JCM Proposed Methodology Form

Cover sheet of the Proposed Methodology Form

Form for submitting the proposed methodology

Host Country	Republic of the Union of Myanmar
Name of the methodology proponents submitting this form	Nikken Sekkei Civil Engineering Ltd., The Japan Research Institute Ltd., Kubota Corporation
Sectoral scope(s) to which the Proposed Methodology applies	13. Waste Handling and Disposal
Title of the proposed methodology, and version number	Methane recovery from organic effluent through controlled anaerobic digestion and its use for energy in Myanmar 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	

A. Title of the methodology

Methane recovery from organic effluent through controlled anaerobic digestion and its use for energy in Myanmar

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, wastewater and organic industrial effluent, and biosolids produced by effluent treatment facility under aerobic condition.
Biogas	Gas generated from an anaerobic digester. Typically, the composition of the gas is 50 to 70% CH_4 and 30 to 50% CO_2, with traces of H_2S and NH_3 (1 to 5%).
Wet thermophilic fermentation	A method of methane fermentation with below 10% concentration of solids and thermophilic (50 to 55 degree Celsius) condition.
Anaerobic membrane	Membrane used for anaerobic digestion, which encourages stability of fermentation by keeping anaerobic bacteria in high concentration.

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 organic waste that would have otherwise been left to decay anaerobically in a plant 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, organic effluent is left to decay in a plant and 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 organic effluent. 2. Emissions on the basis of the electricity and/or fossil fuel consumption that would have been used in the absence of the project activity, times emission factor for the electricity and /or fossil fuel displaced.
Calculation of project emissions	Project emissions are calculated by adding the followings. 1. Project CH_4 emissions from effluent treatment system without biogas plant, affected by the project activity. 2. Project CH_4 emissions from effluent discharged into sea, river or lake. 3. CO_2 emissions from electricity and/or fossil fuel used by the project activity.
Monitoring parameters	1. Volume of wastewater treated in an anaerobic digester. 2. Amount of COD in the wastewater flows in to the anaerobic digester. 3. Amount of FFB prior to the project operating. 4. Amount of biogas generated by an anaerobic digester and electricity generated from this gas.

D. Eligibility criteria

This methodology is applicable to projects that meet 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 organic waste including septage that would have been disposed at a landfill site in the absence of the project activity.
Criteria 3	Anaerobic digester for wet thermophilic fermentation (50 to 55 degree Celsius) is to be installed.
Criteria 4	Anaerobic digester which has anaerobic membrane is to be installed.
Criteria 5	The project secures organic waste as the materials of the project activity and has a proper maintenance system that outlines a maintenance plan and equipment for monitoring activities.

E. Emissions Sources and GHG types

Reference emissions	
Emissions sources	GHG types
Methane emissions from effluent in the absence of the project activity	CH_4
Fossil fuel consumption in the absence of the project activity	CO_2
Grid electricity consumption in the absence of the project activity	CO_2
Project emissions	
Emission sources	GHG types
Methane emissions from effluent in treatment system without anaerobic digester	CH_4
Fossil fuel consumption by product activity	CO_2
Grid electricity consumption by product activity	CO_2

F. Establishment and calculation of reference emissions

F.1. Establishment of reference emissions

Reference emissions are calculated from the amount of CH_4 emissions from wastewater that is left to decay anaerobically, and CO_2 emissions from consumption of the electricity and/ or fossil fuel.

F.2. Calculation of reference emissions

$RE_y = RE_{treatment,y} + RE_{discharge,y} + RE_{power}$

RE_y	Reference emissions in year y (tCO_2e)
$RE_{treatment,y}$	CH_4 emissions from reference wastewater in year y (tCO_2e) (R1)
$RE_{discharge,y}$	CH_4 emissions from effluent discharged into sea, river or lake in year y (tCO_2e) (R2)
$RE_{power,y}$	CO_2 emissions from consumption of electricity and/or fossil fuel in year y (tCO_2e) (R3)

$RE_{treatment,y} = \Sigma_i\{ Q_y * (COD_{inflow,i,RS} — COD_{outflow,i,RS}) /1,000,000 * MCF_{treatment,RS,i}\} * B_{o,ww} * UF_{RS} * GWP_{CH4}$

Q_y	Volume of wastewater treated in year y (m^3)
$COD_{inflow,i,RS}$	Concentration of COD in the wastewater flows in to the system i in the reference scenario (mg/L)
$COD_{outflow,i,RS}$	Concentration of COD in the wastewater flows out from the system i in the reference scenario (mg/L)
$MCF_{treatment,RS,i}$	CH_4 correction factor for reference wastewater treatment systems i

Methane correction factor

Type of treatment system	MCF
Discharged into the sea, river and lake	0.1
Treated in a well-managed aerobic situation	0.0
Treated in a unwell-managed aerobic situation	0.3
Anaerobic reactor, which does not collect methane	0.8
Anaerobic shallow lagoon (Depth less than 2 metres)	0.2
Anaerobic deep lagoon (Depth more than 2 metres)	0.8
Latrine tank	0.5

$B_{o,ww}$	CH_4 producing capacity of the wastewater (t-CH_4/t–COD)
UF_{RS}	Model correction factor to account for model uncertainties
GWP_{CH4}	Global Warming Potential for CH_4
$Q_y = Q_{y,measure}$	*Case of Option 1 or Option 2*
$Q_{y,measure}$	Amount of POME measured, or estimated based on the pump capacity and operation time etc. in year y (m^3)
$Q_y = \alpha_{RS} * P_y * f_Q$	*Case of Option 3 or Option 4*
$\alpha_{RS} = Q_{RS} / P_{RS}$	

f_Q	Model correction factor
α_{RS}	Amount of POME per FFB in the reference scenario (m^3)
Q_{RS}	Amount of POME in the reference scenario (m^3)
P_{RS}	Amount of FFB used in the reference scenario (mt)
P_y	Amount of FFB used in year y (mt)

$RE_{discharge,y} = Q_y * GWP_{CH4} * B_{o,ww} * UF_{RS} * COD_{discharge,RS} / 1,000,000 * MCF_{discharge,RS}$

Q_y	Volume of wastewater treated in year y (m^3)
GWP_{CH4}	Global Warming Potential for CH_4
$B_{o,ww}$	CH_4 producing capacity of the wastewater ($t\text{-}CH_4/t\text{–}COD$)
UF_{RS}	Model correction factor to account for model
$COD_{discharge,RS}$	Concentration of COD discharged into sea, river or lake in the reference scenario
$MCF_{discharge,RS}$	CH_4 correction factor for discharged effluent in the reference scenario

$RE_{power,y} = RE_{electricity,y} + RE_{thermal,y}$

$RE_{electricity,y}$	CO_2 emissions from consumption of electricity in the reference scenario (tCO_2e)
$RE_{thermal,y}$	CO_2 emissions from consumption of fossil fuel (tCO_2e)

$RE_{electricity,y} = EG_{net,electricity,PJ,y} * EF_{electricity}$

$EG_{net,electricity,PJ,y}$	Electricity consumed by the activity in year y
$EF_{electricity}$	CO_2 emissions factor of electricity (tCO_2e/MWh)

$RE_{thermal,y} = EG_{net,thermal,PJ,y} * EF_{FF,RS}$

$EG_{net,thermal,PJ,y}$	Calorific value of fossil fuel in year y (TJ)
$EF_{FF,RS}$	CO_2 emissions factor of fossil fuel (tCO_2/TJ)

G. Calculation of project emissions

$PE_y = PE_{treatment,y} + PE_{discharge,y} + PE_{power,y}$

PE_y	Project emissions during in year y (tCO_2e)
$PE_{treatment,y}$	Project CH_4 emissions from effluent treatment system without biogas plant, affected by the project activity (tCO_2e) (P-1)
$PE_{discharge,y}$	Project CH_4 emissions from effluent discharged into sea, river or lake (tCO_2e) (P-2)
$PE_{power,y}$	CO_2 emissions from electricity and/or fossil fuel used by the project activity (tCO_2e) (P-3)

$PE_{treatment,y} = \Sigma_i\{ Q_y * \Delta COD_{i,y}/1,000,000 * MCF_{treatment,PJ,i}\} * B_{o,ww} * UF_{PJ} * GWP_{CH4}$

Q_y	Volume of wastewater treated in year y (m^3)
$\Delta COD_{i,y}$	The amount of COD removed in the wastewater in the system i in year y (mg/L)
$MCF_{treatment,PJ,i}$	CH_4 correction factor for project wastewater treatment
$B_{o,ww}$	CH_4 producing capacity of the wastewater (t-CH_4/t-COD)
UF_{PJ}	Model correction factor
GWP_{CH4}	Global Warming Potential of methane

Option1 or Option3

$$\Delta COD_{i,y} = COD_{inflow,i,measure} - COD_{outflow,i,measure}$$

Option2 or Option4

$$\Delta COD_{i,y} = COD_{inflow,i,PJ,dsign} * RR_{i,RS} * f_{COD}$$

$$RR_{i,RS} = (COD_{inflow,i,RS} - COD_{outflow,i,RS}) / COD_{inflow,i,RS}$$

$COD_{inflow,i,measure}$	Concentration of COD in POME flows in to the treatment system in year y (mg/L)
$COD_{outflow,i,measure}$	Concentration of COD in POME flows out from the treatment system in year y (mg/L)
$COD_{inflow,i,PJ,dsign}$	Designed value of concentration of COD in POME flows in to the treatment system in year y (mg/L)
$RR_{i,RS}$	COD removal ratio of treatment system i in the reference scenario
$COD_{inflow,i,RS}$	Concentration of COD in the wastewater flows in to the system i in the reference scenario (mg/L)
$COD_{outflow,i,RS}$	Concentration of COD in the wastewater flows out from the system i in the reference scenario (mg/L)
f_{COD}	Model correction factor

$$PE_{discharge,y} = Q_{ww,y} * GWP_{CH4} * B_{o,ww} * UF_{PJ} * COD_{discharge,PJ,y} / 1{,}000{,}000 * MCF_{discharge,PJ}$$

$Q_{ww,y}$	Amount of effluent treated in the system in year y (m^3)
GWP_{CH4}	Global Warming Potential of methane
$B_{o,ww}$	CH_4 producing capacity of the wastewater
UF_{PJ}	Model correction factor
$COD_{discharge,PJ,y}$	Concentration of COD in the treated wastewater discharged into sea, river or lake in year y (mg/L)
$MCF_{discharge,PJ}$	CH_4 correction factor based on discharge pathway

Option1 or Option3

$$COD_{discharge,PJ,y} = COD_{discharge,measure}$$

Option2 or Option4	
$COD_{discharge,PJ,y} = COD_{discharge,PJ,dsign} * f_{COD}$	
$COD_{discharge,measure}$	Concentration of COD, which is measured, in the treated wastewater discharged into sea, river or lake in year y (mg/L)
$COD_{discharge,PJ,dsign}$	Concentration of COD, which is designed, in the treated wastewater discharged into sea, river or lake in year y (mg/L)
f_{COD}	Model correction factor
$PE_{power,y} = EG_{FF,PJ,y} * EF_{FF,PJ,y}$	
$PE_{power,y}$	CO_2 emissions from electricity and fuel used by the project facilities
$EG_{FF,PJ,y}$	Project energy consumption (Electricity)
$EF_{FF,PJ,y}$	CO_2 emissions factor of Electricity

H. Calculation of emissions reductions

$ER_y = RE_y - PE_y$	
ER_y	GHG emission reductions in year *y* (tCO_2e)
RE_y	Reference emissions in year *y* (tCO_2 e)
PE_y	Project emissions in year *y* (tCO_2 e)

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
$COD_{inflow,i,RS}$	Concentration of COD in POME flows in to the treatment system in the reference scenario (mg/L)	monitored data
$COD_{outflow,i,RS}$	Concentration of COD in POME flows out from the treatment system in the reference scenario (mg/L)	monitored data
$MCF_{treatment,RS,i}$	CH_4 correction factor for reference wastewater	IPCC2006 Guideline
$B_{o,ww}$	CH_4 producing capacity of the wastewater (t-CH_4/t–COD)	IPCC2006 Guideline
UF_{RS}	Model correction factor to account for model	SBSTA 2003
GWP_{CH4}	Global Warming Potential for CH_4	IPCC Fourth Assessment Report: Climate Change 2007

f_Q	Model correction factor to account for model	Set based on "IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories"
Q_{RS}	Amount of POME in the reference scenario	monitored data
P_{RS}	Amount of FFB used in the reference scenario	monitored data
$COD_{discharge,RS}$	Concentration of COD in POME discharged into sea, river or lake in the reference scenario (mg/L)	monitored data
$MCF_{discharge,RS}$	CH_4 correction factor for reference wastewater	IPCC2006 Guideline
$EF_{electricity}$	CO_2 emissions factor of electricity (tCO_2/MWh)	Each of regulatory value set by the government of Myanmar, result of the calculation in the project conducted in the past, or result of original calculation
$EF_{FF,RS}$	CO_2 emissions factor of diesel (tCO_2/TJ)	Regulatory value set by the government of Myanmar
$MCF_{treatment,RS,i}$	CH_4 correction factor for reference wastewater	IPCC2006 Guideline
UF_{PJ}	Model correction factor to account for model	SBSTA 2003
f_{COD}	Model correction factor to account for model	Set based on "IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories"