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## TYPE III - OTHER PROJECT ACTIVITIES

Project participants shall apply the general guidelines to SSC CDM methodologies, information on additionality (attachment A to Appendix B) and general guidance on leakage in biomass project activities (attachment C to Appendix B) provided at <http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html> *mutatis mutandis*.

## *III.AO. Methane recovery through controlled anaerobic digestion*

### Technology/measure

1. This methodology comprises measures to avoid the emissions of methane to the atmosphere from biomass or other organic matter that would have otherwise been left to decay anaerobically in a solid waste disposal site (SWDS), or in an animal waste management system (AWMS), or in a wastewater treatment system (WWTS). In the project activity, controlled biological treatment of biomass or other organic matters is introduced through anaerobic digestion in closed reactors equipped with biogas recovery and combustion/flaring system. The following conditions apply:

(a) Digestion of biomass or other organic matter (excluding animal manure and sludge generated in the wastewater treatment works) as a single source of substrate is included;

(b) Co-digestion[1] of multiple sources of biomass substrates, e.g. MSW, organic waste, animal manure, wastewater, where those organic matters would otherwise have been treated in an anaerobic treatment system without biogas recovery is also eligible;

(c) If for one or more sources of substrates, it can not be demonstrated that the organic matter would otherwise been left to decay anaerobically, baseline emissions related to such organic matter shall be accounted for as zero, whereas project emissions shall be calculated according to the procedures presented in this methodology for all co-digested substrates;

(d) Project participants shall apply the procedures related to the "competing use for the biomass" according to the latest "General guidance on leakage in biomass project activities";

(e) Project activities treating animal manure as single source substrate shall apply AMS-III.D "Methane recovery in animal manure management systems", similarly projects only treating wastewater and/or sludge generated in the wastewater treatment works shall apply AMS-III.H "Methane recovery in wastewater treatment";

[1] Co-digestion is the simultaneous digestion of a homogenous mixture of two or more substrates from different sources, e.g. co-digestion of MSW and animal manure and/or domestic/industrial wastewater. The most common situation is when a major amount of a primary basic substrate (e.g. manure) is mixed and digested together with minor amounts of other substrates.

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(f) The project activity does not recover or combust landfill gas from the disposal site (unlike AMS-III.G "Landfill methane recovery"), and does not undertake controlled combustion of the waste that is not treated biologically in a first step (unlike AMS-III.E "Avoidance of methane production from decay of biomass through controlled combustion, gasification or mechanical/thermal treatment"). Project activities that recover biogas from wastewater treatment shall use methodology AMS-III.H.

2. Measures are limited to those that result in emission reductions of less than or equal to 60 kt $CO_2$ equivalent annually.

3. The location and characteristics of the disposal site of the biomass used for digestion in the baseline condition shall be known, in such a way as to allow the estimation of its methane emissions. Guidelines in AMS-III.G, AMS-III.D, AMS-III.E (concerning stockpiles) and AMS-III.H (as the case may be) shall be followed in this regard. Project activities for co-digestion of animal manure shall also meet the requirements under paragraphs 1 and 2(c) of AMS-III.D.

The following requirement shall be checked *ex ante* at the beginning of each crediting period:

(a) Establish that identified landfill(s)/stockpile(s) can be expected to accommodate the waste to be used for the project activity for the duration of the crediting period; or

(b) Establish that it is common practice in the region to dispose off the waste in solid waste disposal site (landfill/stockpile).

4. The project participants shall clearly define the geographical boundary of the region referred to in 3(b), and document it in the CDM-PDD. In defining the geographical boundary of the region, project participants should take into account the source of waste, i.e. if waste is transported up to 50 km, the region may cover a radius of 50 km around the project activity. In addition, it should also consider the distances to which the final product after digestion will be transported. In either case, the region should cover a reasonable radius around the project activity that can be justified with reference to the project circumstances but in no case it shall be more than 200 km. Once defined, the boundary should not be changed amidst the crediting period(s).

5. In case residual waste from the digestion is handled aerobically and submitted to soil application, the proper conditions and procedures (not resulting in methane emissions) for storage and transportation and soil application must be ensured.

6. In case residual waste from the digestion is treated thermally/mechanically, the provisions in AMS-III.E related to thermal/mechanical treatment shall be applied.

7. In case residual waste from the digestion is stored under anaerobic conditions and/or delivered to a landfill, emissions from the residual waste shall to be taken into account and calculated as per the latest version of the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site".

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8. In case the outflow from the digestion is discharged to a subsequent wastewater treatment system or to the natural water receiving body, relevant procedure in AMS-III.H shall be followed to estimate the resultant project emissions.

9. Technical measures shall be used to ensure that all biogas captured from the digester is combusted/flared.

10. All the applications to utilise the recovered biogas detailed in paragraph 3 of AMS-III.H are eligible for use under this methodology. The relevant procedure in AMS-III.H shall be followed in this regard.

**Boundary**

11. The project boundary is the physical, geographical site:

(a) Where the solid waste (including animal manure, where applicable) would have been disposed and the methane emission occurs in absence of the proposed project activity;

(b) In the case of projects co-digesting wastewater, where the wastewater would have been treated anaerobically in the absence of the project activity;

(c) Where the treatment of biomass or other organic matters through anaerobic digestion takes place;

(d) Where the residual waste from biological treatment or products from those treatments, like slurry, are handled, disposed, submitted to soil application, or treated thermally/mechanically;

(e) Where biogas is burned/flared or gainfully used, including biogas sale points, if applicable;

(f) And the itineraries between them (a, b, c, d and e), where the transportation of waste, wastewater, where applicable manure, residual waste after digestion, or biogas occurs.

**Baseline**

12. The baseline scenario is the situation where, in the absence of the project activity, biomass and other organic matter (including manure where applicable) are left to decay within the project boundary and methane is emitted to the atmosphere. The baseline emissions are the amount of methane emitted from the decay of the degradable organic carbon in the biomass and other organic matter. Baseline emissions shall exclude emissions of methane that would have to be captured, fuelled or flared or gainfully used to comply with national or local safety requirement or legal regulations.

$$BE_y = BE_{SWDS,y} + BE_{ww,y} + BE_{manure,y} - MD_{reg,y} * GWP_{CH_4} \quad \textbf{(1)}$$

Where:

| | |
|---|---|
| $BE_{SWDS,y}$ | Where applicable, yearly methane generation potential of the solid waste anaerobically digested by the project activity during the year *x* from the beginning of the project activity (*x*=1) up to the year *y* estimated as per the latest version of the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site" ($tCO_2e$). The tool may be used with the factor "f=0.0" assuming that no biogas is captured, flared or used. With the definition of year *x* as the base year since the project activity started diverting wastes from the SWDS/landfill site. *x* runs from the first year of the crediting period (*x*=1) to the year for which emissions are calculated (*x*=*y*).<br>Where applicable, baseline emission determination of digested waste that would otherwise have been disposed in stockpiles shall follow relevant procedures in AMS-III.E |
| $BE_{manure,y}$ | Where applicable, baseline emissions from the manure co-digested by the project activities, calculated as per the relevant procedures of AMS-III.D |
| $BE_{ww,y}$ | Where applicable, baseline emissions from the wastewater co-digested, calculated as per the procedures of AMS-III.H |
| $MD_{reg,y}$ | Amount of methane that would have to be captured and combusted in the year *y* to comply with the prevailing regulations (tonne) |
| $GWP_{CH_4}$ | *GWP* for $CH_4$ (value of 21 is used) |

**Project Activity Emissions**

13. Project activity emissions consist of:

(a) $CO_2$ emissions due to incremental transportation distances;

(b) $CO_2$ emissions from electricity and/or fossil fuel consumption by the project activity facilities;

(c) In case the residual waste from the digestion is stored under anaerobic conditions and/or delivered to a SWDS, or treated in a WWTS: the methane emissions from the disposal/storage/treatment of these residual waste;

(d) Methane emissions from physical leakages of the anaerobic digester;

(e) Methane emissions due to flare inefficiency;

$$PE_y = \begin{Bmatrix} PE_{transp,y} + PE_{power,y} + PE_{res\ waste,y} \\ + PE_{phy\ leakage,y} + PE_{flaring,y} \end{Bmatrix} \quad \textbf{(2)}$$

Where:

| | |
|---|---|
| $PE_y$ | Project activity emissions in the year *y* ($tCO_2e$) |
| $PE_{transp,y}$ | Emissions from incremental transportation in the year *y* ($tCO_2e$) |
| $PE_{power,y}$ | Emissions from electricity or fossil fuel consumption in the year *y* ($tCO_2e$) |
| $PE_{res\ waste,y}$ | In case residual wastes are subjected to anaerobic storage, or disposed in a landfill: methane emissions from storage/disposal/treatment of waste ($tCO_2e$) |
| $PE_{phy\ leakage,y}$ | Methane emissions from physical leakages of the anaerobic digester in year *y* ($tCO_2e$) |
| $PE_{flaring,y}$ | Methane emissions due to incomplete flaring in year *y* as per the "Tool to determine project emissions from flaring gases containing methane"($tCO_2e$) |

14. Project emissions due to incremental transport distances ( $PE_{transp,y}$ ) are calculated based on the incremental distances between:

(i) The collection points of biomass and/or manure and the digestion site as compared to the baseline solid waste disposal site or manure treatment site;

(ii) When applicable, the collection points of wastewater and treatment site as compared to baseline wastewater treatment site;

(iii) Treatment sites and the sites for soil application, landfilling and further treatment of the residual waste.

$$PE_{transp,y} = (Q_y / CT_y) * DAF_w * EF_{CO2,transport} + (Q_{res\cdot waste,y} / CT_{res\cdot waste,y}) * DAF_{res\cdot waste} * EF_{CO2,transport} \quad \textbf{(3)}$$

Where:

| | |
|---|---|
| $Q_y$ | Quantity of raw waste/manure treated and/or wastewater co-digested in the year *y* (tonnes) |
| $CT_y$ | Average truck capacity for transportation (tonnes/truck) |
| $DAF_w$ | Average incremental distance for raw solid waste/manure and/or wastewater transportation (km/truck) |
| $EF_{CO2,transport}$ | $CO_2$ emission factor from fuel use due to transportation ($kgCO_2$/km, IPCC default values or local values may be used) |
| $Q_{res\cdot waste,y}$ | Quantity of residual waste produced in year *y* (tonnes) |
| $CT_{res\cdot waste,y}$ | Average truck capacity for residual waste transportation (tonnes/truck) |
| $DAF_{res\cdot waste}$ | Average distance for residual waste transportation (km/truck) |

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15. For the calculation of project emissions from electricity and/or fossil fuel consumption by the project activity facilities ( $PE_{power,y}$ ) all the energy consumption of all equipment/devices installed by the project activity shall be included e.g. energy used for chopping of biomass for size reduction and Tool to calculate the emission factor of an electricity system and/or "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion" shall be followed, respectively. If recovered biogas is used to power auxiliary equipment of the project it should be taken into account accordingly, using zero as its emission factor.

16. Methane emissions from anaerobic storage and/or disposal in a landfill of the residual waste from the digestion ( $PE_{res\ waste,y}$ ) are calculated as per the latest version of the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site".

17. Methane emissions due to physical leakages from the digester and recovery system ( $PE_{phy\ leakage,y}$ ) shall be estimated using a default factor of 0.05 m³ biogas leaked/m³ biogas produced. For *ex ante* estimation the expected biogas production of the digester may be used, for *ex post* calculations the effectively recovered biogas amount shall be used for the calculation.

**Leakage**

18. If the project technology is the equipment transferred from another activity or if the existing equipment is transferred to another activity, leakage effects are to be considered ($LE_y$).

**Monitoring**

19. The emission reductions will be calculated as follows and the following monitoring requirements apply:

(a) The emission reductions achieved by the project activity will be determined *ex post* through direct measurement of the amount of biogas fuelled, flared or gainfully used. It is possible that the project activity involves biomass treatment with higher methane conversion factor (MCF) than the MCF for the biomass which otherwise would have been left to decay in the baseline situation. Therefore the emission reductions achieved by the project activity is limited to the *ex post* calculated baseline emissions minus project and leakage emissions using the actual monitored data for the project activity (e.g. $Q_y$, and fossil fuels/electricity used). The emission reductions achieved in any year are the lowest value of the following:

$$ER_{y,ex\ post} = min\left[\begin{array}{l}(BE_{y,ex\ post} - PE_{y,ex\ post} - LE_{y,ex\ post}),(MD_y - PE_{y,power,ex\ post} - \\ PE_{y,transp,ex\ post} - PE_{y,res\ waste,ex\ post} - PE_{y,phy\ leakage,ex\ post} - LE_{y,ex\ post})\end{array}\right] \quad \textbf{(4)}$$

Where:

| | |
|---|---|
| $ER_{y,ex\ post}$ | Emission reductions achieved by the project activity based on monitored values for year $y$ ($tCO_2e$) |
| $BE_{y,ex\ post}$ | Baseline emissions calculated using equation (1) using *ex post* monitored values (e.g. $Q_y$) ($tCO_2e$) |
| $PE_{y,ex\ post}$ | Project emissions calculated using equation (2) using *ex post* monitored values (e.g. $Q_y$, transport distances, the amount of electricity/fossil fuels used, emissions from anaerobic storage). This calculation shall include project emissions from physical leakage ($tCO_2e$) |
| $LE_{y,ex\ post}$ | Leakage emissions calculated using *ex post* monitored values ($tCO_2e$) |
| $MD_y$ | Methane captured and destroyed or used gainfully by the project activity in year $y$ ($tCO_2e$) |
| $PE_{y,transp,ex\ post}$ | Emissions from incremental transportation based on monitored values in the year $y$ ($tCO_2e$) |
| $PE_{y,power,ex\ post}$ | Emissions from the use of fossil fuel or electricity for the operation of the installed facilities based on monitored values in the year $y$ ($tCO_2e$) |
| $PE_{y,res\ waste,ex\ post}$ | Methane emissions from the anaerobic decay/treatment of the residual waste/products based on monitored values in the year $y$ ($tCO_2e$) |
| $PE_{y,phy\ leakage,ex\ post}$ | Methane emissions from physical leakages of the anaerobic digester based on monitored values in year $y$ ($tCO_2e$) |

(b) In case of flaring/combustion $MD_y$ will be measured using the conditions of the flaring process:

$$MD_y = BG_{burnt,y} * w_{CH4,y} * D_{CH4} * FE * GWP\_CH_4 \quad \textbf{(5)}$$

Where:

| | |
|---|---|
| $BG_{burnt,y}$ | Biogas[2] flared/combusted in year $y$ ($m^3$) |
| $w_{CH4,y}$ | Methane content[2] in the biogas in the year $y$ (volume fraction) |

[2] Biogas and methane content measurements shall be on the same basis (wet or dry).

| | |
|---|---|
| $D_{CH4}$ | Density of methane at the temperature and pressure of the biogas in the year *y* (tonnes/$m^3$) |
| *FE* | Flare efficiency in the year *y* (fraction). If the biogas is combusted for gainful purposes, e.g. fed to an engine, an efficiency of 100% may be applied |

(c) The method for integration of the terms to calculate $MD_y$ to obtain the results for one year of measurements within the confidence level, as well as the methods and instruments used for metering, recording and processing the data obtained, shall be described in the project design document and monitored during the crediting period;

(d) Project activities where a portion of the biogas is destroyed through flaring and the other portion is used for energy may consider to apply the flare efficiency to the portion of the biogas used for energy, if separate measurements are not performed; When the amount of methane that is combusted for energy and that is flared is separately monitored, a destruction efficiency of 100% can be used for the amount that is combusted for energy;

(e) Flow meters, sampling devices and gas analysers shall be subject to regular maintenance, testing and calibration to ensure accuracy;

(f) The monitoring plan should include on site inspections for each individual digester included in the project boundary where the project activity is implemented for each verification period.

20. Soil application of the outflow in agriculture or related activities will be monitored as per relevant paragraph in AMS-III.F "Avoidance of methane emissions through composting".

21. Relevant parameters shall be monitored as indicated in the Table III.AO.1 below. The applicable requirements specified in the "General Guidelines to SSC CDM methodologies" (e.g. calibration requirements, sampling requirements) are also an integral part of the monitoring guidelines specified below and therefore shall be referred by the project participants.

**Table III.AO.1. Parameters for monitoring during the crediting period**

| No. | Parameter | Description | Unit | Monitoring/recording Frequency | Measurement Methods and Procedures |
|---|---|---|---|---|---|
| 1 | $Q_y$ , $Q_{res\cdot waste,y}$ | Quantity of solid waste(excluding manure), residual waste | tons | Monthly | On-site data sheets recorded monthly using weigh bridge. Weighbridge will be subject to periodic calibration (in accordance with stipulation of the weighbridge supplier) |
| 2 | $BG_{burnt,y}$ | | | | As per the procedure in AMS-III.H |
| 3 | $w_{CH4,y}$ | Methane content in biogas in the year *y* | % | | As per the relevant procedure in AMS-III.H |
| 4 | $T$ | Temperature of the biogas | $^{o}$C | | As per the relevant procedure in AMS-III.H |
| 5 | $P$ | Pressure of the biogas | Pa | | As per the relevant procedure in AMS-III.H |
| 6 | $FE$ | The flare efficiency | % | | As per the "Tool to determine project emissions from flaring gases containing Methane". Regular maintenance shall be carried out to ensure optimal operation of flares |

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| No. | Parameter | Description | Unit | Monitoring/recording Frequency | Measurement Methods and Procedures |
|---|---|---|---|---|---|
| 7 | $CT_y$, $CT_{res\cdot waste,y}$ | Average truck capacity for transportation | tons/truck | | On site measurement |
| 8 | $DAF_w$, $DAF_{res\cdot waste}$ | Average incremental distance for raw solid or product transportation | km/truck | Annually | On site measurement, assumption to be approved by DOE |
| 9 | | Parameters related to emissions from electricity and/or fuel consumption | | | As per the procedure in the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" and/or "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion". Alternatively it shall be assumed that all relevant electrical equipment operate at full rated capacity, plus 10% to account for distribution losses, for 8760 hours per annum |
| 10 | | Parameters related to methane emissions from anaerobic disposal in a landfill of the solid waste/residual waste | | | As per the latest version of the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site" |

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| No. | Parameter | Description | Unit | Monitoring/recording Frequency | Measurement Methods and Procedures |
|---|---|---|---|---|---|
| 11 | | Parameters related to baseline emissions from wastewater co-digested | | | As per relevant provisions in AMS-III.H |
| 12 | | Parameters related to baseline methane emissions from animal manure co-digested | | | As per relevant provisions in AMS-III.D |

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## Project activity under a programme of activities

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

In case the project activity involves the replacement of equipment, and the leakage effect of 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 should be documented and independently verified.

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**History of the document**

| Version | Date | Nature of revision |
|---|---|---|
| 01 | EB 58, Annex #<br>26 November 2010 | To be considered at EB 58. |
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