Draft revision to the approved baseline methodology AM0025

"Avoided emissions from organic waste through alternative waste treatment processes**"**

Source

This baseline methodology is based on the proposed methodologies submitted for the project "Organic waste composting at the Matuail landfill site Dhaka, Bangladesh," whose baseline study, monitoring and verification plan and project design document were prepared by prepared by World Wide Recycling B.V. and Waste Concern. It has been revised to include elements from the methodology for the ¨PT Navigat Organic Energy Indonesia Integrated Solid Waste Management (GALFAD) project in Bali, Indonesia¨, which was prepared by Mitsubishi Securities Co.

For more information regarding these proposals and their consideration by the Executive Board, please refer to case NM0090: "Organic waste composting at the Matuail landfill site Dhaka, Bangladesh," and case NM0127 ¨Integrated solid waste management with methane destruction and energy generation¨, at ¨http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html.

This methodology also refers to the "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (ACM0002), small-scale methodologies 1.D ¨Renewable electricity generation for a grid¨ and the latest version of the *"tool for the demonstration and assessment of additionality"*.

Selected approach from paragraph 48 of the CDM modalities and procedures

"Emissions from a technology that represents an economically attractive course of action, taking into account barriers to investment"

Applicability

The methodology is applicable under the following conditions:

- The project activity involves one or a combination of the following waste treatment options for the fresh waste that in a given year would have otherwise been disposed of in a landfill:
    a) a composting process in aerobic conditions;
    b) gasification to produce syngas and its use;
    c) anaerobic digestion with biogas collection and flaring and/or its use.

- In case of anaerobic digestion or gasification of waste, the residual waste from these processes is either aerobically composted or delivered to a landfill.

- The proportions and characteristics of different types of organic waste processed in the project activity can be determined, in order to apply a multiphase landfill gas generation model to estimate the quantity of landfill gas that would have been generated in the absence of the project activity.

- The project activity may include electricity generation and/or thermal energy generation from the biogas or syngas captured, respectively, from the anaerobic digester and the gasifier.

This methodology is **not applicable** to project activities that involve capture and flaring of methane from existing waste in the landfill. This should be treated as a separate project activity due to the difference in waste characteristics of existing and fresh waste, which may have an implication on the baseline scenario determination.

This baseline methodology shall be used in conjunction with the approved monitoring methodology AM0025 ("Avoided emissions from organic waste through alternative waste treatment processes").

Summary

This methodology addresses project activities where fresh waste originally intended for landfilling is treated either through composting, gasification, or anaerobic digestion. The project activity avoids methane emissions by diverting organic waste from disposal at a landfill, where methane emissions are caused by anaerobic processes. By treating the fresh waste through alternative treatment options these methane emissions are avoided from the landfill. The GHGs involved in the baseline and project activity are CO_2, CH_4 and N_2O.

Identification of the baseline scenario

Project participants should use step 1 of the latest version of the "Tool for the demonstration and assessment of additionality", to identify all realistic and credible baseline alternatives. In doing so, relevant policies and regulations related to the management of landfill sites should be taken into account. Such policies or regulations may include mandatory landfill gas capture or destruction requirements because of safety issues or local environmental regulations.[1] Other policies could include local policies promoting productive use of landfill gas such as those for the production of renewable energy, or those that promote the processing of organic waste. In addition, the assessment of alternative scenarios should take into account local economic and technological circumstances.

Alternatives to be analysed should include, *inter alia*:

- The project activity (i.e. composting, gasification or anaerobic digestion of organic waste with or without energy generation) not implemented as a CDM project;
- Incineration of the waste;
- Disposal of the waste on a landfill with electricity generation using landfill gas captured from the landfill site;
- Disposal of the waste on a landfill with delivery of landfill gas captured from the landfill site to nearby industry for heat generation;
- Disposal of the waste at a landfill where landfill gas captured is flared ;
- Disposal of the waste on a landfill without the capture of landfill gas.

[1] The project developer must bear in mind the relevant clarifications on the treatment of national and/or sectoral policies and regulations in determining a baseline scenario in Annex 3 to the meeting report of the Executive Board's (EB) 22nd meeting and any other forthcoming guidance from the Board on this subject.

Project participants should use steps 2 and/or 3 of the latest version of the "Tool for the determination and assessment of additionality" to assess which of these alternatives should be excluded from further consideration (e.g. alternatives facing prohibitive barriers or those clearly economically unattractive). Where more than one credible and plausible alternative remains, project participants shall, as a conservative assumption, use the alternative baseline scenario that results in the lowest baseline emissions as the most likely baseline scenario. In assessing these scenarios, any regulatory or contractual requirements should be taken into consideration.

The methodology is only applicable if the most plausible baseline scenario is identified as either the disposal of the waste in a landfill without capture of landfill gas or the disposal of the waste in a landfill where the landfill gas is partially captured and subsequently flared.

Additionality

The additionality of the project activity shall be demonstrated and assessed using the latest version of the ***"Tool for the demonstration and assessment of additionality"*** agreed by the CDM Executive Board[2].

Project boundary

The spatial extent of the project boundary is the site of the project activity where the waste is treated. This includes the facilities for processing the waste, on-site electricity generation and/or consumption, onsite fuel use, thermal energy generation, and the landfill site. The project boundary does not include facilities for waste collection, sorting and transport to the project site.

In the case that the project provides electricity to a grid, the spatial extent of the project boundary will also include those plants connected to the energy system to which the plant is connected.

The **greenhouse gases** included in or excluded from the project boundary are shown in Table 1.

Table 1: Overview of emissions sources included in or excluded from the project boundary and baseline

	Source	Gas		Justification / Explanation
Baseline	Emissions from decomposition of waste at the landfill site	CH_4	Included	The major source of emissions in the baseline
		N_2O	Excluded	N_2O emissions are small compared to CH_4 emissions from landfills. Exclusion of this gas is conservative.
		CO_2	Excluded	CO_2 emissions from the decomposition of organic waste are not accounted.[a]
	Emissions from electricity consumption	CO_2	Included	Electricity may be consumed from the grid or generated onsite in the baseline scenario
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is conservative.
	Emissions	CO_2	Included	If thermal energy generation is included in the project activity

[2] Please refer to: < http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html>

	from thermal energy generation	CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is conservative.
Project Activity	On-site fossil fuel consumption due to the project activity	CO_2	Included	May be an important emission source
		CH_4	Excluded	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small.
	Emissions from on-site electricity use	CO_2	Included	May be an important emission source. If electricity is generated from collected biogas/syngas, these emissions are not accounted for.
		CH_4	Excluded	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small.
	Direct emissions from the waste treatment processes.	N_2O	Included	May be an important emission source for composting activities. N_2O can be emitted from Syngas[b] produced and anaerobic digestion of waste.
		CO_2	Included	CO_2 emissions from gasification of fossil based waste shall be included. CO_2 emissions from the decomposition or combustion of organic waste are not accounted.[a]
		CH_4	Included	The composting process may not be complete and result in anaerobic decay. CH_4 leakage from the anaerobic digester and incomplete combustion in the flaring process are potential sources of project emissions. CH_4 may emitted from stacks [b] from the gasification process.

a: CO_2 emissions from the combustion or decomposition of *biomass* (see definition by the EB in Annex 8 of the EB's 20th meeting report) are not accounted as GHG emissions. Where the combustion or decomposition of biomass under a CDM project activity results in a decrease of carbon pools, such stock changes should be considered in the calculation of emission reductions. This is not the case for waste treatment projects.

b: Project proponents wishing to neglect these emission sources shall follow the clarification in annex 2 of EB 22 report which states that "magnitude of emission sources omitted in the calculation of project emissions and leakage effects (if positive) should be equal to or less than the magnitude of emission sources omitted in the calculation of baseline emissions"

Project emissions

The project emissions in year y are:

$$PE_y = PE_{elec,y} + PE_{fuel,\ on\text{-}site,y} + PE_{c,y} + PE_{a,y} + PE_{g,y} \quad (1)$$

where:

PE_y is the project emissions during the year y (tCO_2e)
$PE_{elec,y}$ is the emissions from electricity consumption on-site due to the project activity in year y (tCO_2e)
$PE_{fuel,\ on\text{-}site,y}$ is the emissions on-site due to fuel consumption on-site in year y (tCO_2e)

$PE_{c,y}$	is the emissions during the composting process in year y (tCO_2e)
$PE_{a,y}$	is the emissions from the anaerobic digestion process in year y (tCO_2e)
$PE_{g,y}$	is the emissions from the gasification process in year y (tCO_2e)

Emissions from electricity use ($PE_{elec,y}$)

Where the project activity involves electricity consumption, CO_2 emissions are calculated as follows:

$$PE_{elec,y} = MWh_{e,y} * CEF_{elec} \quad \textbf{(2)}$$

where:

$MWh_{e,y}$ is the amount of electricity generated in an on-site fossil fuel fired power plant or consumed from the grid in the project activity, measured using an electricity meter (MWh)
CEF_{elec} is the carbon emissions factor for electricity generation in the project activity (tCO_2/MWh)

In cases where electricity is generated in an on-site fossil fuel fired power plant, project participants should use, as CEF_{elec}, the default emission factor for a diesel generator with a capacity of more than 200 kW for small-scale project activities (0.8 tCO_2/MWh, see AMS I.D.1 in the simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories).

In cases where electricity is purchased from the grid, the emission factor CEF_{elec} should be calculated according to methodology ACM0002 (“Consolidated baseline methodology for grid-connected electricity generation from renewable sources”). If electricity consumption is less than small scale threshold, AMS. I.D.1 may be used.

Where the project activity involves electricity generation from biogas or syngas that is consumed on-site and/or exported to the grid, project emissions from electricity consumption do not need to be calculated, since only the quantity of electricity exported to the grid is taken into account in calculating emission reductions from on-site power generation with biogas or syngas.

Emissions from fuel use on-site ($PE_{fuel, on\text{-}site,y}$)

Project participants shall account for CO_2 emissions from any on-site fuel combustion (other than electricity generation, e.g. vehicles used on-site, heat generation, for starting the gasifier, etc). Emissions are calculated from the quantity of fuel used and the specific CO_2-emission factor of the fuel, as follows:

$$PE_{fuel, on\text{-}site,y} = F_{cons,y} * NCV_{fuel} * EF_{fuel} \quad \textbf{(3)}$$

where:

$PE_{fuel, on\text{-}site,y}$	is the CO_2 emissions due to on-site fuel combustion in year y (tCO_2)
$F_{cons,y}$	is the fuel consumption on site in year y (l or kg)
NCV_{fuel}	is the net caloric value of the fuel (MJ/l or MJ/kg)
EF_{fuel}	is the CO_2 emissions factor of the fuel (tCO_2/MJ)

Project participants may use IPCC default values for the net calorific values and CO_2 emission factors.

Emissions from composting ($PE_{c,y}$)

$PE_{c,y} = PE_{c,N2O,y} + PE_{c,CH4,y}$

where:

$PE_{c,N2O,y}$ is the N_2O emissions during the composting process in year y (tCO_2e)
$PE_{c,CH4,y}$ is the emissions during the composting process due to methane production through anaerobic conditions in year y (tCO_2e)

N_2O emissions

During the storage of waste in collection containers, as part of the composting process itself, and during the application of compost, N_2O emissions might be released. Based upon Schenk[3] and others, a total loss of 42 mg N_2O-N per kg composted dry matter can be expected (from which 26.9 mg N_2O during the composting process). The dry matter content of compost is around 50% up to 65%.

Based on these values, project participants should use a default emission factor of 0.043 kg N_2O per tonne of compost for $EF_{c,N2O}$ and calculate emissions as follows:[4]

$$PE_{c,N2O,y} = M_{compost,y} * EF_{c,N2O} * GWP_{N2O} \quad \textbf{(4)}$$

where:

$PE_{c,N2O,y}$ is the N_2O emissions from composting in year y (tCO_2e)
$M_{compost,y}$ is the total quantity of compost produced in year y (tonnes/a)
$EF_{c,N2O}$ is the emission factor for N_2O emissions from the composting process (t N_2O / t compost)
GWP is the Global Warming Potential of nitrous oxide, (tCO_2/tN_2O)

CH_4 emissions

During the composting process, aerobic conditions are neither completely reached in all areas nor at all times. Pockets of anaerobic conditions – isolated areas in the composting heap where oxygen concentrations are so low that the biodegradation process turns anaerobic – may occur. The emission behaviour of such pockets is comparable to the anaerobic situation in a landfill. This is a potential emission source for methane similar to anaerobic conditions which occur in unmanaged landfills. Through pre-determined sampling procedures the percentage of waste that degrades under anaerobic conditions can be determined. Using this percentage, project methane emissions from composting are calculated as follows:

$$PE_{c,CH4,y} = MB_{compost,y} * GWP_{CH4} * S_{a,y} \quad \textbf{(5)}$$

where:

$PE_{c,CH4,y}$ is the project methane emissions due to anaerobic conditions in the composting process in year y (tCO_2e)

[3] Manfred K. Schenk, Stefan Appel, Diemo Daum, "N2O emissions during composting of organic waste", Institute of Plant Nutrition University of Hannover, 1997

[4] Assuming 650 kg dry matter per ton of compost and 42 mg N_2O-N, and given the the molecular relation of 44/28 for N2O-N, an emission factor of 0.043 kg N_2O / tonne compost results.

$S_{a,y}$ is the share of the waste that degrades under anaerobic conditions in the composting plant during year y (%)
$MB_{compost,y}$ is the quantity of methane that would be produced in the landfill in the absence of the composting activity in year y (tCH_4). $MB_{compost,y}$ is estimated by multiplying MB_y estimated from equation (9) by the fraction of waste diverted, from the landfill, to the composting activity relative to the total waste diverted from the landfill to all project activities (composting, gasification and anaerobic digestion)
GWP_{CH4} is the Global Warming Potential of methane (tCO_2e/tCH_4)

Calculation of $S_{a,y}$

$S_{a,y}$ is determined by a combination of measurements and calculations. Bokhorst et al[5] and Richard et al[6] show that if oxygen content is below 5% - 7.5%, aerobic composting processes are replaced by anaerobic processes. To determine the oxygen content during the process, project participants shall measure the oxygen content according to a predetermined sampling scheme and frequency.

These measurements should be undertaken for each year of the crediting period and recorded each year. The percentage of the measurements that show an oxygen content below 10% is presumed to be equal to the share of waste that degrades under anaerobic conditions (i.e. that degrades as if it were landfilled), hence the emissions caused by this share are calculated as project emissions *ex-post* on an annual basis:

$$S_a = S_{OD} / S_{total} \quad \textbf{(6)}$$

where:

S_{OD} is the number of samples per year with an oxygen deficiency (i.e. oxygen content below 10%)
S_{total} is the total number of samples taken per year, where S_{total} should be chosen in a manner that ensures the estimation of S_a with 20% uncertainty at a 95% confidence level.

Emissions from anaerobic digestion ($PE_{a,y}$ **)**

$$PE_{a,y} = PE_{a,l,y} + PE_{a,s,y}$$

where:

$PE_{a,l,y}$ is the CH4 leakage emissions from the anaerobic digesters in year y (tCO_2e)
$PE_{a,s,y}$ is the total emissions of N_2O and CH_4 from stacks of the anaerobic digestion process in year y (tCO_2e)

CH_4 Emissions from leakage ($PE_{a,l,y}$)

A potential source of project emissions is the physical leakage of CH_4 from the anaerobic digester. Three options are provided for quantifying these emissions, in the following preferential order:

[5] Jan Bokhorst. Coen ter Berg – Mest & Compost Behandelen beoordelen & Toepassen (Eng: Manure & Compost – Treatment, judgement and use), Louis Bolk Instituut, Handbook under number LD8, Oktober 2001
[6] Tom Richard, Peter B. Woodbury, Cornell composting, operating fact sheet 4 of 10, Boyce Thompson Institute for Plant Research at Cornell University Cornell University

Option 1: Monitoring the actual quantity of the gas leakage;
Option 2: Applying an appropriate IPCC physical leakage default factor, justifying the selection;
Option 3: Applying a physical leakage factor of zero where advanced technology used by the project activity prevents any physical leakage. In such cases, the project proponent must provide the DOE with the details of the technology to prove that the zero leakage factor is justified.

$PE_{a,l,y} = P_l * M_{a,y}$

where:

$PE_{a,l,y}$ is the leakage of methane emissions from the anaerobic digester in year y (tCO_2e)
P_l is the physical leakage factor from a digester (fraction)
$M_{a,y}$ is the total quantity of methane produced by the digester in year y (tCO_2e)

Emissions from anaerobic digestion stacks ($PE_{a,s,y}$)

Biogas produced from the anaerobic digestion process may be either flared or used for energy generation. The final stack emissions (either from flaring or energy generation process) are monitored from the final stack and estimated as follows:

$PE_{a,s,y} = SG_{ay} * MC_{N2O,a,y} * GWP_{N2O} + SG_y * MC_{CH4,a,y} * GWP_{CH4}$

where:

$PE_{a,s,y}$ is the total emissions of N_2O and CH_4 from stacks of the anaerobic digestion process in year y (tCO_2e)
$SG_{,a,y}$ is the total volume of stack gas from the anaerobic digestion in year y (m^3/yr)
$MC_{N2O,a,y}$ is the monitored content of nitrous oxide in the stack gas from anaerobic digestion in year y ($t\ N_2O\ /\ m^3$)
GWP_{N2O} is the Global Warming Potential of nitrous oxide ($tCO_2e\ /tN_2O$)
$MC_{CH4,a,y}$ is the monitored content of methane in the stack gas from anaerobic digestion in year y ($t\ CH_4\ /\ m^3$)
GWP_{CH4} is the Global Warming Potential of methane ($tCO_2e\ /tCH_4$)

Emissions from gasification ($PE_{g,y}$)

The stack gas from the gasification process may contain small amounts of methane and nitrous oxide. Moreover, fossil-based waste CO_2 emissions from the gasification process should be accounted for.

$PE_{g,y} = PE_{gf,y} + PE_{g,s,y}$

where:

$PE_{g,f,y}$ is the fossil-based waste CO_2 emissions from gasification in year y (tCO_2e)

$PE_{g,s,y}$ is the emissions from the final stacks from gasification in year y (tCO_2e)

Emissions from fossil-based waste ($PE_{g,f,y}$)

The CO_2 emissions are calculated based on the monitored amount of fossil-based waste fed into the gasifier, the fossil-derived carbon content, and combustion efficiency. The calculation of CO_2 derived from gasification of waste of fossil origin is estimated as follows:

$$P_{g,f,y} = \sum_i A_i \times CCW_i \times FCF_i \times EF_i \times \frac{44}{12}$$

where:

$P_{g,f,y}$ is the fossil-based waste CO_2 emissions from gasification in year y (tCO_2e)
A_i is the amount of waste type i fed (t/yr)
CCW_i is the fraction of carbon content in waste type i (fraction)
FCF_i is the fraction of fossil carbon in waste type i (fraction)
EF_i is the combustion efficiency for waste type i (fraction)
44/12 is the conversion factor (tCO_2/tC)

Emissions from gasification stacks ($PE_{g,s,y}$)

$$PE_{g,s,y} = SG_{g,y} * MC_{N2O,g,y} * GWP_{N2O} + SG_{g,y} * MC_{CH4,g,y} * GWP_{CH4}$$

where:

$PE_{g,s,y}$ is the total emissions of N_2O and CH_4 from gasification in year y (tCO_2e)
$SG_{g,y}$ is the total volume of stack gas from gasification in year y (m3/yr)
$MC_{N2O,g,y}$ is the monitored content of nitrous oxide in the stack gas from gasification in year y ($t\ N_2O / m^3$)
GWP_{N2O} is the Global Warming Potential of nitrous oxide (tCO_2e/tN_2O)
$MC_{CH4,g,y}$ is the monitored content of methane in the stack gas from gasification in year y ($t\ CH_4 / m^3$)
GWP_{CH4} is the Global Warming Potential of methane (tCO_2e/tCH_4)

Baseline emissions

To calculate the baseline emissions project participants shall use the following equation:

$$BE_y = (MB_y - MD_{reg,y}) * GWP_{CH4} + EG_y * CEF_{baseline,elec,,y} + EG_{d,y} * CEF_d + HG_y * CEF_{baseline,therm,y} \quad \textbf{(7)}$$

where:

$BE_{,y}$ is the baseline emissions in year y (tCO_2e)
$MB_{,y}$ is the methane produced in the landfill in the absence of the project activity in year y (tCH_4)
$MD_{reg,y}$ is methane that would be destroyed in the absence of the project activity in year y (tCH_4)
GWP_{CH4le} is the Global Warming Potential of methane (tCO_2e/tCH_4)
EG_y is the amount of electricity in the year y that would be consumed at the project site in the absence of the project activity and which is not consumed anymore due to the implementation of the project activity, (MWh).

$CEF_{baseline,, elec,y}$ is the carbon emissions factor for electricity consumed at the project site in the absence of the project activity (tCO2/MWh)
$EG_{d,y}$ is the amount of electricity generated utilizing the biogas/syngas collected and exported to the grid in the project activity during the year y (MWh)
CEFd is the carbon emissions factor for the displaced electricity source in the project scenario (tCO2/MWh)
HG_y is the quantity of thermal energy that would be consumed in year y at the project site in the absence of the project activity and which is not consumed anymore due to the implementation of the project activity (MWh).
$CEF_{baseline, therm,,y}$ is the CO_2 emissions intensity for thermal energy generation (tCO_2e/MJ)

In cases where electricity would in the absence of the project activity be generated in fossil fuel fired power plants (i.e. not utilizing collected biogas/syngas for power generation), project participants should use for CEF_{elec}, the default emission factor for a diesel generator with a capacity of more than 200 kW for small-scale project activities (0.8 tCO_2/MWh, see AMS 1.D.1 in the simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories).

In cases where no fossil fuel fired on-site power generation would occur in the absence of the project activity,, the emission factor CEF_{elec} should be calculated according to methodology ACM0002 ("Consolidated baseline methodology for grid-connected electricity generation from renewable sources"). If the thresholds for small-scale project activities apply, , AMS. 1.D.1 may be used.

Determination of $CEF_{baseline,elec}$: In cases where electricity would in the absence of the project activity be generated in an on-site fossil fuel fired power plant, project participants should use for CEFbaseline,elec, the default emission factor for a diesel generator with a capacity of more than 200 kW for small-scale project activities (0.8 tCO2/MWh, see AMS 1.D.1 in the simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories).

In cases where electricity would in the absence of the project activity be purchased from the grid, the emission factor CEFbaseline,elec should be calculated according to methodology ACM0002 ("Consolidated baseline methodology for grid-connected electricity generation from renewable sources"). If electricity consumption is less than small scale threshold (15 GWh/yr), AMS. 1.D.1 may be used.

Determination of CEF_d: Where the project activity involves electricity generation from biogas or syngas, *CEF_d* should be chosen as follows:

- In case the generated electricity from the biogas/syngas displaces electricity that would have been generated in an on-site fossil fuel fired power plant in the baseline, the default emission factor for a diesel generator with a capacity of more than 200 kW for small-scale project activities (0.8 tCO_2/MWh, see AMS 1.D.1 in the simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories).

- In case the generated electricity from the biogas/syngas displaces electricity that would have been generated in other power plants in the grid in the baseline, CEF_d should be calculated according to methodology ACM0002 ("Consolidated baseline methodology for grid-connected electricity generation from renewable sources"). If electricity generated is less than small scale threshold (15 GWh/yr), AMS. 1.D.1 may be used.

Baseline electricity and thermal energy consumptions should be estimated as the average of the historical 3 years consumptions.

In cases where regulatory or contractual requirements do not specify $MD_{reg,y}$, an Adjustment Factor (AF) shall be used and justified, taking into account the project context. In doing so, the project participant should take into account that some of the methane generated by the landfill may be captured and destroyed to comply with other relevant regulations or contractual requirements, or to address safety and odour concerns.

$$MD_{reg,y} = MB_y * AF \qquad \textbf{(8)}$$

where:

AF is Adjustment Factor for MB_y (%)

AF is defined as the ratio of the destruction efficiency of the collection and destruction system mandated by regulatory or contractual requirement to that of the collection and destruction system in the project activity. The 'Adjustment Factor' shall be revised at the start of each new crediting period taking into account the amount of GHG flaring that occurs as part of common industry practice and/or regulation at that point in the future.

Methane generation from the landfill in the absence of the project activity

The amount of methane that is generated each year (MB_y) is calculated for each year with a multi-phase model. The model is based on a first order decay equation. It differentiates between the different types of waste *j* with respectively different decay rates k_j (fast, moderate, slow) and fraction of degradable organic carbon (DOC_j). The model calculates the methane generation based on the actual waste streams $A_{j,x}$ disposed in the most recent year (y) and all previous years since the project start (x=1 to x=y). The amount of methane produced in the year *y* (MB_y) is calculated as follows:

$$MB_y = j \cdot \frac{16}{12} \cdot F \cdot DOC_f \cdot MCF \cdot \sum_{x=1}^{y} \sum_{j=A}^{D} A_{j,x} \cdot DOC_j \cdot \left(1 - e^{-k_j}\right) \cdot e^{-k_j \cdot (y-x)} \qquad \textbf{(9)}$$

where:

$MB_{,y}$ is the methane produced in the landfill in the absence of the project activity in year y(tCH_4)
f is the model correction factor (default 0.9) to correct for the model-uncertainties
F is the fraction of methane in the landfill gas
DOC_j is the per cent of degradable organic carbon (by weight) in the waste type j
DOC_f is the fraction of DOC dissimilated to landfill gas
MCF is the Methane Correction Factor (fraction)
$A_{j,x}$ is the amount of organic waste type j prevented from disposal in the landfill in the year x (tonnes/year)
k_j is the decay rate for the waste stream type j
j is the waste type distinguished into the waste categories (from A to D), as illustrated in Table 3 below

x is the year during the crediting period: x runs from the first year of the first crediting period (x=1) to the year for which emissions are calculated (x=y)
y is the year for which LFG emissions are calculated

Model Correction Factor (f)

Oonk et el. have validated several landfill gas models based on 17 realized landfill gas projects.[7] The mean relative error of multi-phase models was assessed to be 18%. Given the uncertainties associated with the model and in order to estimate emission reductions in a conservative manner, a discount of 10% should be applied to the model results, i.e. f = 0.9 .

Methane correction factor (MCF)

The methane correction factor (MCF) accounts for the fact that unmanaged landfills produce less methane from a given amount of waste than managed landfills, because a larger fraction of waste decomposes aerobically in the top-layers of unmanaged landfills. The proposed default values for MCF are listed in Table 2 below.

Table 2: Solid Waste Disposal Site (SDWS) Classification and Methane Correction Factors

Type of site	**MCF default values**
Managed site	1.0
Unmanaged site – deep (> 5 m waste)	0.8
Unmanaged site – shallow (< 5 m waste)	0.4
Note: Managed SWDS must have controlled placement of waste (i.e. waste directed to specific deposition areas, a degree of control of scavenging and a degree of control of fires) and will include some of the following: cover material, mechanical compacting or levelling of waste.	

Source: Table 5.1 in the 2000 IPCC Good Practice Guidance

Project participants should use 0.4 as default MCF, unless they can demonstrate that the baseline-scenario would be disposal of the waste at an unmanaged site - with a waste pile of more than 5m depth (MCF in that case would be 0.8) or a managed landfill (MCF in that case would be 1.0).

Fraction of degradable organic carbon dissimilated (DOC_f)

The decomposition of degradable organic carbon does not occur completely and some of the potentially degradable material always remains in the site even over a very long period of time. The revised IPCC Guidelines propose a default value of 0.77 for DOC_f. A lower value of 0.5 should be used if lignin-C is included in the estimated amount of degradable organic carbon.[8]

Degradable carbon content in waste (DOC_j) and decay rates (k_j)

[7] Oonk, Hans et al.:Validation of landfill gas formation models. TNO report. December 1994
[8] IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories – chapter 5

In the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (module 6), default values for degradable organic carbon are presented, as shown in Table 3 below. These values should be used by project participants.[9]

[9] For the categories of waste considered as well as the values of DOC, project participants should consider any revisions to the Revised 1996 IPCC Guidelines and the 2000 IPCC Good Practice Guidance.

Table 3: Waste stream decay rates (k_j) and associated IPCC default values for DOC_j

Waste stream A to E	Per cent DOC_j (by weight)	Decay-rate (k_j)
A. Paper and textiles	40	0.023
B. Garden and park waste and other (non-food) putrescibles	17	0.023
C. Food waste	15	0.231
D. Wood and straw waste [1)]	30	0.023
E. Inert material	0	0

1) Excluding lignin-C

The most rapid decay rates are associated with high moisture conditions and rapidly degradable material such as food waste. The slower decay rates are associated with dry site conditions and slowly degradable waste such as wood or paper. For this methodology, food waste (C) is considered as fast degradable waste, while paper and textiles (A), Garden and park waste and other (non-food) putrescibles (B), Wood and straw waste (D) are considered as slow degradable waste. Inert materials (E) are assumed not to degrade (k=0).

If local measurements have been undertaken for decay rates and if these are documented, and can be considered as more reliable, these may be used instead of the default-values of table 3. Project participants should consider future revisions to the decay-rate constants (k_j) when available, including revisions of IPCC guidelines.

The composition of the waste shall be determined by sampling. The composition of the waste must be defined in accordance with the waste type categories in Table 3, measuring the fractions of each of the following waste types: paper and textile (A); garden and park waste and other (non-food) organic putrescibles (B); food waste (C); wood and straw (D) and; inert/inorganic waste (E). The size and frequency of sampling should be statistically significant with an maximum uncertainty range of 20% at a 95% confidence level. As a minimum, sampling should be undertaken four times per year.

The amount of organic waste type *j* ($A_{j,x}$) is calculated based on the total amount of waste collected in the year x (A_x) and the fraction of the waste type in the samples ($p_{n,j,x}$), as follows:

$$A_{j,x} = A_x \cdot \frac{\sum_{n=1}^{z} p_{n,j,x}}{z} \qquad \textbf{(10)}$$

where:

$A_{j,x}$ is amount of organic waste type j prevented from disposal in the year x (tonnes/year)
A_x is amount of total organic waste collected during the year x (tonnes/year)
$p_{n,j,x}$ is fraction of the waste type j in the sample n collected during the year x
z is number of samples taken during the year x

Calculation of F

The project participant shall determine *F* with the following order of preference**:**

1. Measure *F* on an annual basis as a monitoring parameter, at a landfill in the proximity of the treatment plant, receiving comparable waste as the treatment plant receives.
2. Measure *F* once prior to the start of the project activity at a landfill in the proximity of the treatment plant, receiving comparable waste as the treatment plant will receive.
3. In case there is no access to a landfill, the project participants should apply the conservative default value of 0.5, being the lower end of IPCC range of 0.5 – 0.6.

Leakage

Sources of leakage considered in the methodology is CO_2 emissions from off-site transportation of waste materials in addition to CH_4 and N_2O emissions from the residual waste from the anaerobic digestion and gasification processes. Positive leakage that may occur through the replacement of fossil-fuel based fertilizers with organic composts are not accounted for. Leakage emissions should be estimated from the following equation:

$$L_y = L_{t,y} + L_{r,y}$$

where:

$L_{t,y}$	is the leakage emissions from increased transport in year y (tCO_2e)
$L_{r,y}$	is the leakage emissions from the residual waste from the anaerobic digester or the gasifier in year y (tCO_2e)

Emissions from transportation ($L_{t,y}$)

The project may result in a change in transport emissions. This would occur when the waste is transported from waste collecting points, in the collection area, to the treatment facility, instead of to existing landfills. When it is likely that the transport emissions will increase significantly, such emissions should be incorporated as leakage. In this case, project participants shall document the following data in the CDM-PDD: an overview of collection points from where the waste will be collected, their approximate distance (in km) to the treatment facility, existing landfills and their approximate distance (in km) to the nearest end-user.

For calculations of the emissions, IPCC default values for fuel consumption and emission factors may be used. The CO_2 emissions are calculated from the quantity of fuel used and the specific CO_2-emission factor of the fuel for vehicles i to n, as follows:

$$L_{t,y} = \sum_{i}^{n} NO_{vehicles,i,y} * km_{i,y} * VF_{cons,i} * CV_{fuel} * D_{fuel} * EF_{fuel} \quad \textbf{(11)}$$

where:

$NO_{vehicles,i,y}$	is the number of vehicles for transport with similar loading capacity
$Km_{i,y}$	is the average additional distance travelled by vehicle type i compared to baseline in year y

VF_{cons} is the vehicle fuel consumption in litres per kilometre for vehicle type i (l/km)
CV_{fuel} is the Calorific value of the fuel (MJ/Kg or other unit)
D_{fuel} is the fuel density (kg/l), if necessary
EF_{fuel} is the Emission factor of the fuel (tCO_2/MJ)

For transport of compost to the users, the same formula applies.

Emissions from residual waste from anaerobic digester and gasifier ($L_{r,y}$)

For the residual waste from the anaerobic digestion and the gasification processes, the weight ($A_{ci,x}$) of each of the waste types i in year x should be estimated. Leakage emissions from this residual waste should be estimated using the determined weights as follows:

In case the residual waste is aerobically treated through composting, emissions shall be estimated as follows:

- N_2O emissions shall be estimated using Equation 4 replacing $M_{compost}$ by the sum of the weights of different waste types (A_{ci}).
- CH_4 emissions shall be estimated using Equation 9 replacing $A_{j,x}$ by $A_{ci,x}$. The result should be multiplied by S_l factor. S_l is estimated as follows:

$S_l = S_{ODl} / S_{ltotal}$

where:

S_{ODl} is the number of samples per year with an oxygen deficiency (i.e. oxygen content below 10%)
S_{ltotal} is the total number of samples taken per year, where S_{total} should be chosen in a manner that ensures the estimation of S_a with 20% uncertainty at a 95% confidence level.

In case the residual waste is delivered to a landfill, CH4 emissions are estimated through equation 9 using estimated weights of each waste type (A_{ci}).

Emission Reductions

To calculate the emission reductions the project participant shall apply the following equation:

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

where:

ER_y is the emissions reductions in year y (t CO_2e)
BE_y is the emissions in the baseline scenario in year y (t CO_2e)
PE_y is the emissions in the project scenario in year y (t CO_2e)
L_y is the leakage in year y (t CO_2e)

If the sum of PE_y and L_y is smaller than 1% of BE_y in the first full operation year of a crediting period, the project participants may assume a fixed percentage of 1% for PE_y and L_y combined for the remaining years of the crediting period.

Revision to the approved monitoring methodology AM0025

"Avoided emissions from organic waste through alternative waste treatment processes"

Sources

This monitoring methodology is based on the proposed methodologies submitted for the project ¨Organic waste composting at the Matuail landfill site Dhaka, Bangladesh¨, whose baseline study, monitoring and verification plan and project design document were prepared by World Wide Recycling B.V. and Waste Concern. It has been revised to include elements from the methodology for the ¨PT Navigat Organic Energy Indonesia Integrated Solid Waste Management (GALFAD) project in Bali, Indonesia¨, which was prepared by Mitsubishi Securities Co. For more information regarding the proposal and its consideration by the Executive Board please refer to case NM0090: "Organic waste composting at the Matuail landfill site Dhaka, Bangladesh" and case NM0127 ¨Integrated solid waste management with methane destruction and energy generation¨, at http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html.

This methodology also refers to the "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (ACM0002), small-scale methodologies 1.D ¨Renewable electricity generation for a grid¨ and the latest version of the "*Tool for the demonstration and assessment of additionality*".

Applicability

The methodology is applicable under the following conditions:

- The project activity involves one or a combination of the following waste treatment options for the fresh waste that in a given year would have otherwise been disposed of in a landfill:
  a) a composting process in aerobic conditions;
  b) gasification to produce syngas and its use;
  c) anaerobic digestion with biogas collection and flaring and/or its use.

- In case of anaerobic digestion or gasification of waste, the residual waste from these processes is either aerobically composted or delivered to a landfill.

- The proportions and characteristics of different types of organic waste processed in the project activity can be determined, in order to apply a multiphase landfill gas generation model to estimate the quantity of landfill gas that would have been generated in the absence of the project activity.

- The project activity may include electricity generation and/or thermal energy generation from the biogas or syngas captured, respectively, from the anaerobic digester and the gasifier.

This methodology is **not applicable** to project activities that involve the capture and flaring of methane from existing waste in the landfill. This should be treated as a separate project activity due to the difference in waste characteristics of existing and fresh waste, which may have an implication on the baseline scenario determination.

This monitoring methodology shall be used in conjunction with the approved baseline methodology AM0025 ("Avoided emissions from organic waste through alternative waste treatment processes").

Project emissions parameters

ID number	Data Variable	Source of data	Data unit	Measured (m) calculated (c) estimated (e)	Recording frequency	Pro-portion of data monitored	How will data be archived? (electronic / paper)	Comment
1. MWh_e	Electricity consumption	Electricity meter	MWh	M	Continuous	100%	Electronic	
2. CEF_{elec}	Electricity emissions factor	Official utility documents	tCO2e/MWh	C	Annually or *ex-ante*	100%	Electronic	Calculated according to ACM0002, or as diesel default factor according to AMS1.D.1, or according to data from captive power plant, if any.
3. F_{cons}	Fuel consumption	Purchase invoices	Liters or other quantity unit	C	Annually	100%	Electronic	
4. NCV_{fuel}	Net calorific value of fuel	Reference data or country-specific data	MJ/quantity	M, C, E	Annually or *ex-ante*	100%	Electronic	IPCC default data or country-specific data cited in authentic literature may apply.
5. EF_{fuel}	CO_2 emission factor of fuel	Reference data or country-specific data	t-CO_2/MJ	M, C, E	Annually or *ex-ante*	100%	Electronic	IPCC default data or country-specific data cited in authentic literature may apply.
6. $M_{compost,y}$	Total quantity of compost produced in year	Plant records	Tonnes	M	Annually	100%	Electronic	The produced compost will be trucked off from site. All trucks leaving site will be weighed. Possible temporary storage of compost will be weighed as well or not taken into account for calculated carbon credits.
7. S_a	Share of samples anaerobic		%	C	Weekly	See S_{total}	Electronic	Used to determine percentage of compost material that behaves

ID number	Data Variable	Source of data	Data unit	Measured (m) calculated (c) estimated (e)	Recording frequency	Pro-portion of data monitored	How will data be archived? (electronic / paper)	Comment
								anaerobically.
8. S_{OD}	Number of samples with oxygen deficiency	Oxygen measurement device	Number	M	Weekly	See S_{total}	Electronic	Samples with oxygen content <10%. Weekly measurements throughout the year but accumulated once per year only
9. S_{total}	Number of samples	Oxygen measurement device	Number	M	Weekly	statistically significant	Electronic	Total number of samples taken per year, where S_{total} should be chosen in a manner that ensures estimation of S_a with 20% uncertainty at 95% confidence level.
10. $EF_{c,N2O}$	Emission factor for N_2O emissions from the composting process	Research literature	t-N2O/t-compost	C	Ex-ante	100%	Electronic	default value of 0.043kg-N2O/t-compost, after Schenk et al, 1997.
11. P_l	Leakage of methane emissions from anaerobic digester	IPCC or project participant	t-CO_2e	M, E	Annually or Ex ante	100%	Electronic	
12. $MC_{N2O,y}$, $MC_{CH4,y}$	Fraction of N_2O and CH_4 in stack gas	Project Participants	(t N_2O / m^3), (t CH4/m^3)	M	At least quarterly	100%	Electronic	More frequent sampling is encouraged.

ID number	Data Variable	Source of data	Data unit	Measured (m) calculated (c) estimated (e)	Recording frequency	Pro-portion of data monitored	How will data be archived? (electronic / paper)	Comment
13. SG_y	Stack Gas volume flow rate	Project participants	m^3/yr	M	Continuous or periodic (at least quarterly)	100%	Electronic	The stack gas flow rate is either directly measured or calculated from other variables where direct monitoring is not feasible[10]. Where there are multiple stacks of the same type, it is sufficient to monitor one stack of each type.
14. M_a	Total methane produced from anaerobic digester	Project participants	Quantity methane produced (t/year)	M	Continuous	100%	Electronic	This quantity is necessary to calculate the leakage of methane from the digester which has a default leakage of 15%
15. Ai	Amount of waste type i	Project participants	t/yr	M	Annually	100%	Electronic	
16. CCW_i	Fraction of carbon content in waste type i	IPCC or other reference data	Fraction	M	Annually	100%	Electronic	.
17. FCF_i	Faction of fossil carbon in waste type i	Project participants	Fraction	M	Annually	100%	Electronic	
18. EF_i	Combustion efficiency for waste type i	IPCC or other reference data	Fraction	E	Annually	100%	Electronic	.

[10] The stack gas volume flow rate may be estimated by summing the inlet biogas and air flow rates and adjusting for stack temperature. Air inlet flow rate should be estimated by direct measurement using a flow meter.

Baseline emission parameters

ID number	Data Variable	Source of data	Data unit	Measured (m) calculated (c) estimated (e)	Recording frequency	Pro-portion of data monitored	How will data be archived? (electronic/ paper)	Comment
19. MD_{reg} or AF	Methane destroyed due to regulatory or other requirements	Local and/or national authorities	% or tonnes	E	Annually	100%	Electronic	Changes in regulatory requirements, relating to the baseline landfill(s) need to be monitored in order to update the adjustment factor (AF), or directly MD_{reg}.. This is done at the beginning of each crediting period.
20. EG_y	Electricity generation of project	Electricity meter	MWh	M	Continuous	100%	Electronic	For calculation of emissions from displaced fossil based electricity
21. $CEF_{baseline}$	Emission factor of baseline electricity	Depends on approved methodology selected	tCO_2e/ MWh	M	Annually	100%	Electronic	For calculation of emissions from displaced fossil based electricity
EG_d	Electricity generation of project using biogas/syngas	Electricity meter	MWh	M	Continuous	100%	Electronic	Electricity generated from use of biogas/syngas and exported to the grid
CEF_d	Emission factor of baseline electricity for EG_d	Depends on approved methodology selected	tCO_2e/ MWh	M	Annually	100%	Electronic	
22. HG_y	Quantity of thermal energy consumed	Recording device of steam consumption	MJ	C	Annually	100%	Electronic	Based on the properties of steam / water supplied.

ID number	Data Variable	Source of data	Data unit	Measured (m) calculated (c) estimated (e)	Recording frequency	Pro-portion of data monitored	How will data be archived? (electronic/ paper)	Comment
23.. A_x	Total quantity of waste supplied to waste treatment plant in the year x	Weighbridge	Tonnes	M	Annually	100%	Electronic	The quantity of organic waste prevented from disposal in year x (tonnes/year)
24. $P_{j,x}$	Share of different types of organic waste	Sampling/ Sorting/ weighing	% of waste	M	Quarterly	see note below	Electronic	Determine fraction of each waste stream of total waste input to the treatment facility
25. F	Methane fraction of landfill gas	Calculated	% by weight	M	Annually	100%	Electronic	Monitoring depends of the accessibility of this data coming from landfill in proximity of the treatment plant. If no suitable landfill-data is available, then a default value of 0.5 should be applied.
25. DOCj	Percent degradable organic carbon for waste type j	IPCC	Numbe r	E	Ex-ante	100%	Electronic	IPCC default values may be used
26. DOE_f	Fraction of degradable organic carbon dissimilated to landfill gas	IPCC	Numbe r	E	Ex-ante	100%	Electronic	A default factor of 0.77 may be applied from IPCC. Where lignin-C is included, a figure of 0.5 should be used
27. MCF	Methane correction factor	IPCC	Numbe r	E	Ex-ante	100%	Electronic	IPCC default values may be used
28. k	Decay rate	Default or project specific	Numbe r	M or E	Ex-ante	100%	Electronic	See table 3 in baseline methodology

P_{j}: To adequately determine the share of each fraction of waste, the project proponent should start with 4 samples per year (once every quarter). The size and frequency of sampling should result in a statistically significant mean with a maximum uncertainty range of 20% at a 95% confidence level.

Leakage

ID number	Data Variable	Source of data	Data unit	Measured (m) calculated (c) estimated (e)	Recording frequency	Pro-portion of data monitored	How will data be archived? (electronic/ paper)	Comment
29. $NO_{vehicles}$	Vehicles per carrying capacity per year	Counting	Number	M	Annually	100%	Electronic	Counter should accumulate the number of trucks per carrying capacity
30.. km_v	Additional distance travelled	Expert estimate	km	E	Annually	100%	Electronic	
31. VF_{cons}	Vehicle fuel consumption in litres per kilometre for vehicle type i	Fuel consumptio n record	liters	M	Annualy	100%	Electronic	
32.CV_{fuel}	Calorific value of the fuel	IPCC or other reference data	MJ/kg or other unit	M, C, E	Annually or Ex-ante	100%	Electronic	
33. D_{fuel}	Density of fuel	IPCC or other reference data	kg / l	M, C, E	Annually or Ex-ante	100%	Electronic	Not necessary if CV_{fuel} is demonstrated on a per liter basis
34. EF_{fuel}	Emission factor of the fuel	IPCC or other reference data	tCO_2/MJ	M, C, E	Annually or Ex-ante	100%	Electronic	

ID number	Data Variable	Source of data	Data unit	Measured (m) calculated (c) estimated (e)	Recording frequency	Pro-portion of data monitored	How will data be archived? (electronic/ paper)	Comment
35. A_{ci}	Amount of waste type ci for residual waste from anaerobic digestion or gasifier	Project participants	t/yr	M	Annually	100%	Electronic	
36. S_l	Share of samples anaerobic		%	C	Weekly	See S_{ltotal}	Electronic	Used to determine percentage of compost material that behaves anaerobically.
37. SOD_l	Number of samples with oxygen deficiency	Oxygen measurement device	Number	M	Weekly	See S_{ltotal}	Electronic	Samples with oxygen content <10%. Weekly measurements throughout the year but accumulated once per year only
38. S_{ltotal}	Number of samples	Oxygen measurement device	Number	M	Weekly	statistically significant	Electronic	Total number of samples taken per year, where S_{ltotal} should be chosen in a manner that ensures estimation of Sa with 20% uncertainty at 95% confidence level.

Quality Control (QC) and Quality Assurance (QA) Procedures

All measurements should use calibrated measurement equipment that is maintained regularly and checked for its functioning. QA/QC procedures for the parameters to be monitored are illustrated in the following table.

Data	Uncertainty Level of Data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary
1 MWh_e	Low	Electricity meter will be subject to regular (in accordance with stipulation of the meter supplier) maintenance and testing to ensure accuracy. The readings will be double checked by the electricity distribution company.
2 CEF_{elec}	Low	Calculated as per appropriate methodology at start of crediting period.
3 F_{cons}	Low	The amount of fuel will be derived from the paid fuel invoices (administrative obligation).
4. NCV_{fuel}	Low	IPCC default factor or country-specific data may be applied, resulting in no error due to mesurement.
5. EF_{fuel}	Low	IPCC default factor or country-specific data may be applied, resulting in no error due to mesurement.
6 $M_{compost,y}$	Medium	Weighed on calibrated scale; also cross check with sales of compost.
7 S_a	Medium	O_2-measurement-instrument will be subject to periodic calibration (in accordance with stipulation of instrument-supplier). Measurement itself to be done by using a standardised mobile gas detection instrument. A statistically significant sampling procedure will be set up that consists of multiple measurements throughout the different stages of the composting process according to a predetermined pattern (depths and scatter) on a daily basis.
8 S_{OD}	Medium	
9 S_{total}	Medium	
10. $EF_{c,\ N2O}$	Low	The value itself is highly variable, but reference data shall be used.
11. P_l	Low – Medium	The value itself is highly variable, but reference data shall be used, as well as measurement by project participants.
12. $MC_{N2O,y}$, $MC_{CH4,y}$	Low	Maintenance and calibration of equipment will be carried out according to internationally recognised procedures. Where laboratory work is outsourced, one which follows rigorous standards shall be selected.
13. SG_y	Low	Maintenance and calibration of equipment will be carried out according to internationally recognised procedures. Where laboratory work is outsourced, one which follows rigorous standards shall be selected
14. M_a	Low	Data can be checked from usage records.
15. Ai	Low	
16. CCW_i	Low	
17. FCF_i	Low	

18. EF_i	Low	
19 MD_{reg}	Medium	Data are derived from or based upon local or national guidelines, so QA/QC-procedures for these data are not applicable.
20. EG_y	Low	Maintenance and calibration of equipment will be carried out according to internationally recognised procedures. Third parties will be able to verify.
21. $CEF_{baseline}$	Low	Based on approved methodology.
22. HG_y	Low	Maintenance and calibration of equipment will be carried out according to internationally recognised procedures. Third parties will be able to verify.
23 A_y	Low	Weighbridge will be subject to periodic calibration (in accordance with stipulation of the weighbridge supplier).
24 P_{jx}	Low	Regular sorting & weighing of waste (initially quarterly) by project proponent will be carried out. Procedures will be checked regularly by a certified institute/ DOE.
24 F	Low	Analyser will be calibrated regularly (in accordance with stipulation of the meter supplier) by a certified institute.
25. DOCj	Low - medium	
26. DOE_f	Low – medium	
27. MCF	Low – medium	
28. k	Low – medium	
29$NO_{vehicles}$	Medium	Number of vehicles must match with total amount of sold compost. Procedures will be checked regularly by DOE.
30 KM	Medium	Assumption to be approved by DOE.
31. VF_{cons}	Low	
32.CV_{fuel}	Low	
33. D_{fuel}	Low	
34. EF_{fuel}		
35. S_l	Medium	O2-measurement-instrument will be subject to periodic calibration (in accordance with stipulation of instrument-supplier). Measurement itself to be done by using a standardised mobile gas detection instrument. A statistically significant sampling procedure will be set up that consists of multiple measurements throughout the different stages of the composting process according to a predetermined pattern (depths and scatter) on a daily basis.
36. SOD_l	Medium	
37. S_{ltotal}	Medium	