JCM Proposed Methodology Form

Cover sheet of the Proposed Methodology Form

Form for submitting the proposed methodology

Host Country	Socialist Republic of Viet Nam
Name of the methodology proponents submitting this form	Kubota Corporation, Nikken Sekkei Civil Engineering Ltd., The Japan Research Institute Ltd.
Sectoral scope(s) to which the Proposed Methodology applies	13. Waste Handling and Disposal
Title of the proposed methodology, and version number	Title: Methane recovery from organic waste through controlled anaerobic digestion and its use for energy Version number: V1.0
List of documents to be attached to this form (please check):	☐The attached draft JCM-PDD: ☐Additional information
Date of completion	2 March, 2015

History of the proposed methodology

Version	Date	Contents revised
1.0	9 October 2014	
2.0	13 January 2013	Terms and definitions and Eligibility criteria revised.

A. Title of the methodology

Methane recovery from organic waste through controlled anaerobic digestion and its use for energy

B. Terms and definitions

Terms	Definitions
Anaerobic digester	Equipment that is used to generate heat from liquid or solid waste through anaerobic digestion. The digester is covered or encapsulated to enable biogas capture for its use of energy.
Anaerobic digestion	Degradation and stabilization of organic materials by the action of anaerobic bacteria that result in production of methane and carbon dioxide. Typical organic materials that undergo anaerobic digestion are municipal solid waste (MSW), animal manure, waste water, organic industrial effluent and sludge produced by effluent treatment facility under aerobic condition.
Wet mesophilic fermentation	Treatment system which realizes fermentation with concentration of solids (6 to 10%) and mesophilic condition (30 to 38 degree Celsius).
Wet thermophilic fermentation	Treatment system which realizes fermentation with concentration of solids (6 to 10%) and thermophilic condition (50 to 55 degree Celsius).
Biogas	Gas generated from an anaerobic digester. Typically, the composition of the gas is CH_4 (50 to 70%), CO_2 (30 to 50%) and H_2S and NH_3 (below 1%).
Municipal solid waste (MSW)	A heterogeneous mix of different solid waste types, usually collected by municipalities or other local authorities. MSW includes household waste, garden/park waste and commercial/institutional waste.
Organic waste	Solid waste that contains degradable organic matter. This may include, for example, domestic waste, commercial waste, industrial waste (such as sludge from wastewater treatment plants), hospital waste, MSW and septage.
Garbage	Organic waste categorized as “Food Waste” and “Garden and Park Waste” in “2006 IPCC Guidelines for National Greenhouse Gas Inventories”.

Solid Waste	Discarded and insoluble material (including gases or liquids in cans or containers).
Solid waste disposal site (SWDS)	Designated areas intended as the final storage place for solid waste.

C. Summary of the methodology

Items	Summary
GHG emission reduction measures	This methodology comprises measures to avoid the emissions of methane to the atmosphere from garbage and septage that would have otherwise been left to decay anaerobically and introduces renewable energy technologies that supply users with electricity and heat that displaces fossil fuel use.
Calculation of reference emissions	The reference scenario is the situation where, in the absence of the project activity, garbage is left to decay in a SWDS and septage from households is not properly treated. In the result of that, methane is emitted to the atmosphere. The reference emission is calculated by adding the followings. 1. Emissions on the basis of the amount of methane emitted from the decay of degradable organic carbon in the garbage and septage. 2. Emissions on the basis of the fuel consumption of the technologies that would have been used in the absence of the project activity, times and emission factor for the fossil fuel displaced.
Calculation of project emissions	Project emissions are calculated on the basis of monitored electricity.
Monitoring parameters	1. Amount of garbage input to anaerobic digester 2. Amount of septage input to anaerobic digester 3. Amount of heat generated by the project activity 4. Amount of electricity generated by the project activity 5. Amount of electricity consumption of project activities 6. Percentage of water content in septage 7. Amount of solid waste to be brought in the project boundary (in case if amount of garbage input to anaerobic digester is not be measured) 8. Amount and concentration of biogas (in case if heat generated by project activity is not measured)

D. Eligibility criteria

This methodology is applicable to projects that satisfy all of the following criteria.

Criteria 1	Anaerobic digesters and system that is fuelled by the biogas are to be installed.
Criteria 2	The materials to be fed into the anaerobic digesters are garbage that would be disposed at a landfill site and septage that would not be properly treated in the absence of the project activity.
Criteria 3	The project secures the materials of the project activity and has a proper maintenance system that outlines a maintenance plan and equipment for monitoring activities.
Criteria 4	Anaerobic digester for wet mesophilic fermentation (30 to 38 degree Celsius) or wet thermophilic fermentation (50 to 55 degree Celsius) is to be installed.
Criteria 5	Biogas recovery rate is not less than 40 Nm^3 per a tonne of garbage.
Criteria 6	Track record of installing anaerobic digester, which is used in the project activity is satisfied with the both criteria below. 1. More than two (2) projects to treat garbage or mix of garbage and septage (amount of those are more than 10 tonne per day) 2. More than two (2) projects of which fermentation method is equivalent to the one of the project.

E. Emissions Sources and GHG types

Reference emissions	
Emissions sources	GHG types
Methane emissions from a landfill site	CH_4
Fossil fuel consumption	CO_2
Grid electricity consumption	CO_2
Project emissions	
Emission sources	GHG types
Grid electricity consumption	CO_2

F. Establishment and calculation of reference emissions

F.1. Establishment of reference emissions

Reference emissions are calculated from the amount of waste that is fed into anaerobic digesters, and the amount of heat and electricity to be generated by project activity.

In the methodology, the rates of emission reductions through methane recovery from organic waste and its use for energy are fixed at a lower than those commonly observed. Therefore, the methodology results in a net reduction of emissions, since reference emissions are lower than the BaU emissions.

F.2. Calculation of reference emissions

$RE_y = RE_{CH4,SWDS,y} + (EG_{thermal,y} / \eta_{thermal}) * EF_{FF,CO2} + RE_{EC,y} * EF_{e,y}$

Re_y	Reference CO_2 emissions during the period of year *y* (tCO_2/y)
$RE_{CH4,SWDS,y}$	Reference emission occurring in year *y* generated from waste disposal at a SWDS during a time period ending in year *y* (tCO_2/y)
$EG_{thermal,y}$	The net quantity of steam/heat supplied by the project activity during the year *y* (TJ)
$\eta_{thermal}$	The efficiency of the plant using fossil fuel that would have been used in the absence of the project activity
$EF_{FF,CO2}$	CO_2 emissions factor of the fossil fuel that would have been used in the reference plant (tCO_2/TJ)
$RE_{EC,y}$	The quantity of net electricity generation that is produced by the project activity in year *y* (MWh/y)
$EF_{e,y}$	
$EF_{e,y}$	CO_2 emissions factor of electricity in year *y* (tCO_2/MWh)
y	Years of the crediting period for which methane emissions are calculated (*y* is a consecutive period of 12 months)

$$RE_{CH4,SWDS,y} = \varphi_y \times (1-f_y) \times GWP_{CH4} \times (1-OX) \times 16/12 \times F \times DOC_{f,y} \times MCF_y \times \sum_{x=1}^{y} \sum_{j} W_{j,x} \times DOC_j \times e^{-kj(y-x)} \times (1-e^{-kj})$$

φ_y	Model correction factor account for model uncertainties for year y
f_y	Fraction of methane captured at the SWDS and flared, combusted or used in another manner that prevents the emissions of methane to the atmosphere in year *y*
GWP_{CH4}	Global Warming Potential of methane
OX	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)

16/12	Ratio of molar mass of carbon against methane
F	Fraction of methane in the SWDS gas (volume fraction)
$DOC_{f,y}$	Fraction of degradable organic carbon (DOC) that decomposes under specific conditions occurring in the SWDS for year *y*(weight fraction)
MCF_y	Methane correction factor for year *y*
$W_{j,x}$	Amount of organic waste type *j* disposed or prevented from disposal in the SWDS in the year *x* (t)
DOC_j	Fraction of degradable organic carbon (by weight) in the organic waste type *j*(weight fraction)
K_j	Decay rate for the organic waste type *j*(1/year)
j	Type of residual organic waste or types of organic waste in the MSW
x	Years in the time period in which organic waste is landfilled, extending from the first year in the time period (x=1) to year y(x=y)

G. Calculation of project emissions

$PE_y = PEC_y * EF_{e,y}$

PE_y	Project emissions in the year *y*(tCO_2)
PEC_y	Project electricity consumption by applicable equipment (MWh/y)
$EF_{e,y}$	CO_2 emissions factor of electricity in year *y* (tCO_2/ MWh)

H. Calculation of emissions reductions

$ER_y = RE_y - PE_y$

ER_y	GHG emission reductions in year *y* (tCO_2)
RE_y	Reference emissions in year *y* (tCO_2)
PE_y	Project emissions in year *y* (tCO_2)

I. Data and parameters fixed *ex ante*

The source of each data and parameter fixed *ex ante* is listed as below.

Parameter	Description of data	Source
$EF_{e,y}$	CO_2 emissions factor of electricity (tCO_2/ MWh)	Ministry of Natural Resources and Environment, Viet Nam
EF_{FFco2}	CO_2emission factor of the fossil fuel that would have been used in the reference plant (tCO_2/ TJ)	IPCC2006 guidelines
$\eta_{thermal}$	The efficiency of the plant using fossil fuel that would have been used in the absence of the project activity	Default value
φ_y	Model correction factor account for model uncertainties	Methodological Tool ”Emissions from solid waste disposal sites”(version06.0.1)
GWP_{CH4}	Global Warming Potential of methane	IPCC2006 guidelines
f	Fraction of methane captured at the SWDS and flared, combusted or used in another manner that prevents the emissions of methane to the atmosphere	Measures Value no less than regulatory value set by the government of Viet Nam
OX	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)	IPCC2006 guidelines
F	Fraction of methane in the SWDS gas (volume fraction)	IPCC2006 guidelines
DOC_f	Fraction of degradable organic carbon (DOC) that decomposes under specific conditions occurring in the SWDS (weight fraction)	IPCC2006 guidelines
MCF	Methane correction factor	IPCC2006 guidelines
DOC_j	Fraction of degradable organic carbon (by weight) in the organic waste type *j*(weight fraction)	Default value
K_j	Decay rate for the organic waste type *j*(1/year)	Default value
j	Composition of organic waste type *j*(weight fraction)	Default value