MONITORING REPORT FORM (F-CDM-MR)
Version 02.0

MONITORING REPORT

Title of the project activity	Vinasse Anaerobic Treatment Project - Compañía Licorera de Nicaragua, S. A. (CLNSA)
Reference number of the project activity	Project 0675
Version number of the monitoring report	Version 1
Completion date of the monitoring report	12/07/2012
Registration date of the project activity	09/03/2007
Monitoring period number and duration of this monitoring period	Monitoring Period No. 2 01/07/2008 - 05/05/2010
Project participant(s)	- Compañía Licorera de Nicaragua, S. A. (CLNSA) - Corporación Andina de Fomento – CAF (Acting as intermediary for the benefit of the State of the Netherlands for the purchase of Emission Reductions)
Host Party(ies)	Nicaragua
Sectoral scope(s) and applied methodology(ies)	Sectoral Scope 13: Waste handling and disposal Applied methodology: AM0013 (Version 3) - Avoided methane emissions from organic waste-water treatment
Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD	229,989 tCO_2e Note: this estimation takes into account the annual ex ante estimation (124,827 tCO_2e) and the following monitoring period: 6 months in 2008, 12 months in 2009 and 4 months and 5 days in 2010. The calculation is made as follows: 6/12 * (124,827) + 124,827 + (31 + 28 + 30 + 31 + 5)/365 * (124,827) = 229,989 tCO_2e
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	118,108 tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

The purpose of the project is to treat the wastewater (vinasse) generated during alcohol's productive process, degrading the organic matter to produce methane, which is a clean fuel from a renewable source (biomass).

The project consists of two up-flow anaerobic contact biodigesters (UAC) for the anaerobic treatment of organic wastewater in alcohol production. The methane is generated from chemical reactions of bacteria in an oxygen-free environment, which is captured and combusted to produce heat and/or electricity. The methane is utilized for substitution of fuel oil in the boilers (steam is required for alcohol production), reducing the dependence of CLNSA on fossil fuels.

The Emission Reductions of the project arise from two sources:

i) Methane Capture, which would have been, otherwise, released from the oxidation lagoons to the atmosphere.
ii) The displacements of fuel oil by combusting the recovered methane to produce energy.

The project's construction started on April 2002, while operations began on June 2003. The project had a previous monitoring period that has already been reported (June 3rd, 2003 to June 30th, 2008); and continued its operations in this second monitoring period (01/07/2008 - 05/05/2010).

The amount of emission reductions achieved during current monitoring period is 118,108 tCO_2eq.

A.2. Location of project activity

The project's location is:

Town:	Chichigalpa
City:	Chinandega
Country:	Nicaragua
GPS coordinates:	Latitude 12° 34' 44.8674"(N) Longitude 87° 1' 20.2686" (W)

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)
Nicaragua	Compañía Licorera de Nicaragua, S. A. (CLNSA)	No
The State of the Netherlands	Corporación Andina de Fomento – CAF (acting as administrator of the CAF-Netherlands CDM facility (The Ministry of Infrastructure and the Environment)[1]	Yes

A.4. Reference of applied methodology

Methodologies used for this project are:

- AM0013 – Avoided Methane Emissions from Organic Waste-Water Treatment (Version 3)
- ACM0002 – Consolidated Baseline Methodology for Grid-Connected Electricity Generation from Renewable Sources (Version 6) (This methodology was used solely to calculate the CO_2 emission factor for electricity consumed at the project site in the absence of the project activity ($CEF_{BI,elec}$), as stated by AM0013 v3.)

A.5. Crediting period of project activity

The crediting period for the project is fixed for 10 years: from June 3rd, 2003 to June 2nd, 2013.

[1] Ministry of Housing, Spatial Planning and Environment (VROM) changed its name to Ministry of Infrastructure and the Environment (IenM), who was determined as focal point in the MOC Format

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

The project started operations on June 3rd, 2003 (Stage 1 - the Anaerobic Treatment System). The Second Stage (Heat Generation System), started operations in August 2003. The third Stage (Laminar Irrigation System), which seeks methane avoidance and fertilization, began operating in May 2005. The Fourth Stage (Cogeneration System) has not been implemented in the current monitoring period. The implementation of the Co-Generation System (Stage 4) was originally planned for January 2008, according to the PDD. However, there have been some delays in its implementation due to the following technical and financial reasons:

1. The first three years were fully dedicated to the stabilization of the plant. It took 3 years to reach the biogas production goal. Since the investment in the plant was large and it was still not working as expected, no other large investment was considered until the first phase was working well. This was the major issue that delayed Stage 4.
2. Since the third year several energy generation alternatives have been evaluated, but none of them has been the right choice for CLNSA´s biogas plant. The main problem has been finding a biogas purifying system (SH2 and Humidity Reduction) that fits the characteristics of the biogas generated in CLNSA and demonstrates economic feasibility (up to now, the only technically viable option costs more than the entire effluent treatment plant, making it unviable from an economic standpoint).
3. The original financial analysis of the plant considered the income from the CERs, and since no income has been received from the CERs, the cash flow for the project has been negatively affected. The first verification process took longer than expected because project activities started prior to the approval of methodology AM0013, and the methodology itself was revised twice prior to the registration of the project.

B.2. Post registration changes

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

N/A

B.2.2. Corrections

N/A

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

N/A

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

This period began on July 1st 2008 and ended on May 5th 2010, when the project was stopped due to a strategic decision of CLNSA to move the distillery to a new site (5 kilometers away). This decision would have impacted the project's operating costs significantly since the required vinasse for the biodigester

would have needed to be pumped 5 kilometres away. Because of this, CLNSA decided to stop project operations to avoid economic losses.

B.2.5. Changes to start date of crediting period

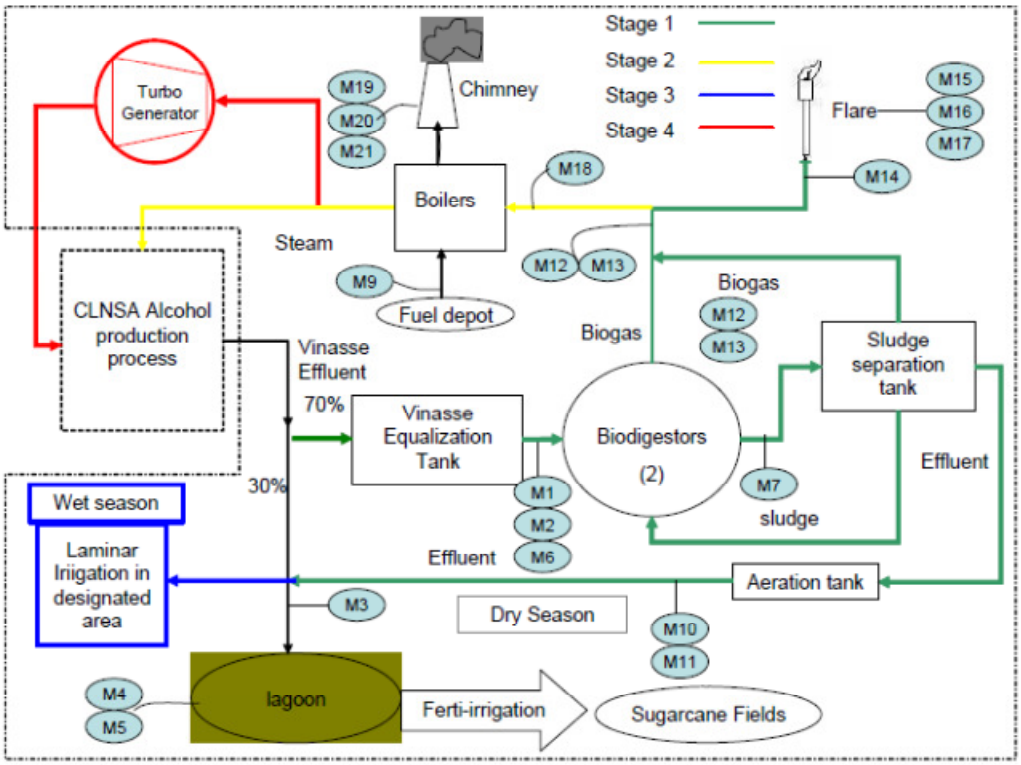
N/A

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

N/A

SECTION C. Description of monitoring system

The monitoring methodology used for project 0675 is Methodology AM0013 – Avoided Methane Emissions from Organic Waste-Water Treatment – Version 3. The relevant monitoring points are shown in the following diagram:



----- Project boundary

Monitoring and reporting systems have been developed and implemented by CLNSA (including systems for the Biodigester), which are ISO-9001 and ISO-14001 certified. As a result, processes and procedures have been established to ensure maximum operational integrity. Laboratory measurement instrumentation is regularly calibrated to maintain ISO certifications. CLNSA has developed specific guidelines for measuring, monitoring, and reporting operational conditions. For these reasons, the monitoring procedures listed above are characterized as appropriate to the exigencies of any audit or verification procedures. Those variables that are measured directly are characterized as having low uncertainty levels; and for those parameters that are measured indirectly uncertainty levels have been characterized as medium to be conservative, according to PDD.

Physical documentation (including records) such as paper-based maps, diagrams, and environmental assessments, Excel files and any digital files related to the Project activity are stored in a central place, together with the monitoring plan and CDM documentation. The storage is carried out in accordance with the controls required by the standard ISO 9001, which among other includes controls for the protection, traceability, access and availability. Documents and record controls are also in compliance with the requirements established in the monitoring methodology, such as record keeping.

All information is stored at CLNSA's production facilities in Chichigalpa, Chinandega. The person with overall responsibility for the documentation of the CLNSA project at Chichigalpa is the Biodigester Plant Manager.

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

Data / Parameter:	**B_O**
Data unit:	kg CH_4/kg COD
Description:	Maximum methane producing capacity
Source of data used:	AM0013 version 03 (p.7)
Value(s) :	0.21
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions calculations
Additional comment:	**-**

Data / Parameter:	**f_d**
Data unit:	%
Description:	Fraction of anaerobic degradation due to depth
Source of data used:	AM0013 version 03 (p. 7)
Value(s) :	50 %
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions calculations
Additional comment:	Table 1 of AM0013 Version 03 states that the fraction of degradation under anaerobic conditions for an average depth of 1.5 meters is 50%.

Data / Parameter:	**Uncertainty conservativeness factor**
Data unit:	**-**
Description:	Uncertainty conservativeness factor
Source of data used:	AM0013 version 03 (p. 7)
Value(s) :	0.89
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions calculations
Additional comment:	The uncertainty conservativeness factor (for an uncertainty range of 30% to 50%) is used to account for the fact that the equation used to estimate $F_{t,monthly}$ assumes full anaerobic degradation at 30 °C.

Data / Parameter:	**E**
Data unit:	Cal / mol
Description:	Activation energy constant
Source of data used:	AM0013 version 03 (p. 7)
Value(s) :	15,175
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions calculations
Additional comment:	**-**

Data / Parameter:	T_1
Data unit:	K
Description:	Temperature at which full anaerobic degradation occurs
Source of data used:	AM0013 version 03 (p. 7)
Value(s) :	303.16
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions calculations
Additional comment:	-

Data / Parameter:	R
Data unit:	Cal / K mol
Description:	Ideal gas constant
Source of data used:	AM0013 version 03 (p. 8)
Value(s) :	1.987
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions calculations
Additional comment:	-

Data / Parameter:	GWP_{CH4}
Data unit:	-
Description:	Global warming potential of CH_4
Source of data used:	AM0013 version 03 (p. 8)
Value(s) :	21
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline / Project emissions calculations
Additional comment:	-

Data / Parameter:	EG
Data unit:	MWh
Description:	The amount of electricity that would be consumed at the project site in the absence of the project activity.
Source of data used:	PDD (p. 48)
Value(s) :	0 (prior to 2012)
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions calculations
Additional comment:	-

Data / Parameter:	CECF
Data unit:	kWh/Nm^3 biogas
Description:	Cogeneration electric conversion factor
Source of data used:	PDD (p. 48)
Value(s) :	0.676
Indicate what the data are used for (Baseline/ Project/	Baseline emissions calculations

Leakage emission calculations)	
Additional comment:	-

Data / Parameter:	**FOE**
Data unit:	gal / Nm^3
Description:	Bunker C fuel oil equivalent of biogas
Source of data used:	PDD (p. 50)
Value(s) :	0.145
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions calculations
Additional comment:	-

Data / Parameter:	**HV**
Data unit:	MJ/gal
Description:	Heating value of bunker C fuel oil
Source of data used:	PDD (p. 50)
Value(s) :	152.9
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions calculations
Additional comment:	-

Data / Parameter:	**TER**
Data unit:	-
Description:	Thermal to electric ratio of the cogeneration system
Source of data used:	PDD (p. 51)
Value(s) :	4.3
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions calculations
Additional comment:	-

Data / Parameter:	$\eta_{baselineboiler}$
Data unit:	%
Description:	Efficiency of the baseline boiler
Source of data used:	PDD (p. 51)
Value(s) :	80%
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions calculations
Additional comment:	-

Data / Parameter:	$BF_{digester}$
Data unit:	Nm^3 biogas/kg COD
Description:	COD to biogas conversion factor
Source of data used:	PDD (p. 60)

Value(s) :	0.364
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emissions calculations
Additional comment:	-

Data / Parameter:	**MF**
Data unit:	%
Description:	Methane fraction of biogas
Source of data used:	PDD (p. 60)
Value(s) :	55%
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emissions calculations
Additional comment:	-

Data / Parameter:	**VM**
Data unit:	$tCH_4 / Nm^3 CH_4$
Description:	Volume to mass conversion factor
Source of data used:	PDD (p. 60)
Value(s) :	0.0007176
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emissions calculations
Additional comment:	-

Data / Parameter:	**$LF_{digester}$**
Data unit:	%
Description:	Percentage of biogas leaking from digester
Source of data used:	PDD (p. 60)
Value(s) :	5%
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emissions calculations
Additional comment:	-

Data / Parameter:	**DEF**
Data unit:	%
Description:	Destruction efficiency factor for low pressure boiler
Source of data used:	PDD (p.61)
Value(s) :	99%
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emissions calculations
Additional comment:	The description of the project emissions calculation formulas in Section E.2 of the PDD (p. 61) suggest a conservative default factor of 99% as destruction efficiency for the heat generation equipment.

Data / Parameter:	DEF
Data unit:	%
Description:	Destruction efficiency factor for open flare
Source of data used:	AM0013 version 3 (p.10)
Value(s) :	50%
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emissions calculations
Additional comment:	As proposed in page 10 of AM0013 Version 3 and in the description of project emissions calculation formulas under Section E.2 of the PDD (p. 61), a conservative destruction factor of 50% should be used for open flares in cases where the efficiency of the flare cannot be measured.

Data / Parameter:	$CEF_{Bl,therm}$
Data unit:	tCO_2 / MJ
Description:	CO_2 emissions intensity for thermal energy generation
Source of data used:	AM0013 version 3 (p.9)
Value(s) :	0.00007652
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculations
Additional comment:	-

D.2. Data and parameters monitored

Variable Equivalence Table				
Variable Number According to PDD	**Variable Number According to Methodology**	**Variable Symbol According to Methodology**	**Description**	**Units**
M1	1	F_{dig}	Flow rate of organic wastewater into the digester	m^3/yr
M2	2	$COD_{c,Bl}$	Concentration of organic wastewater into the digester or directed for land application	kg/m^3
M3	4	$COD_{a,in}$	COD that enters the lagoon	kg/yr
M4	5	T_{lag}	Ambient Temperature	K
M5	6	D_{lag}	Depth of lagoon	m
M6	10	F_{dig_out}	Flow rate of organic wastewater into the digester	m^3/yr
M7	11	COD_{c,dig_out}	Concentrations in discharged effluent from digester	Kg/m^3
M8	12	$EL_{p,y}$	Amount of electricity in the year y that is consumed at the project site for the project activity	MWh

M9	-	-	Mass of fossil fuel used onsite	Kg fuel
M10	18	FR_{bio}	Amount of biogas collected in the outlet of the Biodigester	m^3/yr
M11	19	$P_{CH4,bio}$	Percentage of methane in the biogas in the outlet of the biodigester	%
M12	20	$FR_{f,inlet}$	Flow rate of the biogas entering the flare	m^3/yr
M13	21	$FR_{f,s}$	Flow rate of the flare stack gases	m^3/yr
M14	22	$P_{CH4,f,s}$	Methane content in the stack gas of flare	%
M15	23	$T_{comb,f}$	Fraction of time gas is combusted in the flare	fraction
M16	28	$FR_{e,inlet}$	Flow rate of the biogas entering the heat generation equipment	m^3/yr
M17	29	$FR_{e,s}$	Flow rate of the heat generation equipment stack gases	m^3/yr
M18	30	$P_{CH4,e,s}$	Methane content in stack gas of heat generation equipment	%
M19	31	$T_{comb,e}$	Fraction of time gas is combusted in the heat generation equipment	fraction
M20	24	$FR_{e,inlet}$	Flow rate of the biogas entering the electricity generation equipment	m^3/yr
M21	25	$FR_{e,s}$	Flow rate of the electricity generation equipment stack gases	m^3/yr
M22	26	$P_{CH4,e,s}$	Methane content in stack gas of electricity generation equipment	%
M23	27	$T_{comb,e}$	Fraction of time gas is combusted in the heat generation equipment	fraction
M24	-	-	Electricity consumed by digester parasitics	MWh
M25	-	-	Electricity consumed by condenser pumps and fans associated with electricity generation	MWh
B1	-	-	COD concentration of effluent at digester inlet	Kg/m^3
B2	-	-	Flow rate of effluent at digester inlet	m^3/hr
B3	-	-	Electricity generated by project	MWh
B4	-	-	Low pressure steam at back pressure turbine exit	Klbs

Data / Parameter:	**M1 (F_{dig})**
Unit:	m^3 / yr
Description:	Flow rate of organic wastewater into the digester
Measured /Calculated /Default:	Measured. Since there are two biodigesters, and each has its own flow meter to measure the flow rate of organic wastewater, their results are added to calculate the total amount of wastewater flowing into the digesters. These instruments were calibrated in February 2008 and then in January 2010. The calibration that took place in 2010 showed that the equipment was working within the normal uncertainty range and therefore no correction factor is required.
Source of data:	Flow meter
Value(s) of monitored parameter:	Refer to Monitoring Report Excel data sheet
Monitoring equipment	**Equipment 1:** Magnetic Flow Meter **Brand:** Rosemount **Model:** 570TM **Serial Number:** 02–FM–1023 **Accuracy:** 1% (According to Reference Manual 00809-0100-4900, Rev AA, December 2001) **Calibration Frequency:** Once per year **Date of Last Calibration:** February 2008, January 2010 **Equipment 2:** Magnetic Flow Meter **Brand:** Rosemount **Model:** 570TM **Serial Number:** 02–FM–1024 **Accuracy:** 1% (According to Reference Manual 00809-0100-4900, Rev AA, December 2001) **Calibration Frequency:** Once per year **Date of Last Calibration:** February 2008, January 2010
Measuring/ Reading/ Recording frequency:	Continuous
Calculation method (if applicable):	N/A
QA/QC procedures applied:	Flow meters will be subject to regular maintenance and testing regime to ensure accuracy
Purpose of Data	Baseline emissions calculations
Additional Comments	

Data / Parameter:	**M2 ($COD_{c,Bl}$)**
Unit:	KgCOD / m^3
Description:	COD concentration of organic wastewater into the digester or directed to land application
Measured /Calculated /Default:	Measured by closed reflux, colorimetric method
Source of data:	Spectrophotometer
Value(s) of monitored parameter:	Refer to Monitoring Report Excel data sheet
Monitoring equipment	**Equipment 1:** Spectrophotometer **Brand:** HACH **Model:** DR2800 **Type:** LPG422.99.00002 **Serial Number:** 1209668 **Accuracy: ±** 1,5 nm, 5 mAbs at 0.0–0.5 Abs, 1% at 0.50–2.0 Abs (According to User´s Manual November 2009, Edition 3) **Calibration Frequency:** Every 6 months **Date of Last Calibration:** June 2008, December 2008, June 2009, December 2009. **Equipment 2:** Thermo reactor **Brand:** HACH **Model:** DR200 **Type:** LTG082.03.40001 **Serial Number:** 09120C0236 **Accuracy:** ± 2 °C (According to Manufacturer´s Final Inspection Certificate) **Calibration Frequency:** N/A **Date of Last Calibration:** N/A
Measuring/ Reading/ Recording frequency:	Monthly
Calculation method (if applicable):	N/A
QA/QC procedures applied:	The spectrophotometer will be subject to regular maintenance and testing regime to ensure accuracy
Purpose of Data	Baseline emissions calculations
Additional Comments	

Data / Parameter:	**M3 ($COD_{a,in}$)**
Unit:	KgCOD / yr
Description:	COD that enters the lagoon
Measured /Calculated /Default:	Measured by closed reflux, colorimetric method
Source of data:	Spectrophotometer
Value(s) of monitored parameter:	Refer to Monitoring Report Excel data sheet
Monitoring equipment	**Equipment 1:** Spectrophotometer **Brand:** HACH **Model:** DR2800 **Type:** LPG422.99.00002 **Serial Number:** 1209668 **Accuracy: ±** 1,5 nm, 5 mAbs at 0.0–0.5 Abs, 1% at 0.50–2.0 Abs (According to User´s Manual November 2009, Edition 3) **Calibration Frequency:** Every 6 months **Date of Last Calibration:** June 2008, December 2008, June 2009, December 2009. **Equipment 2:** Thermoreactor **Brand:** HACH **Model:** DR200 **Type:** LTG082.03.40001 **Serial Number:** 09120C0236 **Accuracy:** ± 2 °C (According to Manufacturer´s Final Inspection Certificate) **Calibration Frequency:** N/A **Date of Last Calibration:** N/A **Equipment 3:** Precision Hydrometer (Brixometer) **Brand:** VWR
Measuring/ Reading/ Recording frequency:	Historical 1 year data
Calculation method (if applicable):	(effluent COD / 1000 * inlet flow * 24 hrs) + (untreated vinasse Flow * untreated vinasse COD / 1000 * 24 hrs)
QA/QC procedures applied:	The spectrophotometer will be subject to regular maintenance and testing regime to ensure accuracy
Purpose of Data	Baseline emissions calculations
Additional Comments	

Data / Parameter:	**M4 (T_{lag})**
Unit:	°K
Description:	Ambient Temperature
Measured /Calculated /Default:	Measured In order to avoid any uncertainties related to temperature measurements, ambient temperature measurements from an official weather station close to the project site are used instead of on-site measurements. The weather station is located only 10.9 km away and its elevation is only 33 m higher than the project site, thus ambient temperature measurements are not expected to differ much from on-site measurements. Furthermore, the weather station measurements to be applied are official and have been conducted according to relevant national standards and procedures.
Source of data:	INETER (Nicaraguan Institute of Territorial Studies)
Value(s) of monitored parameter:	Refer to Monitoring Report Excel data sheet
Monitoring equipment	N/A
Measuring/ Reading/ Recording frequency:	Daily
Calculation method (if applicable):	Temperature °C + 273.16 = °K
QA/QC procedures applied:	N/A
Purpose of Data	Baseline emissions calculations
Additional Comments	

Data / Parameter:	**M5 (D_{lag})**
Unit:	M
Description:	Depth of wastewater in the lagoon
Measured /Calculated /Default:	Default
Source of data:	AM0013 version 3 (p.7)
Value(s) of monitored parameter:	Refer to Monitoring Report Excel data sheet
Monitoring equipment	N/A
Measuring/ Reading/ Recording frequency:	N/A
Calculation method (if applicable):	N/A
QA/QC procedures applied:	N/A
Purpose of Data	Project emissions calculations
Additional Comments	

Data / Parameter:	**M6 (F_{dig_out})**
Unit:	m^3 / yr
Description:	Flow rate of wastewater into digester
Measured /Calculated /Default:	Measured Since there are two biodigesters, and each has its own flow meter to measure the flow rate of organic wastewater, their results are added to calculate the total amount of wastewater flowing into the digesters. These instruments were calibrated in February 2008 and then in January 2010. There was a leap in the calibration frequency in February 2009. Since the equipment should have been calibrated annually, for the period from February 2009 to the date of the second calibration (Jan 2010) a correction factor should have been applied to all the measurements that took place during this period. However, the calibration that took place in 2010 showed that the equipment was working within the correct parameters and no correction factor was required.
Source of data:	Flow meter
Value(s) of monitored parameter:	Refer to Monitoring Report Excel data sheet
Monitoring equipment	**Equipment 1:** Magnetic Flow Meter **Brand:** Rosemount **Model:** 570TM **Serial Number:** 02–FM–1023 **Accuracy:** 1% (According to Reference Manual 00809-0100-4900, Rev AA, December 2001) **Calibration Frequency:** Once per year **Date of Last Calibration:** February 2008, January 2010 **Equipment 2:** Magnetic Flow Meter **Brand:** Rosemount **Model:** 570TM **Serial Number:** 02–FM–1024 **Accuracy:** 1% (According to Reference Manual 00809-0100-4900, Rev AA, December 2001) **Calibration Frequency:** Once per year **Date of Last Calibration:** February 2008, January 2010
Measuring/ Reading/ Recording frequency:	Continuous
Calculation method (if applicable):	(Reactor A inlet * operation hrs) + (Reactor B inlet * operation hrs)
QA/QC procedures applied:	Flow meters will be subject to regular maintenance and testing regime to ensure accuracy
Purpose of Data	Project emissions calculations
Additional Comments	

Data / Parameter:	**M7 (COD_{c,dig_out})**
Unit:	kg COD/m^3
Description:	COD concentration in discharged effluent from digester
Measured /Calculated /Default:	Measured by closed reflux, colorimetric method
Source of data:	Spectrophotometer
Value(s) of monitored parameter:	Refer to Monitoring Report Excel data sheet
Monitoring equipment	**Equipment 1:** Spectrophotometer **Brand:** HACH **Model:** DR2800 **Type:** LPG422.99.00002 **Serial Number:** 1209668 **Accuracy: ±** 1,5 nm, 5 mAbs at 0.0–0.5 Abs, 1% at 0.50–2.0 Abs (According to User´s Manual November 2009, Edition 3) **Calibration Frequency:** Every 6 months **Date of Last Calibration:** June 2008, December 2008, June 2009, December 2009. **Equipment 2:** Thermoreactor **Brand:** HACH **Model:** DR200 **Type:** LTG082.03.40001 **Serial Number:** 09120C0236 **Accuracy:** ± 2 °C (According to Manufacturer´s Final Inspection Certificate) **Calibration Frequency:** N/A **Date of Last Calibration:** N/A **Equipment 3:** Precision Hydrometer (Brixometer) **Brand:** VWR
Measuring/ Reading/ Recording frequency:	Monthly
Calculation method (if applicable):	N/A
QA/QC procedures applied:	The spectrophotometer will be subjected to regular maintenance and testing regime to ensure accuracy
Purpose of Data	Project emissions calculations
Additional Comments	

Data / Parameter:	**M8 ($EL_{p,y}$)**
Unit:	MWh
Description:	Amount of electricity consumed by the project activity during the monitoring period
Measured /Calculated /Default:	Measured
Source of data:	Energy meter
Value(s) of monitored parameter:	Refer to Monitoring Report Excel data sheet
Monitoring equipment	**Equipment 1:** Energy Meter at Biodigester Plant **Brand:** Shark **Model:** 200-60-10-V2-D2-INP100S-X **Serial number:** 710-0021874527 **Accuracy:** 0.2% Class (According to Installation & Operation Manual Revision 1.03, November 18, 2009, Doc #: E149721 V1.03) **Callibration Frequency:** every two years **Date of last calibration:** 5 October 2007 **Equipment 2:** Energy Meter at Boilers **Brand:** Shark **Model:** 200-60-10-V2-D2-INP100S-X **Serial number:** 710-0021874426 **Accuracy:** 0.2% Class (According to Installation & Operation Manual Revision 1.03, November 18, 2009, Doc #: E149721 V1.03) **Callibration Frequency:** every two years **Date of last calibration:** 9 October 2007
Measuring/ Reading/ Recording frequency:	Continuous
Calculation method (if applicable):	N/A
QA/QC procedures applied:	Electricity meters will be subject to a regular maintenance and testing regime to ensure accuracy
Purpose of Data	Project emissions calculations
Additional Comments	

Data / Parameter:	**M9**
Unit:	kg
Description:	Mass of fossil fuel used onsite during the monitoring period
Measured /Calculated /Default:	Measured This variable is measured because, for the company´s internal processes, it is necessary to measure the amount of fossil fuel used onsite. However, this value is not used in the calculation of the emission reductions in accordance with the Methodology AM0013 version 3 formulae. Table "Variable Equivalence Table" on this Monitoring Report shows that variable M9 has no corresponding variable according to the methodology.
Source of data:	Flow meter
Value(s) of monitored parameter:	
Monitoring equipment	**Equipment 1:** Mass flow meter at boiler A **Brand:** Yokogawa Rotamass **Model:** RCCT34 - AH1A02A1SL / AP **Serial number:** 311168/001/03 **Accuracy:** +/-0.1% (According to User's Manual IM 01R04B04-00E-E, 6th edition, June 2007), 0.5% (According to Manufacturer's Calibration Certificate) **Calibration frequency:** Once per year **Date of last calibration:** 20 January 2010 **Equipment 2:** Mass flow meter at boiler B **Brand:** Yokogawa Rotamass **Model:** RCCT34 - AH1A02A1SL / AP **Serial number:** 311168/001/02 **Accuracy:** +/-0.1% (According to User's Manual IM 01R04B04-00E-E, 6th edition, June 2007), 0.5% (According to Manufacturer's Calibration Certificate) **Calibration frequency:** Once per year **Date of last calibration:** 20 January 2010 **Equipment 3:** Mass flow meter at boiler C **Brand:** Yokogawa Rotamass **Model:** RCCT34 - AH1A02A1SL / AP **Serial number:** 305484/001/01 **Accuracy:** +/-0.1% (According to User's Manual IM 01R04B04-00E-E, 6th edition, June 2007), 0.5% (According to Manufacturer's Calibration Certificate) **Calibration frequency**: Once per year **Date of last calibration:** 20 January 2010
Measuring/ Reading/ Recording frequency:	Continuous
Calculation method (if applicable):	(Boiler A flow + boiler B flow + boiler C flow)
QA/QC procedures	Flow meters will be subject to regular maintenance and testing regime to

applied:	ensure accuracy.
Purpose of Data	Calculation of project emissions
Additional Comments	

Data / Parameter:	**M10 (FR_{bio})**
Unit:	m^3/yr
Description:	Biogas flow rate at digester outlet
Measured /Calculated /Default:	Measured This equipment was calibrated in February 2008 and then in January 2010. There was a leap in the calibration frequency in February 2009. Since the equipment should have been calibrated annually, for the period from February 2009 to the date of the second calibration (Jan 2010) a correction factor should have been applied to all the measurements that took place during this period. However, the calibration that took place in 2010 showed that the equipment was working within the correct parameters and no correction factor was required.
Source of data:	Flow meter
Value(s) of monitored parameter:	Refer to Monitoring Report Excel data sheet
Monitoring equipment	**Equipment:** Venturi flow meter **Brand:** Rosemount **Model:** 3051 – CD2A02A1AS5E5M5 **Serial number:** 1259143 Accuracy: 0.15% (According to Product Data Sheet 00813-0100-4001, Rev HA, March 2008) **Calibration frequency:** Once per year **Date of last calibration:** February 2008, January 2010
Measuring/ Reading/ Recording frequency:	Continuous
Calculation method (if applicable):	N/A
QA/QC procedures applied:	Flow meters will be subject to regular maintenance and testing regime to ensure accuracy
Purpose of Data	Project emissions calculations
Additional Comments	

Data / Parameter:	**M11 ($P_{CH4,bio}$)**
Unit:	%
Description:	Percentage of methane in the biogas at biodigester outlet
Measured /Calculated /Default:	Measured by chromatographic analysis
Source of data:	Chromatograph
Value(s) of monitored parameter:	Refer to Monitoring Report Excel data sheet
Monitoring equipment	**Equipment:** Chromatograph **Brand:** Varian **Model:** CP3800 **Accuracy:** Injector: ± 0.1 psi, 5% full scale flow. Detector: ± 7% set point flow (According to Data Sheet WCI-0026.r2 15M 9/03) **Calibration frequency:** Once per year **Date of last calibration:** August 2008, August 2009, January 2010
Measuring/ Reading/ Recording frequency:	Quarterly
Calculation method (if applicable):	N/A
QA/QC procedures applied:	Equipment will be subject to regular maintenance and calibration
Purpose of Data	Project emissions calculations
Additional Comments	

Data / Parameter:	**M12 ($FR_{f,inlet}$)**
Unit:	m^3/yr
Description:	Biogas flow rate at flare inlet
Measured /Calculated /Default:	Calculated
Source of data:	Flow meter
Value(s) of monitored parameter:	Refer to Monitoring Report Excel data sheet
Monitoring equipment	Refer to M10 and M16
Measuring/ Reading/ Recording frequency:	Continuous
Calculation method (if applicable):	Mass balance: Biogas outlet from digester (M10) – boilers biogas inlet (M16) = flare biogas inlet (M12)
QA/QC procedures applied:	Flow meters will be subject to regular maintenance and testing regime to ensure accuracy
Purpose of Data	Project emissions calculations
Additional Comments	

Data / Parameter:	**M13 ($FR_{f,s}$)**
Unit:	m^3/yr
Description:	Flow rate at flare stack gases
Measured /Calculated /Default:	Calculated
Source of data:	M12 and AM0013 Version 3 (p. 10)
Value(s) of monitored parameter:	Refer to Monitoring Report Excel data sheet
Monitoring equipment	Refer to M12
Measuring/ Reading/ Recording frequency:	Continuous
Calculation method (if applicable):	Biogas flow rate at flare inlet (M12) * 50%
QA/QC procedures applied:	Refer to M12
Purpose of Data	Project emissions calculations
Additional Comments	

Data / Parameter:	**M14 ($P_{CH4,f,s}$)**
Unit:	%
Description:	Percentage of methane content in stack gas flare
Measured /Calculated /Default:	Calculated
Source of data:	M11 and AM0013 version 3 (p.10)
Value(s) of monitored parameter:	Refer to Monitoring Report Excel data sheet
Monitoring equipment	Refer to M11
Measuring/ Reading/ Recording frequency:	Quarterly
Calculation method (if applicable):	Percentage of methane in the biogas at biodigester outlet (M11) * 50%
QA/QC procedures applied:	Refer to M11
Purpose of Data	Project emissions calculations
Additional Comments	

Data / Parameter:	**M15 ($T_{comb,f}$)**
Unit:	-
Description:	Fraction of time gas is combusted in the flare
Measured /Calculated /Default:	Measured
Source of data:	Thermocouple
Value(s) of monitored parameter:	Refer to Monitoring Report Excel data sheet
Monitoring equipment	**Equipment:** Thermocouple **Brand:** Jumo **Model:** 956550 / 999 - 888 - 888 **Serial number:** 0005166221 0021500533 **Frequency:** Once per year **Last Calibration:** 8 June 2008
Measuring/ Reading/ Recording frequency:	Continuous
Calculation method (if applicable):	N/A
QA/QC procedures applied:	Equipment will be subject to regular maintenance
Purpose of Data	Project emissions calculations
Additional Comments	

Data / Parameter:	**M16 ($FR_{e,inlet}$)**
Unit:	m^3/yr
Description:	Biogas flow rate at low pressure boiler inlet
Measured /Calculated /Default:	Measured Since there are three boilers, and each has its own flowmeter to measure the flowrate of biogas into it, this variable is measured by three flowmeters, whose results are added to calculate the total amount of wastewater flowing into the digesters. These equipment were calibrated in February 2008 and then in January 2010. There was a leap in the calibration frequency in February 2009. Since the equipment should have been calibrated annually, for the period from February 2009 to the date of the second calibration (Jan 2010) a correction factor should have been applied to all the measurements that took place during this period. However, the calibration that took place in 2010 showed that the equipment was working within the correct parameters and no correction factor was required.
Source of data:	Flow meter
Value(s) of monitored parameter:	Refer to Monitoring Report Excel data sheet
Monitoring equipment	**Equipment 1:** Gas flow meter at boiler A **Brand:** Jumo **Model:** dtrans p02 Delta **Serial number:** 0066503201002390001 **Accuracy:** 0.1% (According to Product Guide Instruments for Hazardous Areas PR 00030 EN) **Calibration frequency:** Once per year **Date of last calibration:** February 2008, January 2010 **Equipment 2:** Gas flow meter at boiler B **Brand:** Jumo **Model:** dtrans p02 Delta **Serial number:** 0063129301002180003 **Accuracy:** 0.1% (According to Product Guide Instruments for Hazardous Areas PR 00030 EN) **Calibration frequency:** Once per year **Date of last calibration:** February 2008, January 2010 **Equipment 3:** Gas flow meter at boiler C **Brand:** Jumo **Model:** dtrans p02 Delta **Serial number:** 0063129301002180004 **Accuracy:** 0.1% (According to Product Guide Instruments for Hazardous Areas PR 00030 EN) **Calibration frequency:** Once per year **Date of last calibration:** February 2008, January 2010
Measuring/ Reading/ Recording frequency:	Continuous
Calculation method (if applicable):	(Gas inlet Boiler A + gas inlet boiler B + gas inlet boiler C)

QA/QC procedures applied:	Flow meters will be subjected to regular maintenance and testing regime to ensure accuracy
Purpose of Data	Project emissions calculations
Additional Comments	

Data / Parameter:	**M17 ($FR_{e,s}$)**
Unit:	m^3/yr
Description:	Flow rate of low pressure boiler equipment stack gases
Measured /Calculated /Default:	Calculated
Source of data:	M16 and Section E.2 of the PDD (p. 61)
Value(s) of monitored parameter:	Refer to Monitoring Report Excel data sheet
Monitoring equipment	Refer to M16
Measuring/ Reading/ Recording frequency:	Continuous
Calculation method (if applicable):	Flow rate of low pressure boiler equipment stack gases (M16) * 99%
QA/QC procedures applied:	Refer to M16
Purpose of Data	Project emissions calculations
Additional Comments	

Data / Parameter:	**M18 ($P_{CH4,e,s}$)**
Unit:	%
Description:	Percentage of methane content in stack gases of low pressure boiler equipment
Measured /Calculated /Default:	Calculated
Source of data:	M11 and Section E.2 of the PDD (p. 61)
Value(s) of monitored parameter:	Refer to Monitoring Report Excel data sheet
Monitoring equipment	Refer to M11
Measuring/ Reading/ Recording frequency:	Quarterly
MCalculation method (if applicable):	Percentage of methane in the biogas at biodigester outlet (M11) * 99%
QA/QC procedures applied:	Refer to M11
Purpose of Data	Project emissions calculations
Additional Comments	

Data / Parameter:	**M19 ($T_{comb,e}$)**
Unit:	-
Description:	Fraction of time gas is combusted in low pressure boiler equipment
Measured /Calculated /Default:	Calculated
Source of data:	Control system (SCADA)
Value(s) of monitored parameter:	Refer to Monitoring Report Excel data sheet
Monitoring equipment	System Control and Data Acquisition (SCADA): Intellution iFix Workspace version 3
Measuring/ Reading/ Recording frequency:	Continuous
Calculation method (if applicable):	N/A
QA/QC procedures applied:	Equipment will be subject to regular maintenance
Purpose of Data	Project emissions calculations
Additional Comments	

Data / Parameter:	**M20**
Unit:	m^3/yr
Description:	Biogas flow rate at high pressure boiler inlet
Measured /Calculated /Default:	N/A This variable has not been monitored because the high pressure boilers have not been installed (the co-generation phase was planned to start in 2012)
Source of data:	N/A
Value(s) of monitored parameter:	N/A
Monitoring equipment	N/A
Measuring/ Reading/ Recording frequency:	N/A
Calculation method (if applicable):	N/A
QA/QC procedures applied:	N/A
Purpose of Data	Project emissions calculations
Additional Comments	

Data / Parameter:	**M21**
Unit:	m^3/yr
Description:	Flow rate of high pressure boiler equipment stack gases
Measured /Calculated /Default:	N/A This variable has not been monitored because the high pressure boilers have not been installed (the co-generation phase was planned to start in 2012)
Source of data:	N/A
Value(s) of monitored parameter:	N/A
Monitoring equipment	N/A
Measuring/ Reading/ Recording frequency:	N/A
Calculation method (if applicable):	N/A
QA/QC procedures applied:	N/A
Purpose of Data	Project emissions calculations
Additional Comments	

Data / Parameter:	**M22**
Unit:	%
Description:	Percentage of methane content in stack gases of boiler equipment (co-generation)
Measured /Calculated /Default:	N/A This variable has not been monitored because the high pressure boilers have not been installed (the co-generation phase was planned to start in 2012)
Source of data:	N/A
Value(s) of monitored parameter:	N/A
Monitoring equipment	N/A
Measuring/ Reading/ Recording frequency:	N/A
Calculation method (if applicable):	N/A
QA/QC procedures applied:	N/A
Purpose of Data	Project emissions calculations
Additional Comments	

Data / Parameter:	**M23**
Unit:	**-**
Description:	Fraction of time gas is combusted in high pressure boiler equipment
Measured /Calculated /Default:	N/A This variable has not been monitored because the high pressure boilers have not been installed (the co-generation phase was planned to start in 2012)
Source of data:	N/A
Value(s) of monitored parameter:	N/A
Monitoring equipment	N/A
Measuring/ Reading/ Recording frequency:	N/A
Calculation method (if applicable):	N/A
QA/QC procedures applied:	N/A
Purpose of Data	Project emissions calculations
Additional Comments	

Data / Parameter:	**M24**
Unit:	MWh
Description:	Electricity consumed by digester parasitic
Measured /Calculated /Default:	N/A This variable has not been monitored because the high pressure boilers have not been installed (the co-generation phase was planned to start in 2012)
Source of data:	N/A
Value(s) of monitored parameter:	N/A
Monitoring equipment	N/A
Measuring/ Reading/ Recording frequency:	N/A
Calculation method (if applicable):	N/A
QA/QC procedures applied:	N/A
Purpose of Data	Project emissions calculations
Additional Comments	

Data / Parameter:	**M25**
Unit:	MWh
Description:	Electricity consumed by condenser pumps and fans associated with electricity generation
Measured /Calculated /Default:	N/A This variable has not been monitored because the high pressure boilers have not been installed (the co-generation phase was planned to start in 2012)
Source of data:	N/A
Value(s) of monitored parameter:	N/A
Monitoring equipment	N/A
Measuring/ Reading/ Recording frequency:	N/A
Calculation method (if applicable):	N/A
QA/QC procedures applied:	N/A
Purpose of Data	Project emissions calculations
Additional Comments	

Data / Parameter:	**B1**
Unit:	kg COD/m^3
Description:	COD concentration of raw effluent (at digester inlet)
Measured /Calculated /Default:	Measured
Source of data:	Spectrophotometer
Value(s) of monitored parameter:	Refer to Monitoring Report Excel data sheet
Monitoring equipment	**Equipment 1:** Spectrophotometer **Brand:** HACH **Model:** DR2800 **Type:** LPG422.99.00002 **Serial Number:** 1209668 **Accuracy: ±** 1,5 nm, 5 mAbs at 0.0–0.5 Abs, 1% at 0.50–2.0 Abs (According to User´s Manual November 2009, Edition 3) **Calibration Frequency:** Every 6 months **Date of Last Calibration:** June 2008, December 2008, June 2009, December 2009. **Equipment 2:** Thermoreactor **Brand:** HACH **Model:** DR200 **Type:** LTG082.03.40001 **Serial Number:** 09120C0236 **Accuracy:** ± 2 °C (According to Manufacturer´s Final Inspection Certificate) **Calibration Frequency:** N/A **Date of Last Calibration:** N/A **Equipment 3:** Precision Hydrometer (Brixometer) **Brand:** VWR **Equipment 4:** Flow meter **Brand:** Rosemount **Model:** 570TM **Serial number:** 04-FM-1-109 **Accuracy:** 1% (According to Reference Manual -0100-4900, Rev AA, December 2001) **Calibration Frequency:** Once per year **Date of Last Calibration:** February 2008, January 2010
Measuring/ Reading/ Recording frequency:	At least monthly
Calculation method (if applicable):	N/A
QA/QC procedures applied:	The Spectrophotometer will be subject to regular maintenance and testing regime to ensure accuracy
Purpose of Data	Baseline emissions calculations
Additional Comments	

Data / Parameter:	**B2**
Unit:	m^3/hr
Description:	Flow rate of raw effluent at digester inlet
Measured /Calculated /Default:	Measured
Source of data:	Magnetic flow meter
Value(s) of monitored parameter:	Refer to Monitoring Report Excel data sheet
Monitoring equipment	Baseline emissions calculations
Measuring/ Reading/ Recording frequency:	**Equipment:** Flow meter **Brand:** Rosemount **Model:** 570TM **Serial number:** 04-FM-1-109 **Accuracy:** 1% (According to Reference Manual 00809-0100-4900, Rev AA, December 2001) **Calibration frequency:** Once per year **Date of last calibration:** February 2008, January 2010
Calculation method (if applicable):	Continuous
QA/QC procedures applied:	N/A
Purpose of Data	Flow meters will be subject to regular maintenance and testing regime to ensure accuracy
Additional Comments	

Data / Parameter:	**B3**
Unit:	MWh
Description:	Electricity generated by project
Measured /Calculated /Default:	N/A This variable has not been monitored because the high pressure boilers have not been installed (the co-generation phase will start in 2012)
Source of data:	N/A
Value(s) of monitored parameter:	N/A
Monitoring equipment	Baseline emissions calculations
Measuring/ Reading/ Recording frequency:	N/A
Calculation method (if applicable):	N/A
QA/QC procedures applied:	N/A
Purpose of Data	N/A
Additional Comments	

Data / Parameter:	**B4**
Unit:	Klbs
Description:	Low pressure steam at back pressure turbine exit
Measured /Calculated /Default:	N/A This variable has not been monitored because the high pressure boilers have not been installed (the co-generation phase was planned to start in 2012)
Source of data:	N/A
Value(s) of monitored parameter:	N/A
Monitoring equipment	Baseline emissions calculations
Measuring/ Reading/ Recording frequency:	N/A
Calculation method (if applicable):	N/A
QA/QC procedures applied:	N/A
Purpose of Data	N/A
Additional Comments	

D.3. Implementation of sampling plan

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

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

Equation	Description
Lagoon Baseline Emissions	
$CH_{4\,lagoon\ baseline} = COD_{available,m} \times B_O \times MCF_{baseline}$	$CH_{4\ lagoon\ baseline}$ = CH_4 emissions from wastewater lagoon that would have occurred in the absence of the project (kg/month) $COD_{available,m}$ = The monthly Chemical Oxygen Demand available for conversion which is equal to the monthly COD entering the digester plus COD carried on from the previous month B_o = Maximum methane producing capacity (0.21 kg CH_4/kg COD) $MCF_{baseline}$ = Monthly methane conversion factor
$COD_{available}$, m = $COD_{baseline}$, m x AD + (1-$MCF_{baseline,\ m-1}$) x $COD_{available,\ m-1}$	$COD_{baseline,m}$ = Monthly Chemical Oxygen Demand of effluent entering Lagoons or directed to land application AD = Factor by which the COD is adjusted to account for the effluent present in the lagoon prior to the implementation of the project $MCF_{baseline,\ m-1}$ = The monthly methane conversion factor from the previous month $COD_{available,m}$ = The monthly Chemical Oxygen

Equation	Description
	Demand available for conversion from the previous month
$AD = 1 - \left(\frac{COD_{a,out}}{COD_{a,in}} \right)$	$COD_{a,out}$ = COD that leaves the lagoon with the effluent $COD_{a,in}$ = COD that enters the lagoon
$MCF_{baseline} = f_d \times f_{t,monthly} \times 0.89$	F_d = the fraction of anaerobic degradation due to depth of the sludge pit. Table 1 of AM0013 Version 03 shows the fraction of degradation under anaerobic conditions for different depths. $f_{t,monthly}$ = the fraction of anaerobic degradation due to temperature 0.89 = the uncertainty conservativeness factor (for uncertainty range of 30% to 50%) to account for the fact that the equation used to estimate $F_{t,monthly}$ assumes full anaerobic degradation at 30 °C.
$f_{t,monthly} = \exp\left[\frac{E \times (T_2 - T_1)}{R \times T_1 \times T_2} \right]$	E = The Activation energy constant (15,175 cal/mol) T_2 = Ambient temperature (Kelvin) for the climate. T_1 = 303.16 (273.16° + 30°) R = Ideal gas constant (1.987 cal/ K mol).
$CO_{2e\ lagoon\ base} = CH_{4\ lagoon\ baseline} \times GWP_{CH4} / 1000$	$CO_2e_{\ lagoon\ base}$ = The baseline metric tons of CO_2 equivalent emissions from lagoon that would take place in the absence of the project activity (tCO_{2eq}) GWP_{CH4} = Global warming potential of CH_4 (21)
Electricity Baseline Emissions	
$BE_{elec/heat} = EG_y \times CEF_{Bl,elec,y} + EG_{d,y} \times CEG_{grid} + HG_{Bl,y} \times CEF_{bl,therm,y}$	$BE_{elec/heat}$ = The baseline electricity and thermal energy consumption that would take place in the absence of the project activity (tCO_{2eq}) EG_y = the amount of electricity in the year y that would be consumed at the project site in the absence of the project activity (MWh). $CEF_{Bl,elec,y}$ = the CO_2 emission factor for electricity consumed at the project site in the absence of the project activity (tCO_2/MWh) $EG_{d,y}$ = the amount of electricity generated utilizing the biogas collected during project activity and exported to the grid during the year y (MWh) CEF_{grid} = the CO_2 emission factor for the grid where electricity is exported (tCO_2/MWh) $HG_{BL,y}$= the quantity of thermal energy that would be consumed in year y at the project site in the absence of the project activity using fossil fuel (MJ). $CEF_{Bl,therm,y}$ = the CO_2 emissions intensity for thermal energy generation (tCO_2 e/MJ)
EG_y	Prior to 2008, EG_y is equal to zero. Starting in 2008, EG_y is equal to the project activity electric generation since the electricity that is consumed in the baseline situation is the same as the net generation of the project activity. This holds true

Equation	Description
	because the electric generation will be consumed entirely on-site and will only displace grid imported electricity.
$EG_y = \left[\frac{VB \times CECF}{CF_1} \right]$	VB = The volume of biogas recovered from the biodigester process and used in the cogeneration unit; (Nm^3) CECF = Cogeneration electric conversion factor; (0.676 kWh /Nm^3 biogas) CF1 = Conversion factor; 1000 kWh / MWh
$HG_{BL,y} = VB \times FOE \times HV$	$HG_{BL,y}$ = The quantity of thermal energy that would be consumed in year y at the project site in the absence of the project activity (MJ) VB = Volume of biogas recovered from the digester process and used to replace ; (Nm^3) FOE = Bunker C fuel oil equivalent of biogas; (0.145 gal/ Nm^3) HV = Heating value of Bunker C fuel oil; (152.9 MJ/gal)
$HG_{BL,y} = \frac{EG_y \times TER}{\eta_{baseline\ boiler}} \times CF_2$	TER = The thermal to electric ratio of the cogeneration system; $\eta_{baselineboiler}$ = Efficiency of the baseline boiler; (80%) CF_2 = Conversion factor; 3600 MJ/MWh
$CM_{1stcreditingperiod} = \frac{OM_{year\,1} + BM_{historical\ \_(or\ \_\ year\,1-7)}}{2} = \frac{tCO_{2e}}{MWh}$	$CM_{1stcreditingperiod}$ = Combined Margin emission factor, which represents the carbon intensity (CI) of the grid and is the average of the Operating Margin (OM) and the Build Margin (BM). Since low-cost must-run resources comprise less than 50% of total electricity generation on the Nicaraguan grid, Option B (Simple OM) is allowed for determining the CM. Under Option B, the OM represents the weighted average of all resources except low-cost/must-run facilities.
OMyear i = Sum (E_i) / Sum (EG_i) (tCO_2e/MWh)	OMyear i = Operating Margin for year i, which needs to be calculated according to the proposed procedure of the baseline methodology E_i = Total tonnes of CO_2-equivalent emission per year of plant "i" including all plants except low-cost/must-run facilities (tCO_2e) EG_i = Total annual energy generated (MWh) by plant "i" – including all plants except low-cost/must-run facilities.
$E_i = FC_i \times CV_i \times EF_i \times Ox$	FC_i =Annual fossil fuel consumption of thermal plant "i" (liters, t or m³); CV_i = Calorific value of fuel used in plant "i" (TJ/L, TJ/t or TJ/m³) EF_i = Fossil fuel emission factor (tCO_2e/TJ); Ox = Fraction of carbon oxidized

Equation	Description
OM can be now calculated using the equation above and the following values for the variables are attributed: E_i =1.470.291 tCO_2e in 2002 + 1,486,190 tCO_2e in 2003 + 1,547470 $mtCO_2e$ in 2004; EG_i = 1.946.000 MWh in 2002 + 1,991,000 MWh in 2003 + 2,078,000 MWh in 2004; Thus, OM = 4,503,951 tCO_2e / 6,015,000 MWh OM = 0.749 tCO2e/MWh BM emission factor is BM = 2,490,459 $mtCO_2e$ / 3,773,000 MWh = 0.660 tCO_2/MWh Combined Margin CM = 0.5*OM + 0.5*BM CM = 0.5*0.749 + 0.5*0.660 CM = $CEF_{Bl,elec,y}$ = 0.705 tCO_2/MWh	
$CEF_{Bl,therm,y}$ is the CO_2 emissions intensity for thermal energy generation. Thermal energy generation in the project activity displaces Bunker C fuel oil in the baseline. Therefore, $CEF_{Bl,therm,}$y is equal to 0.00007652 tCO_2/MJ.[2]	
Total GHG Emissions Attributable to the Baseline	
$BE = CO2e_{lagoonbase} + BE_{elec/heat}$	BE = Total baseline emissions (tCO_{2eq})

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

Equation	Description
Methane Emissions From Lagoon	
$CH_{4\,lagoon\,project} = (COD_{enter\ lagoon} + COD_{dig\ out}) \times B_O \times MCF_{baseline}$	$CH_{4\ lagoon\ project}$ = CH_4 emissions from wastewater lagoon (kg/month) $COD_{enter\ lagoon}$ = The COD of effluent sent directly to the lagoon, (kg COD/yr) $COD_{dig\ out}$ = The COD of effluent leaving the digester and entering the lagoon, (kg COD/yr)
$CO_2e_{\ lagoon\ project} = CH_{4\ lagoon\ project}$ x GWP_{CH4} / 1000	$CO_{2e\ lagoon\ project}$ = The metric tons of CO_2 equivalent emissions from lagoon (tCO_2eq) GWP_{CH4} = Global warming potential of CH_4 (21)
Physical Leakage from Biodigesters	
$BDL = VB \times MF \times VM \times LF_{digester} \times GWP_{CH4}$	BDL = Physical leakage from the biodigesters, (tCO_2) VB = Volume of biogas recovered from the digester process (Nm^3) $COD_{available,y}$ = Annual organic waste treated by digester; $BF_{digester}$ = COD-to-biogas conversion factor; (0.364 Nm^3 biogas/kg COD) MF = Methane (CH_4) fraction of biogas; (55%) VM = Volume-to-mass conversion factor; (0.0007176 tCH_4/ Nm^3 CH_4) $LF_{digester}$ = Percentage of biogas leaking from digester; (5%) GWP_{CH4} = Global warming potential of CH_4; (21)
Stack Emissions From Energy Generation	

[2] Refer to page 56 of the registered PDD.

Equation	Description
$SEEG = VB_{EG} \times MF \times VM_{EG} \times (1 - LF_{digester}) \times GWP_{CH4} \times (1 - DEF_{EG})$	SEEG = Stack emissions from energy generation; (tCO_2) DEF = Destruction efficiency factor; (99%)
Stack Emissions From the Flare	
$SE_{flare} = MF \times VB_{flare} \times (1 - DEF_{flare}) \times VM_{flare} \times GWP_{CH4}$	SE_{FLARE} = Stack emissions from the flare; (tCO_2) DEF = Destruction efficiency factor; (50%)
Emissions From Heat Use and Electricity Use due to the Project Activity	
$PE_{elec/heat} = EL_{p,y} \times CEF_d$ [3]	$PE_{elec/heat}$ = The project activity emissions from heat and electricity use due to the project activity; (tCO_2) $EL_{p,y}$ = The amount of electricity in the year y that is consumed at the project site for the project activity; (MWh). It is worth noting that prior to the installation of the meters project electricity consumption for the effluent treatment plant and the boiler was calculated by multiplying the rated capacity of the equipment and assuming 24 hour operation during the monitoring period, as indicated by the Executive Board in the approval for the Request for Deviation. CEF_d = The CO_2 emissions factors for the electricity consumed at the project site during the project activity. This value is equal to the $CEF_{Bl,elec,y}$ variable established above.
Emissions from land application of sludge	
No sludge is present in the project activity as the sludge from the digester is re-injected back into the digester.	
Emissions from wastewater removed in the dewatering process	
The project activity does not include the removal of wastewater from the dewatering process and therefore no emissions are estimated for this section.	
Total GHG Emissions Attributable to the Project are the Sum of Each of the Emissions Components Established Above.	
$PE = CO_2e_{lagoon\text{-}project} + BDL + SEEG + PE_{elec/heat}$	PE = Total project emissions (tCO_2e)

E.3. Calculation of leakage

No leakage is associated with the project activity.

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

Time Period	Baseline emissions or baseline net GHG removals by sinks (tCO_2e)	Project emissions or actual net GHG removals by sinks (tCO_2e)	Leakage (tCO_2e)	Emission reductions or net anthropogenic GHG removals by sinks (tCO_2e)
2008	46,445	9,868	N/A	36,576
2009	63,660	15,764	N/A	47,896

[3] Refer to page 62 of the registered PDD, to the paragraph titled "(iv) Emissions from heat use and electricity use due to the project activity".

2010	42,836	9,200	N/A	33,635
Total	**152,941**	**34,833**	**N/A**	**118,108**

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
2008	62,413.50	36,576
2009	124,827	47,896
2010	42,748.97	33,635
Emission reductions or GHG removals by sinks (tCO_2e)	229,989.47	**118,108**

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

The difference is due to:

- the lower vinasse production at the distillery, which lowers the baseline emissions and therefore the emissions reductions
- the inconstant input flow that affects the volume of biogas produced as well as methane concentration, thus reducing the emission reductions.

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History of the document

Version	Date	Nature of revision
02.0	EB 66 13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01	EB 54, Annex 34 28 May 2010	Initial adoption.
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