Monitoring report form
(Version 03.1)

Monitoring report

Title of the project activity	Bangna Starch Wastewater Treatment and Biogas Utilization Project
Reference number of the project activity	2556
Version number of the monitoring report	1
Completion date of the monitoring report	26/08/2013
Registration date of the project activity	10/11/2009
Monitoring period number and duration of this monitoring period	2nd monitoring period 01/01/2011 – 31/07/2013 (first and last days included)
Project participant(s)	P&Papop Renewable Co.,Ltd. South Pole Carbon Asset Management Ltd.
Host Party(ies)	Thailand
Sectoral scope(s) and applied methodology(ies)	Sectoral scope 13: Waste handling and disposal Sectoral scope 1: Energy industries (renewable/non-renewable sources) Applied methodology: - AMS III.H "Methane Recovery in Wastewater Treatment" (Version 09) - AMS-I.D "Grid connected renewable electricity generation" (Version 13)
Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD	118,431 tCO_2e
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	101,426 tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

>> The proposed project activity consists of the installation of an upflow anaerobic sludge blanket technology (UASB) biogas reactor and power generation (2.85 MW_{el} gas engine (3 x 0.95 MW) at an existing starch manufacturing plant for:

a) extraction of methane (biogas) from the wastewater stream through the biogas reactor, and

b) reuse of biogas as fuel for power generation (installed capacity of 2.85 MWel gas engines).

The implementation of the project activity helps in the avoidance of methane (a GHG) emissions, which would have occurred from the anaerobic decay of wastewater in the baseline. Furthermore, biogas is used as a fuel in gas engines. The use of biogas (renewable fuel) reduces GHG emissions related to fossil fuel use for power generation in the grid in the absence of the project activity.

Brief description of the installed technology and equipment

The following equipments have been installed in the project activity:

Equipment	Manufacturer / Technology provider	Type/Model	Specifications
Wastewater treatment system	Papop Co.,Ltd	Upflow Anaerobic Sludge Blanket (UASB)	Upflow Anaerobic Sludge Blanket has a designed COD reduction efficiency of 90%. The UASB is designed with a total volumetric capacity of 6,581 m^3.
Gas engine	Guascor		There are three electricity generation sets with total installed capacity of 2.85 MW_{el}.
Flare	BKE Flare system	Closed flare	Closed flare has a maximum capacity of 1,250 Nm^3/hr.

Relevant dates for the project activity

Event	Date	Reference
Construction of UASB	20/07/2006	Purchase order
Commissioning of UASB	10/2007	Commissioning certificate by Papop Co.,Ldtd.
Commissioning of gas engines	21/12/2007	Commissioning test report
Registration under UNFCCC	10/11/2009	UNFCCC website
1st monitoring period	10/11/2009 – 31/12/2010	UNFCCC website
Approval of Revision of monitoring plan	23/09/2011	UNFCCC website
Approval of Notification for changes in the registered PDD	23/09/2011	UNFCCC website

Total GHG emission reductions achieved during this monitoring period are 101,426 tCO_2e.

Further background information on the project activity can be found in the registered Project Design Document under the following link: http://cdm.unfccc.int/Projects/DB/RWTUV1241593452.75/view

A.2. Location of project activity

>> The project site is located in Tombol Um Mao, Amphur Yangthalat, Kalasin Province, Thailand (Host country).

The coordinates of the project are Latitude 16°23'7.71"N (16.385475) and Longitude 103°28'21.28"E (103.472578).

A.3. Parties and project participant(s)

Party involved ((host) indicates a host Party)	**Private and/or public entity(ies) project participants (as applicable)**	**Indicate if the Party involved wishes to be considered as project participant (Yes/No)**
Thailand (host)	P&Papop Renewable Co.,Ltd. (Private entity)	No
Switzerland	South Pole Carbon Asset Management Ltd. (Private entity)	No

A.4. Reference of applied methodology

>>

(a) The applied methodology

AMS-III.H version 9 - Methane recovery in wastewater treatment

(https://cdm.unfccc.int/methodologies/DB/4ND00PCGC7WXR3L0LOJTS6SVZP4NSU)

AMS-I.D version 13 - Grid connected renewable electricity generation

(https://cdm.unfccc.int/methodologies/DB/RSCTZ8SKT4F7N1CFDXCSA7BDQ7FU1X)

(b) Within AMS-III.H and AMS-I.D following tools are used for this project activity:

- "Tool to determine project emissions from flaring gases containing methane" (EB 28 annex 13) is used to calculate project emissions from flaring of a residual gas stream containing methane

(https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-06-v1.pdf)

- "Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site" (version 2) is used to refer methane correction factor (MCF)

(http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-04-v2.pdf)

A.5. Crediting period of project activity

>>

Type: Renewable crediting period

Start date and end date of the crediting period: 10/11/2009 – 09/11/2016

Current monitoring period: 01/01/2011 – 31/07/2013

Length of the current monitoring period: 2 years and 7 months

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

>> The project replaces the existing wastewater treatment practice (open lagoon system) and thus avoids the release of methane into the atmosphere that results from the anaerobic digestion of the organic content in the wastewater treated in the lagoon system.

The biogas reactor produces biogas to fuel gas engines for the production electricity grid, thus displacing fossil sources in the grid. Therefore, the project activity reduces green house gases due to avoidance of methane emissions from the existing lagoon system and displacement of fossil fuel based electricity from the grid.

Technical description

The technology implemented by the project activity is an Upflow Anaerobic Sludge Blanket (UASB) system. The UASB system is built, owned and operated by Papop Co., Ltd. Since the company started its business in 1997, it has accumulated know-how and experiences in construction of biogas production and utilization system.

In the UASB process, wastewater flows upward through a sludge blanket composed of microorganisms that naturally form granules or particles of 0.5 to 2 mm in diameter ("sludge granules"). When wastewater comes in contact with the granules, anaerobic decomposition of the organic material contained in the wastewater takes place, resulting in the generation of methane-rich biogas. The hydraulic turbulence caused by produced biogas bubbles provides mixing in the digester. The high sedimentation velocity of biological granules formed in the digester prevents washout of the sludge granules, leading to longer sludge retention time in the digester.

Through the utilization of this advanced technology, the project is able to achieve approximately 90% removal of COD, significantly reducing the COD load to the open lagoons, which subsequently receive effluent from the UASB digester.

The biogas is used as fuel in power generators (gensets) consisting of a biogas fired engine and an alternator, to generate 2,850 kWe of electricity.

In case of any excess biogas, a closed flare system is installed. Flaring starts automatically whenever biogas is diverted to the flare equipment, which contains automatic ignition system and other safety devices to ensure that the biogas is always combusted

Implementation of the project during the monitoring period.

During the monitoring period, there were no significant occurrences of events, which affected the project activity as describe above.

Further, the calibration of the equipment was conducted as per the plan of the project activity. In case of calibration delay, the measured values during the delay period are adjusted by applying an identified error

in a calibration report in a conservative manner which is in line with the VVS requirements.

B.2. Post registration changes

B.2.1. Temporary deviations from registered monitoring plan or applied methodology

>> No temporary deviations from registered monitoring plan or applied methodology during the monitoring period.

B.2.2. Corrections

>> No corrections to project information or parameters fixed at validation during the monitoring period.

B.2.3. Permanent changes from registered monitoring plan or applied methodology

>>

Changes from the registered monitoring plan were requested and approved during previous monitoring as follows.

The approval date of the revised PDD: 23/09/2011

The version and completion date of the revised PDD: version 4 and dated 11/08/2011

(http://cdm.unfccc.int/Projects/DB/RWTUV1241593452.75/view)

There is no change in monitoring plan during the current monitoring period.

B.2.4. Changes to project design of registered project activity

>> The process flow diagram in section B.3 of the registered PDD was revised to be inline with the actual situation at the project site.

The approval date of the revised PDD: 23/09/2011

The version and completion date of the revised PDD: version 4 and dated 11/08/2011

There is no change in project design during the current monitoring period.

B.2.5. Changes to start date of crediting period

>> There are no changes to the start date of crediting period.

B.2.6. Types of changes specific to afforestation or reforestation project activity

>> The section is left blank intentionally.

SECTION C. Description of monitoring system

>>

1. Monitoring Management

The monitoring system is based on meter readings recorded directly at the meter location and regular records of data measured in the laboratory at the project site.

The log sheets are prepared as follows:

- The plant manager checks the data on regular basis, recording the readings on log sheets. The readings are then inserted in an excel file, where from the values from the log sheet are rechecked. This reduces the scope of errors during data transfer.
- Since the totalizer readings are reported in log sheets; any doubtful readings can be cross-checked against the running total of the meter. This ensures a high level of accuracy.

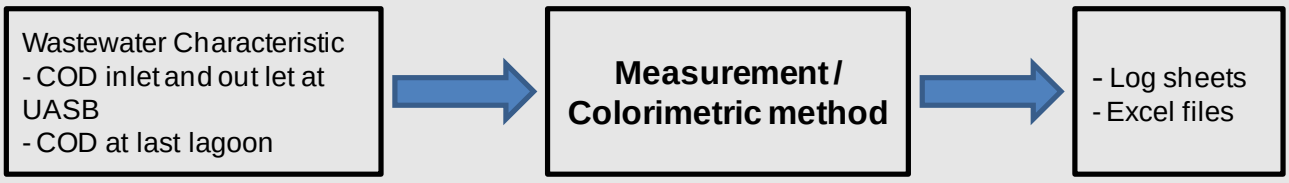
For more details about the QA/QC procedures for each monitoring parameter, please refer to the monitoring parameter tables provided in D.2.

2. Data Storage and Filing – Electric Workbook

The data collection

- Meter readings are recorded into log sheets by the plant operators on daily basis and transferred to electronic log files (excel files).

- The parameters monitored in the laboratory by the lab operator are entered into log sheets, which are later transferred to the electronic log file (excel files).



The data checking

The reporting of monitored parameters is done on daily basis by the plant operator in log sheets. The data is compiled and inserted by the responsible staff into an excel template (electronic log file). The consistency of the data in both log sheets and excel files is checked by the plant manager on a regular basis. The compiled excel report is further sent to the project consultant for detailed emission reduction analysis. The plant manager and project consultant interact on regular basis to discuss emission reduction reporting. The details of the reporting procedure are explained in more detail in the table, which summarizes the responsibility of the staff at the project site.

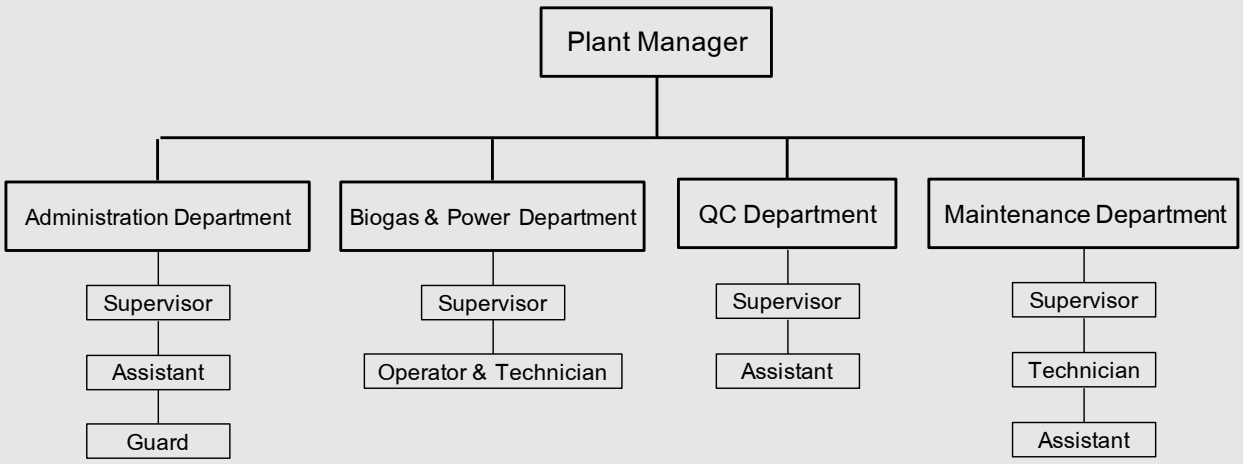


Figure 1: Organization chart

3. Roles and responsibilities

Roles	Responsibilities
Plant Manager	- Supervises the reports in form of log sheets and electronic log files - Approves the calibration plan - Assigns and approves the training plan - Approves the employment - Approves the purchase for equipment - Sends aggregated reports via email to the project consultant on a regular basis
Biogas and Power department - Supervisor	- Checks the completeness of the parameters monitored in log sheets (i.e. Biogas Plant Log Sheet)
Biogas and Power department - Operator & Technician	- Logs the data monitored for biogas and power systems from the meter reading on the Biogas Plant Log Sheet on a daily basis
QC department - Supervisor	- Checks the completeness of the parameters monitored in log sheets (i.e. Lab Data Sheet) and - Fills in the electronic log file (excel file) - Regularly backs up the electronic log files
QC department - Assistant	- Takes samples and analyzes characteristics of wastewater, recording all test results in the Lab Data Sheet on regularly basis
Maintenance department - Supervisor	- Takes care of the installation of equipment - Ensures the preventive and corrective maintenance
Maintenance department - Technician & Assistant	- Assists the supervisor
Administration department	Manages & supports - for the general documentation - for the office supplies

4. Emergency procedures for the monitoring system

The staff of next shift is made aware of any event from the previous day or previous shift and plan to promptly handle the situation. In case of problem in any equipment or machine, the staff shall inform the project owner or the technical consultants to project for quick rectification of the problem.

5. Uncertainty in data

Some uncertainties may result due to malfunction of meters, calibration issues and wrong data collection (gaps in manual log sheets, human errors by plant operators). The operator is expected to put best efforts to prevent such errors, however regular internal audits rectify any such uncertainty in the monitored data.

Monitoring equipment of the project activity

Data / Parameter as in PDD	Short description	Equipment	Tag no.	Serial no.
$Q_{y, ww}$	Wastewater treated	Electromagnetic flowmeter	FM1	93120819000
$COD_{y, inflow, j}$	COD inlet of UASB	Colorimeter	-	070290C62433
$COD_{y, outflow, j}$	COD outlet of UASB			
$COD_{y, removed, j}$	COD removed by UASB			
$COD_{y, ww, treated}$	COD outlet of lagoon			
$S_{y, final}$	Amount of sludge generated	Weighbridge, which belongs to the starch factory	-	-
$\%CH_4$	Methane content in biogas	Biogas Check	-	BM11452
$Q_{biogas, total, y}$	Amount of biogas generated	Thermal mass flowmeter	GM1	9502C002000
$Q_{biogas, flare, y}$	Amount of biogas flared	Thermal mass flowmeter	GM3	9A070502000
$Q_{biogas, generator, y}$	Amount of biogas used in generators	Thermal mass flowmeter	GM2	9502C102000
T_{flare}	Temperature of the exhaust gases of the flare in stack	Thermocouple	TT	-
Time of biogas sent to flare	Amount of minutes per hour where biogas is sent to flare	Thermal mass flowmeter	GM3	9A070502000
EC_y	Electricity imported	Electricity Meter	PM (PEA)	old: 205055772 new: 203327329
EG_y	Electricity exported	Electricity Meter	PM (PEA)	205055798

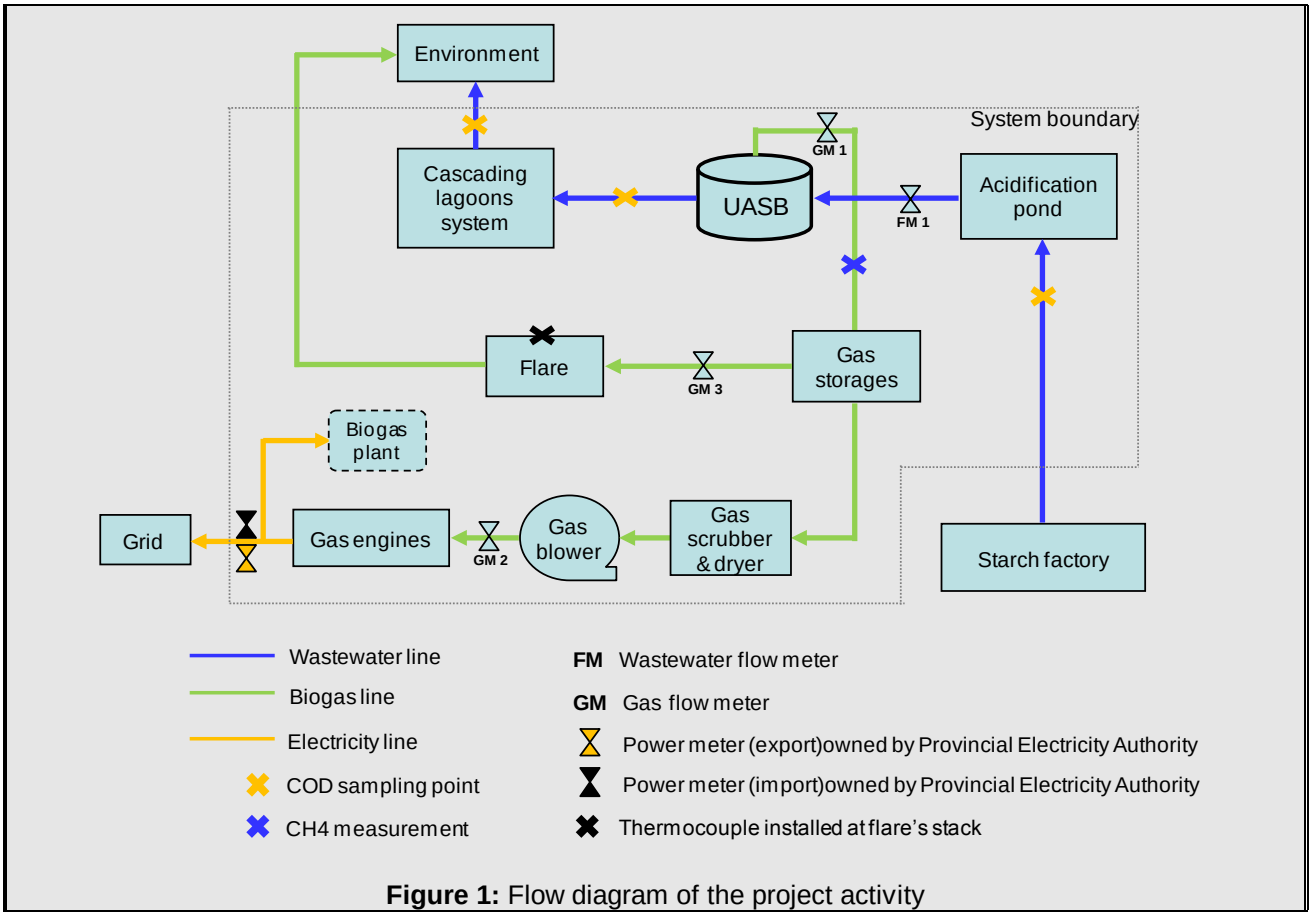


Figure 1: Flow diagram of the project activity

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante or at renewal of crediting period

Data / Parameter:	**GWP_{CH4}**
Unit:	
Description:	Global warming potential
Source of data:	Intergovernmental Panel on Climate Change, Climate Change 1995: The Science of Climate Change (Cambridge, UK: Cambridge University Press, 1996)
Value(s) applied):	21
Purpose of data:	Calculation of baseline and project emissions
Additional comment:	n/a

Data / Parameter:	**$B_{o,ww}$**
Unit:	kg CH_4/ kg COD
Description:	IPCC default value, corrected as per methodology AMS III-H page – 4, is used for estimation
Source of data:	IPCC default value
Value(s) applied):	0.21
Purpose of data:	Calculation of baseline and project emissions
Additional comment:	As per AMS.III.H Version 09, the IPCC default value of 0.25 kg CH_4/kg COD was corrected to take into account the uncertainties.

Data / Parameter:	**MCF**
Unit:	Fraction
Description:	Methane correction factor
Source of data:	Table III.H.1 from AMS-III.H, Version 09 methodology and "Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site (version 02)"
Value(s) applied):	$MCF_{ww, treatment, i}$ = 0.8 (for baseline emissions) $MCF_{ww,l}$ = 1.0 (for project emissions from lagoon system) $MCF_{ww, final}$ = 0.2 (for wastewater released into river)
Purpose of data:	Calculation of baseline and project emissions
Additional comment:	The original source of data can be checked for IPCC default value, Volume 5 Chapter 6, page 6.21. The lower value is used for conservative estimation of baseline emissions. All MCF values have been chosen in a conservative manner (highest values for project and lower for baseline) according to table III.H.1 from AMS-III.H, Version 09 methodology.

Data / Parameter:	**CFE_{ww}**
Unit:	Fraction
Description:	Capture and flare efficiency of the methane recovery and combustion efficiency

Source of data:	Default value specified in AMS-III.H, Version 09 methodology
Value(s) applied):	0.9
Purpose of data:	Calculation of project emissions
Additional comment:	n/a

Data / Parameter:	**$EF_{grid, y} = EF_{y}$**
Unit:	tCO_2/MWh
Description:	CO2 emission factor of the Thailand grid
Source of data:	Validated as part of registered PDD pdf version submitted.
Value(s) applied):	0.5057
Purpose of data:	Calculation of baseline and project emissions.
Additional comment:	n/a

Data / Parameter:	**$[CH4]_{y, ww, treated}$**
Unit:	$Tonnes/m^3$
Description:	Dissolved methane content in the treated wastewater
Source of data:	Methodology AMS-III.H
Value(s) applied):	0.0001
Purpose of data:	Calculation of baseline emissions
Additional comment:	n/a

D.2. Data and parameters monitored

Data / Paramet	**$Q_{y, ww}$**
Unit:	m^3
Description:	Volume of wastewater treated in the year y
Measured/ Calculated / Default:	Measured continuously by the flow meter
Source of data:	Log sheet

Value(s) of monitored parameter:	<table><tr><th>Monitoring period</th><th>Total value (m^3)</th></tr><tr><td>01/01/2011 – 31/12/2011</td><td>846,845</td></tr><tr><td>01/01/2012 – 31/12/2012</td><td>1,139,341</td></tr><tr><td>01/01/2013 – 31/07/2013</td><td>586,738</td></tr></table>
Monitoring equipment:	<table><tr><td>Tag no.</td><td>FM1</td></tr><tr><td>Equipment Type</td><td>Electromagnetic flowmeter</td></tr><tr><td>Manufacturer</td><td>Endress Hauser Flowtec AG</td></tr><tr><td>Model</td><td>PROMAG 10w</td></tr><tr><td>Maximum permissible error</td><td>±0.5%[1]</td></tr><tr><td>Serial No.</td><td>93120819000</td></tr><tr><td>Calibration Frequency</td><td>Once in every three years</td></tr><tr><td>Date of previous calibration</td><td>23/09/2010 22/09/2011</td></tr><tr><td>Date of latest calibration</td><td>11/09/2012</td></tr><tr><td>Validity</td><td>10/09/2015</td></tr></table>
Measuring/ Reading/ Recording frequency:	The meter has continuous monitoring of the flow of wastewater. The accumulated reading is taken from the meter screen and recorded in the log sheet by the operator on a daily basis.
Calculation method (if applicable):	n/a
QA/QC procedures:	The data recorded in log sheets is based on meter readings directly at the meter location and checked by the plant manager on regular basis. The flow meter is regularly calibrated in line with the manufacturer's recommendation and the latest EB guidelines for small-scale project.
Purpose of data:	Calculation of baseline and project emissions
Additional comment:	n/a

Data / Parameter:	**$COD_{y, inflow, j}$**
Unit:	tonnes/m^3
Description:	The COD (chemical oxygen demand) of wastewater entering the project system j. This can be either represented as concentration (mg/) or be represented as tonnes/m^3
Measured/ Calculated / Default:	Measured
Source of data:	Measured and recorded in log sheets, which is shown the test result of COD inlet and outlet The COD content is analyzed using a colorimetric method in the on-site laboratory. The COD test results are logged manually in the plant operation report on a daily basis.
Value(s) of monitored parameter:	<table><tr><th>Monitoring period</th><th>Average value (mg/l)</th></tr><tr><td>01/01/2011 – 31/12/2011</td><td>14,316</td></tr><tr><td>01/01/2012 – 31/12/2012</td><td>14,209</td></tr><tr><td>01/01/2013 – 31/07/2013</td><td>14,260</td></tr></table>

[1] https://portal.endress.com/wa001/dla/50000000584/000/03/TI093DEN_1109.pdf

Monitoring equipment:	<table><tr><td>Equipment Type</td><td>Portable Colorimeter</td></tr><tr><td>Manufacturer</td><td>Hach</td></tr><tr><td>Model</td><td>DR/890</td></tr><tr><td>Maximum permissible error</td><td>±0.24%[2]</td></tr><tr><td>Serial No.</td><td>070290C62433</td></tr><tr><td>Calibration Frequency</td><td>Annually</td></tr><tr><td>Date of previous calibration</td><td>31/05/2011</td></tr><tr><td>Date of latest calibration</td><td>29/05/2012</td></tr><tr><td>Validity</td><td>28/05/2013</td></tr></table>
Measuring/ Reading/ Recording frequency:	Wastewater samples are collected at the inlet of the anaerobic treatment system (project system). The COD content is analyzed using a colorimetric method in the on-site laboratory. The COD test results are logged manually in the plant operation report on a daily basis. Samples collection and analysis for COD are done at least once per day. The results from the plant operation report are transferred to an electronic file i.e. excel sheet template.
Calculation method (if applicable):	n/a
QA/QC procedures:	The data recorded in log sheets is based on the data measured in the laboratory at the project site and checked by the plant manager on regular basis. Since the calibration was not carried out on annual basis as per manufacturer's recommendation, the error identified in the delayed calibration test is applied in the calculation of baseline emission.
Purpose of data:	Calculation of baseline emissions
Additional comment:	The parameter is used to calculate $COD_{y, removed, j}$ Since the calibration of the equipment was delayed during the monitoring period, the measured values of the amount of electricity consumed for the period from 01/01/2011 – 30/05/2011 has been adjusted by applying the identified error in the calibration test dated 31/05/2011 (±5.1%) in a conservative manner. This approach is in line with Standard: Clean development mechanism validation & verification standard, version 03.0. The details can be found in the calculation sheet.

Data / Parameter:	**$COD_{y, outflow, j}$**
Unit:	tonnes/m^3
Description:	The COD (chemical oxygen demand) of wastewater exiting the project system j. This can be either represented as concentration (mg/) or be represented as tonnes/m^3
Measured/ Calculated / Default:	Measured
Source of data:	Measured and recorded in log sheets, which is shown the test result of COD inlet and outlet The COD content is analyzed using a colorimetric method in the on-site laboratory. The COD test results are logged manually in the plant operation report on a daily basis.

[2] http://www.hach.com/fmmimghach?/CODE:SPECCOLCOMPARE-2008-16038|1

Value(s) of monitored parameter:	<table><tr><th>Monitoring period</th><th>Average value (mg/l)</th></tr><tr><td>01/01/2011 – 31/12/2011</td><td>1,216</td></tr><tr><td>01/01/2012 – 31/12/2012</td><td>1,233</td></tr><tr><td>01/01/2013 – 31/07/2013</td><td>1,295</td></tr></table>
Monitoring equipment:	<table><tr><td>Equipment Type</td><td>Portable Colorimeter</td></tr><tr><td>Manufacturer</td><td>Hach</td></tr><tr><td>Model</td><td>DR/890</td></tr><tr><td>Maximum permissible error</td><td>±0.24%[3]</td></tr><tr><td>Serial No.</td><td>070290C62433</td></tr><tr><td>Calibration Frequency</td><td>Annually</td></tr><tr><td>Date of previous calibration</td><td>31/05/2011</td></tr><tr><td>Date of latest calibration</td><td>29/05/2012</td></tr><tr><td>Validity</td><td>28/05/2013</td></tr></table>
Measuring/ Reading/ Recording frequency:	Wastewater samples are collected at the outlet of the anaerobic treatment system (project system). The COD content is analyzed using a colorimetric method in the on-site laboratory. The COD test results are logged manually in the plant operation report on a daily basis. Samples collection and analysis for COD are done at least once per day. The results from the plant operation report are transferred to an electronic file i.e. excel sheet template.
Calculation method (if applicable):	n/a
QA/QC procedures:	The data recorded in log sheets is based on the data measured in the laboratory at the project site and checked by the plant manager on regular basis. Since the calibration was not carried out on annual basis as per manufacturer's recommendation, the error identified in the delayed calibration test is applied in the calculation of baseline emission.
Purpose of data:	Calculation of baseline emissions
Additional comment:	The parameter is used to calculate $COD_{y, removed, j}$ Since the calibration of the equipment was delayed during the monitoring period, the measured values of the amount of electricity consumed for the period from 01/01/2011 – 30/05/2011 has been adjusted by applying the identified error in the calibration test dated 31/05/2011 (±5.1%) in a conservative manner. This approach is in line with Standard: Clean development mechanism validation & verification standard, version 03.0. The details can be found in the calculation sheet.

Data / Parameter:	**$COD_{y, removed, j}$**
Unit:	tonnes/m^3
Description:	The chemical oxygen demand removed by the treatment system "j". Here j is the project system.
Measured/ Calculated / Default:	Calculated
Source of data:	Calculated from $COD_{y, inflow, j}$ and $COD_{y, outflow, j}$

[3] http://www.hach.com/fmmimghach?/CODE:SPECCOLCOMPARE-2008-16038|1

Value(s) of monitored parameter:	<table><tr><th>Monitoring period</th><th>Average value (mg/l)</th></tr><tr><td>01/01/2011 – 31/12/2011</td><td>13,137</td></tr><tr><td>01/01/2012 – 31/12/2012</td><td>12,968</td></tr><tr><td>01/01/2013 – 31/07/2013</td><td>12,969</td></tr></table>
Monitoring equipment:	n/a
Measuring/ Reading/ Recording frequency:	n/a
Calculation method (if applicable):	Calculated from $COD_{y, inflow, i}$ and $COD_{y, outflow, i}$ $COD_{y, removed, j} = COD_{y, inflow, j}$ and $COD_{y, outflow, j}$
QA/QC procedures:	n/a
Purpose of data:	Calculation of baseline emissions
Additional comment:	n/a

Data / Parameter:	**$COD_{y, ww, treated}$**
Unit:	tonnes/m^3
Description:	Chemical oxygen demand of the wastewater prior to discharge. This can be either represented as concentration (mg/l) or be represented as tonnes/m^3
Measured/ Calculated / Default:	Measured by external laboratory
Source of data:	External laboratory test report
Value(s) of monitored parameter:	<table><tr><th>Monitoring period</th><th>Maximum value (mg/l)</th></tr><tr><td>01/01/2011 – 31/12/2011</td><td>114</td></tr><tr><td>01/01/2012 – 31/12/2012</td><td>117</td></tr><tr><td>01/01/2013 – 31/07/2013</td><td>86.1</td></tr></table>
Monitoring equipment:	n/a
Measuring/ Reading/ Recording frequency:	Wastewater samples are collected at the last open anaerobic lagoon prior to discharge. The COD content is analyzed using a standard method in an external laboratory on a monthly basis.
Calculation method (if applicable):	Third party test report.
QA/QC procedures:	The wastewater samples are collected by plant's operator and sent to the external laboratory for analysis of the COD content. Since there was no measurement for two months in 2011, 90/10 confidence / precision level approach is used for the monitored data which conservative value is used for calculation of project emissions.
Purpose of data:	Calculation of project emissions
Additional comment:	The maximum value reported is used for conservative estimation of project emissions.

Data / Parameter:	**$S_{y, final}$**
Unit:	Tonnes
Description:	Amount of final sludge generated by the wastewater treatment in the year "y"

Measured/ Calculated / Default:	Measured
Source of data:	Measured – all the sludge quantity produced during a monitoring period is measured. The end use of this sludge is also monitored
Value(s) of monitored parameter:	
Monitoring equipment:	The sludge shall be monitored (for e.g. using weighbridge) when the sludge is removed from the wastewater treatment system.
Measuring/ Reading/ Recording frequency:	The sludge shall be monitored (for e.g. using weighbridge) when the sludge is removed from the wastewater treatment system. The end-use application of sludge, i.e. destination, shall be recorded in the log sheet.
Calculation method (if applicable):	n/a
QA/QC procedures:	The measurement equipment is tested / calibrated once every 3 years. The same equipment as used by starch plant for tapioca procuring is used for monitoring the amount of sludge.
Purpose of data:	Calculation of project emissions
Additional comment:	No sludge has been removed from the wastewater treatment system during this monitoring period.

Monitoring period	Total value (tonnes)
01/01/2011 – 31/12/2011	0
01/01/2012 – 31/12/2012	0
01/01/2013 – 31/07/2013	0

Data / Parameter:	**$\%CH_4$**
Unit:	%
Description:	Methane content in biogas
Measured/ Calculated / Default:	Measured – Online system to monitor % of methane in biogas. However, during the monitoring period there was malfunction of the online system, the parameter was monitored by portable biogas analyzer which the detail of equipment and the conservative approach for calculation of emission reductions are provided.
Source of data:	Log sheet
Value(s) of monitored parameter:	
Monitoring equipment:	
Measuring/ Reading/ Recording frequency:	The methane content is measured by portable biogas analyzer at least twice a day. Data is logged manually in the log records.

Monitoring period	Average value (%)
01/01/2011 – 31/12/2011	60.1
01/01/2012 – 31/12/2012	60.2
01/01/2013 – 31/07/2013	60.4

Equipment Type	Portable biogas analyzer
Manufacturer	Geotechnical Instruments
Model	Biogas Check
Maximum permissible error	±3%[4]
Serial No.	BM 11452
Calibration Frequency	Annually
Date of previous calibration	15/06/2011
Date of latest calibration	30/08/2012
Validity	29/08/2013

[4] http://www.geotech.co.uk/Downloads/Portable_Biogas_Datasheet.pdf

Calculation method (if applicable):	Simple average is estimated on daily basis.
QA/QC procedures:	For this monitoring period, since the online system was not working, the portable gas analyzer is used to monitor the CH4 content at least twice a day. The monitored data is manually recorded onto log sheets, checked by the plant manager on regular basis, and transferred to excel file.
Purpose of data:	Calculation of baseline and project emissions
Additional comment:	As per the Monitoring plan, there should be an online methane monitoring. However during the period the methane analyzer is not working and portable methane analyzer is used to estimate methane in biogas and recorded in the log book. The biogas sample is analyzed at least 3 times a day and averaged for daily value. Since the calibration of the equipment was delayed during the monitoring period, the measured values of the methane content for the period from 01/01/2011 – 14/06/2011 and 15/06/2012 – 29/08/2012 have been adjusted by applying the maximum permissible error (±3.0%) in a conservative manner. This approach is in line with Standard: Clean development mechanism validation & verification standard, version 03.0. The details can be found in the calculation sheet. Furthermore, since the continuous measurements were not available, the methane percentage value is established using a 95% confidence level and applied in a conservative manner for estimation of baseline and project emissions.

Data / Parameter:	**$Q_{biogas, total, y}$**
Unit:	Nm^3
Description:	Amount of biogas that is generated using the project activity in year y
Measured/ Calculated / Default:	Measured – Gas Flow meter provided at the inlet of flare system. Denoted as GM1
Source of data:	Log sheet
Value(s) of monitored parameter:	

Monitoring period	Total value (Nm^3)
01/01/2011 – 31/12/2011	4,655,353
01/01/2012 – 31/12/2012	6,622,729
01/01/2013 – 31/07/2013	3,584,618

Monitoring equipment:

Tag no.	GM1
Equipment Type	Thermal mass flowmeter
Manufacturer	Endress Hauser Flowtec AG
Model	t-mass 65I
Maximum permissible error	±1% of reading[5]
Serial No.	9502C002000
Calibration Frequency	Once every three years
Date of previous calibration	21/09/2010 30/09/2011
Date of latest calibration	10/09/2012
Validity	09/09/2015

Measuring/ Reading/ Recording frequency:	The amount of biogas generated is continuously measured by means of a cumulative flow meter installed after UASB. Data is logged manually in the log sheet and transferred to the excel sheet template on daily basis.

[5] https://portal.endress.com/wa001/dla/50000092467/000/02/TI069DEN_0610.pdf

Calculation method (if applicable):	n/a
QA/QC procedures:	The data recorded in log sheets is based on meter readings directly at the meter location and checked by the plant manager on regular basis. The flow meter is regularly calibrated in line with the manufacturer's recommendation and the latest EB guidelines for small-scale project.
Purpose of data:	Calculation of baseline emissions
Additional comment:	n/a

Data / Parameter:	**$Q_{biogas, flare, y}$**
Unit:	Nm^3
Description:	Amount of biogas that is flared
Measured/ Calculated / Default:	Measured – Gas Flow meter provided at the inlet of flare system. Denoted as GM3
Source of data:	Log sheet
Value(s) of monitored parameter:	

Monitoring period	Total value (Nm^3)
01/01/2011 – 31/12/2011	0
01/01/2012 – 31/12/2012	660,620
01/01/2013 – 31/07/2013	0

Monitoring equipment:

Tag no.	GM3
Equipment Type	Thermal mass flowmeter
Manufacturer	Endress Hauser Flowtec AG
Model	t-mass 65I
Maximum permissible error	±1% of reading[6]
Serial No.	9A070502000
Calibration Frequency	Once every three years
Date of previous calibration	20/11/2009 30/09/2011
Date of latest calibration	10/09/2012
Validity	09/09/2015

Measuring/ Reading/ Recording frequency:	The amount of biogas sent to the flare is continuously measured by means of a cumulative flow meter installed after the blower and before the flare. Data is logged manually in the log sheet and transferred to the excel sheet template on daily basis.
Calculation method (if applicable):	n/a
QA/QC procedures:	The data recorded in log sheets is based on meter readings directly at the meter location and checked by the plant manager on regular basis. The flow meter is regularly calibrated in line with the manufacturer's recommendation and the latest EB guidelines for small-scale project.
Purpose of data:	Calculation of project emissions
Additional comment:	n/a

Data / Parameter:	**$Q_{biogas, generator, y}$**
Unit:	Nm^3

[6] https://portal.endress.com/wa001/dla/50000092467/000/02/TI069DEN_0610.pdf

Description:	Amount of biogas that is sent to the electricity generator.
Measured/ Calculated / Default:	Measured – Gas Flow meter provided at the inlet of flare system. Denoted as GM2
Source of data:	Log sheet
Value(s) of monitored parameter:	

Monitoring period	Total value (Nm^3)
01/01/2011 – 31/12/2011	4,513,441
01/01/2012 – 31/12/2012	5,904,166
01/01/2013 – 31/07/2013	3,466,368

Monitoring equipment:

Tag no.	GM2
Equipment Type	Thermal mass flowmeter
Manufacturer	Endress Hauser Flowtec AG
Model	t-mass 65I
Maximum permissible error	±1% of reading[7]
Serial No.	9502C102000
Calibration Frequency	Once every three years
Date of previous calibration	21/09/2010 30/09/2011
Date of latest calibration	10/09/2012
Validity	09/09/2015

Measuring/ Reading/ Recording frequency:	The amount of biogas sent to the electricity generators is continuously measured by means of a cumulative flow meter installed at the inlet of the generators. Data is logged manually in the log sheet and transferred to the excel sheet template on daily basis.
Calculation method (if applicable):	n/a
QA/QC procedures:	The data recorded in log sheets is based on meter readings directly at the meter location and checked by the plant manager on regular basis. The flow meter is regularly calibrated in line with the manufacturer's recommendation and the latest EB guidelines for small-scale project.
Purpose of data:	Calculation of project emissions
Additional comment:	n/a

Data / Parameter:	**T_{flare}**
Unit:	˚C
Description:	Temperature of the exhaust gases of the flare in stack (N type thermocouple). Data is recorded automatically on SCADA system.
Measured/ Calculated / Default:	Measurement by project participant
Source of data:	Report from SCADA
Value(s) of monitored parameter:	

Monitoring period	Total value (˚C)
01/01/2011 – 31/12/2011	0
01/01/2012 – 31/12/2012	0
01/01/2013 – 31/07/2013	0

[7] https://portal.endress.com/wa001/dla/50000092467/000/02/TI069DEN_0610.pdf

Monitoring equipment:	<table><tr><td>Equipment Type</td><td>Thermocouple</td></tr><tr><td>Manufacturer</td><td>Taie / WR&W</td></tr><tr><td>Model</td><td>FY800</td></tr><tr><td>Serial No.</td><td>SP08071880025</td></tr><tr><td>Calibration Frequency</td><td>Annually</td></tr><tr><td>Date of latest calibration</td><td>30/09/2011</td></tr><tr><td>Validity</td><td>29/09/2012</td></tr></table>
Measuring/ Reading/ Recording frequency:	Since the parameter was not logged completely for the entire period of 2012 when there was biogas flared, zero is assumed for the flare efficiency.
Calculation method (if applicable):	n/a
QA/QC procedures:	The calibration was not carried out on regular basis as per manufacturer's recommendation or at least once a year. However, the flare efficiency is assumed to be zero since no temperature readings were available for this monitoring period.
Purpose of data:	Calculation of project emissions
Additional comment:	Since the parameter was not logged completely for the entire period of 2012 when there was biogas flared, zero is assumed for the flare efficiency.

Data / Parameter:	**Time of biogas sent to flare**
Unit:	minutes
Description:	Amount of minutes per hour where biogas is sent to the flare
Measured/ Calculated / Default:	Measured / calculated based on SCADA record of biogas flow meter
Source of data:	Report from SCADA
Value(s) of monitored parameter:	<table><tr><th>Monitoring period</th><th>Value (minutes)</th></tr><tr><td>01/01/2011 – 31/12/2011</td><td>0</td></tr><tr><td>01/01/2012 – 31/12/2012</td><td>0</td></tr><tr><td>01/01/2013 – 31/07/2013</td><td>0</td></tr></table>
Monitoring equipment:	The flare system is an automated system and makes sure that the biogas is not sent to the flare, if the flame is not detected. The details of the biogas going to the flare system and flame detection are available as part of the automated monitoring system at project site.
Measuring/ Reading/ Recording frequency:	Whenever biogas flow is registered by the SCADA system of the biogas plant, the time is also recorded, which allows for a calculation of the time period of biogas being sent to the flare.
Calculation method (if applicable):	n/a
QA/QC procedures:	n/a
Purpose of data:	Calculation of project emissions
Additional comment:	Since the parameter was not calculated completely for the entire period of 2012 based on SCADA record, the flare efficiency is assumed to be 0.

Data / Parameter:	**EC_y**
Unit:	MWh/y
Description:	Electricity consumed by waste water treatment facility over the year.

Measured/ Calculated / Default:	Measured – Electricity meter, maintained by PEA
Source of data:	Report by PEA
Value(s) of monitored parameter:	

Monitoring period	Value (MWh)
01/01/2011 – 31/12/2011	241.8
01/01/2012 – 31/12/2012	142.26
01/01/2013 – 31/07/2013	81.6

Monitoring equipment:

Equipment Type	Electricity Meter

Period of use	**beginning – 27/06/2011**
Manufacturer	EDMI
Model	Genius Series
Maximum permissible error	Class 0.2s, ±0.2%
Serial No.	205055772 (PEA No.20963014)
Calibration Frequency	Based on PEA procedure
Date of previous calibration	27/02/2009 27/06/2011

Period of use	**27/06/2011 till date**
Manufacturer	EDMI
Model	Genius Series
Maximum permissible error	Class 0.2s, ±0.2%
Serial No.	203327329 (PEA No.18323271)
Calibration Frequency	Based on PEA procedure
Date of previous calibration	27/06/2011
Date of latest calibration	05/06/2012
Validity	04/06/2013

Measuring/ Reading/ Recording frequency:	The measurement of this parameter is done continuously using electricity meter, owned by PEA. Monthly monitoring of the power meter is done. This can be verified from the reports issued by PEA (Provincial Electricity Authority).
Calculation method (if applicable):	n/a
QA/QC procedures:	The reports are issued by Provincial Electricity Authority (PEA) which the monitored data is monthly recorded by the PEA officer together with plant's operator.
Purpose of data:	Calculation of project emissions
Additional comment:	Since the calibration of the equipment was delayed during the monitoring period, the measured values of the amount of electricity consumed for the period from 01/01/2011 – 30/06/2011 has been adjusted by applying the maximum permissible error (±0.2%) in a conservative manner. This approach is in line with Standard: Clean development mechanism validation & verification standard, version 03.0. The details can be found in the calculation sheet. It is note that the actual period for applying the error is 01/01/2011 – 26/06/2011, however, since the parameter is recorded as monthly basis by PEA, the parameter in June 2011 is applied the error for whole month data.

Data / Parameter:	**EG_y**

Unit:	MWh/y
Description:	Electricity exported to the grid during year y by power generation facility
Measured/ Calculated / Default:	Measured – Electricity meter, maintained by PEA
Source of data:	Report by PEA
Value(s) of monitored parameter:	

Monitoring period	Value (kWh)
01/01/2011 – 31/12/2011	6,502,206
01/01/2012 – 31/12/2012	9,064,620
01/01/2013 – 31/07/2013	5,623,800

Monitoring equipment:

Equipment Type	Electricity Meter
Manufacturer	EDMI
Model	Genius Series
Maximum permissible error	Class 0.2s, ±0.2%
Serial No.	205055798
Calibration Frequency	Based on PEA procedure
Date of previous calibration	27/02/2009 27/06/2011
Date of latest calibration	05/06/2012
Validity	04/06/2013

Measuring/ Reading/ Recording frequency:	The measurement of this parameter is done continuously using electricity meter, owned by PEA. Monthly monitoring of the power meter is done. This can be verified from the reports issued by PEA (Provincial Electricity Authority).
Calculation method (if applicable):	n/a
QA/QC procedures:	The reports are issued by Provincial Electricity Authority (PEA) which the monitored data is monthly recorded by the PEA officer together with plant's operator.
Purpose of data:	Calculation of baseline emissions
Additional comment:	Since the calibration of the equipment was delayed during the monitoring period, the measured values of the amount of electricity consumed for the period from 01/01/2011 – 30/06/2011 has been adjusted by applying the maximum permissible error (±0.2%) in a conservative manner. This approach is in line with Standard: Clean development mechanism validation & verification standard, version 03.0. The details can be found in the calculation sheet. It is note that the actual period for applying the error is 01/01/2011 – 26/06/2011, however, since the parameter is recorded as monthly basis by PEA, the parameter in June 2011 is applied the error for whole month data.

Data / Parameter:	**FE or $\eta_{flare-h}$**
Unit:	%
Description:	Flare efficiency
Measured/ Calculated / Default:	Calculated based on tool to determine project emissions from flaring gases containing methane, EB28, Annex 13
Source of data:	SCADA record

Value(s) of monitored parameter:	During the monitoring period, this parameter was captured by SCADA system; however, the temperature in the exhaust gas of the flare was lower than 500 °C. **Monitoring period** / **Value (%)** 01/01/2011 – 31/12/2011 / 0 01/01/2012 – 31/12/2012 / 0 01/01/2013 – 31/07/2013 / 0
Monitoring equipment:	n/a
Measuring/ Reading/ Recording frequency:	Biogas flow is registered by the SCADA system of the biogas plant, the time is also recorded, which allows for a calculation of the time period of biogas being sent to the flare.
Calculation method (if applicable):	n/a
QA/QC procedures:	Maintenance of the flare system is conducted periodically as per supplier's specifications to ensure optimal operation.
Purpose of data:	Calculation of project emissions
Additional comment:	The parameters, which are the temperature of the exhaust gases of the flare and the time of biogas sent to flare, used for estimation the flare efficiency are not recorded properly, thereby resulting the efficiency is zero.

D.3. Implementation of sampling plan

>> The section is left blank intentionally.

SECTION E. Calculation of emission reductions or GHG removals by sinks

E.1. Calculation of baseline emissions or baseline net GHG removals by sinks

>> Baseline emissions are the sum of emissions from the degradable organic matter in the treated wastewater (calculated according to AMS.III.H version 9) and the emission due to the displacement of electricity from the grid (calculated according to AMS.I.D version 13).

$$\mathbf{BE_y = BE_{y,el} + BE_{y,ww}} \quad \textbf{(1)}$$

Where:

BE_y	Baseline emissions in the year "y" (tCO_2e)
$BE_{y,el}$	Baseline emissions from grid's electricity displaced by the project activity during the year y in tCO_2e
$BE_{y,ww}$	Baseline Emissions from degradable organic carbon in treated wastewater in year "y"

$$\mathbf{BE_{y,el} = EF_y * EG_y} \quad \textbf{(2)}$$

Where:

$BE_{y,el}$	The baseline emissions from grid's electricity displaced by the project activity during the year y in tCO_2e/MWh.

EF_y	Emission factor from the electricity displaced by the project activity during year "y". As electricity is exported to the grid, the emission factor of the national grid will be chosen: EF y = EF grid, y. (Calculated – Fixed ex-ante)
EG_y	Electricity generated during year y by power generation facility (MWh)

For the case of introduction of a sequential anaerobic wastewater treatment system with methane recovery (option (vi) according to AMS.III.H), Paragraph 24 of AMS III.H. Version 09, applies to baseline emissions as follows:

$$\mathbf{BE_{y,ww} = Q_{y,ww} * \sum_i (COD_{y,removed,j} * B_{o,ww} * MCF_{ww,treatment,j} * GWP_{CH4})} \quad \mathbf{(3)}$$

Where:

$BE_{y,ww}$	Baseline Emissions from degradable organic carbon in treated wastewater in year "y" (tCO_2/yr)
$Q_{y,ww}$	Volume of wastewater treated in the year "y" (m^3/yr)
$COD_{y,removed,j}$	Chemical oxygen demand removed by the anaerobic wastewater treatment systems "j" in the baseline situation in the year "y" to which the sequential anaerobic treatment step is being introduced in tonnes/m^3 (COD content of in the inlet and outlet of the lagoon system has been monitored for determination of the COD removed) As electricity is exported to the grid, the emission factor of the national grid will be chosen: EF y = EF grid, y. (Calculated – Fixed ex-ante)
$B_{o,ww}$	Methane producing capacity of the wastewater (The IPCC default value for domestic wastewater of 0.21 kg CH_4/kg COD)[8]
$MCF_{ww,treatment,j}$	Methane correction factor for the existing anaerobic wastewater treatment systems "j" to which the sequential anaerobic treatment step is being introduced (MCF lower value in Table III.H.1.)
GWP_{CH4}	Global Warming Potential for methane (value of 21 is used)

[8] As per AMS.III.H, the IPCC default value of 0.25 kg CH_4/kg COD was corrected to take into account the uncertainties.

Baseline emissions

		2011 01/01 - 31/12	2012 01/01 - 31/12	2013 01/01 - 31/07
$Q_{y, ww}$	m^3	846,845	1,139,341	586,738
$COD_{y, removed}$	mg/l	12,883	12,968	12,969
$Q_{biogas,total,y}$	Nm^3	4,655,353	6,622,729	3,584,618
$Q_{biogas,generator,y}$	Nm^3	4,513,441	5,904,166	3,466,368
%CH4 - 95% lower		58.67%	59.72%	60.32%

$BE_{y, power}$	**tCO_2**	**3,286**	**4,584**	**2,844**
$BE_{y,ww}$(COD)	**tCO_2**	**38,490**	**52,127**	**26,847**
$BE_{y,ww}$ (biogas)	**tCO_2**	**39,815**	**53,015**	**31,440**

E.2. Calculation of project emissions or actual net GHG removals by sinks

>> The project activity emissions are calculated as follows:

$$PE_y = PE_{y, power} + PE_{y, ww, treated} + PE_{y, s, final} + PE_{y, fugitive} + PE_{y, dissolved} + PE_{y, upgrading} + PE_{y, leakage, pipeline} \quad (4)$$

Where:

PE_y	Project activity emissions in the year "y" (tCO_2e)
$PE_{y, power}$	Emissions from electricity or fossil fuel consumption in the year "y"
$PE_{y, ww, treated}$	Emissions from degradable organic carbon in treated wastewater in year "y"
$PE_{y, s, final}$	Emissions from anaerobic decay of the final sludge produced in the year "y"
$PE_{y, fugitive}$	Emissions from methane release in capture and utilization/combustion/flare systems in year "y"
$PE_{y, dissolved}$	Emissions from dissolved methane in treated wastewater in year "y"
$PE_{y, upgrading}$	Emissions related to the upgrading and compression of biogas in year "y"
$PE_{y, leakage, pipeline}$	Emissions due to physical leakage from the dedicated piped network in year "y"

Project activity emissions from degradable organic carbon in the treated wastewater ($PE_{y, ww, treated}$)

$$PE_{y, ww, treated} = Q_{y, ww} * COD_{y, ww, treated} * B_{o, ww} * MCF_{ww, final} * GWP_{CH4} \quad (5)$$

Where:

$PE_{y, ww, treated}$	Emissions from degradable organic carbon in treated wastewater in year "y" (tCO_2e)
$Q_{y, ww}$	Volume of wastewater treated in the year "y" (m^3/yr)
$COD_{y, ww, treated}$	Chemical oxygen demand of the treated wastewater in the year "y" ($tonnes/m^3$)
$B_{o, ww}$	Methane producing capacity of the wastewater (IPCC default value of 0.21 kg CH_4/kg COD)[9]
$MCF_{ww, final}$	Methane correction factor based on type of treatment and discharge pathway of the wastewater (as per AMS.III.H a value of 0.2 shall be used for wastewater discharge to sea, river or lake)
GWP_{CH4}	Global Warming Potential for methane (value of 21 is used)

The sludge removed from project activity is used for starting new anaerobic digesters or restarting other digesters by the same technology provider and is not dumped on a landfill site. Thereby no emissions from sludge removal take place in project activity.

Project activity emissions from anaerobic decay of the final sludge (PEy, s, final)

$$\mathbf{PE_{y, s, final} = S_{y, final} * DOC_{y, s, final} * 16/12 * MCF_{s, final} * DOC_F * F * GWP_{CH4}} \quad \mathbf{(6)}$$

Where:

$PE_{y, s, final}$	Methane emissions from the anaerobic decay of the final sludge generated in the wastewater system in the year "y" (tCO_2e)
$S_{y, final}$	Amount of final sludge generated by the wastewater treatment in the year "y" (tonnes)
$DOC_{y, s, final}$	Degradable organic content of the final sludge generated by the wastewater treatment in the year "y" (fraction). IPCC default value of 0.09 for industrial sludge (wet basis, assuming dry matter content of 35 percent) will be used.
$MCF_{s, final}$	Methane correction factor of the landfill that receives the final sludge, estimated as described in category AMS III.G. A default conservative value of 1 will be used.
DOC_F	Fraction of DOC dissimilated to biogas (IPCC default value of 0.5)
F	Fraction of CH4 in landfill gas (IPCC default of 0.5)
GWP_{CH4}	Global Warming Potential for methane (value of 21 is used)

The sludge removed from project activity is used for starting new anaerobic digesters or restarting other digesters by the same technology provider and is not dumped on a landfill site. Thereby no emissions from sludge removal take place in project activity.

Fugitive emissions from methane release in capture and flare systems ($PE_{y, fugitive}$)

$$\mathbf{PE_{y, fugitive} = PE_{y, fugitive, ww} + PE_{y, fugitive, s}} \quad \mathbf{(7)}$$

Where:

$PE_{y, fugitive, ww}$	Fugitive emissions through capture and utilization/combustion/flare inefficiencies in the

[9] As per AMS.III.H, the IPCC default value of 0.25 kg CH4/kg COD was corrected to take into account the uncertainties.

	anaerobic wastewater treatment in year "y" (tCO_2e)
$PE_{y, fugitive, s}$	Fugitive emissions through capture and utilization/combustion/flare inefficiencies in the anaerobic sludge treatment in the year "y" (tCO_2e)

The second term of the equation above is not applicable because the project activity does not comprise an anaerobic treatment system for sludge; it consists of an anaerobic treatment system for wastewater only. Hence, the term $PE_{y, fugitive, s}$ is neglected.

The first term of the equation above is calculated as follows:

$$\mathbf{PE_{y, fugitive, ww} = (1-CFE_{ww}) * MEP_{y, ww, treatment} * GWP_{CH4}} \quad \mathbf{(8)}$$

Where:

CFE_{ww}	Capture and flare efficiency of the methane recovery and combustion equipment in the wastewater treatment (a default value of 0.9 is used)
GWP_{CH4}	Global Warming Potential for methane (value of 21 is used)
$MEP_{y, ww, treatment}$	Methane emission potential of the wastewater treatment plant in the year "y" (tonnes), which is calculated according to the equation below

$$\mathbf{MEP_{y, ww, treatment} = Q_{y, ww} * B_{o, ww} * \sum_j COD_{y, removed, j} * MCF_{ww, j}} \quad \mathbf{(9)}$$

Where:

$Q_{y, ww}$	Volume of wastewater treated in the year "y" (m^3/yr)
$COD_{y, removed, j}$	The chemical oxygen demand removed by the treatment system "j" of the project activity equipped with methane recovery in the year "y" ($tonnes/m^3$)
$MCF_{ww, j}$	Methane correction factor for the wastewater treatment system "j" equipped with methane recovery and combustion/flare/utilization equipment (MCF higher values in table III.H.1)
$B_{o, ww}$	Methane producing capacity of the wastewater (IPCC default value of 0.21 kg CH_4/kg COD)[10]

For this project, we only consider one treatment system j:

- The treatment system is the UASB digester. $COD_{y, removed, i}$ is estimated as the difference of the COD values between the inlet and outlet of the digester.

Emissions from dissolved methane in treated wastewater ($PE_{y, dissolved}$)

$$\mathbf{PE_{y, dissolved} = Q_{y, ww} * [CH4]_{y, ww, treated} * GWP_{CH4}} \quad \mathbf{(10)}$$

Where:

$PE_{y, dissolved}$	Emissions from dissolved methane in treated wastewater in year "y" (tCO_2e)

[10] As per AMS.III.H, the IPCC default value of 0.25 kg CH4/kg COD was corrected to take into account the uncertainties.

$Q_{y, ww}$	Volume of wastewater treated in the year "y" (m^3/yr)
$[CH4]_{y, ww, treated}$	Dissolved methane content in the treated wastewater (tonnes/m^3). In aerobic wastewater treatment default value is zero, in anaerobic treatment it can be measured, or a default value of $10e^{-4}$ tonnes/m^3 can be used.
GWP_{CH4}	Global Warming Potential for methane (value of 21 is used)

Here a the default value for the dissolved methane in anaerobic treatment has been applied: $[CH4]_{y, ww, treated} = 10^{-4}$ tonnes/m^3

Emissions from flaring of biogas ($PE_{y, flare}$)

The project emissions from flaring are incorporated into the emission reduction calculations as per the clarifications to the version 09 of the methodology[11].

$$PE_{y,flare} = \sum_{h=1}^{8760} TM_{RG,h} * (1 - \eta_{flare,h}) * \frac{GWP_{CH4}}{1000} \quad \textbf{(11)}$$

Where:

$TM_{RG, h}$	Mass flow rate of methane in the residual gas in hour h (kg/h)
$\eta_{flare, h}$	Flare efficiency in hour h

If the flare efficiency is constant / proved to be default value over the whole monitoring period. The formula can be rewritten as follows:

$$\sum_{h=1}^{8760} TM_{RG,h} = Q_{biogas, flare, y} * \%CH_4 * D_{CH4}$$

Where:

$Q_{biogas, flare, y}$	The biogas quantity flared by the project activity (Nm^3)
$\%CH_4$	Methane % in biogas, based on 95% confidence limit, for conservative estimation
D_{CH4}	Density of methane at normal conditions

Emission from upgrading and use of bottled biogas $PE_{y, upgrading}$ and from pipeline leakage $PE_{y, leakage, pipeline}$

No production, upgrading, pipeline transportation and use of bottled biogas is planned in this project, thus:

$PE_{y, leakage, pipeline} = 0$

$PE_{y, upgradining} = 0$

11 http://cdm.unfccc.int/UserManagement/FileStorage/AM_CLAR_7MXW3CMZV4OVLA7J2QFUJ0MAMUKBVA

Project activity emissions from electricity or fossil fuel consumption ($PE_{y, power}$)

All the equipments that are involved in operation of biogas generation and consumption are to be included in estimation of power consumption. The power consumption (MWh) is multiplied with the national grid emission factor of electricity (tCO_2e/MWh).

$$PE_{y, power} = EF_y * EC_y \quad (12)$$

Where:

$PE_{y, power}$	Emissions from electricity or fossil fuel consumption in the year "y" (tCO_2e)
EC_y	Electricity consumed during year y from the national grid (MWh)
EF_y	Emission factor from the national grid electricity consumed by the project activity during year "y" (tCO_2e/MWh)

No fossil fuel is used for the operation of the project activity. Only electricity is contributed to $PE_{y, power}$. $EF_{grid, y}$ is calculated ex-ante and remains fixed during the whole crediting period.

Project emissions

		2011 01/01 - 31/12	2012 01/01 - 31/12	2013 01/01 - 31/07
$Q_{y, ww}$	m^3	846,845	1,139,341	586,738
$COD_{y, ww, treated}$	t/m^3	0.000114	0.000117	0.000086
$PE_{y, ww, treated}$	tCO_2	**85**	**118**	**45**
$PE_{y, s, final}$	tCO_2	**0**	**0**	**0**
$MEP_{y, ww, treatement}$		2,382	3,103	1,598
$Q_{biogas, flare,y}$	Nm^3	0	660,620	0
Flare Efficiency		0%	0%	0%
%CH4 - 95% upper	%	60.67%	60.30%	60.58%
$PE_{y,flare}$	tCO_2	**0**	**5,990**	**0**
$PE_{y, fugutive, ww}$	tCO_2	**5,001**	**6,516**	**3,356**
$PE_{y, dissolved}$	tCO_2	**1,778**	**2,393**	**1,232**
EC_y	MWh	242	142	82
$PE_{y, power}$	tCO_2	**122**	**72**	**41**

E.3. Calculation of leakage

>> For AMS IIIH, there is no bottling unit thereby nil leakages on account of bottling activity.

No equipment transfer takes place as an effect of project activity. All the equipments are purchased first hand and thereby no leakage considerations.

E.4. Summary of calculation of emission reductions or net anthropogenic GHG removals by sinks

Item	Baseline emissions or baseline net GHG removals by sinks (t CO_2e)	Project emissions or actual net GHG removals by sinks (t CO_2e)	Leakage (t CO_2e)	Emission reductions or net anthropogenic GHG removals by sinks (t CO_2e)
Total	128,177	26,749	0	101,426

E.5. Comparison of actual emission reductions or net anthropogenic GHG removals by sinks with estimates in registered PDD

Item	Values estimated in ex-ante calculation of registered PDD	Actual values achieved during this monitoring period
Emission reductions or GHG removals by sinks (t CO_2e)	118,431	101,426

E.6. Remarks on difference from estimated value in registered PDD

>> The actual emission reduction achieved during this monitoring period is less than the values estimated in ex-ante calculation of the registered PDD.

E.7. Actual emission reductions or net anthropogenic GHG removals by sinks during the first commitment period and the period from 1 January 2013 onwards

Item	Actual values achieved up to 31 December 2012	Actual values achieved from 1 January 2013 onwards
Emission reductions or GHG removals by sinks (t CO_2e)	76,410	25,016

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Document information

Version	*Date*	*Description*
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net anthropogenic GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01	28 May 2010	EB 54, Annex 34. Initial adoption.

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