# BCA-BRA-16 MR02

| | |
|---|---|
| **Project title** | Brascarbon Methane Recovery Project BCA-BRA-16 |
| **Project ID** | 2998 |
| **Monitoring period** | 01-02-2022 to 31-12-2023 |
| **Original date of issue** | 10-01-2024 |
| **Most recent date of issue** | 13-08-2024 |
| **Version** | 03 |
| ***VCS Standard* Version** | 4.7 |
| **Prepared by** | Brascarbon Consultoria, Projetos e Representação Ltda<br>David Garcia, +5511989594171 |

# CONTENTS

**PROJECT DETAILS ..... 4**
1.1 Summary Description of the Implementation Status of the Project ..... 4
1.2 Audit History ..... 7
1.3 Sectoral Scope and Project Type ..... 7
1.4 Project Proponent ..... 7
1.5 Other Entities Involved in the Project ..... 8
1.6 Project Start Date ..... 8
1.7 Project Crediting Period ..... 8
1.8 Project Location ..... 9
1.9 Title and Reference of Methodology ..... 12
1.10 Double Counting and Participation under Other GHG Programs ..... 12
1.11 Double Claiming, Other Forms of Credit, and Scope 3 Emissions ..... 12
1.12 Sustainable Development Contributions ..... 13
1.13 Commercially Sensitive Information ..... 16
**2 SAFEGUARDS AND STAKEHOLDER ENGAGEMENT ..... 17**
2.1 Stakeholder Engagement and Consultation ..... 17
2.2 Risks to Stakeholders and the Environment ..... 23
2.3 Respect for Human Rights and Equity ..... 25
2.4 Ecosystem Health ..... 27
**3 IMPLEMENTATION STATUS ..... 29**
3.1 Implementation Status of the Project Activity ..... 29
3.2 Deviations ..... 30
3.3 Grouped Projects ..... 30
3.4 Baseline Reassessment ..... 30
**4 DATA AND PARAMETERS ..... 31**
4.1 Data and Parameters Available at Validation ..... 31
4.2 Data and Parameters Monitored ..... 31
4.3 Monitoring Plan ..... 70
**5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS ..... 86**
5.1 Baseline Emissions ..... 86

5.2 Project Emissions ..... 88
5.3 Leakage Emissions ..... 93
5.4 GHG Emission Reductions and Carbon Dioxide Removals ..... 93

**APPENDIX 1: COMMERCIALLY SENSITIVE INFORMATION ..... 98**

# PROJECT DETAILS

## 1.1 Summary Description of the Implementation Status of the Project

The project is fully implemented and in operation since is 02/01/2021, date in which the first farm begun the monitoring phase.

The purpose of this project is to mitigate and recover animal effluent related Greenhouse Gas (GHG) by improving the Animal Waste Management System practices in the confined animal feed operations in the different cities located at the Mato Grosso do Sul state, central Brazil, developed by BRASCARBON.

In Brazil the agricultural operations related to the confined animals procedures are very wide and grow progressively and intensive to attend the worldwide food demand. There are three types of Confined Animal Operation for this project: finishing, breeding and nursery.

The project is a non-grouped project activity, which will apply a technology based at an ambient temperature storage covered cells (lagoon) with sufficient capacity to create an adequate Hydraulic Retention Time (HRT). The cell will use a single-piece liner affixed to a reinforced outer concrete frame. The outer cover consists of a synthetic vinyl membrane or High-Density Polyethylene (HDPE)-, which is also fastened to the frame. The liner and cover will be sealed together with bolts and iron plate frame. The system also includes a piping biogas collector, from the digester to the flare system.

The flare is enclosed and controlled by a data logger PLC – Programmable Logic Controller – in which the combustion temperature is stored every one minute in the system. This system will record every each minute the combustion temperature to determinate the flare efficiency according to the specification of the flare. A thermocouple installed in the flare is connected to the PLC to control the combustion temperature. The sparkling system in the flare is automatic. Every one second the system sparks. The biogas flow rate will be also controlled by a PLC in which every each minute the system records the flow rate. The sparkling system, the PLC and the control panel are powered by a 12 volts battery charged by solar cells.

A derivation pipe will be installed before the flare and after the flow meter, for future proposals, to supply biogas to the electricity generators, for in site electricity supply where no claims for emissions reductions by the electricity generation will be requested during the entire project activity but by the emissions reductions of the biogas destroyed in the generators.

The treated effluent is discharged to the open lagoons where it is in contact with the natural air as per the design of the original lagoon system. The treated water can be then recycled and sent back to the farm proposals or used for irrigation. No electricity will be consumed from the grid. The technical parts that will be powered by energy will be supplied by solar cells. The energy will be stored in 12 volts batteries.

The sludge from the digesters will be spread aerobically in the surface of the pasture or plantation as fertilizer in a depth less than 0.30 meters.

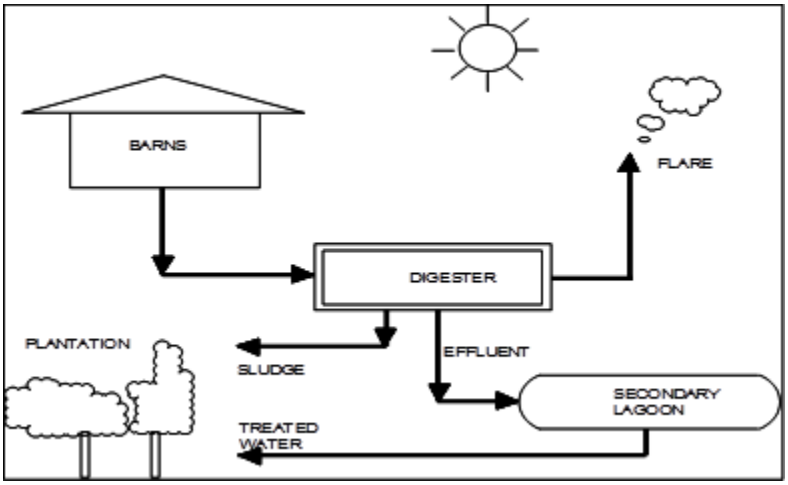



Figure 1 – Flowchart of the treatment system

The scenario existing prior to the implementation of the project activity is the same as the baseline scenario, as follows: the confined animal wastewater, which consists of fresh water mixed with manure and urine that accumulates in pits under or beside the barns, is transported to one open lagoon for evaporation, fed by gravity pipeline systems. The organic material degraded in the primary treatment lagoon is digested, thereby producing significant amounts of methane. These systems emit methane (CH4) resulting from anaerobic decomposition process. The swine livestock operations create profound environmental consequences, such as greenhouse gas emissions, odour and water/land contamination that result of storing animal waste, where this operation is not sustainable due to its sever environmental pollution.

The Project Activity consists in the construction of a new covered in-ground anaerobic reactor (digester) that will utilize the organic material currently treated in the wastewater opened lagoon, of the confined animal operations to produce biogas. All manure will be sent daily directly to digester not exceeding 24 hours in the barns.

The expected 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. The project proponent estimates 55,356 tCO2e / year and 382,487 tCO2e over the first 7 years crediting period will be reduced from the baseline scenario as a result of the installation of the project activity.

All sites included in the PD and the relevant dates of the project implementation for each site are described in the following table 1. The project activity is composed by 9 sites (farms)and consists in gathering and destroying the biogas by the use of an enclosed flare, as previously stated. Hence, considering all the phases presented in table 1 bellow, and according with section 3.7 of the VCS Standard project start date definition, the project begun the generation of emissions reductions in the phase of monitoring phase, where all the biodigesters where fully installed, the flaring system put into place and the biogas started to be flared, therefore destroying methane and by consequence avoiding GHG emissions which are fully accounted since the electric system was installed and tested (PLC and monitoring equipment) and hence, where the monitoring process started (and also the crediting period, see section 1.9).

According with section 3.7 of the VCS Standard, the project start date of a non-AFOLU project is the date on which the project began generating GHG emission reductions or removals. Projects shall complete validation within specific timeframes from the project start date.

Table 1 – Relevant dates of project implementation.

| Farm/Site Name | Brascarbon ID | Start Construction | Finish Construction | Start-up and Tests | Monitoring Start Date |
|---|---|---|---|---|---|
| Fazenda Paraíso do Alto | BCA-300MS1-16 | 01/06/2020 | 20/08/2020 | 29/12/2020 | 02/01/2021 |
| Fazenda São Sebastiao Gleba 6 | BCA-301MS1-16 | 10/06/2020 | 25/08/2020 | 29/12/2020 | 02/01/2021 |
| Granja Serra Dourada I | BCA-302MS1-16 | 12/06/2020 | 18/08/2020 | 29/12/2020 | 03/01/2021 |
| Lote 28 - PA - Assentamento | BCA-303MS1-16 | 30/06/2020 | 05/09/2020 | 30/12/2020 | 03/01/2021 |
| Lote 55 - Assentamento Campanario | BCA-304MS1-16 | 10/07/2020 | 20/09/2020 | 30/12/2020 | 03/01/2021 |
| Fazenda Nossa Senhora Aparecida II | BCA-305MS1-16 | 18/07/2020 | 03/10/2020 | 30/12/2020 | 02/01/2021 |
| Granja Grando | BCA-306MS1-16 | 01/08/2020 | 16/10/2020 | 28/12/2020 | 03/01/2021 |
| Assentamento Campanario | BCA-307MS1-16 | 07/08/2020 | 21/10/2020 | 28/12/2020 | 02/01/2021 |
| Fazenda Quinhão A | BCA-308MS1-16 | 01/09/2020 | 03/12/2020 | 28/12/2020 | 04/01/2021 |

During the current Monitoring Period from 01/02/2022 to 31/12/2023 (First and last date included) the project activity has contributed 99,467 tCO2e GHG reductions.

## 1.2 Audit History

| Audit type | Period | Program | Validation/verification body name | Number of years |
|---|---|---|---|---|
| Validation | 02-01-2021 to 01-01-2028 | VCS | ICONTEC | 7 years |
| Verification | 02-01-2021 to 31-01-2022 | VCS | ICONTEC | 1 year and 29 days (394 days overall) |
| Verification | 01-02-2022 to 31-12-2023 | VCS | ICONTEC | 1 year and 11 months 1 year and 29 days (698 days overall) |

## 1.3 Sectoral Scope and Project Type

| | |
|---|---|
| Sectoral scope[1] | Sectoral Scope 13 – Waste handling and disposal |
| Project activity type | Small scale |

## 1.4 Project Proponent

| | |
|---|---|
| Organization name | Brascarbon Consultoria, Projetos e Representação S/A |
| Contact person | David Garcia |
| Title | Carbon Manager |
| Address | Rua Amália de Noronha, 151, CJ 502, 05410-010 São Paulo, SP, Brazil |
| Telephone | +55 11 98959 4171 |
| Email | david.garcia@brascarbon.com.br |

[1] *Projects, activities, or methodologies may be developed under any of the 16 VCS sectoral scopes: https://verra.org/programs/verified-carbon-standard/vcs-program-details/#sectoral-scopes*

## 1.5 Other Entities Involved in the Project

| | |
|---|---|
| Organization name | There are no other Entities involved in the project. |
| Role in the project | There are no other Entities involved in the project. |
| Contact person | There are no other Entities involved in the project. |
| Title | There are no other Entities involved in the project. |
| Address | There are no other Entities involved in the project. |
| Telephone | There are no other Entities involved in the project. |
| Email | There are no other Entities involved in the project. |

## 1.6 Project Start Date

| | |
|---|---|
| Project start date | 02-01-2021 |
| Justification | Date in which the first farm begun the monitoring phase |

## 1.7 Project Crediting Period

| | |
|---|---|
| Crediting period | ☒ Seven years, twice renewable<br>☐ Ten years, fixed<br>☐ Other (state the selected crediting period and justify how it conforms with the VCS Program requirements) |
| Start and end date of first or fixed crediting period | 02-01-2021 to 01-01-2028 |

## 1.8 Project Location

The project activity has several project sites (9) but it is important to highlight that it is not a grouped project. It is located in the Central Region/State of Mato Grosso do Sul, cities of Rio Verde and São Gabriel do Oeste. The geographical location of the project sites is shown in Figure 2 with specifics detailed in Table 2.

Table 2 – Detailed physical location and identification of project site

| Farm/Site Name | Brascarbon ID | Address | Town/State | Contact | Phone | GPS Coord |
|---|---|---|---|---|---|---|
| Fazenda Paraíso do Alto | BCA-300MS1-16 | BR 163 Sentido Rio verde a esquerda 4,5 KM | Rio Verde de Mato Grosso / MS | Mario Pacifico | 98901 7810 | 19 07 47,3 54 47 52,87 |
| Fazenda São Sebastiao Gleba 6 | BCA-301MS1-16 | BR 163 Proximo ao posto são pedro | São Gabriel do Oeste / MS | Maria Inês | 894361020 | 19 42 18,45 54 20 38,05 |
| Granja Serra Dourada I | BCA-302MS1-16 | BR 163 COOP a direita 2 km | São Gabriel do oeste / MS | Jair Borgman | 98941 1510 | 19 26 18,20 54 33 56,83 |
| Lote 28 - PA - Assentamento Campanario | BCA-303MS1-16 | BR 163 KM 609 | São Gabriel do Oeste / MS | Valderi | 994151610 | 19 17 00,44 54 37 29,71 |
| Lote 55 - Assentamento Campanario | BCA-304MS1-16 | BR 163 KM 607 | São Gabriel do Oeste / MS | Antenor | 993211450 | 19 17 29,58 54 36 06,21 |
| Fazenda Nossa Senhora Aparecida II | BCA-305MS1-16 | Sentido Rio Negro, 10 kg | São Gabriel do Oeste / MS | Jair | 98941 1510 | 19 27 54,61 54 37 48,61 |
| Granja Grando | BCA-306MS1-16 | Sentido Rio verde Km 590 a direita | Rio Verde de Mato Grosso / MS | Nilson | 984561310 | 19 09 17,94 54 45 48,37 |
| Assentamento Campanario | BCA-307MS1-16 | Br 163 KM 606 | São Gabriel do Oeste / MS | Edemar | 893421012 | 19 16 04,06 54 34 57,51 |
| Fazenda Quinhão A | BCA-308MS1-16 | Ponte Vermelha | São Gabriel do Oeste / MS | Mario | 98901 7810 | 19 27 46,8 54 26 5,7 |

*Mário Pacifico has one site in Rio Verde de Mato Grosso city:*

- Fazenda Paraíso do Alto is a finishing swine operation. The site uses two primary open lagoons for animal waste storage. Waste from the barns is removed via the pull plug method and then routed to the open lagoon. The methods of effluent disposition used are surface spread and irrigation.

*Maria Inês has one site in São Gabriel do Oeste city:*

- Fazenda São Sebastião Gleba 6 is a finishing swine operation. The site uses two primary open lagoons for animal waste storage. Waste from the barns is removed via the pull plug method and then routed to the open lagoon. The methods of effluent disposition used are surface spread and irrigation.

*Jair Borgman has one site in São Gabriel do Oeste city:*

- Granja Serra Dourada I is a finishing swine operation. The site uses two primary open lagoons for animal waste storage. Waste from the barns is removed via the pull plug method and then routed to the open lagoon. The methods of effluent disposition used are surface spread and irrigation.

*Valderi has one site in São Gabriel do Oeste city:*

- Lote 28 – PA – Assentamento Campanário is a finishing swine operation. The site uses two primary open lagoons for animal waste storage. Waste from the barns is removed via the pull plug method and then routed to the open lagoon. The methods of effluent disposition used are surface spread and irrigation. Water from this lagoon will be used for irrigation.

*Antenor has one site in São Gabriel do Oeste city:*

- Lote 55 – Assentamento Campanário is a finishing swine operation. The site uses two primary open lagoons for animal waste storage. Waste from the barns is removed via the pull plug method and then routed to the open lagoon. The methods of effluent disposition used are surface spread and irrigation. Water from this lagoon will be used for irrigation.

*Jair has one site in São Gabriel do Oeste city:*

- Fazenda Nossa Senhora Aparecida II is a finishing swine operation. The site uses two primary open lagoons for animal waste storage. Waste from the barns is removed via the pull plug method and then routed to the open lagoon. The methods of effluent disposition used are surface spread and irrigation.

*Nilson has one site in Rio Verde de Mato Grosso city:*

- Granja Grando is a finishing swine operation. The site uses two primary open lagoons for animal waste storage. Waste from the barns is removed via the pull plug method and then routed to the open lagoon. The methods of effluent disposition used are surface spread and irrigation.

*Edemar has one site in São Gabriel do Oeste city:*

- Assentamento Campanário is a finishing swine operation. The site uses two primary open lagoons for animal waste storage. Waste from the barns is removed via the pull plug method and then routed to the open lagoon. The methods of effluent disposition used are surface spread and irrigation.

*Mario has one site in São Gabriel do Oeste city:*

- Fazenda Quinhão A is a finishing swine operation. The site uses two primary open lagoons for animal waste storage. Waste from the barns is removed via the pull plug method and then routed to the open lagoon. The methods of effluent disposition used are surface spread and irrigation. Water from this lagoon will be used for irrigation.

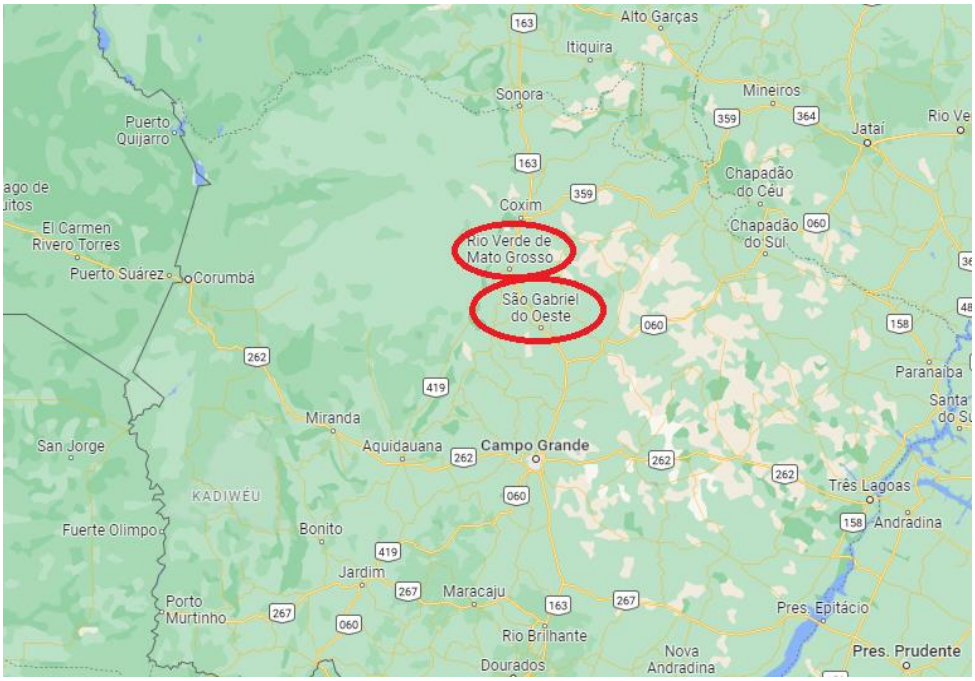



Figure 2 – State of Mato Grosso do Sul, Brazil – city location of the project sites

## 1.9 Title and Reference of Methodology

| Type (methodology, tool or module). | Reference ID, if applicable | Title | Version |
|---|---|---|---|
| Methodology | AMS - III.D | Methane recovery in animal manure management systems | 21.0 |

## 1.10 Double Counting and Participation under Other GHG Programs

### 1.10.1 No Double Issuance

Is the project receiving or seeking credit for reductions and removals from a project activity under another GHG program?

☐ Yes ☒ No

### 1.10.2 Registration in Other GHG Programs

Is the project registered or seeking registration under any other GHG programs?

☐ Yes ☒ No

## 1.11 Double Claiming, Other Forms of Credit, and Scope 3 Emissions

### 1.11.1 No Double Claiming with Emissions Trading Programs or Binding Emission Limits

Are project reductions and removals or project activities also included in an emissions trading program or binding emission limit? See the *VCS Program Definitions* for definitions of emissions trading program and binding emission limit.

☐ Yes ☒ No

### 1.11.2 No Double Claiming with Other Forms of Environmental Credit

Has the project activity sought, received, or is planning to receive credit from another GHG-related environmental credit system? See the *VCS Program Definitions* for definition of GHG-related environmental credit system.

☒ Yes ☒ No

### 1.11.3 Supply Chain (Scope 3) Emissions

Do the project activities affect the emissions footprint of any product(s) (goods or services) that are part of a supply chain?

☐ Yes ☒ No

*If yes:*

Is the project proponent(s) or authorized representative a buyer or seller of the product(s) (goods or services) that are part of a supply chain?

☐ Yes ☒ No

*If yes:*

Has the project proponent(s) or authorized representative posted a public statement on their website saying, “Carbon credits may be issued through the Verified Carbon Standard project [project ID] for the greenhouse gas emission reductions or removals associated with [project proponent or authorized representative organization name(s)] [name of product(s) whose emissions footprint is changed by the project activities].”

☐ Yes ☒ No

## 1.12 Sustainable Development Contributions

According to Brazil’s Inter-Ministerial Commission on Global Climatic Change, manure management is an important issue that needs to be solved. The swine waste storage and treatment systems in Brazil consists of open tanks, open digesting and ponds (anaerobic lagoons) once they are the most economic and viable system approved to manage the manure

in confined animals feed operations. Economic barriers are very common because can invest only in the confined feed operations and with no need to invest in waste management systems. Financial resources are always used to maintain the confined feed operation working. Also, waste treatment involves low technology, as open lagoons need less employees and technicians for operation and maintenance. For these reasons the project is additional, and more details can be found in the section 3.5.

Just few producers invest in bio-digesters to have a modern waste management system. The material cumulated in the open lagoons is normally distributed by pumps or gravity and applied to crops and pastures. EMBRAPA stimulated by the Expansion and Waste Treatment Program of the State of Santa Catarina by giving instructions and providing publications to help the producers and agro-industries to implement projects or systems to control the animal waste management protecting the eco-system.

Failure to do so will spread existing disease continually (i.e. increased (insect) pest populations, problems with allergies and livestock disease). With the purpose of avoiding this problem, Brazil has in recent years, required all confined animals feed operations to change from single to multi-lagoon systems, introducing a Good Practices in confined animal feed operations and even more recently has required them to line the bottom of their primary sedimentation lagoon to prevent effluent infiltration.

In 2005, the swine population in Mato Grosso do Sul state was 855,000. Considering that a typical hog produces 4.9 kilograms of effluent daily (Table 3), annually some 4.2 million metric tons of hog waste are produced in this state alone. Introducing a progressive animal waste management practices throughout this region of Brazil could result in an annual reduction of approximately 655 thousand tons of carbon dioxide equivalent (CO2e/year).

Table 3 – Daily production of effluent by type of swine production

| Stage | Manure kg/day | Manure and Urine kg/day | Volume litres/day |
|---|---|---|---|
| 25-100 kg | 2.3 | 4.9 | 7.0 |
| Gestating sows | 3.6 | 11.0 | 16.0 |
| Nursing sows | 6.4 | 18.0 | 27.0 |
| Boar pig | 3.0 | 6.0 | 9.0 |
| Piglet | 0.35 | 0.95 | 1.4 |

Source: PNMA-II – Projeto de Controlo da Degradação Ambiental Decorrente da Suinocultura em Santa Catarina, coordenado pelo Sr. Paulo Armando Vitoria de Oliveira, Concordia – SC, EMBRAPA Suínos e Aves, 2004 (Environmental Degradation Control Project ,in Suine Farms Santa Catarina, coordinated by . Paulo Armando Vitoria de Oliveira, Concordia – SC, EMBRAPA Suines and Birds 2004);http://www.cnpsa.embrapa.br/sgc/sgc_publicacoes/publicacao_n3r85f3h.pdf

Socio-Economic Sustainability

- Improvement in air quality (e.g. – reduction of Volatile Organic Compounds [VOCs]) and worker safety;
- Elimination of odors in surrounding areas, improving the living standards of neighbours' communities;
- Proper handling of the animal waste ensuring an adequate level of protection of human health and the environment;
- By improving the waste management system at the farm, the project will support the continued production of pork in order to meet the consumption needs of the growing global population.

Economic Sustainability

- An increase in local employment of skilled labour for the manufacturing, installation, Operation and maintenance of equipment;
- Additional employment opportunities in the agro-industrial sector, specifically from the use of recycled water from the waste management system on the farms for agricultural activities in surrounding land;
- Infrastructure improvement is in direct alignment with the national goals and objectives for agriculture, livestock, rural development, fishing and nutrition.

Environmental Sustainability

- An overall decrease in the amount of Greenhouse Gases (GHGs) emitted into the atmosphere;
- Improvement in the quality of the water used in the waste management system and its potential use as water for irrigation;

Avoiding potential dumping of waste into clean sources of water
.http://www.cnpsa.embrapa.br/sgc/sgc_publicacoes/publicacao_n3r85f3h.pdf

According with the requirements of the new version 4.7 of the VCS standard, the PP should identify, at least three SDGs which the project comply with. Considering the registered PD as well as the current document, the project has fairly demonstrated its different contributions to the sustainable development. However, in order to comply with the stated requisition, the PP states that the project complies with the following SDGs:

SDG 6 Clean Water and Sanitation – The project complies with this objective since it contributes to a cleaner effluent, after treatment, which is discharged into to a water body was well as it contributes to the prevention of groundwater contamination through the treatment of the effluent.

SDG 9 Industry, Innovation and Infrastructure – The project complies with this objective since it provides an innovation on the wastewater treatment in swine farms, through the construction of new and more technological infrastructures.

SDG 13 Climate Action – The project complies with this objective since it is a project that reduces the GHG emissions in the normal operation in swine farms, as demonstrated in the registered PD and current MR.

SDG 15 Life on Land – The project complies with this objective since it contributes to a better surrounding in overall, by reducing the smell, insects and air quality by preventing a wastewater treatment (and therefore organic matter decomposition) in open lagoons.

## 1.13 Commercially Sensitive Information

The project does not have any commercially sensitive information.

# 2 SAFEGUARDS AND STAKEHOLDER ENGAGEMENT

## 2.1 Stakeholder Engagement and Consultation

### 2.1.1 Stakeholder Identification

| | |
|---|---|
| Stakeholder Identification | **The main stakeholders considered in this project are:**<br>• Project Site owners;<br>• Secretaria da Agricultura de Bandeirantes;<br>• Sindicato Rural;<br>• Orgão Ambiental São Gabriel do Oeste;<br>• Camara Municipal Rio Verde;<br>• Camara Municipal São Gabriel do Oeste;<br>• Imprensa Local – São Gabriel do Oeste. |
| Legal or customary tenure/access rights | All the project sites in the project activity are within private properties with already existing commercial activities (swine production). All the project sites have contracts with the swine farm owners in order for the PP to have full access to the operation, maintenance and monitoring of the project activity. |
| Stakeholder diversity and changes over time | The PP is a project developer for several years in the region and therefore is quite aware of the stakeholders to be considered and included in all the project activity. In the PP experience there are no changes on the stakeholder's diversity over time but there is a continuous channel of communication for any project clarification that may occur for any giving stakeholder. |
| Expected changes in well-being | Since the project is quite specific regarding the activity and operation, since there are only positive environmental and social impacts in the project facilities as well as in the surrounding areas to the sites. Also, it presents very small risks both in terms of the construction as in the operation.<br><br>The project has quite a positive impact environmentally but also, since it is developed in already operating sites, being a complementary activity to the main operation of the site owners, presents zero |

| | |
|---|---|
| | negative impacts. Also, being an addition, in terms of water treatment, to the required in the legislation (open lagoons – baseline scenario), the site owners also have a positive impact in the renewal of their operational license since they are doing a more advanced treatment than the one required by law.<br><br>Regardless, due to the vast experience of Brascarbon, we have identified possible risks and the needed action to corrected them:<br><br>Possible clogging of the Biodigester and may cause leakage and contamination of the soil.<br><br>Action Taken: installation of Bay Pass for diversion of the residue to secondary pond in the case of clogging, continuous evaluation of the effluent, and when necessary is done the internal recirculation of the bio and with this the dilution of the material and improvement of the biodigestion and consequently the best fluidity of the material.<br><br>Possible hole of the lower canvas caused by drilling material from the farm and may cause lower contamination of the soil by leakage.<br><br>Possible action to be taken: Training of pig workers regarding the care of the perforating materials used in the work routine of the pig farm and installation of barriers in the exit box of the farm to prevent this type of material from being transported to the Biodigester through the pipe.<br><br>Possible excess pressure caused by increased gas generation and with this possible rupture in the upper coating released gas into the atmosphere.<br><br>Possible action to be taken: installation of mechanical safety valve to relieve excess pressure when and if it occurs. |
| Location of stakeholders | Mato Grosso do Sul State |
| Location of resources | All the sites included in the project activity are within private properties and therefore with limited access to each project site owner. Each swine producer is owner of its farm, and the remaining stakeholders are public entities. |

### 2.1.2 Stakeholder Consultation and Ongoing Communication

| | |
|---|---|
| **Ongoing consultation** | 12-03-2020 |
| **Date(s) of stakeholder consultation** | Brascarbon has sent an invitation to all the stakeholders mentioned in section 2.2 of version 01 of the PD. The invitation letter was sent by email due to the pandemic situation, in May 12th of 2020. With the local producer, Brascarbon has met individually to clarify the project, answer their questions and sign the contract related to the ownership of the carbon project. That visit occurred in the week of May 23rd to 27th of 2020[2].<br><br>The public consultation started in the day Brascarbon sent the letter and has the channel open (phone and email) until the present day.<br><br>Due to the worldwide Corona Virus pandemic that was established in 2020, security and protection measures had to be taken to carry out the consultation with stakeholders. To contain new cases and avoid agglomerations, stakeholder consultation was carried out remotely. Thus, the Stakeholder consultation was divided in two steps: an online request for comments (opened until nowadays without any comments) with all the project site owner's participant in the project and a local consultation with the relevant entities and other potential interested community stakeholders which was addressed through email to all the entities above and requested to leave their comments in our dedicated email.<br><br>The invitation letter sent by email is presented below. |
| **Communication of monitored results** | Brascarbon has not received any comment during the entire period where the project was under public consultation. One of the main reasons for that to happen is that Brascarbon has developed several other carbon projects is the surrounding regions and therefore both the company and the project are well known by all stakeholders.<br><br>The public consultation started in the day Brascarbon sent the letter and has the channel open (phone and email) until the present day.<br><br>The PP did not receive any comments from the stakeholders. The producers have made comments, especially regarding the biodigestor location in order to better assist the flow and therefore the supply of the biodigestor, which were attended by Brascarbon. |

[2] Due to timing of the starting date of the project, full pandemic stage, these encounters happened individually with each producer, as follow up of the contract signing, to indicate to start of the project.

| | |
|---|---|
| | Brascarbon procedure, if and/or when any communication should be received is:<br>• Realtime access to email and phone (the two ways to contact us)<br>• Analyze and address the questioning within 5 week days<br>Way for feedback and if nothing is received, follow within one month of the response. |
| Consultation records | The mechanism for on-going communication with local stakeholders Is the same as the one included in the invite letter, meaning a dedicated phone number and email address, which is still available up to this day. However, no comments were received during the entire period until the present day.<br>How due account of all and any input received during the consultation has been taken. Include details on any updates to the project design or justify why updates are not appropriate.<br>The PP did not receive any comments from the stakeholders. The producers have made comments, especially regarding the biodigestor location in order to better assist the flow and therefore the supply of the biodigestor, which were attended by Brascarbon.<br>Brascarbon procedure, if and/or when any communication should be received is:<br>• Realtime access to email and phone (the two ways to contact us)<br>• Analyze and address the questioning within 5 week days<br>Way for feedback and if nothing is received, follow within one month of the response. |
| Stakeholder input | The PP did not receive any comments from the stakeholders. The producers have made comments, especially regarding the biodigestor location in order to better assist the flow and therefore the supply of the biodigestor, which were attended by Brascarbon. |

BrasCarbon
Créditos de Carbono

**Projeto Recuperação de Metano**

A Brascarbon é uma empresa dedicada e especializada no desenvolvimento de projetos de carbono (MDL), tendo iniciado a sua atividade em 2007 e possuindo 13 projetos registrados no Mecanismo de Desenvolvimento Limpo das Nações Unidas e em operação atualmente. A empresa possui milhões de toneladas de carbono reduzidas ao longo dos vários anos dos seus projetos, tendo contribuído para a redução das emissões do gás metano para a atmosfera, redução esta feita em BioDigestores construídos na área de Suinocultura.

No seguimento da sua atividade, a Brascarbon irá desenvolver novos projetos, designado Projeto de Recuperação de Metano, implementado em dezenas de Sites, o qual utilizará o mesmo padrão, premissas, técnicas e monitoramento dos anteriores projetos registrados e em operação, Projetos estes que se encontram disponível publicamente no site das Nações Unidas (UNFCCC).

Assim, a Brascarbon gostaria de solicitar a sua contribuição, enquanto parte interessada, para quaisquer comentários que considerem importantes, qualquer dúvida ou esclarecimentos no que se refere ao projeto de recuperação de metano, projeto este implementado através de construção de BioDigestores Anaeróbicos. Abaixo segue Breve apresentação do projeto a ser implementado, o qual é idêntico aos já em funcionamento.

Favor enviar comentários ou duvidas para o E-Mail info@brascarbon.com.br e ficaremos agradecidos pela sua participação.

**Descrição de Projeto:**

Produzindo atualmente em um total de 5 Projetos registrados e em um total de 67 fazendas de suínos nos estados de Mato Grosso do Sul, no Brasil, para captação de metano e geração de biogás. O projeto tem potencial para gerar energia a partir de resíduos utilizando o biogás produzido e capturado. A energia derivada desse processo pode ser usada para alimentar a eletricidade no local dentro de cada um desses projetos.

Antes da atividade do projeto, os agricultores locais consideravam o desperdício como uma externalidade no processo de produção de suínos. Como tal, o financiamento mínimo foi alocado para esta questão e as águas residuais eram frequentemente tratadas em lagoas de águas abertas – frequentemente com profundos impactos ambientais. O projeto demonstra como a construção de um conjunto de novos digestores anaeróbicos, cobertos e no solo, pode utilizar o material orgânico das operações animais para produzir biogás e fertilizantes, reduzindo as emissões de gases de efeito estufa.

A base do projeto é a digestão anaeróbica, pela qual os microrganismos quebram material biodegradável na ausência de oxigênio. Como parte de um sistema integrado de gestão de resíduos, ocorre a captura e a destruição do gas metano em um sistema de flare desenhado para este fim, reduzindo assim a emissão de gases de efeito estufa na atmosfera, temos então um biogás rico em teor de metano e adequado para a produção de energia, que pode ser usado para substituir combustíveis fósseis. Os sólidos ricos em nutrientes deixados após a digestão são usados como fertilizante e o melhor manejo de águas residuais permite mais água para irrigação.

**Desenvolvimento Sustentável: Benefícios socio-econômicos**

O principal benefício deste projeto é a redução da quantidade de gases de efeito estufa emitidos na atmosfera em cerca de 55.000 toneladas de CO2 equivalente por ano por projeto. Outras vantagens dos projetos incluem:

- A criação de empregos, incluindo trabalhadores de campo, funcionários operacionais e colaboradores agrícolas
- Redução dos Compostos Orgânicos Voláteis (VOCs) transportados pelo ar como resultado do uso de digestores de águas residuais cobertas para armazenar efluentes das fazendas. Essa melhoria na qualidade do ar aumenta o padrão de vida tanto para os agricultores quanto para as comunidades locais
- O melhor manuseio dos resíduos animais garante um melhor nível de proteção à saúde humana e ao meio ambiente;
- Melhoria na qualidade da água no sistema de gestão de resíduos e seu potencial uso como água para irrigação;
- Uma melhoria nas condições de vida dos suínos, pois os produtores devem cumprir as diretrizes de Boas Práticas para participar do projeto.

BrasCarbon Consultoria projetos e Representação S/A

### 2.1.3 Free, Prior, and Informed Consent

| | |
|---|---|
| **Consent** | All the project sites are within private properties with already existing economical and commercial activities so, in order to develop the project activity in all the sites above mentioned, all project sites were dully accommodated in a concession contract with the property owners for full access to develop maintenance and/or monitoring services. |
| **Outcome of FPIC** | As previously stated, all the sites included in the project activity are within private properties and therefore with limited access to each project site owner. Each farm included in the project activity was subjected to an individual contract, with the length of the entire crediting period. Additionally, since the project is developed in an already existing operation, it did not encroach on land, relocated people without consent, and forced physical or economic displacement. |

### 2.1.4 Grievance Redress Procedure

| Grievances received | Resolution and outcome |
|---|---|
| **No grievance received** | PP has internal procedures for the management of grievances. If the company receives any grievance from anyone, the PP has fairly demonstrated that he has a dedicated email which Is regularly checked and is within company policy that any grievance should be answered and, if possible, resolved, under a period of 10 labour days. |

### 2.1.5 Public Comments

| Summary of comments received | Actions taken |
|---|---|
| No comments received | Not Applicable |

## 2.2 Risks to Stakeholders and the Environment

| | Risk identified | Mitigation or preventative measure taken |
|---|---|---|
| **Risks to stakeholder participation** | No risk identified | All the Stakeholders have the same communication channel as |

| | | |
|---|---|---|
| | | the ones during the stakeholder consultation, prior to the registry of the project in VERRA. No communications nor grievance were received as stated in the points above. |
| Working conditions | No risk identified | Brascarbon has a really small internal structure, with only 3 employees, besides the director (2 Regional Technicians and 1 Carbon Manager), all of which have all the employees rights, according with Brazil law fully assured. No complain in the labour entities were ever received by the company. The employees have regular training according with the POP11. |
| Safety of women and girls | No risk identified | Unfortunately, ate the time, Brascarbon does not have any female on its colaborators. |
| Safety of minority and marginalized groups, including children | No risk identified | Brascarbon projects are developed in confined areas, within pig farm properties, without minority and marginalized groups, including children in the surrounding. Additionally, the project does not affect the safety of any population, in fact it increases the quality of live of the surroundings as described in point 1.12. |
| Pollutants (air, noise, discharges to water, generation of waste, release of hazardous materials) | No risk identified | Brascarbon projects are developed in confined areas, within pig farm properties, increasing the quality of live of the surroundings as described in point 1.12. There are no pollutants discharged or emitted, in fact, they are avoided by the project activity. |

## 2.3 Respect for Human Rights and Equity

### 2.3.1 Labor and Work

| | |
|---|---|
| Discrimination and sexual harassment | Brascarbon has a really small internal structure, with only 3 employees, besides the director (2 Regional Technicians and 1 Carbon Manager), all of which have all the employees rights, according with Brazil law fully assured. No complain of sexual harassment nor discrimination have ever occured. |
| Management experience | Brascarbon is a company which is in operation since 2008, always with the focus on developing methane avoidance projects in swine farms. Since then, the company has developed nearly 20 carbon projects registered in different standards (UNFCCC and VERRA). |
| Gender equity in labor and work | Brascarbon does not discriminate gender nor is that an issue for the company. Due to its small structured, it happens that only man work at the company. However, in board is constituted by a man and a woman. |
| Human trafficking, forced labor, and child labor | Brascarbon fully complies with all Brazilian laws and these practices, Human trafficking, forced labor, and child labor are, of course forbidden hence not in line with the companys values, procedures and practices. No complain of these practices was ever received by the company. |

### 2.3.2 Human Rights

The project activity is developed within private properties with other pre-existing activity (in this case, swine production). The project activity boundary in within these private properties hence fully respecting and promoting the protection of the rights of IPs, LCs, and customary rights holders in line with applicable international human rights law, and the United Nations Declaration on the Rights of Indigenous Peoples and ILO Convention 169 on Indigenous and Tribal Peoples.

### 2.3.3 Indigenous Peoples and Cultural Heritage

There are no Indigenous Peoples nor Cultural Heritage involved in the development of the project activity since, as it was fairly state in sections above, the project activity boundary is in within private properties with other pre-existing activity (in this case, swine production).

### 2.3.4 Property Rights

| | |
|---|---|
| **Disputes over rights to territories and resources** | All the project sites are within private properties with already existing economical and commercial activities so, in order to develop the project activity in all the farms above mentioned, all project sites were dully accommodated in a concession contract with the property owners for full access to develop maintenance and/or monitoring services. |
| **Respect for property rights** | The project activity does not have issues regarding the protection or preservation of property rights since the contract between the PP and the involved stakeholders (project site owner) considers the activity to be developed, the length of the project activity, the stakeholders compensation and the access to the project sites which, as stated are all within private properties with already ongoing economic activities. |

### 2.3.5 Benefit Sharing

| | |
|---|---|
| **Summary of the benefit sharing plan** | The PP has, per contract, a compromise to give 10% of all the gross revenue by the commercialization of the carbon units with each project site owner involved in the project activity. |
| **Benefit sharing during the monitoring period** | As previously stated, the PP has, per contract, the mandatory commitment to transfer 10% of all the gross revenue by the commercialization of the carbon units with each project site owner involved in the project activity. Additionally, since the project activity provides a more advanced wastewater treatment system than the mandatory country requirements, the project site owners also have a less tangible benefit of obtaining their operation licence renewals with less constrains, having the project activity implemented. |

## 2.4 Ecosystem Health

| | Risk identified | Mitigation or preventative measure taken during the monitoring period |
|---|---|---|
| Impacts on biodiversity and ecosystems | No Risk Identified | Brascarbon projects are developed in confined areas, within pig farm properties, increasing the quality of live of the surroundings as described in point 1.12. There are no Impacts on biodiversity and ecosystems, in fact, they are prevented by the project activity. Additionally, all the farms have mandatory compliance with the environmental and operation license which scopes not only the project boundary of the project activity but also the entire property. In the point 6 of each license, it is stated that, in order to obtain the document, the farm owner must assure that all conditions regarding the biodiversity and ecosystems are not harmed nor at risk. Since all farmers have their environmental licenses valid, it is therefore assured that no risk nor impacts on biodiversity and ecosystems occur. |
| Soil degradation and soil erosion | No Risk Identified | Brascarbon projects are developed in confined areas, within pig farm properties, increasing the quality of live of the surroundings as described in point 1.12. There are no Soil Degradation or Erosion, in fact, they are prevented by the project activity. Additionally, all the farms have mandatory compliance with the environmental and operation license which scopes not only the project boundary of the project activity but also the entire |

| | | |
|---|---|---|
| | | property. Also in the point 6 of each license, it is stated that, in order to obtain the document, the farm owner must assure that all conditions regarding the soil degradation and soil erosion are not harmed nor at risk. Since all farmers have their environmental licenses valid, it is therefore assured that no risk of soil degradation and soil erosion occur. |
| **Water consumption and stress** | No Risk Identified | The project does not consume any water |
| **Usage of fertilizers** | No Risk Identified | The project does not use fertilizers |

### 2.4.1 Rare, Threatened, and Endangered species

| | |
|---|---|
| **Species or habitat** | N/A |

### 2.4.2 Introduction of species

Not Aplicable. Brascarbon projects are developed in confined areas, within swine farm properties, which have their activity ongoing for a long time, hence without any existing Rare, threatened, and Endangered species.

| Species introduced | Classification | Justification for use | Adverse effects and mitigation |
|---|---|---|---|
| No species introduced | N/A | N/A | N/A |

| Existing invasive species | Mitigation measures to prevent spread or continued existence of invasive species |
|---|---|
| No existing invasive species | N/A |

### 2.4.3 Ecosystem conversion

Brascarbon projects are developed in confined areas, within swine farm properties, which have their activity ongoing for a long time, hence without any existing ecosystems.

# 3 IMPLEMENTATION STATUS

## 3.1 Implementation Status of the Project Activity

The project is fully implemented since 02/01/2021, date in which the first farm begun the monitoring phase.

All sites included in the PD and the relevant dates of the project implementation for each site are described in the following table1. The project activity is composed by 9 sites (farms)and consists in gathering and destroying the biogas by the use of an enclosed flare, as previously stated. Hence, considering all the phases presented in table 1 bellow, and according with section 3.7 of the VCS Standard project start date definition, the project begun the generation of emissions reductions in the phase of monitoring phase, where all the biodigesters where fully installed, the flaring system put into place and the biogas started to be flared, therefore destroying methane and by consequence avoiding GHG emissions which are fully accounted since the electric system was installed and tested (PLC and monitoring equipment) and hence, where the monitoring process started (and also the crediting period, see section 1.9).

According with section 3.7 of the VCS Standard, the project start date of a non-AFOLU project is the date on which the project began generating GHG emission reductions or removals. Projects shall complete validation within specific timeframes from the project start date.

Table 4 – Relevant dates of project implementation.

| Farm/Site Name | Brascarbon ID | Start Construction | Finish Construction | Start-up and Tests | Monitoring Start Date |
|---|---|---|---|---|---|
| Fazenda Paraíso do Alto | BCA-300MS1-16 | 01/06/2020 | 20/08/2020 | 29/12/2020 | 02/01/2021 |
| Fazenda São Sebastiao Gleba 6 | BCA-301MS1-16 | 10/06/2020 | 25/08/2020 | 29/12/2020 | 02/01/2021 |
| Granja Serra Dourada I | BCA-302MS1-16 | 12/06/2020 | 18/08/2020 | 29/12/2020 | 03/01/2021 |
| Lote 28 - PA - Assentamento | BCA-303MS1-16 | 30/06/2020 | 05/09/2020 | 30/12/2020 | 03/01/2021 |
| Lote 55 - Assentamento Campanario | BCA-304MS1-16 | 10/07/2020 | 20/09/2020 | 30/12/2020 | 03/01/2021 |
| Fazenda Nossa Senhora Aparecida II | BCA-305MS1-16 | 18/07/2020 | 03/10/2020 | 30/12/2020 | 02/01/2021 |
| Granja Grando | BCA-306MS1-16 | 01/08/2020 | 16/10/2020 | 28/12/2020 | 03/01/2021 |
| Assentamento Campanario | BCA-307MS1-16 | 07/08/2020 | 21/10/2020 | 28/12/2020 | 02/01/2021 |
| Fazenda Quinhão A | BCA-308MS1-16 | 01/09/2020 | 03/12/2020 | 28/12/2020 | 04/01/2021 |

## 3.2 Deviations

### 3.2.1 Methodology Deviations

No methodology deviations apply to the current monitoring period.

### 3.2.2 Project Description Deviations

No project description deviations apply to the current monitoring period.

## 3.3 Grouped Projects

The project activity is not a grouped project.

## 3.4 Baseline Reassessment

Did the project undergo baseline reassessment during the monitoring period?

☐ Yes ☒ No

# 4 DATA AND PARAMETERS

## 4.1 Data and Parameters Available at Validation

| | |
|---|---|
| Data / Parameter | MCFj |
| Data unit | % |
| Description | Annual methane conversion factor for the baseline animal waste management system “j”. |
| Source of data | Obtained from 2019 Refinement of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, vol 4, chapter 10, Tables 10.17. |
| Value applied | 79% |
| Justification of choice of data or description of measurement methods and procedures applied | Average temperature of southwest region, mainly where the project sites are located is 23 to 25 Celsius during the year, according to CPTEC/INPE/EMBRAPA http://satelite.cptec.inpe.br/PCD/ |
| Purpose of data | Calculation of Baseline Emissions |
| Comments | No comments |

| | |
|---|---|
| Data / Parameter | MS%BI,j |
| Data unit | Fraction |
| Description | Fraction of manure handled in baseline animal manure management system “j”. |
| Source of data | Project proponents |
| Value applied: | 1 |
| Justification of choice of data or description of measurement methods and procedures applied | 100% of the manure will be handled per category T, system S and climate region k. |
| Purpose of Data | Calculation of Baseline Emissions |
| Comments | No comments |

| | |
|---|---|
| Data / Parameter | $VS_{default}$ |
| Data 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 2019 Refinement of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, vol 4, chapter 10, Tables 10A-7. |
| Value applied: | 0.3 for Market Swine (finishers, nursery/weaners, boars)<br>0.46 for Breeding Swine (guilts, sows) |
| Justification of choice of data or description of measurement methods and procedures applied | Genetics and nutrition adopted for these farms as so as in western Europe. More details or information of the genetics can be obtained at the producers or at the Associação Brasileira dos Criadores de Suinos (Brazilian Swine Association).<br>http://www.abcs.org.br/<br>The genetic source of production operation is originated from Annex I; The farm uses formulated feed rations optimized for the various stages of growth and animals category; The formulated feed rations can be validated through on farm record keeping; The project specific animal weights are more similar to developed country IPCC default values.<br>Used of factors as defined in 2019 Refinement of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, chapter 10, volume 4, since that there is no national data for the default value for the volatile solid excretion rate per day on a dry-matter basis for a defined livestock population. |
| Purpose of Data | Calculation of Baseline Emissions |
| Comments | The four conditions to apply VS value of developed countries are fully applicable to developed countries can be used provided the following four conditions are satisfied:<br>- *The genetic source of the livestock originates from an Annex I Party;* Genetics and nutrition adopted for these farms as so as in western Europe. More details or information of the genetics can be obtained at the producers or at the Associação Brasileira dos Criadores de Suinos (Brazilian Swine Association) – http://www.abcs.org.br/ and also at COOASGO (Cooperativa de São Gabriel do Oeste). |

The genetic source of the livestock is therefore in compliance with this methodology requirement, which can be confirmed and verified by the genetic documents of the animals of each farm. These evidences were provided and assessed to assure their applicability to this requirement.

- *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;*

The formulated feed rations are created according with the characteristics of the animals, their stage of growth, category, weight gain and genetics. Each farm possesses their FFR composition according with the type of animal(s) accommodated, which was confirmed and verified. These evidences were provided and assessed to assure their applicability this requirement.

- *The use of FFR can be validated (through on-farm record keeping, feed supplier, etc.);*

The formulated feed rations are part of the management system of the farms and therefore, each site possesses on-farm records which attest the FFR used. These evidences are also monitored on a monthly basis, according monitoring plan for the parameter FFR, as described in section 5.3., and the PP internal procedure POP 14.

- *The project specific animal weights are more similar to developed country IPCC default values.*

The $W_{site}$ value considered for each category of swine is the result of an average weight of the animals of all farms included in the project, and this value was applied in the baseline calculation.

Finishers is the animal category that represents the totality of all animals from the farms included in this PD. Finishers are considered to be “market swine” and presented an average weight of 90kg among all farms included in the PD by the time of the project’s registration (and this was the value adopted for the parameter Wsite). Taking into account the figures presented in Tables 10 A-7 and 10 A-8 from the 2019 Refinement of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, chapter 10, the weights that are more similar to the project situation are those from the Western Europe region (50 kg) – the values form Latin America (28 kg), where the project is located, is even lower than Western Europe’s.

This situation is also observed for the remaining four categories of swine (nursery and boars for market swine, guilts and sows for breeding swine): the values are more similar to those adopted in Western Europe than in Latin America, especially regarding the Breeding Swine (guilts and sows) and in the Market Swine (boars) which presented an average weight of 210kg and 230 kg respectively, among all farms included in the PD by the time of the project’s registration (and this was the value adopted for the parameter Wsite). Taking into account the figures presented in Tables 10 A-7 and 10 A-8 from the 2019 Refinement of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, chapter 10, the weights that are more similar to the project situation are those from the Western Europe region (198kg for Breeding

| | |
|---|---|
| | Swine and 50 kg for Market Swine) – the values form Latin America (28kg for both classes of Breeding and Market Swine), where the project is located, is much lower than Western Europe's. Only in the category nursery (also Market Swine), which roughly represents 30% of all animals from the farms included in this PD, have an average weight of 20 kg, closer to the Latin America values than the Western Europe values.<br><br>Therefore, is fair to consider that "the project specific animal weights are more similar to developed country IPCC default values" condition is fulfilled and that the VS adopted values for developed counties is in full compliance with the methodology requirements. |

| | |
|---|---|
| **Data / Parameter** | $GWP_{CH_4}$ |
| **Data unit** | $tCO_2e/tCH_4$ |
| **Description** | Global warming potential of $CH_4$ |
| **Source of data** | IPCC Fifth Assessment Report: Climate Change 2013 |
| **Value applied:** | 28 |
| **Justification of choice of data or description of measurement methods and procedures applied** | Conversion factor for metric tons of $CH_4$ to metric tons of $CO_2$ equivalent. |
| **Purpose of Data** | Calculation of Baseline Emissions and Project Emissions |
| **Comments** | No comments. |

| | |
|---|---|
| Data / Parameter | $B_{0,LT}$ |
| Data unit | $m^3$ $CH_4$/kg dm |
| Description | Maximum methane producing potential of the volatile solid generated for animal type “LT”. |
| Source of data | 2019 Refinement of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Tables 10-A7 and 10-A8. |
| Value applied: | 0.45 |
| Justification of choice of data or description of measurement methods and procedures applied | Default value according to 2019 Refinement of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories in western Europe region. Genetics and nutrition adopted for these farms as so as in western Europe. More details or information of the genetics can be obtained at the producers or at the Associação Brasileira dos Criadores de Suinos (Brazilian Swine Association). http://www.abcs.org.br/<br><br>The genetic source of production operation is originated from Annex I; The farm uses formulated feed rations optimized for the various stage of growth and animals category; The formulated feed ratings can be validated through on farm record keeping; The project specific animal weights are more similar to developed country IPCC default values.<br><br>Used of factors as defined in 2019 Refinement of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, chapter 10, volume 4, since that there is no national data for the Maximum methane producing potential of the volatile solid generated for animal type “LT” |
| Purpose of Data | Calculation of Baseline Emissions |
| Comments | The four conditions to apply B0 value of developed countries are fully applicable to developed countries can be used provided the following four conditions are satisfied:<br><br>- *The genetic source of the livestock originates from an Annex I Party;* Genetics and nutrition adopted for these farms as so as in western Europe. More details or information of the genetics can be obtained at the producers or at the Associação Brasileira dos Criadores de Suinos (Brazilian Swine Association) – http://www.abcs.org.br/ and also at COOASGO (Cooperativa de São Gabriel do Oeste).<br><br>The genetic source of the livestock is therefore in compliance with this methodology requirement, which can be confirmed and verified by the genetic documents of the animals of each farm. These evidences were provided and |

assessed to assure their applicability to this requirement.

- *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;*

The formulated feed rations are created according with the characteristics of the animals, their stage of growth, category, weight gain and genetics. Each farm possesses their FFR composition according with the type of animal(s) accommodated, which was confirmed and verified. These evidences were provided and assessed to assure their applicability this requirement.

- *The use of FFR can be validated (through on-farm record keeping, feed supplier, etc.);*

The formulated feed rations are part of the management system of the farms and therefore, each site possesses on-farm records which attest the FFR used. These evidences are also monitored on a monthly basis, according monitoring plan for the parameter FFR, as described in section 5.3., and the PP internal procedure POP 14.

- *The project specific animal weights are more similar to developed country IPCC default values.*

The $W_{site}$ value considered for each category of swine is the result of an average weight of the animals of all farms included in the project, and this value was applied in the baseline calculation.

Finishers is the animal category that represents the totality of all animals from the farms included in this PD. Finishers are considered to be “market swine” and presented an average weight of 90kg among all farms included in the PD by the time of the project’s registration (and this was the value adopted for the parameter Wsite). Taking into account the figures presented in Tables 10 A-7 and 10 A-8 from the 2019 Refinement of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, chapter 10, the weights that are more similar to the project situation are those from the Western Europe region (50 kg) – the values form Latin America (28 kg), where the project is located, is even lower than Western Europe’s.

This situation is also observed for the remaining four categories of swine (nursery and boars for market swine, guilts and sows for breeding swine): the values are more similar to those adopted in Western Europe than in Latin America, especially regarding the Breeding Swine (guilts and sows) and in the Market Swine (boars) which presented an average weight of 210kg and 230 kg respectively, among all farms included in the PD by the time of the project’s registration (and this was the value adopted for the parameter Wsite). Taking into account the figures presented in Tables 10 A-7 and 10 A-8 from the 2019 Refinement of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, chapter 10, the weights that are more similar to the project situation are those from the Western Europe region (198kg for Breeding Swine and 50 kg for Market Swine) – the values form Latin America (28kg for both classes of Breeding and Market Swine), where the project is located, is much lower than Western Europe’s. Only in the category nursery (also Market Swine), which roughly represents 30% of

| | |
|---|---|
| | all animals from the farms included in this PD, have an average weight of 20 kg, closer to the Latin America values than the Western Europe values.<br><br>Therefore, is fair to consider that "the project specific animal weights are more similar to developed country IPCC default values" condition is fulfilled and that the B0 adopted values for developed counties is in full compliance with the methodology requirements. |

| | |
|---|---|
| **Data / Parameter** | $W_{default}$ |
| **Data unit** | kg |
| **Description** | Default average animal weight of a defined population at the project site. |
| **Source of data** | 2019 Refinement of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. |
| **Value 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 |
| **Justification of choice of data or description of measurement methods and procedures applied** | Default value according to 2019 Refinement of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories in western Europe region. Genetics and nutrition adopted for these farms as so as in western Europe. More details or information of the genetics can be obtained at the producers or at the Associação Brasileira dos Criadores de Suinos (Brazilian Swine Association). http://www.abcs.org.br/<br><br>The genetic source of production operation is originated from Annex I; The farm uses formulated feed rations optimized for the various stage of growth and animals category; The formulated feed ratings can be validated through on farm record keeping; The project specific animal weights are more similar to developed country IPCC default values.<br><br>Used of factors as defined in 2019 Refinement of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, chapter 10, volume 4, since that there is no national data for the Maximum methane producing potential of the volatile solid generated for animal type "LT" |
| **Purpose of Data** | Calculation of Baseline Emissions |
| **Comments** | The four conditions to apply $W_{DEFAULT}$ value of developed countries are fully applicable to developed countries can be used provided the following four conditions are satisfied: |

- *The genetic source of the livestock originates from an Annex I Party;*

Genetics and nutrition adopted for these farms as so as in western Europe. More details or information of the genetics can be obtained at the producers or at the Associação Brasileira dos Criadores de Suinos (Brazilian Swine Association) – http://www.abcs.org.br/ and also at COOASGO (Cooperativa de São Gabriel do Oeste).

The genetic source of the livestock is therefore in compliance with this methodology requirement, which can be confirmed and verified by the genetic documents of the animals of each farm. These evidences were provided and assessed to assure their applicability to this requirement.

- *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;*

The formulated feed rations are created according with the characteristics of the animals, their stage of growth, category, weight gain and genetics. Each farm possesses their FFR composition according with the type of animal(s) accommodated, which was confirmed and verified. These evidences were provided and assessed to assure their applicability this requirement.

- *The use of FFR can be validated (through on-farm record keeping, feed supplier, etc.);*

The formulated feed rations are part of the management system of the farms and therefore, each site possesses on-farm records which attest the FFR used. These evidences are also monitored on a monthly basis, according monitoring plan for the parameter FFR, as described in section 5.3., and the PP internal procedure POP 14.

- *The project specific animal weights are more similar to developed country IPCC default values.*

The $W_{site}$ value considered for each category of swine is the result of an average weight of the animals of all farms included in the project, and this value was applied in the baseline calculation.

Finishers is the animal category that represents the totality of all animals from the farms included in this PD. Finishers are considered to be “market swine” and presented an average weight of 90kg among all farms included in the PD by the time of the project’s registration (and this was the value adopted for the parameter Wsite). Taking into account the figures presented in Tables 10 A-7 and 10 A-8 from the 2019 Refinement of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, chapter 10, the weights that are more similar to the project situation are those from the Western Europe region (50 kg) – the values form Latin America (28 kg), where the project is located, is even lower than Western Europe’s.

This situation is also observed for the remaining four categories of swine (nursery and boars for market swine, guilts and sows for breeding swine): the values are more similar to those adopted in Western Europe than in Latin America, especially regarding the Breeding Swine (guilts and sows) and in the Market Swine (boars) which presented an average

| | |
|---|---|
| | weight of 210kg and 230 kg respectively, among all farms included in the PD by the time of the project's registration (and this was the value adopted for the parameter Wsite). Taking into account the figures presented in Tables 10 A-7 and 10 A-8 from the 2019 Refinement of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, chapter 10, the weights that are more similar to the project situation are those from the Western Europe region (198kg for Breeding Swine and 50 kg for Market Swine) – the values form Latin America (28kg for both classes of Breeding and Market Swine), where the project is located, is much lower than Western Europe's. Only in the category nursery (also Market Swine), which roughly represents 30% of all animals from the farms included in this PD, have an average weight of 20 kg, closer to the Latin America values than the Western Europe values.<br><br>Therefore, is fair to consider that "the project specific animal weights are more similar to developed country IPCC default values" condition is fulfilled and that the WDEFAULT adopted values for developed counties is in full compliance with the methodology requirements. |

| | |
|---|---|
| **Data / Parameter** | $UF_b$ |
| **Data unit** | Fraction |
| **Description** | Model correction factor to account for model uncertainties |
| **Source of data** | FCCC/SBSTA/2003/10/Add.2, page 25. |
| **Value applied:** | 0.94 |
| **Justification of choice of data or description of measurement methods and procedures applied** | Default value according to methodology AMS-III.D |
| **Purpose of Data** | Calculation of Baseline Emissions |
| **Comments** | No comments. |

| | |
|---|---|
| Data / Parameter | $SPEC_{flare}$ |
| Data unit | Temperature - °C<br>Flow rate or heat flux - kg/h or m3/h<br>Maintenance schedule - number of days |
| Description | Manufacturer's flare specifications for temperature, flow rate and maintenance schedule |
| Source of data | Flare manufacturer |
| Value applied: | The flare optimal conditions are, according the manufacturers specifications:<br>Flow: between + 40% of the estimated flow (in m3/h) for any giving farm;<br>Temperature: between 500ºC and 800ºC<br>Maintenance: Annually, recommended by the manufacturer. The PP preforms monthly maintenance, both preventive and corrective, if needed. |
| Justification of choice of data or description of measurement methods and procedures applied | N/A |
| Purpose of Data | N/A |
| Comments | The maintenance schedule is not required if Option A is selected to determine flare efficiency of an enclosed flare |

## 4.2 Data and Parameters Monitored

| | |
|---|---|
| **Data / Parameter** | $T_f$ |
| **Data unit** | °.C |
| **Description** | Combustion temperature of the flare |
| **Source of data** | Brascarbon Monitoring Report System |
| **Description of measurement methods and procedures applied** | Every 1 minute measurement and registration by a Control Logic Program (CLP) |
| **Frequency of monitoring/recording** | Every 1 minute measurement and registration by the PLC. Data is collected monthly from the field by the use of the pen drive.<br>According to the Monitoring Operational Procedure POP-01 |
| **Value applied:** | The aggregate values of Tf (hours with Tf above 500° C and hours with Tf below 500°C) can be found in the spreadsheet calculation file "CER Calculation MR02 - BCA-BRA-16_v2" in the folder MDy-PEpower,y,ex-post. |
| **Monitoring equipment** | Thermocouple [1] |

| Farm name | Site ID | Thermocouple Serial Number [2] | Calibration Certification Number | Calibration Date | Instalation Date [3] | Expiration Date |
|---|---|---|---|---|---|---|
| Fazenda Paraiso do Alto | BCA-300MS1-16 | 320330 | CA 6912 21 | 08/11/21 | 30/12/21 | 29/12/22 |
| | | 83892 | CA 1684 22 | 08/03/22 | 27/12/22 | 26/12/23 |
| | | 455088 | CA 0613 23 | 18/01/23 | 22/12/23 | 21/12/24 |
| Fazenda São Sebastião - Gleba 06 | BCA-301MS1-16 | 320331 | CA 6913 21 | 08/11/21 | 30/12/21 | 29/12/22 |
| | | 83893 | CA 1686 22 | 08/03/22 | 27/12/22 | 26/12/23 |
| | | 455089 | CA 0614 23 | 18/01/23 | 22/12/23 | 21/12/24 |
| Granja Serra Dourada I | BCA-302MS1-16 | 320332 | CA 6914 21 | 08/11/21 | 30/12/21 | 29/12/22 |
| | | 83857 | CA 1692 22 | 08/03/22 | 27/12/22 | 26/12/23 |
| | | 455090 | CA 0615 23 | 18/01/23 | 22/12/23 | 21/12/24 |
| Lote 28 - PA - Assentamento Campanario | BCA-303MS1-16 | 320333 | CA 6915 21 | 08/11/21 | 30/12/21 | 29/12/22 |
| | | 82858 | CA 1693 22 | 08/03/22 | 27/12/22 | 26/12/23 |
| | | 455092 | CA 0616 23 | 18/01/23 | 22/12/23 | 21/12/24 |
| Assentamento Campanario 55 | BCA-304MS1-16 | 320334 | CA 6916 21 | 08/11/21 | 30/12/21 | 29/12/22 |
| | | 83859 | CA 1694 22 | 08/03/22 | 27/12/22 | 26/12/23 |
| | | 455094 | CA 0617 23 | 18/01/23 | 22/12/23 | 21/12/24 |
| Fazenda Nossa Senhora Aparecida II | BCA-305MS1-16 | 320335 | CA 6917 21 | 08/11/21 | 30/12/21 | 29/12/22 |
| | | 83860 | CA 1695 22 | 08/03/22 | 27/12/22 | 26/12/23 |
| | | 455095 | CA 0618 23 | 18/01/23 | 22/12/23 | 21/12/24 |
| Granja Grando | BCA-306MS1-16 | 320336 | CA 6918 21 | 08/11/21 | 30/12/21 | 29/12/22 |
| | | 83897 | CA 1697 22 | 08/03/22 | 27/12/22 | 26/12/23 |
| | | 455096 | CA 0619 23 | 18/01/23 | 22/12/23 | 21/12/24 |
| Assentamento Campanario 88 | BCA-307MS1-16 | 320337 | CA 6919 21 | 08/11/21 | 30/12/21 | 29/12/22 |
| | | 83906 | CA 1698 22 | 08/03/22 | 27/12/22 | 26/12/23 |
| | | 455097 | CA 0620 23 | 18/01/23 | 22/12/23 | 21/12/24 |
| Bambu Q. A | BCA-308MS1-16 | 320338 | CA 6920 21 | 08/11/21 | 30/12/21 | 29/12/22 |
| | | 83909 | CA 1700 22 | 08/03/22 | 27/12/22 | 26/12/23 |
| | | 455098 | CA 0621 23 | 18/01/23 | 22/12/23 | 21/12/24 |

| | |
|---|---|
| Monitoring equipment type: | Standard Thermocouple from ALUTAL |
| Accuracy class: | ± 1.5 °C or ± 0.25% |
| Calibration frequency: | Every year of continuous operation (counted from the date of installation) |

| | |
|---|---|
| QA/QC procedures applied | Check the data for more accurate information. |
| Purpose of data | Calculation of Baseline Emissions and Project Emissions |
| Calculation method | Monitoring operational procedure POP-01 can be found at the Brascarbon Operational Procedure Manual |
| Comments | Check the data for more accurate information. |

| | |
|---|---|
| Data / Parameter | $W_{site}$ |
| Data unit | kg |
| Description | Average animal weight of a defined livestock population at the project site in year |
| Source of data | Brascarbon Monitoring Report System |
| Description of measurement methods and procedures applied | The data collection is realized quarterly by each farm owner, together with COOASGO (Cooperativa de São Gabriel do Oeste) and provided to the PP. COOASGO is the Pig Producers Association to whom the farms contained in the PD are associated; its main role is to act as a third party responsible for the assurance of all the logistics associated with the swine producers, providing the animal nutrition, genetics and all the overall animal weight. |
| Frequency of monitoring/recording | Quarterly (based on sampling following COOASGO's internal procedure) and at full weight of the batch of pigs every time it leaves the farms (each batch stays around 5 to 6 months per farm). |
| Value applied: | Annual follow-up of the documentation to check the expiration date, changes in the production lay-out and surroundings of the digester. Actions within the property and around the biodigesters should be taken both by the contractor and the client Brascarbon. Photos should be attached to the annual inspection report to prove that the system of wastewater management has not changed namely regarding the following items: pipes, gutters, roofs, fences, trees, control panel, flare, terminal boxes and general cleaning.<br>Use of the annex attached at the operational procedure POP-02 |
| Monitoring equipment | N/A |

| | |
|---|---|
| QA/QC procedures applied | Check of the site records and documents. The values of the quarterly weights presented by COOASGO's (following the association's internal procedures) to the PP are cross-checked against two different credible sources:<br><br>- reference figures from EMBRAPA (an undisputed Brazilian Agricultural Research Corporation nationally recognized for these scope) for each category; and<br><br>- the figures provided by COOASGO when each of the swine batches exits each farm (each batch stays around 5 to 6 months per farm), as explained below. Here COOASGO provides invoices with 100% of the animals weight (and number), allowing a full cross- check with the weight values provided and assuring that all the information is accurate.<br><br>- If the PP verifies during the cross-check any discrepancy between the values provided quarterly and the full weighting and counting of the animals in the invoices provided by COOASGOs each time any batch exits a giving farm, those values will be updated accordingly with these real figures. |
| Purpose of data | Calculation of Baseline Emissions and Project Emissions |
| Calculation method | The current practice of swine farms in Brazil is that each farm receives new batches of animals every 5 to 6 months (which is also the average time that a batch stays in a farm) and the producer, together with COOASGO, performs regular and periodical visits to each farm in order to assess and evaluate the correct development of each batch in terms of growing/weighting of the animals (according with what is expected at each growing stage of a given batch). It is important to highlight that both the farm owners COOASGO rely on the quality of the values measured since their sole professional occupation is the pig production and, therefore, it is within their best interests to have a correct and reliable way to assess the weighting of the animals (which is their business) based on their experience and internal procedures.<br><br>Every 5 to 6 months (depending on each batch and farm), the animal batches leave the farms and they are, in this specific situation, 100% weighted by the producers, together with COOASGO – this weighting is undertaken to the totality of animal presented in the batch since the profits associated with the animal production are weight based. According with COOASGO a possible range of +/- 5kg within the animal growing is considered a normal fluctuation and therefore admissible.<br><br>Each time a batch exits a farm, COOASGO provides the invoices to attest the feasibility of the figures adopted, allowing a complete and thorough cross-check by PP of all the data used for this parameter.<br><br>Monitoring operational procedure POP-016 |
| Comments | Check the data for more accurate information. |

| | |
|---|---|
| Data / Parameter | SITE INSPECTION |
| Data unit | N/A |
| Description | Inspection on the site considering relevant regulation and the infra-structure of the site |
| Source of data | Brascarbon Monitoring Report System |
| Description of measurement methods and procedures applied | Annual follow-up of the documentation to check the expiration date, changes in the production lay-out and surroundings of the digester. Actions within the property and around the biodigesters should be taken both by the contractor and the client Brascarbon. Photos should be attached to the annual inspection report to prove that the system of wastewater management has not changed namely regarding the following items: pipes, gutters, roofs, fences, trees, control panel, flare, terminal boxes and general cleaning.<br><br>Use of the annex attached at the operational procedure POP-02 |
| Frequency of monitoring/recording | Annually |
| Value applied: | N/A |
| Monitoring equipment | N/A |
| QA/QC procedures applied | A copy of the documents is submitted to the central office to the Quality Coordinator, who will verify the data, controlling it through an electronic system and ensuring its integrity. |
| Purpose of data | Calculation of Baseline Emissions and Project Emissions |
| Calculation method | N/A |
| Comments | Monitoring operational procedure POP-02 can be found at the Brascarbon Operational Procedure Manual |

| | |
|---|---|
| **Data / Parameter** | $N_{LT,y}$ |
| **Data unit** | Number |
| **Description** | Annual average number of animals of type “LT” in year “y” |
| **Source of data** | Calculated. Data for calculation gathered according with Brascarbon Monitoring Report System |
| **Description of measurement methods and procedures applied** | Checking of the documentation located at the confined animal production and use of the table annexed at the operational procedure POP-03.<br><br>Use of the Equation 4 established in the section 4 step 2 item B – determination of the annual average number of animals. |
| **Frequency of monitoring/recording** | Monthly |
| **Value applied:** | The values of NLT,y can be found in the spreadsheet calculation file “CER Calculation MR02 - BCA-BRA-16_v2” in the folder BEy ex-post – PEy ex-post. |
| **Monitoring equipment** | N/A |
| **QA/QC procedures applied** | A copy of the documents is submitted to the central office to the Quality Coordinator, who will verify the data, controlling it through an electronic system and ensuring its integrity. |
| **Purpose of data** | Calculation of Baseline Emissions and Project Emissions |
| **Calculation method** | N/A |
| **Comments** | Monitoring operational procedure POP-03 can be found at the Brascarbon Operational Procedure Manual |

| | |
|---|---|
| **Data / Parameter** | $BG_{burnt,y}$ |
| **Data unit** | $m^3$ |
| **Description** | Biogas flared or used as a fuel in the year y. |
| **Source of data** | Brascarbon Monitoring Report System |
| **Description of measurement methods and procedures applied** | Minute by minute measurement and cumulative registration by a Control Logic Program (CLP). Monthly the registered data will be recovered in the data logger (CLP) of the volume in the local control panel according to the operational procedure POP-04 |
| **Frequency of monitoring/recording** | Continuously recording. Every 1 minute measurement and registration by the PLC. Data is collected monthly from the field. |
| **Value applied:** | The values of BGburnt,y can be found in the spreadsheet calculation file "CER Calculation MR02 - BCA-BRA-16_v2" in the folder MDy-PEpower,y,ex-post. |
| **Monitoring equipment** | Flow Meter [1][2] Calibration Control<br>Monitoring equipment type: Endress+Hauser thermal mass flow meter t-trend - ATT12<br>Accuracy class: ± 5% of factory full scale<br>Calibration frequency: Every 2 years of continuous operation (counted from the date of installation) |
| **QA/QC procedures applied** | Check the monthly registers sent from the field to proceed with the emissions reductions calculation. The registers are read and stored every minute continuously in the CLP. The data is recovered from the CLP every month. The QA/QC also controls and assures the calibration program of the flow meter. |
| **Purpose of data** | Calculation of Baseline Emissions |

| Site ID | Farm Name | Flow Meter Serial Number | Calibration Certification Number | Instalation Calibration Date [3] | Expiration Date |
|---|---|---|---|---|---|
| BCA-300MS1-16 | Fazenda Paraiso do Alto | C400583412A | EN 10204 - 2.1 | 02/01/21 | 01/01/23 |
| | | | | 27/12/22 | 26/12/24 |
| BCA-301MS1-16 | Fazenda São Sebastião - Gleba 06 | C400753412A | EN 10204 - 2.1 | 02/01/21 | 01/01/23 |
| | | | | 27/12/22 | 26/12/24 |
| BCA-302MS1-16 | Granja Serra Dourada I | A700643412A | EN 10204 - 2.1 | 03/01/21 | 02/01/23 |
| | | | | 27/12/22 | 26/12/24 |
| BCA-303MS1-16 | Lote 28 - PA - Assentaemnto Campanario | A700583412A | EN 10204 - 2.1 | 03/01/21 | 02/01/23 |
| | | | | 27/12/22 | 26/12/24 |
| BCA-304MS1-16 | Assentamento Campanario - Lote 55 | A700613412A | EN 10204 - 2.1 | 03/01/21 | 02/01/23 |
| | | | | 27/12/22 | 26/12/24 |
| BCA-305MS1-16 | Fazenda Nossa Senhora Aparecida II | C400623412A | EN 10204 - 2.1 | 02/01/21 | 01/01/23 |
| | | | | 27/12/22 | 26/12/24 |
| BCA-306MS1-16 | Granja Grando | A700693412A | EN 10204 - 2.1 | 03/01/21 | 02/01/23 |
| | | | | 27/12/22 | 26/12/24 |
| BCA-307MS1-16 | Assentamento Campanario | C400703412A | EN 10204 - 2.1 | 02/01/21 | 02/01/23 |
| | | | | 27/12/22 | 26/12/24 |
| BCA-308MS1-16 | Fazenda Quinhao A | A700713412A | EN 10204 - 2.1 | 04/01/21 | 03/01/23 |
| | | | | 27/12/22 | 26/12/24 |

| | |
|---|---|
| Calculation method | N/A |
| Comments | Monitoring operational procedure POP-04 can be found at the Brascarbon Operational Procedure Manual |

| | |
|---|---|
| Data / Parameter | $W_{CH_4}$ |
| Data unit | % |
| Description | Methane content in biogas in the year “y” |
| Source of data | Brascarbon Monitoring Report System |
| Description of measurement methods and procedures applied | Use of methane concentration analysis instrument on dry basis in the sampling point at piping to the flare. |
| Frequency of monitoring/recording | Periodical. To assure. that the monitoring frequency provides a 90% confidence level and 10% precision. The adequate frequency will be determined through a statistical analysis of the methane fraction variation, based on methane fraction data gathered on a group of farms per region during a certain period time.<br><br>According with the data/parameter table 6 of the methodology AMS III.D version 21.0, The fraction of methane in the biogas should be measured with a continuous analyser (values are recorded with the same frequency as the flow) or, with periodical measurements at a 90/10 confidence/precision level by following General guidelines for sampling and surveys for SSC project activities, or, alternatively a default value of 60% methane content can be used The option chosen was periodical measurements at a 90/10 confidence/precision level. For details, please see Section regarding the Sampling Plan. |
| Value applied: | The values of WCH4,y can be found in the spreadsheet calculation file “CER Calculation MR02 - BCA-BRA-16_v2” in the folder MDy-PEpower,y,ex-post. |

**Monitoring equipment**

Biogas Analyser [1][2] Calibration Control

| Site ID | Farm Name | Biogas Analyser Serial Number | Calibration Certificate Number | Last Calibration Date [3] | Expiration Date |
|---|---|---|---|---|---|
| BCA-300MS1-16 | Fazenda Paraiso do alto | | | | |
| BCA-301MS1-16 | Fazenda São Sebastiao Gleba 6 | | | | |
| BCA-302MS1-16 | Granja Serra Dourada I | BM 11043 | BM11043_9/4550 | 28/12/2021 | 27/06/2022 |
| BCA-303MS1-16 | Lote 28 - PA - Assentamento | BM 11043 | RBC.0900.22.rev.00 | 25/06/2022 | 24/12/2022 |
| BCA-304MS1-16 | Assentamento Campanario - Lote 55 | BM 11043 | RBC.1343.22.rev.00 | 19/12/2022 | 18/06/2023 |
| BCA-305MS1-16 | Fazenda Nossa Senhora Aparecida II | BM 11043 | RBC.0235.23.rev.00 | 16/06/2023 | 15/12/2023 |
| BCA-306MS1-16 | Granja Grando | BM 11043 | RBC.0510.23.rev.00 | 13/12/2023 | 12/06/2024 |
| BCA-307MS1-16 | Assentamento Campanario | | | | |
| BCA-308MS1-16 | Fazenda Quinhao A | | | | |

| | |
|---|---|
| Monitoring equipment type: | Biogas Check Portable Digital Analyzer from Geotech/Landtech |
| Accuracy class: | • **CH4:** ± 0.5% from 0-5% CH4 content; ± 1.0% from 5-15% CH4 content; ± 3.0% from 15%-full scale CH4 content<br>• **Temperature:** ± 0.2°C (Biogas check analyzer accuracy) ± 0.5°C (temperature probe accuracy)<br>• **Pressure**: ± 4mbar typically and ±15 mbar maximum |
| Calibration frequency: | Every 6 months |

**QA/QC procedures applied**

Check the registers in the generated documents. Control and assure the calibration program of the instrument.

**Purpose of data**

Calculation of Baseline Emissions

**Calculation method**

N/A

**Comments**

Monitoring frequency to be determined to attend 90% confidence level and 10% precision. To assure that the monitoring frequency provides a 90% confidence level and 10% precision, the adequate frequency will be determined through a statistical analysis of the methane fraction variation, based on methane fraction data gathered on a group of farms per region during a certain period time. The results will be analyzed to guarantee that the required confidence/precision level has been met and the monitoring frequency will be, at least, monthly. For details, please see Section regarding the Sampling Plan.

The equipment used can directly measure methane content in the biogas. The methane content measurement will be carried out close to a location in the system where a biogas flow measurement takes place, and on the same basis (wet or dry) as required by the methodology.

Monitoring operational procedure POP-05 can be found at the Brascarbon Operational Procedure Manual

| | |
|---|---|
| **Data / Parameter** | $T_{biogas}$ |
| **Data unit** | °C |
| **Description** | Temperature of the biogas at operation conditions |
| **Source of data** | Brascarbon Monitoring Report System |
| **Description of measurement methods and procedures applied** | Measurement with a local thermometer, with the same equipment as the methane content and at the same time, in the sampling point at piping to the flare. Measurement according with Operational Procedure POP-06. |
| **Frequency of monitoring/recording** | Periodical. To assure. that the monitoring frequency provides a 90% confidence level and 10% precision. The adequate frequency will be determined through a statistical analysis of the methane fraction variation, based on methane fraction data gathered on a group of farms per region during a certain period time.<br><br>According with the data/parameter table 6 of the methodology AMS III.D version 21.0, The fraction of methane in the biogas should be measured with a continuous analyser (values are recorded with the same frequency as the flow) or, with periodical measurements at a 90/10 confidence/precision level by following General guidelines for sampling and surveys for SSC project activities, or, alternatively a default value of 60% methane content can be used The option chosen was periodical measurements at a 90/10 confidence/precision level. For details, please see Section regarding the Sampling Plan. |
| **Value applied:** | The values of Tbiogas can be found in the spreadsheet calculation file “CER Calculation MR02 - BCA-BRA-16_v2” in the folder MDy-PEpower,y,ex-post. |
| **Monitoring equipment** | Biogas Analyser [1][2] Calibration Control |

| Site ID | Farm Name | Biogas Analyser Serial Number | Calibration Certificate Number | Last Calibration Date [3] | Expiration Date |
|---|---|---|---|---|---|
| BCA-300MS1-16 | Fazenda Paraiso do alto | | | | |
| BCA-301MS1-16 | Fazenda São Sebastiao Gleba 6 | | | | |
| BCA-302MS1-16 | Granja Serra Dourada I | BM 11043 | BM11043_9/4550 | 28/12/2021 | 27/06/2022 |
| BCA-303MS1-16 | Lote 28 - PA - Assentamento | BM 11043 | RBC.0900.22.rev.00 | 25/06/2022 | 24/12/2022 |
| BCA-304MS1-16 | Assentamento Campanario - Lote 55 | BM 11043 | RBC.1343.22.rev.00 | 19/12/2022 | 18/06/2023 |
| BCA-305MS1-16 | Fazenda Nossa Senhora Aparecida II | BM 11043 | RBC.0235.23.rev.00 | 16/06/2023 | 15/12/2023 |
| BCA-306MS1-16 | Granja Grando | BM 11043 | RBC.0510.23.rev.00 | 13/12/2023 | 12/06/2024 |
| BCA-307MS1-16 | Assentamento Campanario | | | | |
| BCA-308MS1-16 | Fazenda Quinhao A | | | | |

| | |
|---|---|
| Monitoring equipment type: | Biogas Check Portable Digital Analyzer from Geotech/Landtech |

| | | |
|---|---|---|
| | Accuracy class: | • **CH4:** ± 0.5% from 0-5% CH4 content; ± 1.0% from 5-15% CH4 content; ± 3.0% from 15%-full scale CH4 content<br>• **Temperature:** ± 0.2°C (Biogas check analyzer accuracy) ± 0.5°C (temperature probe accuracy)<br>• **Pressure**: ± 4mbar typically and ±15 mbar maximum |
| | Calibration frequency: | Every 6 months |
| **QA/QC procedures applied** | Check the registers in the generated documents and thermometer calibration | |
| **Purpose of data** | Calculation of Baseline Emissions | |
| **Calculation method** | N/A | |
| **Comments** | Monitoring frequency to be determined to attend 90% confidence level and 10% precision. To assure that the monitoring frequency provides a 90% confidence level and 10% precision, the adequate frequency will be determined through a statistical analysis of the methane fraction variation, based on methane fraction data gathered on a group of farms per region during a certain period time. The results will be analyzed to guarantee that the required confidence/precision level has been met and the monitoring frequency will be, at least, monthly. For details, please see Section regarding the Sampling Plan.<br><br>The equipment used can directly measure methane content in the biogas. The methane content measurement will be carried out close to a location in the system where a biogas flow measurement takes place, and on the same basis (wet or dry) as required by the methodology.<br><br>Monitoring operational procedure POP-05 can be found at the Brascarbon Operational Procedure Manual | |

| | |
|---|---|
| Data / Parameter | $D_{CH4,y}$ |
| Data unit | $t/m^3$ |
| Description | Density of the methane combusted |
| Source of data | Brascarbon Monitoring Report System |
| Description of measurement methods and procedures applied | Calculation according to the Operational Procedure POP-07. Use of the formula considering pressure, temperature and molecular mass of methane |
| Frequency of monitoring/recording | Monthly |
| Value applied: | The values of DCH4,y can be found in the spreadsheet calculation file“CER Calculation MR02 - BCA-BRA-16_v2” in the folder MDy- PEpower,y,ex-post. |
| Monitoring equipment | N/A |
| QA/QC procedures applied | Check and approve the density value calculation. |
| Purpose of data | Calculation of Baseline Emissions |
| Calculation method | N/A |
| Comments | Monitoring operational procedure POP-07 can be found at the Brascarbon Operational Procedure Manual. Reference: Tool to determine project emissions from flaring gases containing methane. |

| | |
|---|---|
| Data / Parameter | $Q_{DM}$ |
| Data unit | N/A |
| Description | Sludge soil application |
| Source of data | Brascarbon Monitoring Report System |
| Description of measurement methods and procedures applied | Supervision in the field, performed during the regular site visit of the regional techicians as part of the operation assessment of the biodigestor, to each farm. |
| Frequency of monitoring/recording | Defined according to the digester performance |
| Value applied: | Sludge was not removed during this monitoring period. |
| Monitoring equipment | N/A |
| QA/QC procedures applied | Check the registers in the generated documents. |
| Purpose of data | N/A |
| Calculation method | N/A |
| Comments | Monitoring operational procedure POP-09 can be found at the Brascarbon Operational Procedure Manual |

| | |
|---|---|
| **Data / Parameter** | FE or $\eta_{flare,\,h}$ |
| **Data unit** | % |
| **Description** | Enclosed Flare Efficiency |
| **Source of data** | Brascarbon Monitoring Report System |
| **Description of measurement methods and procedures applied** | Enclosed flare (low height) is used in the entire project.<br><br>Brascarbon registers the gas flow sent to the flares and the combustion temperature of the flares every minute.<br><br>A 80% efficiency for a specific hour is considered if the following conditions are met for all minutes in that specific hours:<br><br>(i) all temperature records are above or equal to 500° Celsius and<br>(ii) the temperature of the flare (TEG.m) and the flow rate of the residual gas to the flare (FRG,m) are within the manufacturer's specification for the flare (SPECflare).<br>(iii) The flame is detected in minute m (Flamem).<br>Otherwise, a 0% efficiency for the specific hour is applied if at any minute the records of temperature measurement are below 500° Celsius or the flare is operating outside of the manufacturer's specification (SPECflare).<br><br>This discount will be applied to the volume of that specific hour since it is a more conservative approach than to discount in the average of the flare efficiency percentage for any giving hour. |
| **Frequency of monitoring/recording** | Every 1 minute measurement and registration by a CLP of flare temperature and biogas flow rate. Data is recovered monthly for Flare Efficiency hourly calculation |
| **Value applied:** | 80% |
| **Monitoring equipment** | N/A |
| **QA/QC procedures applied** | Check the registers in the generated documents.<br><br>The enclosed flare will regularly undergo a maintenance process subject to the appropriate industrial standards and/or manufacturer´s specifications in order to ensure measurement accuracy. |

| | |
|---|---|
| | The Monitoring Operational Procedure POP-08 was developed to calculate the flare efficiency and it can be found at the Brascarbon Operational Procedure Manual. |
| **Purpose of data** | Calculation of Baseline Emissions and Project Emissions |
| **Calculation method** | N/A |
| **Comments** | The Monitoring Operational Procedure POP-08 was developed to calculate the monthly efficiency and it can be found at the Brascarbon Operational Procedure Manual. |

| | |
|---|---|
| Data / Parameter | $ER_{y,ex\text{-}post}$ |
| Data unit | t CO2e |
| Description | Ex-post emission reductions achieved by the project activity based on monitored values for the year “y”. |
| Source of data | Calculated. Data for calculation gathered according with Brascarbon Monitoring Report System |
| Description of measurement methods and procedures applied | Comparison of the baseline with the actual measured data according to the operational procedure POP-17. The minimum value between the $BE_{ex\text{-}post}$ and $MD_y$ will be chosen for the calculation of the $ER_{y\ ex\text{-}post}$. |
| Frequency of monitoring/recording | Yearly |
| Value applied: | The values of ERy,ex-post can be found in the spreadsheet calculation file “CER Calculation MR02 - BCA-BRA-16_v2” in the folder ERy ex-post. |
| Monitoring equipment | N/A |
| QA/QC procedures applied | Check the ER calculation and the registers in the generated documents. |
| Purpose of data | N/A |
| Calculation method | According with the formulas presented in the current Section |
| Comments | Used to cap the maximal emission reduction in any year. Monitoring operational procedure POP-17 can be found at the Brascarbon Operational Procedure Manual |

| | |
|---|---|
| Data / Parameter | FFR |
| Data unit | N/A |
| Description | Formulated Feed Rations |
| Source of data | Brascarbon Monitoring Report System |
| Description of measurement methods and procedures applied | According to the Operational Procedure POP-14 |
| Frequency of monitoring/recording | Monthly |
| Value applied: | N/A |
| Monitoring equipment | N/A |
| QA/QC procedures applied | Check the registers and/or food purchases records on the farm. |
| Purpose of data | Calculation of Baseline Emissions (to validate B0 and VS values used) |
| Calculation method | N/A |
| Comments | Monitoring operational procedure POP-14 can be found at the Brascarbon Operational Procedure Manual |

| | |
|---|---|
| **Data / Parameter** | $P_{biogas}$ |
| **Data unit** | mbar |
| **Description** | Pressure of the biogas at operation conditions |
| **Source of data** | Brascarbon Monitoring Report System |
| **Description of measurement methods and procedures applied** | Measurement with portable local pressure gauge, with the same equipment as the methane content and at the same time, in the sampling point at piping to the flare. Measurement according with Operational Procedure POP-13. |
| **Frequency of monitoring/recording** | Periodical. To assure. that the monitoring frequency provides a 90% confidence level and 10% precision. The adequate frequency will be determined through a statistical analysis of the pressure variation, based on pressure data gathered on a group of farms per region during a certain period time.<br>According to the data/parameter table 6 of the methodology AMS III.D version 21.0, the pressure of the biogas at the flow measurement site is not measured by a continuous analyser, the frequency of periodical measurements at a 90/10 statistical confidence/precision level shall be determined following the "Standard for sampling and surveys for CDM project activities and programme of activities". The minimum sample size required would be dependent on the variability in the values of pressure, which will be determined in the sampling plan. For details, please see Section regarding the Sampling Plan. |
| **Value applied:** | The values of Pbiogas can be found in the spreadsheet calculation file "CER Calculation MR02 - BCA-BRA-16_v2" in the folder MDy-PEpower,y,ex-post. |
| **Monitoring equipment** | Biogas Analyser [1][2] Calibration Control |

| Site ID | Farm Name | Biogas Analyser Serial Number | Calibration Certificate Number | Last Calibration Date [3] | Expiration Date |
|---|---|---|---|---|---|
| BCA-300MS1-16 | Fazenda Paraiso do alto | | | | |
| BCA-301MS1-16 | Fazenda São Sebastiao Gleba 6 | | | | |
| BCA-302MS1-16 | Granja Serra Dourada I | BM 11043 | BM11043_9/4550 | 28/12/2021 | 27/06/2022 |
| BCA-303MS1-16 | Lote 28 - PA - Assentamento | BM 11043 | RBC.0900.22.rev.00 | 25/06/2022 | 24/12/2022 |
| BCA-304MS1-16 | Assentamento Campanario - Lote 55 | BM 11043 | RBC.1343.22.rev.00 | 19/12/2022 | 18/06/2023 |
| BCA-305MS1-16 | Fazenda Nossa Senhora Aparecida II | BM 11043 | RBC.0235.23.rev.00 | 16/06/2023 | 15/12/2023 |
| BCA-306MS1-16 | Granja Grando | BM 11043 | RBC.0510.23.rev.00 | 13/12/2023 | 12/06/2024 |
| BCA-307MS1-16 | Assentamento Campanario | | | | |
| BCA-308MS1-16 | Fazenda Quinhao A | | | | |

| | |
|---|---|
| Monitoring equipment type: | Biogas Check Portable Digital Analyzer from Geotech/Landtech |
| Accuracy class: | • **CH4:** ± 0.5% from 0-5% CH4 content; ± 1.0% from 5-15% CH4 content; ± 3.0% from 15%-full scale CH4 content<br>• **Temperature:** ± 0.2°C (Biogas check analyzer accuracy) ± 0.5°C (temperature probe accuracy) |

| | | |
|---|---|---|
| | | • **Pressure**: ± 4mbar typically and ±15 mbar maximum |
| | Calibration frequency: | Every 6 months |
| **QA/QC procedures applied** | Check the registers in the generated documents and equipment for measurement calibration | |
| **Purpose of data** | Calculation of Baseline Emissions | |
| **Calculation method** | N/A | |
| **Comments** | Monitoring frequency to be determined to attend 90% confidence level and 10% precision. To assure that the monitoring frequency provides a 90% confidence level and 10% precision, the adequate frequency will be determined through a statistical analysis of the methane fraction variation, based on methane fraction data gathered on a group of farms per region during a certain period time. The results will be analyzed to guarantee that the required confidence/precision level has been met and the monitoring frequency will be, at least, monthly. For details, please see Section regarding the Sampling Plan.<br><br>The equipment used can directly measure methane content in the biogas. The methane content measurement will be carried out close to a location in the system where a biogas flow measurement takes place, and on the same basis (wet or dry) as required by the methodology.<br><br>Monitoring operational procedure POP-05 can be found at the Brascarbon Operational Procedure Manual | |

| | |
|---|---|
| Data / Parameter | GENETIC SOURCE |
| Data unit | N/A |
| Description | Genetic source from annex I party |
| Source of data | Brascarbon Monitoring Report System |
| Description of measurement methods and procedures applied | Data and records from the confined feed animal operation. According Operational Procedure POP-15 |
| Frequency of monitoring/recording | Annually |
| Value applied: | Western Europe |
| Monitoring equipment | N/A |
| QA/QC procedures applied | Check data and records from the farm operation |
| Purpose of data | Calculation of Baseline Emissions (to validate Bo and VS values used) |
| Calculation method | N/A |
| Comments | Monitoring operational procedure POP-15 can be found at the Brascarbon Operational Procedure Manual |

| | |
|---|---|
| Data / Parameter | $MS_{\%\ i,y}$ |
| Data unit | Fraction |
| Description | Fraction of manure handled in project emissions in system “i”, year “y”. |
| Source of data | Brascarbon Monitoring Report System |
| Description of measurement methods and procedures applied | During the site inspection, checking if changes in the adopted waste management system and surroundings of the digester was modified from the original proposal project activity. Use of the annex attached at the operational procedure POP-02 |
| Frequency of monitoring/recording | Annually, based on daily measurement and monthly aggregation |
| Value applied: | 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 |
| QA/QC procedures applied | A copy of the documents is submitted to the central office to the Quality Coordinator, who will verify the data, controlling it through an electronic system and ensuring its integrity. |
| Purpose of data | Calculation of Project Emissions |
| Calculation method | N/A |
| Comments | Monitoring operational procedure POP-02 can be found at the Brascarbon Operational Procedure Manual |

| | |
|---|---|
| Data / Parameter | $N_{da,y}$ |
| Data unit | Number |
| Description | Number of days animal is alive in the farm, in year “y” |
| Source of data | Brascarbon Monitoring Report System |
| Description of measurement methods and procedures applied | Checking of the documentation located at the confined animal production and use of the operational procedure POP-03 |
| Frequency of monitoring/recording | Annually, based on monthly records |
| Value applied: | Please see explanation in data/parameter NLT,y |
| Monitoring equipment | N/A |
| QA/QC procedures applied | Information is cross-checked with the documents available at the confined feed operation including, when available, animal purchase and sale records or information on food purchase records. |
| Purpose of data | Calculation of Baseline Emissions |
| Calculation method | N/A |
| Comments | Monitoring operational procedure POP-03 can be found at the Brascarbon Operational Procedure Manual |

| | |
|---|---|
| Data / Parameter | Np,y |
| Data unit | Number |
| Description | Number of animals produced annually of type “LT” in year “y” |
| Source of data | Brascarbon Monitoring Report System |
| Description of measurement methods and procedures applied | Checking of the documentation located at the confined animal production and use of the table annexed at the operational procedure POP-03 |
| Frequency of monitoring/recording | Annually, based on monthly records |
| Value applied: | Please see explanation in data/parameter NLT,y |
| Monitoring equipment | N/A |
| QA/QC procedures applied | Information is cross-checked with the documents available at the confined feed operation including, when available, animal purchase and sale records or information on food purchase records. |
| Purpose of data | Calculation of Baseline Emissions |
| Calculation method | N/A |
| Comments | Monitoring operational procedure POP-03 can be found at the Brascarbon Operational Procedure Manual |

| | |
|---|---|
| Data / Parameter | $nd_y$ |
| Data unit | Number |
| Description | Number of days in year "y" where the treatment plant was operational |
| Source of data | Brascarbon Monitoring Report System |
| Description of measurement methods and procedures applied | The number of days the animal manure management system is operational can be determined by the POP 24 – days of functioning, where it is monitored the number of days in a year "y" that the treatment plant has operated.<br>According to the operational procedure POP-24 |
| Frequency of monitoring/recording | Annually, based on daily records and monthly aggregation |
| Value applied: | The values of ndy can be found in the spreadsheet calculation file "CER Calculation MR02 - BCA-BRA-16_v2" in the folder BEy ex-post – PEy ex-post. |
| Monitoring equipment | N/A |
| QA/QC procedures applied | The documentation should be sent to the central office to the Quality Coordinator, who will verify the data, controlling and ensuring its integrity. |
| Purpose of data | Calculation of Baseline Emissions |
| Calculation method | N/A |
| Comments | Monitoring operational procedure POP-24 can be found at the Brascarbon Operational Procedure Manual |

| | |
|---|---|
| **Data / Parameter** | $VS_{LT,y}$ |
| **Data unit** | kg dry matter/animal/year |
| **Description** | Volatile solids for livestock *LT* entering the animal manure management system in year *y* |
| **Source of data** | Calculated. Data for calculation gathered according with Brascarbon Monitoring Report System |
| **Description of measurement methods and procedures applied** | N/A |
| **Frequency of monitoring/recording** | Annually |
| **Value applied:** | The values of ndy can be found in the spreadsheet calculation file "CER Calculation MR02 - BCA-BRA-16_v2" in the folder BEy ex-post – PEy ex-post. |
| **Monitoring equipment** | N/A |
| **QA/QC procedures applied** | Check the registers in the generated documents. Control and assure the correct calculation of the parameter. |
| **Purpose of data** | Calculation of Baseline Emissions |
| **Calculation method** | N/A |
| **Comments** | The four conditions to apply B0 value of developed countries are fully applicable to developed countries can be used provided the following four conditions are satisfied:<br><br>- *The genetic source of the livestock originates from an Annex I Party;* Genetics and nutrition adopted for these farms as so as in western Europe. More details or information of the genetics can be obtained at the producers or at the Associação Brasileira dos Criadores de Suinos (Brazilian Swine Association) – http://www.abcs.org.br/.<br><br>The genetic source of the livestock is therefore in compliance with this methodology requirement, which can be confirmed and verified by the genetic documents of the animals of each farm. These evidences were provided and assessed to assure their applicability to this requirement.<br><br>- *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;* |

The formulated feed rations are created according with the characteristics of the animals, their stage of growth, category, weight gain and genetics. Each farm possesses their FFR composition according with the type of animal(s) accommodated, which was confirmed and verified. These evidences were provided and assessed to assure their applicability this requirement.

- The use of FFR can be validated (through on-farm record keeping, feed supplier, etc.);

The formulated feed rations are part of the management system of the farms and therefore, each site possesses on-farm records which attest the FFR used. These evidences are also monitored on a monthly basis, according monitoring plan for the parameter FFR, as described in section 5.3, and the PP internal procedure POP 14.

- The project specific animal weights are more similar to developed country IPCC default values.

The Wsite value considered for each category of swine is the result of an average weight of the animals of all farms included in the project, and this value was applied in the baseline calculation.

Finishers is the animal category that represents the totality of all animals from the farms included in this PD. Finishers are considered to be “market swine” and presented an average weight of 90kg among all farms included in the PD by the time of the project’s registration (and this was the value adopted for the parameter Wsite). Taking into account the figures presented in Tables 10 A-7 and 10 A-8 from the 2019 Refinement of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, chapter 10, the weights that are more similar to the project situation are those from the Western Europe region (50 kg) – the values form Latin America (28 kg), where the project is located, is even lower than Western Europe’s.

This situation is also observed for the remaining four categories of swine (nursery and boars for market swine, guilts and sows for breeding swine): the values are more similar to those adopted in Western Europe than in Latin America, especially regarding the Breeding Swine (guilts and sows) and in the Market Swine (boars) which presented an average weight of 210kg and 230 kg respectively, among all farms included in the PD by the time of the project’s registration (and this was the value adopted for the parameter Wsite). Taking into account the figures presented in Tables 10 A-7 and 10 A-8 from the 2019 Refinement of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, chapter 10, the weights that are more similar to the project situation are those from the Western Europe region (198kg for Breeding Swine and 50 kg for Market Swine) – the values form Latin America (28kg for both classes of Breeding and Market Swine), where the project is located, is much lower than Western Europe’s. Only in the category nursery (also Market Swine), which roughly represents 30% of all animals from the farms included in this PD, have an average weight of 20 kg, closer to the Latin America values than the Western Europe values.

| | |
|---|---|
| Data / Parameter | $Q_{manure,LT,y}$ |
| Data unit | Tonnes DM/year |
| Description | Quantity of manure treated from livestock type *LT* at animal manure management system *j* |
| Source of data | Brascarbon Monitoring Report System |
| Description of measurement methods and procedures applied | Supervision in the field, performed during the regular site visit of the regional techicians as part of the operation assessment of the biodigestor, to each farm.<br>Use of the annex attached at the operational procedure POP-02 |
| Frequency of monitoring/recording | Annually, based on daily measurement and monthly aggregation |
| Value applied: | N/A |
| Monitoring equipment | N/A |
| QA/QC procedures applied | Check the registers in the generated documents. |
| Purpose of data | Calculation of Baseline Emissions |
| Calculation method | N/A |
| Comments | N/A |

| | |
|---|---|
| Data / Parameter | $SVS_{j,LT\ ,y}$ |
| Data unit | tonnes VS/tonnes DM |
| Description | Specific volatile solids content of animal manure from livestock type *LT* and animal manure management system *j* in year *y* |
| Source of data | Brascarbon Monitoring Report System |
| Description of measurement methods and procedures applied | This parameter and the parameter $VS_{LT,y}$ are the same. Please refer to the monitoring frequency from the parameter $VS_{LT,y}$ |
| Frequency of monitoring/recording | This parameter and the parameter $VS_{LT,y}$ are the same. Please refer to the QA/QC procedures from the parameter $VS_{LT,y}$ |
| Value applied: | This parameter and the parameter $VS_{LT,y}$ are the same. Please refer to the value applied from the parameter $VS_{LT,y}$ |
| Monitoring equipment | This parameter and the parameter $VS_{LT,y}$ are the same. Please refer to the monitoring equipment from the parameter $VS_{LT,y}$ |
| QA/QC procedures applied | This parameter and the parameter $VS_{LT,y}$ are the same. Please refer to the QA/QC procedures from the parameter $VS_{LT,y}$ |
| Purpose of data | Calculation of Project Emissions |
| Calculation method | This parameter and the parameter $VS_{LT,y}$ are the same. Please refer to the calculation method from the parameter $VS_{LT,y}$ |
| Comments | This parameter and the parameter $VS_{LT,y}$ are the same. Please refer to the comments from the parameter $VS_{LT,y}$ |

| | |
|---|---|
| Data / Parameter | $AI_l$ |
| Data unit | Days |
| Description | Annual average interval between manure collection and delivery for treatment at a given storage device l |
| Source of data | N/A |
| Description of measurement methods and procedures applied | Supervision in the field |
| Frequency of monitoring/recording | Annually, based on monthly records |
| Value applied: | N/A |
| Monitoring equipment | |
| QA/QC procedures applied | Check the registers in the generated documents. |
| Purpose of data | Calculation of Project Emissions |
| Calculation method | N/A |
| Comments | No comments |

| | |
|---|---|
| **Data / Parameter** | $Flame_m$ |
| **Data unit** | Flame on or Flame off |
| **Description** | Flame detection of flare in the minute m |
| **Source of data** | Brascarbon Monitoring Report System |
| **Description of measurement methods and procedures applied** | Measure will be made using a fixed installation optical flame detector |
| **Frequency of monitoring/recording** | Once per minute. |
| **Value applied:** | ON/OFF |
| **Monitoring equipment** | Ultraviolet flame sensor Model C7035 |
| **QA/QC procedures applied** | Check the registers in the generated documents.<br>The enclosed flare will regularly undergo a maintenance process subject to the appropriate industrial standards and/or manufacturer´s specifications in order to ensure measurement accuracy.<br>The Monitoring Operational Procedure POP-08 was developed to calculate the flame and it can be found at the Brascarbon Operational Procedure Manual. |
| **Purpose of data** | Calculation of Project Emissions |
| **Calculation method** | N/A |
| **Comments** | No comments. |

## 4.3 Monitoring Plan

The methodology applied to this project activity is AMS-III.D./version 21.0, Methane recovery in animal manure management systems. The simplified monitoring methodologies are applicable to this project activity because they provide a method to accurately measure and record the GHG emissions that will be captured and combusted by the project activity.

Each individual farm will be monitored independently according with the parameters described in the following section 5.3 and monitored according with the monitoring plan described in the section 5.4.

All data monitored and required for verification and issuance is kept for a minimum of two years after the end of the crediting period or the last issuance of CERs for this project activity, whichever occurs later. All parameters are deeply controlled by operational procedures developed by Brascarbon. A list and the procedures contained in the Brascarbon Operational Procedures Manual are mentioned in this section.

Brascarbon trained several regional technicians who will be responsible for the maintenance and the monitoring system based in ISO 9001 (Brascarbon Operational Procedure Manual).

a) Sampling design

According to methodology AMS-III.D version 21.0 requirements, the parameter methane content in biogas will be measured with periodical measurements to attend 90% confidence level and 10% precision level.

Since the biogas is flowing continuously, the study population can be thought of as all the possible methane content measurements in a certain period – so large as to be almost infinite. The sampling method to be applied will be systematic sampling with a random start date which is appropriate for this type of population.

The sample size/adequate frequency of measurements will be determined using data from ex-ante methane content measurements gathered on a group of farms located in the same region during a certain period time and will be done in accordance with the Guidelines for Sampling and Surveys for CDM Project Activities and Programme of Activities. The collected data will be analyzed in order to assess compliance with the 90/10 confidence/precision level.

The monitoring plan will concentrate on ensuring the emission reductions are accurately accounted within the project boundary. Brascarbon introduced operational procedures, from the Brascarbon Operational Procedures Manual, to facilitate the monitoring system of the parameters described in the the following table presents the monitoring plan followed by Brascarbon in order to achieve certified emissions reductions, after each validation and verification process.

Table 5 – Monitoring Plan

| ID | DATA | Data Type | Data Unit | Data Variable | Frequency | Measured(m) Calculated(c) Estimated(e) Documented(d) | Proportion of the data to be monitored | How will the data be archived? | For how long is archived data to be kept? | Comment |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | $T_f$ | Temp | °C | Flare Temperature | Every 1 minute | M | 100% | electronic | Until end of CP + 2 years | Use for flare efficiency |
| 2 | Site Inspection | Document | ---- | ---- | Annually | D | 100% | electronic | Until end of CP + 2 years | General Site Inspection |
| 3 | $N_{LT,y}$ | Number | - | Nr, Of heads | Monthly | C | 100% | electronic | Until end of CP + 2 years | Used to quantify the methane generation potential |
| 4 | $BG_{burnt,y}$ | Volume | $m^3$ | Biogas produced | Every 1 minute | M | 100% | electronic | Until end of CP + 2 years | Cumulative biogas production |
| 5 | $W_{CH4}$ | Fraction | % | Methane content | TBD(*) | M | 100% | electronic | Until end of CP + 2 years | Concentration in wet basis |
| 6 | $T_{biogas}$ | Temp | °C | Biogas Temperature | TBD(*) | M | 100% | electronic | Until end of CP + 2 years | Use to biogas density calculation |
| 7 | $D_{CH4}$ | Mass | $tonne/m^3$ | Density | Monthly | C | 100% | electronic | Until end of CP + 2 years | Density |
| 8 | FE | Efficiency | % | Temperature and flare operation parameters | every 1 minute data | C | 100% | electronic | Until end of CP + 2 years | Efficiency determined by the burning temp and flare operation parameters |
| 9 | QDM | Supervision | -- | --- | Every Batch Disposed | E | 100% | electronic | Until end of CP + 2 years | Sludge disposed outside project boundary |
| 10 | $W_{site}$ | Mass | kg | Average Animal weight | Quarterly | D | 100% | electronic | Until end of CP + 2 years | Average Animal weight |
| 11 | $ER_{y,ex\text{-}post}$ | Mass | tonne | $CO_2e$ | Annually | C | 100% | electronic | Until end of CP + 2 years | Yearly methane potential generation |
| 12 | FFR | ------ | --- | Feed Formulation | Monthly | D | 100% | electronic | Until end of CP + 2 years | Feed Formulation Rations |
| 13 | $P_{biogas}$ | Pressure | mbar | Biogas Pressure | TBD(*) | M | 100% | electronic | Until end of CP + 2 years | Biogas pressure |
| 14 | Genetic Source | Document | ------- | genetic | Annually | D | 100% | electronic | Until end of CP + 2 years | Genetic Source |
| 15 | $MS_{\%i,y}$ | fraction | % | Manure handled | Annually, based on daily measurement and monthly aggregation | E | 100% | electronic | Until end of CP + 2 years | General Site Inspection |
| 16 | $N_{da,y}$ | number | days | days | Annually, based on monthly records | M | 100% | electronic | Until end of CP + 2 years | Nr. Of days animal is alive |
| 17 | $N_{p,y}$ | number | heads | Nr of heads | Annually, based on Monthly records | M | 100% | electronic | Until end of CP + 2 years | Nr. Of heads per category annually |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 18 | ndy | number | Days | days | Annually, based on daily records and monthly aggregation | M | 100% | electronic | Until end of CP + 2 years | Number of days the treatment plant was operational |
| 19 | VSLT,y | Mass | kg | Volatile solids for livestock | Annually | C | 100% | electronic | Until end of CP + 2 years | Volatile solids for livestock LT entering the animal manure management system in year y |
| 20 | Qmanure LT,y | Mass | ton | Manure handled | Annually, based on daily measurement and monthly aggregation | E | 100% | electronic | Until end of CP + 2 years | Quantity of manure treated from livestock type LT at animal manure management system j |
| 21 | SVSjLT,y | Mass | ton | Specific volatile solids content of animal manure | Annually | C | 100% | electronic | Until end of CP + 2 years | Specific volatile solids content of animal manure from livestock type LT and animal manure management system j in year y |
| 22 | Flamem | On/Off | N/A | Flame detection of flare in the minute m | Every minute | M | 100% | electronic | Until end of CP + 2 years | Flamem is measured every minute and assesses if the flame is on or off. |

*(*)TBD: to be determined to attend 90% confidence level and 10% precision. The monitoring frequency will be, at least, monthly.*

The following table presents the explanation of the QA/QC procedures of the monitoring plan followed by BRASCARBON in order to achieve certified emission reductions, after each validation and verification process:

Table 6 – QA/QC procedures of the monitoring plan

| ID | DATA VARIABLE | UNCERTAINTY LEVEL | DATA UNIT | DATA ORIGIN |
|---|---|---|---|---|
| 1 | $T_f$ | Low | °C | Register from the measurement system, information managed by Brascarbon, |
| 2 | Site Inspection | Low | ----- | Register information managed by Brascarbon |
| 3 | $N_{LT,y}$ | Low | Nr, Of heads by category | Register from the measurement system, information managed by Brascarbon, |
| 4 | $BG_{burned,y}$ | Low | $m^3$ | Register from the measurement system, information managed by Brascarbon, |
| 5 | $W_{CH4}$ | Low | % | Register from the measurement system, information managed by Brascarbon, |
| 6 | $T_{biogas}$ | Low | °C | Register from the measurement system, information managed by Brascarbon, |
| 7 | $D_{CH4}$ | Low | $t/m^3$ | Register from the measurement system, information managed by Brascarbon, |
| 8 | FE | Low | % | Register information managed by Brascarbon, |
| 9 | QDM | Low | --- | Register from the measurement system, information managed by Brascarbon, |
| 10 | $W_{site}$ | Low | Kg | Register from the measurement system, information managed by Brascarbon, |
| 11 | $ER_{y,ex\text{-}post}$ | Low | t $CO_2e$ | Register from the measurement system, information managed by Brascarbon, |
| 12 | FFR | Low | ----- | Register from the measurement system, information managed by Brascarbon, |
| 13 | $P_{biogas}$ | Low | mbar | Register information managed by Brascarbon. |
| 14 | Genetic Source | Low | ----- | Register information managed by Brascarbon. |
| 15 | $MS_{\%i,y}$ | Low | % | Register information managed by Brascarbon. |
| 16 | $N_{da,y}$ | Low | days | Register information managed by Brascarbon. |
| 17 | $N_{p,y}$ | Low | Nr, Of heads by category | Register information managed by Brascarbon. |
| 18 | ndy | Low | days | Register information managed by Brascarbon. |
| 19 | $VS_{LT,y}$ | Low | kg | Register information managed by Brascarbon. |
| 20 | $Q_{manure\ LT,y}$ | Low | ton | Register information managed by Brascarbon. |
| 21 | $SVSj_{LT,y}$ | Low | ton | Register information managed by Brascarbon. |
| 22 | $Flame_m$ | Low | ON/OFF | Register information managed by Brascarbon. |

BRASCARBON has implemented the Operation Procedures Manual and forms to capture and report monitored data and maintenance activities throughout the project lifecycle. On-site assessment, supplier production data, task tracking, and post-implementation auditing tools have been developed to ensure accurate, consistent, and complete data gathering and project implementation.

By coupling these capabilities with an ISO-based quality and environmental management system, BRASCARBON enables transparent data collection and verification.

Procedures from Brascarbon Operation Procedures Manual to ensure accurate and consistent data for monitoring system have been developed as indicated in the following table:

Table 7 – Procedures from Brascarbon Operation Procedures Manual

| ID | DATA /PARAMETERS/TITLE | RESPONSIBLE | PROCEDURE | COMENTS |
|---|---|---|---|---|
| 1 | $T_f$ | TR | POP 1 | Flare Temperature |
| 2 | SITE INSPECTION<br>MS% i,y<br>$VS_{LT,y}$ $SVS_{jLT,y}$ | TR | POP 2 | General site Inspection |
| 3 | $N_{LT,y}$<br>$N_{aa,y}$ $N_{p,y}$ | TR | POP 3 | Number of heads |
| 4 | $BG_{burnt,y}$ | TR | POP 4 | Biogas produced and burnt |
| 5 | $W_{CH4}$ | TR | POP 5 | Methane content |
| 6 | $T_{biogas}$ | TR | POP 6 | Biogas Temperature |
| 7 | $D_{CH4}$ | QC | POP 7 | Methane Density |
| 8 | FE<br>$Flame_m$ | TR | POP 8 | Flare Efficiency Flame on or Flame off |
| 9 | QDM<br>$Q_{manure}$ | TR | POP 9 | Sludge Mass |
| 10 | TRAINING | QC | POP 11 | General training of procedures and safety issues |
| 11 | MAINTENANCE | OM | POP 12 | Up-date of the maintenance activities |
| 12 | $P_{biogas}$ | TR | POP 13 | Biogas pressure |
| 13 | FFR | TR | POP 14 | Formulated Feed Rations |
| 14 | GENETIC SOURCE | TR | POP 15 | Genetic source |
| 15 | $W_{site}$ | TR | POP 16 | Average animal weight |
| 16 | $ER_{ex-post}$ | QC | POP 17 | Yearly emissions reductions ex-post |
| 17 | Ndy | QC | POP 24 | Number of days the treatment plant was operational |

**Legend:**

| | |
|---|---|
| A: Annually | TR: Regional Technician |
| Q: Quarterly | QC: Quality Control |
| M: Monthly | TBD: to be determined to attend 90% confidence level and 10% precision. The monitoring frequency will be, at least, monthly. |
| S: Semesterly | OM: Operation Manager |

**Monitoring of the Flare Temperature**

The temperature of the flare will be controlled by a logic system, able to store the flare temperature continuously. The sensor - thermo coupling - is installed in the flare body.

The signal from the thermocouple is sent to the PLC where the information of the temperature is recorded every each minute.

The file information from the logic system will be recovered monthly, by using a pen drive and the file will be sent to the QA/QC officer to manage the information for further verification. Then, a spreadsheet in excel will be available from the system to show the temperature per minute per day. The system PLC and the thermocouple will be powered by solar cell – no use of energy from the grid. A 12 volts battery is also included in the system to save energy to be used during the night or days lack of sun. The battery capacity is for 240 hours.

In the operational procedure POP 1 is the form 01.001 where the temperature information is managed according to the specification mentioned above. All QA/QC procedures are described in the operational procedure related to the maintenance and/or calibration of the equipment.

PEN DRIVE PLC

**Site Inspection.**

A check list included in the procedure POP 2 – Site Inspection - number 02.001 is the basic orientation to guide the technicians during inspection in the field to follow all items related to the project activity installation.

Attached on it, the MS% i,y - Fraction of manure handled in the system during the year, is included to be inspected during the each farm visit.

No changes in the manure managing system will be permitted during the project activity. Variables to be monitored: SITE INSPECTION and MS%i,y.

**Average number of animals.**

To calculate the average number of animals per category LT in the year y (NLT,y) the operational procedure has the forms 03.003 and 03.001 in the operational procedure POP 3 (average number of animals) where it takes into account of the number of days the animal is alive in the year y (Nda,y) and the number of animals produced per category LT in the year y (Np,y).

The days of animals alive and the total animal produced is also monitored with the same procedure and the formulary 03.003.

The formula used to the calculation is indicated in the PD section B.4, step 2, equation 4. Variables to be monitored: N LT,y, N day,y and N p,y.

**Measurement of the volumetric flow rate of the biogas and residual gas.**

The operational procedure POP 4- Measurement of the biogas flow rate, is a guide that explains to the technicians how to obtain the biogas flow rate.

The control of the flow rate is by a PLC (see picture in the POP 1 description above) installed in the control panel in the project activity site.

The panel is equipped with solar cells that supply energy to the system. A battery (capacity for 10 days lack of sun) and the flow rate transmitter device to receive information from the thermal mass meter. The flow meter used in the project activity is a thermal mass flow meter.

The system is very reliable and supplied by Endress+hauser, leader of measurement system of liquids and gases. Example of the meter used in the project activity:

The information recorded in the PLC is recovered by the use of a pen drive and the file containing the information will be send to the QA/QC officer to manage information for further verification. A spreadsheet in excel is available from the system to show the flow rate per minute per day.

The variables measured with this procedure are: BG burnt,y and FV RG,h..

The data monitored is controlled in the form 04.001 attached in the operational procedure POP 04.

**Methane content determination.**

The POP 5- Methane content was prepared to guide the technicians how to obtain the methane content using electronic equipment.

The methane content is obtained by BIOGAS or TESTO electronic equipment.

The concentration of methane is measured in few seconds before starting the measurement button.

The equipment operation and the devices to be used are described in the operational procedure, as well as in the equipment manual.

Both equipment are able to measure the methane concentration in the biogas or in the flare residual gas.

The variables measured with this equipment are: WCH4 and fvCH4,RG,y.

All QA/QC procedures are described in the operational procedure related to the maintenance and/or calibration of the equipment.

The data monitored is controlled in the form 04.001.

**Biogas temperature measurement.**

The biogas temperature is obtained by an electronic equipment BIOGAS.

The methane temperature is measured in few seconds after inserting the thermocouple in the biogas line device.

The equipment operation and the devices to be used are described in the operational procedure, as well as in the equipment manual.

All QA/QC procedures are described in the operational procedure related to the maintenance and/or calibration of the equipment.

The variable measured with this equipment is: T biogas.

The data monitored is controlled in the form 04.001 described in the operational procedure POP 6 – Biogas temperature measurement.

**Density of the methane determination.**

The POP 7- Density of the Methane - is a guide to calculate the methane density. The form 07.001 attached in the operational procedure shows the data to be filled to make the calculation. The methane density calculation is in accordance with the Tool to determine the mass flow of a greenhouse gas in a gaseous stream version 3.0

The variable monitored with this procedure: DCH4.

**Flare efficiency.**

According with the of version 04 of the tool Project emissions from flaring, in its step 2 – Determination of flare efficiency, for determining the efficiency of combustion of enclosed flares there is the option to apply a default value or determine the efficiency based on monitored data. The operational procedure POP 8 – Flare efficiency was developed to monitor and calculate the flare efficiency.

In the case of enclosed flares, project participants may choose between two options to determine the flare efficiency for minute m (ηflare,m). The PP has chosen Option A – Apply a default value for flare efficiency.

The flare efficiency for the minute m (ηflare,m) is 90% when the following two conditions are met to demonstrate that the flare is operating:

The temperature of the flare (TEG.m) and the flow rate of the residual gas to the flare (FRG,m) is within the manufacturer's specification for the flare (SPECflare) in minute m; and

The flame is detected in minute m (Flamem).

Otherwise ηflare,m is 0%.

All the flares in the project are considered, as per definition of the tool as low height, hence a default value of 80% flare efficiency is applied to the entire project. All data and parameters that are required to monitor whether the flare operates within the range of operating conditions according to manufacturer´s specifications will be continuously monitored. The temperature and biogas flow rate will be monitored minute by minute by a sensor installed in the enclosed flare and are registered by a CLP. The data stored in the CLP is recovered monthly by the use of a pen drive and the file containing the information will be sent to the QA/QC officer to manage the information. Brascarbon developed the formulary 08.001 in the operational procedure to monitor the hourly flare efficiency according to the criteria above mentioned.

The variable monitored with this procedure: FE.

**Biogas pressure.**

The biogas pressure is obtained by an electronic equipment BIOGAS and procedures described in the operational procedure POP 13- Biogas pressure.

The operating pressure of the biodigestor is atmospherically.

The equipment operation and the devices to be used are described in the operational procedure, as well as in the equipment manual.

All QA/QC procedures are described in the operational procedure related to the maintenance and/or calibration of the equipment.

The variable measured with this equipment is: P biogas. The data monitored is controlled in the form 04.001.

**Formulated feed rations.**

Monitoring and controlling of the formulated feed rations used per animal category per confined feed animal operation.

The variable monitored: FFR.

Reference of the operational procedure: POP 14 – formulated feed rations monitoring.

**Genetic Source.**

Monitoring and controlling of the genetic source in the project activity per farm. The variable monitored: GENETIC SOURCE.

Reference of the operational procedure: POP 15 – Genetic Source Monitoring.

**Animal weight.**

The data collection is realized quarterly by each farm owner, together with COOASGO (Associação de Suinocultores de São Gabriel do Oeste) and provided to the PP. COOASGO is the Pig Producers Association to whom the farms contained in the PD are associated; its main role is to act as a third party responsible for the assurance of all the logistics associated with the swine producers, providing the animal nutrition, genetics and all the overall animal weight.

The quarterly weight of the animals for each producer of the PD is made following COOASGO's internal procedure, that is not under the PP's control – the association selects the animals based on a random sampling approach applied in each category, since it is infeasible to weight each animal individually in the farms belonging to the project (these farms can more than 5,000 animals each). In addition, each project site presents the actual animal weight by using Brascarbon form 16.001 after a cross-check by the PP, using the real information after each batch of animals exits each farm; the template was designed to quarterly report animal weight per category.

The values of the quarterly weights presented by COOASGO (following the association's internal procedures) to the PP are cross-checked against two different credible sources:

Reference figures from EMBRAPA (an undisputed Brazilian Agricultural Research Corporation nationally recognized for these scope) for each category; and

Figures provided by COOASGO when each of the swine batches exits each farm (each batch stays around 5 to 6 months per farm), as explained below. Here COOASGO provides invoices with 100% of the animals weight (and number), allowing a full cross- check with the weight values provided and assuring that all the information is accurate.

If the PP verifies during the cross-check any discrepancy between the values provided quarterly and the full weighting and counting of the animals in the invoices provided by COOASGO each time any batch exits a giving farm, those values will be updated accordingly with these real figures.

The current practice of swine farms in Brazil is that each farm receives new batches of animals every 5 to 6 months (which is also the average time that a batch stays in a farm) and the producer, together with COOASGO, performs regular and periodical visits to each farm in order to assess and evaluate the correct development of each batch in terms of growing/weighting of the animals (according with what is expected at each growing stage of a given batch). It is important to highlight that both the farm owners COOASGO rely on the quality of the values measured since their sole professional occupation is the pig production and, therefore, it is within their best interests to have a correct and reliable way to assess the weighting of the animals (which is their business) based on their experience and internal procedures.

Every 5 to 6 months (depending on each batch and farm), the animal batches leave the farms and they are, in this specific situation, 100% weighted by the producers, together with COOASGO – this weighting is undertaken to the totality of animal presented in the batch since the profits associated with the animal production are weight based. The results are cross-checked against reference figures from EMBRAPA (the Brazilian Agricultural and Livestock Research Corporation, a recognized federal institution responsible for studies and research in these scopes). According with COOASGO a possible range of +/- 5kg within the animal growing, related to the figures from EMBRAPA, is considered a normal fluctuation and therefore admissible.

Each time a batch exits a farm, COOASGO provides the invoices to attest the feasibility of the figures adopted, allowing a complete and thorough cross-check by PP of all the data used for this parameter.

Quarterly the data from the feed operations are checked and transferred to the form.

Records available in the feed operations will be copied and filed at Brascarbon office and attached with the form 16.001.

The variable monitored: W site.

**Methane mass flow rate in the residual gas.**

The residual mass flow rate can be determinate by the POP 17 – Emissions reductions ex-post, where it calculates all parameters to determine the emissions reductions ex-post.

To be calculated according to the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream version 3.0". An operational procedure POP 17 includes the instruction to the calculation.

According with the step 1 – Determination of the methane mass flow in the residual gas of this tool, this parameter should be determined using another tool, namely Tool to determine the mass flow of a greenhouse gas in a gaseous stream. In second tool, there are several options to determine the Mass flow rate of methane in the residual gaseous stream. Option 2 - Simplified calculation without measurement of the moisture content was chosen by the PP.

Within this option, option A will be applicable by the demonstration that the gaseous stream is dry. The PP will demonstrate that the temperature of the gaseous stream (Tt) is less than 60ºC (333.15 K) at the flow measurement point.

Hence this parameter will be calculated according with Equations 5 and 6 of the tool. This means:

$$F_{i,t} = V_{t,db} \times v_{i,t,db} \times \rho_{i,t}$$ Equation (5)

With:

$$\rho_{i,t} = \frac{P_t \times MM_i}{R_u \times T_t}$$ Equation (6)

Where:

| | | |
|---|---|---|
| $F_{i,t}$ | = | Mass flow of greenhouse gas *i* in the gaseous stream in time interval *t* (kg gas/h) |
| $V_{t,db}$ | = | Volumetric flow of the gaseous stream in time interval *t* on a dry basis ($m^3$ dry gas/h) |
| $v_{i,t,db}$ | = | Volumetric fraction of greenhouse gas *i* in the gaseous stream in a time interval *t* on a dry basis ($m^3$ gas *i*/$m^3$ dry gas) |
| $\rho_{i,t}$ | = | Density of greenhouse gas *i* in the gaseous stream in time interval *t* (kg gas *i*/$m^3$ gas *i*) |
| $P_t$ | = | Absolute pressure of the gaseous stream in time interval *t* (Pa) |
| $MM_i$ | = | Molecular mass of greenhouse gas *i* (kg/kmol) |
| $R_u$ | = | Universal ideal gases constant (Pa.$m^3$/kmol.K) |
| $T_t$ | = | Temperature of the gaseous stream in time interval *t* (K) |

The formulary 17.001 (CER spreadsheet) is used to determine the variables above mentioned.

Number of days the treatment plant was operational.

The number of days the treatment plant was operational can be determinate by the POP 24 – days of functioning, where it is monitored the number of days in a year "y" that the treatment plant has operated.

The variables monitored with this procedure: ndy

Volatile solids.

The four conditions to apply B0 value of developed countries are fully applicable to developed countries can be used provided the following four conditions are satisfied:

The genetic source of the livestock originates from an Annex I Party;

Genetics and nutrition adopted for these farms as so as in western Europe. More details or information of the genetics can be obtained at the producers or at the Associação Brasileira dos Criadores de Suinos (Brazilian Swine Association) – http://www.abcs.org.br/.

The genetic source of the livestock is therefore in compliance with this methodology requirement, which can be confirmed and verified by the genetic documents of the animals of each farm. These evidences were provided and assessed to assure their applicability to this requirement.

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;

The formulated feed rations are created according with the characteristics of the animals, their stage of growth, category, weight gain and genetics. Each farm possesses their FFR composition according with the type of animal(s) accommodated, which was confirmed and verified. These evidences were provided and assessed to assure their applicability this requirement.

The use of FFR can be validated (through on-farm record keeping, feed supplier, etc.);

The formulated feed rations are part of the management system of the farms and therefore, each site possesses on-farm records which attest the FFR used. These evidences are also monitored on a monthly basis, according monitoring plan for the parameter FFR, as described in section B.7.1, and the PP internal procedure POP 14.

The project specific animal weights are more similar to developed country IPCC default values.

The Wsite value considered for each category of swine is the result of an average weight of the animals of all farms included in the project, and this value was applied in the baseline calculation.

Finishers is the animal category that represents majority of all animals from the farms included in this PD, around 60% of the total number of animals (only three farms have other types of animals but not as significant as finishers). Finishers are considered to be "market swine" and presented an average weight of 90kg among all farms included in the PD by the time of the

project's registration (and this was the value adopted for the parameter Wsite). Taking into account the figures presented in Tables 10 A-7 and 10 A-8 from the 2019 Refinement of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, chapter 10, the weights that are more similar to the project situation are those from the Western Europe region (50 kg) – the values form Latin America (28 kg), where the project is located, is even lower than Western Europe's.

This situation is also observed for the remaining four categories of swine (nursery and boars for market swine, guilts and sows for breeding swine): the values are more similar to those adopted in Western Europe than in Latin America, especially regarding the Breeding Swine (guilts and sows) and in the Market Swine (boars) which presented an average weight of 210kg and 230 kg respectively, among all farms included in the PD by the time of the project's registration (and this was the value adopted for the parameter Wsite). Taking into account the figures presented in Tables 10 A-7 and 10 A-8 from the 2019 Refinement of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, the weights that are more similar to the project situation are those from the Western Europe region (198kg for Breeding Swine and 50 kg for Market Swine) – the values form Latin America (28kg for both classes of Breeding and Market Swine), where the project is located, is much lower than Western Europe's. Only in the category nursery (also Market Swine), which roughly represents 30% of all animals from the farms included in this PD, have an average weight of 20 kg, closer to the Latin America values than the Western Europe values.

Therefore, is fair to consider that "the project specific animal weights are more similar to developed country IPCC default values" condition is fulfilled and that the VS adopted values for developed counties is in full compliance with the methodology requirements.

Monitoring System.

The monitoring system will be followed according to the Brascarbon Operations Procedures Manual, detailed to attend all necessary controls in the site.

Operational / Monitoring Procedures

Operational / Monitoring procedures listed above.

Quality Assurance/Control: QA/QC.

The measuring instruments will be calibrated by the manufacturers' representatives on a manufacturer recommendation basis. The certification of calibration will be controlled by QA/QC officer. Also, the QA/QC officer will be responsible to assure that all Brascarbon Operations Procedures will be executed based in the ISO 9001.

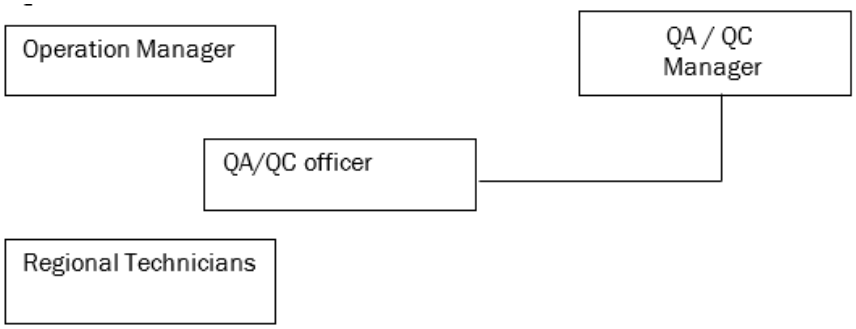
**Training.**

The training of the technicians and all employees is provided by the Operations Manager. The topics of the training are as below:

1. General explanation of the project.
2. Explanation of the procedures of the Operations Procedure Manual.
3. Procedures and preparations for the star-up.
4. Maintenance procedures.
5. Biogas safety instructions.
6. Biogas measurement.
7. Safety Issues.

The training document and the equipment manuals are stored for easy reference in the Brascarbon office.

**Organization.**




Operation Manager

Engineer, responsible for the project maintenance and monitoring data collection.

QA/QC Manager

Engineer, responsible for the monitoring operation and emissions for the project activity.

Regional Technicians

Technician, responsible for the monitoring and maintenance of the site projects according to the procedures in the Operations Procedure Manual.

**Maintenance.**

For maintenance of the equipment and to attend the monitoring system, BRASCARBON will use the practices recommended by the equipment supplier for repairs, calibration, etc. The regular maintenance in the site project boundary will be according to the Brascarbon Operation Procedures Manual for all items considered in the project such as the digester, flare, measuring systems, piping, electrical parts and others.

# 5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

## 5.1 Baseline Emissions

Equation 1

$$BE_y = GWP_{CH4} \times D_{CH4} \times UF_b \times \sum_{j,LT} MCF_j \times B_{0,LT} \times N_{LT,y} \times VS_{LT,y} \times MS\%_{BL,j}$$

Where:

BEy – Baseline emissions in year "y" (tCO2e)

GWPCH4 – Global Warming Potential (GWP) of CH4 (28)

DCH4– CH4 density (0.00067 t/m3 at room temperature (20 °C) and 1 atm pressure).

LT– Index for all types of livestock

J – Index for animal waste management system

MCFj – Annual methane conversion factor (MCF) for the baseline animal waste management system "j"

B0,LT – Maximum methane producing potential of the volatile solid generated for animal type "LT" (m3 CH4/kg dm)

NLT,y – Annual average number of animals of type "LT" in year "y" (numbers)

VSLT,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"

UFb – Model correction factor to account for model uncertainties (0.94)

Where VSLT,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:

Wsite – Average animal weight of a defined livestock population at the project site (kg)

Wdefault – Default average animal weight of a defined population, this data is sourced from 2019 Refinement of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (kg)

VSdefault – Default value for the volatile solid excretion rate per day on a dry-matter basis for a defined livestock population (kg dm/animal/day)

Ndy – Number of days in year "y" where the treatment plant was operational.

As explained in the previous section, the values used for the parameters B0 and VS are those applied for Western Europe.

Table 8. summarizes the BEy,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 8. – Baseline Emissions (BEy,ex post) in the current monitoring period

| ID | Site ID | Farm/Site | $BE_{y,ex\text{-}post}$ (t $CO_2e$) |
|---|---|---|---|
| 1 | BCA-300MS1-16 | Fazenda Paraíso do Alto | 15,302 |
| 2 | BCA-301MS1-16 | Fazenda São Sebastiao Gleba 6 | 16,468 |
| 3 | BCA-302MS1-16 | Granja Serra Dourada I | 14,397 |
| 4 | BCA-303MS1-16 | Lote 28 - PA - Assentamento Campanario | 12,431 |
| 5 | BCA-304MS1-16 | Lote 55 - Assentamento Campanario | 11,038 |
| 6 | BCA-305MS1-16 | Fazenda Nossa Senhora Aparecida II | 32,787 |
| 7 | BCA-306MS1-16 | Granja Grando | 10,164 |
| 8 | BCA-307MS1-16 | Assentamento Campanario | 15,519 |
| 9 | BCA-308MS1-16 | Fazenda Quinhão A | 15,782 |
| TOTAL | | | 143,888 |

## 5.2 Project Emissions

According to the simplified baseline and monitoring methodology for a small-scale CDM project Type-III (AMS.III.D – version 21.0), project emissions consist of:

(a) 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 ( PEPL,y);

(b) Emissions from flaring or combustion of the gas stream (PEflare,y);

(c) CO2emissions from use of fossil fuels or electricity for the operation of all the installed facilities (PEpower,y).

(d) CO2 emissions from incremental transportation distances (PEtransp,y)

(e) Emissions from the storage of manure before being fed into the anaerobic digester (PEstorage,y)

Equation 3 (equation 6 of the meth)

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

Where:

PEy – Project emissions in year "y" (tCO2e)

PEPL,y – Emissions due to physical leakage of biogas in year "y" (tCO2e)

PEflare,y – Emissions from flaring or combustion of the biogas stream in the year "y" (tCO2e)

PEpower,y – Emissions from the use of fossil fuel or electricity for the operation of the installed facilities in the year "y" (tCO2e)

PEtransp,y – Emissions from incremental transportation in the year "y" (tCO2e), as per relevant paragraph in AMS-III.AO

PEstorage,y – Emissions from the storage of the manure in the year "y" (tCO2e)

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

Equation 4 (equation 7 of the meth)

$$PE_{PL,y} = 0.10 \times GWP_{CH4} \times D_{CH4} \times \sum_{i,LT} B_{0,LT} \times N_{LT,y} \times VS_{LT,y} \times MS\%_{i,y}$$

Where:

PEPL,y – Emissions due to physical leakage of biogas in year "y" (t CO2e)

GWPCH4 – Global Warming Potential (GWP) of CH4 (28)

DCH4 – CH4 density (0.00067 t/m3 at room temperature (20 ºC) and 1 atm pressure).

LT – Index for all types of livestock

I – Index for animal waste management system

B0,LT – Maximum methane producing potential of the volatile solid generated for animal type "LT" (m3 dm)

NLT,y – Annual average number of animals of type "LT" in year "y" (numbers)

VSLT,y – Volatile solids for livestock "LT" entering the animal manure management system in year "y" (o matter weight basis, kg dm/animal/year)

MS%i,y – Fraction of manure handled in system "i" in year "y"

**(D) Emissions from flaring determinate as follows:**

According with the tool Project emissions from flaring version 4, the calculation procedure in this tool determines the project emissions from flaring the residual gas (PEflare,y) based on the flare efficiency (ηflare,m) and the mass flow of methane to the flare (FCH4,RG,m). The flare efficiency is determined for each minute m of year y based either on monitored data or default values.

The project emissions calculation procedure is given in the following steps:

(a) STEP 1: Determination of the methane mass flow of the residual gas;

(b) STEP 2: Determination of the flare efficiency;

(c) STEP 3: Calculation of project emissions from flaring.

Step 1: Determination of the methane mass flow in the residual gas

The “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” shall be used to determine the following parameter:

The following requirements apply:

(a) The gaseous stream tool will be applied to the residual gas;

(b) The flow of the gaseous stream will be measured continuously;

(c) CH4 is the greenhouse gas i for which the mass flow will be determined;

(d) The simplification offered for calculating the molecular mass of the gaseous stream is valid (equations 3 and 17 in the tool); and

(e) The time interval t for which mass flow should be averaged is every minute m.

According with the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” version 03, The mass flow of a greenhouse gas i in a gaseous stream (Fi,t) is determined through measurement of the flow and volumetric fraction of the gaseous stream.

Option A was chosen

The flow measurement on a dry basis is not doable for a wet gaseous stream. Therefore, it is necessary to demonstrate that the gaseous stream is dry to use this option. According with the tool, there are two ways to do this:

(a) Measure the moisture content of the gaseous stream (CH2O,t,db,n) and demonstrate that this is less or equal to 0.05 kg H2O/m3 dry gas; or

(b) Demonstrate that the temperature of the gaseous stream (Tt) is less than 60ºC (333.15 K) at the flow measurement point.

The temperature of the biogas is less than 60ºC, and that will be demonstrated during the monitoring of the parameter, according with the MP.

Step 2: Determination of flare efficiency

The flare efficiency depends on the combustion efficiency of in the flare and the time that the flare is operating. For determining the efficiency of enclosed flares project participants shall choose to determine the efficiency based on monitored data or the option to apply a default value. For open flares a default value must be applied. The time the flare is operating is determined by using a flame detector and, for the case of enclosed flares, in addition the monitoring requirements provided by the manufacturer’s specifications for operating conditions shall be met.

In the case of enclosed flares, project participants may choose between the following two options to determine the flare efficiency for minute m (ηflare,m) and shall document in the PD which option is selected:

(a) Option A: Apply a default value for flare efficiency;

(b) Option B: Measure the flare efficiency.

Option A was chosen

**Option A: Default value**

The flare efficiency for the minute m (ηflare,m) is 90% when the following two conditions are met to demonstrate that the flare is operating:

(a) The temperature of the flare (TEG.m) and the flow rate of the residual gas to the flare (FRG,m) is within the manufacturer's specification for the flare (SPECflare) in minute m; and

(b) The flame is detected in minute m (Flamem).

Otherwise ηflare,m is 0%.

It is important to highlight that the flares are considered a low height so, in line with the tool, a conservative approach should be applied, and 10 percentile points should be subtracted to the flare efficiency. Hence the flare efficiency adopted in the current PD will be the default value of 80%.

In line with the monitoring plan, if any minute of any hour presents a temperature value below 500ºC the entire hour will be discount form the CER calculation. This discount will be applied to the volume of that specific hour since it is a more conservative approach than to discount in the average of the fla re efficiency percentage.

Step 3: Calculation of project emissions from flaring

Project emissions from flaring are calculated as the sum of emissions for each minute m in year y, based on the methane mass flow in the residual gas (FCH4,RG,m) and the flare efficiency (ηflare,m), as follows:

Equation 5 (equation 15 of the Tool 6)

$$PE_{flare,y} = GWP_{CH4} \times \sum_{m=1}^{525600} F_{CH4,RG,m} \times (1 - \eta_{flare,m}) \times 10^{-3}$$

Where:

PEflare,y – Project emissions from flaring of the residual gas stream in year y, tCO 2e

GWPCH4 – Global Warming Potential of methane valid for the commitment period, tCO2e/tCH4

FCH4,RG,m – Mass flow rate of methane in the residual gas in the minute m, kg/h

ηflare, m – Flare efficiency in the minute m

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

No fossil fuel or electricity will be used in the project, therefore, PEpower,y = zero.

**(D) Emissions from incremental transportation:**

No incremental transportation will occur in the project activity, and therefore, PEtransp,y = 0

**(E) Emissions from storage of the manure:**

The manure will not be stored in the entire project. Each day all the manure is washed and sent to the digester, therefore, PEstorage,y = 0.

Table 9 summarizes the project emissions for the current monitoring period (PEy,ex-post)and more detailed information can be obtained in the CER calculation spreadsheet (folder BEy ex-post – PEy ex- post).

Table 9 – Project Emissions (PEy,ex-post) in the current monitoring period

| ID | Site ID | Farm/Site | $PE_{y,ex\text{-}post}$ (t $CO_2e$) |
|---|---|---|---|
| 1 | BCA-300MS1-16 | Fazenda Paraíso do Alto | 4,520 |
| 2 | BCA-301MS1-16 | Fazenda São Sebastiao Gleba 6 | 4,875 |
| 3 | BCA-302MS1-16 | Granja Serra Dourada I | 4,352 |
| 4 | BCA-303MS1-16 | Lote 28 - PA - Assentamento Campanario | 3,893 |
| 5 | BCA-304MS1-16 | Lote 55 - Assentamento Campanario | 3,302 |
| 6 | BCA-305MS1-16 | Fazenda Nossa Senhora Aparecida II | 11,205 |
| 7 | BCA-306MS1-16 | Granja Grando | 3,040 |
| 8 | BCA-307MS1-16 | Assentamento Campanario | 4,603 |
| 9 | BCA-308MS1-16 | Fazenda Quinhão A | 4,631 |
| TOTAL | | | 44,421 |

## 5.3 Leakage Emissions

According to the simplified baseline and monitoring methodology AMS-III.D - version 21 and the tool "Project and leakage emissions from anaerobic digesters" (version 02), no leakage calculation is required if the storage of digestate or the composting of digestate is occurring within the project boundary, these emissions will be considered as project emissions, (in line with paragraph 25 of the tool).

## 5.4 GHG Emission Reductions and Carbon Dioxide Removals

The calculation of the emission reductions is based on the equations used on the approved methodology AMS.III.D – Version 21 – "Methane recovery in animal manure management systems" and data from 2019 Refinement of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, volume 4, chapter 10.

For baseline emissions calculation see Table 4 and Table 5.

The project emissions for this project activity are defined as the amount of methane that would be emitted to the atmosphere during the crediting period due to the project activity. In this case an anaerobic digester is considered the project activity and estimated emissions are determined as follows:

Step 1: Emission Reductions

Equation 6 (equation 1 of the meth)

$$ER_{y,estimated} = BE_y - PE_y$$

Where:

- ERy – Emission reductions in t CO2e/year
- BEY – The annual baseline methane emissions in t CO2e/year PE Y = project emissions in t CO2e/year

The emission reductions which will be achieved by the project activity ex post will be determined through direct measurement of the amount of methane flared. The emission reductions achieved in any year will be the lowest value of the following:

Equation 6.1 (equation 1.1 of the meth)

$$ER_{y,estimated} = BE_y - PE_y$$

Where:

ERy,ex-post – Emission reductions achieved by the project activity based on monitored values for year y (tCO2e)

BEy ex post – Baseline emissions calculated using equation 2 and using ex post monitored values of NLT,y and if applicable VSLT,y for year y (tCO2e)

PEy,ex post – Project emissions calculated using Equation 5 (equation 6 of the meth) using ex post monitored values of NLT,y ,MS%i,y and if applicable VSLT,y for year y (tCO2e)

MDy – Methane captured and destroyed or used gainfully by the project activity in year y (tCO2e)

PEpower,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)

Table 10 – Methane captured and destroyed ($MD_y$) in the current monitoring period

| ID | Site ID | Farm/Site | $MD_y$ (t $CO_2e$) |
|---|---|---|---|
| 1 | BCA-300MS1-16 | Fazenda Paraíso do Alto | 11,014 |
| 2 | BCA-301MS1-16 | Fazenda São Sebastiao Gleba 6 | 11,901 |
| 3 | BCA-302MS1-16 | Granja Serra Dourada I | 10,808 |
| 4 | BCA-303MS1-16 | Lote 28 - PA - Assentamento Campanario | 9,936 |
| 5 | BCA-304MS1-16 | Lote 55 - Assentamento Campanario | 8,130 |
| 6 | BCA-305MS1-16 | Fazenda Nossa Senhora Aparecida II | 30,403 |
| | BCA-306MS1-16 | Granja Grando | 7,484 |
| | BCA-307MS1-16 | Assentamento Campanario | 11,257 |
| 7 | BCA-308MS1-16 | Fazenda Quinhão A | 11,223 |
| TOTAL | | | 112,156 |

Table 11 – ERy, ex-post in the current monitoring period

| SITE ID: | SITE NAME | $MD_y$ (t $CO_2e$) | $PE_{power,y,ex-post}$ (t $CO_2e$) | $MDy - PE_{power,y,ex-post}$ (t $CO_2e$) | $BE_{y,ex-post}$ (t $CO_2e$) | $PE_{y,ex-post}$ (t $CO_2e$) | $BE_{y,ex-post} - PE_{y,ex-post}$ (t $CO_2e$) | $ER_{y,ex-post}$ = min [($BE_{y,ex-post} - PE_{y,ex-post}$), ($MD_y - PE_{power,y,ex-post}$)] (t $CO_2e$) |
|---|---|---|---|---|---|---|---|---|
| BCA-300MS1-16 | Fazenda Paraíso do Alto | 11 014 | 0 | 11 014 | 15 302 | 4 520 | 10 782 | 10 782 |
| BCA-301MS1-16 | Fazenda São Sebastiao Gleba 6 | 11 901 | 0 | 11 901 | 16 468 | 4 875 | 11 593 | 11 593 |
| BCA-302MS1-16 | Granja Serra Dourada I | 10 808 | 0 | 10 808 | 14 397 | 4 352 | 10 045 | 10 045 |
| BCA-303MS1-16 | Lote 28 - PA - Assentamento Campanario | 9 936 | 0 | 9 936 | 12 431 | 3 893 | 8 538 | 8 538 |
| BCA-304MS1-16 | Lote 55 - Assentamento Campanario | 8 130 | 0 | 8 130 | 11 038 | 3 302 | 7 736 | 7 736 |
| BCA-305MS1-16 | Fazenda Nossa Senhora Aparecida II | 30 403 | 0 | 30 403 | 32 787 | 11 205 | 21 582 | 21 582 |
| BCA-306MS1-16 | Granja Grando | 7 484 | 0 | 7 484 | 10 164 | 3 040 | 7 124 | 7 124 |
| BCA-307MS1-16 | Assentamento Campanario | 11 257 | 0 | 11 257 | 15 519 | 4 603 | 10 916 | 10 916 |
| BCA-308MS1-16 | Fazenda Quinhão A | 11 223 | 0 | 11 223 | 15 782 | 4 631 | 11 151 | 11 151 |
| TOTAL | | 112 156 | 0 | 112 156 | 143 888 | 44 421 | 99 467 | 99 467 |

The Table 11 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 07,0 which is more designed for a one site only project activity.

| Vintage period | Baseline emissions ($tCO_2e$) | Project emissions ($tCO_2e$) | Leakage emissions ($tCO_2e$) | Reduction VCUs ($tCO_2e$) | Removal VCUs ($tCO_2e$) | Total VCUs ($tCO_2e$) |
|---|---|---|---|---|---|---|
| 01-Feb-2022 to 31-Dec-2022 | 69,493 | 23,169 | 0 | 46,324 | 0 | 46,324 |
| 01-Jan-2023 to 31-Dec-2023 | 74,392 | 21,245 | 0 | 53,147 | 0 | 53,147 |
| **Total** | **143,888** | **44,421** | **0** | **99,467** | **0** | **99,467** |

Comparison of emission reductions or net anthropogenic removals achieved with estimates in the registered PD.

| Amount achieved during this monitoring period (t CO2e) | Amount estimated ex ante for this monitoring period in the PD (t CO2e) |
|---|---|
| 99,467 tCO2e | 106,011 tCO2e* |

* Annual emission reductions in ex-ante calculation of the PD are 55,356 tCO2e, The value presented is adjusted to 106,011 considering the monitoring period has 699 days,

The project is not required to assess permanence risk.

| Vintage period | Baseline emissions ($tCO_2e$) | Project emissions ($tCO_2e$) | Leakage emissions ($tCO_2e$) | Buffer pool allocation ($tCO_2e$) | Reductions VCUs ($tCO_2e$) | Removals VCUs ($tCO_2e$) | Total VCU issuance ($tCO_2e$) |
|---|---|---|---|---|---|---|---|
| 01-Feb-2022 to 31-Dec-2022 | 69,493 | 23,169 | 0 | 0 | 46,324 | 0 | 46,324 |
| 01-Jan-2023 to 31-Dec-2023 | 74,392 | 21,245 | 0 | 0 | 53,147 | 0 | 53,147 |
| **Total** | **143,888** | **44,421** | **0** | **0** | **99,467** | **0** | **99,467** |

Table 12 – ERy, ex-post vs PD in the current monitoring period

| SITE ID | SITE NAME | $ER_{y,ex\text{-}post}$ in the MP ($t\ CO_2e$) | PDD ($t\ CO_2e$) | % achieved | Variation |
|---|---|---|---|---|---|
| BCA-300MS1-16 | Fazenda Paraíso do Alto | 10 782 | 11 822 | 91% | -9% |
| BCA-301MS1-16 | Fazenda São Sebastiao Gleba 6 | 11 593 | 12 664 | 92% | -8% |
| BCA-302MS1-16 | Granja Serra Dourada I | 10 045 | 10 292 | 98% | -2% |
| BCA-303MS1-16 | Lote 28 - PA - Assentamento Campan | 8 538 | 8 706 | 98% | -2% |
| BCA-304MS1-16 | Lote 55 - Assentamento Campanario | 7 736 | 7 915 | 98% | -2% |
| BCA-305MS1-16 | Fazenda Nossa Senhora Aparecida II | 21 582 | 23 745 | 91% | -9% |
| BCA-306MS1-16 | Granja Grando | 7 124 | 7 124 | 100% | 0% |
| BCA-307MS1-16 | Assentamento Campanario | 10 916 | 11 872 | 92% | -8% |
| BCA-308MS1-16 | Fazenda Quinhão A | 11 151 | 11 872 | 94% | -6% |
| TOTAL | | 99 467 | 106 011 | 94% | -6% |

| Vintage period | Ex-ante estimated reductions/ removals | Achieved reductions/ removals | Percent difference | Explanation for the difference |
|---|---|---|---|---|
| 01-Feb-2022 to 31-Dec-2023 | 106,011 | 99,467 | -6% | Annual emission reductions in ex-ante calculation of Project Design are 53,356 tCO2e. The PD value presented is adjusted to 106,011 tCO2e considering that the duration of the monitoring period is 699 days. This number of days is secured by the CER Calculation MR02 - BCA-BRA-16_v2 where the number of hours the project was operation is assessed. |
| Total | 106,011 | 99,467 | -6% | |

# APPENDIX 1: COMMERCIALLY SENSITIVE INFORMATION

Not Applicable