CLEAN DEVELOPMENT MECHANISM

CDM-MP78-A12

Draft Small-scale Methodology

AMS-I.C.:Thermal energy production with or without electricity

Version 21.0

Sectoral scope(s): 01

COVER NOTE

1. Procedural background

1. The Board, at its eighty-third meeting (EB 83), considered a concept note on "Non-binding best practice examples within the CDM methodologies" and requested the Methodologies Panel (MP) and the Small-Scale Working Group (SSC WG) to recommend non-binding best practice examples to be included in the methodologies identified in table 1 and table 2 of the concept note as contained in annex 4 to the annotated agenda of EB 83. The concept note also provided the criteria for the selection of priority methodologies to include non-binding best practice examples.

2. The Board, at its ninety-eighth meeting (EB 98), adopted the workplan of the MP for 2018, which included work on "Non-binding best practice examples in methodologies" as part of the project 223 - Simplification of methodologies.

3. The Board, at its ninety-ninth meeting (EB 99), considered the concept note on further prioritizing methodologies for revision to include non-binding best-practice examples, and requested the MP to revise the methodologies, as identified in the concept note, to include non-binding best-practice examples. Specifically, the Board requested that the revision of "ACM0006: Electricity and heat generation from biomass" and "AMS-II.G: Energy efficiency measures in thermal applications of non-renewable biomass" be prioritized and thereafter revise "ACM0019: N2O abatement from nitric acid production" and "AMS-I.C: Thermal energy production with or without electricity".

2. Purpose

4. The purpose of this revision is to include non-binding best practice examples in the methodology AMS-I.C.

3. Key issues and proposed solutions

5. The MP included non-binding best practice examples in the methodology, building on the secretariat/MP experience of the project and PoA registration/issuance assessment and taking into account common pitfalls in the application of the methodology.

6. The request for clarifications, post registration changes and methodological issues identified at the information and reporting check (IRC) were analysed to identify the area for which non-binding best examples can be developed. In addition, issues raised by designated operational entities (DOEs) at the calibration workshop were used to derive the possible non-binding examples.

7. Best practice examples cover, among others, the applicability of the biomass-based cogeneration and trigeneration systems, the spatial extent of the project boundary, and the baseline emissions for co-fired systems.

4. Impacts

8. Project participants and designated operational entities (DOEs) that aim to utilize the methodologies will benefit from having non-binding best practice examples in the methodologies. The non-binding best practice examples will reduce instances of misinterpretation and enhance the understanding of the requirements. This understanding will reduce the number of documents deemed incomplete at the "information and reporting" and "request for review" stage at the request for registration and issuance on areas related to methodological requirements.

5. Subsequent work and timelines

9. The MP, at its 78th 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 meeting of the Board.

6. Recommendations to the Board

10. 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)	Thermal energy production using renewable energy sources including biomass-based cogeneration and/or trigeneration. Projects that seek to retrofit or modify existing facilities for renewable energy generation are also applicable
Type of GHG emissions mitigation action	Renewable energy. Displacement of more-GHG-intensive thermal energy production, displacement of more-GHG-intensive thermal energy and/or electricity generation

2. Scope, applicability, and entry into force

2.1. Scope

2. This methodology comprises renewable energy technologies that supply users i.e. residential, industrial or commercial facilities with thermal energy that displaces fossil fuel use. These units include technologies such as solar thermal water heaters and dryers, solar cookers, energy derived from renewable biomass and other technologies that provide thermal energy that displaces fossil fuel.

2.2. Applicability

3. Biomass-based cogeneration and trigeneration systems are included in this category.

4. ~~Emission reductions from a biomass cogeneration or trigeneration system can accrue from one of the following activities:~~

~~(a) Electricity supply to a grid;~~

~~(b) Electricity and/or thermal energy production for on-site consumption or for consumption by other facilities;~~

~~(c) Combination of (a) and (b).~~

5. Emission reductions from a biomass cogeneration or trigeneration system can accrue from one of the following activities:

   (a) Thermal energy production for on-site consumption or for consumption by other facilities;

   (b) Electricity as a coproduct for:

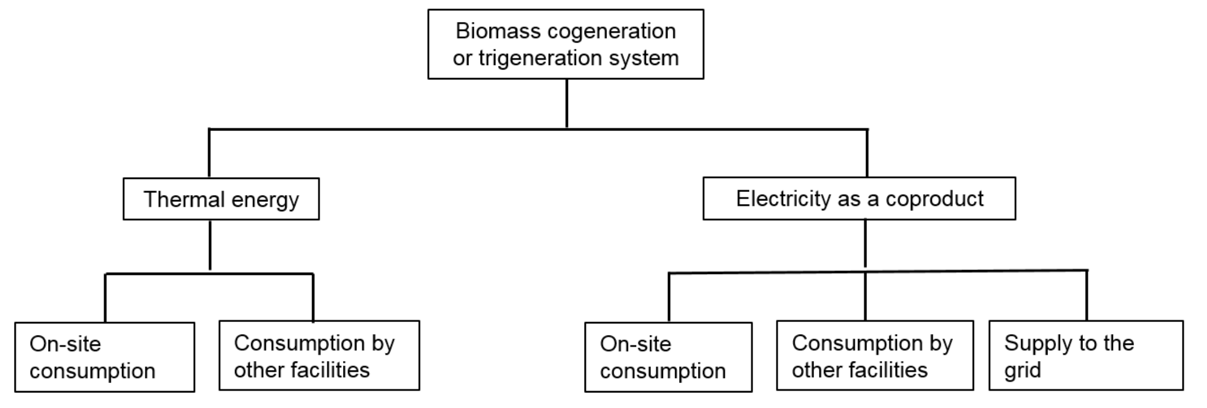
      (i) on-site consumption, and/or

      (ii) for consumption by other facilities; and/or

      (iii) supply to the grid;

Box 1. Non-binding best practice example 1: Applicability of the biomass-based cogeneration and trigeneration systems

Project participants implementing a biomass-based cogeneration or trigeneration system can claim emission reductions as per graphic below:



6. Project activities that seek to retrofit or modify an existing facility for renewable energy generation are included in this category.

7. In the case of new facilities (Greenfield projects) and project activities involving capacity additions the relevant requirements related to determination of baseline scenario provided in the "General guidelines for SSC CDM methodologies" for Type-II and Type-III Greenfield/capacity expansion project activities also apply.

8. The total installed/rated thermal energy generation capacity of the project equipment is equal to or less than 45 MW thermal[1] (see paragraph 9 for the applicable limits for cogeneration and trigeneration project activities).

9. For co-fired systems, the total installed thermal energy generation capacity of the project equipment, when using both fossil and renewable fuel, shall not exceed 45 MW thermal (see paragraph 9 for the applicable limits for cogeneration project activities).

10. The following capacity limits apply for biomass cogeneration and trigeneration units:

    (a) If the emission reductions of the project activity are on account of thermal and electrical energy production, the total installed thermal and electrical energy generation capacity of the project equipment shall not exceed 45 MW thermal. For the purpose of calculating the capacity limit the conversion factor of 1:3 shall be used for converting electrical energy to thermal energy (i.e. for renewable energy project activities, the installed capacity of 15 MW(e) is equivalent to 45 MW thermal output of the equipment or the plant);

[1] Thermal energy generation capacity shall be manufacturer's rated thermal energy output, or if that rating is not available the capacity shall be determined by taking the difference between enthalpy of total output (for example steam or hot air or chilled water in kcal/kg or kcal/m^3) leaving the project equipment and the total enthalpy of input (for example feed water or air in kcal/kg or kcal/m^3) entering the project equipment. For boilers, condensate return (if any) must be incorporated into enthalpy of the feed.

(b) If the emission reductions of the project activity are solely on account of thermal energy production (i.e. no emission reductions accrue from the electricity component), the total installed thermal energy production capacity of the project equipment shall not exceed 45 MW thermal;

(c) If the emission reductions of the project activity are solely on account of electrical energy production (i.e. no emission reductions accrue from the thermal energy component), the total installed electrical energy generation capacity of the project equipment shall not exceed 15 MW.

11. The capacity limits specified in paragraphs 7 to 9 above apply to both new facilities and retrofit projects. In the case of project activities that involve the addition of renewable energy units at an existing renewable energy facility, the total capacity of the units added by the project shall comply with capacity limits specified in the paragraphs 7 to 9, and shall be physically distinct[2] from the existing units.

12. If solid biomass fuel (e.g. briquette) is used, it shall be demonstrated that it has been produced using solely renewable biomass and all project or leakage emissions associated with its production shall be taken into account in the emissions reduction calculation.

13. Where the project participant is not the producer of the processed solid biomass fuel, the project participant and the producer are bound by a contract that shall enable the project participant to monitor the source of the renewable biomass to account for any emissions associated with solid biomass fuel production. Such a contract shall also ensure that there is no double-counting of emission reductions.

14. If electricity and/or thermal energy produced by the project activity is delivered to a third party i.e. another facility or facilities within the project boundary, a contract between the supplier and consumer(s) of the energy will have to be entered into that ensures there is no double-counting of emission reductions.

15. If the project activity recovers and utilizes biogas for producing electricity and/or thermal energy and applies this methodology on a standalone basis i.e. without using a Type III component of a SSC methodology, any incremental emissions occurring due to the implementation of the project activity (e.g. physical leakage of the anaerobic digester, emissions due to inefficiency of the flaring), shall be taken into account either as project or leakage emissions as per relevant procedures in the tool “Emissions from solid waste disposal sites” and/or “Project emissions from flaring”. In the event that the biomass fuel (solid/liquid/gas) is sourced from an existing CDM project, then the emissions associated with the production of the fuel shall be accounted with that project.

16. If project equipment contains refrigerants, then the refrigerant used in the project case shall have no ozone depleting potential (ODP).

[2] Physically distinct units are those that are capable of producing thermal/electrical energy without the operation of existing units, and that do not directly affect the mechanical, thermal, or electrical characteristics of the existing facility. For example, the addition of a steam turbine to an existing combustion turbine to create a combined cycle unit would not be considered “physically distinct”.

17. Charcoal based biomass energy generation project activities are eligible to apply the methodology only if the charcoal is produced from renewable biomass sources-provided:

    (a) Charcoal is produced in kilns equipped with methane recovery and destruction facility; or

    (b) If charcoal is produced in kilns not equipped with a methane recovery and destruction facility, methane emissions from the production of charcoal shall be considered. These emissions shall be calculated as per the procedures defined in the approved methodology "AMS-III.K: Avoidance of methane release from charcoal production by shifting from traditional open-ended methods to mechanized charcoaling process". Alternatively, conservative emission factor values from peer reviewed literature or from a registered CDM project activity can be used, provided that it can be demonstrated that the parameters from these are comparable e.g. source of biomass, characteristics of biomass such as moisture, carbon content, type of kiln, operating conditions such as ambient temperature.

18. In cases where the project activity utilizes biomass, sourced from dedicated plantations, applicability conditions prescribed in the tool "Project emissions from cultivation of biomass" shall apply.

2.3. Entry into force

19. The date of entry into force is the date of the publication of the EB XX meeting report on DD Month YYYY.

3. Normative references

20. Project participants shall apply the "General guidelines for SSC CDM methodologies", "Guidelines on the demonstration of additionality of small-scale project activities" and "General guidance on leakage in biomass project activities" (attachment C to Appendix eB) provided at <http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html> mutatis mutandis.

21. This methodology also refers to the latest approved versions of the following approved methodologies, tools and guidelines:

    (a) "AMS-I.D: Grid connected renewable electricity generation";

    (b) "AMS-I.F: Renewable electricity generation for captive use and mini-grid";

    (c) "AMS-III.K: Avoidance of methane release from charcoal production by shifting from traditional open-ended methods to mechanized charcoaling process";

    (d) "TOOL03: Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion";

    (e) ~~"Tool to calculate baseline, project and/or leakage emissions from electricity consumption";~~ "TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation";

(f) ~~"Tool to determine the baseline efficiency of thermal or electric energy generation systems"~~ "TOOL09: Determining the baseline efficiency of thermal or electric energy generation systems";

(g) ~~Tool: "Project emissions from cultivation of biomass";~~ "TOOL16: Project and leakage emissions from biomass"

(h) ~~Tool:~~ "TOOL04: Emissions from solid waste disposal sites";

(i) ~~Tool:~~ "TOOL06: Project emissions from flaring";

(j) ~~Tool:~~ "TOOL12: Project and leakage emissions from transportation of freight";

(k) ~~Guideline: "Sampling and surveys for CDM project activities and programmes of activities".~~ "Guidelines for sampling and surveys for CDM project activities and programme of activities".

4. Definitions

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

23. For the purpose of this methodology following definitions shall apply:

(a) **Cogeneration** - means the simultaneous generation of heat and electrical energy in one process.[3] Project activities that produce heat and electrical energy in separate element processes (for example heat from a boiler and electricity from a biogas engine) do not fit under the definition of cogeneration;

(b) **Trigeneration** - means the simultaneous generation of electrical energy and thermal energy in the form of cooling and heating in one process.[4] Project activities that produce electrical energy and thermal energy in separate element processes (for example thermal energy from a boiler and electricity from a biogas engine) do not fit under the definition of trigeneration;

(c) **Existing facilities** - are those that have been in operation for at least three years immediately prior to the start date of the project activity;

(d) **Thermal energy** - means either heating (e.g. steam or hot water or hot air) or cooling (e.g. chilled water), or both;

(e) **Co-fired system** - uses both fossil and renewable fuels in a single boiler for simultaneous combustion and fossil fuel may be used during a period of time when the biomass is not available.

[3] This methodology, however, does not preclude production of heat and power from the same heat generating equipment, for example a portion of steam produced in a boiler is used for process heat and another portion of steam from the same boiler is used for electricity production.

[4] This methodology, however, does not preclude production of thermal energy in the form of heating and cooling and power from the same heat generating equipment, for example a portion of steam produced in a boiler is used as process heat and another portion to generate chilled water and remaining portion of steam from the same boiler is used for electricity production.

5. Baseline methodology

5.1. Project boundary

24. The spatial extent of the project boundary encompasses:

(a) All plants generating electricity and/or thermal energy located at the project site, whether fired with biomass, fossil fuels or a combination of both;

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

(c) Industrial, commercial or residential facility, or facilities, consuming energy generated by the system and the processes or equipment affected by the project activity;

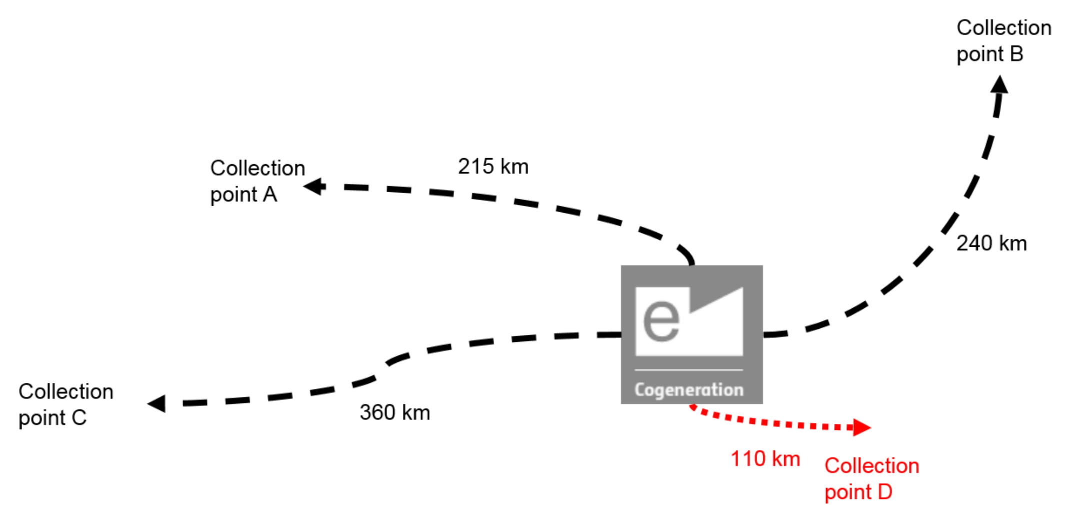
(d) The processing plant of biomass residues, for project activities using solid biomass fuel (e.g. briquette), unless all associated emissions are accounted for as leakage emissions or are part of an independently registered CDM project;

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

(f) The transportation itineraries, if the biomass is transported over distances greater than 200 kilometres, unless all associated emissions are accounted for as leakage emissions;

Box 2. Non-binding best practice example 2: Spatial extent of the project boundary

A project activity involves the use of biomass residues to produce electricity and heat in an existing industrial facility. The biomass residues are collected from several locations as indicated in the illustration below:



The transportation itineraries to collection points A, B and C should be included within the spatial extent of the project boundary. The transportation itinerary to collection points D does not have to be accounted, since the distance is lower than 200 km.

(g) The site of the anaerobic digester in the case of project activity that recovers and utilizes biogas for producing electricity and/or thermal energy and applies this methodology on a standalone basis, i.e. without using a Type III component of a SSC methodology.

5.2. Baseline emissions

5.2.1. General criteria on determining baseline emissions

25. For renewable energy technologies that displace technologies using fossil fuels, the simplified baseline is the fuel consumption of the technologies that would have been used in the absence of the project activity, times an emission factor for the fossil fuel displaced.

26. For project activities implemented in existing facilities, baseline calculations shall be based on operational data on energy use (e.g. electricity, fossil fuel) and plant output (e.g. thermal and/or electrical energy) using;

(a) Most recent three years operational data immediately prior to the start date of the project activity in case of existing facilities which has more than three years of operation history;

(b) A minimum of most recent one year data in case of existing facilities which has more than three years of operation history but do not have three years operational data; or

(c) A performance test/measurement campaign carried out prior to the implementation of the project activity in case of existing facilities which has more than three years of operation history but do not have operational data/information such as efficiency, energy consumption and output or the available data is not reliable due to various factors such as the use of imprecise or non-calibrated measuring equipment. The project proponent may follow the relevant provisions from the ~~"Tool to determine baseline efficiency of thermal and electricity systems"~~ "TOOL09 Determining the baseline efficiency of thermal or electric energy generation systems".

27. In the case of project activities that export thermal and/or electrical energy to other facilities, historical data from the recipient plants is also required.

28. For project activities implemented in existing facilities where the additionality is demonstrated based on a baseline scenario that is not the continuation of the current practice (e.g. continued use of the fossil fuel that was used prior to the implementation of the project activity), the baseline emission factor is chosen as lower of the two: (a) the emission factor of the fossil fuel that would have been used in the absence of the project activity; and (b) the emission factor of the fossil fuel that was used prior to the implementation of the project activity.

5.2.2. Baseline scenario for electrical and/or thermal energy production

29. Project activities producing both electricity and thermal energy shall use one of the following baseline scenarios:

(a) Electricity is imported from a grid and thermal energy is produced using fossil fuel;

(b) Electricity is produced in an on-site captive power plant using fossil fuel (with a possibility of export to the grid) and thermal energy is produced using fossil fuel;

(c) A combination of (a) and (b);

(d) Electricity and thermal energy are produced in a cogeneration or trigeneration unit using fossil fuel (with a possibility of export of electricity to a grid/other facilities and/or thermal energy to other facilities);

(e) Electricity is imported from a grid and/or produced in an on-site captive power plant using fossil fuels (with a possibility of export to the grid); thermal energy is produced using biomass;

(f) Electricity is produced in an on-site captive power plant using biomass (with a possibility of export to a grid) and/or imported from a grid; thermal energy is produced using fossil fuel;

(g) Electricity and thermal energy are produced in a biomass fired cogeneration or trigeneration unit (without a possibility of export of electricity either to a grid or to other facilities and without a possibility of export of thermal energy to other facilities);

(h) Electricity and/or thermal energy produced in a co-fired system;

(i) Electricity is imported from a grid and/or produced in a biomass fired cogeneration or trigeneration unit (without a possibility of export of electricity either to the grid or to other facilities); thermal energy is produced in a biomass fired cogeneration or trigeneration unit and/or a biomass fired boiler (without a possibility of export of thermal energy to other facilities);

(j) Electricity is imported from a grid and/or produced in an on-site captive power plant using fossil fuel and thermal energy is produced using electricity.

30. The scenario mentioned in paragraph 28(g) applies to a project activity that installs a new grid connected biomass cogeneration or trigeneration system that produces surplus electricity and this surplus electricity is exported to a grid.[5]

31. This scenario mentioned in paragraph 28(i) to a project activity that installs a new biomass cogeneration or trigeneration system that displaces electricity which otherwise would have been imported from a grid.[6]

5.2.3. Baseline emissions for electricity production

32. Baseline emissions for electricity produced in captive plants shall be calculated as follows:

$$BE_{captelec,y} = \left(\frac{EG_{captelec,PJ,y}}{\eta_{BL,captive\ plant}}\right) \times EF_{BL,FF,CO2} \qquad \text{Equation (1)}$$

Where:

$BE_{captelec,y}$	=	Baseline emissions from electricity displaced by the project activity during the year *y* (t CO_2)
$EG_{captelec,PJ,y}$	=	Amount of electricity produced by the project activity during the year *y* (MWh)
$EF_{BL,FF,CO2}$	=	CO_2 emission factor of the fossil fuel that would have been used in the baseline plant (t CO_2/MWh)
$\eta_{BL,captive\ plant}$	=	Efficiency of the plant using fossil fuel that would have been used in the absence of the project activity determined using paragraph 39 or 40 below

33. Baseline emissions for supply of electricity to and/or displacement of electricity from a grid shall be calculated as follows:

$$BE_{grid,y} = EG_{grid,y} \times EF_{grid,y} \qquad \text{Equation (2)}$$

5 All the services provided in pre-project scenario baseline i.e. energy supply (process heat, cooling, chilled water and electricity) are maintained at the same level or improved during the crediting period. This shall be demonstrated using the most recent three years of historical data. (see also paragraph 25).

6 It shall be demonstrated using the three most recent years of historical data that electricity imported from the grid is more than captive electricity generated using biomass. All the services provided in pre-project scenario i.e. energy supply (process heat and electricity) are maintained at the same level or improved during the crediting period (see also paragraph 25).

Where:

$BE_{grid,y}$	=	Baseline emissions for the grid electricity displaced by the project in year *y* (t CO_2e)
$EG_{grid,y}$	=	Amount of grid electricity displaced by project in year *y* (MWh)
$EF_{grid,y}$	=	Emission factor of the grid (t CO_2e/MWh)

5.2.4. Baseline emissions for heat production

34. For thermal energy produced using fossil fuels and/or grid electricity the baseline emissions are calculated as follows:

$$BE_{thermal,Co2,y} = \left(\frac{EG_{thermal,y}}{\eta_{BL,thermal}}\right) \times EF_{FF,CO2} \qquad \text{Equation (3)}$$

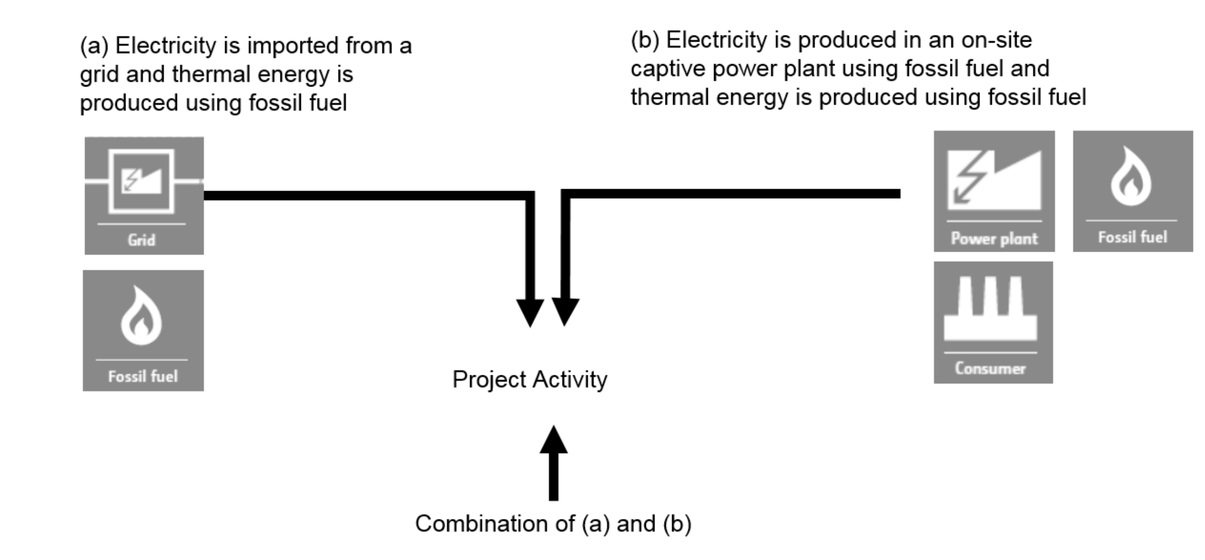
Where:

$BE_{thermal,Co2,y}$	=	Baseline emissions from thermal energy displaced by the project activity during the year *y* (t CO_2)
$EG_{thermal,y}$	=	Net quantity of thermal energy supplied by the project activity during the year *y* (TJ)
$EF_{FF,CO2}$	=	CO_2 emission factor of the fossil fuel that would have been used in the baseline plant obtained from reliable local or national data if available, alternatively, IPCC default emission factors can be used (t CO_2/TJ)
$\eta_{BL,thermal}$	=	Efficiency of the plant using fossil fuel that would have been used in the absence of the project activity determined as per paragraph 39 or 40

35. For cases 28(a), (b) and (c), baseline emissions shall be calculated as the sum of emissions from the production of electricity and thermal energy considering most recent historical records (average of the data from a minimum of the three most recent years excluding abnormal years is required).

Box 3. Non-binding best practice example 3: Baseline scenario for electrical and/or thermal energy production

A project activity producing both electricity and thermal energy shall use one of the following baseline scenarios:



5.2.5. Determination of emission factor for electricity

36. For project activities that displace on-site captive electricity and/or displace grid electricity import and/or supply electricity to a grid, the electricity emission factor should reflect the emissions intensity of the captive power plant and the grid of the baseline scenario. If annual electricity produced in the project activity is less than or equal to the sum of on-site captive generation and net grid import[7] in the baseline scenario, the emission factor shall be calculated as the weighted average of on-site captive electricity generation and the net grid electricity import in the baseline.[8] If annual electricity produced in the project activity is greater than the sum of on-site captive generation and net grid import in the baseline, the lower of the two, i.e. the emission factor of the grid or the emission factor of the baseline captive plant shall be used for the incremental generation (i.e. the difference between the electricity generation in the project activity and the sum of captive generation and net grid import).

[7] Difference of total electricity imported from the grid and total electricity exported to the grid.

[8] ~~For example in the baseline if 80 per cent of annual electricity requirement was met by grid import and the rest by captive generation, the weighted average emission factor (*EF*) would be 0.8 EF_{grid} + 0.2 $EF_{captive}$.~~

Box 4. Non-binding best practice example 4: Weighted average of on-site captive electricity generation and the net grid electricity import in the baseline

> In the baseline, 80 per cent of annual electricity requirement is met by grid import and the rest by captive generation, the weighted average baseline emission factor (EF) would be 0.8 EFgrid

37. For project activities that do not displace captive electricity generated by an existing plant but displace grid electricity import and/or supply electricity to a grid, the emission factor of the grid shall be calculated as per the procedures detailed in “AMS-I.D: Grid connected renewable electricity generation” or “AMS-I.F: Renewable electricity generation for captive use and mini-grid”.

38. For new facilities, the most conservative (lowest) emission factor of the two power sources (captive power plant and grid) should be used.

5.2.6. Baseline emissions for electricity and heat production

39. For electricity and thermal energy produced in a baseline cogeneration or trigeneration unit, using fossil fuel (case 28(d)), the following equation shall be used to determine baseline emissions:

$$BE_{cogen/trigen,CO2,y} = \left[\left(\frac{EG_{PJ,thermal,y} + EG_{PJ,electrical,y} \times 3.6}{\eta_{BL,cogen/trigen}}\right)\right] \times EF_{FF,CO2}$$ Equation (4)

Where:

$BE_{cogen/trigen,CO2,y}$	=	Baseline emissions from electricity and thermal energy displaced by the project activity during the year *y* (t CO_2)
$EG_{PJ,electrical,y}$	=	Amount of electricity supplied by the project activity during the year *y*; (GWh)
3.6	=	Conversion factor (TJ/GWh)
$EG_{PJ,thermal,y}$	=	Net quantity of thermal energy supplied by the project activity during the year *y* (TJ)
$EF_{FF,CO2}$	=	CO_2 emission factor of the fossil fuel that would have been used in the baseline cogeneration plant obtained from reliable local or national data if available, alternatively, IPCC default emission factors can be used (t CO_2/TJ)
$\eta_{BL,cogen/trigen}$	=	Total annual average efficiency of the cogeneration or trigeneration plant using fossil fuel determined as per paragraph 39 or 40

40. In the case of an existing baseline cogeneration or trigeneration plant, the efficiency shall be calculated as the total annual energy produced over the last three years using the historical data as prescribed in paragraph 25 above (total electricity generated and total thermal energy extracted divided by the thermal energy value of the fuel use).

41. In the case of a Greenfield project cogeneration or trigeneration plant where the baseline is a cogeneration or trigeneration plant (e.g. using a steam turbine and steam generator that would have been built in the absence of the project activity), the total annual average efficiency of the cogeneration or trigeneration plant using fossil fuel shall be defined as the ratio of thermal energy and electricity produced to total thermal energy value of the fuel use. This ratio shall be determined using one of the two following options (in preferential order):

(a) Calculated as a single value with consideration of the following:

(i) Step 1:

a. The total annual average efficiency of the cogeneration or trigeneration plant using fossil fuel is determined using documented efficiency specification for new steam turbines and steam generators provided by two or more manufacturers for each type of such equipment within in the region:[9]

b. Efficiency values for the steam turbine(s) and steam generator(s) shall be based on turbines and steam generators with specifications nearly equivalent to baseline units that would have been utilized in the absence of the project activity;

c. The efficiency values utilized shall be the highest individual efficiency values (over the full range of expected operating conditions of the baseline cogeneration or trigeneration system) that can be achieved by the steam turbine(s) and steam generator(s).

(ii) Step 2:

a. The total annual average efficiency of the cogeneration or trigeneration plant using fossil fuel is then calculated as the product of the highest efficiency value for the steam turbine(s) and the highest efficiency value of the steam generator(s), assuming both efficiencies are in the form of a percentage of output per input;

(b) Calculated as a single value with consideration of the following:

(i) Step 1:

a. A default steam turbine efficiency of 100 per cent;

b. Default steam generator efficiency determined using the values provided in appendix;

(ii) Step 2:

a. The total annual average efficiency of the cogeneration or trigeneration plant using fossil fuel is then calculated as the product of the efficiency value for the steam turbine(s) and the efficiency

[9] In case equipment is not available within the region the project proponent shall consider adjoining regions.

value of the steam generator(s), assuming both efficiencies are in the form of a percentage of output per input.

42. Efficiency of the baseline units (excluding cogeneration or trigeneration plants) shall be determined by adopting one of the following criteria (in preferential order):

(a) Highest measured operational efficiency over the full range of operating conditions of a unit with similar specifications, using baseline fuel. The efficiency tests shall be conducted following the guidance provided in relevant national/international standards;

(b) Highest of the efficiency values provided by two or more manufacturers for units with similar specifications, using the baseline fuel;

(c) A default efficiency of 100 per cent.

43. For household or commercial applications/systems, whose maximum output capacity is less than 45 kW thermal and where it can be demonstrated that the metering of thermal energy output is not plausible, as in the case of cooking stoves, gasifiers, driers, water heaters etc., efficiency of the baseline units shall be determined by adopting one of the following criteria:

(a) Highest measured operational efficiency over the full range of operating conditions of a representative sample of units with similar specifications, using baseline fuel. The efficiency tests shall be conducted following the guidance provided in relevant national/international standards;

(b) Highest of the efficiency values provided by two or more manufacturers for units with similar specifications using the baseline fuel;

(c) Highest efficiency from referenced literature values or default efficiency of 100 per cent.

44. For case 28(e), baseline emissions from the production of electricity shall be calculated as per paragraph 29 and 30. Emission reductions from heat generation are not eligible.

45. For case 28(f), baseline emissions from the production of thermal energy using fossil fuel shall be calculated as per paragraph 31. Emission reductions from displacing on-site electricity generation are not eligible.

46. For case 28(g) and (i), baseline emissions from the additional production of electricity that displaces grid electricity import and/or supply electricity to the grid, shall be calculated as per paragraph 29.

5.2.7. Baseline emissions for co-fired systems

47. For case 28(h) and other project activities where the baseline is co-fired system,[10] baseline emissions shall be determined based on three years average historical data on the relative

[10] For project activities where the baseline is not a co-fired system equation (1) for electricity and equation (2) for heat/steam can be applied.

share of fossil fuel and biomass in the baseline fuel mix.[11] The relative share is determined based on the energy content of each fuel.

Box 5. Non-binding best practice example 5: Baseline emissions for co-fired systems

A project activity involves electricity and thermal energy produced in a co-fired system (fuel oil and rice husk) in an industrial facility constructed in 2012. That has operated with a high share of fossil fuels. The start date of the project activity with the high share of biomass is 01 January 2018. Yearly baseline operation data are available, as per table below:

Year	Fuel type 1 Coal Relative share (%)	Fuel type 2 Petroleum coke Relative share (%)	Relative share – Fossil Fuel (%)	Rice Husk (Biomass Fuel) Relative share (%)	Thermal Energy Generated GWh_{th}	Electricity Generated (GWh_e)
2013	50	48	98	2	40	21
2014	50	40	90	3	43	25
2015	40	55	95	5	46	22
2016	30	55	85	15	39	15
2017	40	50	90	10	40	20

For the baseline emissions, the weighted average emission factors (in energy basis) among the identified fossil fuels (coal and petroleum coke) for 2015, 2016 and 2017 were used to determine the CO_2 emission factor of the baseline co-fired plant ($EF_{cofire,CO2}$).

$$BE_{cofire,Co2,y} = \left(\frac{EG_{cofire,PJ,y}}{\eta_{BL,cofire}}\right) \times EF_{cofire,CO2}$$ Equation (5)

Where:

$BE_{cofire,Co2,y}$	=	Baseline emissions from thermal and/or electrical energy displaced by the project activity during the year *y* (t CO_2e)
$EG_{cofire,PJ,y}$	=	Net quantity of energy (electricity/thermal) supplied by the project activity during the year *y* (TJ)
$EF_{cofire,CO2}$	=	CO_2 emission factor of the baseline co-fired plant established using three years average historical data (t CO_2/TJ)
$\eta_{BL,cofire}$	=	Efficiency of the co-fired plant that would have been used in the absence of the project activity determined using paragraph 39 or 40 above

11 In the case where more than one fossil fuel is used by the co-fired plant, the weighted average emission factor (in energy basis) among the identified fossil fuels shall be used.

5.2.8. Baseline emissions for trigeneration systems

48. For case 28(j) the baseline emissions, BE_y are calculated using equation (6):

$$BE_y = BE_{grid,y} + BE_{captelec,y} + B_{BC,y} + BE_{BH,y} \quad \text{Equation (6)}$$

Where:

$BE_{grid,y}$	=	Baseline emissions associated with the grid electricity displaced by the project in year y (t CO_2e)
$BE_{captelec,y}$	=	Baseline emissions from electricity displaced by the project activity during the year y (t CO_2)
$B_{BC,y}$	=	Baseline emissions associated with the cooling (e.g. chilled water) produced in year y (t CO_2e)
$BE_{BH,y}$	=	Baseline emissions associated with the heat (e.g. steam or hot water) produced in year y (t CO_2e)

49. Baseline electricity related emissions ($BE_{grid,y}$) are calculated as per equation (2) above.

50. The baseline emissions ($BE_{captelec,y}$) from electricity obtained from captive power plant(s), is calculated using equation (1) above.

51. Baseline emissions associated with the electricity consumed, whether it is from captive power plants and/or power from the grid, to produce chilled water within the project boundary are determined per equation (7).

$$BE_{BC,y} = EF_{grid,y} \times \sum_i \frac{C_{P,i,y}}{COP_{c,i}} \quad \text{Equation (7)}$$

Where:

$EF_{grid,y}$	=	Electricity emission factor of the grid (t CO_2e/MWh)
$COP_{c,i}$	=	Coefficient of Performance (COP) of the baseline scenario chiller(s) i (MWh_{th}/MWh_e). The COP estimated as ‘cooling output divided by electricity input’
$C_{P,i,y}$	=	Cooling output of baseline scenario chiller(s) i in year y (MWh_{th})

(a) Baseline scenario chiller COP ($COP_{c,i}$) is determined as follows:

(i) If the baseline scenario is an existing chiller or chillers, then the COP shall be based on existing chiller performance data as specified in paragraph 25. In the case where multiple chillers exist, average performance data shall be used in a conservative manner with consideration of the historic output and power consumption of each chiller;

(ii) If the baseline scenario is a chiller or chillers that would have been built (i.e. not existing chillers), the COP shall be determined as the highest COP full load performance value provided by two or more manufacturers for chillers commonly sold in the project country for the indicated commercial application;

(b) The cooling output of each baseline scenario chiller *i* is calculated using measured values of the total chilled water mass flow-rate and of the differential temperature of incoming and outgoing chilled water; as recorded on an hourly basis per equation (8).

$$C_{p,i,y} = \frac{\sum_{h=1}^{8,760} m_{C,i,h} \times C_{pw} \times \Delta T_{C,i,h}}{3600}$$

Equation (8)

Where:

$C_{p,i,y}$	=	Cooling output of the baseline chiller(s) *i* in year *y* (MWh_{th})
$m_{C,i,h}$	=	Chilled water mass flow-rate for chiller(s) *i* produced by project in hour *h* of year *y* (tonnes/hour)
C_{pw}	=	Specific heat capacity of water (MJ/tonnes°C)
$\Delta T_{C,i,h}$	=	Differential temperature of inlet and outlet chilled water for chiller(s) *i* in hour *h* of year *y* of incoming and outgoing water from project (°C)

52. For project activities with water heating systems, that use electricity, the baseline emissions are determined using the electricity emission factor and hourly measurements of the total water mass flow-rate and differential temperature of incoming and outgoing water, per equation (9). This equation is based on the assumption that the efficiency of electric water heating systems is 100 per cent.

$$BE_{BH,y} = EF_{grid,y} \times \frac{\sum_{h=1}^{8,760} m_h \times C_{pw} \times \Delta T_h}{3600}$$

Equation (9)

Where:

$BE_{BH,y}$	=	Baseline emissions for hot water produced in the project activity in year *y* (t CO_2e)
$EF_{grid,y}$	=	Electricity emission factor of the grid(t CO_2e/MWh)
m_h	=	The water mass flow-rate from heater(s) during hour *h* in year *y* (tonnes)
C_{pw}	=	Specific heat capacity of water (MJ/tonnes^{0}C)
ΔT_h	=	Differential temperature of inlet and outlet hot water for heater(s) during hour *h* (°C)

5.2.9. Baseline emissions for project activities involving new renewable energy units

53. In the case of project activities that involve the addition of renewable energy units at an existing renewable energy production facility, where the existing and new units share the use of common and limited renewable resources (e.g. biomass residues), the potential for the project activity to reduce the amount of renewable resource available to, and thus

thermal energy production by, existing units must be considered in the determination of baseline emissions, project emissions, and/or leakage, as relevant.

54. For project activities that involve the addition of new energy production units (e.g. turbines) at an existing facility, net increase in thermal energy generation should be calculated as follows:

$$EG_{thermal,add,y} = EG_{thermal,PJ,y} - EG_{thermal,old,y}$$ Equation (10)

Where:

$EG_{thermal,add,y}$	=	Net increase in thermal energy generation at existing plant in year *y* that should be considered as energy baseline (EG_{BL}) (TJ)
$EG_{thermal,PJ,y}$	=	Total actual thermal energy produced in year *y* by all units, existing and new project units (TJ)
$EG_{thermal,old,y}$	=	Estimated thermal energy that would have been produced by existing units (installed before the project activity) in year *y* in the absence of the project activity (TJ)

55. The value $EG_{thermal,old,y}$ is given by:

$$EG_{thermal,old,y} = MAX\left(EG_{thermal,actual,y}, EG_{thermal,estimated,y}\right)$$ Equation (11)

Where:

$EG_{thermal,actual,y}$	=	Actual, measured thermal energy production of the existing units in year *y* (TJ)
$EG_{thermal,estimated,y}$	=	Estimated thermal energy that would have been produced by the existing units under the observed availability of the renewable resource for year *y* (TJ)

56. If the existing units shut down, are derated, or otherwise become limited in production, the project activity should not get credit for generating thermal energy from the same renewable resources that would have otherwise been used by the existing units (or their replacements). Therefore, the equation for $EG_{thermal,old,y}$ still holds, and the value for $EG_{thermal,estimated,y}$ should continue to be estimated assuming the capacity and operating parameters are the same as that at the time of the start of the project activity.

57. If the existing units are subject to modifications or retrofits that increase production, then $EG_{thermal,old,y}$ can be estimated using the procedures described for $EG_{BL,thermal,retrofit,y}$ below.

5.2.10. Baseline emissions for retrofit project activities

58. For project activities that seek to retrofit or modify an existing facility for renewable energy generation, the baseline scenario is the following:

59. In the absence of the CDM project activity, the existing facility would continue to provide thermal energy $EG_{BL,thermal,retrofit,y}$ at historical average levels $EG_{HY,thermal,retrofit,y}$, until the time at which the thermal energy facility would be likely to be replaced or retrofitted in the absence of the CDM project activity ($DATE_{BaselineRetrofit}$). From that point of time onwards,

the baseline scenario is assumed to correspond to the project activity, and baseline thermal energy production is assumed to equal project thermal energy production and no emission reductions are assumed to occur.

$$EG_{BL,thermal,retrofit,y} = MAX\left(EG_{HY,thermal,retrofit,y}, EG_{estimated,thermal,y}\right) \ until \ DATE_{BaselineRetrofit}$$ Equation (12)

Where:

$EG_{BL,thermal,retrofit,y}$	=	Thermal energy production by an existing facility in the absence of the project activity in year *y* (TJ)
$EG_{HY,thermal,retrofit,y}$	=	Average of historical thermal energy levels delivered by the existing facility, spanning all data from the most recent available year (or month, week or other time period) to the time at which the facility was constructed, retrofitted, or modified in a manner that significantly affected output (i.e. by five per cent or more) (TJ)
$EG_{estimated,thermal,y}$	=	Estimated thermal energy that would have been produced by the existing units under the observed availability of renewable resources in year *y* (TJ)
$DATE_{BaselineRetrofit}$	=	Date at which the existing generation facility is likely to be replaced or retrofitted in the absence of the CDM project activity

60. For project activities that seek to retrofit or modify an existing facility to enhance the energy conversion efficiency, the baseline emissions $BE_{retrofit,CO2,y}$ then correspond to the difference of the thermal energy supplied by the project activity and the baseline thermal energy supplied in the case of modified or retrofit facilities multiplied by the emission factor of the fuel that would have been used to generate the incremental energy:

$$BE_{retrofit,CO2,y} = \left(EG_{thermal,retrofit,y} - EG_{BL,thermal,retrofit,y}\right) \times EF_{FF,CO2}$$ Equation (13)

Where:

$BE_{retrofit,CO2,y}$	=	Baseline emissions from the incremental thermal energy supplied due to retrofit (t CO_2)
$EG_{thermal,retrofit,y}$	=	Thermal energy supplied by the project activity (after retrofit) in year *y* (TJ)
$EG_{BL,thermal,retrofit,y}$	=	Thermal energy production by an existing facility in the absence of the project activity (before retrofit) in year *y* (TJ)
$EF_{FF,CO2}$	=	CO_2 emission factor of the fossil fuel that would have been used in the baseline plant to generate the incremental energy obtained from reliable local or national data if available, alternatively, IPCC default emission factors can be used (t CO_2/TJ)

61. The requirements concerning demonstration of the remaining lifetime of the replaced equipment shall be met as described in the “General guidelines for SSC CDM methodologies”. If the remaining lifetime of the affected systems increases due to the

project activity, the crediting period shall be limited to the estimated remaining lifetime, i.e. the time when the affected systems would have been replaced in the absence of the project activity.

62. In order to estimate the point in time when the existing equipment would need to be replaced in the absence of the project activity *($DATE_{BaselineRetrofit}$)*, project participants may follow the procedures described in the “General guidelines for SSC CDM methodologies”.

63. For project activities that seek to retrofit or modify an existing facility for the purpose of fuel switch from fossil fuels to biomass in heat generation equipment, the baseline emissions shall be calculated as per equation (2).

5.2.11. Baseline emissions for project activities with capacity less than 45 kW thermal

64. For household or commercial applications/systems, whose maximum output capacity is less than 45 kW thermal and where it can be demonstrated that the metering of thermal energy output is not plausible, as in the case of biomass stoves, gasifiers, driers, water heaters etc., the project output energy shall be estimated based on consumption of the biomass (in terms of energy quantity) times the efficiency of the project equipment. The equation below shall be used:

$$BE_y = \left[\frac{HG_{PJ,y}}{\eta_{BL}}\right] \times EF_{FF,CO2} = \left\{\left[\frac{B_{biomass,PJ,y} \times NCV_{biomass} \times \eta_{PJ}}{\eta_{BL}}\right]\right\} \times EF_{FF,CO2}$$

Equation (14)

Where:

BE_y	=	Baseline emissions from thermal energy displaced by the project activity using renewable biomass during the year *y* (t CO_2)
$HG_{PJ,y}$	=	Net quantity of thermal energy supplied by the project activity using renewable biomass during the year *y* (TJ)
η_{BL}	=	Efficiency of the baseline equipment being replaced determined as per paragraph 39 or 40
η_{PJ}	=	Efficiency of the project equipment measured using representative sampling methods or based on referenced literature values. The efficiency tests shall be conducted following the guidance provided in the relevant national/international standards
$EF_{FF,CO2}$	=	CO_2 emission factor of the fossil fuel that would have been used in the baseline (t CO_2/TJ)
$B_{biomass,PJ,y}$	=	Net quantity of the biomass consumed in year *y* (tonnes)
$NCV_{biomass}$	=	Net calorific value of the biomass (TJ/tonnes)

5.2.12. Ex ante estimations

65. The quantities and types of biomass and the biomass to fossil fuel ratio (in the case of co-fired systems) to be used during the crediting period should be explained and documented transparently in the CDM-PDD. For the selection of the baseline scenario, an ex ante estimation of these quantities should be provided.

5.3. Project emissions

66. Project emissions shall be calculated using the following equation:

$$PE_y = PE_{FF,y} + PE_{Ec,y} + PE_{Geo,y} + PE_{ref,y} + PE_{cultivation,y}$$ Equation (15)

Where:

PE_y	=	Project emissions from the project activity during the year *y* (t CO_2)
$PE_{FF,y}$	=	Project emissions from fossil fuel consumption during the year *y* (t CO_2)
$PE_{Ec,y}$	=	Project emissions from electricity consumption during the year *y* (t CO_2)
$PE_{Geo,y}$	=	Project emissions from a geothermal project activity in year *y* (t CO_2)
$PE_{ref,y}$	=	Project emissions from use of refrigerant in project activity in year *y* (t CO_2)
$PE_{cultivation,y}$	=	Project emissions from cultivation of biomass in a dedicated plantation in year *y* (t CO_2e)

5.3.1. Emissions from fuel combustion

67. CO_2 emissions from on-site combustion of fossil fuels ($PE_{FF,y}$) shall be calculated using the latest version of the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion”.

5.3.2. Emissions from electricity consumption

68. CO_2 emissions from electricity consumption ($PE_{EC,y}$) shall be calculated using the latest version of the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”.

5.3.3. Emissions from geothermal project activities

69. For geothermal project activities, project participants shall account for the following emission sources, where applicable: fugitive emissions of carbon dioxide and methane due to release of non-condensable gases from produced steam; and carbon dioxide emissions resulting from combustion of fossil fuels related to the operation of the geothermal power plant.[12]

[12] Fugitive carbon dioxide and methane emissions due to well testing and well bleeding are not considered, as they are negligible.

70. Project emissions in the case of geothermal project activities ($PE_{Geo,y}$) are calculated as follows:

$$PE_{Geo,y} = PE_{s,y} + PE_{FF,y}$$ Equation (16)

Where:

$PE_{s,y}$	=	Project emissions of carbon dioxide and methane due to the release of non-condensable gases from the steam produced in the geothermal power plant in year *y* (t CO_2)
$PE_{FF,y}$	=	Project emissions from combustion of fossil fuels related to the operation of the geothermal power plant in year *y* (t CO_2)

71. Project emissions of carbon dioxide and methane due to the release of non-condensable gases from the steam produced in the geothermal power plant are calculated as:

$$PE_{s,y} = \left(w_{Main,CO2} + w_{Main,CH4} \times GWP_{CH4}\right) \times M_{s,y}$$ Equation (17)

Where:

$w_{Main,CO2}$	=	Average mass fraction of carbon dioxide in the produced steam (non-dimensional)
$w_{Main,CH4}$	=	Average mass fraction of methane in the produced steam (non-dimensional)
GWP_{CH4}	=	Global warming potential of methane valid for the relevant commitment period (t CO_2e/t CH_4)
$M_{s,y}$	=	Quantity of steam produced during the year *y* (tonnes)

72. Project emissions from combustion of fossil fuels related to the operation of the geothermal power plant are calculated as:

$$PE_{FF,y} = PE_{FC,j,y}$$ Equation (18)

Where:

$PE_{FC,j,y}$	=	CO_2 emissions from fossil fuel combustion in process *j* during the year *y* (t CO_2). This parameter shall be calculated as per the latest version of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" where *j* stands for the processes required for the operation of the geothermal power plant

5.3.4. Project emissions from use of refrigerant

73. For trigeneration project activities, the project participants shall account for emissions due to physical leakage of refrigerant from new cooling equipment (e.g. electrical compression chillers which are an integral part of a cogeneration and/or trigeneration system or in the case of a new facility where electrical compression chillers are used as a backup).

74. Project emissions due to physical leakage of refrigerant from new cooling equipment in cogeneration and/or trigeneration project activities ($PE_{ref,y}$) shall be calculated as follows:[13]

(a) For first year of the monitoring period:

$$PE_{ref,1} = \left(Q_{ref,PJ,start}\right) \times GWP_{ref,PJ} \qquad \text{Equation (19)}$$

(b) For rest of the monitoring period:

$$PE_{ref,y} = \left(Q_{ref,PJ,y}\right) \times GWP_{ref,PJ} \qquad \text{Equation (20)}$$

Where:

$PE_{ref,y}$	=	Project emissions from physical leakage of refrigerant from new cooling equipment in year *y* (t CO_2e)
$Q_{ref,PJ,start}$	=	Quantity of refrigerant charge in new cooling equipment at its start of operation (tonnes)
$Q_{ref,PJ,y}$	=	Quantity of refrigerant used in year *y* to replace refrigerant that has leaked in year *y* (tonnes)
$GWP_{ref,PJ}$	=	Global warming potential of the refrigerant that is used in new cooling equipment (t CO_2e/t refrigerant)

75. $Q_{ref,PJ,y}$ can be determined using one of the following options:

(a) **Option A:** using the higher of the two quantities below:

(i) The monitored quantity of refrigerant used for top-up to compensate for the leaked quantity during the year *y*; or

(ii) The typical refrigerant leakage rate for the type of cooling equipment as determined from the emission factors (expressed in terms percentage of the initial charge/year) provided in the IPCC 2006 Guidelines, Chapter 7, Table 7.9 “Estimates for charge, lifetime and emissions factors for refrigeration and air conditioning systems”;

(b) **Option B:** use a default value of 35 per cent of the initial refrigerant charge, i.e. $Q_{ref,PJ,y} = 0.35 \times Q_{ref,PJ,start}$.

5.3.5. Project emissions from cultivation of biomass

76. In cases where the project activity utilizes biomass sourced from dedicated plantations, the project emissions from biomass cultivation shall be calculated according to the tool ~~“Project emissions from cultivation of biomass”.~~ “TOOL16: Project and leakage emissions from biomass”.

[13] Baseline emissions related to refrigerant use are assumed to equal zero.

5.4. Leakage

77. If the energy generating equipment currently being utilised is transferred from outside the boundary to the project activity, leakage is to be considered.

78. In cases where the collection, processing and transportation of biomass residues is outside the project boundary and due to the implementation of the project activity biomass residues are transported over a distance of 200 kilometres CO_2 emissions from the collection, processing and transportation of biomass residues to the project site shall be taken into account as leakage using with the latest version of tool "Project and leakage emissions from transportation of freight".

79. If the displaced refrigerant is a greenhouse gas as defined in annex A of the Kyoto Protocol or in paragraph 1 of the Convention and is not destroyed, emissions from its storage or usage in equipment must be considered[14] as leakage.

80. Leakage emissions on account of the diversion of biomass residues from other uses (competing uses) shall be calculated as per the ~~"General guidance on leakage in biomass project activities".~~ "TOOL16: Project and leakage emissions from biomass".

5.5. Emission reductions

81. Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y \qquad \text{Equation (21)}$$

Where:

ER_y	=	Emission reductions in year *y* (t CO_2e)
BE_y	=	Baseline emissions in year *y* (t CO_2e)
PE_y	=	Project emissions in year *y* (t CO_2)
LE_y	=	Leakage emissions in year *y* (t CO_2)

[14] The global warming potentials used to calculate the carbon dioxide equivalence of anthropogenic emissions by sources of greenhouse gases not listed in annex A of the Kyoto Protocol, shall be those accepted by the Intergovernmental Panel on Climate Change in its third assessment report.

6. Monitoring

82. Relevant parameters shall be monitored as indicated in the tables below:~~[15]~~

Box 6. Non-binding best practice example 6: Emission reductions of the cogeneration project activity

If emission reductions of a cogeneration project activity are solely on account of electrical energy production (i.e. no emission reductions accrue from the thermal energy component), thermal energy used to produce electrical energy also need to be monitored where applicable. Also, those parameters are required to be monitored where energy balance is used to cross-check the net quantity of biomass consumed in year *y*.

Data / Parameter table 1.

Data / Parameter:	**-**
Data unit:	-
Description:	Continuous operation of the equipment/system
Source of data	Records maintained by PP/CME
Measurement procedures (if any):	If the emissions reduction per system is less than five tonnes of CO_2e a year; or In the case of household or commercial applications/systems, whose maximum output capacity is less than 45 kW thermal and where it can be demonstrated that the metering of thermal energy output is not plausible: (i) Recording annually the number of systems operating (evidence of continuing operation, such as on-going rental/lease payments could be a substitute), if necessary using survey methods; (ii) Estimating the annual hours of operation of an average system, if necessary using survey methods. Annual hours of operation can be estimated from total output (e.g. tonnes of grain dried) and output per hour if an accurate value of output per hour is available. Where necessary refer to the "~~General~~ Guideline~~s~~ for sampling and surveys for CDM ~~SSC~~ project activities and programmes of activities"
Monitoring frequency:	Annual
QA/QC procedure	Check of all appliances or a representative sample thereof to ensure that they are still operating or are replaced by an equivalent in service appliance
Any comment:	-

~~[15] For example, if emission reductions of the cogeneration project activity are solely on account of electrical energy production (i.e. no emission reductions accrue from the thermal energy component), thermal energy used to produce electrical energy also need to be monitored where applicable. Also those parameters are required to be monitored where energy balance is used to cross-check the net quantity of biomass consumed in year *y*.~~

Data / Parameter table 2.

Data / Parameter:	$EF_{grid,y}$
Data unit:	t CO_2e/kWh
Description:	CO_2 emission factor for the grid electricity in year *y*
Source of data	-
Measurement procedures (if any):	As described in AMS-I.D
Monitoring frequency:	Annual
QA/QC procedure	-
Any comment:	The parameter need to be monitored for project activities which export and/or displaces or import grid electricity

Data / Parameter table 3.

Data / Parameter:	$EF_{FF,CO2,i}$
Data unit:	t CO_2e/GJ
Description:	CO_2 emission factor of fossil fuel type *i*
Source of data	As per the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion”
Measurement procedures (if any):	As per the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion”
Monitoring frequency:	As per the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion”
QA/QC procedure	-
Any comment:	The parameter need to monitor for project activities which displaces electricity from the fossil fuel based captive power plants

Data / Parameter table 4.

Data / Parameter:	$EG_{grid,y}$
Data unit:	MWh
Description:	Quantity of electricity generated/supplied
Source of data	Plant records
Measurement procedures (if any):	Measured using calibrated meters. Calibration shall be as per the relevant paragraphs of “General guidelines for SSC CDM methodologies”. In case the project activity is exporting electricity to other facilities, the metering shall be carried out at the recipient’s end and measurement results shall be cross checked with records for sold/purchased electricity (e.g. invoices/receipts). Metering the energy produced by a sample of the systems where the simplified baseline is based on the energy produced multiplied by an emission coefficient
Monitoring frequency:	Continuous monitoring, integrated hourly and at least monthly recording
QA/QC procedure	-

Any comment:	The parameter need to be monitored for project activities which export and/or displaces or import grid electricity

Data / Parameter table 5.

Data / Parameter:	**-**
Data unit:	Nm^3/hr
Description:	Quantity of hot air
Source of data	Plant records
Measurement procedures (if any):	Measured using calibrated meters. Where it is not feasible (e.g. because of too high temperature), spot measurements can be used through sampling with a 90 per cent confidence level and a 10 per cent precision
Monitoring frequency:	Continuous monitoring, integrated hourly and at least monthly recordings
QA/QC procedure	Calibration shall be as per the relevant paragraphs of “General guidelines for SSC CDM methodologies”.
Any comment:	If applicable, measurement results shall be cross checked with records for sold/purchased thermal energy (e.g. invoices/receipts)

Data / Parameter table 6.

Data / Parameter:	**-**
Data unit:	Nm^3/hr
Description:	Quantity of steam
Source of data	Plant records
Measurement procedures (if any):	Measured using calibrated meters
Monitoring frequency:	Continuous monitoring, integrated hourly and at least monthly recording
QA/QC procedure	Calibration shall be as per the relevant paragraphs of the “General guidelines for SSC CDM methodologies”
Any comment:	If applicable, measurement results shall be cross checked with records for sold/purchased thermal energy e.g. invoices/receipts)

Data / Parameter table 7.

Data / Parameter:	$EG_{thermal,y}$
Data unit:	TJ
Description:	Net quantity of thermal energy supplied by the project activity during the year *y*
Source of data	Plant records

Measurement procedures (if any):	Heat generation is determined as the difference of the enthalpy of the steam or hot fluid and/or gases generated by the heat generation equipment and the sum of the enthalpies of the feed-fluid and/or gases blow-down and if applicable any condensate returns. The respective enthalpies should be determined based on the mass (or volume) flows, the temperatures and, in case of superheated steam, the pressure. Steam tables or appropriate thermodynamic equations may be used to calculate the enthalpy as a function of temperature and pressure. In case of equipment that produces hot water/oil this is expressed as the difference in the enthalpy between the hot water/oil supplied to and returned by the plant. In case of equipment that produces hot gases or combustion gases, this is expressed as the difference in the enthalpy between the hot gas produced and all streams supplied to the plant. The enthalpy of all relevant streams shall be determined based on the monitored mass flow, temperature, pressure, density and specific heat of the gas. In case the project activity is exporting heat to other facilities, the metering shall be carried out at the recipient’s end
Monitoring frequency:	Continuous monitoring, aggregated annually
QA/QC procedure	Measurement results shall be cross checked with records for sold/purchased thermal energy (e.g. invoices/receipts)
Any comment:	Metering the energy produced by a sample of the systems where the simplified baseline is based on the energy produced multiplied by an emission coefficient

Data / Parameter table 8.

Data / Parameter:	**$PE_{FF,y}$**
Data unit:	t CO_2/yr
Description:	Project emissions from fossil fuel combustion in year *y*
Source of data	-
Measurement procedures (if any):	As per the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion”
Monitoring frequency:	As per the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion”
QA/QC procedure	As per the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion”
Any comment:	-

Data / Parameter table 9.

Data / Parameter:	**$PE_{EC,y}$**
Data unit:	t CO_2/yr
Description:	Project emissions from electricity consumption in year *y*
Source of data	-
Measurement procedures (if any):	As per the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”

Monitoring frequency:	As per the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”
QA/QC procedure	As per the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”
Any comment:	-

Data / Parameter table 10.

Data / Parameter:	$B_{Biomass,y}$
Data unit:	Mass or volume
Description:	Net quantity of biomass consumed in year *y*
Source of data	Plant records
Measurement procedures (if any):	Use mass or volume based measurements. Adjust for the moisture content in order to determine the quantity of dry biomass. The quantity of biomass shall be measured continuously or in batches. If more than one type of biomass fuel is consumed, each shall be monitored separately. For the case of processed renewable biomass (e.g. briquettes) data shall be collected for mass, moisture content, NCV of the processed biomass that is supplied to users with an appropriate sampling frequency
Monitoring frequency:	Continuously and estimate using annual mass/energy balance
QA/QC procedure	Cross-check the measurements with an annual energy balance that is based on purchased quantities (e.g. with sales receipts) and stock changes. In cases where emission reductions are calculated based on energy output, check the consistency of measurements ex post with annual data on energy generation, fossil fuels and biomass used and the efficiency of energy generation as determined ex ante
Any comment:	-

Data / Parameter table 11.

Data / Parameter:	**-**
Data unit:	%
Description:	Moisture content of the biomass (wet basis)
Source of data	Plant records
Measurement procedures (if any):	On-site measurements. This applies in the case where emission reductions are calculated based on biomass energy input. For all cases, ex ante estimates should be provided in the PDD and used during the crediting period. Alternatively, moisture content value provided by supplier of biomass should be used if it can be shown that it is reliable (e.g. the price paid for the biomass procured depends on its moisture content) and provided that the project continues to use same type of biomass during the rest of the crediting period. In case of dry biomass, monitoring of this parameter is not necessary

Monitoring frequency:	The moisture content of biomass of homogeneous quality shall be monitored for each batch of biomass. The weighted average should be calculated for each monitoring period and used in the calculations
QA/QC procedure	-
Any comment:	-

Data / Parameter table 12.

Data / Parameter:	**T**
Data unit:	°C
Description:	Temperature
Source of data	Plant records
Measurement procedures (if any):	Measured using calibrated meters
Monitoring frequency:	Continuous monitoring, integrated hourly and at least monthly recording
QA/QC procedure	Calibration shall be as per the relevant paragraphs of the "General guidelines for-SSC CDM methodologies"
Any comment:	-

Data / Parameter table 13.

Data / Parameter:	**P**
Data unit:	kg/cm^2
Description:	Pressure
Source of data	Plant records
Measurement procedures (if any):	Measured using calibrated meters
Monitoring frequency:	Continuous monitoring, integrated hourly and at least monthly recording
QA/QC procedure	Calibration shall be as per the relevant paragraphs of the "General guidelines for SSC CDM methodologies"
Any comment:	-

Data / Parameter table 14.

Data / Parameter:	$\mathbf{NCV_{i,y}}$
Data unit:	GJ/mass or volume unit
Description:	Net calorific value of fossil fuel type *i*
Source of data	As per the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"
Measurement procedures (if any):	As per the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"

Monitoring frequency:	As per the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"
QA/QC procedure	As per the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"
Any comment:	-

Data / Parameter table 15.

Data / Parameter:	**NCV_k**
Data unit:	GJ/mass or volume unit
Description:	Net calorific value of biomass type *k*
Source of data	Plant records
Measurement procedures (if any):	Measurement in laboratories according to relevant national/international standards. Measure quarterly, taking at least three samples for each measurement. The average value can be used for the rest of the crediting period. Measure the NCV based on dry biomass - Check the consistency of the measurements by comparing the measurement results with, relevant data sources (e.g. values in the literature, values used in the national GHG inventory) and default values by the IPCC
Monitoring frequency:	Determine once in the first year of the crediting period
QA/QC procedure	If the measurement results differ significantly from previous measurements or other relevant data sources, conduct additional measurements
Any comment:	-

6.1. Parameters related to geothermal project activity

Data / Parameter table 16.

Data / Parameter:	**$w_{Main,CO2}$**
Data unit:	t CO_2/t steam
Description:	Average mass fraction of carbon dioxide in the produced steam
Source of data	Plant records
Measurement procedures (if any):	Non-condensable gases sampling should be carried out in production wells and/or at the steam field-power plant interface using ASTM Standard Practice E1675 for Sampling 2-Phase Geothermal Fluid for Purposes of Chemical Analysis (as applicable to sampling single phase steam only). The CO_2 and CH_4 sampling and analysis procedure consists of collecting non-condensable gases samples from the main steam line with glass flasks, filled with sodium hydroxide solution and additional chemicals to prevent oxidation. Hydrogen sulphide (H_2S) and carbon dioxide (CO_2) dissolve in the solvent while the residual compounds remain in their gaseous phase. The gas portion is then analyzed using gas chromatography to determine the content of the residuals including CH_4. All alkanes concentrations are reported in terms of methane

Monitoring frequency:	At least every three months and more frequently, if necessary
QA/QC procedure	-
Any comment:	-

Data / Parameter table 17.

Data / Parameter:	$\mathbf{w_{Main,CH4}}$
Data unit:	t CH_4/t steam
Description:	Average mass fraction of methane in the produced steam
Source of data	Plant records
Measurement procedures (if any):	As per the procedures outlined for $w_{Main,CO2}$
Monitoring frequency:	At least every three months and more frequently, if necessary
QA/QC procedure	-
Any comment:	-

Data / Parameter table 18.

Data / Parameter:	$\mathbf{M_{S,y}}$
Data unit:	Nm^3/hr
Description:	Quantity of steam produced during the year *y*
Source of data	Plant records
Measurement procedures (if any):	The steam quantity discharged from the geothermal wells should be measured with a venture flow meter (or other equipment with at least the same accuracy). Measurement of temperature and pressure upstream of the venture meter is required to define the steam properties. The calculation of steam quantities should be conducted on a continuous basis and should be based on international standards. The measurement results should be summarized transparently in regular production reports
Monitoring frequency:	Daily
QA/QC procedure	-
Any comment:	-

6.2. Parameters related to trigeneration project activity

Data / Parameter table 19.

Data / Parameter:	$\mathbf{C_{P,I,y}}$
Data unit:	MWh_{th}/yr
Description:	Cooling output of the baseline chiller *i* displaced as a result of the installation of project activity in year *y*
Source of data	Plant records
Measurement procedures (if any):	Measured using calibrated meters
Monitoring frequency:	Continuous monitoring, hourly measurement and at least monthly recording

QA/QC procedure	The cooling output of each baseline scenario chiller *i* is calculated using measured values of the total chilled water mass flow-rate and of the differential temperature of incoming and outgoing chilled water; as recorded on an hourly basis
Any comment:	-

Data / Parameter table 20.

Data / Parameter:	$C_{P,I,y}$
Data unit:	MWh_{th}/yr
Description:	Cooling output of the baseline chiller *i* displaced as a result of the installation of project activity in year *y*
Source of data	Plant records
Measurement procedures (if any):	Measured using calibrated meters
Monitoring frequency:	Continuous monitoring, hourly measurement and at least monthly recording
QA/QC procedure	The cooling output of each baseline scenario chiller *i* is calculated using measured values of the total chilled water mass flow-rate and of the differential temperature of incoming and outgoing chilled water; as recorded on an hourly basis
Any comment:	-

Data / Parameter table 21.

Data / Parameter:	$m_{C,I,h}$
Data unit:	tonnes/hour
Description:	The chilled water mass flow-rate for chiller(s) *i* produced by project in hour *h* of year *y*
Source of data	Plant records
Measurement procedures (if any):	Measured using calibrated meters
Monitoring frequency:	Continuous, integrated hourly, at least monthly recording
QA/QC procedure	The cooling output of each baseline scenario chiller *i* is calculated using measured values of the total chilled water mass flow-rate and of the differential temperature of incoming and outgoing chilled water; as recorded on an hourly basis
Any comment:	-

Data / Parameter table 22.

Data / Parameter:	C_{pw}
Data unit:	MJ/tonne °C
Description:	Specific heat capacity of water
Source of data	4.2
Measurement procedures (if any):	-

Monitoring frequency:	-
QA/QC procedure	-
Any comment:	-

Data / Parameter table 23.

Data / Parameter:	$\mathbf{\Delta T_{C,I,h}}$
Data unit:	°C
Description:	Differential temperature for chiller(s) *i* in hour *h* of year *y* of incoming and outgoing water from project
Source of data	Plant records
Measurement procedures (if any):	Measured using calibrated meters
Monitoring frequency:	Continuous, integrated hourly, at least monthly recording
QA/QC procedure	-
Any comment:	-

Data / Parameter table 24.

Data / Parameter:	$\mathbf{m_{H,I,h}}$
Data unit:	tonnes/hour
Description:	The waster mass flow-rate from heater unit(s) *i* in the year *y*
Source of data	Plant records
Measurement procedures (if any):	Measured using calibrated meters
Monitoring frequency:	Continuous, integrated hourly, at least monthly recording
QA/QC procedure	-
Any comment:	-

Data / Parameter table 25.

Data / Parameter:	$\mathbf{\Delta T_{HI,h}}$
Data unit:	°C
Description:	Differential temperature of incoming and outgoing water from heater unit *i*
Source of data	Plant records
Measurement procedures (if any):	Measured using calibrated meters
Monitoring frequency:	Continuous, integrated hourly, at least monthly recording
QA/QC procedure	-
Any comment:	-

Data / Parameter table 26.

Data / Parameter:	$Q_{ref,PJ,start}$
Data unit:	Tonnes
Description:	Quantity of refrigerant charge in new cooling equipment at its start of operation
Source of data	Plant records
Measurement procedures (if any):	As per manufacturer's specifications of the cooling equipment
Monitoring frequency:	Only accounted for in the first year of the first crediting period
QA/QC procedure	-
Any comment:	-

Data / Parameter table 27.

Data / Parameter:	$Q_{ref,PJ,y}$
Data unit:	tonnes/yr
Description:	Quantity of refrigerant used in year *y* to replace refrigerant that has leaked in year *y*
Source of data	Plant records
Measurement procedures (if any):	Based on inventory of refrigerant cylinders consumed in year *y*
Monitoring frequency:	Annually
QA/QC procedure	-
Any comment:	The total annual amount of refrigerant ordered as indicated in purchase orders cross checked against invoices

Data / Parameter table 28.

Data / Parameter:	$GWP_{ref,PJ}$
Data unit:	t CO_2e/t refrigerant
Description:	Global warming potential of the refrigerant that is used in new cooling equipment
Source of data	-
Measurement procedures (if any):	-
Monitoring frequency:	Annually
QA/QC procedure	-
Any comment:	If the refrigerants have no GWP, this term shall be taken as zero

6.3 Project activity under a Programme of Activities

83. The methodology is applicable to a programme of activities, no additional leakage estimations are necessary other than that indicated under leakage section above.

Appendix. Default baseline efficiency values

Table 1: Default baseline efficiency values for different technologies

Technology of the energy generation system	Default efficiency
New natural gas fired boiler (w/o condenser)	92%
New oil fired boiler	90%
Old natural gas fired boiler (w/o condenser)	87%
New coal fired boiler	85%
Old oil fired boiler	85%
Old coal fired boiler	80%

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Document information

Version	*Date*	*Description*
21.0	11 March 2019	MP 78, Annex 12 A call for input will be issued for this draft document. If no public inputs are received, this draft document will be considered by the Board at a future meeting. Revision to include non-binding best practice examples.
20.0	1 June 2014	EB 79, Annex 14 To extend the applicability of the methodology to trigeneration projects and include a reference to tool “Project emissions from cultivation of biomass”. Further clarifies baseline and monitoring procedures taking into account clarifications issued by the SSC WG.
19.0	3 June 2011	EB 61, Annex 16 To simplify the monitoring requirements for quantity, net calorific value and moisture content of biomass; and include an additional scenario for cogeneration project activities.
18.0	17 September 2010	EB 56, Annex 18 To include a procedure for determining baseline efficiency for a new cogeneration system.
17.0	28 May 2010	EB 54, Annex 9 To include additional guidelines on determining baseline emissions for project activities involving fuel switch from fossil fuel to biomass in thermal generating equipment. An applicability criterion on the use of biomass briquette has also been provided.
16.0	04 December 2009	EB 51, Annex 19

Version	*Date*	*Description*
		To expand the applicability of the methodology to biomass based cogeneration project activities supplying surplus electricity to a grid.
15.0	17 July 2009	EB 48, Annex 24 To: (a) Include simplified procedures for determining efficiency of small thermal appliances used in household or commercial applications (<45kW thermal capacity); and (b) Include procedures for the estimation of baseline emission factors for co-fired systems.
14.0	25 March 2009	EB 46, Annex 21 To include additional baseline scenarios; expanded applicability of the methodology for renewable fuel based heat and/or power generation project activities (including cogeneration) that supply: (a) Electricity to a grid and/or displace grid electricity; (b) Electricity and/or thermal energy for on-site consumption or for consumption by other facilities and combination of (a) and (b); guidance on use of charcoal from renewable biomass sources; procedures for project emission calculations when applying to geothermal projects; more guidance on metering of thermal energy output.
13.0	14 March 2008	EB 38, Annex 9 To expand its applicability to include additional baseline scenarios (e.g. steam/heat produced from renewable biomass and electricity imported from the grid and/or generated in a captive plant in the baseline, while in the project case heat and electricity are produced by a renewable biomass based co-generation unit).
12.0	27 July 2007	EB 33, Annex 22 To allow for their application under a programme of activities (PoA), where the limit of the entire PoA exceeds the limit for small-scale CDM project activities.
11.0	22 June 2007	EB 32, Annex 27 To clarify the monitoring of biomass in project activities that apply these methodologies which is consistent with monitoring of biomass in the approved methodology AMS-I.D.
10.0	04 May 2007	EB 31, Annex 20 To provide options for baseline calculations when cogeneration from fossil fuels is the baseline activity thereby broadening the applicability of AMS-I.C.
09.0	15 December 2006	EB 28, Annex 23 To align the guidance on capacity addition and retrofit activities to be consistent with the revisions of AMS-I.D.
08.0	24 February 2006	EB 23, Annex 31 To: (i) Include provisions for retrofit and renewable energy capacity additions as eligible activities; (ii) Provide clarification for baseline calculations under category I.D; and (iii) Provide clarification on the applicability of Category I.A as against Category I.D.

Version	*Date*	*Description*

* This document, together with the 'General Guidance' and all other approved SSC methodologies, was part of a single document entitled: Appendix B of the Simplified Modalities and Procedures for Small-Scale CDM project activities until version 07.

Appendix B of the Simplified Modalities and Procedures for Small-Scale CDM project activities contained both the General Guidance and Approved Methodologies until version 07. After version 07 the document was divided into separate documents: 'General Guidance' and separate approved small-scale methodologies (AMS).

07.0	25 November 2005	EB 22, Para. 59 References to "non-renewable biomass" in Appendix B deleted.
06.0	30 September 2005	EB 21, Annex 22 Guidance on consideration of non-renewable biomass in Type I methodologies, thermal equivalence of Type II GWhe limits included.
05.0	25 February 2005	EB 18, Annex 6 Guidance on 'capacity addition' and 'cofiring' in Type I methodologies and monitoring of methane in AMS-III.D included.
04.0	22 October 2004	EB 16, Annex 2 AMS-II.F was adopted; leakage due to equipment transfer was included in all Type I and Type II methodologies.
03.0	14 June 2004	EB 14, Annex 2 New methodology AMS-III.E was adopted.
02.0	28 November 2003	EB 12, Annex 2 Definition of build margin included in AMS-I.D, minor revisions to AMS I.A, AMS-III.D, AMS-II.E.
01.0	21 January 2003	EB 7, Annex 6 Initial adoption. The Board at its seventh meeting noted the adoption by the Conference of the Parties (COP), by its decision 21/CP.8, of simplified modalities and procedures for small-scale CDM project activities (SSC M&P).

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