product of the production process (e.g. sugar cane, rice) produced in year *x* from plants operated at the project site
x	=	Last calendar year prior to the start of the crediting period
n	=	Biomass residue type from one particular source for which the baseline scenario is partly B5 and partly B1/B2/B3 B1 is the baseline scenario

5.5.1.3.2. Determination of $\eta_{BL,BR,p}$

51. This methodology covers situations where a power plant *p* includes different heat generators which can use different fuel types and which operate in parallel, supplying heat to a common heat header, as well as several heat engines with different efficiencies that also operate in parallel and all use heat from the common heat header. Therefore, the definition of a single efficiency of electricity generation for a baseline power plant *p* is challenging, and a simplified and conservative approach (i.e. an approach that tends to overestimate $\eta_{BL,BR,p}$) is taken.

52. The parameter $\eta_{BL,BR,p}$ should be calculated using one of the following options for each power plant *p*:

Option 1: Default values

53. Use the following conservative default values:

(a) For existing plants operated at the project site prior to the implementation of the project activity: $\eta_{BL,BR,p}$ = 0.37;

(b) For new plants that would be in the baseline scenario be constructed and operated at the project site: $\eta_{BL,BR,p}$ = 0.39.

Option 2: Manufacturer's data

54. This option is only applicable to plants that were operated at the project site prior to the implementation of the project activity (and not new plants that would be constructed and operated at the project site in the baseline scenario). The overall efficiency of the plant is determined based on manufacturer's data of the efficiency of the main components under optimal operating conditions, as follows:

$$\eta_{BL,BR,p} = \eta_{BL,hg,p} \times \eta_{BL,mg,p} \times \eta_{BL,eg,p} \quad \text{Equation (9)}$$

Where:

$\eta_{BL,BR,p}$	=	Efficiency of electricity generation of baseline power plant *p* if fired only with biomass residues and not with fossil fuels (ratio)

$\eta_{BL,hg,p}$	=	Conservative efficiency of heat generation of baseline power plant *p* if fired only with biomass residues and not with fossil fuels (ratio)
$\eta_{BL,mg,p}$	=	Conservative efficiency of conversion from heat to mechanical shaft power of baseline power plant *p* (ratio)
$\eta_{BL,eg,p}$	=	Conservative efficiency of the electric generators of baseline power plant *p* (ratio)

55. For any of the parameters $\eta_{BL,hg,p}$, $\eta_{BL,mg,p}$ and $\eta_{BL,BR,p}$, if several heat generators, heat engines and electric generators would operate in the baseline and if it cannot clearly defined which configuration would prevail in the baseline, the most conservative values for efficiencies should be assumed in determining $\eta_{BL,BR,p}$. For example, if several boilers, turbines, speed reducers and electric generators operate in the power plant *p*, it should be assumed that the most efficient boiler and the most efficient set of turbine-speed reducer-electric generator would be used. The efficiency of conversion from heat to mechanical shaft power should include the speed-reducers or gear boxes required to couple the mechanical shaft power generator to the electric generator.

Option 3: Commissioning performance data

56. This option is only applicable to plants that were operated at the project site prior to the implementation of the project activity (and not new plants that would be constructed and operated at the project site in the baseline scenario). The overall efficiency of the plant is determined based on commissioning performance data of the efficiency of the main components, as follows:

$$\eta_{BL,BR,p} = \eta_{BL,hg,p} \times \eta_{BL,mg,p} \times \eta_{BL,eg,p}$$ Equation (10)

57. Where:

$\eta_{BL,BR,p}$	=	Efficiency of electricity generation of baseline power plant p when fired only with biomass residues and not with fossil fuels (ratio)
$\eta_{BL,hg,p}$	=	Conservative efficiency of heat generation of baseline power plant p when fired only with biomass residues and not with fossil fuels (ratio)
$\eta_{BL,mg,p}$	=	Conservative efficiency of conversion from heat to mechanical shaft power of baseline power plant p (ratio)
$\eta_{BL,eg,p}$	=	Conservative efficiency of the electric generators of baseline power plant p (ratio)

Option 4: Historical records

58. This option is only applicable to plants that were operated at the project site for at least three calendar years prior to the implementation of the project activity. The overall efficiency of a plant *p* is determined based on the historical quantity of biomass residues used in the plant and electricity generation of the plant, as follows:

$$\eta_{BL,BR,p} = MAX \left\{ \frac{EG_{BR,p,x}}{\sum_n BR_{n,p,x} \times NCV_{n,x}} ; \frac{EG_{BR,p,x-1}}{\sum_n BR_{n,p,x-1} \times NCV_{n,x-1}} ; \frac{EG_{BR,p,x-2}}{\sum_n BR_{n,p,x-2} \times NCV_{n,x-2}} \right\}$$ Equation (11)

Where:

$\eta_{BL,BR,p}$	=	Efficiency of electricity generation of baseline power plant *p* if fired only with biomass residues and not with fossil fuels (ratio)
$EG_{BR,p,x}$	=	Net quantity of electricity generated from using biomass residues in power plant *p* in year *x* (MWh / yr)
$BR_{n,p,x}$	=	Quantity of biomass residues of category *n* used in year *x* in power plant *p* (tonnes on dry-basis)
$NCV_{n,x}$		Net calorific value of biomass residue category *n* in year *x* (GJ/tons on a dry basis)
p	=	Power-only plants at the site of the project activity that would (partly) use biomass residues to generate electricity in the baseline
x	=	Last calendar year prior to the start of the crediting period
n	=	Biomass residues categories

59. If only biomass residues and no fossil fuels were used for electricity generation in the power plant *p* prior to the implementation of the project activity, then $EG_{BR,p,x}$, $EG_{BR,p,x-1}$ and $EG_{BR,p,x-2}$ can be obtained directly from historical electricity generation records ($EG_{BR,p,x} = EG_{p,x}$; $EG_{BR,p,x-1} = EG_{p,x-1}$; $EG_{BR,p,-2x} = EG_{p,x-2}$).

60. If fossil fuels and biomass residues were used for electricity generation in power plant *p* prior to the implementation of the project activity, then $EG_{BR,p,x}$, $EG_{BR,p,x-1}$ and $EG_{BR,p,x-2}$ are determined as follows:

$$EG_{BR,p,x} = EG_{p,x} \times \frac{\sum_n BR_{n,p,x} \times NCV_{n,x}}{\sum_n BR_{n,p,x} \times NCV_{n,x} + \sum_m FF_{m,p,x} \times NCV_{m,x}}$$ Equation (12)

Where:

$EG_{BR,p,x}$	=	Net quantity of electricity generated from using biomass residues in power plant *p* in year *x* (MWh/yr)
$EG_{p,x}$	=	Net quantity of electricity generated in power plant *p* in year *x* (MWh/yr)
$BR_{n,p,x}$	=	Quantity of biomass residues of category *n* used in year *x* in power plant *p* (tonnes on dry-basis)
$NCV_{n,x}$	=	Net calorific value of biomass residue category *n* in year *x* (GJ/tons on a dry basis)
$FF_{m,p,x}$	=	Quantity of fossil fuel type *m* fired in power plant *p* in year *x* (mass or volume unit/yr)

$NCV_{m,x}$	=	Net calorific value of fossil fuel type *m* in year *x* (GJ/mass or volume unit)
m	=	Fossil fuel types used in the power plants *p* in years *x*, *x*-1 and *x*-2
p	=	Power-only plants at the site of the project activity that would (partly) use biomass residues to generate electricity in the baseline
x	=	Last calendar year prior to the start of the crediting period
n	=	Biomass residues categories

Option 5: Determination of a benchmark for the baseline efficiency

61. Use the average efficiency of the top 20 per cent performing biomass residue power-only plants in the relevant region among the plants that were built in the most recent five calendar years prior to the implementation of the project activity. The region should be defined in a manner that it includes at least 10 plants.

5.5.1.4. Step 1.4: Determination of $EG_{BL,FF,y}$

62. The minimum amount of electricity that would be generated with fossil fuels at the project site in the baseline in year *y* ($EG_{BL,FF,y}$) should, in accordance with the baseline scenario and the historical situation before project implementation, be determined as follows:

Case 1: No use of fossil fuels in the baseline

63. This case applies if no fossil fuels would be used for electricity generation in the baseline scenario at the project site. In this case, $EG_{BL,FF,y} = 0$.

Case 2: No connection to the electricity grid

64. This case applies if all power plants included in the project boundary are off-grid power plants. In this case, the electricity generated by the project can only displace on-site electricity generation with fossil fuel and/or biomass residues ($EG_{PJ,y} = EG_{BL,FF,y} + EG_{BL,BR,y}$). Accordingly, $EG_{BL,FF,y}$ is calculated as follows:

$$EG_{BL,FF,y} = EG_{PJ,y} - EG_{BL,BR,y}$$ Equation (13)

Where:

$EG_{BL,FF,y}$	=	Minimum amount of electricity that would be generated with fossil fuels at the project site in the baseline in year *y* (MWh)
$EG_{PJ,y}$	=	Electricity generated in power plants included in the project boundary in year *y* (MWh/yr)
$EG_{BL,BR,y}$	=	Amount of electricity that would be generated with biomass residues in power-only plants operated at the project site in the baseline in year *y* (MWh/yr)

Case 3: Grid connection and historical use of fossil fuels

65. This case applies if:

(a) At least one power plant included in the project boundary is not an off-grid plant;

(b) Fossil fuels were used for power generation at the project site at any point in time during the most recent three calendar years prior to the implementation of the project activity; and

(c) The baseline scenario is the continued use of fossil fuels for power generation at the project site either in existing or new (co-fired) power plant(s) at the project site which is/are (co-)fired with fossil fuels.

66. In this case, it is assumed that at least the lowest annual amount of fossil fuel use during the most recent three years would continue to be used for electricity generation in the baseline. $EG_{BL,FF,y}$ is then determined as the lowest annual amount of electricity generation with fossil fuels during the most recent three years prior to the implementation of the project activity, as follows:

$$EG_{BL,FF,y} = MIN\left(EG_{FF,x}; EG_{FF,x-1}; EG_{FF,x-2}\right) \quad \text{Equation (14)}$$

Where:

$EG_{BL,FF,y}$	=	Minimum amount of electricity that would be generated with fossil fuels at the project site in the baseline in year *y* (MWh/yr)
$EG_{FF,x}$	=	Electricity generation with fossil fuels in power plant(s) operated in year *x* at the project site and included in the project boundary (MWh/yr)
$EG_{FF,x-1}$	=	Electricity generation with fossil fuels in power plant(s) operated in year *x*-1 at the project site and included in the project boundary (MWh/yr)
$EG_{FF,x-2}$	=	Electricity generation with fossil fuels in power plant(s) operated in year *x*-2 at the project site and included in the project boundary (MWh/yr)
x	=	Last calendar year prior to the start of the crediting period

67. If only fossil fuels and no biomass residues were used for electricity generation at the project site prior to the implementation of the project activity, then $EG_{FF,x}$, $EG_{FF,x-1}$ and $EG_{FF,x-2}$ can be obtained directly from historical electricity generation records.

68. If fossil fuels and biomass residues were used for electricity generation at the project site prior to the implementation of the project activity, then $EG_{FF,x}$, $EG_{FF,x-1}$ and $EG_{FF,x-2}$ are determined as follows:

$$EG_{FF,x} = \sum_{m}\sum_{p} \eta_{p,FF} \times \frac{1}{3.6} \times FF_{m,p,x} \times NCV_{m,x} \quad \text{Equation (15)}$$

Where:

$EG_{FF,x}$	=	Electricity generation with fossil fuels in power plant(s) operated in year *x* at the project site and included in the project boundary (MWh/yr)
$\eta_{p,FF}$	=	Efficiency of electricity generation of power plant *p* if fired only with fossil fuels and not with biomass residues
$FF_{m,p,x}$	=	Quantity of fossil fuel type *m* fired in power plant *p* in year *x* (mass or volume unit/yr)
$NCV_{m,x}$	=	Net calorific value of fossil fuel type *m* in year *x* (GJ/mass or volume unit)
m	=	Fossil fuel types used in the power plants *p* in years *x*, *x*-1 and *x*-2
p	=	Power plants that are operated at the site of the project activity, included in the project boundary, and (partially) fired with fossil fuels in the years *x*, *x*-1 and *x*-2
x	=	Last calendar year prior to the start of the crediting period

Case 4: Grid connection, no historical use of fossil fuels, and construction of a new power plant (co-)fired with fossil fuels in the baseline scenario

69. This case applies if:

(a) At least one power plant included in the project boundary is not an off-grid plant;

(b) No fossil fuels were used for power generation at the project site during the most recent three years prior to the implementation of the project activity; and

(c) The baseline scenario is the construction of new power plant(s) at the project site which is/are (co-)fired with fossil fuels.

70. In this case, it is difficult to establish a reasonable minimum amount of electricity that would be generated with fossil fuels at the project site. The project activity could displace electricity in both on-site fossil fuel fired power plants or in the grid. To what extent the on-site power plant(s) is/are dispatched and to what extent grid electricity is used could depend on several parameters, including the price of electricity, the price of the fossil fuels, the on-site demand for electricity and/or the reliability of the grid. However, all these parameters may change during the crediting period.

71. For this reason, the following conservative approach is taken:

(a) If the new power plant constructed in the baseline scenario would only use fossil fuels and not co-fire any biomass residues, then $EG_{BL,FF,y}$ = 0. This implies that the amount of electricity that could displace on-site electricity generation with fossil fuels is allocated to $EG_{BL,FF/grid,y}$;

(b) If the new power plant constructed in the baseline scenario would co-fire fossil fuels and biomass residues, then $EG_{BL,FF,y}$ should correspond to the minimum amount of fossil fuels that must be used due to technical or operational constraints to operate the power plant. This quantity should be determined based on technical specifications obtained from manufacturers. The determination of this amount should be transparently documented and explained in the CDM-PDD. Otherwise, if there are no technical constraints, if these cannot be demonstrated or if the project participants do not wish to determine a minimum amount, it should be assumed that $EG_{BL,FF,y}$ = 0.

5.5.1.5. Step 1.5: Determination of $EG_{BL,grid,y}$

72. The minimum amount of electricity that would be generated by power plants in the electricity grid in the baseline ($EG_{BL,grid,y}$) should, in accordance with the baseline scenario, be determined as follows:

Case 1: No connection to the electricity grid

73. If all power plants included in the project boundary are off-grid power plants, then the project does not displace grid electricity and $EG_{BL,grid,y}$ = 0.

Case 2: No electricity generation at the project site in the baseline

If no power plants would be operated at the project site in the baseline, then all electricity **generated** by the project displaces grid electricity and $EG_{BL,grid,y} = EG_{PJ,y}$.

Case 3: Use of only biomass residues for electricity generation at the project site in the baseline

74. If only biomass residues and no fossil fuels would be used for electricity generation at the project site in the baseline, then the electricity generated by the project displaces grid electricity and electricity generated with biomass residues ($EG_{PJ,y} = EG_{BL,grid,y} + EG_{BL,BR,y}$). Accordingly, $EG_{BL,grid,y}$ is calculated as follows:

$$EG_{BL,grid,y} = EG_{PJ,y} - EG_{BL,BR,y} \quad \text{Equation (16)}$$

Where:

$EG_{BL,grid,y}$	=	Minimum amount of electricity that would be generated by power plants in the electricity grid in the baseline in year *y* (MWh/yr)
$EG_{PJ,y}$	=	Electricity generated in power plants included in the project boundary in year *y* (MWh/yr)
$EG_{BL,BR,y}$	=	Amount of electricity that would be generated with biomass residues in power-only plants operated at the project site in the baseline in year *y* (MWh/yr)

Case 4: Use of only fossil fuels for electricity generation at the project site in the baseline

75. If only fossil fuel and no biomass residues would be used for electricity generation at the project site in the baseline, then the electricity generated by the project can displace grid electricity and electricity generated with fossil fuels at the project site.

76. $EG_{BL,grid,y}$ represents the amount of electricity that could not be generated in on-site power plant(s) using fossil fuels and would have to be supplied by the grid. This applies to the amount of electricity generated in the project activity that exceeds the maximum amount

of electricity that could be generated with fossil fuels at the project site in the baseline ($EG_{BL,MAX,FF}$). Accordingly, $EG_{BL,grid,y}$ is calculated as follows:

$$EG_{BL,grid,y} = \begin{cases} EG_{PJ,y} - EG_{BL,MAX,FF,y} \; if \; EG_{PJ,y} > EG_{BL,MAX,FF} \\ 0 \; if \; EG_{PJ,y} \leq EG_{BL,MAX,FF} \end{cases}$$ Equation (17)

Where:

$EG_{BL,grid,y}$	=	Minimum amount of electricity that would be generated by power plants in the electricity grid in the baseline in year *y* (MWh/yr)
$EG_{PJ,y}$	=	Electricity generated in power plants included in the project boundary in year *y* (MWh/yr)
$EG_{BL,MAX,FF,y}$	=	Maximum amount of electricity that could be generated with fossil fuels at the project site in the baseline (MWh/yr)

Case 5: Use of fossil fuels and biomass residues for electricity generation at the project site in the baseline

77. If biomass residues and fossil fuels would be used for electricity generation at the project site in the baseline, then the electricity generated by the project can displace grid electricity, electricity generated with fossil fuels at the project site and electricity generated with biomass residues at the project site. The following scenarios can occur:

(a) **Use of all biomass residues in co-fired heat generator(s):** all biomass residues that would be used in the baseline for electricity generation would be co-fired with fossil fuels. In this case, $EG_{BL,grid,y}$ corresponds to the amount of electricity generated in the project activity that exceeds the maximum amount of electricity generation that could be generated by co-firing fossil fuels and biomass residues in plants at the project site in the baseline ($EG_{BL,MAX,FF/BR}$). Accordingly, $EG_{BL,grid,y}$ is calculated as follows:

$$EG_{BL,grid,y} = \begin{cases} EG_{PJ,y} - EG_{BL,MAX,FF/BR,y} \; if \; EG_{PJ,y} > EG_{BL,MAX,FF/BR,y} \\ 0 \; if \; EG_{PJ,y} \leq EG_{BL,MAX,FF/BRy} \end{cases}$$ Equation (18)

Where:

$EG_{BL,grid,y}$	=	Minimum amount of electricity that would be generated by power plants in the electricity grid in the baseline in year *y* (MWh/yr)
$EG_{PJ,y}$	=	Electricity generated in power plants included in the project boundary in year *y* (MWh/yr)
$EG_{BL,MAX,FF/BR,y}$	=	Maximum amount of electricity that could be generated with fossil fuels and any co-firing of biomass residues at the project site in the baseline in year *y* (MWh/yr)

(b) **Use of all biomass residues in biomass residues only heat generator(s):** all biomass residues that would be used in the baseline for electricity generation would be used in heat generator(s) that use only biomass residues and no fossil fuels. In this case, $EG_{BL,grid,y}$ is determined as follows:

$$EG_{BL,grid,y} = \begin{cases} EG_{PJ,y} - EG_{BL,BR,y} - EG_{BL,MAX,FF,y} \; if \; EG_{PJ,y} > \left(EG_{BL,BR,y} + EG_{BL,MAX,FF}\right) \\ 0 \; if \; EG_{PJ,y} \leq \left(EG_{BL,BR,y} + EG_{BL,MAX,FF}\right) \end{cases}$$ Equation (19)

Where:

$EG_{BL,grid,y}$	=	Minimum amount of electricity that would be generated by power plants in the electricity grid in the baseline in year *y* (MWh/yr)
$EG_{PJ,y}$	=	Electricity generated in power plants included in the project boundary in year *y* (MWh/yr)
$EG_{BL,BR,y}$	=	Amount of electricity that would be generated with biomass residues in power-only plants operated at the project site in the baseline in year *y* (MWh/yr)
$EG_{BL,MAX,FF,y}$	=	Maximum amount of electricity that could be generated with fossil fuels at the project site in the baseline (MWh/yr)

(c) **Use of biomass residues in both biomass residues only heat generator(s) and co-fired heat generator(s):** the biomass residues that would be used in the baseline for electricity generation would partially be co-fired in fossil fired heat generator(s) and partially be used in heat generator(s) that use only biomass residues. In this case, the project participants should document and justify in the CDM-PDD what quantities of which types of biomass residues would be used in each type of heat generator, ensuring that:

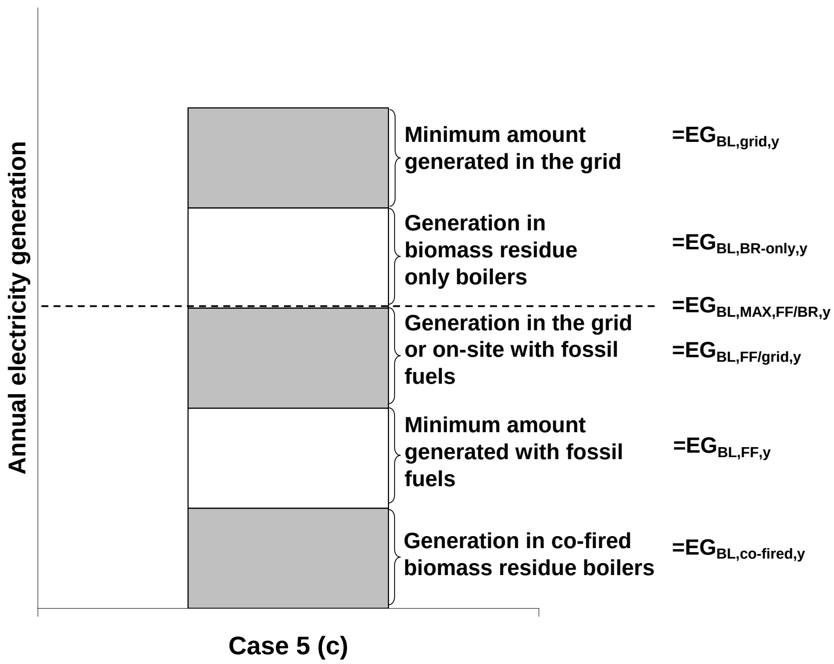
$$\sum_n \sum_p BR_{BL,n,p,y} = BR_{BL,BR-only,y} + BR_{BL,co-fired,y}$$ Equation (20)

Where:

$BR_{BL,n,p,y}$	=	Quantity of biomass residues of category *n* that would be fired in power-only plant *p* in the baseline in year *y* (tonnes on dry-basis)
$BR_{BL,BR-only,y}$	=	Quantity of biomass residues that would be fired in biomass-residue-only heat generators (of power-only plants) in the baseline in year *y* (tonnes on dry-basis)
$BR_{BL,co-fired,y}$	=	Quantity of biomass residues that would be fired in co-fired heat generators (of power-only plants) in the baseline in year *y* (tonnes on dry-basis)

78. This case is illustrated in Figure 2.

Figure 2. Determination of the baseline emission factor in case 5(c)



79. In this case, $EG_{BL,grid,y}$ corresponds to the amount of electricity generated in the project activity that exceeds the maximum amount of electricity generation that could be generated by co-firing fossil fuels and biomass residues in plants at the project site in the baseline ($EG_{BL,MAX,FF/BR,y}$) and by firing biomass residues in biomass residues only heat generators ($EG_{BL,BR\text{-}only,y}$). Accordingly, $EG_{BL,grid,y}$ is calculated as follows:

$$EG_{BL,grid,y} = \begin{cases} EG_{PJ,y} - EG_{BL,BR,only,y} - EG_{BL,MAX,FF/BR,y} \; if \; EG_{PJ,y} > \begin{pmatrix} EG_{BL,BR,only,y} + \\ EG_{BL,MAX,FF/BR,y} \end{pmatrix} \\ 0 \; if \; EG_{PJ,y} \leq \begin{pmatrix} EG_{BL,BR,only,y} + \\ EG_{BL,MAX,FF/BR,y} \end{pmatrix} \end{cases}$$ Equation (21)

Where:

$EG_{BL,grid,y}$	=	Minimum amount of electricity that would be generated by power plants in the electricity grid in the baseline in year *y* (MWh/yr)
$EG_{PJ,y}$	=	Electricity generated in power plants included in the project boundary in year *y* (MWh/yr)
$EG_{BL,BR,only,y}$	=	Amount of electricity that would be generated with biomass-residue-only heat generators at the project site in the baseline in year *y* (MWh/yr)
$EG_{BL,MAX,FF/BR,y}$	=	Maximum amount of electricity that could be generated with fossil fuels and any co-firing of biomass residues at the project site in the baseline in year *y* (MWh/yr)

80. The parameter $EG_{BL,BR\text{-}only,y}$ should be estimated based on the parameter $BR_{BL,BR\text{-}only,y}$ and the corresponding efficiency of power generation.

5.5.1.5.1. Determination of $EG_{BL,MAX,FF,y}$

81. $EG_{BL,MAX,FF,y}$ corresponds to the maximum amount of electricity that could be generated with fossil fuels at the project site in the baseline. This parameter needs to be determined if fossil fuels would be used for electricity generation at the project site in the baseline (cases 4 and 5 above).

82. $EG_{BL,MAX,FF,y}$ is determined as follows:

$$EG_{BL,MAX,FF,y} = \sum_{n} CAP_{FF,p} \times 0.9 \times 8.760\ hours/yr$$ Equation (22)

Where:

$EG_{BL,MAX,FF,y}$	=	Maximum amount of electricity that could be generated with fossil fuels at the project site in the baseline in year *y* (MWh/yr)
$CAP_{FF,p}$	=	Maximum electricity generation capacity of baseline power plant *p* if fired only with fossil fuels (MW)
P	=	Power-only plants that would operate at the project site in the baseline scenario

5.5.1.5.2. Determination of $EG_{BL,MAX,FF/BR,y}$

83. $EG_{BL,}MAX_{,FF/BR,y}$ corresponds to the maximum amount of electricity that could be generated with fossil fuels and any co-firing of biomass residues at the project site in the baseline in year *y* (MWh/yr). This parameter needs to be determined if fossil fuels and biomass residues would be co-fired in heat generators of any power plant that would be used for electricity generation at the project site in the baseline (case 5(c) above).

84. $EG_{BL,MAX,FF/BR,y}$ is determined as follows:

$$EG_{BL,MAX,FF/BR,y} = \sum_{n} CAP_{FF/BR,p,y} \times 0.9 \times 8.760\ hours/yr$$ Equation (23)

Where:

$EG_{BL,MAX,FF/BR,y}$	=	Maximum amount of electricity that could be generated with fossil fuels and any co-firing of biomass residues at the project site in the baseline in year *y* (MWh/yr)
$CAP_{FF/BR,p,y}$	=	Maximum electricity generation capacity of baseline power plant *p* in year *y* if fossil-fuel-only heat generators and co-fired heat generators are used (MW)
p	=	Power-only plants that would operate at the project site in the baseline scenario

85. $CAP_{FF/BR,p,y}$ should be based on the maximum heat quantity that can be generated for use in heat engines if fossil-fuel-only heat generators and co-fired heat generators are used (but no biomass-residue-only heat generators). Note that $CAP_{FF/BR,p,y}$ depends on the amount of biomass residues co-fired in heat generators of the power plant. It is therefore determined based on the monitored amounts of biomass residues that would be co-fired in heat generators in year *y* ($BR_{BL,co\text{-}fired,y}$). Project participants should document transparently and justify in the CDM-PDD how they determine $CAP_{FF/BR,p,y}$ as a function of $BR_{BL,co\text{-}fired,y}$ for each calendar year.

86. Alternatively, as a conservative approach, the following can be assumed: $EG_{BL,MAX,FF/BR,y} = EG_{BL,MAX,FF}$.

5.5.1.6. Step 1.6: Determination of $EG_{BL,FF/grid,y}$

87. $EG_{BL,FF/grid,y}$ represents the amount of electricity that could be generated in the baseline in the grid or at the project site using fossil fuels. $EG_{BL,FF/grid,y}$ corresponds to the remainder of electricity generation, i.e. the amount that exceeds the minimum amount of electricity that would be generated by power plants in the electricity grid ($EG_{BL,grid,y}$), the minimum amount of electricity that could be generated with fossil fuels at the project site ($EG_{BL,FF,y}$), and the amount of electricity that would be generated with biomass residues at the project site ($EG_{BL,BR,y}$). Accordingly, $EG_{BL,FF/grid,y}$ is calculated as follows:

$$EG_{BL,FF/grid,y} = EG_{Pj,y} - EG_{BL,BR,y} - EG_{BL,FF,y} - EG_{BL,grid,y}$$ Equation (24)

Where:

$EG_{BL,FF/grid,y}$	=	Amount of electricity that could be generated in the baseline either by power plants in the electricity grid or by power plants at the project site using fossil fuels in year *y* (MWh)
$EG_{Pj,y}$	=	Electricity generated in power plants included in the project boundary in year *y* (MWh)
$EG_{BL,BR,y}$	=	Amount of electricity that would be generated with biomass residues in power-only plants operated at the project site in the baseline in year *y* (MWh)
$EG_{BL,FF,y}$	=	Minimum amount of electricity that would be generated with fossil fuels at the project site in the baseline in year *y* (MWh)
$EG_{BL,grid,y}$	=	Minimum amount of electricity that would be generated by power plants in the electricity grid the baseline in year *y* (MWh)

5.5.1.7. Step 1.7: Determination of $EF_{BL,FF,y}$

88. $EF_{BL,FF,y}$ should be determined using Option A or Option B below. If fossil fuel power plants were operated at the project site prior to the implementation of the project activity, either Option A or Option B can be used to determine $EF_{BL,FF,y}$. For new power plants that would be constructed at the project site in the baseline scenario, Option B should be used.

Option A

89. Determine $EF_{BL,FF,y}$ as per the procedure described under "Scenario B: Electricity consumption from an off-grid captive power plant" in the latest approved version of ~~the~~

methodological tool "TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation", using data from the three calendar years prior to the implementation of the project activity.

Option B

90. Determine a default emission factor for $EF_{BL,FF,y}$ based on a default efficiency of the power plant that would be operated at the project site in the baseline and a default CO_2 emission factor for the fossil fuel types that would be used, as follows:

$$EF_{BL,FF,y} = 3.6 \times \frac{EF_{BL,CO2,FF}}{\eta_{BL,FF}}$$ Equation (25)

Where:

$EF_{BL,FF,y}$	=	CO_2 emission factor for electricity generation with fossil fuels in power plant(s) at the project site in the baseline in year *y* (t CO_2/MWh)
$EF_{BL,CO2,FF}$	=	CO_2 emission factor of the fossil fuel type that would be used for power generation at the project site in the baseline (t CO_2/GJ)
$\eta_{BL,FF}$	=	Efficiency of the fossil fuel power plant(s) at the project site in the baseline

5.5.1.8. Step 1.8: Determination of $EF_{grid,CM,y}$

91. $EF_{grid,CM,y}$ should be determined as the combined margin CO_2 emission factor for grid connected power generation in year *y*, calculated using the latest approved version of the "TOOL07: Tool to calculate the emission factor for an electricity system".

5.5.2. Step 2: Determination of baseline emissions due to uncontrolled burning or decay of biomass residues ($BE_{BR,y}$)

92. The calculation of baseline emissions due to uncontrolled burning or decay of biomass residues is optional and project participants can decide whether to include these emission sources or not. If project participants wish to include these emission sources, the procedure below should be followed, and emissions from combustion of biomass residues under the project activity should be also be determined. Otherwise, this section does not need to be applied and project emissions do not need to include emissions from the combustion of biomass residues under the project activity.

93. Baseline emissions due to uncontrolled burning or decay of biomass residues are only determined for those categories of biomass residues for which B1, B2 or B3 has been identified as the baseline scenario.

94. The emissions are determined separately for biomass residues categories for which scenarios B1 and B3 (aerobic decay or uncontrolled burning) apply, and for biomass residues categories for which scenario B2 (anaerobic decay) apply:

$$BE_{BR,y} = BE_{BR,B1/B3,y} + BE_{BR,B2,y}$$ Equation (26)

Where:

$BE_{BR,y}$	=	Baseline emissions due to uncontrolled burning or decay of biomass residues in year *y* (t CO_2)
$BE_{BR,B1/B3,y}$	=	Baseline emissions due to aerobic decay or uncontrolled burning of biomass residues in year *y* (t CO_2)
$BE_{BR,B2,y}$	=	Baseline emissions due to anearobic decay of biomass residues in year *y* (t CO_2)

5.5.2.1. Step 2.1: Determination of $BE_{BR,B1/B3,y}$

95. For the biomass residues categories, for which the most likely baseline scenario is either that the biomass residues would be dumped or left to decay under mainly aerobic conditions (B1), or burnt in an uncontrolled manner without utilizing them for energy purposes (B3), baseline emissions are calculated assuming, for both scenarios (aerobic decay and uncontrolled burning), that the biomass residues would be burnt in an uncontrolled manner.

96. Baseline emissions are calculated by multiplying the quantity of biomass residues with the net calorific value and an appropriate emission factor, as follows:

$$BE_{BR,B1/B3,y} = GWP_{CH4} \times \sum_{n} BR_{n,B1/B3,y} \times NCV_{n,y} \times EF_{BR,n,y}$$

Equation (27)

Where:

$BE_{BR,B1/B3,y}$	=	Baseline emissions due to aerobic decay or uncontrolled burning of biomass residues in year *y* (t CO_2)
GWP_{CH4}	=	Global warming potential of methane valid for the commitment period (t CO_2/t CH_4)
$BR_{n,B1/B3,y}$	=	Amount of biomass residues category *n* used in the project plant(s) included in the project boundary in year *y* for which B1 or B3 has been identified as the baseline scenario (tonnes on dry-basis)
$NCV_{n,y}$	=	Net calorific value of the biomass residues category *n* in year *y* (GJ/tonnes on dry-basis)
$EF_{BR,n,y}$	=	CH_4 emission factor for uncontrolled burning of the biomass residues category *n* during the year *y* (t CH_4/GJ)
n	=	Categories of biomass residues

97. To determine the CH_4 emission factor, project participants may undertake measurements or use referenced default values. ~~In the absence of more accurate information, it is recommended to use 0.0027 t CH_4 per ton of biomass as default value for the product of NCV_k and $EF_{burning,CH4,k,y}$.[5]~~

~~[5] 2006 IPCC Guidelines, Volume 4, Table 2.5, default value for agricultural residues.~~

98. In the absence of more accurate information for $NCV_{BR,n,y}$ and $EF_{BR,n,y}$.[6], a default value of 0.0027 t CH_4/ t biomass is recommended,[7] adjusted by a conservativeness factor (i.e. 0.73) to address the high level of uncertainty. In this case, an emission factor of 0.001971 t CH_4/t biomass should be used.

99. The uncertainty of the CH_4 emission factor ($EF_{BR,n,y}$) 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. The appropriate conservativeness factor from Table 3 below shall be chosen and multiplied with the estimate for the CH_4 emission factor. For example, if the default CH_4 emission factor of 0.0027 t CH_4/t biomass is used, the uncertainty can be deemed to be greater than 100 per cent, resulting in a conservativeness factor of 0.73. Thus, in this case an emission factor of 0.001971 t CH_4/t biomass should be used.

Table 3. Conservativeness factors

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

5.5.2.2. Step 2.2: Determination of $BE_{BR,B2,y}$

100. For the biomass residues categories, as described in the biomass residues categories table, for which the most likely baseline scenario is that the biomass residues would decay under clearly anaerobic conditions (case B2), project participants shall calculate baseline emissions using the latest approved version of the tool "TOOL04: Emissions from solid waste disposal sites". The variable $BE_{CH4,SWDS,y}$ calculated by the tool corresponds to $BE_{BR,B2,y}$ in this methodology. The project participants shall use as waste quantities prevented from disposal ($W_{j,x}$) in the tool, those quantities of biomass residues ($BR_{n,B2,y}$) for which B2 has been identified as the baseline scenario.

101. The determination of $BR_{n,B2,y}$ shall be based on the monitored amounts of biomass residues used in power plants included in the project boundary. Where all biomass residues with the baseline scenario B2 come from one particular source, the monitored quantities of biomass residues used from that source in the project plant ($BR_{PJ,n,y}$) can be directly used. Where only parts of the biomass residues from one source would be dumped under clearly anaerobic conditions (B2), an allocation should be made consistently with Table 3 above, as provided for the project activity in the CDM-PDD. The allocation should

[6] 2006 IPCC Guidelines, Volume 4, Table 2.5, default value for agricultural residues.

[7] 2006 IPCC Guidelines, Volume 4, Table 2.5, default value for agricultural residues.

be made in a conservative manner and consistent with the guidance provided before for $BR_{BL,n,p,y}$. The project participants should specify and justify in the CDM-PDD in a transparent manner how the relevant allocations should be made and how $BR_{n,B2,y}$ should be determined for the relevant biomass residue category *n* based on the monitored quantities. The approaches used should be consistent with the identified baseline scenario and reflect the particular situation of the underlying project activity.

5.6. Project emissions

102. Project emissions are calculated as follows:

$$PE_y = PE_{FF,y} + PE_{EL,y} + PE_{TR,y} + PE_{BR,y} + PE_{WW,y} + PE_{BG2,y} + PE_{BC,y} \quad \text{Equation (28)}$$

Where:

PE_y	=	Project emissions during year *y* (t CO_2e)
$PE_{FF,y}$	=	Emissions during the year *y* due to fossil fuel consumption (t CO_2)
$PE_{EL,y}$	=	Emissions during the year *y* due to electricity use off-site for the processing of biomass residues (t CO_2)
$PE_{TR,y}$	=	Emissions during the year *y* due to transport of the biomass residues to the project plant (t CO_2)
$PE_{BR,y}$	=	Emissions from the combustion of biomass residues during the year *y* (t CO_2e)
$PE_{WW,y}$	=	Emissions from waste water generated from the treatment of biomass in year *y* (t CO_2e)
$PE_{BG2,y}$	=	Emissions from the production of biogas in year *y* (t CO_2e)
$PE_{BC,y}$	=	Project emissions associated with the cultivation of land to produce biomass in year *y* (t CO_2)

5.6.1. Determination of PE_{FFy}

103. The following emission sources should be included in determining $PE_{FF,y}$:

(a) Emissions from on-site fossil fuel consumption for the generation of electric power. This includes all fossil fuels used at the project site in heat generators (e.g. boilers) for the generation of electric power;

(b) Emissions from on-site fossil fuel consumption of auxiliary equipment and systems related to the generation of electric power. This includes fossil fuels required for the operation of auxiliary equipment related to the power plants (e.g. for pumps, fans, cooling towers, instrumentation and control, etc.) which are not accounted in the first bullet;

(c) Fossil fuels required for the operation of equipment related to the on-site or off-site preparation, storage, processing and transportation of fuels and biomass (e.g. for mechanical treatment of the biomass, conveyor belts, driers, pelletization, shredding, briquetting processes, etc.);

(d) If any fossilized or non-biodegradable materials are used in the processing of biomass and incorporated in the processed biomass (e.g. binders) then emissions arising from those materials should be accounted for when the processed biomass are combusted. For that purpose those materials should be deemed as fossil fuels. If net calorific values, carbon content and/or emission factors of those materials are available they should be used, otherwise the net calorific values, carbon content and/or emission factors of the most carbon intensive fossil fuel available in the country should be used.

104. The latest approved version ~~of the~~ "TOOL03: Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" should be used to calculate $PE_{FF,y}$. All combustion processes *j* as described in the two bullets above should be included.

5.6.2. Determination of $PE_{EL,y}$

105. Emissions should be included that result from the generation of electric power required for the operation of equipment related to the off-site preparation, processing, storage and transportation of biomass (e.g. for mechanical treatment of the biomass, conveyor belts, driers, pelletization, shredding, briquetting processes, etc.). The latest approved version of ~~the~~ "TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" should be used to calculate $PE_{EL,y}$. Note that the electric power used on-site for the purposes described above are already accounted as part of $EG_{PJ,aux,y}$. $PE_{EL,y}$ should account thus only for the off-site use of electricity.

5.6.3. Determination of $PE_{TR,y}$

106. In cases where the biomass residues are not generated directly at the project site, and always in the case of biomass from plantations, project participants shall determine CO_2 emissions resulting from transportation of the biomass to the project plant using the latest version of ~~the tool~~ "TOOL12: Project and leakage emissions from transportation of freight". $PE_{TR,m}$ in the tool corresponds to the parameter $PE_{TR,y}$ in this methodology and the monitoring period *m* is one year.

5.6.4. Determination of $PE_{BR,y}$

107. If project proponents chose to include emissions due to uncontrolled burning or decay of biomass residues ($BE_{BR,y}$) in the calculation of baseline emissions, then emissions from the combustion of biomass residues have also to be included in the project scenario. Otherwise, this emission source may be excluded. Corresponding emissions are calculated as follows:

$$PE_{BR,y} = GWP_{CH4} \times EF_{CH4,BR} \times \sum_{n} BR_{PJ,n,y} \times NCV_{n,y}$$ Equation (29)

Where:

$PE_{BR,y}$	=	Emissions from the combustion of biomass residues during the year *y* (t CO_2)
GWP_{CH4}	=	Global Warming Potential for methane valid for the relevant commitment period (t CO_2/t CH_4)
$EF_{CH4,BR}$	=	CH_4 emission factor for the combustion of biomass residues in the project plant (t CH_4/GJ)
$BR_{PJ,n,y}$	=	Quantity of biomass residues of category *n* used in power plants which are located at the project site and included in the project boundary in year *y* (tonnes on dry-basis/yr)
$NCV_{n,y}$	=	Net calorific value of the biomass residues category *n* in year *y* (GJ/tonnes on dry-basis)

108. To determine the CH_4 emission factor, project participants may conduct measurements at the plant site or use IPCC default values, as provided in **Table 4** below. 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 of 1.37 ~~must be~~ is 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 5** below and shall multiply the estimate for the CH_4 emission factor with the conservativeness factor.~~

~~109. For example, where the default CH_4 emission factor of 30 kg/TJ from **Table 4** is used, the uncertainty is estimated to be 300 per cent, resulting in a conservativeness factor of 1.37. Thus, in this case a CH_4 emission factor of 41.1 kg/TJ should be used.~~

Table 4. Default CH_4 emission factors for combustion of biomass residues[8]

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

~~**Table 5. 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~~

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

~~**Estimated uncertainty range (%)**~~	~~**Assigned uncertainty band (%)**~~	~~**Conservativeness factor where higher values are more conservative**~~
~~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~~

5.6.5. Determination of $PE_{WW,CH4,y}$

110. This emission source should be estimated in cases where waste water originating from the treatment of the biomass is (partly) treated under anaerobic conditions and where methane from the waste water is not captured and flared or combusted. Project emissions from waste water are estimated as follows:

$$PE_{WW,CH4,y} = GWP_{CH4} \times V_{WW,y} \times COD_{WW,y} \times B_{o,WW} \times MCF_{WW}$$ Equation (30)

Where:

$PE_{WW,CH4,y}$	=	CH_4 emissions from waste water generated from the treatment of biomass in year *y* (t CH_4)
GWP_{CH4}	=	Global Warming Potential for methane valid for the relevant commitment period (t CO_2/t CH_4)
$V_{WW,y}$	=	Quantity of waste water generated in year *y* (m^3)
$COD_{WW,y}$	=	Average chemical oxygen demand of the waste water in year *y* (tCOD/m^3)
$B_{o,WW}$	=	Methane generation potential of the waste water (t CH_4/tCOD)
MCF_{WW}	=	Methane correction factor for the waste water (ratio)

5.6.6. Determination of $PE_{BG2,y}$

111. In case the project includes biogas the consideration of project emissions associated with the production of biogas depends on the selected baseline scenario for biogas and whether the biogas is sourced from a registered CDM project activity according to the following provisions:

(a) In case the biogas is provided by a registered CDM project activity, the project emissions will be covered in the PDD of the registered CDM project activity;

(b) In case the biogas is not provided by a registered CDM project activity:

(i) If baseline scenario BG1 is selected, the project emissions should be included in this proposed CDM project activity. The emission source shall include project emissions from physical leakage of methane from the anaerobic digester, from treatment of wastewater effluent from the anaerobic digester (where applicable), and from land application of sludge (where applicable). The estimation of these emission sources shall follow the procedures for these sources as identified in the project emissions section of ACM0014;

(ii) In case of baseline scenario BG2 or BG3, no project emissions need to be included.

5.6.7. Determination of $PE_{BC,y}$

112. If the project includes biomass from dedicated plantations, the associated emissions shall be calculated according to ~~the methodological tool~~ "TOOL16: Project and leakage emissions from biomass".

5.7. Leakage

113. Leakage emissions due to diversion of biomass residues from other applications shall be calculated according to ~~the methodological tool~~ "TOOL16: Project and leakage emissions from biomass".

114. Leakage emissions due to shift of pre-project activities shall be calculated according to ~~the methodological tool~~ "TOOL16: Project and leakage emissions from biomass".

115. In the case that negative overall emission reductions arise in a year through application of the leakage emissions, 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 t CO_2e occur in the year *t* and positive emission reductions of 100 t CO_2e occur in the year t+1, only 70 CERs are issued for the year t+1.

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

116. At the start of the second and third crediting period for a project activity, the continued validity of the baseline shall be assessed by applying the latest version of ~~the methodological tool~~ "TOOL11: Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period".

5.9. Data and parameters not monitored

117. In addition to the parameters and procedures described herein, all monitoring provisions contained in the tools referred to in this methodology also apply.

118. Document and justify all selected values in the CDM-PDD.

119. The following are not monitored data and parameters:

Data / Parameter table 1.

Data / Parameter:	GWP_{CH4}
Data unit:	t CO_2e/t CH_4
Description:	Global warming potential for methane valid for the relevant commitment period

Source of data:	IPCC
Measurement procedures (if any):	Shall be updated according to any future COP/MOP decisions
Any comment:	-

Data / Parameter table 2.

Data / Parameter:	**Amount of fuel used in the heat generation equipment, if any**
Data unit:	GJ
Description:	If any heat which is used for purposes other than power generation (e.g. heat which is produced in boilers or extracted from the header to feed thermal loads in the process) is generated during the crediting period or was generated prior to the implementation of the project activity, by any on-site or off-site heat generation equipment connected to the project site, the amount of fuel used in the heat generation equipment should be monitored and clearly differentiated from any fuel used in the project activity. The following conditions should be checked using this data: • The implementation of the project activity does not influence directly or indirectly the operation of the heat generation equipment, i.e. the heat generation equipment would operate in the same manner in the absence of the project activity; and • The heat generation equipment does not influence directly or indirectly the operation of the project plant, e.g. no fuels are diverted from the heat generation equipment to the project plant
Source of data:	On-site measurements
Measurement procedures (if any):	Use weight or volume meters. The quantity shall be cross-checked with the quantity of electricity generated and any fuel purchase receipts (if available)
Any comment:	This parameter is related to an applicability condition

Data / Parameter table 3.

Data / Parameter:	**Biomass categories and quantities used for the selection of the baseline scenario selection and assessment of additionality**
Data unit:	• Type (i.e. bagasse, rice husks, empty fruit bunches, etc.); • Source (e.g. produced on-site, obtained from an identified biomass residues producer, obtained from a biomass residues market, etc.); • Fate in the absence of the project activity (Scenarios B); • Use in the project scenario (Scenarios P); • Quantity (tonnes on dry-basis)
Description:	Explain and document transparently in the CDM-PDD, which quantities of which biomass categories are used in which installation(s) under the project activity and what is their baseline scenario. Include the quantity of each category of biomass (tonnes). For the selection of the baseline scenario and demonstration of additionality, at the validation stage, an ex ante estimation of these quantities should be provided
Source of data:	On-site assessment of biomass categories and quantities

Measurement procedures (if any):	-
Any comment:	This parameter is related to the procedure for the selection of the baseline scenario selection and assessment of additionality

Data / Parameter table 4.

Data / Parameter:	$BR_{n,power\text{-}only,x}$
Data unit:	tonnes on dry-basis
Description:	Quantity of biomass residues of category *n* used in year *x* in power-only plants which were used at the project site prior to the implementation of the project activity
Source of data:	On-site measurements
Measurement procedures (if any):	Use weight meters. Adjust for the moisture content in order to determine the quantity of dry biomass. The quantity shall be cross-checked with the quantity of heat generated and any fuel purchase receipts (if available)
Any comment:	-

Data / Parameter table 5.

Data / Parameter:	$BR_{n,p,x}$
Data unit:	tonnes on dry-basis
Description:	Quantity of biomass residues of category *n* used in year *x* in power plant *p*
Source of data:	On-site measurements
Measurement procedures (if any):	Use weight meters. Adjust for the moisture content in order to determine the quantity of dry biomass. The quantity shall be cross-checked with the quantity of heat generated and any fuel purchase receipts (if available)
Any comment:	-

Data / Parameter table 6.

Data / Parameter:	$FF_{m,p,x}$
Data unit:	mass or volume unit/yr
Description:	Quantity of fossil fuel type *m* fired in power plant *p* in year *x*
Source of data:	On-site measurements
Measurement procedures (if any):	Use weight meters. Adjust for the moisture content in order to determine the quantity of dry biomass. The quantity shall be cross-checked with the quantity of heat generated and any fuel purchase receipts (if available)
Any comment:	-

Data / Parameter table 7.

Data / Parameter:	P_x
Data unit:	Use suitable units, as appropriate

Description:	Quantity of the main product of the production process (e.g. sugar cane, rice, etc.) produced in year *x* from plants operated at the project site
Source of data:	On-site measurements
Measurement procedures (if any):	-
Any comment:	-

Data / Parameter table 8.

Data / Parameter:	$EG_{p,x}$
Data unit:	MWh/yr
Description:	Net quantity of electricity generated in power plant *p* in year *x*
Source of data:	On-site measurements
Measurement procedures (if any):	Use calibrated electricity meters
Any comment:	-

Data / Parameter table 9.

Data / Parameter:	$EG_{FF,x,}$
Data unit:	MWh/yr
Description:	Electricity generation with fossil fuels in power plant(s) included in the project boundary, operated respectively in years *x*, *x*-1 and *x*-2 at the project site
Source of data:	On-site measurements
Measurement procedures (if any):	Use calibrated electricity meters
Any comment:	-

Data / Parameter table 10.

Data / Parameter:	$NCV_{n,x}$
Data unit:	GJ/tons on a dry basis
Description:	Net calorific value of biomass residue category *n* in year *x*
Source of data:	Either conduct measurements or use accurate and reliable local or national data where available. Where such data is not available, use IPCC default net calorific values (country-specific, if available) if they are deemed to reasonably represent local circumstances. Choose the values in a conservative manner and justify the choice
Measurement procedures (if any):	Measurements shall be carried out at certified laboratories and according to relevant international standards
Any comment:	-

Data / Parameter table 11.

Data / Parameter:	$NCV_{m,x}$
Data unit:	GJ/mass or volume unit

Description:	Net calorific value of fossil fuel type *m* in year *x*
Source of data:	Either conduct measurements or use accurate and reliable local or national data where available. Where such data is not available, use IPCC default net calorific values (country-specific, if available) if they are deemed to reasonably represent local circumstances. Choose the values in a conservative manner and justify the choice
Measurement procedures (if any):	Measurements shall be carried out at certified laboratories and according to relevant international standards
Any comment:	-

Data / Parameter table 12.

Data / Parameter:	$EF_{BL,CO2,FF,d}$
Data unit:	t CO_2/GJ
Description:	CO_2 emission factor of the fossil fuel type that would be used for power generation at the project site in the baseline
Source of data:	Either conduct measurements or use accurate and reliable local or national data where available. Where such data is not available, use IPCC default emission factors (country-specific, if available) if they are deemed to reasonably represent local circumstances. Choose the value in a conservative manner and justify the choice
Measurement procedures (if any):	Measurements shall be carried out at certified laboratories and according to relevant international standards
Any comment:	In case of plants existing before project implementation, the lowest CO_2 emission factor should be used in case of multi fuel plants

Data / Parameter table 13.

Data / Parameter:	$\eta_{BL,BR,p}$
Data unit:	ratio
Description:	Efficiency of electricity generation of baseline power plant *p* if fired only with biomass residues and not with fossil fuels
Source of data:	Survey conducted by the project participants or third parties
Measurement procedures (if any):	Use the average efficiency of the top 20 per cent performing biomass residue power-only plants in the relevant region among the plants that were built in the most recent five calendar years prior to the implementation of the project activity. The region should be defined in a manner that it includes at least ten plants
Any comment:	-

Data / Parameter table 14.

Data / Parameter:	$\eta_{BL,hg,p}$, $\eta_{BL,mg,p}$, $\eta_{BL,eg,p}$
Data unit:	ratio
Description:	Respectively: conservative efficiency of heat generation of baseline power plant *p* if fired only with biomass residues and not with fossil fuels; conservative efficiency of conversion from heat to mechanical shaft power of baseline power plant *p*; and conservative efficiency of the electric generators of baseline power plant *p*

Source of data:	Manufacturer's data, commissioning performance data.
Measurement procedures (if any):	-
Any comment:	If several heat generators, heat engines and electric generators would operate in the baseline and if it cannot clearly defined which configuration would prevail in the baseline, the most conservative values for efficiencies should be assumed. For example, if several boilers, turbines, speed reducers and electric generators operate in the power plant p, it should be assumed that the most efficient boiler and the most efficient set of turbine-speed reducer-electric generator would be used. The efficiency of conversion from heat to mechanical shaft power should include the speed-reducers or gear boxes required to couple the mechanical shaft power generator to the electric generator

Data / Parameter table 15.

Data / Parameter:	$\eta_{p,FF}$
Data unit:	Ratio
Description:	Efficiency of electricity generation of power plant *p* if fired only with fossil fuels and not with biomass residues
Source of data:	Either use the higher value among: (a) the measured efficiency and (b) manufacturer's information on the efficiency OR assume an efficiency of 100 per cent as a conservative default value
Measurement procedures (if any):	If measurements are conducted, use recognized standards for the measurement of the heat generator efficiency, such as the "*British Standard Methods for Assessing the thermal performance of boilers for steam, hot water and high temperature heat transfer fluids*" (BS845). Where possible, use preferably the direct method (dividing the net heat generation by the energy content of the fuels fired during a representative time period), as it is better able to reflect average efficiencies during a representative time period compared to the indirect method (determination of fuel supply or heat generation and estimation of the losses). Document measurement procedures and results and manufacturer's information transparently in the CDM-PDD
Any comment:	-

Data / Parameter table 16.

Data / Parameter:	$\eta_{BL,FF}$
Data unit:	Ratio
Description:	Efficiency of the fossil fuel power plant(s) at the project site in the baseline
Source of data:	Either use the higher value among: (a) the measured efficiency and (b) manufacturer's information on the efficiency; or use default values as provided in annex 1 of ~~the~~ "TOOL07: Tool to calculate the emission factor for an electricity system"; or assume an efficiency of 100 per cent

Measurement procedures (if any):	If measurements are conducted, use recognized standards for the measurement of the heat generator efficiency, such as the "*British Standard Methods for Assessing the thermal performance of boilers for steam, hot water and high temperature heat transfer fluids*" (BS845). Where possible, use preferably the direct method (dividing the net heat generation by the energy content of the fuels fired during a representative time period), as it is better able to reflect average efficiencies during a representative time period compared to the indirect method (determination of fuel supply or heat generation and estimation of the losses). Document measurement procedures and results and manufacturer's information transparently in the CDM-PDD
Any comment:	-

Data / Parameter table 17.

Data / Parameter:	$CAP_{FF,p}$
Data unit:	MW
Description:	Maximum electricity generation capacity of baseline power plant *p* if fired only with fossil fuels
Source of data:	On-site measurements or manufacturer's data
Measurement procedures (if any):	-
Any comment:	-

6. Monitoring methodology

6.1. Monitoring procedures

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

121. All data collected as part of monitoring should be archived electronically and be kept at least for two years after the end of the last crediting period. One hundred per cent of the data should be monitored if not indicated differently in the comments in the tables below.

122. In addition to the parameters and procedures described herein, all monitoring provisions contained in the tools referred to in this methodology also apply.

6.2. Data and parameters monitored

Data / Parameter table 18.

Data / Parameter:	P_y
Data unit:	Use suitable units, as appropriate
Description:	Quantity of the main product of the production process (e.g. sugar cane, rice) produced in year *y* from plants operated at the project site
Source of data:	On-site measurements

Measurement procedures (if any):	-
Monitoring frequency:	Data aggregated as appropriate, to calculate emissions reductions
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 19.

Data / Parameter:	**Amount of fuel used in the heat generation equipment, if any**
Data unit:	GJ
Description:	If any heat which is used for purposes other than power generation (e.g. heat which is produced in boilers or extracted from the header to feed thermal loads in the process) is generated during the crediting period or was generated prior to the implementation of the project activity, by any on-site or off-site heat generation equipment connected to the project site, the amount of fuel used in the heat generation equipment should be monitored and clearly differentiated from any fuel used in the project activity. The following conditions should be checked using this data: • The implementation of the project activity does not influence directly or indirectly the operation of the heat generation equipment, i.e. the heat generation equipment would operate in the same manner in the absence of the project activity; and • The heat generation equipment does not influence directly or indirectly the operation of the project plant, for example no fuels are diverted from the heat generation equipment to the project plant
Source of data:	On-site measurements
Measurement procedures (if any):	Use weight or volume meters. The quantity shall be cross-checked with the quantity of electricity generated and any fuel purchase receipts (if available)
Monitoring frequency:	Data monitored continuously and aggregated as appropriate, to calculate emissions reductions
QA/QC procedures:	-
Any comment:	This parameter is related to an applicability condition

Data / Parameter table 20.

Data / Parameter:	**Biomass categories and quantities used in the project activity**
Data unit:	• Type (i.e. bagasse, rice husks, empty fruit bunches, etc.); • Source (e.g. produced on-site, obtained from an identified biomass residues producer, obtained from a biomass residues market, etc.); • Fate in the absence of the project activity (Scenario B); • Use in the project scenario (Scenario P); • Quantity (tonnes on dry-basis)

Description:	Explain and document transparently in the CDM-PDD, , which quantities of which biomass residues categories are used in which installation(s) under the project activity and what is their baseline scenario. Include the quantity of each category of biomass residues (tonnes on dry-basis). These quantities should be updated every year of the crediting period as part of the monitoring plan so as to reflect the actual use of biomass residues in the project scenario. These updated values should be used for emissions reductions calculations. Along the crediting period, new categories of biomass residues (i.e. new types, new sources, with different fate) can be used in the project activity. In this case, a new line should be added to the table. If those new categories are of the type B1, B2 or B3, the baseline scenario for those types of biomass residues should be assessed using the procedures outlined in the guidance provided in the procedure for the selection of the baseline scenario and demonstration of additionality
Source of data:	On-site measurements
Measurement procedures (if any):	Use calibrated weight meters. Adjust for the moisture content in order to determine the quantity of dry biomass
Monitoring frequency:	Data monitored continuously and aggregated as appropriate, to calculate emissions reductions
QA/QC procedures:	Cross-check the measurements with an annual energy balance that is based on purchased quantities and stock changes
Any comment:	-

Data / Parameter table 21.

Data / Parameter:	$BR_{PJ,n,y}$
Data unit:	tonnes on dry-basis
Description:	Quantity of biomass of category *n* used in power plants which are located at the project site and included in the project boundary in year *y*
Source of data:	On-site measurements
Measurement procedures (if any):	Use calibrated weight meters. Adjust for the moisture content in order to determine the quantity of dry biomass
Monitoring frequency:	Data monitored continuously and aggregated as appropriate, to calculate emissions reductions
QA/QC procedures:	Cross-check the measurements with an annual energy balance that is based on purchased quantities and stock changes
Any comment:	The biomass quantities used should be monitored separately for (a) each type of biomass and each source (e.g. produced on-site, obtained from biomass residues suppliers, obtained from a biomass residues market, obtained from an identified biomass residues producer, etc.). Biogas should be included as appropriate if applicable (in which case convenient units such as m3 should be used).

Data / Parameter table 22.

Data / Parameter:	$BR_{n,B1/B3,y}$
Data unit:	tonnes on dry-basis

Description:	Amount of biomass residues category *n* used in the project plant(s) included in the project boundary in year *y* for which B1 or B3 has been identified as the baseline scenario
Source of data:	On-site measurements
Measurement procedures (if any):	Use calibrated weight meters. Adjust for the moisture content in order to determine the quantity of dry biomass
Monitoring frequency:	Data monitored continuously and aggregated as appropriate, to calculate emissions reductions
QA/QC procedures:	Cross-check the measurements with an annual energy balance that is based on purchased quantities and stock changes
Any comment:	Biogas should be included as appropriate if applicable (in which case convenient units such as m3 should be used).

Data / Parameter table 23.

Data / Parameter:	$BR_{B4,n,y}$
Data unit:	tonnes of dry matter
Description:	Quantity of biomass residues of category *n* used in the CDM project activity in year *y*, for which the baseline scenario is B4 (tonnes on dry-basis)
Source of data:	On-site measurements
Measurement procedures (if any):	Use calibrated weight meters. Adjust for the moisture content in order to determine the quantity of dry biomass
Monitoring frequency:	Data monitored continuously and aggregated as appropriate, to calculate emissions reductions
QA/QC procedures:	Crosscheck the measurements with an annual energy balance that is based on purchased quantities and stock changes
Any comment:	Biogas should be included as appropriate if applicable (in which case convenient units such as m^3 should be used)

Data / Parameter table 24.

Data / Parameter:	$BR_{B5,n,y}$
Data unit:	tonnes on dry-basis
Description:	Quantity of biomass residues of category *n* used in the CDM project activity in year *y* for which the baseline scenario is B5 (tonne on dry-basis)
Source of data:	On-site measurements
Measurement procedures (if any):	Use calibrated weight meters. Adjust for the moisture content in order to determine the quantity of dry biomass
Monitoring frequency:	Data monitored continuously and aggregated as appropriate, to calculate emissions reductions
QA/QC procedures:	Crosscheck the measurements with an annual energy balance that is based on purchased quantities and stock changes
Any comment:	

Data / Parameter table 25.

Data / Parameter:	**For biomass residues categories for which scenarios B1, B2 or B3 is deemed a plausible baseline alternative, project participants shall demonstrate that this is a realistic and credible alternative scenario**
Data unit:	Tones
Description:	• Quantity of available biomass residues of type n in the region; • Quantity of biomass residues of type n that are utilized (e.g. for energy generation or as feedstock) in the defined geographical region; • Availability of a surplus of biomass residues type n (which cannot be sold or utilized) at the ultimate supplier to the project and a representative sample of other suppliers in the defined geographical region
Source of data:	Surveys or statistics
Measurement procedures (if any):	-
Monitoring frequency:	At the validation stage for biomass residues categories identified ex ante, and always that new biomass residues categories are included during the crediting period
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 26.

Data / Parameter:	$BR_{BL,BR\text{-}only,y}$
Data unit:	tonnes on dry-basis
Description:	Quantity of biomass residues that would be fired in biomass-residue-only heat generators (of power-only plants) in the baseline in year *y*
Source of data:	On-site measurements
Measurement procedures (if any):	Use calibrated weight meters. Adjust for the moisture content in order to determine the quantity of dry biomass. The quantity shall be cross-checked with the quantity of heat generated and any fuel purchase receipts (if available)
Monitoring frequency:	Yearly
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 27.

Data / Parameter:	$BR_{BL,co\text{-}fired,y}$
Data unit:	tonnes on dry-basis
Description:	Quantity of biomass residues that would be fired in co-fired heat generators (of power-only plants) in the baseline in year *y*
Source of data:	On-site measurements

Measurement procedures (if any):	Use calibrated weight meters. Adjust for the moisture content in order to determine the quantity of dry biomass. The quantity shall be cross-checked with the quantity of heat generated and any fuel purchase receipts (if available)
Monitoring frequency:	Yearly
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 28.

Data / Parameter:	$EG_{PJ,gross,y}$
Data unit:	MWh
Description:	Gross quantity of electricity generated in all power plants which are located at the project site and included in the project boundary in year *y*
Source of data:	On-site measurements
Measurement procedures (if any):	Use calibrated electricity meters
Monitoring frequency:	Data monitored continuously and aggregated as appropriate, to calculate emissions reductions
QA/QC procedures:	The consistency of metered electricity generation should be cross-checked with receipts from electricity sales (if available) and the quantity of fuels fired (e.g. check whether the electricity generation divided by the quantity of fuels fired results in a reasonable efficiency that is comparable to previous years)
Any comment:	-

Data / Parameter table 29.

Data / Parameter:	$EG_{PJ,aux,y}$
Data unit:	MWh
Description:	Total auxiliary electricity consumption required for the operation of the power plants at the project site
Source of data:	On-site measurements
Measurement procedures (if any):	Use calibrated electricity meters
Monitoring frequency:	Data monitored continuously and aggregated as appropriate, to calculate emissions reductions
QA/QC procedures:	The consistency of metered electricity generation should be cross-checked with receipts from electricity sales (if available) and the quantity of fuels fired (e.g. check whether the electricity generation divided by the quantity of fuels fired results in a reasonable efficiency that is comparable to previous years)
Any comment:	$EG_{PJ,aux,y}$ shall include all electricity required for the operation of equipment related to the preparation, storage and transport of biomass residues (e.g. for mechanical treatment of the biomass, conveyor belts, driers, etc.) and electricity required for the operation of all power plants which are located at the project site and included in the project boundary (e.g. for pumps, fans, cooling towers, instrumentation and control, etc.)

Data / Parameter table 30.

Data / Parameter:	$\boldsymbol{NCV_{n,y}}$
Data unit:	GJ/tonnes on dry-basis
Description:	Net calorific value of biomass residues of category *n* in year *y*
Source of data:	On-site measurements
Measurement procedures (if any):	Measurements shall be carried out at certified laboratories and according to relevant international standards. Measure the NCV on dry-basis
Monitoring frequency:	At least every six months, taking at least three samples for each measurement
QA/QC procedures:	Check the consistency of the measurements by comparing the measurement results with measurements from previous years, relevant data sources (e.g. values in the literature, values used in the national GHG inventory) and default values by the IPCC. If the measurement results differ significantly from previous measurements or other relevant data sources, conduct additional measurements. Ensure that the NCV is determined on the basis of dry biomass
Any comment:	The proposed sampling plan shall ensure that samples are randomly selected and are representative of the population.

Data / Parameter table 31.

Data / Parameter:	$\boldsymbol{EF_{BR,n,y}}$
Data unit:	t CH_4/GJ
Description:	CH_4 emission factor for uncontrolled burning of the biomass residues category *n* during the year *y*
Source of data:	Conduct measurements or use reference default values
Measurement procedures (if any):	To determine the CH_4 emission factor, project participants may undertake measurements or use referenced default values. In the absence of more accurate information, it is recommended to use 0.0027 t CH_4 per ton of biomass as default value for the product of NCV_k and $EF_{burning,CH4,k,y}$
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 32.

Data / Parameter:	**Moisture content of the biomass**
Data unit:	% water content
Description:	Moisture content of each biomass type *k*
Source of data:	On-site measurements
Measurement procedures (if any):	-
Monitoring frequency:	The moisture content should be monitored for each batch of biomass of homogeneous quality. The weighted average should be calculated for each monitoring period and used in the calculations

QA/QC procedures:	-
Any comment:	In case of dry biomass, monitoring of this parameter is not necessary

Data / Parameter table 33.

Data / Parameter:	$CAP_{FF/BR,p,y}$
Data unit:	MW
Description:	Maximum electricity generation capacity of baseline power plant *p* in year *y* if fossil-fuel-only heat generators and co-fired heat generators are used
Source of data:	On-site measurements
Measurement procedures (if any):	$CAP_{FF/BR,p,y}$ should be based on the maximum heat quantity that can be generated for use in heat engines if fossil-fuel-only heat generators and co-fired heat generators are used (but no biomass-residue-only heat generators). Note that $CAP_{FF/BR,p,y}$ depends on the amount of biomass residues co-fired in heat generators of the power plant. It is therefore determined based on the monitored amounts of biomass residues that would be co-fired in heat generators in year *y* ($BR_{BL,co-fired,y}$). Project participants should document transparently and justify in the CDM-PDD how they determine $CAP_{FF/BR,p,y}$ as a function of $BR_{BL,co-fired,y}$ for each calendar year
Monitoring frequency:	Yearly
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 34.

Data / Parameter:	$EF_{CH4,BR}$
Data unit:	t CH_4/GJ
Description:	CH_4 emission factor for the combustion of biomass residues in the project plant
Source of data:	On-site measurements or default values, as provided in **Error! Reference source not found.**
Measurement procedures (if any):	The CH_4 emission factor may be determined based on a stack gas analysis using calibrated analyzers
Monitoring frequency:	At least quarterly, taking at least three samples per measurement
QA/QC procedures:	Check the consistency of the measurements by comparing the measurement results with measurements from previous years, relevant data sources (e.g. values in the literature, values used in the national GHG inventory) and default values by the IPCC. If the measurement results differ significantly from previous measurements or other relevant data sources, conduct additional measurements
Any comment:	Monitoring of this parameter for project emissions is only required if CH_4 emissions from biomass combustion are included in the project boundary. Note that a conservative factor shall be applied, as specified in the baseline methodology

Data / Parameter table 35.

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

Data / Parameter table 36.

Data / Parameter:	$V_{WW,y}$
Data unit:	m^3
Description:	Quantity of waste water generated in year *y*
Source of data:	On-site measurements
Measurement procedures (if any):	-
Monitoring frequency:	Data monitored continuously and aggregated as appropriate, to calculate emissions reductions
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 37.

Data / Parameter:	$COD_{WW,y}$
Data unit:	tCOD/m^3
Description:	Average chemical oxygen demand of the waste water in year *y*
Source of data:	On-site measurements
Measurement procedures (if any):	-
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 38.

Data / Parameter:	$B_{o,ww}$
Data unit:	t CH_4/tCOD
Description:	Methane generation potential of the waste water
Source of data:	On-site measurements or reference default values
Measurement procedures (if any):	-
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 39.

Data / Parameter:	MCF_{ww}
Data unit:	ratio
Description:	Methane correction factor for the waste water
Source of data:	On-site measurements or reference default values
Measurement procedures (if any):	-
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	-

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Document information

Version	*Date*	*Description*
05.0	11 October 2019	MP 80, Annex 4 A call for input will be issued for this draft document. Revision to ensure consistency with AM0036 and ACM0006.
04.0	22 September 2017	EB 96, Annex 2 Revision to: • Add reference to the methodological tool “Project and leakage emissions from biomass” (TOOL16); • Streamline the determination of baseline and additionality demonstration.
03.0	8 November 2013	EB 76, Annex 9 Revision to: Include project activities generating electricity using solar thermal technology in combination with biomass residues;

Version	Date	Description
		Change the title from "Consolidated methodology for electricity generation from biomass residues in power-only plants" to "Electricity generation from biomass residues in power-only plants".
02.0.0	2 March 2012	EB 66, Annex 40 Revision to incorporate reference to the tools: • "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of a crediting period"; • "Tool for project and leakage emissions from road transportation of freight".
01.3.0	29 September 2011	EB 63, Annex 18 Amendment to: • Broaden the applicability of the methodology by increasing the maximal share of the co-fired fossil fuels in the total fuel fired from 50% to 80% on an energy basis.
01.2.0	26 November 2010	EB 58, Annex 10 The methodology was revised to include project activities that process the biomass residues prior to combustion by means of pelletization, shredding and/or briquetting.
01.1	30 July 2010	EB 55, Annex 17 Editorial revision to: • Revise the monitoring procedure of the biomass moisture content so that the parameter can be monitored for each batch of biomass, rather than continuously.
01	12 February 2010	EB 52, Annex 3 Initial adoption.

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