



Monitoring report form (Version 03.1)

Monitoring report

Title of the project activity	BRASCARBON Methane Recovery Project BCA-BRA-05
Reference number of the project activity	Project 3455
Version number of the monitoring report	Version 01
Completion date of the monitoring report	15/04/2013
Registration date of the project activity	21/08/2010
Monitoring period number and duration of this monitoring period	Third monitoring period from 01/11/2011 to 31/12/2012 (first and last days included)
Project participant(s)	Brascarbon Consultoria, Projetos e Representação Ltda. Luso Carbon Fund – Fundo Especial de Investimento Fechado
Host Party(ies)	Brazil (host)
Sectoral scope(s) and applied methodology(ies)	Sectorial scope 15 – Agriculture. Methodology AMS-III.D version 14
Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD	61,879 t CO ₂ e (427 days)
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	57,481 t CO ₂ e (427 days)

SECTION A. Description of project activity**A.1. Purpose and general description of project activity**

The Project Activity involves the capture and combustion of biogas produced from the decomposing manure at swine confined animal feed operations located in Mato Grosso do Sul state, Brazil. It consists in the construction of a new covered in-ground anaerobic reactor (digester) that utilizes the manure previously treated in anaerobic open lagoons to produce biogas. The resulting biogas is measured and destroyed through a flaring system.

The result of this project is a significant reduction of GHG emissions compared to those emissions that would have occurred in the absence of the project and also promotion of sustainable swine production farms, bringing environmental and social benefits, moving from a high-GHG animal waste management system practice to anaerobic digester with capture and combustion of resulting biogas.

This project applies version 14 of the Methane Recovery methodology identified in Section III.D, of the Indicative Simplified Baseline and Monitoring Methodologies for Small-Scale CDM Project Activity Categories, to swine confined feed operations located in the state of Mato Grosso do Sul, Brazil.

The start of the first construction was 03/03/2008. All sites included in the PDD and the relevant dates of the project implementation for each site are described in the Section B1, because this project activity is composed of 18 different sites.

The total emission reductions achieved in this monitoring period are 57,481 tCO₂e.

A.2. Location of project activity

The project is located in the city of São Gabriel do Oeste, state of Mato Grosso do Sul, Brazil. The detailed physical location for each project site is presented in Table A1.

Table A1 - Detailed physical location and identification of project site.

Farm/Site Name	Brascarbon ID	Address	Town/ State	Contact	Phone	GPS Coord
Fazenda Agua Branca	BCA-030MS1-05	BR 163 - Km 592 – countryside – toward C. Grande -left	São G. do Oeste - MS	Delcio Guzzi	+55 67 9969 3706	S 19,5492 W 54,4331
Fazenda Rodeio - Gleba C	BCA-031MS1-05	Chácara Bairro jardim Gramado - Road to Cuiabá – left side	São G. do Oeste - MS	Alídio Biazus	+55 67 3295 1304	S 19,3772 W 54,6128
Fazenda Dragão	BCA-032MS1-05	BR 163 - toward Cuiaba left	São Gabriel do Oeste - MS	Antonio Macari	+55 67 9611 8958	S 19,1547 W 54,7625
Lote 55 e 54	BCA-034MS1-05	BR 163 toward Coxim - Assentamento Campanário	São Gabriel do Oeste - MS	Antenor Barbosa de Oliveira Roque Luiz Busanello	+55 67 9962 2063	S 19,2911 W 54,6051
Lote 101	BCA-035MS1-05	BR 163 toward Coxim - Assentamento Campanário	São Gabriel do Oeste - MS	Leonildo Gama da Silva	+55 67 9936-7840	S 19,2683 W 54,5650
Lote 105	BCA-036MS1-05	BR 163 toward Coxim - Assentamento Campanário	São Gabriel do Oeste - MS	Vanderlei Carlos Shimit	+55 67 9934-0227	S 19,2644 W 54,5628
Lote 71	BCA-037MS1-05	BR 163 toward Coxim - Assentamento Campanário	São Gabriel do Oeste - MS	Airton José Borgmam	+55 67 9915-7335	S 19,2736 W 54,5942

Lote 82	BCA-038MS1-05	BR 163 toward Coxim - Assentamento Campanário	São Gabriel do Oeste - MS	João Ferreira dos Santos	+55 67 9962-1715	S 19,2714 W 54,5900
Lote 28 e 27	BCA-039MS1-05	BR 163 toward Coxim - Assentamento Campanário	São Gabriel do Oeste - MS	Hilário Valentini e Valderi Valentin	+55 67 8424-8682	S 19,2836 W 54,6264
Fazenda Bela Vista	BCA-040MS1-05	BR163 - Km 609 – country Road to Ponto Alto - left side	São Gabriel do Oeste - MS	Jair Antonio Borgman	+55 67 3295 5031	S 19,4414 W 54,5622
Granja Serra Dourada	BCA-041MS1-05	BR163 - Km 609 – country Road to Ponto Alto right side	São G. do Oeste - MS	Rainer Josef Ruiz de Goehr	+55 67.8122-35661	S 19,2647 W 54,5642
Fazenda Cachoeira	BCA-042MS1-05	BR163 - Km 609 – country Road to Ponto Alto - left side	São Gabriel do Oeste - MS	Valdir Scotton	+55 67 9962 1494	S 19,4364 W 54,5589
Granja Capivara	BCA-043MS1-05	BR163 - Km 609 – Country Road to Ponto Alto left	São G. do Oeste - MS	Zélio Antonio Pessato	+55 67 3295 1242	S 19,4269 W 54,5483
Fazenda Sorgatto	BCA-046MS1-05	BR 163 - Km 604 – toward south – right side 8 km from São Gabriel.do Oeste	São Gabriel do Oeste - MS	João Carlos Sorgatto	+55 67 9996 9990	S 19,4658 W 54,5256
Fazenda Santa Catarina	BCA-047MS1-05	BR163 - Km 594 – country Road to Ponto Alto	São G. do Oeste - MS	Cooasgo	+55 67 3295 1201	S 19,5600 W 54,3197
Fazenda Bambú - Quinhão A	BCA-051MS1-05	Ponte Vermelha – District of São Gabriel do Oeste	São Gabriel do Oeste - MS	Ari Fernando Grando	+55 67 3295 1097	S 20,2939 W 54,6383
Fazenda Folleto	BCA-052MS1-05	Old BR163 - toward Ponto Alto	São G. do Oeste - MS	Jose Jorge Foletto	+55 67 9905 7306	S 19,5383 W 54,5208
Fazenda Ponte Vermelha	BCA-068MS1-05	BR 163 - KM 586 – Road to Area da Ponte Vermelha - 3 km right	São G. do Oeste - MS	Valdinei Viviam	+55 67 3295 5345	S 19,4753 W 54,4061

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)
Brazil (host)	Brascarbon Consultoria, Projetos e Representação Ltda	No
Portugal	Luso Carbon Fund – Fundo Especial de Investimento Fechado	No

A.4. Reference of applied methodology

The approved baseline and monitoring methodology applied is **AMS-III.D - Methane recovery in animal manure management systems** (version 14.0). Also applied is the associated **Tool to determine project emissions from flaring gases containing methane** (EB 28, Annex 13).

A.5. Crediting period of project activity

The renewable crediting period of 7 years $\times 3$ is chosen. The first crediting period starts from 21/08/2010 to 20/08/2017.

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

The technology used is an anaerobic digestion process in which microorganisms break down biodegradable material in the absence of oxygen. The process is widely used to treat wastewater sludge and organic wastes because it provides volume and mass reduction of the input material.

The equipment is based on in one ambient temperature storage covered cell which uses a single-piece liner affixed to a reinforced outer concrete frame. The outer cover consists of a synthetic vinyl membrane which is also fastened to the frame. The liner and cover are sealed together with bolts and iron plate frame. The system also includes a biogas collector piping, from the digester to the flare system. Since the starting of the project, no power generators were installed for in site electricity supply and all the biogas produced has been flared.

The flare is enclosed and a thermocouple installed in the flare measures the combustion temperature every minute. The thermocouple measures and sends the temperature information to a PLC (Programmable Logic Control) system where the minute by minute combustion temperature data is stored. The sparking system in the flare is automatic. Every one second the system sparks. The biogas volume that is directed to the flare is measured cumulatively every minute by a flow meter and also controlled by the PLC, which stores the minute by minute cumulative volume data. The sparking system, the PLC and the control panel are powered by a 12 volts battery charged by solar cells.

The treated effluent is discharged to the existent open lagoons and it is used for irrigation.

During the monitoring period, no electricity was consumed from the grid for the operation of the project facility. The technical parts of the project activity are powered by energy supplied by solar cells. The energy is also stored in 12 volts batteries in case of lack of sun.

The sludge from the digesters was not removed in the monitoring period.

Figure 1 presents a schematic flowchart of the project activity.

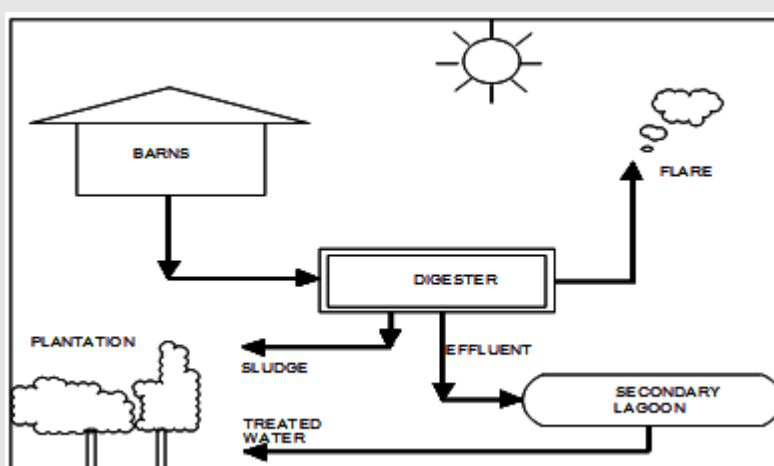


Figure 1- Flowchart of the treatment system

This project is made up of 18 sites (farms) where each phase of the project implementation as so as the construction, start-up and continuous operation, was concluded in different dates which can be found in Table B1.

Table B1. Relevant dates of project implementation.

Farm/Site Name	Brascarbon ID	Start Construction	Finish Construction	Start-up and Tests	Monitoring Start Date
Fazenda Agua Branca	BCA-030MS1-05	03/03/2008	02/03/2009	06/04/2009	09/06/2009
Fazenda Rodeio - Gleba C	BCA-031MS1-05	24/11/2008	27/04/2009	01/06/2009	16/07/2009
Fazenda Dragão	BCA-032MS1-05	24/11/2008	27/04/2009	01/06/2009	08/07/2009
Lote 55 e 54	BCA-034MS1-05	10/11/2008	13/04/2009	25/05/2009	01/07/2009
Lote 101	BCA-035MS1-05	10/11/2008	13/04/2009	25/05/2009	01/07/2009
Lote 105	BCA-036MS1-05	10/11/2008	13/04/2009	25/05/2009	01/07/2009
Lote 71	BCA-037MS1-05	10/11/2008	13/04/2009	25/05/2009	01/07/2009
Lote 82	BCA-038MS1-05	10/11/2008	13/04/2009	25/05/2009	01/07/2009
Lote 28 e 27	BCA-039MS1-05	10/11/2008	13/04/2009	25/05/2009	01/07/2009
Fazenda Bela Vista	BCA-040MS1-05	03/03/2008	02/03/2009	06/04/2009	18/06/2009
Granja Serra Dourada	BCA-041MS1-05	03/03/2008	02/03/2009	06/04/2009	17/08/2009
Fazenda Cachoeira	BCA-042MS1-05	03/03/2008	02/03/2009	06/04/2009	01/06/2009
Granja Capivara	BCA-043MS1-05	03/03/2008	02/03/2009	06/04/2009	07/06/2009
Fazenda Sorgatto	BCA-046MS1-05	24/11/2008	27/04/2009	01/06/2009	11/07/2009
Fazenda Santa Catarina	BCA-047MS1-05	03/03/2008	02/03/2009	06/04/2009	01/06/2009
Fazenda Bambú - Quinhão A	BCA-051MS1-05	09/03/2009	10/08/2009	21/09/2009	29/10/2009
Fazenda Folleto	BCA-052MS1-05	24/11/2008	27/04/2009	01/06/2009	01/07/2009
Fazenda Ponte Vermelha	BCA-068MS1-05	24/11/2008	27/04/2009	01/06/2009	01/07/2009

During the current monitoring the project facilities (digester, flare, etc) were operational for all sites. No overhaul times nor downtimes of equipment have occurred and no exchange of equipment was done.

The main events that can be reported regard changes (increases or decreases) in the average number of animals per type and/or in the average animal weight per type reported in the monitoring period when compared to PDD ex-ante estimation. Because the animal population and its characteristics can vary significantly, the project facilities have all been dimensioned in order to accommodate significant variations in the swine population, so the reported changes have not affected the effective operation of the project facilities. The situations where these changes have led to higher emission reductions than the ex-ante PDD estimation are explained in full detail in Section E.

No events or situations that may impact the applicability of the applied methodology occurred during the monitoring period.

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 are requested.

B.2.2. Corrections

No corrections are made.

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

No permanent changes from registered monitored plan or applied methodology are made.

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

No changes are made to project design of registered project activity.

B.2.5. Changes to start date of crediting period

No changes to start date of crediting period are made.

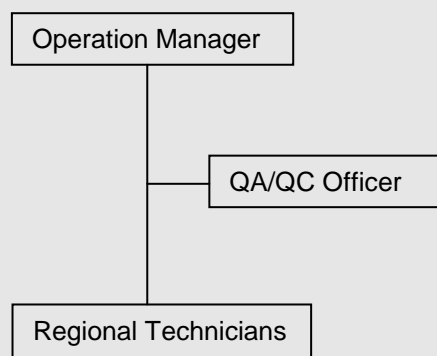
B.2.6. Types of changes specific to afforestation or reforestation project activity

Not applicable.

SECTION C. Description of monitoring system

In order to guarantee compliance with the monitoring plan, Brascarbon elaborated an Operational Procedure Manual composed of Monitoring Operational Procedures (POP) for each parameter to be monitored. Each POP includes detailed instructions to be followed for data collection, equipment handling, preventive/corrective actions to be taken and QA/QC procedures to be applied. If applicable, the POP also includes auxiliary forms that are used for the data collection, with examples and instructions on how they are to be fulfilled.

The organization structure of the Brascarbon Monitoring System is the presented below:



Operation Manager (OM): The OM is the overall responsible for the project operations, including maintenance and monitoring issues. The OM is in charge of divulging the Operational Procedures (POP) to the regional technicians, namely the instructions and procedures for measurement, data collection, site maintenance, preventive and corrective actions and safety and emergency issues. The OM also assures that all data and documents received from the field are filed in the office and is responsible to prepare an electronic copy of all the documents received and save it in the respective folder related to each PDD per farm, performing daily backups of the electronic documents in the server and weekly in an external drive. The OM is also responsible to assure the overall maintenance of the equipment to attend the monitoring system (following the equipment suppliers' recommendations) and, when necessary, provide equipment calibration, replacement or substitution.

Regional Technicians (RT): The RT is responsible for on-site measurements and data collection according to the procedures in the POP. During monitoring site visits for data collection the field technician also assures regular maintenance of the site considering the site area, instrumentation, equipment, cleaning and is trained to identify any problems in the operation of the equipment and proceed with standard repairs on-site. In case of fatal failure, the substitution of the equipment is required immediately by the field technician and the operation department is responsible to provide the immediately substitution of the failed equipment. For the avoidance of doubt, in the event of downtimes of equipment (thermocouple, flow meter, etc), no emission reductions are accounted for the downtime period. Every year and according to the procedures described in POP 11 (Operation General Training), which details, *inter alia*, the programmatic contents, all the RT have a training course (one of the days at a site), which focuses on monitoring, operation of the equipments, maintenance, safety and emergency issues.

Quality Assurance/Quality Control officer (QA/QC officer): The QA/QC officer is responsible to assure the quality control and check of the information collected. When the results are not satisfactory according to the expected, the QA/QC officer recommends additional instructions to be followed in the field such as checking eventual leaks, verifying the components of the flare, valves, batteries etc. This corrective action is implemented by the RT. The QA/QC officer is also responsible for the preparation of all documents related to the CDM project for verification, including elaboration of the monitoring report, emission reductions calculation and preparation of a CD with all relevant information for the verification process (certificates, formularies, POP, on-site official documents, etc). Finally, the QA/QC officer, in coordination with the OM, also controls the calibration of equipments, checking all the calibration certificates, expiration dates and suppliers' recommendations, in order to guarantee the sound calibration of the equipments throughout the monitoring periods.

All documents associated with the monitoring system (POP, associated formularies, confined feed operation documents, calibration certificates, *inter alia*) have been sent to the DOE for verification and are available at Brascarbon office for 2 years after the end of the crediting period.

For each parameter, the data generation, collection and reporting procedures, responsibilities and monitoring points are outlined below:

Flare Temperature (Tf)

Operational procedure:	POP 01
Formulary:	01.001 (converted xls from PLC dat file)
Monitoring point:	Inside the enclosed flare structure

The flare temperature is measured every minute by a thermocouple installed in the flare, which sends the temperature data to the PLC (Programmable Logic Control). The minute by minute data is stored in the PLC. The data is recovered monthly by downloading the file through a pen drive connection, and converted to the form 01.001.

In the monitoring period under verification, the thermocouples used in the project are MAFS and ALUTAL. The thermocouples are calibrated by the supplier and the calibration frequency is according to the supplier requirements, which demands calibration every two years (for MAFS thermocouples) and every year (for ALUTAL thermocouples).

Site Inspection and $MS\%_{i,y}$

Operational procedure: POP 02
 Formulary: 02.001 (checklist for site inspection)
 Monitoring point: N/A

The 02.001 checklist for site inspection is the basic orientation to guide the technicians during inspection in the field to follow all items related to the project activity installation. Inspection concerns basic site and digester inspections in terms of lay-out, considering changes in the process flow which can compromise the biogas production and the residual water treatment. Also it controls if the site regulation where the digester is located is in conformity with legal requirements, when applicable. The $MS\%_{i,y}$ - Fraction of manure handled in the system during the year, is also included to be inspected during the farm visit. The information is inserted in the form 02.001. The site inspection takes place once every monitoring period, or at least once a year (also, monthly the regional technicians perform a site visit for data collection during which any abnormal situations are reported for further action and preventive maintenance is performed).

Number of animals ($N_{LT,y}$, $N_{da,y}$ and $N_{p,y}$)

Operational procedure: POP 03
 Formulary: 03.001 and 03.003 (animal control system form)
 Monitoring point: N/A

The calculation of the average number of animals ($N_{LT,y}$) is done monthly. The form 03.003 (animal control system form) is fulfilled by the confined feed operation proprietary. It presents the daily records of animal entries (ex: purchase; births, internal transfer) and exit (ex: sale, death, internal transfer) and the final daily record of animals (number of animals on the day-1 + entrance on day – exit on day) per animal category (ex: nursery, finishers, gilts, sows, boars). The average number of animals per animal category is then calculated monthly in the same form through the monthly average of animals that have been recorded daily. Using this approach for calculating $N_{LT,y}$, it is not necessary to calculate separately an $N_{da,y}$ and an $N_{p,y}$, since the number of days the animal is alive ($N_{da,y}$) and the number of animals produced per category LT ($N_{p,y}$) are already implicitly considered in the daily records and taken into account when calculating $N_{LT,y}$. The form 03.001 is the input for the emission reduction calculation spreadsheet and aggregates the monthly average number of animals per animal category per farm for all farms included in the PDD. The forms 03.003 and 03.001 are checked by the QA/QC officer to guarantee consistency. Other on-site documents including, when available, animal purchase and sale records are used to cross-check the information reported.

Biogas Volume ($BG_{burnt,y}$ and $FV_{RG,h}$)

Operational procedure: POP 04
 Formulary: 01.001 (converted xls from PLC dat file) and 04.001 (field data collection)
 Monitoring point: In the connection pipe between the digester and the flare

The biogas volume that is directed to the flare is measured cumulatively every minute by the flow meter installed in the connection pipe, which sends the biogas volume data to the PLC. The minute by minute cumulative data is stored in the PLC. The data is recovered monthly by downloading the file through a pen drive connection and converted to form 01.001. During the monthly field collection data, the regional technician also inserts the information of biogas volume flow rate on form 04.001 (field data collection form) based on the 01.001 form information. The biogas volume is measured in wet basis.

The volumetric flow rate of the residual gas ($FV_{RG,h}$) used for the determination of Project Emissions from flaring or combustion of the gas stream ($PE_{flare,y}$) is calculated in normal conditions, monthly dividing the total biogas volume in normal conditions directed to the flare in one month ($BG_{burnt,y \text{ normal}}$) in the period by the total hours of operation in that month ($FV_{RG,h} = BG_{burnt,y \text{ normal}} / \text{total hours}_{y,y}$). This approach has been considered accurate for the calculation of $FV_{RG,h}$ since the biogas hourly flow is considered to be constant as there is no artificial blower or pump.

The flow meter used in the project is from ENDRESS+HAUSER, FLOW MONITOR, t- trend, ATT12-A99D314D1 MODEL, type: Thermal Mass Flow. The flow meter is calibrated by the supplier and the calibration frequency is according to the supplier requirements, which demands calibration every two years.

Methane Content ($W_{CH_4,v}$ and $fv_{CH_4,RG,h}$)

Operational procedure: POP 05

Formulary: 04.001 (field data collection)

Monitoring point: In the connection pipe between the digester and the flare

The methane content is measured monthly by the regional technician with a portable digital analyzer (Biogas Check portable model from Geotech/Landtech). The equipment is connected through a hose to a purpose built device in the connection pipe. A biogas sample is taken and after a few seconds the instrument informs the methane content in the equipment panel. The information is inserted in the 04.001 form.

The methane content is measured in wet basis. The monthly monitoring frequency guarantees a 95% confidence level (for details, please see Section D.3 – Implementation of sampling plan).

The methane content measured monthly ($W_{CH_4,v}$) is used as an (average) $fv_{CH_4,RG,h}$ and used for the determination of Project Emissions from flaring or combustion of the gas stream ($PE_{flare,v}$). This approach has been considered accurate for the calculation of $PE_{flare,v}$ since the monthly monitored $W_{CH_4,v}$ assures a 95% confidence level in the methane concentration measurement.

The portable digital analyzer is calibrated by the supplier and the calibration frequency is according to the supplier requirements, which demands calibration every six months.

Biogas Temperature (T_{biogas})

Operational procedure: POP 06

Formulary: 04.001 (field data collection)

Monitoring point: In the connection pipe between the digester and the flare

The biogas temperature is monitored monthly by the regional technician with a portable digital analyzer (Biogas Check portable model from Geotech/Landtech). The equipment is connected through a temperature probe to a purpose built device in the connection pipe. After inserting the probe the instrument takes a few seconds to inform the biogas temperature. The information is inserted in the 04.001 form.

The portable digital analyzer (and temperature probe attached) is calibrated by the supplier and the calibration frequency is according to the supplier requirements, which demands calibration every six months.

Methane Density (D_{CH_4})

Operational procedure: POP 07

Formulary: 07.001

Monitoring point: N/A

The methane density for MD_v calculation is, according to version 14 of the AMS-III.D methodology, calculated ex-post, using the monitored data of biogas pressure and biogas temperature. The frequency of the calculation is monthly.

For BE_v calculation, the methane density considered is the one indicated in version 14 of the AMS-III.D methodology (0.00067 t/m^3); for the $TM_{RG,h}$ calculation, the methane density considered is the one indicated in EB 28 Annex 13 – Methodological “Tool to determine project emissions from flaring gases containing methane”, step 5 (0.716 kg/m^3).

Flare Efficiency (FE)

Operational procedure: POP 08

Formulary: 08.001

Monitoring point: N/A

The (Hourly) Flare Efficiency (FE) it is the efficiency of the methane destruction in the hour h. The flare efficiency is considered 90% when the flare temperature is higher or equal to 500°C for the respective hour (if the flare operation is operating according to the flare specification). If in any specific moment (minute) the flare operation is out of the specification then 50% efficiency is adopted for the respective hour. The flare efficiency is 0% for a specific hour when the flare temperature is less than 500°C in any specific moment (minute) of that hour.

The information of the flare efficiency for each hour during 24 hour per day is registered in the formulary

08.001 and obtained through a macro applied to 01.001 form (form with minute by minute temperature and biogas volume data stored in the PLC). The hourly flare efficiency is compounded monthly for emission reduction calculation through a monthly weighted average that takes into consideration the number of hours that the flare has operated in each different condition (90%, 50%, 0%) (please see detailed formula in Section D.2). The flare operation is continuously monitored. To assure that the flare operates adequately a maintenance program is established to guarantee that the flare operation is according to the manufacturer specification

Digester Sludge Removal (QDM)

Operational procedure: POP 09
Formulary: 09.001
Monitoring point: N/A

The digester sludge is the heavier fraction of waste, composed by minerals and organic components, in liquid form. This material should be removed from digester and disposed outside the project boundary from time to time, not resulting in methane emissions. When the sludge is removed, the regional technician will follow the POP 09 to certify that the sludge will be spread aerobically in the field. The information is registered on 09.001 form.

Average animal weight (W_{site})

Operational procedure: POP 16
Formulary: 16.001
Monitoring point: N/A

Each quarter, information obtained in the confined animal feed operation on animal weight for each category (obtained by the confined feed operation proprietary through direct weighting of a representative sample of animals in each category) is collected and checked by the regional technician during the site visit. The information is inserted in the formulary 16.001 and is further analyzed by the QA/QC officer, who cross-checks values reported with indirect sources, namely public information from EMPRAPA (Brazilian Agricultural Research Corporation) on weight ranges per category of animal.

Emission Reductions – $ER_{v,ex-post}$

Operational procedure: POP 17
Formulary: 17.001 (CER Calculation spreadsheet)
Monitoring point: N/A

The emission reductions achieved by the project activity are calculated monthly by the QA/QC officer. The equations can be found in the CER Calculation spreadsheet and are detailed in Section E.

Formulated feed rations (FFR)

Operational procedure: POP 14
Formulary: 14.001
Monitoring point: N/A

The formulated feed rations used per animal category in the confined feed animal operations are monitored and controlled, to guarantee that the Bo and VS default values applied are accurate. Records available in the feed operations, namely regarding food composition and, when available, regarding food purchases are requested by the regional technician, copied and filed at Brascarbon office. This information is inserted in the formulary 14.001.

Biogas Pressure (P_{biogas})

Operational procedure: POP 13
Formulary: 04.001
Monitoring point: In the connection pipe between the digester and the flare

The biogas pressure is measured monthly by the regional technician with a portable digital analyzer (Biogas Check portable model from Geotech/Landtech). The equipment is connected through a hose to a purpose built device in the connection pipe. After a few seconds after starting the instrument it informs the biogas pressure in its panel. The information is inserted in the 04.001 form.

The portable digital analyzer is calibrated by the supplier and the calibration frequency is according to the supplier requirements, which demands calibration every six months.

GENETIC SOURCE

Operational procedure: POP 15
 Formulary: 15.001
 Monitoring point: In the connection pipe between the digester and the flare

The genetic source origin of the livestock in the confined feed animal operations is monitored and controlled, to guarantee that the Bo and VS default values applied are accurate. Records available in the feed operations, regarding the livestock genetic sources are requested (purchase notes if available), copied and filed at Brascarbon office. The genetic source information is inserted in the formulary 15.001.

Methane mass flow rate in the residual gas ($TM_{RG,h}$)

Operational procedure: POP 17
 Formulary: 17.001 (CER Calculation spreadsheet)
 Monitoring point: N/A

The residual mass flow rate is calculated according to the formula presented in the “Tool to determine project emissions from flaring gases containing methane” EB 28, Annex 13. The calculation is done monthly by the QA/QC officer using the monthly average calculated value of $FV_{RG,h}$ and the monthly monitored value of $f_{V_{CH_4, RG,h}}$ and both values are referred to in the same basis (wet). This approach is considered accurate for the calculation of $PE_{flare,y}$.

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

Data / Parameter:	$VS_{default}$
Unit:	kg dry matter/animal/day
Description:	Default value for the volatile solid excretion rate per day on a dry-matter basis for a defined livestock population
Source of data:	Obtained from IPCC2006, vol 4, chapter 10, Tables 10A-7 and 10A-8.
Value(s) applied:	0.3 for Market Swine 0.46 for Breeding Swine 0.46 for Gilts
Purpose of data:	Baseline emissions
Additional comment:	No comments

Data / Parameter:	MCF_j
Unit:	%
Description:	Annual methane conversion factor for the baseline animal waste management system “j”.
Source of data:	Obtained from IPCC2006, vol. 4, chapter 10, Tables 10.17.
Value(s) applied:	79%
Purpose of data:	Baseline emissions
Additional comment:	No comments

Data / Parameter:	$MS\%_{BI,j}$
Unit:	Fraction
Description:	Fraction of manure handled in baseline animal manure management system "j".
Source of data:	Project proponents
Value(s) applied:	1
Purpose of data:	Baseline emissions
Additional comment:	No comments

Data / Parameter:	GWP_{CH_4}
Unit:	tCO ₂ e/tCH ₄
Description:	Global warming potential of CH ₄
Source of data:	IPCC 2006
Value(s) applied:	21
Purpose of data:	Baseline emissions and Project Emissions
Additional comment:	No comments

Data / Parameter:	$B_{0,LT}$
Unit:	m ³ CH ₄ /kg dm
Description:	Maximum methane producing potential of the volatile solid generated for animal type "LT".
Source of data:	IPCC 2006, Tables 10-A7 and 10-A8.
Value(s) applied:	Sows(breeding swine more than 200 kg mass): 0.45 Finishers(market swine more than 50 kg mass): 0.45 Nursery: 0.45 Boars and Gilts (market swine more than 100 kg mass): 0.45
Purpose of data:	Baseline emissions
Additional comment:	No comments

Data / Parameter:	$W_{default}$
Unit:	kg
Description:	Default average animal weight of a defined population at the project site.
Source of data:	IPCC 2006, Tables 10-A7 and 10-A8.
Value(s) applied:	Sows(breeding swine): 198 kg Finishers(market swine): 50 kg Nursery (market swine): 50 kg Boars (market swine): 50 kg Gilts (breeding swine): 198 kg
Purpose of data:	Baseline emissions
Additional comment:	No comments

Data / Parameter:	UF _b
Unit:	No unit applied
Description:	Model correction factor to account for model uncertainties
Source of data:	Reference: FCCC/SBSTA/2003/10/Add.2, page 25.
Value(s) applied:	0.94
Purpose of data:	Baseline emissions
Additional comment:	No comments

D.2. Data and parameters monitored

Data / Parameter:	T _f																																																																																																																																												
Unit:	°C																																																																																																																																												
Description:	Combustion temperature of the flare																																																																																																																																												
Measured/ Calculated / Default:	Measured																																																																																																																																												
Source of data:	Brascarbon Monitoring Report System (form 01.001)																																																																																																																																												
Value(s) of monitored parameter:	The aggregate values of T _f (hours with Tf above 500° C and hours with Tf below 500°C) can be found in the spreadsheet calculation file “CER Calculation MR03 - BCA-BRA-05_v1” in the folder MDy-PEpower,y,ex-post.																																																																																																																																												
Monitoring equipment:	<table><tr><th colspan="7">Thermocouple ⁽¹⁾</th></tr><tr><th>Farm name</th><th>Site ID</th><th>Thermocouple Serial Number (2)</th><th>Calibration Certification Number</th><th>Calibration Date</th><th>Installation Date (3)</th><th>Expiration Date</th></tr><tr><td>Fazenda Aqua Branca</td><td>BCA-030MS1-05</td><td>TM-14492/3 166919</td><td>021/10-3 48283-1</td><td>21-03-10 02-01-12</td><td>23-03-10 19-03-12</td><td>20-03-12 18-03-13</td></tr><tr><td>Fazenda Rodeio - Gleba C</td><td>BCA-031MS1-05</td><td>TM-14492/13 166920</td><td>021/10-12 48283-2</td><td>21-03-10 02-01-12</td><td>23-03-10 19-03-12</td><td>20-03-12 18-03-13</td></tr><tr><td>Fazenda Dragão</td><td>BCA-032MS1-05</td><td>TM-14502/01 166921</td><td>021/10-17 48283-3</td><td>21-03-10 02-01-12</td><td>23-03-10 19-03-12</td><td>20-03-12 18-03-13</td></tr><tr><td>Lote 55 e 54</td><td>BCA-034MS1-05</td><td>TM-14492/7 166922</td><td>021/10-7 48283-4</td><td>21-03-10 02-01-12</td><td>23-03-10 19-03-12</td><td>20-03-12 18-03-13</td></tr><tr><td>Lote 101</td><td>BCA-035MS1-05</td><td>TM 15036/9 166923</td><td>062/10-5 48283-5</td><td>15-05-10 02-01-12</td><td>17-05-10 19-03-12</td><td>14-05-12 18-03-13</td></tr><tr><td>Lote 105</td><td>BCA-036MS1-05</td><td>TM-14492/15 166924</td><td>021/10-14 48283-6</td><td>21-03-10 02-01-12</td><td>23-03-10 19-03-12</td><td>20-03-12 18-03-13</td></tr><tr><td>Lote 71</td><td>BCA-037MS1-05</td><td>TM-14492/5 166925</td><td>021/10-5 48283-7</td><td>21-03-10 02-01-12</td><td>23-03-10 19-03-12</td><td>20-03-12 18-03-13</td></tr><tr><td>Lote 82</td><td>BCA-038MS1-05</td><td>TM-14492/11 166926</td><td>021/10-10 48283-8</td><td>21-03-10 02-01-12</td><td>23-03-10 19-03-12</td><td>20-03-12 18-03-13</td></tr><tr><td>Lote 28 e 27</td><td>BCA-039MS1-05</td><td>TM-14492/6 166927</td><td>021/10-6 48283-9</td><td>21-03-10 02-01-12</td><td>23-03-10 19-03-12</td><td>20-03-12 18-03-13</td></tr><tr><td>Fazenda Bela Vista</td><td>BCA-040MS1-05</td><td>TM-14492/2 166928</td><td>021/10-2 48283-10</td><td>21-03-10 02-01-12</td><td>23-03-10 19-03-12</td><td>20-03-12 18-03-13</td></tr><tr><td>Granja Serra Dourada</td><td>BCA-041MS1-05</td><td>TM-14492/9 166929</td><td>021/10-8 48283-11</td><td>21-03-10 02-01-12</td><td>23-03-10 19-03-12</td><td>20-03-12 18-03-13</td></tr><tr><td>Fazenda Cachoeira</td><td>BCA-042MS1-05</td><td>TM-14492/14 166930</td><td>021/10-13 48283-12</td><td>21-03-10 02-01-12</td><td>23-03-10 19-03-12</td><td>20-03-12 18-03-13</td></tr><tr><td>Granja Capivara</td><td>BCA-043MS1-05</td><td>TM-15036/16 166931</td><td>062/10-10 48283-13</td><td>15-05-10 02-01-12</td><td>17-05-10 19-03-12</td><td>14-05-12 18-03-13</td></tr><tr><td>Fazenda Sorogatto</td><td>BCA-046MS1-05</td><td>TM-14492/16 166933</td><td>021/10-15 48283-15</td><td>21-03-10 02-01-12</td><td>23-03-10 19-03-12</td><td>20-03-12 18-03-13</td></tr><tr><td>Fazenda Santa Catarina</td><td>BCA-047MS1-05</td><td>TM-14492/17 166934</td><td>021/10-16 48283-16</td><td>21-03-10 02-01-12</td><td>23-03-10 19-03-12</td><td>20-03-12 18-03-13</td></tr><tr><td>Fazenda Bambú - Quinhão A</td><td>BCA-051MS1-05</td><td>TM-14492/4 166932</td><td>021/10-4 48283-14</td><td>21-03-10 02-01-12</td><td>23-03-10 19-03-12</td><td>20-03-12 18-03-13</td></tr><tr><td>Fazenda Folleto</td><td>BCA-052MS1-05</td><td>TM-14492/12 166936</td><td>021/10-11 48283-18</td><td>21-03-10 02-01-12</td><td>23-03-10 19-03-12</td><td>20-03-12 18-03-13</td></tr><tr><td>Fazenda Ponte Vermelha</td><td>BCA-068MS1-05</td><td>TM-14492/10 166935</td><td>021/10-9 48283-17</td><td>21-03-10 02-01-12</td><td>23-03-10 19-03-12</td><td>20-03-12 18-03-13</td></tr></table> <div><div>(1)</div><div>Monitoring equipment type:</div><div>Standard Thermocouple from MAFS (2010-2012) Standard Thermocouple from ALUTAL (2012-2013)</div></div> <div><div>(2)</div><div>Accuracy class:</div><div>MAFS: 3°C until 600°C and 0.5% of the temperature measured above 600°C ALUTAL: ± 1.5°C or ± 0.25%</div></div> <div><div>(3)</div><div>Calibration frequency:</div><div>MAFS: Every two years of continuous operation (counted from the date of installation) ALUTAL: Every year of continuous operation (counted from the date of installation)</div></div> <p>NOTE: Replacement of thermocouples was done on all farms during the monitoring period, but the replacement procedure takes place on site with no implication on the functioning or normal operation of the equipment.</p>	Thermocouple ⁽¹⁾							Farm name	Site ID	Thermocouple Serial Number (2)	Calibration Certification Number	Calibration Date	Installation Date (3)	Expiration Date	Fazenda Aqua Branca	BCA-030MS1-05	TM-14492/3 166919	021/10-3 48283-1	21-03-10 02-01-12	23-03-10 19-03-12	20-03-12 18-03-13	Fazenda Rodeio - Gleba C	BCA-031MS1-05	TM-14492/13 166920	021/10-12 48283-2	21-03-10 02-01-12	23-03-10 19-03-12	20-03-12 18-03-13	Fazenda Dragão	BCA-032MS1-05	TM-14502/01 166921	021/10-17 48283-3	21-03-10 02-01-12	23-03-10 19-03-12	20-03-12 18-03-13	Lote 55 e 54	BCA-034MS1-05	TM-14492/7 166922	021/10-7 48283-4	21-03-10 02-01-12	23-03-10 19-03-12	20-03-12 18-03-13	Lote 101	BCA-035MS1-05	TM 15036/9 166923	062/10-5 48283-5	15-05-10 02-01-12	17-05-10 19-03-12	14-05-12 18-03-13	Lote 105	BCA-036MS1-05	TM-14492/15 166924	021/10-14 48283-6	21-03-10 02-01-12	23-03-10 19-03-12	20-03-12 18-03-13	Lote 71	BCA-037MS1-05	TM-14492/5 166925	021/10-5 48283-7	21-03-10 02-01-12	23-03-10 19-03-12	20-03-12 18-03-13	Lote 82	BCA-038MS1-05	TM-14492/11 166926	021/10-10 48283-8	21-03-10 02-01-12	23-03-10 19-03-12	20-03-12 18-03-13	Lote 28 e 27	BCA-039MS1-05	TM-14492/6 166927	021/10-6 48283-9	21-03-10 02-01-12	23-03-10 19-03-12	20-03-12 18-03-13	Fazenda Bela Vista	BCA-040MS1-05	TM-14492/2 166928	021/10-2 48283-10	21-03-10 02-01-12	23-03-10 19-03-12	20-03-12 18-03-13	Granja Serra Dourada	BCA-041MS1-05	TM-14492/9 166929	021/10-8 48283-11	21-03-10 02-01-12	23-03-10 19-03-12	20-03-12 18-03-13	Fazenda Cachoeira	BCA-042MS1-05	TM-14492/14 166930	021/10-13 48283-12	21-03-10 02-01-12	23-03-10 19-03-12	20-03-12 18-03-13	Granja Capivara	BCA-043MS1-05	TM-15036/16 166931	062/10-10 48283-13	15-05-10 02-01-12	17-05-10 19-03-12	14-05-12 18-03-13	Fazenda Sorogatto	BCA-046MS1-05	TM-14492/16 166933	021/10-15 48283-15	21-03-10 02-01-12	23-03-10 19-03-12	20-03-12 18-03-13	Fazenda Santa Catarina	BCA-047MS1-05	TM-14492/17 166934	021/10-16 48283-16	21-03-10 02-01-12	23-03-10 19-03-12	20-03-12 18-03-13	Fazenda Bambú - Quinhão A	BCA-051MS1-05	TM-14492/4 166932	021/10-4 48283-14	21-03-10 02-01-12	23-03-10 19-03-12	20-03-12 18-03-13	Fazenda Folleto	BCA-052MS1-05	TM-14492/12 166936	021/10-11 48283-18	21-03-10 02-01-12	23-03-10 19-03-12	20-03-12 18-03-13	Fazenda Ponte Vermelha	BCA-068MS1-05	TM-14492/10 166935	021/10-9 48283-17	21-03-10 02-01-12	23-03-10 19-03-12	20-03-12 18-03-13
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Measuring/ Reading/ Recording frequency:	Every 1 minute measurement and registration by the PLC. Data is collected monthly from the field.																																																																																																																																												
Calculation method (if applicable):	N/A																																																																																																																																												

QA/QC procedures:	The information of the temperature is managed by the use of the form 01.001. The form 01.001 is extracted from the PLC, where the continuous information is stored and is further checked by the QA/QC officer. The calibration certificates are managed to guarantee the thermocouples are calibrated during all the monitoring period. The QA/QC officer checks one month before the expiration date, to proceed with the new calibration.
Purpose of data:	Baseline Emissions and Project Emissions
Additional comment:	No comments

Data / Parameter:	SITE INSPECTION
Unit:	Documents
Description:	Inspection on the site considering relevant regulation and the infrastructure of the site
Measured/ Calculated / Default:	Documented
Source of data:	Brascarbon Monitoring Report System (form 02.001)
Value(s) of monitored parameter:	During the current monitoring period all sites were inspected and no relevant changes were observed. Also, all the licenses and documents were in place and it was confirmed that all the manure produced (MS% _{i,v}) has been directed to the project activity facilities.
Monitoring equipment:	N/A
Measuring/ Reading/ Recording frequency:	Annually/Every monitoring period
Calculation method (if applicable):	N/A
QA/QC procedures:	The site inspection is monitored by the use of the form 02.001 to help the regional technician during the monitoring visit and is further checked by the QA/QC officer, together with the on-site documents and all documents received from the field, namely the confined animal production official documents.
Purpose of data:	N/A
Additional comment:	No comments

Data / Parameter:	$N_{LT,y}$
Unit:	Number
Description:	Annual average number of animals of type "LT" in year "y"
Measured/ Calculated / Default:	Calculated
Source of data:	Brascarbon Monitoring Report System (forms 03.003 and 03.001)
Value(s) of monitored parameter:	The values of $N_{LT,y}$ can be found in the spreadsheet calculation file "CER Calculation MR03 - BCA-BRA-05_v1" in the folder <i>BEy ex-post – PEy ex-post</i> .
Monitoring equipment:	N/A
Measuring/ Reading/ Recording frequency:	Monthly
Calculation method (if applicable):	The calculation of the average number of animals ($N_{LT,y}$) is done monthly. The form 03.003 (animal control system form) is fulfilled by the confined feed operation proprietary. It presents the daily records of animal entries (ex: purchase; births, internal transfer) and exit (ex: sale, death, internal transfer) and the final daily record of animals (number of animals on the day-1 + entrance on day – exit on day) per animal category (ex: nursery, finishers, gilts, sows, boars). The average number of animals per animal category is then calculated monthly in the same form through the monthly average of animals that have been recorded daily. Using this approach for calculating $N_{LT,y}$, it is not necessary to calculate separately an $N_{da,y}$ and an $N_{p,y}$, since the number of days the animal is alive ($N_{da,y}$) and the number of animals produced per category LT ($N_{p,y}$) are already implicitly considered in the daily records and taken into account when calculating $N_{LT,y}$. The form 03.001 is the input for the emission reduction calculation spreadsheet and aggregates the monthly average number of animals per animal category per farm for all farms included in the PDD.
QA/QC procedures:	The forms 03.003 and 03.001 are checked by the QA/QC officer to guarantee consistency. Other on-site documents including, when available, animal purchase and sale records are used to cross-check the information reported.
Purpose of data:	Baseline Emissions
Additional comment:	No comments

Data / Parameter:	$N_{da,y}$
Unit:	Number
Description:	Number of days animal is alive in the farm, in year “y”
Measured/ Calculated / Default:	Measured
Source of data:	Brascarbon Monitoring Report System (forms 03.003 and 03.001)
Value(s) of monitored parameter:	Please see explanation in data/parameter $N_{LT,y}$
Monitoring equipment:	N/A
Measuring/ Reading/ Recording frequency:	Daily
Calculation method (if applicable):	N/A
QA/QC procedures:	Please see explanation in data/parameter $N_{LT,y}$
Purpose of data:	Baseline Emissions
Additional comment:	No comments

Data / Parameter:	$N_{p,y}$
Unit:	Number
Description:	Number of animals produced annually of type “LT” in year “y”
Measured/ Calculated / Default:	Measured
Source of data:	Brascarbon Monitoring Report System (forms 03.003 and 03.001)
Value(s) of monitored parameter:	Please see explanation in data/parameter $N_{LT,y}$
Monitoring equipment:	N/A
Measuring/ Reading/ Recording frequency:	Daily
Calculation method (if applicable):	N/A
QA/QC procedures:	Please see explanation in data/parameter $N_{LT,y}$
Purpose of data:	Baseline Emissions
Additional comment:	No comments

Data / Parameter:	BG _{burnt,y}																																																																																																																		
Unit:	m ³																																																																																																																		
Description:	Biogas flared or used as a fuel in the year y.																																																																																																																		
Measured/ Calculated / Default:	Measured on wet basis																																																																																																																		
Source of data:	Brascarbon Monitoring Report System (form 01.001)																																																																																																																		
Value(s) of monitored parameter:	The values of BG _{burnt,y} can be found in the spreadsheet calculation file "CER Calculation MR03 - BCA-BRA-05_v1" in the folder MDy-PEpower,y,ex-post.																																																																																																																		
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Measuring/ Reading/ Recording frequency:	Every 1 minute measurement and registration by the PLC. Data is collected monthly from the field.																																																																																																																		
Calculation method (if applicable):	The biogas volume measurement is done on wet basis. As the flow meter registers the biogas that is directed to the flare cumulatively (and that is also the data registered in the PLC), the BG _{burnt,y} for a certain period is calculated by differential with the previous biogas volume reading.																																																																																																																		
QA/QC procedures:	The information of the biogas volume is managed by the use of the form 01.001. The form 01.001 is extracted from the PLC, where the continuous information is stored and is further checked by the QA/QC officer. The calibration certificates are managed to guarantee the flow meters are calibrated during all the monitoring period. The QA/QC officer checks one month before the expiration date, to proceed with the new calibration.																																																																																																																		
Purpose of data:	Baseline Emissions																																																																																																																		
Additional comment:	No comments																																																																																																																		

Data / Parameter:	$W_{CH_4,y}$																																																																																																																								
Unit:	Fraction																																																																																																																								
Description:	Methane content in biogas in the year “y”																																																																																																																								
Measured/ Calculated / Default:	Measured on wet basis																																																																																																																								
Source of data:	Brascarbon Monitoring Report System (form 04.001)																																																																																																																								
Value(s) of monitored parameter:	The values of $W_{CH_4,y}$ can be found in the spreadsheet calculation file “CER Calculation MR03 - BCA-BRA-05_v1” in the folder MDy-PEpower,y,ex-post.																																																																																																																								
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Measuring/ Reading/ Recording frequency:	The monitoring frequency is monthly and guarantees a 95% confidence level (for details, please see Section D.3 – Implementation of sampling plan).																																																																																																																								
Calculation method (if applicable):	The methane content measurement is done on wet basis.																																																																																																																								
QA/QC procedures:	The information of the methane content is managed by the use of the form 04.001 (formulary for field data collection). The calibration certificates are managed to guarantee the portable analyzers are calibrated during all the monitoring period. The QA/QC officer checks one month before the expiration date stated in the calibration certificates to proceed with the new calibration.																																																																																																																								
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Purpose of data:	Baseline Emissions																																																																																																																								
Additional comment:	No comments																																																																																																																								

Data / Parameter:	$D_{CH_4,y}$
Unit:	kg / m ³
Description:	Density of the methane combusted
Measured/ Calculated / Default:	Calculated
Source of data:	Brascarbon Monitoring Report System
Value(s) of monitored parameter:	The values of $D_{CH_4,y}$ can be found in the spreadsheet calculation file "CER Calculation MR03 - BCA-BRA-05_v1" in the folder <i>MDy-PEpower,y,ex-post</i> .
Monitoring equipment:	N/A
Measuring/ Reading/ Recording frequency:	Monthly
Calculation method (if applicable):	$D_{CH_4,y} = \frac{P_n}{\frac{R_u}{MM_{RG,h}} \times T_n}$ <p> $D_{CH_4,y}$: Density of methane in the biogas (kg/m³) P_n: Pressure of biogas (Pa) R_u: Universal Gas Constant (8314 Pa.m³/Kmol.K) $MM_{RG,h}$: Molecular mass of methane (16.04 kg/kmol) T_n: Biogas temperature (K) </p>
QA/QC procedures:	The density calculation is done by the QA/QC officer based on monitoring data and it is further confirmed if the calculated value is within the interval of standard density values reported for methane density.
Purpose of data:	Baseline Emissions
Additional comment:	No comments

Data / Parameter:	FE
Unit:	%
Description:	Flare Efficiency
Measured/ Calculated / Default:	Calculated
Source of data:	Brascarbon Monitoring Report System (form 08.001)
Value(s) of monitored parameter:	The aggregate monthly values of FE can be found in the spreadsheet calculation file "CER Calculation MR03 - BCA-BRA-05_v1" in the folder <i>MDy-PEpower,y,ex-post</i> . Please note that during the current monitoring period, the flare always operated within the range of manufacturer specifications when above 500°C, hence the level of 50% flare efficiency has not been applied.
Monitoring equipment:	Enclosed flare is used in the entire project. All data and parameters that are required to monitor the flare operation within the range of operating conditions according to manufacturer's specifications are continuously monitored.
Measuring/ Reading/ Recording frequency:	Every 1 minute measurement and registration of flare temperature and biogas flow rate by the PLC. Data is recovered monthly for Flare Efficiency calculation
Calculation method (if applicable):	<p>For the hourly flare efficiency calculation, the following is considered:</p> <ul style="list-style-type: none"> • If flare temperature $\geq 500^{\circ}\text{C}$ for all minutes in an hour, then 90% efficiency is considered for that hour; • If flare temperature $\geq 500^{\circ}\text{C}$ but the flare is operating out of manufacturer specification in any minute, then 50% efficiency is considered for that hour; • If flare temperature $< 500^{\circ}\text{C}$ in any minute, then 0% efficiency is considered for that hour; <p>The hourly flare efficiency is compounded monthly in a weighted average for the purpose of emission reduction calculation, through the following formula:</p> $FE = \frac{[\sum H(\text{temp} \geq 500^{\circ}\text{C}) * 0,9 + \sum H(\text{temp} \geq 500^{\circ}\text{C out of spec}) * 0,5 + \sum H(\text{temp} < 500^{\circ}\text{C}) * 0]}{Ht} * 100$ <p>Where FE: Flare efficiency for the total of operational hours in the operational period, in % H (temp$\geq 500^{\circ}\text{C}$): Sum of hours total in the measured period in which the temperature is higher or equal to 500°C. H (temp$\geq 500^{\circ}\text{C}$) out of spec: Sum of hours in the measured period in which the flare parameters is out of the range of specifications. H (temp$< 500^{\circ}\text{C}$): Sum of hours total in the measured period in which the temperature is lower than 500°C. Ht: Total of hours in the measured period</p>
QA/QC procedures:	The information of the flare efficiency is managed by the use of the form 08.001 with hourly flare efficiency values and monthly calculated average and is further checked by the QA/QC officer. The enclosed flare regularly undergoes a maintenance process subject to the appropriate industrial standards and/or manufacturer's specifications in order to ensure measurement accuracy.
Purpose of data:	Baseline Emissions and Project Emissions
Additional comment:	No comments

Data / Parameter:	QDM
Unit:	N/A
Description:	Sludge soil application
Measured/ Calculated / Default:	N/A
Source of data:	Brascarbon Monitoring Report System (form 09.001)
Value(s) of monitored parameter:	N/A. Sludge was not removed during this monitoring period.
Monitoring equipment:	N/A
Measuring/ Reading/ Recording frequency:	Defined according to the digester performance.
Calculation method (if applicable):	N/A
QA/QC procedures:	Check the registers in the generated documents.
Purpose of data:	N/A
Additional comment:	No comments

Data / Parameter:	W_{site}
Unit:	kg
Description:	Average animal weight of a defined livestock population at the project site
Measured/ Calculated / Default:	Measured
Source of data:	Brascarbon Monitoring Report System (form 16.001)
Value(s) of monitored parameter:	The values of W_{site} can be found in the spreadsheet calculation file "CER Calculation MR03 - BCA-BRA-05_v1" in the folder <i>MDy-PEpower,y,ex-post</i> .
Monitoring equipment:	N/A
Measuring/ Reading/ Recording frequency:	Quarterly
Calculation method (if applicable):	The average animal weight is obtained by the confined feed operation proprietary through direct weighting of a representative sample of animals in each category. Quarterly, the information is collected and checked by the regional technician during the site visit and inserted in the formulary 16.001.
QA/QC procedures:	The weight of the animals is controlled by the use of the form 16.001. The data is further analyzed by the QA/QC officer and cross-checked with indirect sources, including public information from EMPRAPA (Brazilian Agricultural Research Corporation) on weight ranges per category of animal.
Purpose of data:	Baseline Emissions
Additional comment:	No comments

Data / Parameter:	$ER_{y,ex-post}$
Unit:	t CO ₂ e
Description:	Ex-post emission reductions achieved by the project activity based on monitored values for the year “y”.
Measured/ Calculated / Default:	Calculated
Source of data:	Brascarbon Monitoring Report System (form 17.001 – CER Calculation spreadsheet)
Value(s) of monitored parameter:	The values of $ER_{y,ex-post}$ can be found in the spreadsheet calculation file “CER Calculation MR03 - BCA-BRA-05_v1” in the folder <i>ERY ex-post</i> .
Monitoring equipment:	N/A
Measuring/ Reading/ Recording frequency:	Monthly and compounded annually
Calculation method (if applicable):	$ER_{y,ex-post} = \min[(BE_{y,ex-post} - PE_{y,ex-post}), (MD_y - PE_{power,y,ex-post})]$ <p>Where</p> <p>$ER_{y,ex-post}$ Emission reductions achieved by the project activity based on monitored values for year y (tCO₂e)</p> <p>$BE_{y,ex post}$ Baseline emissions calculated using equation 1 and using ex post monitored values of $N_{LT,y}$ and if applicable $VS_{LT,y}$ for year y (tCO₂e)</p> <p>$PE_{y,ex post}$ Project emissions calculated using equation 3 using ex post monitored values of $N_{LT,y}$, $MS\%_{i,y}$ and if applicable $VS_{LT,y}$ for year y (tCO₂e)</p> <p>MD_y Methane captured and destroyed or used gainfully by the project activity in year y (tCO₂e)</p> <p>$PE_{power,y,ex post}$ Emissions from the use of fossil fuel or electricity for the operation of the installed facilities based on monitored values in the year y (tCO₂e)</p> <p>Please see more details in Section E</p>
QA/QC procedures:	The $ER_{y,ex-post}$ is calculated by the QC officer using the emissions reduction spreadsheet calculation. When the results are not accordant with the expected/projected, the QA/QC officer recommends additional corrective action to be checked and/or followed in the field.
Purpose of data:	N/A
Additional comment:	No comments

Data / Parameter:	FFR
Unit:	No data unit applied
Description:	Formulated feed rations
Measured/ Calculated / Default:	N/A
Source of data:	Brascarbon Monitoring Report System (form 14.001)
Value(s) of monitored parameter:	The monitoring of FFR during the monitoring period confirmed that the farm uses formulated feed rations (FFR) which are optimized for the various animal(s), stage of growth, category, weight gain/productivity and/or genetics
Monitoring equipment:	N/A
Measuring/ Reading/ Recording frequency:	Monthly
Calculation method (if applicable):	N/A
QA/QC procedures:	The formulated feed rations used per animal category is controlled by the use of the form 14.001 and is further checked by the QA/QC officer, together with information and records obtained in the confined animal feed operation on food composition and, when available, on food purchases.
Purpose of data:	Baseline emissions (to validate Bo and VS values used)
Additional comment:	No comments

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Calculation method (if applicable):	N/A																																																																																																																								
QA/QC procedures:	The information of the biogas pressure is managed by the use of the form 04.001 (formulary for field data collection) and is further checked by the QA/QC officer. The calibration certificates are managed to guarantee the portable analysers are calibrated during all the monitoring period. The QA/QC officer checks one month before the expiration date stated in the calibration certificates to proceed with the new calibration.																																																																																																																								
Purpose of data:	Baseline Emissions																																																																																																																								
Additional comment:	No comments																																																																																																																								

Data / Parameter:	GENETIC SOURCE
Unit:	No data unit applied
Description:	Genetic source from annex I party
Measured/ Calculated / Default:	N/A
Source of data:	Brascarbon Monitoring Report System (form 15.001)
Value(s) of monitored parameter:	The monitoring of Genetic Source during the monitoring period confirmed that the farms use Western Europe genetic
Monitoring equipment:	N/A
Measuring/ Reading/ Recording frequency:	Annually
Calculation method (if applicable):	N/A
QA/QC procedures:	The genetic source used per animal category is controlled by the use of the form 15.001 and is further checked by the QA/QC officer, together with information and records obtained in the confined animal feed operation regarding the livestock genetic composition of each producer (purchase notes if available).
Purpose of data:	Baseline Emissions (to validate Bo and VS values used)
Additional comment:	No comments

Data / Parameter:	MS% _{i,y}
Unit:	Fraction
Description:	Fraction of manure handled in system "i", year "y".
Measured/ Calculated / Default:	Estimated
Source of data:	Brascarbon Monitoring Report System (form 02.001)
Value(s) of monitored parameter:	During the site inspection, it was confirmed that no changes in the manure management system occurred and all the manure was handled in the project facilities. Value is therefore 1.
Monitoring equipment:	N/A
Measuring/ Reading/ Recording frequency:	Annually
Calculation method (if applicable):	N/A
QA/QC procedures:	The fraction of manure handled in in system is observed during the site visit and controlled by the use of the form 02.001 and is further checked by the QA/QC officer.
Purpose of data:	Project Emissions
Additional comment:	No comments

Data / Parameter:	$TM_{RG,h}$
Unit:	kg/h
Description:	Mass flow rate of methane in the residual gas in the hour h
Measured/ Calculated / Default:	Calculated
Source of data:	Brascarbon Monitoring Report System (form 17.001 – CER Calculation spreadsheet)
Value(s) of monitored parameter:	The values of $TM_{RG,h}$ can be found in the spreadsheet calculation file "CER Calculation MR03 - BCA-BRA-05_v1" in the folder BEy ex-post – PEy ex-post.
Monitoring equipment:	N/A
Measuring/ Reading/ Recording frequency:	Monthly
Calculation method (if applicable):	<p>Calculated according to the "Tool to determine project emissions from flaring gases containing methane", using the monthly average calculated value of $FV_{RG,h}$ and the monthly monitored value of $fv_{CH4,RG,h}$ (both values referred to in the same basis - wet).</p> $TM_{RG,h} = FV_{RG,h} * fv_{CH4,RG,h} * 0,716$ <p>Where:</p> <p>$FV_{RG,h}$ Volumetric flow rate of the residual gas at normal conditions in hour h</p> <p>$fv_{CH4,RG,h}$ Volumetric fraction of methane in the residual gas in hour h</p> <p>0.716 Density of methane in normal conditions: default value indicated in EB 28, ANNEX 13, "Tool to determine project emissions from flaring gases containing methane", Page 9</p>
QA/QC procedures:	The $TM_{RG,h}$ calculation is done by the QA/QC officer based on monitoring data using the emissions reduction spreadsheet calculation and it is further checked.
Purpose of data:	Project Emissions
Additional comment:	No comments

Data / Parameter:	FV _{RG,h}																																																																																																																																															
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Calculation method (if applicable):	<p>The parameter FV_{RG,h} is calculated in normal (NTP) conditions (101.325 kPa and 273.15 K) as requested by the “Tool to determine project emissions from flaring gases containing methane” (EB 28, Annex 13). Hence, the measured BG_{burnt,v} at measurement conditions (pressure and temperature) is converted to normal conditions using the following formula:</p> $V_{normal\ conditions} = (PV/T)_{measurement\ conditions} * (T/P)_{normal\ conditions}$ <p>Then, the calculation is made according to the formula below and based on monitored data of total biogas volume directed to the flare in a one month and the total hours of operation in that month. FV_{RG,h} obtained is in wet basis (same basis as BG_{burnt,v normal})</p> $FV_{RG,h} = BG_{burnt,v\ normal} / Total\ hours$ <p>This approach has been considered accurate for the calculation of FV_{RG,h} since the biogas hourly flow is considered to be constant as there is no artificial blower or pump.</p>																																																																																																																																															
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Purpose of data:	Project Emissions
Additional comment:	No comments

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Lote 101	BCA-035MS1-05	BM 11043	BM 11043_5/1325	31-10-2011	30-04-2012																																																																																																																				
Lote 105	BCA-036MS1-05	BM 11043	BM 11043_5/1325	05-03-2012	04-09-2012																																																																																																																				
Lote 71	BCA-037MS1-05	BM 11043	BM 11043_5/1543	29-05-2012	28-11-2012																																																																																																																				
Lote 82	BCA-038MS1-05	BM 11043	BM 11043_5/1502	26-11-2012	25-04-2013																																																																																																																				
Lote 28 e 27	BCA-039MS1-05																																																																																																																								
Fazenda Bela Vista	BCA-040MS1-05																																																																																																																								
Granja Serra Dourada	BCA-041MS1-05																																																																																																																								
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Granja Capivara	BCA-043MS1-05																																																																																																																								
Fazenda Sorgatto	BCA-046MS1-05																																																																																																																								
Fazenda Santa Catarina	BCA-047MS1-05																																																																																																																								
Fazenda Bambú - Quinhão A	BCA-051MS1-05																																																																																																																								
Fazenda Folleto	BCA-052MS1-05																																																																																																																								
Fazenda Ponte Vermelha	BCA-068MS1-05																																																																																																																								
(1) Monitoring equipment type:	Biogas Check Portable Digital Analyser from Geotech/Landtech																																																																																																																								
(2) Accuracy class:	<ul style="list-style-type: none"> • CH₄: ± 0.5% from 0-5% CH₄ content; ± 1.0% from 5-15% CH₄ content; ± 3.0% from 15%-full scale CH₄ content • Temperature: ± 0.2°C (Biogas check analyser accuracy) ± 0.5°C (temperature probe accuracy) • Pressure: ± 4mbar typically and ±15 mbar maximum 																																																																																																																								
(3) Calibration frequency:	Every 6 months																																																																																																																								
Measuring/ Reading/ Recording frequency:	The monitoring frequency is monthly and guarantees a 95% confidence level (for details, please see Section D.3 – Implementation of sampling plan).																																																																																																																								
Calculation method (if applicable):	The methane content measured monthly ($W_{CH_4, v}$) is used as an (average) $fv_{CH_4, RG, h}$. This approach is considered accurate for the calculation of $PE_{flare, v}$ since the monthly monitored $W_{CH_4, v}$ (measured on wet basis) assures a 95% confidence level in the methane concentration measurement.																																																																																																																								
QA/QC procedures:	The information of the methane content is managed by the use of the form 04.001 (formulary for field data collection). The calibration certificates are managed to guarantee the portable analysers are calibrated during all the monitoring period. The QA/QC officer checks one month before the expiration date stated in the calibration certificates to proceed with the new calibration.																																																																																																																								
Purpose of data:	Project Emissions																																																																																																																								
Additional comment:	No comments																																																																																																																								

D.3. Implementation of sampling plan

a) Sampling design

According to methodology AMS-III.D version 14 requirements, the parameter methane content in biogas can be measured with periodical measurements at a 95% confidence level (alternative to measuring with a continuous analyzer).

The sampling method chosen is systematic sampling with a random start date. However, as the sampling times are sufficiently far apart (monthly sampling), the data can be regarded as a set of independent observations and considered simple random sampling.

In order to implement the sampling plan, the project developer conducted an *ex-ante* study in all sites included in the PDD. The study consisted in measuring the methane content hourly during 7 consecutive days (total of 168 samples). The 168 measurements allowed the definition of a 95% confidence level interval specific for each farm, providing a minimum and maximum value of methane content inside the 95% confidence interval. The *ex-ante* statistical study has been provided to the DOE for verification.

b) Collected data

For the current monitoring period of 427 days (from 1st November 2011 to 31st December 2012), monthly measurements of methane content were taken in each site included in the PDD. The collection of data is done by the Regional Technician (RT) with a portable digital analyzer (Biogas Check portable model from Geotech/Landtech) during the monthly site visit, which takes place between the 1st and 20th day of each month. The RT is trained on procedures for data collection, namely with regards methane content measurement (included in Brascarbon Operational Procedure POP 05). Each monthly collected value for each site is used for the emission reduction calculation of the respective month and site.

c) Analysis of the collected data and compliance with the required confidence level

The collected data for each site have been analyzed in order to assess compliance with the 95% confidence level. According to the analysis undertaken, all measurements have been within the pre-defined interval, so it is concluded that the required 95% confidence for the parameter methane content has been met.

SECTION E. Calculation of emission reductions or GHG removals by sinks**E.1. Calculation of baseline emissions or baseline net GHG removals by sinks**

The baseline emission can be calculated as follows:

Equation 1

$$BE_y = GWP_{CH_4} * D_{CH_4} * UF_b * \sum MCF_j * B_{0,LT} * N_{LT,y} * VS_{LT,y} * MS\%_{Bl,j}$$

Where:

BE_y	Baseline emissions in year “y” (tCO ₂ e)
GWP_{CH_4}	Global Warming Potential (GWP) of CH ₄ (21)
D_{CH_4}	CH ₄ density (0.00067 t/m ³ at room temperature (20 °C) and 1 atm pressure).
LT	Index for all types of livestock
j	Index for animal waste management system
MCF_j	Annual methane conversion factor (MCF) for the baseline animal waste management system “j”
$B_{0,LT}$	Maximum methane producing potential of the volatile solid generated for animal type “LT” (m ³ CH ₄ /kg dm)
$N_{LT,y}$	Annual average number of animals of type “LT” in year “y” (numbers)
$VS_{LT,y}$	Volatile solids for livestock “LT” entering the animal manure management system in year “y” (on a dry matter weight basis, kg dm/animal/year)
$MS\%_{Bl,j}$	Fraction of manure handled in baseline animal manure management system “j”
UF_b	Model correction factor to account for model uncertainties (0.94)

Where $VS_{LT,y}$ can be determined by scaling default IPCC values to adjust for a site-specific average animal weight according to Equation 2:

Equation 2

$$VS_{LT,y} = \left(\frac{W_{site}}{W_{default}} \right) * VS_{default} * nd_y$$

Where:

W_{site}	Average animal weight of a defined livestock population at the project site (kg)
$W_{default}$	Default average animal weight of a defined population, this data is sourced from IPCC 2006
$VS_{default}$	Default value for the volatile solid excretion rate per day on a dry-matter basis for a livestock population (kg dm/animal/day)
nd_y	Number of days in year “y” where the treatment plant was operational.

Table E.1. summarizes the $BE_{y,ex\ post}$ for each farm during the current monitoring period. The detailed calculations are available in the CER Calculation spreadsheet (folder *BEy ex-post – PEy ex-post*)

Table E1. Baseline Emissions ($BE_{y,ex-post}$) in the current monitoring period

Site Name	Site ID	$BE_{y,ex-post}$ (t CO ₂ e)
Fazenda Agua Branca	BCA-030MS1-05	2,341
Fazenda Rodeio - Gleba C	BCA-031MS1-05	4,946
Fazenda Dragão	BCA-032MS1-05	2,705
Lote 55 e 54	BCA-034MS1-05	4,888
Lote 101	BCA-035MS1-05	3,843
Lote 105	BCA-036MS1-05	3,563
Lote 71	BCA-037MS1-05	3,190
Lote 82	BCA-038MS1-05	2,220
Lote 28 e 27	BCA-039MS1-05	3,834
Fazenda Bela Vista	BCA-040MS1-05	5,539
Granja Serra Dourada	BCA-041MS1-05	7,284
Fazenda Cachoeira	BCA-042MS1-05	7,046
Granja Capivara	BCA-043MS1-05	5,693
Fazenda Sorgatto	BCA-046MS1-05	5,491
Fazenda Santa Catarina	BCA-047MS1-05	6,524
Fazenda Bambú - Quinhão A	BCA-051MS1-05	3,535
Fazenda Folleto	BCA-052MS1-05	2,580
Fazenda Ponte Vermelha	BCA-068MS1-05	1,243
Total $BE_{y,ex-post}$		76,465

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

According to the simplified baseline and monitoring methodology for a small-scale CDM project Type-III (AMS-III.D - version 14), project emissions consist of:

- Physical leakage of biogas in the manure management systems, which includes production, collection and transport of biogas to the point of flaring/combustion or gainful use ($PE_{PL,y}$);
- Emissions from flaring or combustion of the gas stream ($PE_{flare,y}$);
- CO₂ emissions using fossil fuels or electricity for the operation of all the installed facilities (PE_p)

Equation 3

$$PE_y = PE_{PL,y} + PE_{flare,y} + PE_{power,y}$$

Where:

PE_y	Project emissions in year "y" (tCO ₂ e)
$PE_{PL,y}$	Emissions due to physical leakage of biogas in year "y" (tCO ₂ e)
$PE_{flare,y}$	Emissions from flaring or combustion of the biogas stream in the year "y" (tCO ₂ e)
$PE_{power,y}$	Emissions from the use of fossil fuel or electricity for the operation of the installed facilities in the year "y" (tCO ₂ e)

(A) Emissions due to physical leakage of biogas can be determinate as follows:

Equation 4

$$PE_{PL,y} = 0,10 * GWP_{CH_4} * D_{CH_4} * \sum B_{0,LT} * N_{LT,y} * VS_{LT,y} * MS\%_{i,y}$$

Where:

$PE_{PL,y}$	Emissions due to physical leakage of biogas in year "y" (tCO ₂ e)
GWP_{CH_4}	Global Warming Potential (GWP) of CH ₄ (21)
D_{CH_4}	CH ₄ density (0.00067 t/m ³ at room temperature (20 °C) and 1 atm pressure).
LT	Index for all types of livestock
I	Index for animal waste management system
$B_{0,LT}$	Maximum methane producing potential of the volatile solid generated for animal type "LT" (m ³ CH ₄ /kg dm)
$N_{LT,y}$	Annual average number of animals of type "LT" in year "y" (numbers)
$VS_{LT,y}$	Volatile solids for livestock "LT" entering the animal manure management system in year "y" (on a dry matter weight basis, kg dm/animal/year)
$MS\%_{i,y}$	Fraction of manure handled in system "i" in year "y"

(B) Emissions from flaring determinate as follows:

Equation 5

$$PE_{flare,y} = \sum_{h=1}^{8760} TM_{RG,h} * (1 - \eta_{flare,h}) * GWP_{CH_4} / 1000$$

Where:

$PE_{flare,y}$	Project emissions from flaring of the residual gas stream in year y, tCO ₂ e
$TM_{RG,h}$	Mass flow rate of methane in the residual gas in the hour h, kg/h
GWP_{CH_4}	Global Warming Potential of methane valid for the commitment period, tCO ₂ e/tCH ₄
$\eta_{flare,h}$	Flare efficiency in the hour h

Equation 6

$$TM_{RG,h} = FV_{RG,h} * fV_{CH_4,RG,h} * 0.716$$

Where:

$FV_{RG,h}$	Volumetric flow rate of the residual gas at normal conditions in hour
$fV_{CH_4,RG,h}$	Volumetric fraction of methane in the residual gas in hour h
0.716	Density of methane in normal conditions: default value indicated in EB 28, ANNEX 13, "Tool to determine project emissions from flaring gases containing methane", Page 9.

(C) Emissions from use of fossil fuels or electricity for the operation:

No fossil fuel or electricity will be used in the project, therefore, $PE_{power,y}$ = zero.

Table E.2 summarizes the project emissions for the current monitoring period ($PE_{y,ex-post}$) and more detailed information can be obtained in the CER Calculation spreadsheet (folder *BEy ex-post – PEy ex-post*).

Table E2. Project Emissions ($PE_{y,ex-post}$) in the current monitoring period

Site Name	Site ID	$PE_{y,ex-post}$ (t CO ₂ e)
Fazenda Agua Branca	BCA-030MS1-05	583
Fazenda Rodeio - Gleba C	BCA-031MS1-05	1,069
Fazenda Dragão	BCA-032MS1-05	607
Lote 55 e 54	BCA-034MS1-05	1,049
Lote 101	BCA-035MS1-05	843
Lote 105	BCA-036MS1-05	797
Lote 71	BCA-037MS1-05	730
Lote 82	BCA-038MS1-05	540
Lote 28 e 27	BCA-039MS1-05	819
Fazenda Bela Vista	BCA-040MS1-05	1,220
Granja Serra Dourada	BCA-041MS1-05	1,596
Fazenda Cachoeira	BCA-042MS1-05	1,537
Granja Capivara	BCA-043MS1-05	1,235
Fazenda Sorgatto	BCA-046MS1-05	1,188
Fazenda Santa Catarina	BCA-047MS1-05	1,597
Fazenda Bambú - Quinhão A	BCA-051MS1-05	810
Fazenda Folleto	BCA-052MS1-05	577
Fazenda Ponte Vermelha	BCA-068MS1-05	317
Total $PE_{y,ex-post}$		17,115

E.3. Calculation of leakage

According to the simplified baseline and monitoring methodology AMS-III.D - version 14, no leakage calculation is required.

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

The emission reductions achieved by the project activity are determined ex post through direct measurement of the amount of methane fuelled, flared or gainfully used.

The emission reductions achieved in any year are the lowest value of the following:

Equation 7

$$ER_{y,ex-post} = \min[(BE_{y,ex-post} - PE_{y,ex-post}), (MD_y - PE_{power,y,ex-post})]$$

Where:

$ER_{y,ex-post}$	Emission reductions achieved by the project activity based on monitored values for year y (tCO ₂ e)
$BE_{y,ex-post}$	Baseline emissions calculated using equation 1 and using ex post monitored values of $N_{LT,y}$ and if applicable $VS_{LT,y}$ for year y (tCO ₂ e)
$PE_{y,ex-post}$	Project emissions calculated using equation 3 using ex post monitored values of $N_{LT,y}$, $MS\%_{i,y}$ and if applicable $VS_{LT,y}$ for year y (tCO ₂ e)
MD_y	Methane captured and destroyed or used gainfully by the project activity in year y (tCO ₂ e)
$PE_{power,y,ex-post}$	Emissions from the use of fossil fuel or electricity for the operation of the installed facilities based on monitored values in the year y (tCO ₂ e)

The flaring/combustion MD_y is measured using the conditions of the flaring process and according to the following equation:

Equation 8

$$MD_y = BG_{burnt,y} * W_{CH_4,y} * D_{CH_4} * FE * GWP_{CH_4}$$

Where:

$BG_{burnt,y}$	Biogas flared or combusted in year y (m^3)
$W_{CH_4,y}$	Methane content in biogas in the year y (volume fraction)
FE	Flare efficiency in the year y (fraction)
GWP_{CH_4}	Global Warming Potential (GWP) of CH_4 (21)
D_{CH_4}	Density of methane at the temperature and pressure of the biogas in the year " y " (t/m^3).

Table E.3. summarizes the MD_y for each farm during the current monitoring period and Table E4. presents the $ER_{y,ex-post}$ calculated for the project activity, as per Equation 7. More detailed information can be obtained in the CER Calculation spreadsheet (folder *BEy ex-post – PEy ex-post* and folder *ERY ex-post*).

Table E.3. Methane captured and destroyed (MD_y) in the current monitoring period

Site Name	Site ID	MD_y (t CO ₂ e)
Fazenda Agua Branca	BCA-030MS1-05	2,368
Fazenda Rodeio - Gleba C	BCA-031MS1-05	3,589
Fazenda Dragão	BCA-032MS1-05	2,178
Lote 55 e 54	BCA-034MS1-05	3,503
Lote 101	BCA-035MS1-05	2,928
Lote 105	BCA-036MS1-05	2,815
Lote 71	BCA-037MS1-05	2,678
Lote 82	BCA-038MS1-05	2,165
Lote 28 e 27	BCA-039MS1-05	2,672
Fazenda Bela Vista	BCA-040MS1-05	4,264
Granja Serra Dourada	BCA-041MS1-05	5,460
Fazenda Cachoeira	BCA-042MS1-05	5,239
Granja Capivara	BCA-043MS1-05	4,187
Fazenda Sorgatto	BCA-046MS1-05	4,323
Fazenda Santa Catarina	BCA-047MS1-05	5,085
Fazenda Bambú - Quinhão A	BCA-051MS1-05	3,001
Fazenda Folleto	BCA-052MS1-05	2,056
Fazenda Ponte Vermelha	BCA-068MS1-05	1,337
Total MD_y		59,848

Table E.4 $ER_{y,ex-post}$ in the current monitoring period

SITE ID:	SITE NAME:	MD_y (t CO ₂ e)	$PE_{power,y,ex-post}$ (t CO ₂ e)	$MD_y - PE_{power,y,ex-post}$ (t CO ₂ e)	$BE_{y,ex-post}$ (t CO ₂ e)	$PE_{y,ex-post}$ (t CO ₂ e)	$BE_{y,ex-post} - PE_{y,ex-post}$ (t CO ₂ e)	$ER_{y,ex-post}$ $= \min [(BE_{y,ex-post} - PE_{y,ex-post}), (MD_y - PE_{power,y,ex-post})]$ (t CO ₂ e)
BCA-030MS1-05	Fazenda Agua Branca	2,368	0	2,368	2,341	583	1,758	1,758
BCA-031MS1-05	Fazenda Rodeio - Gleba C	3,589	0	3,589	4,946	1,069	3,876	3,589
BCA-032MS1-05	Fazenda Dragão	2,178	0	2,178	2,705	607	2,098	2,098
BCA-034MS1-05	Lote 55 e 54	3,503	0	3,503	4,888	1,049	3,838	3,503
BCA-035MS1-05	Lote 101	2,928	0	2,928	3,843	843	3,000	2,928
BCA-036MS1-05	Lote 105	2,815	0	2,815	3,563	797	2,765	2,765
BCA-037MS1-05	Lote 71	2,678	0	2,678	3,190	730	2,459	2,459
BCA-038MS1-05	Lote 82	2,165	0	2,165	2,220	540	1,679	1,679
BCA-039MS1-05	Lote 28 e 27	2,672	0	2,672	3,834	819	3,015	2,672
BCA-040MS1-05	Fazenda Bela Vista	4,264	0	4,264	5,539	1,220	4,319	4,264
BCA-041MS1-05	Granja Serra Dourada	5,460	0	5,460	7,284	1,596	5,688	5,460
BCA-042MS1-05	Fazenda Cachoeira	5,239	0	5,239	7,046	1,537	5,509	5,239
BCA-043MS1-05	Granja Capivara	4,187	0	4,187	5,693	1,235	4,457	4,187
BCA-046MS1-05	Fazenda Sorgatto	4,323	0	4,323	5,491	1,188	4,302	4,302
BCA-047MS1-05	Fazenda Santa Catarina	5,085	0	5,085	6,524	1,597	4,926	4,926
BCA-051MS1-05	Fazenda Bambú - Quinhão A	3,001	0	3,001	3,535	810	2,724	2,724
BCA-052MS1-05	Fazenda Folleto	2,056	0	2,056	2,580	577	2,003	2,003
BCA-068MS1-05	Fazenda Ponte Vermelha	1,337	0	1,337	1,243	317	925	925
TOTAL		59,848	0	59,848	76,465	17,115	59,341	57,481

The Table E.4 above presents all the components which are calculated for each farm in order to comply with the methodology requirements for emission reductions determination. Due to the amount of information and methodology particularities, and in order to improve the reading of each parameter for all the farms, it was decided to include the emission reduction table in a different format from the one stated in the Monitoring Report Form, Version 03.1.

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 ₂ e)	61,879	57,481

* Annual emission reductions in ex-ante calculation of the registered CDM-PDD are 50,516 tCO₂e for the year 2011 and 53,197 tCO₂e for the remaining years (from 2012 onwards). The PDD value presented is adjusted to 61,897 tCO₂e considering that the duration of the monitoring period is 427 days (61 days in the year 2011 and 366 days in the year 2012).

A comparison between the actual emission reductions reached in the monitoring period and the estimated value in the PDD is presented for each farm in Table E.5. below.

Table E.5. Comparison between the ER_{v, ex-post} and the PDD values, for the monitoring period

Site Name	Site ID	ER _{v, ex-post} in the MP (t CO ₂ e)	PDD (t CO ₂ e)	% achieved	Variation
Fazenda Agua Branca	BCA-030MS1-05	1,758	4,223	42%	-58%
Fazenda Rodeio - Gleba C	BCA-031MS1-05	3,589	3,375	106%	6%
Fazenda Dragão	BCA-032MS1-05	2,098	2,530	83%	-17%
Lote 55 e 54	BCA-034MS1-05	3,503	3,375	104%	4%
Lote 101	BCA-035MS1-05	2,928	1,687	174%	74%
Lote 105	BCA-036MS1-05	2,765	1,687	164%	64%
Lote 71	BCA-037MS1-05	2,459	1,687	146%	46%
Lote 82	BCA-038MS1-05	1,679	1,687	100%	0%
Lote 28 e 27	BCA-039MS1-05	2,672	3,375	79%	-21%
Fazenda Bela Vista	BCA-040MS1-05	4,264	5,484	78%	-22%
Granja Serra Dourada	BCA-041MS1-05	5,460	4,219	129%	29%
Fazenda Cachoeira	BCA-042MS1-05	5,239	7,595	69%	-31%
Granja Capivara	BCA-043MS1-05	4,187	4,219	99%	-1%
Fazenda Sorgatto	BCA-046MS1-05	4,302	2,762	156%	56%
Fazenda Santa Catarina	BCA-047MS1-05	4,926	7,823	63%	-37%
Fazenda Bambú - Quinhão A	BCA-051MS1-05	2,724	3,375	81%	-19%
Fazenda Folleto	BCA-052MS1-05	2,003	1,687	119%	19%
Fazenda Ponte Vermelha	BCA-068MS1-05	925	1,089	85%	-15%
Total		57,481	61,879	93%	-7%

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

The project activity achieved 93% of the PDD values during the monitoring period.

The increases from PDD ex-ante estimation occurred in Fazenda Rodeio – Gleba C, Lote 55 e 54, Lote 101, Lote 105, Lote 71, Granja Serra Dourada, Fazenda Sorgatto and Fazenda Folleto, whereas the remaining farms achieved lower emission reductions than PDD estimation. The increases on the reported farms in the monitoring period (MP) are explained in Table E.6 below.

For information purposes, a comparison between average number of animals ($N_{LT,y}$) and average animal weight (W_{site}) reported in the MP when compared to PDD ex-ante estimation is presented in the CER Calculation spreadsheet (folder *Comparison NLT,y* and folder *Comparison Wsite*, respectively).

Table E.6. Explanation of increases between PDD estimation and actual values reached during the MP

Site Name	Swine type operation	Justification	Impact in the operation of the project facilities
Fazenda Rodeio – Gleba C	Finishing type operation	Increase in the average number of finishers in the MP when compared to PDD ex-ante estimation (+13%).	No. Because the animal population and its characteristics can vary significantly, the project facilities have been dimensioned in order to accommodate significant variations in the swine population, so the reported changes have not affected the effective operation of the project facilities.
Lote 55 e 54	Finishing type operation	Increase in the average number of finishers in the MP when compared to PDD ex-ante estimation (+11%).	
Lote 101	Finishing type operation	Increase in the average number of finishers in the MP when compared to PDD ex-ante estimation (+78%).	
Lote 105	Finishing type operation	Increase in the average number of finishers in the MP when compared to PDD ex-ante estimation (+68%).	
Lote 71	Finishing type operation	Increase in the average number of finishers in the MP when compared to PDD ex-ante estimation (+43%).	
Granja Serra Dourada	Finishing type operation	Increase in the average number of finishers in the MP when compared to PDD ex-ante estimation (+28%).	
Fazenda Sorgatto	Finishing type operation	Increase in the average number of finishers in the MP when compared to PDD ex-ante estimation (+51%).	
Fazenda Folleto	Finishing type operation	Increase in the average number of finishers in the MP when compared to PDD ex-ante estimation (+16%).	

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 CO₂e)	57,481	N/A

Document information

<i>Version</i>	<i>Date</i>	<i>Description</i>
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.
Decision Class: Regulatory		
Document Type: Form		
Business Function: issuance		
Keywords: monitoring report, performance monitoring		