Indicative simplified baseline and monitoring methodologies
for selected small-scale CDM project activity categories

TYPE III - OTHER PROJECT ACTIVITIES

Project participants shall take into account the general guidance to the methodologies, information on additionality, abbreviations and general guidance on leakage provided at http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html.

III.H. Methane Recovery in Wastewater Treatment

Technology/measure

1. This project category comprises measures that recover methane from biogenic organic matter in wastewaters by means of one of the following options:

(i) Substitution of aerobic wastewater or sludge treatment systems with anaerobic systems with methane recovery and combustion.

(ii) Introduction of anaerobic sludge treatment system with methane recovery and combustion to an existing wastewater treatment plant without sludge treatment.

(iii) Introduction of methane recovery and combustion to an existing sludge treatment system.

(iv) Introduction of methane recovery and combustion to an existing anaerobic wastewater treatment system such as anaerobic reactor, lagoon, septic tank or an on site industrial plant[1].

(v) Introduction of anaerobic wastewater treatment with methane recovery and combustion, with or without anaerobic sludge treatment, to an untreated wastewater stream.

(vi) Introduction of a sequential stage of wastewater treatment with methane recovery and combustion, with or without sludge treatment, to an existing wastewater treatment system without methane recovery (e.g. introduction of treatment in an anaerobic reactor with methane recovery as a sequential treatment step for the wastewater that is presently being treated in an anaerobic lagoon without methane recovery).

The recovered methane from the above measures may also be utilised for thermal or electrical energy generation or for hydrogen production instead of combustion/flaring.

2. If the recovered methane is used for heat and or electricity generation that component of the project activity can use a corresponding category under type I.

[1] Other technologies in table 6.3 of Chapter 6: Wastewater Treatment and Discharge of 2006 IPCC Guidelines for National Greenhouse Gas Inventories are included.

3. If the recovered methane is utilized for production of hydrogen, that component of project activity shall use corresponding category AMS III.O.

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

Boundary

5. The project boundary is the physical, geographical site where the wastewater and sludge treatment takes place.

Project Activity Emissions

6. Project activity emissions consist of:

(i) CO_2 emissions on account of power used by the project activity facilities. Emission factors for grid electricity or diesel fuel use as the case may be shall be calculated as described in category AMS I.D;

(ii) Methane emissions on account of inefficiency of the wastewater treatment and presence of degradable organic carbon in treated wastewater;

(iii) Methane emissions from the decay of the final sludge generated by the treatment systems;

(iv) Methane fugitive emissions on account of inefficiencies in capture and flare systems;

(v) Methane emissions resulting from dissolved methane in the treated wastewater effluent.

$$PE_y = PE_{y,\,power} + PE_{y,ww,treated} + PE_{y,s,final} + PE_{y,fugitive} + PE_{y,dissolved} \quad (1)$$

Where:

PE_y	Project activity emissions in the year "y" (tCO_2e).
$PE_{y,power}$	Emissions from electricity or diesel consumption in the year "y".
$PE_{y,ww,treated}$	Emissions from degradable organic carbon in treated wastewater in year "y".
$PE_{y,s,final}$	Emissions from anaerobic decay of the final sludge produced in the year "y". If the sludge is controlled combusted, disposed in a landfill with methane recovery, or used for soil application, this term can be neglected, and the final disposal of the sludge shall be monitored during the crediting period.
$PE_{y,fugitive}$	Emissions from methane release in capture and utilization/combustion/flare systems in year "y".
$PE_{y,dissolved}$	Emissions from dissolved methane in treated wastewater in year "y".

7. Project activity emissions from electricity consumption are determined as per the procedures described in AMS I.D. For project activity emissions from fossil fuel consumption the emission factor for the fossil fuel shall be used (tCO2/tonne). Local values are to be used, if local values are difficult to obtain, IPCC default values may be used. If biogas is used to power auxiliary equipment of the project it should be taken into account accordingly, using zero as its emission factor.

8. Project activity emissions from degradable organic carbon in treated wastewater are determined as follows:

$$PE_{y,ww,treated} = Q_{y,ww} * COD_{y,ww,treated} * B_{o,ww} * MCF_{ww,final} * GWP\_CH_4 \quad (2)$$

Where:

$Q_{y,}ww$	Volume of wastewater treated in the year “y” (m^3)
$COD_{y,ww,treated}$	Chemical oxygen demand of the treated wastewater in the year “y” (tonnes/m^3)[2]
$B_{o,ww}$	Methane producing capacity of the wastewater (IPCC default value for domestic wastewater of 0.21 kg CH_4/kg.COD)[2]
$MCF_{ww,final}$	Methane correction factor based on type of treatment and discharge pathway of the wastewater (fraction) (MCF Higher Value in table III.H.1 for sea, river and lake discharge i.e. 0.2).
GWP_CH4	Global Warming Potential for methane (value of 21 is used)

Table III.H.1. IPCC default values[1)] for Methane Correction Factor (MCF)

Type of wastewater treatment and discharge pathway or system	**MCF lower values**	**MCF higher values**
Discharge of wastewater to sea, river or lake	0.0	0.2
Aerobic treatment, well managed	0.0	0.1
Aerobic treatment, poorly managed or overloaded	0.2	0.4
Anaerobic digester for sludge without methane recovery	0.8	1.0
Anaerobic reactor without methane recovery	0.8	1.0
Anaerobic shallow lagoon (depth less than 2 metres)	0.0	0.3
Anaerobic deep lagoon (depth more than 2 metres)	0.8	1.0
Septic system	0.5	0.5
[1)] Default values from chapter 6 of volume 5.Waste in *2006 IPCC Guidelines for National Greenhouse Gas Inventories*		

9. Project activity emissions from anaerobic decay of the final sludge produced are determined as follows:

[2] The IPCC default value of 0.25 kg CH_4/kg COD was corrected to take into account the uncertainties. For domestic waste water, a COD based value of $B_{o,ww}$ can be converted to BOD_5 based value by dividing it by 2.4 i.e. a default value of 0.504 kg CH_4/kg BOD can be used.

$$PE_{y,s,final} = S_{y,final} * DOC_{y,s,final} * MCF_{s,final} * DOC_F * F * 16/12 * GWP\_CH_4 \quad (3)$$

Where:

$PE_{y,s,final}$	Methane emissions from the anaerobic decay of the final sludge generated in the wastewater system in the year "y" (tCO_2e)
$S_{y,final}$	Amount of final sludge generated by the wastewater treatment in the year y (tonnes)
$DOC_{y,s,final}$	Degradable organic content of the final sludge generated by the wastewater treatment in the year y (fraction). It shall be measured by sampling and analysis of the sludge produced, and estimated ex-ante using the IPCC default values of 0.05 for domestic sludge (wet basis, considering a default dry matter content of 10 percent) or 0.09 for industrial sludge (wet basis, assuming dry matter content of 35 percent).
$MCF_{s,final}$	Methane correction factor of the landfill that receives the final sludge, estimated as described in category AMS III.G.
DOC_F	Fraction of DOC dissimilated to biogas (IPCC default value of 0.5)
F	Fraction of CH_4 in landfill gas (IPCC default of 0.5).

10. Project activity emissions from methane release in capture and utilization/combustion/flare systems are determined as follows:

$$PE_{y,fugitive} = PE_{y,fugitive,ww} + PE_{y,fugitive,s} \quad (4)$$

Where:

$PE_{y,fugitive,ww}$	Fugitive emissions through capture and utilization/combustion/flare inefficiencies in the anaerobic wastewater treatment in the year "y" (tCO_2e)
$PE_{y,fugitive,s}$	Fugitive emissions through capture and utilization/combustion/flare inefficiencies in the anaerobic sludge treatment in the year "y" (tCO_2e)

$$PE_{y,fugitive,ww} = (1 - CFE_{ww}) * MEP_{y,ww,treatment} * GWP\_CH_4 \quad (5)$$

Where:

CFE_{ww}	Capture and utilization/combustion/flare efficiency of the methane recovery and combustion/utilization equipment in the wastewater treatment (a default value of 0.9 shall be used, given no other appropriate value)
$MEP_{y,ww,treatment}$	Methane emission potential of wastewater treatment plant in the year "y" (tonnes)

$$MEP_{y,ww,treatment} = Q_{y,ww} * COD_{y,ww,untreated} * B_{o,ww} * MCF_{ww,treatment} \quad (6)$$

Where:

$COD_{y,ww,untreated}$	Chemical oxygen demand of the wastewater entering the anaerobic treatment reactor/system with methane capture in the year "y" ($tonnes/m^3$)

$MCF_{ww,\ treatment}$	Methane correction factor for the wastewater treatment system that will be equipped with methane recovery and combustion/flare/utilization equipment (MCF higher values in table III.H.1).

$$PE_{y,fugitive,s} = (1 - CFE_s) * MEP_{y,s,treatment} * GWP\_CH_4 \quad (7)$$

Where:

CFE_s	Capture and utilization/combustion/flare efficiency of the methane recovery and combustion/utilization equipment in the sludge treatment (a default value of 0.9 shall be used, given no other appropriate value)
$MEP_{y,s,treatment}$	Methane emission potential of the sludge treatment system in the year “y” (tonnes)

$$MEP_{y,s,treatment} = S_{y,untreated} * DOC_{y,s,untreated} * DOC_F * F * 16/12 * MCF_{s,treatment} \quad (8)$$

Where:

$S_{y,}$untreated	Amount of untreated sludge generated in the year “y” (tonnes)
$DOC_{y,s,untreated}$	Degradable organic content of the untreated sludge generated in the year y (fraction). It shall be measured by sampling and analysis of the sludge produced, and estimated ex-ante using the IPCC default values of 0.05 for domestic sludge (wet basis, considering a default dry matter content of 10 percent) or 0.09 for industrial sludge (wet basis, assuming dry matter content of 35 percent)
$MCF_{s,treatment}$	Methane correction factor for the sludge treatment system that will be equipped with methane recovery and combustion/utilization/flare equipment (MCF Higher value of 1.0 as per table III.H.1).

11. Project activity emissions from dissolved methane in treated wastewater are determined as follows:

$$PE_{y,dissolved} = Q_{y,ww} * [CH_4]_{y,ww,treated} * GWP\_CH_4 \quad (9)$$

Where:

$[CH_4]_{y,ww,treated}$	Dissolved methane content in the treated wastewater (tonnes/m^3). In aerobic wastewater treatment default value is zero, in anaerobic treatment it can be measured, or a default value of 10e-4 tonnes/m^3 can be used[3].

Baseline

12. The baseline scenario will be one of the following situations:

[3] Value calculated using approach given by Greenfield, P.F. and Batstone, D.J. Anaerobic digestion: impact of future GHG mitigation policies on methane generation and usage. In: Proceedings of Anaerobic Digestion Congress, Montreal, Canada, 2004.

(i) The existing aerobic wastewater or sludge treatment system, in the case of substitution of one or both of these systems for anaerobic ones with methane recovery and combustion.

(ii) The existing sludge disposal system, in the case of introduction of anaerobic sludge treatment system with methane recovery and combustion to an existing wastewater treatment plant.

(iii) The existing sludge treatment system without methane recovery and combustion.

(iv) The existing anaerobic wastewater treatment system without methane recovery and combustion.

(v) The untreated wastewater being discharged into sea, river, lake, stagnant sewer or flowing sewer, in the case of introducing the anaerobic treatment to an untreated wastewater stream.

(vi) The existing anaerobic wastewater treatment system without methane recovery for the case of introduction of a sequential anaerobic wastewater treatment system with methane recovery.

13. The baseline emissions are calculated as follows:

(a) For the cases 6 (i) and 6 (ii) the baseline emissions (BE_y) are calculated as:

$$BE_y = BE_{y,power} + BE_{y,ww,treated} + BE_{y,s,final} \quad (10)$$

Where:

BE_y Baseline emissions in the year "y" (tCO_2 e)

$BE_{y,power}$ Emissions on account of electricity or diesel consumed in the year "y" by the replaced aerobic wastewater or sludge treatment system

$BE_{y,ww,treated}$ Emissions from degradable organic carbon in treated wastewater in year "y", calculated using the same formula as that used for calculating the project emissions ($PE_{y,ww,treated}$). The value of this term is zero for the case 6 (ii).

$BE_{y,s,final}$ Emissions on account of anaerobic decay of the final sludge produced in the year "y", calculated using the formula as for the project emission ($PE_{y,s,final}$). If the sludge is controlled combusted, disposed in a landfill with methane recovery, or used for soil application, this term shall be neglected, and the end-use of the final sludge will be monitored during the crediting period.

(b) For the cases 6 (iii) and 6 (iv) the baseline emissions are calculated as per the formulas provided for calculating the project emissions, with the exception that MCF lower values in Table III.H.1 are used:

$$BE_y = MEP_{y,ww,treatment} * GWP\_CH4 + MEP_{y,s,treatment} * GWP\_CH4 \quad (11)$$

(c) For the case of 6 (v) since the MCF lower value for discharge of wastewater to sea, river or lake is 0.0 as per Table III.H.1, but may vary up to 0.2, the project participants shall demonstrate by measurements or by mathematical modelling of the impact of the discharge on the receiving water body, that anaerobic conditions do appear and the baseline emissions occur (a positive MCF is found). This MCF is used to determine the baseline emission scenario:

$$BE_y = Q_{y,ww} * COD_{y,ww,untreated} * B_{o,ww} * MCF_{ww,final} * GWP\_CH_4 \quad (12)$$

(d) For the case 6 (vi) the baseline emissions are calculated as:

$$BE_y = Q_{y,ww} * COD_{y,ww,untreated} * B_{o,ww} * MCF_{ww,treatment} * GWP\_CH_4 \quad (13)$$

Where:

$MCF_{ww,treatment}$ Methane correction factor for the existing wastewater treatment system to which the sequential anaerobic treatment step is being introduced (MCF lower value in Table III.H.1.)

For the above cases (a), (b) and (c) the methane generation capacity of the treated wastewater ($B_{o,ww}$) shall be IPCC lower value of 0.21 kg CH_4/kg .COD.

Leakage

14. If the used technology is equipment transferred from another activity or if the existing equipment is transferred to another activity, leakage effects at the site of the other activity are to be considered.

Monitoring

15. For the cases listed in paragraph 1 as:

(i) Substitution of aerobic wastewater or sludge treatment system by an anaerobic treatment system with methane recovery and combustion; or

(v) Introduction of an anaerobic wastewater treatment system with methane recovery and combustion to an untreated wastewater stream;

the emission reduction achieved by the project activity will be the difference between the baseline emission and the sum of the project emission and leakage.

$$ER_y = BE_y – (PE_y + Leakage_y) \quad (14)$$

The existing records of electricity consumption, COD content of treated wastewater, and quantity of sludge produced by the replaced aerobic units will be used for the baseline calculation in case (i). The project emissions will be monitored by regular measurements and recording of:

- the flow of wastewater and/or sludge treated ($Q_{y,ww}$ and $S_{y,untreated}$);

- their initial and final content of degradable carbon ($COD_{y,ww,untreated}$, $COD_{y,ww,treated}$, $DOC_{y,s,untreated}$, $DOC_{y,s,treated}$);
- and the dissolved methane in the wastewater just leaving the anaerobic reactor (if the default value for dissolved methane is not used), for the case (i).

16. For the cases of (ii) introduction of anaerobic sludge treatment with methane recovery and combustion to untreated sludge; (iii) and (iv) introduction of methane recovery and combustion unit to an existing anaerobic wastewater or sludge treatment system, and (vi) introduction of a sequential stage of wastewater treatment with methane recovery and combustion to an existing wastewater treatment, the calculation of emission reductions shall be based on the amount of methane recovered and fuelled or flared, that is monitored ex-post. Also for these cases, the project emissions and leakage will be deducted from the emission reductions calculated from the methane recovered and combusted.

17. In all cases, the amount of methane recovered, fuelled, flared or utilized shall be monitored ex-post, using continuous flow meters. The fraction of methane in the gas should be measured with a continuous analyser or, alternatively, with periodical measurements at a 95% confidence level. Temperature and pressure of the gas are required to determine the density of methane combusted.

18. Regular maintenance should ensure optimal operation of flares. The flare efficiency, defined as the fraction of time in which the gas is combusted in the flare, multiplied by the efficiency of the flaring process, shall be monitored. One of the two following options shall be used to determine the efficiency of the flaring process in an enclosed flare:

(a) To adopt a 90% default value, or

(b) To perform a continuous monitoring of the efficiency[4].

If option (a.) is chosen continuous check of compliance with the manufacturers specification of the flare device (temperature, biogas flow rate) should be done. If in any specific hour any of the parameters is out of the range of specifications 50% of default value should be used for this specific hour. For open flare 50% default value should be used, as it is not possible in this case to monitor the efficiency. If at any given time the temperature of the flare is below 500ºC, 0% default value should be used for this period.

19. If the methane emissions from anaerobic decay of the final sludge were to be neglected because the sludge is controlled combusted, disposed in a landfill with methane recovery, or used for soil application, then the end-use of the final sludge will be monitored during the crediting period.

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:

[4] The procedures described in the Tool to determine project emissions from flaring gases containing methane shall be used.

20. 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.