Proposed Revision for AMS-I.C. (ver. 16)

I.C. Thermal energy production with or without electricity

Technology/measure

1. This category comprises renewable energy technologies that supply users[1] 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. Biomass-based co-generating systems that produce heat and electricity are included in this category. For the purpose of this methodology "Cogeneration" shall mean the simultaneous generation of thermal energy and electrical and/or mechanical energy in one process. Cogeneration system may supply one of the following:

(a) Electricity to a grid[2];
(b) Electricity and/or thermal energy (steam or heat) for on-site consumption or for consumption by other facilities;
(c) Combination of (a) and (b).

3. The total installed/rated thermal energy generation capacity of the project equipment is equal to or less than 45 MW thermal[3] (see paragraph 5 for the applicable limits for cogeneration project activities).

4. For co-fired[4] 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 5 for the applicable limits for cogeneration project activities).

5. The following capacity limits apply for biomass cogeneration units:

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

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1 E.g., residential, industrial or commercial facilities.

2 Grid includes isolated mini-grids, that are not connected to the regional or national grids and not exporting and/or importing power from national/regional grids..

3 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 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.

4 Co-fired system uses both fossil and renewable fuels.

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

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

6. In case electricity and/or steam/heat produced by the project activity is delivered to 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 specifying that only the facility generating the energy can claim emission reductions from the energy displaced.

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

8. The capacity limits specified in the above paragraphs 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 should comply with capacity limits in paragraphs 3 to 5 and should be physically distinct[5] from the existing units.

9. Charcoal based biomass energy generation project activities are eligible to apply the methodology only if the charcoal is produced from renewable biomass sources[6] 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. 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.

10. Plant oil[7] based biomass energy generation project activities are eligible to apply the methodology

[5] 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”.

[6] Refer to Annex 18, EB 23 for the definition of renewable biomass.

[7] Plant oil, or vegetable oil, is oil of plant origin composed of triglycerides. Although many different parts of the plants may yield oil, most often oil is extracted from the seeds or fruits of the plant. Examples of plant oil are

by fulfilling the following conditions:

(i) Plant oil is produced from renewable biomass sources and by pressing and filtering oilseeds (not trans-esterified).

(ii) If the project participants are not the producers of the plant oil, the project participants shall have access to sufficient data to calculate and perform monitoring of the emission reductions from the plant oil production. Under such cases, project participants (user of plant oil) shall be bound by a contract with the producers that states clearly who is entitled to claim emission reductions resulting from its consumption.

(iii) Under this methodology, only the CO2 emissions from fossil fuel displace by plant oil are considered.

(iv) In accordance with the approved "General guidance on leakage in biomass project activities" for small scale projects, the project participants should demonstrate that the area where the biomass is grown is not a forest (as per DNA forest definition) and has not been deforested, according to the forest definition by the national DNA, during the last 10 years prior to the implementation of the project activity. In the absence of forest definition from the DNA, definitions provided by relevant international organizations (e.g. FAO) shall be used.

(v) Biomass and/or wastes generated/used in the cultivation and processing of the oilseeds shall be properly treated or disposed of.

Project Boundary

10. The physical, geographical site of the project equipment producing the renewable energy delineates the project boundary. The boundary also extends to the industrial, commercial or residential facility, or facilities, consuming energy generated by the system and the processes or equipment that is affected by the project activity. In case of plant oil, the project boundary also includes the geographical area of the cultivation, production, processing of oil-seeds and disposal of waste products.

Baseline Emissions

11. 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. For calculating the emission factor, reliable local or national data shall be used. IPCC default values shall be used only when country or project specific data are not available or demonstrably difficult to obtain.

12. Project activities producing both heat and electricity including cogeneration shall use one of the following baseline scenarios[8]:

sunflower oil, rapeseed oil or jatropha oil.

8 Cases where no historical information is available, the most plausible energy supply sources shall be established in accordance with the guidance on Greenfield projects in the general guidance to SSC methodologies.

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

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

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

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

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

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

(g) Electricity and thermal energy (steam/heat) are produced in a biomass fired cogeneration unit (without a possibility of export of electricity either to the grid or to other facilities and without a possibility of export of thermal energy to other facilities)[9];

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

(i) Electricity is produced using fossil fuel and exported to the grid and thermal energy (steam/heat) is produced using fossil fuel;

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

$$BE_{captelec,y} = (EG_{captelec,PJ,y} / \eta_{BL,captive\ plant}) * EF_{BL,FF,CO_2} \quad (1)$$

Where:

$BE_{captelec\ y}$, year y; tCO_2	The baseline emissions from electricity displaced by the project activity during the
$EG_{captelec\ PJ\ y}$	The amount of electricity produced by the project activity during the year y; GWh
$EF_{BL,FF,\ CO_2}$	The 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; otherwise, IPCC default emission factors are used; (tCO_2 /GWh)
$\eta_{BL,captive\ plant}$	The efficiency of the plant using fossil fuel that would have been used in the absence

9 This scenario applies to the situation where new grid connected biomass cogeneration system/s installed by the project activity produces surplus electricity compared to the pre-project situation and all the services provided in baseline i.e energy supply are maintained at the same level or improved during the crediting period.

of the project activity

14. Baseline emissions for supply of electricity to and/or displacement electricity from a grid shall be calculated as per the procedures detailed in AMS-I.D.

15. For steam/heat produced using fossil fuels the baseline emissions are calculated as follows:

$$BE_{thermal,CO_2,y} = (EG_{thermal,y} / \eta_{BL,thermal}) * EF_{FF,CO_2} \quad (2)$$

Where:

$BE_{thermal\ CO_2,y}$	The baseline emissions from steam/heat displaced by the project activity during the year *y*; tCO_2e
$EG_{thermal\ y,}$	The net quantity of steam/heat supplied by the project activity during the year *y*; TJ
$EF_{BL,\ FF,\ CO_2}$	The CO_2 emission factor of the fossil fuel that would have been used in the baseline plant; tCO_2 / TJ, obtained from reliable local or national data if available, otherwise, IPCC default emission factors are used
$\eta_{BL,thermal,plant}$	The efficiency of the plant using fossil fuel that would have been used in the absence of the project activity

16. For cases 12 (a), (b), and (c), baseline emissions shall be calculated as the sum of emissions from the production of electricity and steam/heat considering most recent historical records (average of the data from a minimum of three most recent years excluding abnormal years is required).

For project activities that displace on-site captive electricity and/or displace grid electricity import and/or supply electricity to grid, the emission factor for the electricity 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[10] (average of most recent three years data) 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[11]. If annual electricity produced in the project activity is greater than the sum of on-site captive generation and net grid import (average of most recent three years data) in the baseline, lower of the two i.e., 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).

For project activities that do not displace captive electricity generated by existing plant but displace grid electricity import and/or supply electricity to grid or mini-grid, the emission factor of the grid shall be calculated as per the procedures detailed in AMS-I.D.

The net calorific values (in GJ/physical unit) of plant oil used are determined based on direct measurements of a representative sample.

17. For electricity and thermal energy (steam/heat) produced in a cogeneration unit, using fossil fuel (case 12 (d)), the following equation shall be used:

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10 Difference of total electricity imported from the grid and total electricity exported to the grid.

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

$$BE_{cogen,CO_2,y} = [(EG_{PJ,thermal,y} + EG_{PJ,electrical,y} * 3.6) / \eta_{BL,cogen}] * EF_{FF,CO_2} \quad (3)$$

Where:

$BE_{cogen\ CO_2,\ y}$	Baseline emissions from electricity and thermal energy displaced by the project activity during the year *y*; tCO_2e
$EG_{PJ\ electrical,\ y}$	The amount of electricity supplied by the project activity during the year *y*; GWh
3.6	Conversion factor; TJ/GWh
$EG_{PJ\ thermal,\ y}$	The net quantity of thermal energy supplied by the project activity during the year y; TJ
$EF_{FF,CO2}$	The CO2 emission factor of the fossil fuel that would have been used in the baseline cogeneration plant; tCO2 / TJ obtained from reliable local or national data if available, otherwise IPCC default emission factors are used
$\eta_{BL,cogen}$	The total efficiency (including both thermal and electrical) of the cogeneration plant using fossil fuel that would have been used in the absence of the project activity. Efficiency should be calculated as the total energy produced (electricity and steam/heat extracted) divided by thermal energy of the fuel used

18. Efficiency of the baseline units shall be determined by adopting one of the following criteria (in a 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) Default efficiency of 100%.

19. 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%.

20. For case 12 (e), baseline emissions from the production of electricity shall be calculated as per paragraph 16. Emission reductions from heat generation are not eligible.

21. For case 12 (f), baseline emissions from the production of steam/heat using fossil fuel shall

be calculated as per paragraph 15. Emission reductions from displacing on-site electricity generation are not eligible.

22. For case 12 (g), baseline emissions from the production of electricity that displaces grid electricity import and/or supply electricity to the grid, shall be calculated as per paragraph 14. Emission reductions from both the generation of electricity and thermal energy (steam/heat) for on-site consumption are not eligible.

23. For 12 (h), baseline emissions shall be determined based on three years average historical data on the relative share of fossil fuel and biomass in the baseline fuel mix. The relative share is determined based on the energy content of each fuel.

$$BE_{cofire,CO_2,y} = (EG_{cofire,PJ,y} / \eta_{BL,cofire}) * EF_{cofire,CO_2} \quad \textbf{(4)}$$

Where:

$BE_{cofire\ CO,\ y}$	The baseline emissions from thermal and/or electrical energy displaced by the project activity during the year *y*; tCO_2e
$EG_{cofire\ PJ,\ y}$	The net quantity of energy (electricity/thermal) supplied by the project activity during the year *y*; TJ
EF_{cofire,CO_2}	CO_2 emission factor of the baseline co-fired plant established using three years average historical data (tCO_2 / TJ) . 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
$\eta_{BL,cofire}$	The efficiency of the co-fired plant that would have been used in the absence of the project activity

24. 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.
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:

$$EG_{thermal,add,y} = EG_{thermal,PJ,y} - EG_{thermal,old,y} \quad \textbf{(5)}$$

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

The value $EG_{thermal,old\ y}$ is given by

$$EG_{thermal,old,y} = MAX\left(EG_{thermal,actual,y}, EG_{thermal,estimated,y}\right) \quad \textbf{(6)}$$

Where:

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

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.

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.

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

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.

$$EG_{BL,thermal,retrofit,y} = MAX\left(EG_{historical,thermal,y}, EG_{estimated,thermal,y}\right) \quad until \quad DATE_{BaselineRretrofit} \quad \textbf{(7)}$$

Where:

$EG_{BL,thermal,retrofit,y}$	Thermal energy production by an existing facility in the absence of the project activity; TJ
$EG_{historical,thermal,y}$	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, retrofit, or modified in a manner that significantly affected output (i.e., by 5% or more). A minimum of 3 years (excluding abnormal years) of historical production data is required. In the case that 3 years of historical data are not available - e.g., due to recent retrofits or exceptional circumstances, a new methodology or methodology revision must be proposed; TJ
$EG_{estimated,thermal,y}$	Estimated thermal energy that would have been produced by the existing units under the observed availability of renewable resource in year *y;* TJ
$DATE_{BaselineRretrofit}$	Date at which the existing generation facility is likely to be replaced or retrofitted in the absence of the CDM project activity

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:

$$BE_{retrofit,CO2,y} = \left(EG_{thermal,retrofit,y} - EG_{BL,thermal,retrofit,y}\right) * EF_{FF,CO2} \quad (8)$$

Where:

$BE_{retrofit,CO2,y}$	Baseline emissions from the incremental thermal energy supplied due to retrofit; tCO_2e
$EG_{thermal,retrofit,y}$	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
$EF_{FF,CO2}$	The CO_2 emission factor of the fossil fuel that would have been used in the baseline plant to generate the incremental energy; tCO_2 / TJ obtained from reliable local or national data if available, otherwise IPCC default emission factors are used

The requirements concerning demonstration of the remaining lifetime of the replaced equipment shall be met as described in the General Guidance for SSC 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

In order to estimate the point in time when the existing equipment would need to be replaced in the absence of the project activity ($DATE_{BaselineRretrofit}$), project participants may follow the procedures described in the general guidance.

Project Emissions

26. Project emissions include:

- CO_2 emissions from on-site consumption of fossil fuels due to the project activity shall be calculated using the latest version of "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion";
- CO_2 emissions from electricity consumption by the project activity using the latest version of "Tool to calculate baseline, project and/or leakage emissions from electricity consumption";
- Any other significant emissions associated with project activity within the project boundary;
- 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].
- For plant oil fuelled cogeneration project activities, the project participants shall account for project emissions related to i) the cultivation of oil seeds (if lands are newly cultivated

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

for the project activities), ii) production of plant oil, iii) transportation of waste to a final disposal site and iv) waste disposal. These emissions will be attributed to the plant oil produced, and not shared over different co-products. The project emissions related to the cultivation of oil seeds and production of plant oil are calculated as per the procedures defined in the approved methodology AMS-III.T.

- For transportation of waste, project emissions are accounted for only transportation to outside the project site. The emissions can be calculated based on either distance and vehicle type (Option 1) or on fuel consumption (Option 2), as described in ACM0006.
- For project emissions from waste disposal related to plant oil, if the waste is combusted in a controlled manner, disposed in a landfill with biogas recovery, or used for soil application in aerobic conditions in the project activity, the project emission will be neglected, and the waste treatment and/or use and/or final disposal shall be monitored during the crediting period. If the waste is composted, project emissions are calculated as per the procedures defined in the approved methodology AMS-III.F.. Otherwise, project emissions are calculated using the latest version of "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site." In case of stockpiling, an adjustment method explained in the approved methodology AMS-III.E. shall be applied when using the tool.

27. Project emissions in the case of geothermal project activities are calculated as follows:

$$PE_{Geo,y} = PES_y + PEFF_y \tag{9}$$

Where:

$PE_{Geo,y}$	Project emissions in year *y* (tCO_2/y)
PES_y	Project emissions of carbon dioxide and methane due to the release of noncondensable gases from the steam produced in the geothermal power plant in year *y* (tCO_2)
$PEFF_y$	Project emissions from combustion of fossil fuels related to the operation of the geothermal power plant in year *y* (tCO_2)

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

$$PES_y = \left(w_{Main,CO2} + w_{Main,CH4} \cdot GWP_{CH4}\right) \cdot M_{S,y} \tag{10}$$

Where:

PES_y	Project emissions due to release of carbon dioxide and methane from the produced steam in the geothermal power plant in year *y* (tCO_2)
$w_{Main,CO2}$	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 (tCO_2e/tCH_4)
$M_{S,y}$	Quantity of steam produced during the year *y* (tonnes)

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

$$PEFF_y = PE_{FC,j,y} \tag{11}$$

Where:

$PEFF_y$	Project emissions from combustion of fossil fuels related to the operation of the geothermal power plant in year y (tCO_2)
$PE_{FC,j,y}$	CO_2 emissions from fossil fuel combustion in process j during the year y (tCO_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

Leakage

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

29. In case collection/processing/transportation of biomass residues is outside the project boundary, CO_2 emissions from collection/processing/transportation[13] of biomass residues to the project site.

30. In case of plant oil cogeneration project activities, following leakage shall be considered:

- Leakage emissions due to a shift of pre-project activities shall be accounted for as per the approved "general guidance on leakage in biomass project activities" for small-scale project act; and
- Leakage emissions in case plant oil is produced in the baseline situation in the area of land where plant oil is cultivated in the project situation according to the guidance on competing uses for biomass in "the general guidance on leakage in biomass project activities" for small scale projects.

Emission reductions

31. Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y \quad \textbf{(12)}$$

Where:

ER_y	Emission reductions in year y (tCO_2e)
BE_y	Baseline emissions in year y (tCO_2e)
PE_y	Project emissions in year y (tCO_2)
LE_y	Leakage emissions in year y (tCO_2)

Monitoring

32. Monitoring shall consist of one of the following:

13 If biomass residues are transported over a distance of more than 200 kilometres due to the implementation of the project activity then this leakage source attributed to transportation shall be considered, otherwise it can be neglected.

(a) 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;

(b) Metering the thermal and/or electrical energy produced;[14]

(i) In the case of heat energy (e.g., hot air, hot water), direct measurement of flow and temperature is required.

(ii) In the case of steam energy, direct measurement of flow, temperature, pressure is required to determine enthalpy of the steam.

(c) If the emissions reduction per system is less than 5 tonnes of CO_2e a year:

(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.

(d) 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

$$BE_y = [HG_{PJ,y} / \eta_{BL}] * EF_{FF,CO2}$$
$$= \{[B_{biomass,PJ,y} * NCV_{biomass} * \eta_{PJ}] / \eta_{BL}\} * EF_{FF,CO2} \quad \textbf{(13)}$$

BE_y	The baseline emissions from thermal energy displaced by the project activity using renewable biomass during the year *y* in tCO_2
$HG_{PJ,y}$	The net quantity of thermal energy supplied by the project activity using renewable biomass during the year *y* in TJ
η_{BL}	Efficiency of the baseline equipment being replaced (determined as per paragraph 18 or19)
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.

[14]In case project activity is exporting heat/electricity to other facilities, metering shall be carried out at the recipient end.

$EF_{FF,CO2}$	The CO_2 emission factor of the fossil fuel that would have been used in the baseline in tCO_2/TJ
$B_{biomass,PJ,y}$	The net quantity of the biomass consumed in year *y* in tons
$NCV_{biomass}$	The net calorific value of the biomass in TJ/tons

Monitoring shall consist of an annual 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.

33. For projects where only biomass or biomass and fossil fuel are used the amount of biomass and fossil fuel input shall be monitored.

34. If more than one type of biomass fuel is consumed, each shall be monitored separately.

35. In the case of project activity consuming biomass and fossil fuel to produce thermal and or electrical energy, specific energy consumption[15] of each type of fuel (biomass or fossil) to be used shall be specified *ex ante*. The consumption of each type of fuel shall be monitored.
Specific energy consumption can be derived as follows:

$$SEC_{j,PJ,y,measured} = \frac{\sum_{j}(FC_{j,PJ,y} \times NCV_{j,y})}{EG_{PJ,y}} \qquad \textbf{(14)}$$

Where:

$SEC_{j,PJ,y,measured}$	Specific energy consumption of fuel type *j* of the project activity in year *y* in TJ/MWh
$EG_{PJ,y}$	Energy generation in MWh in *y*
$FC_{j,PJ,y}$	Quantity of fuel type *j* combusted in the project activity during the year *y* in volume or mass unit
$NCV_{j,y}$	Average net calorific value of fuel type *j* combusted during the year *y* in TJ per unit volume or mass unit

36. For the specific case of co-fired plants, the baseline emissions for the amount of thermal energy or electricity produced corresponding to biomass fuels use shall be calculated as follows:

$$BE_{cofire,y} = \frac{\sum_{k}(FC_{biomass,k,y} \times NCV_{biomass,k,y})}{SEC_{PJ,j,y,measured} \times \eta_{BL}} \cdot EF_{BL} \qquad \textbf{(15)}$$

Where:

$BE_{cofire,y}$	Baseline emissions during the year *y* in tCO_2
$FC_{biomass,k,y}$	Quantity of biomass type *k* combusted during the year *y* in volume or mass unit
$NCV_{biomass,k,y}$	Average net calorific value of biomass type *k* combusted during the year *y* in TJ

[15] Specific energy consumption is the fuel consumption (in energy basis) per unit of thermal energy or electricity generated (e.g., TJ of bagasse energy per MWh output).

	per unit volume or mass unit
EF_{BL}	CO_2 emission factor of the fossil fuel that would have been used in the baseline co-fired plant established using three years average historical data (tCO_2 / TJ)
η_{BL}	Energy efficiency of the equipment that would have been used in the baseline

37. For the co-fired systems, baseline emissions calculated as per paragraph 21 shall be compared with the baseline emissions calculated as per paragraph 35 4. The lower of the two values shall be used to calculate emission reductions.

38. For the determination of the emission factor ($EF_{BL,i}$) and of the net calorific value (NCV_j) for the fossil fuel used in the baseline scenario, guidance by the most recent version of IPCC Guidelines for National Greenhouse Gas Inventories shall be followed where appropriate. Project participants may either conduct measurements or they may use accurate and reliable local or national data where available. In the case of coal, the data shall be based on test results for periodic samples of the coal purchased if such tests are part of the normal practice for coal purchases. Where such data is not available, IPCC default emission factors (country-specific, if available) may be used if they are deemed to reasonably represent local circumstances. All values shall be chosen in a conservative manner (i.e., lower values should be chosen within a plausible range) and the choice shall be justified and documented in the SSC-CDM-PDD. Where measurements are undertaken, project participants shall document the measurement results and the calculated average values of the emission factor or net calorific value for the baseline fuel *ex ante* in the SSC-CDMPDD.

39. For plant oil-fuelled cogeneration project activities, the following parameters shall be monitored:

(i) Plant oil consumption by project activities

(ii) Oil content of seeds and amount of plant oil produced per crop source per production location. The extent of the area where plant oil is produced should be consistent with the yield of the cultivation and/or harvesting and the plant oil extraction, if they are from a plantation.

(iii) The energy use (electricity and fossil fuel) for the production of plant oil and the amount of fertilizer applied for the cultivation of plant oil per crop source per production location. The occurrence of shift of pre-project activities and the competing uses of biomass shall be monitored and verified.

(iv) The NCV of plant oils are determined based on direct measurements of a representative sample.

(v) The contract between the producer and the user of the plant oil (project participants) states clearly who is entitled to claim emission reductions resulting from its consumption, if the producer and the user of the plant oil are not the same.

(vi) Final waste treatment and/or use and/or disposal site

(vii) Emissions from the transportation of waste. Monitoring is to be conducted based on the choice of either Option 1 or Option 2.

Project activity under a programme of activities

The following conditions apply for use of this methodology in a project activity under a programme of activities:

(a) In the specific case of biomass project activities the applicability of the methodology is limited to either project activities that use biomass residues only or biomass from dedicated plantations complying with the applicability conditions of AM0042.

(b) In the specific case of biomass project activities the determination of leakage shall be done following the general guidance for leakage in small-scale biomass project activities (attachment C of appendix B[12] of simplified modalities and procedures for small-scale clean development mechanism project activities; decision 4/CMP.1) or following the procedures included in the leakage section of AM0042.

(c) In case the project activity involves the replacement of equipment, and the leakage from the use of the replaced equipment in another activity is neglected, because the replaced equipment is scrapped, an independent monitoring of scrapping of replaced equipment needs to be implemented. The monitoring should include a check if the number of project activity equipment distributed by the project and the number of scrapped equipment correspond with each other. For this purpose scrapped equipment should be stored until such correspondence has been checked. The scrapping of replaced equipment