Approved baseline methodology AM0012

"Baseline methodology for biomethanation of municipal solid waste in India, using compliance with MSW rules"

Source

This methodology is based on the municipal solid waste treatment cum energy generation project, Lucknow, India whose baseline study, monitoring and verification plan and project design document were prepared by Infrastructure Development Finance Company Limited on behalf of Prototype Carbon Fund.

For more information regarding the proposal and its consideration by the Executive Board please refer to case NM0032: "Municipal Solid Waste Treatment cum Energy Generation Project, Lucknow, India" on http://cdm.unfccc.int/methodologies/approved.

Selected approach from paragraph 48 of the CDM modalities and procedures

"Existing actual or historical emissions as applicable."

Applicability

This methodology is applicable to municipal waste treatment by biomethanation under the following conditions:

- The project is located in India;
- Waste handling in the baseline scenario shows a continuation of current practice despite environmental regulation;
- The compliance rate of the 2000 MSW Management Rules during (part of) the crediting period is below 50%; if monitored compliance with the MSW rules exceeds 50%, the project activity shall receive no further credit, since the assumption that the policy is not enforced is no longer tenable;
- Too little data is available to use the first decay model or other more accurate models of methane emissions under baseline conditions;
- The additionality of the project activity must be assessed taking into account the revenue from electricity generation and organic fertilizer, regardless of whether credit is to be claimed for these components or not.

Note: This methodology deals exclusively with the component biomethanation of municipal waste resulting in reduction of methane emissions. In case the proposed project also reduces emissions through electricity generation and organic fertilizer production, approved methodologies should be applied to these components as well.

Project Activity

The project activity encompasses the implementation of a biomethanation plant in India that uses the biogas produced from the processing of municipal solid waste (MSW) to generate electricity. This methodology however exclusively deals with the emission reduction resulting from the capture and destruction of methane.

Project Emissions

The project emissions of biomethanation of MSW are zero as the project involves the capture and destruction of methane, unless there is physical leakage at the biodigester (which is monitored *ex post*).

Baseline

MSW that is generated in cities in India is usually disposed in unmanaged solid waste disposal sites. This practice leads to uncontrolled methane emission from the anaerobic decomposition of organic matter in MSW.

Recognizing the increasing problem of unmanaged waste sites the Ministry of Environment and Forests issued the Municipal Solid Wastes (Management and Handling) Rules (2000). The rules identify various technical options for treatment and disposal of MSW, including biomethanation, that have to be in place by December 2003. However, since environmental regulation in India is poorly enforced and allocation of substantial financial resources to implement the Rule is lacking, it is likely that unmanaged MSW disposal sites would continue to be the prevalent means of waste management.

The baseline scenario therefore is identified as a gradual improvement of waste management practices to the acceptable technical options expected over a period of time to comply with the MSW Management Rules. The possible baseline options, which the MSW Management Rule (2000) requires are: (1) incineration, (2) compost, (3) sanitary land-filling, (4) biomethanation or their combination.

The baseline emissions ($BE_{\_y}$) are calculated as follows:

$$BE_{\_y} = BE^{NoRule}_{y} * (1 - RATE^{Compliance}_{y}) \quad \textbf{(1)}$$

where:

BE^{NoRule}_{y} Is the CO_2-equivalent methane emissions for no regulation case.

$RATE^{Compliance}_{y}$ Is the state-level compliance rate of the MSW Management Rules in that year *y*. The compliance rate shall be lower than 50%; if it exceeds 50% the project activity shall receive no further credit.

The compliance ratio $RATE^{Compliance}_{y}$ shall be monitored *ex post* based on the information (annual report) to be provided by the municipal bodies to the State Pollution Control Board.

The no-rule case methane emissions BE^{NoRule}_{y} are determined as the lower value of the measured amount at the biomethanation plant and the calculated amount using the IPCC theoretical gas yielding method:

$$BE^{NoRule}_{y} = \min [BE^{Util}_{y}, BE^{IPCC}_{y}] \quad \textbf{(2)}$$

where:

BE^{Util}_{y} Is the measured amount at the biomethanation plant (directly monitored *ex post*).

BE^{IPCC}_{y} Is the calculated amount using the IPCC theoretical gas yielding method.

The measured amount of methane emission (in CO_2-eq) is calculated as follows:

$$BE^{Util}_{y} = Q^{LFG}_{y} * F_y * GWP\_CH_4 \quad \textbf{(3)}$$

where:

Q^{LFG}_{y}	The quantity of land-fill gas utilized in tonne (monitored).
F_y:	The fraction of methane in landfill gas in % (monitored).
GWP_CH_4	The Global Warming Potential of methane (21) specified in the IPCC Second Assessment Report.

Theoretical calculation method of the methane emissions (in CO_2-eq.) according to IPCC is:

$$BE^{IPCC}_{y} = MSW_{T,y} * DOC_y * DOC_F * MCF * F_y * (16/12) * (1-OX) * GWP\_CH_4 \quad \textbf{(4)}$$

where:

$MSW_{T,y}$	The total MSW disposed at the landfill in tonne (monitored).
DOC_y	The degradable carbon fraction in the MSW in % (monitored).
DOC_F	The fraction of DOC that actually degrades in % (default value used).
MCF	Methane correction factor for landfill (default value used).
F_y	Fraction of methane in the project's landfill gas in % (use the lower of F_y from equation 3 and the IPCC default value for LFG)
OX	Oxidization factor in % (default value used).
GWP_CH_4	The Global Warming Potential of methane (21) specified in the IPCC Second Assessment Report

The parameters $MSW_{T,y}$, DOC_y and F_y depend entirely on the waste characteristics of the proposed project and are monitored. For the purpose of emission reduction projections, the IPCC default values in the below table can be used. The parameters DOC_F, MCF, OX depend both on the waste characteristics as well as on the landfill environment and cannot be monitored within the project. For these parameters IPCC default values are used for the baseline calculation.

Table 1 IPCC default values for baseline parameters

Parameters	IPCC Default Values	Project Specific Value
DOC_y	0.18 (for India)	To be monitored
DOC_F	0.77 (for whole world)	Not Available. Default value is used.
MCF	0.6 (for uncategorized solid waste disposal site)	Not Available. Default value is used.
F_y	0.5 (for whole world)	To be monitored.
OX	0 (for developing countries)	Not Available. Default value is used.

The default values used here should be up-dated as soon as new IPCC Guidelines become available.

Leakage

The project boundary includes the whole biomethanation project. As the baseline emissions are based on the waste management practice in the state, potential leakage in the sense of displacing emissions to other sites[1] is captured in the baseline scenario emissions.

Emission Reductions

As the methodology finds no emissions in the project scenario (assuming no physical leakage occurs from the biodigester), the emission reductions ER_y are identical to the baseline emissions. In case leakage does occur, the project emissions need to be subtracted from the baseline emissions.

Additionality

Additionality is shown by the application of a barrier analysis for the various baseline options. The waste handling options, which the MSW Management Rules (2000) requires are: (1) incineration, (2) compost, (3) sanitary landfilling, (4) biomethanation or their combination. However, incineration for waste is not considered feasible in India and the barrier analysis is thus carried out for (1) compost, (2) sanitary landfilling, (3) biomethanation.

Several barriers such as (i) investment barrier, (ii) technological barrier, and (iii) absence of common practice are assessed to exclude the biomethanation project as a baseline option.

(i) Investment barrier: A number of other, financially more viable alternatives, to biomethanation exist for treating municipal solid waste. The project proponent shall demonstrate this through the identification of the lowest tipping fee option. The tipping fee is the fee that has to be paid per ton of waste to be treated and disposed. The option requiring the least tipping fee reflects the fact that municipalities usually choose the cheapest disposal option within the restrictions set by the MSW Rules. The minimum tipping fee is calculated by using the same project IRR (internal rate of return) for all the options. All costs and income should be taken into account, including the income from electricity generation and fertilizer sale of the biomethanation. All technical and financial parameters have to be consistent across the 3 baseline options.

(ii) Technological barrier: Biomethanation is the most technologically advanced option of the three baseline options. Landfilling with inertization followed by composting and landfilling are less technologically advanced alternative to biomethanation and involves lower risks due to the performance uncertainty and low market share. The project proponent should provide evidence of the state of development of biomethanation in India and document evidence of barriers to the implementation of more advanced technology.

(iii) Common practice: The project proponent should provide evidence of the early stage of development of biomethanation and is not common practice in India. To this end, they should provide an analysis of waste management practices.

[1] The formal definition is: "Leakage is defined as the net change of anthropogenic emissions by sources of greenhouse gases (GHG) which occurs outside the project boundary, and which is measurable and attributable to the CDM project activity". Physical leakage refers to the escape of gas e.g. through faulty pipelines or connections, and is considered under project emissions and monitored *ex post*.

Approved monitoring methodology AM0012

"Monitoring methodology for biomethanation of municipal solid waste in India, using compliance with MSW rules"

Source

This methodology is based on the municipal solid waste treatment cum energy generation project, Lucknow, India whose baseline study, monitoring and verification plan and project design document were prepared by Infrastructure Development Finance Company Limited on behalf of Prototype Carbon Fund.

For more information regarding the proposal and its consideration by the Executive Board please refer to case NM0032: "Municipal Solid Waste Treatment cum Energy Generation Project, Lucknow, India" on http://cdm.unfccc.int/methodologies/approved.

Applicability

This methodology is applicable to municipal waste treatment by biomethanation with the following conditions:

- The project is located in India;
- Waste handling in the baseline scenario shows a continuation of current practice despite environmental regulation;
- The compliance rate of the 2000 MSW Management Rules during (part of) the crediting period is below 50%; if monitored compliance with the MSW rules exceeds 50%, the project activity shall receive no further credit, since the assumption that the policy is not enforced is no longer tenable;
- Too little data is available to use the first decay model or other more accurate models of methane emissions under baseline conditions.

Note: This methodology deals exclusively with the component biomethanation of municipal waste resulting in reduction of methane emissions. In case the proposed project also reduces emissions through electricity generation and organic fertilizer production, approved methodologies should be applied on these components as well.

Monitoring Methodology

The monitoring methodology involves monitoring of the following:

- Compliance rate with the MSW Management Rules 2000 in the state of India ($RATE^{Compliance}_{y}$);
- Amount of waste input to the plant ($MSW_{T,y}$);
- Two parameters specific for the waste characteristics (DOC_y, F_y);
- Utilized amount of land-fill gas by the project (Q^{LFG}_{y});
- The amount of physical biogas leakage from the biodigester ($BD^{leakage}_{y}$). Leakage from pipelines can be captured by flow meters, while for leakage from the digestor itself a methane sensor measuring the concentration above the digestor should be used.

The monitoring of Q^{LFG}_{y} could be also carried out be the monitoring methodology on the electricity generated by the project. In that case Q^{LFG}_{y}, the project participants may monitor the parameter once and use it in both methodologies.

Baseline Emission Parameters

ID number	Data type	Data variable	Data unit	Measured (m) calculated (c) estimated (e)	Recording frequency	Proportion of data monitored	How will data be archived? (electronic/ paper)	For how long is archived data kept?	Comment
1. $RATE^{Compliance}_{y}$	%	Compliance rate with the MSW Management Rules 2000 in the state	%	e	annually	100%	paper	12 years	The compliance rate is based on the annual reporting of the State Pollution Control Board. This organization monitors and reports the compliance level based on the annual compliance reports by municipalities and corporation. The state-level aggregation involves all landfill sites except for the site of the project. If the rate exceeds 50%, no CERs can be claimed.
2. $MSW_{T,y}$	mass	Amount of municipal solid waste input to the plant	ton per day	m	daily	100%	electronic and paper	12 years	Each load of MSW to be weighed at the plant entry.

ID number	Data type	Data variable	Data unit	Measured (m) calculated (c) estimated (e)	Recording frequency	Proportion of data monitored	How will data be archived? (electronic/ paper)	For how long is archived data kept?	Comment
3. DOC_y	%	Organic content of MSW	%	m	daily	2 samples per day	electronic and paper	12 years	Degradable Organic Content of the incoming waste to the plant will be determined through lab analysis of the digester feed sample. The sample analysis indicates the quantity of organic carbon (TPD) (without lignin) present in the digester feed produced in a day which will be related to the incoming MSW quantity to determine the DOC of MSW in percentage terms. This is the DOC carbon content of the lignin.
4. F_y	%	Methane fraction in biogas	%	m	daily	2 samples per day	electronic and paper	12 years	The automatic gas analyzer is used to measure the volume percentage of methane in the biogas generated by the digester.

ID number	Data type	Data variable	Data unit	Measured (m) calculated (c) estimated (e)	Recording frequency	Proportion of data monitored	How will data be archived? (electronic/ paper)	For how long is archived data kept?	Comment
5. Q^{LFG}_{y}	mass	Utilized amount of biogas, at specified temperature and pressure	ton	m	daily	100%	electronic and paper	12 years	Flow meter is used to measure the amount of biogas (landfill gas) at the entry of the generator. Biogas temperature and pressure shall also be monitored, unless the project participants can justify that this information is not needed in order to adequately determine Q^{LFG}_{y}.
6. $BD^{leakage}_{y}$	mass	Biogas emissions through physical leakage	tCO_2eq	m	annually	100%	electronic and paper	12 years	Leakage from pipelines can be captured by flow meters, while for leakage from the digestor itself a methane sensor measuring the concentration above the digestor should be used.

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

Data	Uncertainty level of data (High/Medium/Low)	Are QA/QC procedures planned for these data?	Outline explanation why and how QA/QC procedures are planned
1	Low	Yes	The increase in compliance rate of the data at the state level is cross-checked against the national aggregate increase rate. The higher compliance rate of both values will be used in order to be conservative.
2, 3, 4, 5, 6	Low	Yes	QA & QC procedures are set and implemented in order to: 1. Secure a good consistency through planning to implementation of this CDM project; 2. Stipulate who has responsibility for what, and 3. Avoid any misunderstanding between people and organization involved.