F-CDM-DEV-METH ver 01

CDM: Form for submission of requests for deviation from methodology
(Version 01)
(To be used by the DOE, for requesting a deviation)

Name of the entity (DOE) submitting this form	*DNV Climate Change Services AS (DNV)*
Title of the project activity	Methane Recovery from Advanced Wastewater Treatment System in an Ethanol Plant
Title of methodology	ACM0014 - Mitigation of greenhouse gas emissions from treatment of industrial wastewater
Title/Subject (give a short title or specify the subject of your submission, maximum 200 characters)	Cogeneration and allocation of emission reductions from biogas
Attach draft CDM-PDD of project activity	☒ Yes, is attached
Date and signature for the DOE	

Description of the request for deviation

Please use the space below to describe the deviation and substantiate the reason for requesting a deviation from approved methodologies (validation/registration stage).

The requested deviation concerns the project titled *Methane Recovery from Advanced Wastewater Treatment System in an Ethanol Plant* that will take place in the Philippines.

The purpose of the project activity is to mitigate greenhouse gas (GHG) emissions by applying an anaerobic digester system at an ethanol plant (a greenfield facility). The proposed wastewater treatment system will recover the biogas generated from anaerobic digestion to produce steam and electricity using a cogeneration system. Biogas and other renewable sources of energy such as dry vinasse and bagasse will be fed to the cogeneration unit. As a conservative approach, only the portion of emission reductions associated with biogas use will be credited to this project activity. The quantity of steam that will be generated from biogas is estimated to represent about 30% of the total energy produced from the boiler (ex-ante calculations presented by project proponent and reviewed by DOE).

Scenario 1 presented in the methodology ACM0014 version 4.1.0 applies to the proposed greenfield project, along with all other eligibility criteria listed (refer to PDD attached for details).

As listed under scenario 1, the biogas extracted from the anaerobic digester will indeed be used to generate electricity and/or heat. The methodology is however not providing instructions for the monitoring of project emission where emission reductions are attributed only to one energy carrier (in this case biogas only, not bagasse nor dry vinasse). Parameters listed in equations 15 and 18 of the methodology relate to the net quantity of electricity and heat generated only. In order to calculate the emission reductions attributed to only one energy carrier (biogas), as more than one energy carrier is used in the project case, a deviation is requested in the way this can be calculated. Accordingly, the fraction of heat and electricity generated attributed to biogas (w biogas,y) shall be calculated based on the share of its energy content out of total energy content of all energy carriers as illustrated below:

Fraction of heat/electricity associated with biogas

$w_{biogas,y} = (NCV_{biogas,boiler} * F_{biogas,boiler,y}) / [(NCV_{dry\ vinasse,\ boiler} * F_{dry\ vinasse,\ boiler,y}) + (NCV_{bagasse,boiler} * F_{bagasse,boiler,y}) + (NCV_{biogas,\ boiler} * F_{biogas,boiler,y})]$

$w_{biogas,y}$	Fraction of heat/electricity associated with biogas at the turbine
$NCV_{biogas,boiler}$	Net calorific value of biogas (kJ per volume or mass unit)
$NCV_{dry\ vinasse,\ boiler}$	Net calorific value of dry vinasse (kJ per volume or mass unit)
$NCV_{bagasse,boiler}$	Net calorific value of bagasse (kJ per volume or mass unit)
$F_{biogas,boiler,y}$	Amount of biogas sent to boiler in year *y* (m^3/yr)
$F_{dry\ vinasse,\ boiler,y}$	Amount of dry vinasse sent to boiler in year y (t/y)
$F_{bagasse,boiler,y}$	Amount of bagasse sent to boiler in year y (t/y)

Emission reductions associated with electricity generation using biogas:

$EG_{PJ,y} = (w_{biogas,y} * E_{tot,y}) - E_{con,\ WWT,y}$

$EG_{PJ,y}$	Net quantity of electricity generated in year y with biogas from the new anaerobic biodigester (MWh/y)
$E_{tot,y}$	Electricity generated from the turbine in year *y* (MWh)
$E_{con,\ WWT,y}$	Electricity consumed for the wastewater treatment in year *y* (MWh)

Emission reductions associated with heat generation using biogas:

$HG_{PJ,y} = w_{biogas,y} * [(F_{steam,y} * E_{steam,y}) - E_{feed\ water,y}]/10E9$

$HG_{PJ,y}$	Net quantity of heat generate in year y with biogas from the new anaerobic digester (TJ/y)
$w_{biogas,y}$	Fraction of heat/electricity associated with biogas at the turbine
$F_{steam,y}$	Quantity of steam generated from the boiler in year *y* (kg/y)
$E_{steam,y}$	Enthalpy of the steam generated by the boiler in year y (kJ/kg)
$E_{feed\ water,y}$	Heat content of the feed water entering boiler in year y(kJ/y)

$E_{feed\ water,y} = F_{feed\ water,y} * T_{feed\ water,y} * 4.1868$ kJ/kg C

$F_{feed\ water,y}$	Quantity of feed water in year *y* (kg/y)
$T_{feed\ water,y}$	Temperature of feed water in year *y* (deg C)

This request for deviation of monitoring methodology is illustrated with the following calculations (ex-ante), based on 300 days of operation per year:

Parameters	*Values*	*Sources (for ex ante calculations)*
$NCV_{biogas,boiler}$	*24, 480 kJ/m^3*	Biogas technology center, 2004, monitored ex-post
$NCV_{dry\ vinasse,\ boiler}$	*12 ,540 kJ/kg*	Roxol Energy Balance.pdf, monitored ex-post
$NCV_{bagasse,boiler}$	*7 ,500 kJ/kg*	Calorific value of bagasse, L. Wong Sak Hoi, 2002, monitored ex-post
$F_{biogas,boiler,y}$	*34, 450 m^3/d (based on 300 days of operation)*	Roxol Energy Balance.pdf, monitored ex-post and project FSR
$F_{dry\ vinasse,\ boiler,y}$	*62.4 t/d (based on 300 days of operation)*	Roxol Energy Balance.pdf, monitored ex-post
$F_{bagasse,boiler,y}$	*142,000 kg/d (based on 300 days of operation)*	Roxol Energy Balance.pdf, monitored ex-post
$F_{steam,y}$	*360,000 kg/d (based on 300 days of operation)*	Energy balance sheet, projection, KBK, monitored ex-post
$E_{steam,y}$	*3 ,238.9 kJ/kg*	at T_{steam} =380°C and P_{steam} = 1.5 kg/cm^2 ,source: NIST webbook; Determined ex-post based on monitored temperature and pressure and of steam supplied to the turbine (T_{steam};P_{steam})..
$E_{feed\ water,y}$	*2.64E10 kJ/y*	Calculated based on the flow of feed water ($F_{feed\ water,y}$ = 210,000 kg/d over 300 days) and temperature of the feed water ($T_{feed\ water,y}$ = 100 deg C) (specific heat of water is 1 kcal/kg/deg C)

$w_{biogas,y}$ = *(24 480 kJ/m³ * 34 450 m³/d * 300 d/y) / [(12,540 kJ/kg * 62,400 kg/d *300 d/y) + (7,500 kJ/kg * 142,000 kg/d * 300 d/y) + (24,480 kJ/m³ * 34,450 m³/d * 300 d/y)]*

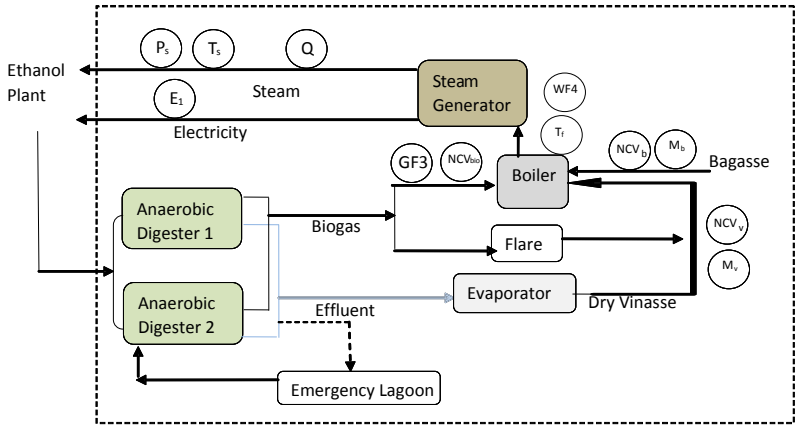
w_{biogas} = *0.3134*

$EG_{PJ,y} = (w_{biogas,y} * E_{tot,y}) - E_{con, WWT,y}$
$EG_{PJ,y}$ = *[(0.3134 * 4 000 kW[1] * 300 d/y * 24 h/d) – (240 kW[2] * 300d/y * 24 h/d)] / 1 000*
$EG_{PJ,y}$ = *7 298 MWh/y*

$HG_{PJ,y}$= [0.3134* [(360000 kg/d*300d/y) * 3238.9 kJ/kg]- [210000 kg/d *300 d/y * 100 deg C* 4.1868 kJ/kg C] / 10E9

$HG_{PJ,y}$= 83 TJ

In order to apply the above mentioned methodology, additional parameters will be monitored and their monitoring points are illustrated in the diagram below (refer to Annex 4 of the PDD for detailed monitoring of all parameters, this is a simplified scheme)



Monitoring points	Description	Monitored Parameters in the Monitoring Plan
WF4	Flow feed water to boiler	$F_{feed\ water,y}$
NCV_{bio}	Net calorific value of biogas consumed by the boiler	$NCV_{biogas,boiler}$
NCV_v	Net calorific value of dry vinasse consumed by the boiler	$NCV_{dry\ vinasse,\ boiler}$
NCV_b	Net calorific value of bagasse consumed by the boiler	$NCV_{bagasse,boiler}$
GF3	Gas flow meter to measure gas sent to the boilers	$F_{biogas,boiler,y}$
M_v	Weight of the dry vinasse consumed by the boiler	$F_{dry\ vinasse,\ boiler,y}$
M_b	Weight of the bagasse consumed by the boiler	$F_{bagasse,boiler,y}$
E1	Electricity generated from the turbine in year y	$E_{tot,y}$
E2	Electricity consumed for the wastewater treatment in year y	$E_{con,\ WWT,y}$
Q	Quantity of steam generated at the turbine	$F_{steam,y}$
T_s	Temperature of the steam (to determine the enthalpy)	$T_{steam,y}$
T_f	Temperature of the feed water	$T_{feed\ water,y}$
P_s	Pressure of the steam (to determine the enthalpy)	$P_{steam,y}$

[1] Source: Proposal for Turbine 4 MW Technical Specifications, KBK, 30 July 2008, KBK.

Please use the space below to describe and substantiate the assessment of the DOE that the deviation does not require an amendment to the approved methodology used by the proposed project activity.	
The proposed deviation changes the procedure for measuring the net quantity of electricity generated in year y with biogas from the new anaerobic system ($EG_{PJ,y}$) and the net quantity of heat generated in year y with biogas from the new anaerobic digester ($HG_{PJ,y}$) by introducing a new parameter $w_{biogas,y}$ (the fraction of heat/electricity associated with biogas at the turbine). The introduction of the parameter wbiogas,y will allow to calculate the emission reduction attributed only to biogas (and not bagasse nor dry vinasse). As per the terms described in EB49 Annex 4, the project participants deviate from AM00014 version 4.1.0, when applying the methodology to the proposed project activity and the DOE considers that the deviation is due to the proposed project specific situation, and not applicable for other projects applying AM00014 version 4.1.0, implying a revision of the methodology would not be required to address the issue**.**	
Please use the space below to describe the impact of the deviation on the estimates of the emissions reductions for the proposed project activity with the use of approved methodology as existing and with the deviation. Please substantiate the estimations with relevant and verifiable data.	
There is no impact on emission reduction as the consideration of the emission reductions attributed to the biogas from a mix of renewable resources used in the cogeneration unit is considered to be conservative. The inclusion of the fraction factor $w_{biogas,y}$ will ensure that only the portion of emission reductions associated with biogas use will be credited to this project activity.	
Link to the documentation made available at validation stage	http://cdm.unfccc.int/Projects/Validation/DB/TEDQ47YBGWZXDX6UNSNCQIE1JUVVWA/view.html
If necessary, list attached files containing relevant information which is not available through the above link	PDD version 08, 2 November 2011 CER calculations

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Version	Date	Nature of revision
01	EB 49, Annex 5 11 September 2009	Initial adoption. This form replaces the form included as part of the *Procedures for request for deviation to the Executive Board* (version 02, EB 24, Annex 30). This form should be used in conjunction with *Procedures for requests to the Executive Board for deviation from an approved methodology.*
Decision Class: Regulatory **Document Type**: Form **Business Function**: Methodology		

[2] Source: Roxol Ethanol Plant Power Mix.pdf