Approved baseline and monitoring methodology AM0039

"Methane emissions reduction from organic waste water and bioorganic solid waste using co-composting"

I. SOURCE AND APPLICABILITY

Source

This methodology is based on the project activity "Methane abatement through composting", whose baseline and monitoring methodology and project design document were prepared by "Danish Energy Management A/S".

For more information regarding the proposal and its consideration by the Executive Board please refer to case NM0147: "Methane emission reduction from organic waste water" on http://cdm.unfccc.int/goto/MPappmeth.

This methodology also refers to the latest version of the:

(i) "Tool for the demonstration and assessment of additionality"
(ii) "Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site".

Selected approach from paragraph 48 of the CDM modalities and procedures

"Actual or historical emissions, as applicable"

Applicability

The methodology is applicable to project activities that avoid methane emissions:

- Resulting from anaerobic degradation of the organic wastewater in open lagoons or storage tanks; and
- From natural decay of bioorganic solid waste in landfills.

The methodology is applicable under the following conditions:

- Organic wastewater and bioorganic solid waste can be generated at separate locations;
- The bioorganic solid waste can be of a single type or multiple types mixed in different proportions. The proportions and characteristics of different types of bioorganic 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;
- Project activities shall employ co-composting process for treatment of the organic wastewater and the bioorganic waste;
- The anaerobic lagoons or storage tanks utilized for the treatment of the organic wastewater, which is processed in the project co-composting activity, in the baseline shall meet the following conditions:
  - The monthly average ambient temperatures are greater than 10 ºC ;(the methodology is applicable even if some of the months during year have monthly average ambient temperature less than 10 ºC, but in such cases only months where monthly average ambient temperature are greater than 10 ºC shall be included in estimation of methane emissions)

- Depth of the wastewater anaerobic lagoon or storage tank is greater than 1 m;
- Residence time of the organic matter should be at least 30 days.

NOTE: The methodology is not applicable to waste streams from manure management.

This methodology is only applicable if the baseline is:

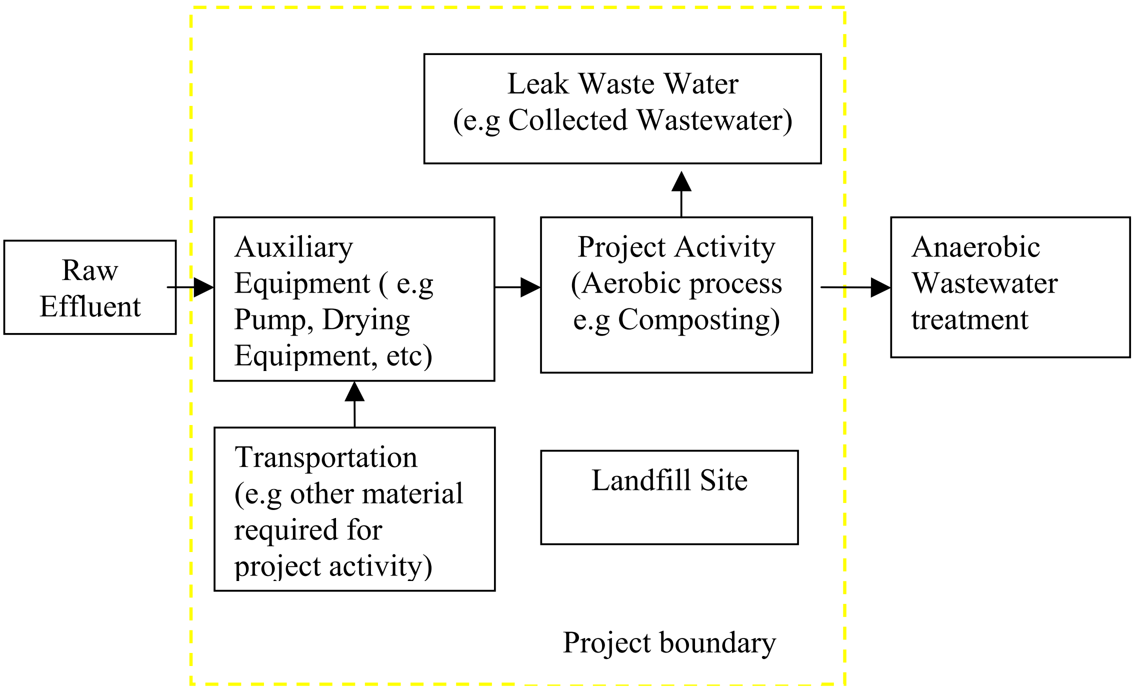
- Landfilling of the bioorganic solid waste; and
- An existing or new to be built anaerobic lagoon or open tanks for the treatment of organic wastewater.

II. BASELINE METHODOLOGY

Project boundary

The project boundary includes all GHG emission sources from anaerobic process including open lagoons or storage tanks treating organic wastewater, the landfill site where the bioorganic solid waste would be disposed of in the absence of project activity, the proposed aerobic process, transportation and auxiliary equipment.

Project boundary is graphically represented in the following block diagram.



Emissions sources included in or excluded from the project boundary are shown in Table 1.

Table 1: Summary of gases and sources included in the project boundary

	Source	Gas	Included?	Justification / Explanation
Baseline	Biomass disposed in unmanaged landfills	CO_2	No	CO_2 emissions from biomass decay in landfills is considered GHG neutral.
		CH_4	Yes	Methane emission from biomass decay in the landfills
		N_2O	No	Not significant. Excluded for simplification and conservativeness.
	Open Lagoons	CO_2	No	CO_2 emissions from biomass source are considered GHG neutral.
		CH_4	Yes	Methane emission from anaerobic process
		N_2O	No	Not significant. Excluded for simplification and conservativeness.
	Transportation	CO_2	Yes	Emission from combustion of fossil fuel in transport vehicles.
		CH_4	No	Not significant. Excluded for simplification and conservativeness
		N_2O	No	Not significant. Excluded for simplification and conservativeness
	Auxiliary Equipment	CO_2	Yes	Emission from Grid Electricity or Fossil fuel
		CH_4	No	Not significant. Excluded for simplification and conservativeness
		N_2O	No	Not significant. Excluded for simplification and conservativeness
Project Activity	Composting process	CO_2	No	CO_2 emissions from composting process is considered GHG neutral.
		CH_4	Yes	Methane emissions from anaerobic pockets during composting process
		N_2O	Yes	N_2O emissions from loss of N_2O-N during composting process and during application of the compost
	Leaked Waste Water	CO_2	No	CO_2 emission from biomass source and considered GHG neutral.
		CH_4	Yes	Methane emission from anaerobic process of wastewater collected after the project activity.
		N_2O	No	Not significant, excluded for simplification
	Additional Transportation due to Project Activity	CO_2	Yes	Emission from combustion of fossil fuel in transport vehicles.
		CH_4	No	Not significant, excluded for simplification
		N_2O	No	Not significant, excluded for simplification
	Auxiliary Equipment	CO_2	Yes	Emission from Grid Electricity or Fossil fuel
		CH_4	No	Not significant, excluded for simplification
		N_2O	No	Not significant, excluded for simplification

Procedure for the selection of the most plausible baseline scenario

The most plausible baseline scenario is determined through the application of the steps described below. The most plausible baseline scenario shall be determined for, both, the fate of organic wastewater and the bioorganic solid waste separately.

Step 1: Draw up a list of possible realistic and credible alternatives for the treatment of the organic wastewater and bioorganic solid waste

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

For organic wastewater:

- Continuation of current practice of using anaerobic lagoons or open storage tanks without methane recovery and flaring;
- Anaerobic lagoons or storage tanks with methane recovery and flaring;
- Anaerobic lagoons or storage tanks with methane recovery and utilization for electricity or heat generation;
- Building of a new anaerobic lagoon or open storage tanks without methane recovery and flaring;
- Building of a new anaerobic lagoon or open storage tanks with methane recovery and flaring;
- Using the organic wastewater for co-composting (The project activity implemented without CDM)
- Other treatment options provided in table 6.3, Volume 5, chapter 6 of the IPCC 2006 guidelines for greenhouse gas inventory.
- Other treatment options provided in table 6.3, Volume 5, chapter 6 of the IPCC 2006 guidelines for greenhouse gas inventory.

For bioorganic solid waste:

- Waste used for co-composting (the project activity implemented without CDM);
- Uncontrolled open burning;
- Waste returned to the plantation for mulching;
- Waste incinerated in controlled conditions or used for energy purposes including power generation;
- Waste disposed on a landfill without the capture of landfill gas;
- Waste disposed on a landfill where landfill gas is captured and flared;
- Waste disposed on a landfill where landfill gas is captured and electricity generated;
- Waste disposed on a landfill where landfill gas is captured and delivered to nearby industries for heat generation.

Step 2: Eliminate alternatives that are not complying with applicable laws and regulations

Eliminate alternatives that are not in compliance with all applicable legal and regulatory requirements. Apply Sub-step 1b of the latest version of the “Tool for demonstration assessment and of additionality” agreed by the CDM Executive Board.

Step 3: Eliminate alternatives that face prohibitive barriers

Scenarios that face prohibitive barriers should be eliminated by applying step 3 of the latest version of the "Tool for demonstration assessment and of additionality" agreed by the CDM Executive Board.

Step 4: Compare economic attractiveness of remaining alternatives

Compare the economic attractiveness without revenues from CERs for all alternatives that are remaining by applying Step 2 of the latest version of the "Tool for demonstration and assessment of additionality" agreed by the CDM Executive Board. The economic investment analysis shall use the IRR analysis, and explicitly state the following parameters:

- Incremental investment costs;
- O&M costs and
- All other costs of implementing the technology of the each alternative option;
- All revenues generated by the implementation of the technology except carbon revenues.

Compare the IRR of the different alternatives and select the most cost-effective alternative (i.e. with the highest IRR) as the baseline scenario. Include a sensitivity analysis applying Sub-step 2d of the latest version of the "Tool for demonstration assessment and of additionality" agreed by the CDM Executive Board. The investment analysis provides a valid argument that the most cost-effective scenario is the baseline scenario if it consistently supports (for a realistic range of assumptions) this conclusion. In case the sensitivity analysis is not fully conclusive, select the baseline scenario alternative with least emissions among the alternatives that are the most economically attractive according to the investment analysis and the sensitivity analysis.

Step 5: Assessment whether the identified baseline scenario is common practice

In the case where the baseline is a new to be built open lagoon or open storage tank demonstrate whether the identified baseline scenario is common practice (defined as at least 50% of the waste water treatment systems constructed during the last 5 years) in the relevant geographical area for similar industry (for example, municipal waste water, agro industry, pulp and paper). This group should at least comprise of 10 similar activities.

This methodology is only applicable if:

- The most plausible baseline scenario for treatment of the wastewater is the continuation of the use of open anaerobic lagoons or storage tanks throughout the crediting period or building of new anaerobic lagoons or open storage tanks; and
- The most plausible baseline of the treating bioorganic waste is landfilling.

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[1].

Baseline emissions

The following types of baseline emissions will be accounted under this methodology:

a) Methane (CH_4) emissions from waste water in anaerobic lagoons or open storage tanks;
b) Methane (CH_4) emissions from decay of bioorganic solid waste in disposal sites;
c) CO_2 emissions from transportation of organic wastewater and bioorganic solid waste;
d) CO_2 emissions from fossil fuels used for energy requirements and
e) CO_2 emissions from grid electricity consumption.

Total baseline emissions are expressed as:

$$BE_y = BE_{CH4,WW,y} + BE_{CH4,SW,y} + BE_{CO2,Trans,y} + BE_{CO2,FF,y} + BE_{CO2,Elec,y} \quad \textbf{(1)}$$

Where:

BE_y	Is the total baseline emissions during the year *y*, (tCO_2e)
$BE_{CH4,WW,y}$	Is the baseline methane emissions from existing open lagoon or open storage tanks during the year *y* (tCO_2e)
$BE_{CH4,SW,y}$	Is the baseline methane emissions from decay of bio-organic solid waste during the year *y* (tCO_2e)
$BE_{CO2,Trans,y}$	Is the baseline CO_2 emissions from transportation of organic wastewater and bioorganic solid waste during the year y (tCO_2e)
$BE_{CO2,FF,y}$	Is the baseline CO_2 emissions from use of fossil fuels during the year *y* (tCO_2)
$BE_{CO2,Elec,y}$	Is the baseline CO_2 emissions from grid electricity consumption during the year *y* (tCO_2)

The above emissions shall be calculated as explained below:

(a) Methane (CH_4) emissions from wastewater in open storage systems ($BE_{CH4,WW,y}$)

The baseline methane emissions from anaerobic lagoons or storage tanks are estimated based on the chemical oxygen demand (COD) of the effluent that would enter the lagoon in the absence of the project activity, the maximum methane producing capacity (Bo) and a methane conversion factor (MCF) that expresses what proportion of the effluent would be anaerobically digested in the open lagoons.

These CH_4 emissions from wastewater should be calculated according to following procedure :

$$BE_{CH4,WW,m} = COD_{available,m} \cdot B_o \cdot MCF_{baseline} \cdot GWP_{CH4} \quad \textbf{(2)}$$

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

Where:

$BE_{CH4,WW,m}$	Is the baseline monthly methane emissions from wastewater (tCO_2e)
$COD_{available,m}$	Is the monthly Chemical Oxygen Demand available for conversion which is equal to the monthly COD of the wastewater used for co-composting $COD_{baseline,m}$ plus COD carried on from the previous month (tCOD)
$COD_{baseline,m}$	Is the monthly Chemical Oxygen Demand of effluent entering anaerobic lagoons or storage tanks (measured in the project activity) (tCOD)
B_o	Is the maximum methane producing capacity of the inlet effluent (tCH_4/tCOD)
$MCF_{baseline}$	Is the methane conversion factor of the baseline storage system (fraction)
GWP_{CH4}	Is the Global Warming Potential of methane, default value 21

$COD_{baseline,m}$ is to be directly measured in the project as the baseline activity level since the effluent that goes into the anaerobic lagoon or storage tanks in the baseline situation is the same as the one that goes into the project. $COD_{baseline,m}$ is calculated as the product of $COD_{c,baseline}$ concentration ($kgCOD/m^3$) in the wastewater input to the project and the flow rate F_{dig} (m^3/month).

In case there is an effluent from the lagoons where the wastewater does not reside for at least 30 days in the baseline, $COD_{baseline}$ values should be adjusted by multiplying $COD_{baseline}$ by the following factor AD:

$$AD = 1 - \left(\frac{COD_{a,out}}{COD_{a,in}} \right) \qquad \textbf{(3)}$$

Where:

$COD_{a,out}$	Is the COD that leaves the lagoon with the effluent that does not reside for at least 30 days
$COD_{a,in}$	Is the COD that enters the lagoon

$COD_{a,out}$ and $COD_{a,in}$ should be based on one year historical data

The amount of organic matter available for conversion to methane $COD_{available,m}$ is assumed to be equal to the amount of organic matter produced during the month ($COD_{baseline,m}$ input to the project) plus the organic matter that may remain in the system from previous months.

The amount of organic matter consumed during the month is equal to the amount available for conversion $COD_{available,m}$ multiplied by $MCF_{monthly}$.

The amount of organic matter carried over from one month to the next equals to the amount available for conversion minus the amount consumed and minus the amount removed from the anaerobic lagoon or storage tank. In the case of the emptying of the anaerobic lagoon or storage tank, the accumulation of organic matter restarts with the next inflow.

Carry on calculations are limited to a maximum of one year. In case the residence time is less than one-year carry-on calculations are limited to this period where the organic wastewater resides in the anaerobic lagoon or storage tank. Project participants should provide evidence of the residence time of the organic matter in the anaerobic lagoon or storage tank.

In the case where the baseline is a new to be built anaerobic lagoon or storage tank, the residence time should be verified based on a literature review of country/region to establish an average lagoon depth for a particular industry. If such literature does not exist, conduct a survey within the industry based on a control group of the five most recently built lagoon systems identified in the lagoon systems identified in the common practice test of the baseline scenario selection procedure (step 5). Alternatively the project developer shall discount 20% of the CERs.

The default IPCC value for B_o, the maximum amount of CH_4 that can be produced from a given quantity of wastewater, is 0.25 kg CH_4/kg COD. Taking into account the uncertainty of this estimate, project participants should use a value of 0.21 kg CH_4/kg COD[2] as a conservative assumption for B_o.

$MCF_{baseline,m}$ is estimated as the product of the fraction of anaerobic degradation due to depth (f_d) and the fraction of anaerobic degradation due to temperature (f_t):

$$MCF_{baseline,m} = f_d \cdot f_{t,monthly} \cdot 0.89 \qquad \textbf{(4)}$$

Where:

f_d	Is the fraction of anaerobic degradation due to depth as per Table 1
f_t	Is the fraction of anaerobic degradation due to temperature
0.89	Is an uncertainty conservativeness factor (for an uncertainty range of 30% to 50%) to account for the fact that the equation used to estimate $f_{t,monthly}$ assumes full anerobic degradation at 30 ºC

	Deep > 5m	Medium depth 1–5m	Small depth <1m
Fraction of degradation under anaerobic conditions due to depth of anaerobic lagoons or storage tank	70%	50%	0

In the case where the baseline is a new to be built anaerobic lagoon or storage tank, the depth should be verified based on a literature review of country/region to establish an average lagoon depth for a particular industry. If such literature does not exist, conduct a survey within the industry based on a control group of the five most recently built lagoon systems identified in the lagoon systems identified in the common practice test of the baseline scenario identification procedure (step 5). If the average depth of lagoons within the industry is at least 5 meters, the 70% factor can be used. Alternatively the 50% value can be chosen as a default value.

Establish for the specific location what the lowest cost option is for the lagoon in terms of surface and depth. Take into account legal requirements and the ground water level at the project site, e.g., if legal requirements state that lagoons must be at least 2 meters above ground water level, you can only use the 70% factor if the ground water is at least 7 meters deep, and if cost analysis shows that a lagoon of more than 5 meters is the most cost effective option.

$f_{t,monthly}$ is calculated as follows:

[2] Lowest value provided by IPCC Good Practice guidance, 2000, Page 5.19

$$f_{t,monthly} = \exp\left[\frac{E \cdot (T_2 - T_1)}{R \cdot T_1 \cdot T_2}\right] \qquad \textbf{(5)}$$

Where:

$f_{t,monthly}$	Anaerobic degradation factor due to temperature
E	Activation energy constant (15,175 cal/mol)
T_2	Ambient temperature (Kelvin) for the climate
T_1	303.16 (273.16° + 30°)
R	Ideal gas constant (1.987 cal/ K mol).

The factor '$f_{t, monthly}$' represents the proportion of organic matter that is biologically available for conversion to methane based upon the temperature of the system. The assumed temperature is equal to the ambient temperature. The value of f_t to be used cannot exceed unity.

Monthly values for $f_{t,monthly}$ is calculated as follows:

(1) The monthly average temperature for the area is obtained from published national weather service information.
(2) Monthly temperatures are used to calculate a monthly van't Hoff – Arrhenius '$f_{t,monthly}$' factor above.

A minimum temperature of 10 °C is used. Months where the average temperature is less than 10 ºC, $f_{t,monthly} = 0$. The value of $f_{t,monthly}$ to be used cannot exceed unity.

It is the possible to calculate the MCF both monthly and annual.

Annual MCF can be estimated from the following equation:

$$MCF_{annual} = \frac{\sum_{m=1}^{12} CH_{4,m}}{B_o \cdot \sum_{m=1}^{12} COD_{baseline,m}} \qquad \textbf{(6)}$$

Monthly baseline CH_4 emissions ($BE_{CH4,}$~~$_{WW,m,}$~~ $_{WW,m}$) shall be aggregated into annual emissions as follows:

$$BE_{CH4,WW,y} = \sum_{m=1}^{12} BE_{CH4,WW,m} \qquad \textbf{(7)}$$

Where:

$BE_{CH4,WW,y}$	Is the estimated annual methane production in tCO_2e, during the year *y*
$BE_{CH4,WW,m}$	Is the estimated monthly methane production in tCO_2e

(b) Methane (CH_4) emissions from decay of bioorganic solid waste in disposal sites ($BE_{CH4,SW,y}$)

~~The amount of methane that is generated from the biomass solid waste $BE_{CH4, SW, y}$ 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 *kj* (fast, moderate, slow) and~~

fraction of degradable organic carbon (DOCj). The model calculates the methane generation based on the actual waste streams Aj,x diverted from the landfill in the most recent year and all previous years since the project start (x=1 to x=y). The amount of methane produced in *a year* is calculated as follows.

The amount of methane that would be generated each year in absence of project activity (MBy $BE_{CH4,SW,y}$) is calculated as per the latest version of the approved "tool to determine methane emissions avoided from dumping waste at a solid waste disposal site", considering as per the following additional equation:

$$BE_{CH4,SW,y} = BE_{CH4,SWDS,y} - MD_{reg} \quad \textbf{(8)}$$

Where:

$BE_{CH4,SWDS,y}$ Methane generation from the landfill in the absence of the project activity at year "y" calculated as per the *"Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site"*. The tool estimates methane generation adjusted for, using adjustment factor (f) any landfill gas in the baseline that would have been captured and destroyed to comply with relevant regulations or contractual requirements, or to address safety and odour concerns. As this is already accounted for in equation 8, "f" in the tool shall be assigned a value 0.

$$BE_{CH4,SW,y} = \left[\varphi \cdot \frac{16}{12} \cdot F \cdot DOC_f \cdot MCF \cdot GWP_{CH4} \cdot \sum_{x=1}^{y} \sum_{j=A}^{D} A_{j,x} \cdot DOC_j \cdot \left(1 - e^{-k_j}\right) \cdot e^{-k_j(y-x)}\right] - MD_{reg} \quad \textbf{(8)}$$

Where:

$BE_{CH4,SW,y}$	is the amount of methane produced in the landfill in the absence of the project activity from biomass solid waste used in composting during the year *y* (tCO_2e)
MD_{reg}	is methane that would be destroyed in the absence of the project activity in year y (tCH_4)
φ	is the model correction factor (default 0.9) to correct for the model-uncertainties
F	is the fraction of methane in the landfill gas, IPCC default value 0.5
DOC_j	is the percentage of degradable organic carbon (by weight) in the waste type *j*
DOC_f	is the fraction of DOC dissimilated to landfill gas, IPCC default value 0.77
MCF	is the Methane Correction Factor (fraction), IPCC default value 0.4 (to be conservative)
GWP_{CH4}	is the global warming potential for Methane, IPCC default value 21
$A_{j,x}$	is the amount of organic waste type *j* prevented from disposal in the landfill during the year *x* (tons)
k_j	is the decay rate for waste stream type *j*
j	is the waste type distinguished into the waste categories (from A to D), as illustrated in the Table 4 below.
x	is the year during the crediting period: x runs from the first year of first crediting period (x=1) to the year for which emissions are calculated (x=y)
y	is the year for which methane emissions are calculated

MD_{reg}

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.

$$MD_{reg,y} = BE_{CH4,SW,y} \; MB_y * AF \quad (9)$$

Where:

AF is Adjustment Factor for $BE_{CH4,SW,y}$ 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. In some situations the landfill gas may be collected and destroyed previous to implementation of project activity for reasons other than regulation or contracts. The project participants provide clear data/estimation procedure to estimate the fraction of such landfill gas destroyed and report in the CDM-PDD.

Model Correction Factor (φ)

Oonk et el. have validated several landfill gas models based on 17 realized landfill gas projects[3]. 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. φ = 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 the Table 3 below.

Table 3: 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).

[3] Oonk, Hans et al.:Validation of landfill gas formation models. TNO report. December 1994

Degradable carbon content in waste (DOCj) and decay rates (kj)

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 4 below. These values should be used by project participants in the case no specific data are available.
Table 4: Waste stream decay rates (kj) and associated IPCC default values for DOCj

Waste stream A to E	**Per cent DOCj (by weight)**	**Decay-rate (kj)**
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*	30	0.023
E. Inert material	0	0

**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 4. Project participants should consider future revisions to the decay-rate constants (kj) 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 4, 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 a 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:

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

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.

Fraction of degradable organic carbon dissimilated (DOCf)

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 DOCf. A lower value of 0.5 should be used if lignin-C is included in the estimated amount of degradable organic carbon.[4]

(c) CO_2 emissions from transportation of organic wastewater and bioorganic solid waste ($BE_{CO2,FF,y}$)

The baseline emissions from transportation are to be calculated using distance travelled by trucks and the fuel emission factor, as follows:

$$BE_{CO2,Trans,y} = \sum_i N_{vehicles,i,y} \cdot Dist_{i,y} \cdot FC_{i,Trans} \cdot NCV_i \cdot EF_{CO2,i} \qquad \textbf{(10)}$$

Where:

$N_{vehicles,i,y}$	Is the number of vehicle trips used for transportation, with similar loading capacity
$Dist_{i,y}$	Is the average distance per trip travelled by transportation vehicles type *i* in the baseline scenario during the year *y* (km)
FC_i	Is the vehicle fuel consumption in volume or mass units per km for vehicle type *i*
NCV_i	Is the net calorific value of fuel type *i* in TJ per volume or mass units
$EF_{CO2,i}$	Is the CO_2 emission factor of the fossil fuel type *i* used in transportation vehicles, (tCO_2e/TJ)

(d) CO_2 emissions from fossil fuels used for energy requirements ($BE_{CO2,FF,y}$)

CO_2 emissions from fossil fuel used in the baseline for energy requirements such as heating shall be calculated as follows:

[4] IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories – chapter 5

$$BE_{CO2,FF,y} = \sum_{i} FC_{i,y} \cdot NCV_i \cdot EF_{CO2,i}$$

$$BE_{CO2,FF,y} = FC_{i,y} \cdot NCV_i \cdot EF_{CO2,i} \cdot OXID_i \quad \textbf{(11)}$$

Where:

$FC_{i,y}$	Is the baseline fossil fuels consumed of type *i* for energy requirements during the year *y* in mass or volume units
NCV_i	Is the Net Calorific Value (energy content) in TJ of fuel type *i*, per mass unit or volume unit
EF_{CO2i}	Is the CO_2 emission factor per unit of energy of the fuel *i* (tCO_2e/TJ)
$OXID_i$	is the oxidation factor of the fuel (see page 1.29 in the 1996 Revised IPCC Guidelines for default values),

Where available, local values of NCV_i and $EF_{CO2,i}$ should be used. If no such values are available, country-specific values (see e.g. IPCC Good Practice Guidance) are preferable to latest version of IPCC Guidelines.

(e) CO_2 emissions from grid electricity consumption ($BE_{CO2,Elec,y}$)

In case electricity is consumed for energy requirements in the baseline, CO_2 emissions from electricity consumption shall be calculated as follows:

$$BE_{CO2,Elec,y} = EC_y \cdot EF_{GridElec,y} \quad \textbf{(12)}$$

Where:

EC_y	is the baseline electricity consumption during the year *y* (MWh)
$EF_{GridElec,y}$	is the grid electricity emission factor for the year *y* (tCO_2/MWh)

In cases where electricity is purchased from the grid, the emission factor $EF_{GridElec,y}$ should be calculated according to the "Tool for calculation of emission factor for electricity systems"[5]. If electricity consumption is less than small scale threshold of 15 GWh/yr, AMS. I.D.1 may be used.

Project emissions

The following types of project emissions will be accounted under this methodology:

a) N_2O emissions from composting process
b) CH_4 emissions from composting process
c) CH_4 emissions from leaked waste water
d) CO_2 emissions from transportation
e) CO_2 emissions from fossil fuels consumption
f) CO_2 emissions from grid electricity consumption

Total project emissions are expressed as:

$$PE_y = PE_{N2O,Comp,y} + PE_{CH4,Comp,y} + PE_{CH4,Bww,y} + PE_{CO2,Trans,y} + PE_{CO2,FF,y} + PE_{CO2,Elec,y} \quad \textbf{(13)}$$

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[5] Please refer to http://cdm.unfccc.int/goto/MPappmeth

Where:

PE_y	Is the total project emissions during the year *y*, (tCO_2e)
$PE_{N2O,Comp,y}$	is the N_2O emissions from composting of bio-organic solid waste during the year *y* (tCO_2e)
$PE_{CH4,Comp,y}$	Is the CH_4 emissions from composting of bio-organic solid waste during the year *y* (tCO_2e)
$PE_{CH4,Bww,y}$	Is the CH_4 emissions from leaked waste water discharged after the project activity during the year *y* (tCO_2e)
$PE_{CO2,Trans,y}$	Is the CO_2 emissions from transportation in the project situation during the year y (tCO_2e)
$PE_{CO2,FF,y}$	Is the CO_2 emissions from use of fossil fuels in the project situation during the year *y* (tCO_2)
$PE_{CO2,Elec,y}$	Is the CO_2 emissions from grid electricity consumption in project situation during the year *y* (tCO_2)

The above emissions shall be calculated as explained below:

(a) N_2O emissions from composting ($PE_{N2O,Comp,y}$):

N_2O emissions from composting during the year y are calculated as follows:

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~~ occur. Project Participants should use a default N_2O emission factor of 0.043 kg N_2O per tonne of compost and calculate emissions as follows[6]:

$$PE_{N2O,Comp,y} = Q_{Compost,y} \cdot EF_{N2O,Comp} \cdot GWP_{N2O} \qquad \textbf{(14)}$$

Where:

$Q_{Compost,y}$	is the total quantity of compost produced during the year *y*, (tons of compost)
$EF_{N2O,Comp}$	is the emission factor for N_2O emissions from composting process (tN_2O/ton of compost)
GWP_{N2O}	is the global warming potential of N_2O, default value 310

(b) CH_4 emissions from composting ($PE_{CH4,Comp,y}$):

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 behavior 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 predetermined sampling procedures the percentage of waste that degrades under anaerobic conditions can

[6] Manfred K. Schenk, Stefan Appel, Diemo Daum, "N2O emissions during composting of organic waste", Institute of Plant Nutrition University of Hannover, 1997. Based upon Schenk[6] and others, a total loss of 42 mg N2O-N per kg composted dry matter can be expected (from which 26.9 mg N2O during the composting process). The dry matter content of compost is around 50% up to 65%. Assuming 650 kg dry matter per ton of compost and 42 mg N2O-N, and given the molecular relation of 44/28 for N2O-N, an emission factor of 0.043 kg N2O / tonne compost results.

be determined. Using this percentage, project methane emissions from composting process are calculated, as follows:

$$PE_{CH4,Comp,y} = PE_{CH4,Anaerobic,y} \cdot GWP_{CH4} \cdot S_{a,y} \quad \textbf{(15)}$$

Where:

$PE_{CH4,Anaerobic,y}$	Is the quantity of methane that would be generated from anaerobic pockets in the composting process, during the year *y* (tCH_4)
GWP_{CH4}	Is the global warming potential of CH_4, default value 21
$S_{a,y}$	Is the share of waste that degrades under anaerobic conditions in the composting plant during the year *y* (%)

The amount of methane that is generated in anaerobic pockets ($PE_{CH4,Anaerobic,y}$) 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 (DOCj). The model calculates the methane generation based on the actual waste streams Aproject,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 is calculated as follows:

$$PE_{CH4,Anaerobic,y} = \varphi \cdot \frac{16}{12} \cdot F \cdot DOC_f \cdot MCF \cdot GWP_{CH4} \cdot \sum_{x=1}^{y} \sum_{j=A}^{D} A_{project,j,x} \cdot DOC_j \cdot \left(1 - e^{-k_j}\right) \cdot e^{-k_j(y-x)} \quad \textbf{(16)}$$

Variables used in the above equation are analogous to those of equation 8.

Project participants should use 0.8 as default MCF, unless they can demonstrate that the project-scenario is an aerobic composting of the solid biomass waste with a much lower MCF value.

Calculation of $S_{a,y}$*:*

$S_{a,y}$ is determined by a combination of measurements and calculations. Bokhorst et al[7] and Richard et al[8] 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 oxygen content below 10%[9] 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:

[7] 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
[8] Tom Richard, Peter B. Woodbury, Cornell composting, operating fact sheet 4 of 10, Boyce Thompson Institute for Plant Research at Cornell University Cornell University
[9] By adding 20% uncertainty to the maximum value of 7.5% from the research literature mentioned above, 10% is selected as a conservative value.

$S_{a,y} = SOD_y / S_{total,y}$

Where:

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

(c) CH_4 emissions from the leaked wastewater ($PE_{CH4,bww,y}$):

Projects such as composting will usually have no wastewater discharge but there is a possibility that a small quantity of leaked wastewater is collected from windrows or as a balance of waste water and this leak wastewater may cause CH_4 emissions.

CH_4 emissions from leak and/or balance of waste water shall be calculated as follows.

$$PE_{CH4,BWW,y} = COD_{outlet,total,y} \cdot B_o \cdot MCF_{outlet} \cdot GWP_{CH4} \quad \textbf{(17)}$$

Where:

$PE_{CH4,BWW,y}$	Is the project methane emissions from wastewater during the year *y* (tCO_2e)
$COD_{outlet,total,y}$	Is the outlet total COD of the wastewater during the year *y* (tCOD)
B_o	Is the outlet maximum methane producing capacity of wastewater (tCH_4/tCOD)
MCF_{outlet}	Is the methane conversion factor of the storage system (fraction)
GWP_{CH4}	Is the Global Warming Potential of methane

MCF_{outet} is to be estimated in the same manner as that of $MCF_{baseline,m}$ in the baseline.

(d) CO_2 emissions from transportation ($PE_{CO2,Trans,y}$):

The project emissions from transportation are to be calculated using the total distance and local, national or latest version of IPCC Guidelines default values ~~IPCC default values~~ for transportation fuel, as follows:

$$PE_{CO2,Trans,y} = \sum_i N_{vehicles,i,y} \cdot Dist_{i,y} \cdot FC_i \cdot NCV_i \cdot EF_{CO2,i} \quad \textbf{(18)}$$

Where:

$N_{vehicles,i,y}$	Is the number of vehicle trips used for transportation, with similar loading capacity
$Dist_{i,y}$	Is the average distance per trip travelled by transportation vehicles type *i* in the project scenario during the year *y* (km)
FC_i	Is the vehicle fuel consumption in volume or mass units per km for vehicle type *i*
NCV_i	Is the net calorific value of fuel type *i* in TJ per volume or mass units
$EF_{CO2,i}$	Is the CO_2 emission factor of the fossil fuel type *i* used in transportation vehicles, (tCO_2e/TJ)

(e) CO_2 emissions from fossil fuels used for energy requirements ($PE_{CO2,FF,y}$)

CO_2 emissions from fossil fuel used in the project for energy requirements such as heating shall be calculated as follows:

$$PE_{CO2,FF,y} = \sum_i FC_{i,project,y} \cdot NCV_i \cdot EF_{CO2,i}$$

$$PE_{CO2,FF,y} = FC_{i,project,y} \cdot NCV_i \cdot EF_{CO2,i} \cdot OXID_i \quad \textbf{(19)}$$

Where:

$FC_{i,project,y}$	Is the fossil fuels consumed of type *i* for energy requirements during the year *y* in mass or volume units
NCV_i	Is the Net Calorific Value (energy content) in TJ of fuel type *i*, per mass unit or volume unit
EF_{CO2i}	Is the CO_2 emission factor per unit of energy of the fuel *i*. (tCO_2e/TJ)
~~$OXID_i$~~	~~is the oxidation factor of the fuel (see page 1.29 in the 1996 Revised IPCC Guidelines for default values),~~

Where available, local values of NCV_i and $EF_{CO2,i}$ should be used. If no such values are available, country-specific values (see e.g. IPCC Good Practice Guidance) are preferable to latest version of IPCC Guidelines world-wide default values.

~~Where available, local values of NCV_i and $EF_{CO2,i}$ should be used. If no such values are available, country-specific values (see e.g. IPCC Good Practice Guidance) are preferable to IPCC world-wide default values.~~

(f) CO_2 emissions from electricity consumption ($PE_{CO2,Elec,y}$):

In case electricity is consumed for energy requirements in the baseline, CO_2 emissions from electricity consumption shall be calculated as follows:

$$PE_{CO2,Elec,y} = EC_{project,y} \cdot EF_{GridElec,y} \quad \textbf{(20)}$$

Where:

$EC_{project,y}$	Is the project electricity consumption during the year *y* (MWh)
$EF_{GridElec,y}$	Is the grid electricity emission factor for the year *y* (tCO_2/MWh)

In cases where electricity is purchased from the grid, the emission factor $EF_{GridElec,y}$ should be calculated according to "Tool for calculation of emission factor for electricity systems". ~~If electricity consumption is less than small scale threshold of 15 GWh/yr, AMS. I.D.1 may be used.~~

Leakage

No leakage effects need to be accounted under this methodology.

Emission reductions

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y \quad (21)$$

Where:

ER_y = Emission reductions during the year y (tCO_2/yr)
BE_y = Baseline emissions during the year y (tCO_2/yr)
PE_y = Project emissions during the year y (tCO_2/yr)
LE_y = Leakage emissions during the year y (tCO_2/yr)

Changes Required For Methodology Implementation In 2nd And 3rd Crediting Periods

Project participants shall check for updates of default values of IPCC used in this methodology. In case the default values are revised by IPCC, project participants shall use only revised values during methodology implementation in 2nd and 3rd crediting periods.

Data and parameters not monitored

Data / parameter:	**$Dist_y$**
Data unit:	Km
Description:	Total distance travelled in a year
Source of data:	Host facility
Measurement procedures (if any):	Based on estimation of actual distance used for transportation in the baseline.
QA/QC procedures:	
Any comment:	Estimate by an expert.

Data / parameter:	**$FC_{i,y}$**
Data unit:	tons or m^3 (mass or volume units)
Description:	Amount of fossil fuels consumed in the baseline
Source of data:	Host facility
Measurement procedures (if any):	Based on the onsite data sheets recorded prior to the project implementation
QA/QC procedures:	
Any comment:	

Data / parameter:	**EC_y**
Data unit:	MWh
Description:	Amount of electricity consumed in the baseline
Source of data:	Host facility
Measurement procedures (if any):	Based on the on-site record for power meter readings.
QA/QC procedures:	
Any comment:	

Data / parameter:	**$EF_{GridElec,y}$**
Data unit:	tCO_2e/MWh
Description:	Grid electricity emission factor
Source of data:	Host facility
Measurement procedures (if any):	Obtained from the latest local statistics or calculated *ex ante* using latest version of approved tool "Tool for calculation of emission factor for electricity systems".
QA/QC procedures:	
Any comment:	Applicable for both for baseline and project situation

Data / parameter:	**$COD_{a,out}$**
Data unit:	tCOD
Description:	COD of the effluent that leaves the lagoon in the baseline situation
Source of data:	Host facility
Measurement procedures (if any):	Obtained from the most recent year prior to the implementation of the project activity
QA/QC procedures:	
Any comment:	

Data / parameter:	**$COD_{a,in}$**
Data unit:	tCOD
Description:	COD that enters the lagoon in the baseline situation
Source of data:	Host facility
Measurement procedures (if any):	Obtained from the most recent year prior to the implementation of the project activity
QA/QC procedures:	
Any comment:	

III. MONITORING METHODOLOGY

Monitoring procedures

Baseline emissions

The following parameters have been included in the monitoring plan for baseline emissions.

1. $COD_{inlet,total,y}$: Total COD of the organic wastewater produced by the process during the year *y*
2. F: Fraction of methane in landfill gas

All other data items used in the methodology procedure are either not monitored or obtained from IPCC default values. IPCC default values are provided in respective procedures in this methodology.

Project emissions

The following parameters have been included in the monitoring plan for project emissions.

1. $COD_{outlet,total,y}$: COD of the effluent at the outlet of the project activity
2. $A_{project,j,x}$: Amount of organic waste type *j*, used in co-composting
3. $Dist_{project,y}$: Distance travelled by transportation vehicles
4. $FC_{i,project,y}$: Amount of fossil fuels consumed by the project for thermal energy requirements
5. $EC_{project,y}$: Amount of electricity consumed by the project for auxiliary equipment
6. SOD: Number of samples per year with Oxygen deficiency
7. S_{total}: Number of total samples
8. $Q_{compost,y}$: Amount of compost produced in a year

All other data items used in the methodology procedure are either not monitored or obtained from IPCC default values. IPCC default values are provided in respective procedures in this methodology.

All the above data items are measured in the host facility. All data will be available for 2 years after the crediting period. Other data and parameters in the methodology are obtained from IPCC. Default values are provided in the methodology procedure. More details on the above parameters are provided in the table below.

Leakage

Monitoring of leakage is not applicable under this methodology.

Data and parameters monitored

Baseline emissions:

Data / parameter:	**$COD_{baseline,m}$**
Data unit:	tons of COD
Description:	COD at the inlet of the project activity
Source of data:	Host facility
Measurement procedures (if any):	Calculated as the product of COD concentration in ton COD/m^3 in the wastewater input to the project activity and the flow rate of wastewater in m^3/year.
Monitoring frequency:	Monthly
QA/QC procedures:	COD concentration is to be measured monthly using sampling techniques and flow rate is to be measured continuously. Sampling to be carried out adhering to internationally recognized procedures. Flow meters undergo maintenance/calibration subject to appropriate industry standards.
Any comment:	

Data / parameter:	**F**
Data unit:	fraction
Description:	Fraction of methane in landfill gas
Source of data:	On-site measurements
Measurement procedures (if any):	
Monitoring frequency:	Annually
QA/QC procedures:	
Any comment:	This parameter to be used in the order of preference as below. 1. Annually measured value, 2. Measured at once before prior to the start of the project activity 3. default value of 0.5.

Project emissions:

Data / parameter:	**$COD_{outlet,total,y}$**
Data unit:	tons of COD
Description:	COD at the outlet of the project activity
Source of data:	Host facility
Measurement procedures (if any):	Calculated as the product of COD concentration in ton COD/m^3 in the wastewater outlet from the project activity and the flow rate of wastewater in m^3/year.
Monitoring frequency:	Monthly
QA/QC procedures:	COD is measured using sampling techniques. Sampling will be carried out adhering to internationally recognized procedures. Flow meters undergo maintenance/calibration subject to appropriate industry standards.
Any comment:	

Data / parameter:	**$A_{project,j,x}$**
Data unit:	tonnes
Description:	Amount of organic waste type *j* disposed in landfill in the year *x*
Source of data:	Host facility
Measurement procedures (if any):	On-site data sheets recorded monthly using weigh bridge
Monitoring frequency:	Monthly
QA/QC procedures:	Weighbridge will be subject to periodic calibration (in accordance with stipulation of the weighbridge supplier).
Any comment:	

Data / parameter:	**$Dist_{i,y}$**
Data unit:	km
Description:	Distance travelled per trip during the year *y*
Source of data:	Host facility
Measurement procedures (if any):	Based on the estimation of actual distance used for transportation in the project activity.
Monitoring frequency:	Yearly
QA/QC procedures:	
Any comment:	

Data / parameter:	**$FC_{i,project,y}$**
Data unit:	tons or m^3 (mass or volume units)
Description:	Fossil fuels of type *i* consumed by the project for energy requirements during the year *y*,
Source of data:	Host facility
Measurement procedures (if any):	On-site data sheets recorded according to the monitoring frequency
Monitoring frequency:	Monthly
QA/QC procedures:	Data will be acquired based on measurement of quantity of fuel used. Measurement equipment / meters will be calibrated according to the suppliers specifications
Any comment:	

Data / parameter:	**$FC_{i,trans,y}$**
Data unit:	tons or m^3 (mass or volume units)
Description:	Fossil fuels of type *i* consumed by the project for transportation during the year *y*,
Source of data:	Host facility
Measurement procedures (if any):	On-site data sheets recorded according to the monitoring frequency
Monitoring frequency:	Monthly
QA/QC procedures:	Data will be acquired based on measurement of quantity of fuel used. Measurement equipment / meters will be calibrated according to the suppliers specifications.
Any comment:	

Data / parameter:	**$N_{vehicles,i,y}$**
Data unit:	Number
Description:	Number of vehicle trips used for transportation, of fuel type i, during the year *y*,
Source of data:	Host facility
Measurement procedures (if any):	On-site monitoring records
Monitoring frequency:	Daily
QA/QC procedures:	
Any comment:	Applicable for both project situation and baseline situation.

Data / parameter:	**$EC_{Project,y}$**
Data unit:	MWh
Description:	Amount of electricity consumed
Source of data:	Host facility
Measurement procedures (if any):	On-site data sheets recorded according to the monitoring frequency
Monitoring frequency:	Continuously
QA/QC procedures:	Data will be acquired based on measurement of electricity consumed. Meters will be calibrated according to the suppliers specification.
Any comment:	

Data / parameter:	**$EF_{GridElec,y}$**
Data unit:	tCO_2e/MWh
Description:	Grid electricity emission factor during the project situation
Source of data:	Host facility
Measurement procedures (if any):	Calculated as per the most recent version of the approved tool "Tool for calculation of emission factor for electricity systems".
Monitoring frequency:	Yearly
QA/QC procedures:	Data obtained from latest local / regional statistics and calculated as per "Tool for calculation of emission factor for electricity systems"
Any comment:	
Data / parameter:	**SOD_y**
Data unit:	Number
Description:	Number of samples with Oxygen deficiency

Source of data:	Host facility
Measurement procedures (if any):	Samples with Oxygen content less than 10%. Measurement itself to be done by using a standardised mobile gas detection instrument.
Monitoring frequency:	Depends on the frequency of $S_{total,y}$ ~~Stotal.~~
QA/QC procedures:	O_2 measurement instrument will be subjected to periodic calibration (in accordance with stipulation of instrument supplier). A statistically significant sampling procedure will be setup that consists of multiple measurements throughout different stages of the composting process according to a predetermined pattern (depths and scatter).
Any comment:	

Data / parameter:	$S_{total,y}$
Data unit:	Number
Description:	Total number of samples
Source of data:	Host facility
Measurement procedures (if any):	Total number of samples taken ~~per year~~in year y. Measurement itself to be done by using a standardised mobile gas detection instrument.
Monitoring frequency:	$S_{total,y}$ should be chosen in a manner that ensures estimation of ~~S_a~~ $S_{a,y}$ with 20% uncertainty at 95% confidence level
QA/QC procedures:	O_2 measurement instrument will be subjected to periodic calibration (in accordance with stipulation of instrument supplier). A statistically significant sampling procedure will be setup that consists of multiple measurements throughout different stages of the composting process according to a predetermined pattern (depths and scatter).
Any comment:	

Data / parameter:	$Q_{compost,y}$
Data unit:	tons
Description:	Quantity of compost produced during the year *y*
Source of data:	Host facility
Measurement procedures (if any):	On-site data sheets recorded according to the monitoring frequency
Monitoring frequency:	Monthly
QA/QC procedures:	Weighed on calibrated scale; also cross check with sales of compost
Any comment:	

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