

CDM-MP73-A13

Draft Methodological tool

TOOL16: Project and leakage emissions from biomass

Version 04.0

DRAFT



United Nations
Framework Convention on
Climate Change

COVER NOTE

1. Procedural background

1. The Executive Board of the clean development mechanism (CDM) (hereinafter referred to as the Board), at its ninety-fourth meeting considered the concept note on cost-effective and context-appropriate approaches for monitoring, reporting and verification, and requested the secretariat, the Methodologies Panel (MP), and Small-Scale Working Group (SSC WG), to jointly include best practice examples covering monitoring aspects into the methodological tools and sampling guidelines.

2. Purpose

2. The purpose of the draft revision is to improve the consistency of monitoring requirements and to reduce transaction costs associated with monitoring emissions from biomass by providing flexible and objective requirements and best practice examples for missing data management.

3. Key issues and proposed solutions

3. None.

4. Impacts

4. The revision of the tool, if approved, will simplify and streamline the requirements in monitoring emissions from biomass, thus reducing the monitoring costs of the applicable projects.

5. Subsequent work and timelines

5. The methodological tool is recommended by the MP and SSC WG for consideration and approval by the Board at its ninety-sixth meeting.

6. Recommendations to the Board

6. The MP and SSC WG recommends that the Board approve the draft revised methodological tool, to be made effective at the time of the Board's approval.

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1. Introduction

1. This tool provides procedures to calculate project and leakage emissions relevant for project activities which utilise biomass. The biomass may be used as either fuel or feedstock in the project activity. The biomass may be biomass residues or cultivated in a dedicated plantation.

Table 1. Parameters determined

Parameter	Unit	Description
$PE_{BC,y}$	t CO ₂ e	Project emissions resulting from cultivation of biomass in a dedicated plantation, in year y (Section 5)
$PE_{BR,y}$	t CO ₂ e	Project emissions resulting from utilization of biomass residues, in year y (Section 6)
$LE_{BC,y}$	t CO ₂ e	Leakage emissions due to shift of pre-project activities resulting from cultivation of biomass in a dedicated plantation, in year y (Section 7)
$LE_{BR,y}$	t CO ₂ e	Leakage emissions due to diversion of biomass residues from other applications, in year y (Section 8)

2. Scope, applicability, and entry into force

2.1. Scope

2. This tool can be used for estimation of project and leakage emissions resulting from cultivation of biomass in a dedicated plantation of a CDM project activity that uses biomass.
3. This tool also includes approaches for identifying and estimating project and leakage emissions from project activities that utilise biomass residues.
4. Unless the methodology's procedures allow it, only positive leakage, i.e. increased emissions outside the project boundary are allowed by this tool. If the biomass production or utilization results in any reduction of greenhouse gas (GHG) emissions outside the project boundary, they will not be accounted for.
5. The tool does not calculate methane emissions from anaerobic decomposition of biomass, for example in stockpiles or wastewater.

2.2. Applicability

6. For project activities which include biomass cultivation:
 - (a) The land in which biomass is cultivated:
 - (i) Does not contain wetlands;
 - (ii) Does not contain organic soils as defined in paragraph 12(c);

- (iii) Is not subjected to flood irrigation.
 - (b) The land in which biomass is cultivated:
 - (i) Does not contain forest nor contained forest since 31 December 1989; or
 - (ii) Contains a forest plantation that before the start of the project will be harvested and the land would be neither reforested nor will regenerate on its own into a forest in the absence of the project activity.
 - (c) Desalination is not a substantial source of water in the host country.
- 7. In case the land contains a forest plantation, the project proponent shall demonstrate and document transparently in the CDM-PDD that before the start of the project activity the plantation will be finally harvested and regeneration to forestland (according to the respective national definition) will not take place. In doing so, the project proponent shall:
 - (a) Identify realistic and credible alternatives with regard to the possible land use scenarios that would occur in the absence of the project activity, including but not limited to:
 - (i) The forest plantation continues under the current management practice;
 - (ii) The forest plantation is harvested and the land is replanted;
 - (iii) The forest plantation is harvested and the land is abandoned.
 - (b) Assess the economic attractiveness of the existing forest plantation by applying Step 2 of the latest approved version of the “Tool for the demonstration and assessment of additionality”;
 - (c) Confirm, based on the plantation management practices in the region for the considered species, that the situation referred to in paragraph 6 (b) (ii) is the common practice; and
 - (d) Use relevant credible evidence, including but not limited to official land use maps, satellite images/aerial photographs, cadastral information, official land use records.
- 8. The tool is also applicable if biomass residues are consumed in a CDM project activity. These could be:
 - (a) Procured by the project proponents; or
 - (b) The result of an agro-industrial process under the control of the project proponents.

2.3. Entry into force

- 9. The date of entry into force is the date of the publication of the EB 96 meeting report on 22 September 2017.

3. Normative references

- 10. This tool refers to the following documents:
 - (a) “Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion”;

- (b) “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation”;
- (c) “Project and leakage emissions from transportation of freight”.

4. Definitions

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

12. For the purpose of this tool, the following definitions apply:

- (a) **Forest** - As defined by the minimum values of tree crown cover, land area, and tree height selected by the host party for the purposes of the CDM. Forest is a minimum area of land of 0.05–1.0 hectares with tree crown cover (or equivalent stocking level) of more than 10–30 per cent with trees with the potential to reach a minimum height of 2–5 metres at maturity in situ. A forest may consist either of closed forest formations where trees of various storeys and undergrowth cover a high portion of the ground or open forest. Young natural stands and all plantations which have yet to reach a crown density of 10–30 per cent or tree height of 2–5 metres are included under forest, as are areas normally forming part of the forest area which are temporarily unstocked as a result of human intervention such as harvesting or natural causes but which are expected to revert to forest;
- (b) **Indirect land use change** - is land-use change that may be induced on land areas not included in the project boundary as a result of shifting of pre-project activities;
- (c) **Organic soil**¹ - soils are organic if they satisfy the requirements (i) and (ii), or (i) and (iii) below:
 - (i) Thickness of 10 cm or more. A horizon less than 20 cm thick must have 12 per cent or more organic carbon when mixed to a depth of 20 cm;
 - (ii) If the soil is never saturated with water for more than a few days, and contains more than 20 per cent (by weight) organic carbon (about 35 per cent organic matter);
 - (iii) If the soil is subject to water saturation episodes and has either:
 - a. At least 12 per cent (by weight) organic carbon (about 20 per cent organic matter) if it has no clay; or
 - b. At least 18 per cent (by weight) organic carbon (about 30 per cent organic matter) if it has 60 per cent or more clay; or
 - c. An intermediate, proportional amount of organic carbon for intermediate amounts of clay;
- (d) **Pre-project activities** - the land use prior to the implementation of the project activity, considering both land use practices and the primary and final products of

¹ As defined in “Annex A: Glossary” of the 2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry.

the practices. This includes, for example, grazing, cultivation of crops, agroforestry, collection of biomass;

- (e) **Project region** – area within a radius of 250km around the project activity;
- (f) **Stratum** - area of land with uniform properties;
- (g) **Wetland**² - this category includes land that is covered or saturated by water for all or part of the year (e.g. peatland) and that does not fall into the forest land, cropland, grassland or settlements categories. This category can be subdivided into managed and unmanaged according to national definitions. It includes reservoirs as a managed sub-division and natural rivers and lakes as unmanaged sub-divisions;

5. Project emissions from cultivation of biomass

13. Project emissions resulting from cultivation of biomass in a dedicated plantation are estimated as follows:

$$PE_{BC,y} = PE_{SOC,y} + PE_{SM,y} + PE_{EC,y} + PE_{BB,y} + PE_{TR,y} \quad \text{Equation (1)}$$

Where:

$PE_{BC,y}$	= Emissions resulting from cultivation of biomass in a dedicated plantation, in year y (t CO ₂ e)
$PE_{SOC,y}$	= Emissions resulting from loss of soil organic carbon, in year y (t CO ₂ e)
$PE_{SM,y}$	= Emissions resulting from soil management, in year y (t CO ₂ e)
$PE_{EC,y}$	= Emissions resulting from energy consumption, in year y (t CO ₂ e)
$PE_{BB,y}$	= Emissions resulting from clearance or burning of biomass, in year y (t CO ₂ e)
$PE_{TR,y}$	= Emissions resulting from transport of biomass, in year y (t CO ₂ e)

14. Biomass originating from land areas included in registered afforestation/reforestation (A/R) project activities may be considered to have no project emissions, provided that the emission reductions from the A/R project activity have been verified and issued for the time period in which the biomass was harvested.

5.1. Emissions resulting from loss of soil organic carbon

15. To estimate emissions resulting from loss of soil organic carbon, the areas of land are stratified according to:
- (a) Climate region and soil types given in Table 1 in appendix 1;

² As defined in “Annex A: Glossary” of the 2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry.

- (b) Land-use and land management activities on croplands given in Tables 2 and 3 in appendix 1; and
- (c) Land-use and land management activities on grasslands given in Table 4 in appendix 1. These apply also to abandoned land.
16. For each stratum of the areas of land which is subjected to soil disturbance attributable to project activity and for which the total area disturbed is less than 10% of the area of the stratum, emissions resulting from loss of soil organic carbon may be accounted as zero.
17. Subject to the provision of the paragraph 16 above, emissions resulting from loss of soil organic carbon are estimated as follows:

$$PE_{SOC,y} = \max\left(\frac{44}{12} \times \frac{1.156}{T} \times \sum_i \Delta SOC_i, 0\right) \quad \text{Equation (2)}$$

Where:

$PE_{SOC,y}$	= Emissions resulting from loss of soil organic carbon, in year y (t CO ₂ e)
T	= Length of the first crediting period of the project in years (7 or 10)
ΔSOC_i	= Loss of soil organic carbon in land stratum i , (t C)
$\frac{44}{12}$	= Factor for converting units from t C to t CO ₂ e; dimensionless
1.156	= Factor to account for soil N ₂ O emissions associated with loss of soil organic carbon, ³ dimensionless
i	= Strata of areas of land

18. Loss of soil organic carbon in a stratum is estimated as follows:

$$\Delta SOC_i = 1.21 \times A_{SOC,i} \times SOC_{REF,i} \times (f_{LUB,i} \times f_{MGB,i} \times f_{INB,i} - f_{LUP,i} \times f_{MGP,i} \times f_{INP,i}) \quad \text{Equation (3)}$$

Where:

ΔSOC_i	= Loss of soil organic carbon in land stratum i , (t C)
$A_{SOC,i}$	= Area of land stratum i ; (ha)
$SOC_{REF,i}$	= Reference SOC stock applicable to land stratum i , (t C/ha)
$f_{LUB,i}$	= Relative stock change factor for land-use in the baseline in stratum i
$f_{MGB,i}$	= Relative stock change factor for land management in the baseline in stratum i
$f_{INB,i}$	= Relative stock change factor for input in the baseline in stratum i
$f_{LUP,i}$	= Relative stock change factor for land-use in the project in stratum i

³ Based on 2006 IPCC Guidelines for National Greenhouse Gas Inventories. For details, see appendix 3.

$f_{MGP,i}$	=	Relative stock change factor for land management in the project in stratum i
$f_{INP,i}$	=	Relative stock change factor for input in the project in stratum i
i	=	Strata of areas of land
1.21	=	Conservativeness factor accounting for the uncertainties in the values in Tables 2-4 in appendix 1 ⁴

19. The values of relative stock change factors shall be determined according to Tables 2–4 in appendix 1 of this tool.⁵
20. After the first crediting period of the project, the value of $PE_{SOC,y}$ shall be 0.

5.2. Emissions resulting from soil management

21. Emissions resulting from soil management are estimated as follows:

$$PE_{SM,y} = PE_{SF,y} + PE_{SA,y} \quad \text{Equation (4)}$$

Where:

$PE_{SM,y}$	=	Emissions resulting from soil management, in year y (t CO ₂ e)
$PE_{SF,y}$	=	Emissions resulting from of soil fertilization and management, in year y (t CO ₂ e)
$PE_{SA,y}$	=	Emissions resulting from soil amendment, in year y (t CO ₂ e)

5.2.1. Emissions resulting from soil fertilization and management

22. Emissions resulting from soil fertilisation and management are estimated as follows:

$$PE_{SF,y} = q_{N,y} \times A_{FTM,y} \times EF_{FT} \quad \text{Equation (5)}$$

Where:

$PE_{SF,y}$	=	Emissions resulting from soil fertilization and management, in year y (t CO ₂ e)
$q_{N,y}$	=	Rate of nitrogen applied, in year y (t N/ha)
$A_{FTM,y}$	=	Area of land subjected to soil fertilization and management, in year y (ha)

⁴ According to FCCC/SBSTA/2003/10/Add.2/6. For details, see appendix 3.

⁵ Project proponents are encouraged to suggest revisions for this tool with alternative procedures (e.g. monitoring) to determine the relative stock change. Where the land contains a forest plantation in its last rotation in the baseline, or contains a forest plantation in the project activity, the relative stock change factors for land-use, land management and inputs each shall be assumed as 1.00, i.e. forest plantation is a reference scenario for the purpose of soil organic carbon.

EF_{FT} = Aggregate emission factor for N₂O and CO₂ emissions resulting from production and application of nitrogen (t CO₂e/(t N)). A default value of 13.3 t CO₂e/(t N)⁶ shall be used

5.2.2. Emissions resulting from soil amendment

23. Emissions resulting from soil amendment (liming) are estimated as follows:

$$PE_{SA,y} = \sum_i q_{SA,i,y} \times A_{SA,i,y} \times EF_{SA,i,y} \quad \text{Equation (6)}$$

Where:

$PE_{SA,y}$ = Emissions resulting from soil amendment by liming, application of dolomite, urea or other carbon containing agent, in year y (t CO₂e)

$q_{SA,i,y}$ = Rate of application of soil amendment agent type i , in year y (t/ha)

$A_{SA,i,y}$ = Area of land in which soil amendment agent type i is applied, in year y (ha)

$EF_{SA,i}$ = Emission factor for CO₂ emissions from application of soil amendment agent type i (t CO₂e/t). Default values for limestone (0.12 t CO₂e/t)⁷, dolomite (0.13 t CO₂e/t)⁸ and urea (0.20 t CO₂e/t)⁹ shall be used.

5.3. Emissions resulting from energy consumption

24. Emissions resulting from energy consumption are estimated, unless otherwise required in the relevant methodology, by following the provisions in the “Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion” and the tool “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation”. These emissions include emissions due to:

- (a) Biomass cultivation practices; and
- (b) Thermal and mechanical processing of the biomass.

25. Small scale project activities may, unless otherwise required by the methodology, neglect emissions from energy consumption associated with cultivation of biomass.

5.4. Emissions resulting from clearance or burning of biomass

26. Emissions resulting from clearance or burning of biomass are estimated as follows:

$$PE_{BB,y} = \frac{44}{12} \times 0.47 \times \sum_i A_{FR,i,z} \times b_i \times (1.07 + R_i) \quad \text{Equation (7)}$$

⁶ Based on 2006 IPCC Guidelines for National Greenhouse Gas Inventories. For details, see appendix 3.

⁷ 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Vol 4, Ch 11, Eq 11.12.

⁸ Ibid.

⁹ 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Vol 4, Ch 11, Eq 11.13.

Where:

$PE_{BB,y}$	= Emissions resulting from clearance or burning of biomass, in year y (t CO ₂ e)
$\frac{44}{12}$	= Factor for converting units from t C to t CO ₂ e; dimensionless
0.47	= Default value of carbon fraction of biomass burnt; ¹⁰ dimensionless
1.07	= Factor to account for non-CO ₂ emissions from biomass clearance or burning; ¹¹ dimensionless. If biomass is cleared without using open fire, then this factor is set equal to 1 (one)
$A_{FR,i,y}$	= Area of stratum i of land subjected to clearance or fire in year y (ha)
b_i	= Fuel biomass consumption per hectare in stratum i of land subjected to clearance or fire (t dry matter/ha)
R_i	= Root-shoot ratio (i.e. ratio of below-ground biomass to above-ground biomass) for stratum i of land subjected to clearance or fire; dimensionless
i	= Strata of areas of land

5.5. Emissions resulting from transport

27. Emissions resulting from transport of biomass to the processing/utilisation facility are estimated, unless otherwise required in the relevant methodology, by following the provisions in the methodological tool “Project and leakage emissions from transportation of freight”.
28. Small scale project activities may, unless otherwise required by the methodology, neglect this source of emissions if the transportation distance is less than 200 km.

6. Project emissions from utilization of biomass residues

29. Project emissions resulting from utilization of biomass residues are estimated as follows:

$$PE_{BU,y} = PE_{EC,y} + PE_{TR,y} \quad \text{Equation (8)}$$

Where:

$PE_{BU,y}$	= Emissions resulting from utilization of biomass residues, in year y (t CO ₂ e)
$PE_{EC,y}$	= Emissions resulting from energy consumption, in year y (t CO ₂ e)
$PE_{TR,y}$	= Emissions resulting from transport of biomass, in year y (t CO ₂ e)

¹⁰ 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Vol 4, Ch 4 Table 4.3.

¹¹ Based on 2006 IPCC Guidelines for National Greenhouse Gas Inventories. For details, see appendix 3.

6.1. Emissions resulting from energy consumption

30. Emissions resulting from energy consumption are estimated, unless otherwise required in the relevant methodology, by following the provisions in the “Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion” and the tool “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation”. These emissions include emissions due to thermal and mechanical processing of the biomass residue.
31. Small scale project activities may, unless otherwise required by the methodology, neglect emissions from energy consumption associated with processing of biomass residue.

6.2. Emissions resulting from transport

32. Emissions resulting from transport of biomass residue to the processing/utilisation facility are estimated, unless otherwise required in the relevant methodology, by following the provisions in the methodological tool “Project and leakage emissions from transportation of freight”.
33. Small scale project activities may, unless otherwise required by the methodology, neglect this source of emissions if the transportation distance is less than 200 km.

7. Leakage due to shift of pre-project activities

34. This section is applicable only if the project activity utilizes biomass cultivated in a dedicated plantation. Project proponents are advised to avoid pre-project activities from being shifted outside the project boundary, to avoid indirect land use changes as a result of the project activity. Rather, project proponents are encouraged to include in the project boundary the land in which the pre-project activities will take place after the project implementation.
35. No leakage due to shift of pre-project activities occurs if one of the following two conditions applies:
 - (a) The plantation area was or would have been abandoned land prior to the implementation of the project activity;
 - (b) The plantation area was used prior to the implementation of the project area but the pre-project land use of the plantation area will be accommodated for, providing at least the same level of service during the project activity, within the land area included in the project boundary. The project area may be expanded to accommodate for this condition. This could be achieved, inter alia, in the following ways:
 - (i) At least the same number of cattle as prior to the implementation of the project activity will continue being grazed during the project activity within the land area included in project boundary;
 - (ii) Due to more efficient farming practice, the pre-project crops can be grown on a smaller area, which is included in the land area included in the project boundary, to achieve the same level of annual production of crops, freeing land for the dedicated plantation;

- (iii) Settlements are not removed from the land area included in the project boundary.
- 36. Project participants should assess the possibility of leakage from the displacement of activities or people by monitoring the following indicators:
 - (a) Percentage of families/households of the community involved in or affected by the project activity displaced (from within to outside of the project boundary) due to the project activity;
 - (b) Percentage of total production of the main product (e.g. meat, corn) within the project boundary displaced due to the cultivation of biomass.
- 37. For project activities which fall above the small-scale threshold, no shift of pre-project activities is allowed.
- 38. For project activities which fall below the small-scale threshold:
 - (a) If the value of both indicators is lower than 10 per cent, then leakage from this source is assumed to be zero;
 - (b) If the value of any of the two indicators is higher than 10 per cent and less than or equal to 50 per cent, then leakage shall be equal to 15 per cent of the difference between baseline emissions and project emissions;
 - (c) If the value of either of these two indicators is larger than 50 per cent, then this tool is not applicable and a new procedure must be submitted for the approval of the Board.

8. Leakage due to diversion of biomass residues from other applications

39. This section is applicable for project activities which utilise biomass residues. It quantifies leakage due to diversion of biomass residues to the project to be used as either fuel or feedstock. These biomass residues could have been used outside the project boundary in competing applications, and due to the implementation of the project activity these competing application might be forced to use inputs which are not carbon neutral.

8.1. Determination of the alternative scenario of the biomass residues in absence of the project activity

40. The alternative scenario for the “use”, in absence of the project activity, of biomass residues that will be used in the underlying CDM project activity shall include:
- (a) B1: The biomass residues are dumped or left to decay mainly under aerobic conditions. This applies, for example, to dumping and decay of biomass residues on fields;
 - (b) B2: The biomass residues are dumped or left to decay under clearly anaerobic conditions. This applies, for example, to landfills which are deeper than five meters. This does not apply to biomass residues that are stock-piled or left to decay on fields;

- (c) B3: The biomass residues are burnt in an uncontrolled manner without utilizing it for energy purposes;
 - (d) B4: The biomass residues are used for energy or non-energy applications, or the primary source of the biomass residues and/or their fate cannot be clearly identified.¹²
41. Project proponents may choose to combine some or all relevant biomass types into one category when determining the fate of biomass residues, and treat the combined types as one, for instance in the biomass availability determination. These combinations shall be documented transparently in the CDM project design document (CDM-PDD) and remain consistent throughout the crediting period.
42. When defining plausible and credible alternative scenarios for the use of biomass residues, the guidance below shall be followed:
- (a) If the biomass residues processing (drying, pelletization, shredding, briquetting, etc.) is not included in the project boundary, the processed biomass obtained from that plant should be considered as B4 above;
 - (b) The alternative scenario for the categories of biomass residues identified according to paragraphs 40 and 41 above should be separately identified, covering the whole amount of biomass residues supposed to be used in the project activity along the crediting period;
 - (c) A category of biomass residues is defined by three attributes: (1) its type or types (i.e. bagasse, rice husks, empty fruit bunches, etc.); (2) its source (e.g. produced on-site, obtained from an identified biomass residues producer, obtained from a biomass residues market, etc.); and (3) its alternative scenario in the absence of the project activity (Scenarios B1 to B4 above);
 - (d) Explain and document transparently in the CDM-PDD, using a table similar to Table 1 in Appendix 2, what quantities of which biomass residues categories are used in which installation(s) under the project activity and what is their alternative scenario;
 - (e) For biomass residues categories for which scenarios B1, B2 or B3 are deemed a plausible alternative scenario, the following procedures should be applied for the combined amount of biomass identified:
 - (i) Demonstrate that there is an abundant surplus of the biomass residue in the project region which is not utilized. For this purpose, demonstrate that the total quantity of that type of biomass residues annually available in the project region is at least 25 per cent larger than the quantity of biomass residues which is utilized annually in the project region (e.g. for energy generation or as feedstock), including the project facility;
 - (ii) Demonstrate for the sites from where biomass residues are sourced that the biomass residues have not been collected or utilized (e.g. as fuel, fertilizer or

¹² For example, this scenario can be used if biomass residues are purchased from a market, or biomass residues retailers, or if processed biomass is purchased from biomass processing plants which are not included in the project boundary.

feedstock) but have been dumped and left to decay, land-filled, left in the field to decay after harvest,¹³ or burnt without energy generation (e.g. field burning). This approach is only applicable to biomass residues categories for which project participants can clearly identify the site from where the biomass residues are sourced;

- (iii) In case surplus of biomass residues in the project region cannot be demonstrated, the alternative use of the biomass shall be considered unknown (B4) and result in leakage emissions.

43. If during the crediting period, new categories of biomass residues of the type B1, B2 or B3 are used in the project activity which were not listed at the validation stage, for example due to new sources of biomass residues, the alternative scenario for those types of biomass residues should be assessed using the procedures outlined in this tool for each new category of biomass residues.

8.2. Calculation of Leakage due to diversion of biomass residues

44. The main potential source of leakage due to biomass residues is an increase in emissions from fossil fuel combustion or other sources due to diversion of biomass residues from other uses to the project plant as a result of the project activity. The alternative scenario for biomass residues for which this potential leakage is relevant is B4.
45. The actual leakage emissions in each of these cases may differ significantly and depend on the specific situation of each project activity. For that reason, a simplified approach is used in this tool: it is assumed that an equivalent amount of fossil fuels, on energy basis, would be used if biomass residues are diverted from other users, no matter what the use of biomass residues would be in the alternative scenario.
46. Therefore, for the categories of biomass residues whose alternative scenario has been identified as B4, project participants shall calculate leakage emissions as follows:

$$LE_{BR,y} = EF_{CO2,LE} \times \sum_n BR_{PJ,n,y} \times NCV_{n,y} \quad \text{Equation (9)}$$

Where:

$LE_{BR,y}$	=	Leakage emissions in year y (t CO ₂ e)
$EF_{CO2,LE}$	=	CO ₂ emission factor of the most carbon intensive fossil fuel used in the country (t CO ₂ /GJ)
$BR_{PJ,n,y}$	=	Quantity of biomass residues used in the project site and included in the project boundary in year y (tonnes on dry-basis)
$NCV_{n,y}$	=	Net calorific value of the biomass residues of category n in year y (GJ/tonne of dry matter)
n	=	Categories of biomass residues for which B4 has been identified as the alternative scenario

¹³ Project proponents shall demonstrate the fraction of biomass which exceeds the function of refertilising the soil, as only this part of the biomass may be considered unutilised.

47. The determination of $BR_{P,J,n,y}$ shall be based on the monitored amounts of biomass residues used in facilities included in the project boundary.

9. Monitoring methodology

9.1. Data and parameters not monitored

48. Data and parameters not monitored have been provided along with the relevant equation in the preceding section of the tool. Furthermore, for projects including biomass cultivation, the following parameter shall be known.

Data / Parameter table 1.

Data / Parameter:	Pre-project land use
Data unit:	variable
Description:	Service level of the pre-project land use
Source of data:	Land management records, records of the relevant local authority, stakeholders' interviews etc.
Measurement procedures (if any):	-
Any comment:	-

49. For projects including biomass residues, the following parameter shall be known.

Data / Parameter table 2.

Data / Parameter:	Biomass residues categories and quantities used in the project activity
Data unit:	(a) Type (i.e. bagasse, rice husks, empty fruit bunches, etc.); (b) Source (e.g. produced on-site, obtained from an identified biomass residues producer, obtained from a biomass residues market, etc.); (c) Fate in the absence of the project activity (Scenario B); (d) Use in the project scenario
Description:	Explain and document transparently in the CDM-PDD, using a table similar to table 1 in appendix 2 which quantities of which biomass residues categories are used in which installation(s) under the project activity and what is their alternative scenario. The last column of table 1 in appendix 2 corresponds to the quantity of each category of biomass residues (tonnes on dry-basis). These quantities should be updated every year of the crediting period so as to reflect the actual use of biomass residues in the project scenario. These updated values should be used for leakage calculations, if the determined alternative fate indicates associated leakage emissions. Along the crediting period, new categories of biomass residues (i.e. new types, new sources, with different fate) can be used in the project activity. In this case, a new line should be added to the table. If those new categories are of the type B1, B2 or B3, the alternative scenario for those types of biomass residues should be assessed using the procedures outlined in the guidance provided in the procedure for the determination of the alternative scenario

Measurement procedures (if any):	-
Any comment:	-

9.2. Data and parameters monitored

50. Data and parameters relevant to projects including biomass cultivation are monitored as described in the following parameter tables.

Data / Parameter table 3.

Data / Parameter:	$A_{SOC,i}$
Data unit:	ha
Description:	Area of land stratum <i>i</i>
Source of data:	Measurement by project participants
Measurement procedures (if any):	Standard land area measurement methods applicable in the host party
Monitoring frequency:	Annual
QA/QC procedures:	Check that standard land area measurement methods applicable in the host party country are used
Any comment:	-

Data / Parameter table 4.

Data / Parameter:	$q_{N,y}$
Data unit:	t N/ha
Description:	Rate of nitrogen applied, in year <i>y</i>
Source of data:	Land management records maintained by project participants and fertiliser composition information from supplier, study or independent laboratory. Alternatively, the default conservative value of 0.20 t N/ha per year may be used
Measurement procedures (if any):	-
Monitoring frequency:	Annual
QA/QC procedures:	Cross-check records of applied quantities with purchase receipts and inventory
Any comment:	Nitrogen applied through the following methods shall be added up to arrive at this value: (i) synthetic fertilisers; (ii) organic manure; (iii) return of the residues or cover crops

Data / Parameter table 5.

Data / Parameter:	$A_{FTM,y}$
Data unit:	ha
Description:	Area of land subjected to soil fertilization and management, in year <i>y</i>
Source of data:	Measurement by project participants

Measurement procedures (if any):	Standard land area measurement methods applicable in the host party
Monitoring frequency:	Annual
QA/QC procedures:	Check that standard land area measurement methods applicable in the host party are used
Any comment:	Areas receiving one or more of the following inputs shall be added up to arrive at this value: (i) synthetic fertilisers; (ii) organic manure; (iii) return of the residues or cover crops

Data / Parameter table 6.

Data / Parameter:	$q_{SA,i,y}$
Data unit:	t/ha
Description:	Rate of application of oil amendment agent type <i>i</i> , in year <i>y</i>
Description:	
Source of data:	Land management records maintained by project participants
Measurement procedures (if any):	-
Monitoring frequency:	Annual
QA/QC procedures:	Cross-check records of applied quantities with purchase receipts and inventory
Any comment:	-

Data / Parameter table 7.

Data / Parameter:	$A_{SA,i,y}$
Data unit:	ha
Description:	Area of land in which oil amendment agent type <i>i</i> is applied, in year <i>y</i>
Source of data:	Measurement by project participants
Measurement procedures (if any):	Standard land area measurement methods applicable in the host party
Monitoring frequency:	Annual
QA/QC procedures:	Check that standard land area measurement methods applicable in the host party are used
Any comment:	-

Data / Parameter table 8.

Data / Parameter:	$A_{FR,i,y}$
Data unit:	ha
Description:	Area of stratum <i>i</i> of land subjected to fire in year <i>y</i>
Source of data:	Measurement by project participants
Measurement procedures (if any):	Standard land area measurement methods applicable in the host party
Monitoring frequency:	Annual

QA/QC procedures:	Check that standard land area measurement methods applicable in the host party are used
Any comment:	-

Data / Parameter table 9.

Data / Parameter:	b_i
Data unit:	t dry matter/ha
Description:	Fuel biomass consumption per hectare in stratum <i>i</i> of land subjected to fire
Source of data:	Measurement by project participants. Alternatively, the default 'average above-ground biomass content in forest' values from Table 3A.1.4 of the Good Practice Guidance for Land Use, Land-Use Change and Forestry (IPCC-GPG-LULUCF 2003)
Measurement procedures (if any):	Measurement may be carried out through sample plots
Monitoring frequency:	Annual
QA/QC procedures:	If sample plots are used, the estimated mean value should not have an uncertainty of greater than 10 per cent at 90 per cent confidence level
Any comment:	-

Data / Parameter table 10.

Data / Parameter:	R_i
Data unit:	Dimensionless
Description:	Root-shoot ratio (i.e. ratio of below-ground biomass to above-ground biomass) for stratum <i>i</i> of land subjected to fire
Source of data:	Measurement by project participants. Alternatively, the default values from Table 4.4 of the 2006 IPCC Guidelines for National GHG Inventories may be used
Measurement procedures (if any):	Measurement may be carried out through sample plots
Monitoring frequency:	Annual
QA/QC procedures:	If sample plots are used, the estimated mean value should not have an uncertainty of greater than 10% at 90% confidence level
Any comment:	-

Data / Parameter table 11.

Data / Parameter:	Land use
Data unit:	variable
Description:	Service level of the project land use
Source of data:	-
Measurement procedures (if any):	-
Monitoring frequency:	Annually

QA/QC procedures:	-
Any comment:	The service level of the project land use shall at least provide the pre-project service level, otherwise leakage shall be accounted for

51. For projects utilising biomass residues, in the absence of relevant data/parameter tables in the methodology, the following parameter tables shall be used.

Data / Parameter table 12.

Data / Parameter:	BR_{P,J,n,y}
Data unit:	tonnes on dry-basis
Description:	Quantity of biomass residues of category <i>n</i> used in facilities which are located at the project site and included in the project boundary in year <i>y</i>
Source of data:	On-site measurements
Measurement procedures (if any):	Use weight meters. Adjust by the moisture content in order to determine the quantity of dry biomass
Monitoring frequency:	Data monitored continuously and aggregated as appropriate, to calculate emissions reductions
QA/QC procedures:	Cross-check the measurements with an annual energy balance that is based on purchased quantities and stock changes
Any comment:	<p>The biomass residue quantities used should be monitored separately for (a) each type of biomass residue (e.g.) and each source (e.g. produced on-site, obtained from biomass residues suppliers, obtained from a biomass residues market, obtained from an identified biomass residues producer, etc.).</p> <p>In case of missing data of up to 30 consecutive days within six consecutive months one of the following options may be used to estimate the quantity of biomass:</p> <ol style="list-style-type: none"> 1. an annual mass balance that is based on purchased or collected quantities and stock changes; 2. calculated based on the carrying capacity of each truck delivering biomass (moisture content and density shall be known); 3. The highest value of the parameter for the same calendar period of the previous years. <p>These options are applicable for project activities or PoAs, where end users of the subsystems or measures are households/communities/small and medium enterprises (SMEs).</p>

Data / Parameter table 13.

Data / Parameter:	NCV_{n,y}
Data unit:	GJ/tonnes on dry-basis
Description:	Net calorific value of biomass residues of category <i>n</i> in year <i>y</i>
Source of data:	On-site measurements
Measurement procedures (if any):	Measurements shall be carried out at reputed laboratories and according to relevant international standards. Measure the NCV on dry-basis

Monitoring frequency:	At least every six months, taking at least three samples for each measurement
QA/QC procedures:	Check the consistency of the measurements by comparing the measurement results with measurements from previous years, relevant data sources (e.g. values in the literature, values used in the national GHG inventory) and default values by the IPCC. If the measurement results differ significantly from previous measurements or other relevant data sources, conduct additional measurements. Ensure that the NCV is determined on the basis of dry biomass
Any comment:	The proposed sampling plan shall ensure that samples are randomly selected and are representative of the population. In case of missing data, the following can be used for project activities or PoAs, where end users of the subsystems or measures are households/communities/small and medium enterprises (SMEs): <ul style="list-style-type: none"> • IPCC default values at the upper limit of the uncertainty at a 95 per cent confidence interval as provided in table 1.2 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories; or • The highest value from the previous monitoring periods of the same biomass type.

Data / Parameter table 14.

Data / Parameter:	Moisture content of the biomass residues
Data unit:	% Water content in mass basis in wet biomass residues
Description:	Moisture content of each biomass residues type <i>n</i>
Source of data:	On-site measurements
Measurement procedures (if any):	-
Monitoring frequency:	The moisture content should be monitored for each batch of biomass of homogeneous quality. The weighted average should be calculated for each monitoring period and used in the calculations
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 15.

Data / Parameter:	EF_{CO₂,LE}
Data unit:	t CO ₂ /GJ
Description:	CO ₂ emission factor of the most carbon intensive fuel used in the country
Source of data:	Identify the most carbon intensive fuel type from the national communication, other literature sources (e.g. IEA). Possibly consult with the national agency responsible for the national communication/GHG inventory. If available, use national default values for the CO ₂ emission factor. Otherwise, IPCC default values may be used
Measurement procedures (if any):	-
Monitoring frequency:	Annually

QA/QC procedures:	-
Any comment:	-

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Appendix 1. Default values for biomass cultivation

Table 1. Default reference SOC stocks (SOC_{REF}) for mineral soils (tC/ha in 0–30 cm depth)

Climate region	HAC soils ¹	LAC soils ²	Sandy soils ³	Spodic soils ⁴	Volcanic soils ⁵
Boreal	68	NA	10	117	20
Cold temperate, dry	50	33	34	NA	20
Cold temperate, moist	95	85	71	115	130
Warm temperate, dry	38	24	19	NA	70
Warm temperate, moist	88	63	34	NA	80
Tropical, dry	38	35	31	NA	50
Tropical, moist	65	47	39	NA	70
Tropical, wet	44	60	66	NA	130
Tropical montane	88	63	34	NA	80

Table 2. Relative stock change factors for different management activities on cropland⁶

Factor type	Level	Temperature regime	Moisture regime	Factor value	Description and criteria
Land use (f_{LU})	Long-term cultivated	Temperate/Boreal	Dry	0.80	Area has been continuously managed for crops for more than 20 years
			Moist	0.69	
		Tropical	Dry	0.58	
			Moist/Wet	0.48	
		Tropical montane	n/a	0.64	
Land use (f_{LU})		Temperate/	Dry	0.93	

¹ Soils with high activity clay (HAC) minerals are lightly to moderately weathered soils, which are dominated by 2:1 silicate clay minerals (in the World Reference Base for Soil Resources (WRB) classification these include Leptosols, Vertisols, Kastanozems, Chernozems, Phaeozems, Luvisols, Alisols, Albeluvisols, Solonetz, Calcisols, Gypsisols, Umbrisols, Cambisols, Regosols; in USDA classification includes Mollisols, Vertisols, high-base status Alfisols, Aridisols, Inceptisols).

² Soils with low activity clay (LAC) minerals are highly weathered soils, dominated by 1:1 clay minerals and amorphous iron and aluminium oxides (in WRB classification includes Acrisols, Lixisols, Nitisols, Ferralsols, Durisols; in USDA classification includes Ultisols, Oxisols, acidic Alfisols).

³ Includes all soils (regardless of taxonomic classification) having >70 per cent sand and <8 per cent clay, based on standard textural analyses (in WRB classification includes Arenosols; in USDA classification includes Psamments).

⁴ Soils exhibiting strong podzolization (in WRB classification includes Podzols; in USDA classification Spodosols).

⁵ Soils derived from volcanic ash with allophanic mineralogy (in WRB classification Andosols; in USDA classification Andisols).

⁶ Adapted from 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, Table 5.5.

Factor type	Level	Temperature regime	Moisture regime	Factor value	Description and criteria
	Short-term cultivated (<20 years) or set aside (<5 years)	Boreal and Tropical	Moist/Wet	0.82	Area has been managed for crops for less than 20 years and/or the area is cropland that has been in a fallow state for less than five years at any point during the last 20 years
		Tropical montane	n/a	0.88	
Management (f_{MG})	Full tillage	All	Dry and Moist/Wet	1.00	Substantial soil disturbance with full inversion and/or frequent (within year) tillage operations. At planting time, little (e.g. <30 per cent) of the surface is covered by residues
Management (f_{MG})	Reduced tillage	Temperate/Boreal	Dry	1.02	Primary and/or secondary tillage but with reduced soil disturbance (usually shallow and without full soil inversion). Normally leaves surface with >30 per cent coverage by residues at planting
			Moist	1.08	
		Tropical	Dry	1.09	
			Moist/Wet	1.15	
		Tropical montane	n/a	1.09	
Management (f_{MG})	No-tillage	Temperate/Boreal	Dry	1.10	Direct seeding without primary tillage, with only minimal soil disturbance in the seeding zone. Herbicides are typically used for weed control
			Moist	1.15	
		Tropical	Dry	1.17	
			Moist/Wet	1.22	
		Tropical montane	n/a	1.16	

Table 3. Relative stock change factors for different levels of nutrient input on cropland⁷

Factor type	Level	Temperature regime	Moisture regime	Factor value	Description and criteria
Input (f_{IN})	Low	Temperate/Boreal	Dry	0.95	There is removal of residues (via collection or burning), or frequent bare-fallowing, or production of crops yielding low
			Moist	0.92	
		Tropical	Dry	0.95	
			Moist/Wet	0.92	

⁷ Ibid.

Factor type	Level	Temperature regime	Moisture regime	Factor value	Description and criteria
		Tropical montane	n/a	0.94	residues (e.g. vegetables, tobacco, cotton), or no mineral fertilization or N-fixing crops
Input (f_{IN})	Medium	All	Dry and Moist/Wet	1.00	All crop residues are returned to the field. If residues are removed then supplemental organic matter (e.g. manure) is added. Additionally, mineral fertilization or N-fixing crop rotation is practised
Input (f_{IN})	High without manure	Temperate/Boreal and Tropical	Dry	1.04	Represents significantly greater crop residue inputs over medium C input cropping systems due to additional practices, such as production of high residue yielding crops, use of green manures, cover crops, improved vegetated fallows, irrigation, frequent use of perennial grasses in annual crop rotations, but without manure applied
			Moist/Wet	1.11	
		Tropical Montane	n/a	1.08	
Input (f_{IN})	High with manure	Temperate/Boreal and Tropical	Dry	1.37	
			-	Moist/Wet	
		Tropical Montane	n/a	1.41	

Table 4. Relative stock change factors (f_{LU} , f_{MG} , and f_{IN}) for grassland management⁸

Factor type	Level	Climate regime	Factor value	Description
Land use (f_{LU})	All	All	1.00	All permanent grassland is assigned a land-use factor of 1
Management (f_{MG})	Non-degraded grassland	All	1.00	Non-degraded and sustainably managed grassland, but without significant management improvements
Management (f_{MG})	Moderately degraded grassland	Temperate/Boreal	0.95	Overgrazed or moderately degraded grassland, with somewhat reduced
		Tropical	0.97	

⁸ Adapted from 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, Table 6.2.

Factor type	Level	Climate regime	Factor value	Description
		Tropical Montane	0.96	productivity (relative to the native or nominally managed grassland) and receiving no management inputs
Management (f_{MG})	Severely degraded	All	0.70	Implies major long-term loss of productivity and vegetation cover, due to severe mechanical damage to the vegetation and/or severe soil erosion
Management (f_{MG})	Improved grasslands	Temperate/Boreal	1.14	Represents grassland which is sustainably managed with moderate grazing pressure and that receive at least one improvement (e.g. fertilization, species improvement, irrigation)
		Tropical	1.17	
		Tropical Montane	1.16	
Input (f_{IN}) (applied only to improved grassland)	Medium	All	1.00	All grassland without input of fertilizers is assigned an input factor of 1
	High	All	1.11	Grasslands with direct application of fertilizers (organic or inorganic) beyond what is required to be classified as improved grassland

Appendix 2. Example identification of alternative uses

1. Consider a project activity which includes the installation of a new biomass-only power plant, and the retrofit of an existing co-fired biomass-fossil-fuel power plant, which has historically used rice husks, produced on-site. Suppose that the project activity will use two types of biomass residues, rice husks (historical use plus an additional amount) and diverse agricultural residues (as additional biomass residues compared to the historical situation). Further consider that the rice husks used in the project would come from two different sources, on-site production and off-site supply from an identified rice mill. Presumably, the rice husks produced on-site would have been partly used on-site for electricity generation and partly be dumped in the determined alternative scenario. The rice husks procured off-site would have been dumped in the determined alternative scenario. The diverse agricultural residues are purchased from a biomass retailer. For this example, four categories of biomass residues should be considered in the subsequent analysis, as illustrated in Table 1.
2. The last column of Table 1 corresponds to the quantity of each category of biomass residues (tonnes). For the determination of the alternative scenario, at the validation stage, an ex ante estimation of these quantities should be provided. These quantities should be updated every year of the crediting period as part of the monitoring plan so as to reflect the actual use of biomass residues in the project scenario. These updated values should be used for emissions reductions calculations. Along the crediting period, new categories of biomass residues (i.e. new types, new sources, with different fate) can be used in the project activity. In this case, a new line should be added to the table.

Table 1. Table for biomass residues categories

Biomass residues category (k)	Biomass residues type	Biomass residues source	Biomass residues fate in the absence of the project activity	Biomass residues use in project scenario	Biomass residues quantity (tonnes)
1	Rice husks	On-site production	Electricity generation on-site (B4)	Electricity generation on-site (biomass-only boiler)	See comments above
2	Rice husks	On-site production	Dumped (B1)	Electricity generation on-site (biomass-only boiler)	See comments above
3	Rice husks	Off-site from an identified rice mill	Dumped (B1)	Electricity generation on-site (biomass-only boiler)	See comments above
4	Agricultural residues	Off-site from a biomass residues retailer	Unidentified (B4)	Electricity generation on-site (co-fired boiler)	See comments above

Appendix 3. Explanation of factors used

1. In equation (2), the factor to account for soil N₂O emissions associated with loss of soil organic carbon is calculated following volume 4 chapters 3 and 11 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Loss of SOC leads to associated mineralisation of N in the soil, leading to N₂O emissions:
 - (a) The mineralised *N* can be calculated using equation (11.1) and (11.10), with $EF_1=0.01$, $EF_5 = 0.0075$ and $Frac_{LEACH} = 0.3$, results in total 0.01225 tN-N₂O/tN;
 - (b) Using equation (11.8) of the IPCC guidelines, in which *R* is set to 10 tSOC/tN, results in 0.001225 tN-N₂O/tSOC;
 - (c) Converting to t CO₂e/tSOC by multiplying with 298 (GWP_{N₂O}) and dividing by 28/44 (Weight of *N* in N₂O) results in 0.574 t CO₂e/tSOC;
 - (d) Dividing by 44/12 (mass ratio of CO₂ and C) to convert to t CO₂e/t CO₂ (dimensionless factor) results in 0.156 t CO₂e released in N₂O for each t CO₂ released from SOC.
2. In equation (3), the factor to account for the IPCC default factor was derived from evaluating worse-case scenario, i.e. worse uncertainties, in the used factors:
 - (a) Reviewing the IPCC data, SOC_{REF} has error estimate of 90 per cent (IPCC table 2.3, table note), whereas the various *f* factors have error estimate of up to 50 per cent (IPCC tables 5.4 and 6.2). These are two sigma estimates, equivalent to 95 per cent confidence interval;
 - (b) Converting them to 90 per cent confidence interval (equivalent to 1.282 sigma), which is deemed appropriate for the tool, by multiplying with 1.282/2, results in SOC_{REF} uncertainty of 58 per cent, and the various *f* factors in uncertainties of 32 per cent;
 - (c) Adding the root-mean-square of these error estimates result in total 70 per cent error (Note the *f* uncertainties have each half the weight of the SOC_{REF} error estimate, due to the addition in the equation);
 - (d) As SOC_{REF} always has error estimate of 58 per cent, total error estimate has range of 58–70 per cent;
 - (e) The error estimates being in the uncertainty band of 50-100 per cent, result in a corrective factor of 1.21 according to FCCC/SBSTA/2003/10/Add.2/6.
3. In equation (5), the default value of the aggregate emission factor for N₂O and CO₂ emissions resulting from production and application of nitrogen, is calculated following volume 4 chapters 3 and 11 of 2006 IPCC Guidelines for National Greenhouse Gas

Inventories, as well as based on Wood and Cowie (2004) and Swaminathan (2004). The calculation is for ammonium nitrate, which is considered conservative:⁹

- (a) Direct and indirect N₂O emissions (emissions associated to the fertiliser application on the soil) calculated, using IPCC equations (11.1), (11.9) and (11.10), with $EF_1 = 0.01$, $EF_4 = 0.01$, $EF_5 = 0.0075$, $Frac_{GASF} = 0.1$ and $Frac_{LEACH} = 0.3$, results in total 0.01325 tN-N₂O/tN. This is converted, by multiplying with 298 (GWP_{N₂O}) dividing by 28/44 (Weight of N in N₂O), to 6.20 t CO₂e/tN;
 - (b) Emissions from synthetic fertiliser production, including fuel, feedstocks and emissions during production, calculated based on Wood and Cowie (2004) and Swaminathan (2004), taken for ammonium nitrate, a conservative fertiliser, is 7.1 t CO₂e/tN;
 - (c) Adding the above emissions results in 13.3 t CO₂e/tN.
4. In equation (7), the factor to account for non-CO₂ emissions from biomass clearance or burning was calculated using the values in table 2.5, volume 4 chapter 2 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories:
- (a) Taking the values for savannah and grassland, which are most conservative;
 - (b) $(1613 \text{ g CO}_2 + 2.3 \text{ g CH}_4 \times 25 (\text{GWP}_{\text{CH}_4}) + 0.21 \text{ g N}_2\text{O} \times 298 (\text{GWP}_{\text{N}_2\text{O}}))/1613 \text{ g CO}_2 = 1.07$.

⁹ As a comparison, the calculation is repeated for organic fertiliser:

- (a) Direct and indirect N₂O emissions calculated similarly to ammonium nitrate, but with $Frac_{GASM} = 0.2$ resulting in 6.67 t CO₂e/tN;
- (b) No emissions from fertiliser production are considered, resulting in total 6.67 t CO₂e/tN. As an additional comparison, the calculation is also repeated for synthetic urea:
- (c) Direct and indirect N₂O identical to ammonium nitrate equals 6.20 t CO₂e/tN;
- (d) Emissions from urea production, from the same source as ammonium nitrate, is 1.70 t CO₂e/tN;
- (e) Emissions from urea applications (carbon released from the urea decomposition) calculated as 0.429 tC/tN, which is the C/N mass ratio in urea. This is converted, by dividing by 12/44 (Weight of C in CO₂), to 1.57 t CO₂e/tN;
- (f) Adding the above emissions results in 9.5 t CO₂e/tN.

Document information

<i>Version</i>	<i>Date</i>	<i>Description</i>
04.0	28 July 2017	MP 73, Annex 13 To be considered by the Board at EB 96. Revision to provide flexible and objective requirements and best practice examples for missing data management.
03.0	4 November 2016	EB 92, Annex 6. Revision to provide clarity on eligible types of land and to broaden its applicability to cover biomass cultivation in forest that is at its last rotation of forest plantation.
02.0	16 April 2015	EB 83, Annex 8 Revision to: <ul style="list-style-type: none"> • Simplify and streamline the requirements for accounting for leakage emissions from use of biomass residues or biomass from cultivation; • Introduce leakage calculation due to use of biomass residues; • Expand simplified approaches to include both small-scale and large-scale methodologies; • Includes project emissions due to biomass processing and biomass transport; • Change the title from “Project emissions from cultivation of biomass” to “Project and leakage emissions from biomass”.
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