CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

Capture and combustion of methane emissions from swine manure treatment systems in ACCS farms, Santa Catarina, Brazil
Version number of the document: 1
Date: 13/01/2007

The current version: Version 01
The date of the document was completed: 13/01/2007

A.2. Description of the project activity:

Purpose of the project activity:

The purpose of the present project activity is to reduce the GHG emissions into the atmosphere from all ACCS's swine barns. The emission reduction will be achieved through replacing the current practice of animal manure management system - uncovered anaerobic lagoons - with an advanced anaerobic digester system, with capture and flare of the methane emissions

Description of GHG reduction:

The Concentred Animal Feeding Operations (CAFOs) use similar animal manure management system – AMMS, i.e., uncovered anaerobic lagoons, to treat and store swine manure. However, as this type of AMMS emits large amount of GHG due its anaerobic decomposition process, the present PDD proposes the GHG mitigation by replacing anaerobic lagoons with an advanced anaerobic digester system, including capture and flare of methane emissions. The decision to consider the implementation of a more advanced technology is influenced by the possibility of obtaining revenues from the sale of Certified Emission Reduction - CER under the Kyoto Protocol / UNFCCC, which will finance the project activity.

Contribution of the project activity to sustainable development:

The project activity contributes to the sustainable development by:

Anaerobic lagoons are widely used to treat and store liquid manure from confined swine production facilities in Brazil. Even though they are in compliance with Brazilian legislation, environmental and health concerns with the lagoon technology still persists because the system is considered unable to reduce ammonia emissions, odors, pathogens, and water quality deterioration (Vanotti et al., 2006).

Vinotti et al. (2006) consider as environmentally superior technology (EST) any technology, or combination of any feasible technologies that meet the following environmental performance standards: 1. Eliminate the discharge of animal waste to surface waters and groundwater through direct discharge, seepage, or runoff; 2. Substantially eliminate atmospheric emissions of ammonia; 3. Substantially eliminate the emission of odor that is detectable beyond the boundaries of the swine farm; 4. Substantially eliminate the release of disease-transmitting vectors and airborne pathogens; 5. Substantially eliminate contamination of soil and groundwater by manure residues.

Although anaerobic lagoon meets most of these performance standards, it fails mainly regarding items 3 and 4. Differently, anaerobic digester fits well in all these performance standards, so that it is why this system is considered an advanced technology. Besides, it is a more efficacious system as the time required for lowering the wastewater COD concentration is reduced, when compared to the anaerobic lagoon.

In a step forward and following the project installation, the use of biogas as energy source, replacing liquefied Petroleum Gas - LPG for cooking etc.

The anaerobic digester to be implemented uses local technology, and will favour local skilled labour for the project installation and maintenance.

A.3. Project participants:

Please list project participants and Party(ies) involved and provide contact information in Annex 1. Information shall be indicated using the following tabular format.

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Indicate if the Party involved wishes to be considered as a project participant (Yes/No)
Brazil	• ACCS…	No
	• None	Yes
	• None	No
…	• …	…

(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.

Note: Note: When the PDD is filled in support of a proposed new methodology (form CDM-NM), at least the host Party(ies) and any known project participant (e.g. those proposing a new methodology) shall be identified.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

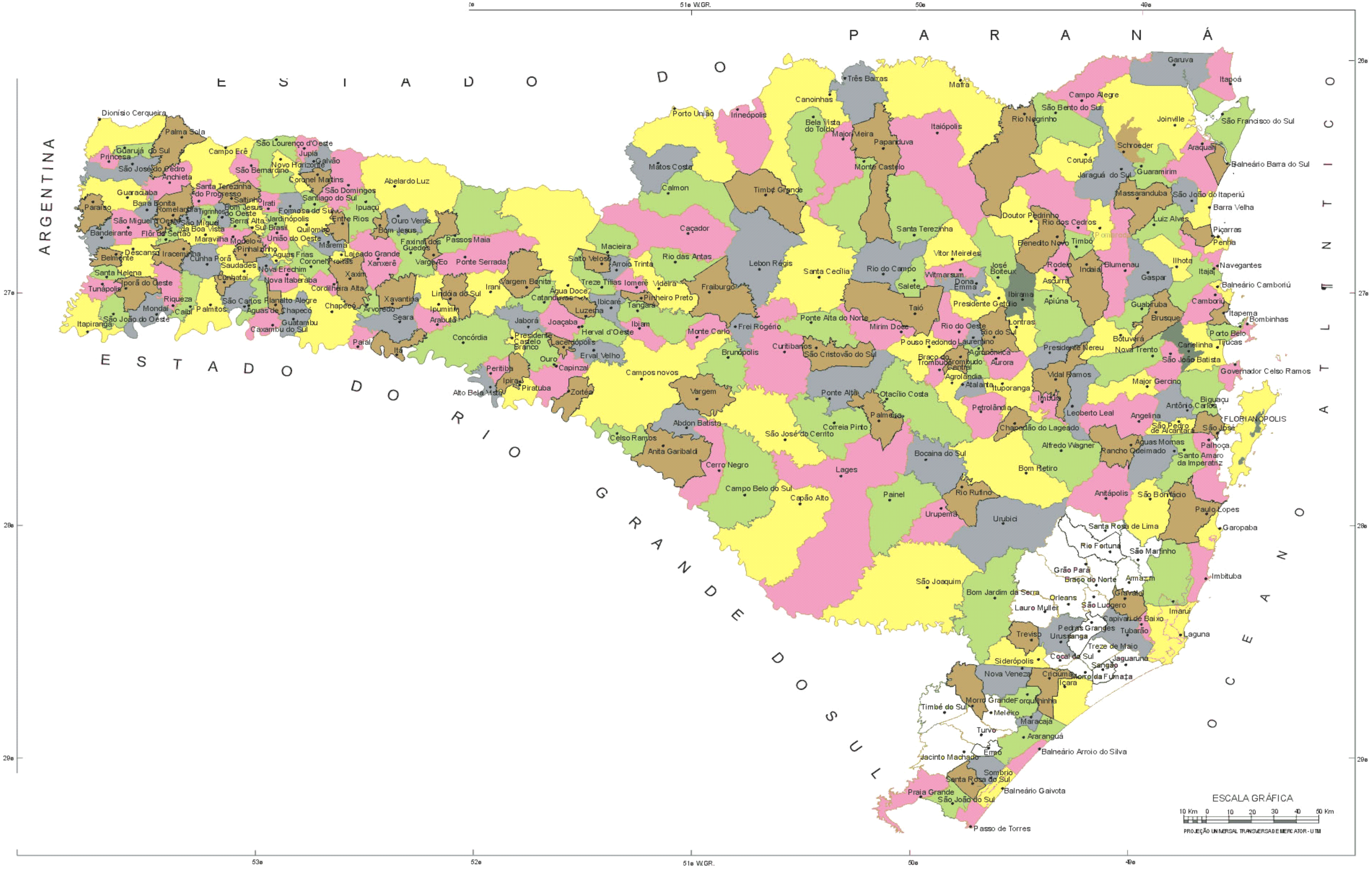
>> The Federative Republic of Brazil

A.4.1.2. Region/State/Province etc.:

The sites included in the current project activity are located in the State of Santa Catarina.

A.4.1.3. City/Town/Community etc:

The project sites, as shown in the figure A1 and detailed in the Table A1, are located in or near the Cities of Águas Frias; Armazém; Braço do Norte; Campos Novos; Canoinhas; Chapecó; Concórdia; Descanso; Grão Pará; Guarujá do Sul; Guatambu; Guraraciaba; Itapiranga; Ituporanga; Nova Itaberaba; Orleans; Ouro; Pomerode; Quilombo; Rio das Antas; Salto Veloso; Sangão; São Carlos; São João do Oeste; Saudades; Seara; Treze Tílias; União do Oeste; Videira; Xanxerê; and Xavantina.


ESTADO DO PARANÁ
ARGENTINA
ESTADO DO RIO GRANDE DO SUL
OCEANO ATLÂNTICO
FLORIANÓPOLIS
ESCALA GRÁFICA

A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity (maximum one page):

	Farmer name	Farm	Municipality
1	Francisco Zanella	Granja Zanella	Águas Frias
2	Nelson das Neves / Celso das Neves	Nelson das Neves / Celso das Neves	Armazém
3	Edson Wiggers	Granja Wiggers	Braço do Norte
4	Edson Wiggers	Granja Wiggers	Braço do Norte
5	Athos de Almeida Lopes	Fazenda do Triunfo	Campos Novos
6	Athos de Almeida Lopes	Fazenda Bom Retiro	Campos Novos
7	Antoninho Iagher	Granja Regina	Canoinhas
8	Érico Tormen	Granja Tormen	Chapecó
9	Clair Eloy Dariva	Granja São Roque	Chapecó
10	Mauro Jordão	Granja Zampieron	Concórdia
11	Gustavo Júlio	Granja Pinheiros	Concórdia
12	Ovidio e Angelo Mores	Granja Pery	Concórdia
13	Oraldi Martelli	Granja Bagdá	Concórdia
14	David Napoleão Simioni	Granja Simioni	Concórdia
15	David Napoleão Simioni	Granja Simioni	Concórdia
16	Roberto Perondi	Granja União	Concórdia
17	Clair e Clóvis Lusa	Granja Suruvi	Concórdia
18	Osmarino de Souza	Arvoredo	Concórdia
19	Vilson Spessatto	Granja Spessatto	Descanso
20	Edemo Souza Boing / Osmar Boing	Granja Boing	Grão Pará
21	Claudir Kielling	Granja Kielling	Guarujá do Sul
22	Adil Augusto Tadielo	Granja Durlo	Guatambú
23	Itacir Lunardi	Granja Lunardi	Guraraciaba
24	Erni Schoeler	Granja Schoeler	Itapiranga
25	Aloisio Iengert	Granja Santo Antônio	Itapiranga
26	Salvio Roberto Clasem	Granja Clasem	Ituporanga
27	Antônio Domingos	Granja Ferrarini	Nova Itaberaba
28	Jacir Anzolin	Jacir Anzolin	Nova Itaberaba
29	Losanio André de Lorenzi e Antônio de	Losanio André de Lorenzi e Antônio de	Orleans
30	Osvaldo Tessaro e	Granja Rio do Peixe II	Ouro

31	Valdir Tessaro	Granja Rio do Peixe I	Ouro
32	Genética Pomerode	Genética Pomerode	Pomerode
33	Lenoir Bigolin	Granja Bigolin	Quilombo
34	Adiles Aparecida Contini	Granja Contini	Rio das Antas
35	José Carlos Zamboni e Darcilo Artur Webber	Sitio Luiz Carlos Zamboni	Salto Veloso
36	José Meurer Michels	José Meurer Michels	Sangão
37	Eliseu e Alfredo Ely	Granja Ely	São Carlos
38	Ruben Grasel	Granja Beato Roque	São João do Oeste
39	Lenoir Meier	Granja Meier	São João do Oeste
40	Darci José Franz	Granja Saudades	Saudades
41	Gentil de Cesaro	Gentil de Cesaro	Seara
42	Valdemar Bordignon	Granja Bordignon	Seara
43	Deoclécio Grando	Granja São Valentim	Seara
44	Deoclécio Grando e Clévio Márcio Grando	Granja Pinhal	Seara
45	Germano Thaler, George Thaler e Tomas	Germano Thaler, George Thaler e Tomas	Treze Tílias
46	Joveli Luiz Cassaro	Granja Cabes	União do Oeste
47	Silmar Demenech	Granja Demenech	Videira
48	Adair Trevisan	Granja Trevisan	Xanxerê
49	Adriano Piaseski e	Granja Urussanga	Xanxerê
50	Adriano Piaseski e	Granja Voltão	Xanxerê
51	Adriano Piaseski e	Granja Maria Rosa I	Xanxerê
52	Ana Gaspari Piaseski	Granja Maria Rosa II	Xanxerê
53	João Carlos Prezzotto e Outros	Granja Baliza	Xanxerê
54	Ari Gugel	Ari Gugel	Xanxerê
55	Ademar Vidi	Ademar Vidi	Xanxerê
56	Deonir Poletto	Deonir Poletto	Xavantina
57	Clair Simoni	Clair Simoni	Xavantina
58	Antônio Pinzetta	Antônio Pinzetta	Xavantina
59	Pedro Biondo	Pedro Biondo	Xavantina
60	Vitor Pelizza	Vitor Pelizza	Xavantina
61	Antônio Spagnol	Antônio Spagnol	Xavantina

A.4.2. Category(ies) of project activity:

This project belongs to Category 13 and 15: Waste handling and disposal" and "Agriculture" listed in the *Sectoral Scopes* for accreditation of the operational entities.

A.4.3. Technology to be employed by the project activity:

The project activity is based on the implementation and operation of a liquid waste treatment. The Gter Energias Renováveis, a Brazilian Company specialized on renewable energy, developed a hybrid model of anaerobic bio-digester based on the main technical attributes of other types of bio-digesters such as

Completely Mixed; Contact process; Up-flow Anaerobic Sludge Blanket (UASB); and Plug-flow anaerobic digester systems. Environmental and socioeconomic aspects of the west region of the State of Santa Catarina were also taken into account for its development. The hybrid model uses as structure a high-density polyethylene (HDPE) membrane and, according to Gter empirical experience, it can be considered as efficient as the main digesters listed for manure treatment.

This hybrid model consists on a rectangular tank with prismatic shape at the bottom. The tank surface is covered by a HDPE with 1.0 mm thickness, impermeable to the biogas. The digester is built in a way that, as the fresh swine manure is introduced into the tank, it causes the displacement of all manure mass in the interior of the bio-digester and, at the same time, an equal amount of treated wastewater is thrown out from digester, similar to the plug-flow process. Besides, it adds some characteristics similar to the "completely mixed" process, on which the fresh material is mixed with the partially-digested material by a system of tubes installed on the bottom of the tank.

The loss of active anaerobic biomass is also controlled by the digester, by favouring the maintenance of a stable population of low growth bacterias. The system, inspired on the 'contact digester' system, can increase the retention time on anaerobic digestion, based on mechanisms that retain the manure not totally digested. The system push the manure not totally digested down to the bottom of the tank, mixing it with the remaining wastewater, allowing it to finishing the digestion.

The biogas released by anaerobic digestion is retained by the flexible HDPE membrane, working as a gasometer. Through the gasometer, the biogas may be flared or treated for its use as fuel.

A.4.4 Estimated amount of emission reductions over the chosen crediting period:

The project activity is estimated to reduce GHG emissions annually by 83,868 tCO_2e.

Table 1 - Emission reductions over the crediting period

Years	**Annual estimation of emission reductions in tonnes of CO_2e**
Beginning in January 2008	83,868
Year 2009	83,868
Year 2010	83,868
Year 2011	83,868
Year 2012	83,868
Year 2013	83,868
Year 2014	83,868
Year 2015	83,868
Year 2016	83,868
Ending in December 2017	83,868
Total estimated reductions (tons of CO_2e)	838,683
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tons of CO_2e)	**83,868**

A.4.5. Public funding of the project activity:

>>
The project will be funded by Japan Carbon Fund (JCF)

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the project activity:

>> Version 02 of ACM 0010 - "*Consolidated baseline methodology for GHG emission reduction from manure management systems*".

Available on the UNFCCC website:
http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html.

B.2 Justification of the choice of the methodology and why it is applicable to the project activity:

This project meets the applicability criteria of ACM 0010 as:

1. Farms where livestock populations, comprising of **swine** are managed under confined conditions;
2. Farms where manure is not discharged into natural water resources (e.g. rivers or estuaries);
3. In case of **anaerobic lagoons treatments** systems, the depth of the lagoons used for manure management under the baseline scenario consists at least in 1m^2.
4. The annual average temperature in the site where the **anaerobic manure treatment** facility in the baseline existed is higher than 5°C.
5. In the baseline case, the **minimum retention time** of manure waste in the anaerobic treatment system is greater than **1 month.**
6. The AWMS/process in the **project case ensure that no leakage** of manure waste into ground water **takes place**, e.g., the lagoon should have a **non-permeable layer at the lagoon bottom**.

B.3. Description of the sources and gases included in the project boundary

Table 1: Description of the sources and gases included in the project boundary

	Source	Gas	Included?	Justification/explanation
Baseline	**Direct** (and indirect) Emissions from the waste treatment process	CH_4	**Yes**	The major source of emissions in the baseline (fugitive emissions from storage lagoons)
		N_2O	**Yes**	N_2O indirect emissions from land applications and runoff losses (N_2O emission from anaerobic lagoon EF = 0)
		CO_2	No	Not taken into account under anaerobic conditions.
	Emissions from electricity consumption/generation	CH_4	No	Excluded for simplification. This is conservative
		N_2O	No	Excluded for simplification. This is conservative
		CO_2	**Yes**	Consumed from the grid
	Emissions from thermal energy generation	CH_4	No	Excluded for simplification. This is conservative
		N_2O	No	Excluded for simplification. This is conservative
		CO_2	**No**	Not important emission source

Table 2: Description of the sources and gases included in the project boundary

	Source	Gas	Included?	Justification/explanation
Project Activity	Emissions from thermal energy generation	CH_4	No	Excluded for simplification. This is conservative
		N_2O	No	Excluded for simplification. This is conservative
		CO_2	**No**	Not important emission source
	Emissions from on site electricity use	CH_4	No	Excluded for simplification. This is conservative
		N_2O	No	Excluded for simplification. This is conservative
		CO_2	**Yes**	Consumed from the grid; but not accounted for if generated from collected biogas
	Direct (and indirect) Emissions from the waste treatment process	CH_4	**Yes**	Emissions from uncombusted methane, physical leakage
		N_2O	**Yes**	N_2O indirect emissions from land applications and runoff losses (N_2O emission from anaerobic digester EF = 0)
		CO_2	No	Not taken into account under anaerobic conditions.

B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

In this section it is determined the most plausible baseline scenario following all the steps pointed on the Approved Consolidated Methodology ACM 0010. This methodology determines the baseline scenario through the following steps:

Step I: Define alternative scenarios to the proposed CDM project activity;

Step II: Barriers analysis;

Step III: Investment analysis;

Step IV: Baseline revision at renewal of crediting period.

Step I: Definition of alternative scenarios to the proposed project activity

It is common practice in Brazilian Concentred Animal Feeding Operations -CAFOs to wash swine manure from the barns with flush water. The amount of water spent for cleaning barns varies according to swine production stage. Nursing and gestating barns spend on average 20 litres of water per head per day, while breeding and finishing barns about 1 to 1.5 litres of water per head per day. The liquid manure is transported by pipes to a liquid manure treatment system (i.e. mostly anaerobic lagoon).

A list of AWMS manure treatments is provided by 2006 IPCC, table 10.18 (i.e., daily spread; solid storage; dry lot; liquid/slurry; pit storage below animal confinements; swine deep bedding; composting; anaerobic lagoon; anaerobic digester; and aerobic treatment). The most suitable alternative scenarios are that which fit in with the current practice of washing manure with flush water in Brazil. Therefore, in order to pull out the most suitable ones, the IPCC list is firstly classified according to the manure water content, as follows: ‘solid systems’ and ‘liquid systems’. In general, solid manure presents less than 70% of moisture and is handled mechanically. Liquid manure presents more than 90% of moisture and are handled hydraulically.

The IPCC AWMS list is then presented according to the following classification:

1. **Liquid manure systems**:
    - Anaerobic lagoon;
    - Anaerobic digester;
    - liquid/slurry;
    - Aerobic treatment

2. **Solid manure systems**:
    - Daily spread;
    - Solid storage;
    - Dry lot;
    - Pit storage below animal confinements;
    - Swine deep bedding;
    - Composting.

All these alternatives are in compliance with the Brazilian applicable legal and regulatory requirements. According to the current legislation of the State of Santa Catarina, Normative Instruction NI-11/2004, a permit (an Environmental License) is required for swine production. According to this normative instruction, the swine manure shall be treated or, otherwise, shall remain stored for a period not inferior to 120 days before its discharge into lands or watercourses. There is no legislation specifying any type of manure treatment. However, due to its favourable cost-benefit ratio, most of ACCS farms have introduced open lagoon systems.

The baseline alternatives are presented below in order to identify which of them would occur in the absence of the project. The justification for including or excluding a scenario from consideration is provided.

Included Baseline scenarios:

1. **Liquid manure systems**:

    - *Anaerobic lagoon:*

In Brazil, the current practice is to wash swine manure from barns with flush water. The liquid manure is then collected by gravity or pumped out to an open anaerobic lagoon, where the manure is partially digested by natural micro-organisms at an ambient temperature, releasing CO_2, CH_4 and NH_3. After fulfilling the minimum period of time for reaching quality parameters, the treated liquid manure is pumped out from lagoon and applied to agriculture lands. This system is the most current practice in the country, and it is also considered to be the most economical, efficient, and reliable manure management system.

- *Anaerobic digester:*

Even though anaerobic digester is considered an advanced system, superior to the anaerobic lagoon system, there are only a few systems installed for swine manure treatment in Brazil. These systems can capture significant part of the digested volatile solids (VS) from the liquid manure in the form of gases

(CH_4 and CO_2) under anaerobic conditions. The biogas collected by a gas piping may be used as fuel for electricity or thermal generation, or even be flared.
This scenario enhances financial barrier due to the high initial investment necessary to the equipments and high installation costs. These barriers are developed in section B.5 as part of an additionality test. This scenario has been included as the "proposed project activity."

Excluded Baseline scenarios:

1. **Liquid systems**

- *Aerobic system:*

Regarding aerobic treatment system, as this system is only indicated for liquid manure with low content of organic matter, it would be unsuitable for manure with high organic matter content like swine manure. Under high organic matter conditions, it would require forced aeration, demanding high expenditures with energy costs to run the aerators. Besides, this system produces higher bio-solids production than in anaerobic systems. Therefore, this scenario is excluded from the list of plausible baseline scenarios.

- *Liquid/slurry*:

The manure is stored as excreted or with some minimal quantity of water. Due to the current practice (i.e., wash swine manure from barns with flush water), this system would not be suitable for Brazilian conditions and is excluded from plausible scenarios.

2. **Solid systems**

Regarding the 'solid systems' (i.e. 'daily spread', 'solid storage', 'dry lot', 'liquid/slurry', 'pit storage below animal confinements' and 'deep bedding'), unless swine farmers have a good reason for changing their cleaning practices (i.e. economic incentives), manure treatment systems based on 'solid manure or 'manure with minimum addition of water' would be unlikely to be fit in as a plausible baseline scenario.

- *In-vessel composting system:* it is in experimental phase in Brazil. This system is adapted to accept liquid manure and dry it. It is a controlled aeration system and is designed to provide optimal composting conditions involving mechanical mixing of compost (i.e. sawdust + liquid manure) under controlled environmental conditions. This system is suitable for farms with space constraints and also for farmers who want to stock the manure treated to further use or sell as fertiliser. Disadvantages of the enclosed vessel (or in-vessel) method include high capital and operational costs due to the use of computerized equipment and skilled labour (capital and management intensive).

- *Daily spread:* In this system, the manure is routinely removed with low moisture content from a confinement facility and is applied to cropland or pasture within 24 hours. Disadvantages may include more labour in manure collection and handling on a daily basis. Considering the current practice (wash manure from barns with flush water), this scenario would be very unlikely to occur as baseline scenario.

- *Solid storage*: in this system, the manure is routinely removed with low moisture content from a confinement facility and stored with low moisture content for several months.

Disadvantages may include more labour in manure collection and handling. Considering the current practice (wash manure from barns with flush water), this scenario would be very unlikely to occur as baseline scenario.

- *Pit storage*: In this system, the manure is collected and stored with little or no added water below a slated floor in an enclosed animal confinement facility. The existing barns from ACCS farms are not suitable for this kind of manure treatment system. There is no storage structure under the existing barns to fit in with this system. Besides, this system would be not applicable for manure with high water content.

- *Dry lot and swine deep bedding*: It is excluded because these systems are not in compliance with the sanity conditions required for the industrial swine production.

Step II: Barrier Analysis

Two alternatives scenarios were identified above as the common practice in Brazil. Following, a barrier analysis was conducted to find out if an alternative may be constrained to occur in the absence of the CDM. The barriers include the investment, technological constraints and also barriers due to prevailing practice.

- **Investment barriers**

Anaerobic digester system is considered an advanced manure management systems, and only a few countries have implemented it. The most important constraint of this technology consists in the high investment required in comparison with the other manure systems. The farmers don't have enough capital to finance the project and, therefore, it is necessary to get loan from financial institutions. However, the investment required to biogas electricity generation is high and the costs are higher than electricity prices in the market, resulting in a project financial unattractiveness and making difficult to obtain the loan from the investors. The CDM incentives would encourage the investors to finance the implementation of this swine manure system.

- **Technological barriers**

Anaerobic digester system has to be sized to handle projected animal volumes, this system will become progressively more expensive on a 'per animal' basis when the farm size is smaller. The daily operation involved in this technology includes a detailed monitoring program to monitor various parameters of the system, requiring an equipment maintenance system. The farmers have a lack of skilled labour to provide the required maintenance, probably, resulting in an occurrence of frequent equipment operating problems. On the other hand, the anaerobic lagoon system is technologically simple and easy to operate and maintain.

Based on the above analysis, the uncovered anaerobic lagoon is the only alternative not prevented by the financial and technological barriers, then this scenario alternative is the most plausible baseline scenario.

Step III: Investment Analysis

Und Undertake investment analysis of all the alternatives that don't face any barriers, as identified in Step II. For each alternative, all costs and economic benefits attributable to the waste management scenario should be illustrated in a transparent and complete manner.

In step II, it was identified that the most plausible baseline scenario consists in the anaerobic lagoon, as the anaerobic digester system enhances technological and financial barrieres. Than, the investment analysis was made to show in numbers these constraints through the cash flow evaluation of the two plausible alternatives identified in Step I. Tables 1 and 2 show the cash flow of anaerobic lagoon and anaerobic digester, respectively. The financial assumptions consist on:

- *Average nominal Brazil's basic interest rate:* 13.25% per year (source: Banco Central do Brasil - Bacen[1], December, 2006);
- *Inflation:* Based on the Extended National Consumer Price Index (IPCA): 3.11 % per year (source: IBGE[2], December, 2006)
- *Average exchange rate* (US$/Real): 2.15 (source: Bacen, December,2006)

[1] Available on: www.bacen.gov.br

[2] Available on: www.ibge.gov.br

Table 1: Calculation of NPV and IRR

AWMS: ANAEROBIC LAGOON				
COSTS AND BENEFITS (US$)	Year 1	Year 2	Year n	year n+1
Equipment and Installation costs (geo-membrane and excavation)	(1,427,644)	-	-	-
Maintenance costs (sludge drying, sludge removal, land incorporation)	-	(349)	(349)	(349)
Revenues from the sale of electricity or other project related products, when applicable	-	-	-	-
SUBTOTAL	(1,427,644)	(349)	(349)	(349)
TOTAL BASELINE	(1,427,644)	(349)	(349)	(349)
NPV (US$) (10.14% discount rate)	(1,296,994)			
IRR (%)	undefined			

Table 2: Calculation of NPV and IRR

AWMS: ANAEROBIC BIODIGESTER				
COSTS AND BENEFITS (US$)	Year 1	Year 2	Year n	Year n+1
Equipment costs (Cover, PVC piping, flare) and Installation Costs (ground excavation / impermeabilization)	(2,773,445)	-	-	-
Maintenance costs		(122,358)	(122,358)	(122,358)
Revenues from the sale of electricity or other project related products, when applicable	-	-	-	-
SUBTOTAL	(2,771,438)	(122,358)	(122,358)	(122,358)
TOTAL BASELINE	(2,771,438)	(122,358)	(122,358)	(122,358)
NPV (US$) (10.14% discount rate)	(2,791,879)			
IRR (%)	undefined			

The Internal Return Rate (IRR) cannot be calculated due to the existence of only negative flows in the financial analysis. Therefore, the alternative's comparison was based on the NPV indicator, using the discount rate of 10.14%. As demonstrated in above Tables 1 and 2, there is no positive cash flow scenario involved in the baseline or in the project activity. Therefore, a cost – effective comparison through the NPV comparison is assumed to be adequate in order to determine the prevailing practice.

According to this cost comparison analysis, baseline scenario is identified as the economically most attractive course of action, i.e., alternative with the highest NPV.

Step IV: **Baseline revision at renewal of crediting period**

The crediting period adopted in the project activity is fixed crediting period – 10 years, so this step is not applicable.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality):

According to the consolidated baseline methodology ACM0010, if the baseline determination demonstrates that the baseline is different from the proposed project activity not undertaken as a CDM project, it may be concluded that the project is additional.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

Baseline Emissions

Baseline emissions are:

$$BE_y = BE_{CH4,y} + BE_{N2O,y} + BE_{elec/heat,y} \quad (1)$$

where,

BE_y - Baseline emissions in year y, in tCO2e/year.
$BE_{CH4,y}$ - Baseline methane emissions in year y, in tCO2e/year.
$BE_{N2O,y}$ Baseline N2O emissions in year y, in tCO2e/year.
$BE_{elec/heat,y}$ Baseline CO2 emissions from electricity and/or heat used in the baseline, in tCO2e/year.

(i) Methane emissions

$$BE_{CH4,y} = GWP_{CH4} * D_{CH4} * \sum MCF_j * B_{0,LT} * N_{LT} * VS_{LT,y} * MS_j \quad (2)$$

$BE_{CH4,y}$ the annual baseline methane emissions in t CO2e/y
GWP_{CH4} Global Warming Potential (GWP) of CH4.
D_{CH4} Methane density (0.00067 t/m3 at room temperature (20 ºC) and 1 atm pressure).
MCF_j Annual methane conversion factor (MCF) for the baseline AWMSj from IPCC 2006 table 10.17, chapter 10, volume 4.

$B_{0,LT}$ Maximum methane producing potential of the volatile solid generated, in m^3CH_4/kg_dm, by animal type LT.
N_{LT} Number of animals of type LT for the year y, expressed in numbers.
$VS_{LT,y}$ Annual volatile solid for livestock LT entering all AWMS [on a dry matter weight basis (kg-dm/animal/year), as estimated below.
$MS_{,j}$ Fraction of manure handled in system j

(ii) N_2O emissions from manure management

$$BE_{N2O,y} = GWP_{N2O} * CF_{N2O\text{-}N,N} * 1/1000 * (E_{N2O,D,y} + E_{N2O,ID,y}) \quad (3)$$

where:

$BE_{N2O,y}$ Annual baseline N2O emissions in t CO2e / yr
GWP_{N2O} Global Warming Potential (GWP) for N_2O.
$CF_{N2O\text{-}N,N}$ Conversion factor N_2O-N to N_2O (44/28).
$E_{N2O,D,y}$ Direct N_2O emission in kg N_2O -N/year.
$E_{N2O,ID,y}$ Indirect N_2O emission in kg N_2O -N/year.

$$E_{N2O,D,y} = \sum_{j,LT} (EF_{N2O,D,j} * NEX_{LT,y} * N_{LT} * MS\%_{Bl,j}) \quad (4)$$

where:

$E_{N2O,D,y}$ Are the direct nitrous oxide emissions in kg of N2O per year.
$EF_{N2O,D,j}$ Is the direct N2O emission factor for the treatment system j of the manure management system in kg N2O-N/kg N (estimated with site-specific, regional or national data if such data is available, otherwise use default EF3 from table 10.21, chapter 10, volume 4, in the IPCC 2006).
$NEX_{LT,y}$ Is the annual average nitrogen excretion per head of a defined livestock population in kg N/animal/year estimated as described in Annex 2 of the methodology ACM 0010.
$MS\%_{Bl,j}$ Fraction of manure handled in system j, in %
N_{LT} Number of animals of type LT for the year y, expressed in numbers.

$$E_{N2O,ID,y} = \sum_{j,LT} (EF_{N2O,ID,j} * F_{gasm} * NEX_{LT,y} * N_{LT} * MS\%_{Bl,j}) \quad (5)$$

where:

$E_{N2O,ID,y}$ Are the indirect nitrous oxide emissions in kg of N2O per year.
$EF_{N2O,ID,j}$ Is the indirect N2O emission factor for N2O emissions from atmospheric deposition of nitrogen on soils and water surfaces, kg N2O-N/kg NH3-N and NOx-N emitted, estimated with site-specific, regional or national data if such data is available. Otherwise, default values for EF4 from table 11.3, chapter 11, volume 4 of IPCC 2006 can be used.

$NEX_{LT,y}$ Is the annual average nitrogen excretion per head of a defined livestock population in kg N/animal/year estimated as described in Annex 2 of the methodology ACM 0010.
$MS\%_{Bl,j}$ Fraction of manure handled in system j
F_{gasm} Percent of managed manure nitrogen for livestock category that volatilises as NH3 and NOx in the manure management system.
N_{LT} Number of animals of type LT for the year y, expressed in numbers.

(iii) CO2 emission from electricity and heat within the project boundary

$$BE_{elec/heat,y} = EG_{BL,y} * CEF_{Bl,\,elec,y} * EG_{d,y} * CEF_{grid} * HG_{BL,y} * CEF_{Bl,\,therm} \quad (6)$$

where,

$BE_{elec/heat,y}$ Baseline Co2 emissions from electricity and/or hest used in the baseline, in tCO2e/year;
$EG_{BL,y}$ is the amount of electricity in the year y that would be consumed at the project site in the absence of the project activity (MWh) for operating AWMS.
$CEF_{Bl,\,elec,y}$ is the carbon emissions factor for electricity consumed at the project site in the absence of the project activity (tCO2/MWh)
$EG_{d,y}$ is the amount of electricity generated utilizing the biogas collected during project activity and exported to the grid during the year y (MWh)
CEF_{grid} is the carbon emissions factor for the grid in the project scenario (tCO2/MWh)
$HG_{BL,y}$ is the quantity of thermal energy that would be consumed in year y at the project site in the absence of the project activity (MJ) using fossil fuel for operating AWMS.
$CEF_{Bl,\,therm}$ is the CO2 emissions intensity for thermal energy generation (tCO2 e/MJ)

Project Emissions

The project activity might include one or more AWMS to treat the manure. In this case, the manure is first treated in an anaerobic digester and the treated waste is further processed using an aerobic pond. Each AWMS is referred to as a treatment stage.

Project emissions estimates:

$$PE_y = PE_{AD,\,y} + PE_{Aer,\,y} + PE_{N2O,y} + PE_{PL,y} + PE_{flare,y} + PE_{elec/heat} \quad (7)$$

PE_y Project emissions in year y, in t CO2e/year.
$PE_{AD,\,y}$ Leakage from AWMS systems that capture’s methane in t CO2e/yr
$PE_{Aer,\,y}$ Methane emissions from AWMS that aerobically treats the manure in t CO2e/yr
$PE_{N2O,y}$ Nitrous oxide emission from project manure waste management system in t CO2e/yr
$PE_{PL,y}$ Physical leakage of emissions from biogas network to flare the captured methane or supply to the facility where it is used for heat and/or electricity generation in t CO2e/yr
$PE_{flare,y}$ Project emissions from flaring of the residual gas stream in t CO2e/yr
$PE_{elec/heat}$ Project emissions from use of heat and/or electricity in the project case in t CO2e/yr

(i) Methane emissions from Anaerobic Digester ($PE_{AD,\,y}$):

If project case AWMS is anaerobic digester only, then use equation (8.a), else use equation (8.b).

$$PE_{AD,y} = GWP_{CH4} * D_{CH4} * LF_{AD} * F_{AD} * \sum(B_{0,LT} * N_{LT} * VS_{LT,y}) \quad (8.a)$$

$$PE_{AD,y} = GWP_{CH4} * D_{CH4} * LF_{AD} * F_{AD} [\prod (1- R_{VS,n})*\sum(B_{0,LT} * N_{LT} * VS_{LT,y}*MS\%_{j}) \quad (8.b)$$

D_{CH4} CH4 density (0.00067 t/m3 at room temperature (20 ºC) and 1 atm pressure).
LF_{AD} Methane leakage from Anaerobic digesters, default of 0.15 multiplied by methane content of biogas.
F_{AD} Fraction of volatile solid directed to anaerobic digester.
$R_{VS,n}$ Fraction of volatile solid treated in AWMS stage n. The project proponents shall provide the values based on proven test results. In absence of such values the conservative value of volatile solids treated in Annex 1 shall be used.
LT Index for livestock type
$B_{0,LT}$ CH4 production capacity from manure for livestock type LT, in m3 CH4/kg-VS, to be chosen based on procedure provided for in the baseline methodology section.
N_{LT} Population of livestock type LT for the year y, expressed in numbers.
$VS_{LT,y}$ Annual volatile solid excretion of livestock type LT on a dry-matter basis in kg/animal/year
MS%j Fraction of manure handled in system j

As noted in equations (8.a.) and (8.b.), not all volatile solids are degraded in the anaerobic digester. If the undegraded volatile solid in the effluent from anaerobic digester is discharged outside the project boundary without further treatment, these emissions should be treated as leakage and appropriately reported and accounted.

(ii) Methane emissions from aerobic AWMS treatment ($PE_{Aer,y}$):

IPCC guidelines specify emissions from aerobic lagoons as 0.1% of total methane generating potential of the waste processed, which can be used as a default for all types of aerobic AWMS treatment.

$$PE_{Aer,y} = GWP_{CH4} * D_{CH4} *0.001*F_{Aer} [\prod (1- R_{VS,n})*\sum(B_{0,LT} * N_{LT} * VS_{LT,y}*MS\%_{j}) + PE_{Sl,y} \quad (9)$$

D_{CH4} CH4 density (0.00067 t/m3 at room temperature (20 ºC) and 1 atm pressure).
F_{AD} Fraction of volatile solid directed to anaerobic digester.
$R_{VS,n}$ Fraction of volatile solid treated in AWMS stage n. The project proponents shall provide the values based on proven test results. In absence of such values the conservative value of volatile solids treated in Annex 1 shall be used.
LT Index for livestock type
$B_{0,LT}$ CH4 production capacity from manure for livestock type LT, in m3 CH4/kg-VS, to be chosen based on procedure provided for in the baseline methodology section.
N_{LT} Population of livestock type LT for the year y, expressed in numbers.
$VS_{LT,y}$ Annual volatile solid excretion of livestock type LT on a dry-matter basis in kg/animal/year
MS%j Fraction of manure handled in system j

$PE_{Sl,y}$ CH4 emissions from sludge disposed of in storage pit prior to disposal during the year y, expressed in tons of CO2e /yr.

Aerobic treatment results in large accumulations of sludge. Sludge requires removal and has large VS values. It is important to identify the following management process for the sludge and estimate the emissions from that management process. If the sludge ponds are not within the project boundary, the emissions should be included in leakages. The emissions from sludge ponds shall be estimated as follows:

$$PE_{Sl,y} = GWP_{CH4} * D_{CH4} * MCF_{sl} * F_{Aer} [\prod (1- R_{VS,n}) * \sum(B_{0,LT} * N_{LT} * VS_{LT,y} * MS\%_{j}) \qquad (10)$$

$R_{VS,n}$ Fraction of volatile solid degraded in AWMS treatment method n of the N treatment steps prior to sludge being treated. Values for Rvs should be taken from Annex 1.
D_{CH4} CH4 density (0.00067 t/m3 at room temperature (20 ºC) and 1 atm pressure).
F_{Aer} Fraction of volatile solid directed to Aerobic system.
LT index for livestock type
$B_{0,LT}$ CH4 production capacity from manure for livestock type LT, in m3 CH4/kg-VS, to be chosen based on procedure provided for in the baseline methodology section.
$VS_{LT,y}$ Annual volatile solid excretion of livestock type LT on a dry-matter basis in kg/animal/year.
N_{LT}, Population of livestock type LT for the year y, expressed in numbers.
$MS\%_{j}$ Fraction of manure handled in system j
MCF_{sl} Methane conversion factor (MCF) for the sludge stored in sludge pits estimated as in the baseline emissions section.

(iii) N2O emissions from manure management

$$PE_{N2O,y} = GWP_{N2O} * CF_{N2O-N,N} * 1/1000 * (E_{N2O,D,y} + E_{N2O,ID,y}) \qquad (11)$$

where:

$PE_{N2O,y}$ Annual project N2O emissions in t CO2e / yr
GWP_{N2O} Global Warming Potential (GWP) for N_2O.
$CF_{N2O-N,N}$ Conversion factor N_2O-N to N_2O (44/28).
$E_{N2O,D,y}$ Direct N_2O emission in kg N_2O -N/year.
$E_{N2O,ID,y}$ Indirect N_2O emission in kg N_2O -N/year.

$$E_{N2O,D,y} = \sum_{j,LT} (EF_{N2O,D,j} * NEX_{LT,y} * N_{LT} * MS\%_{Bl,j}) \qquad (12)$$

where:

$E_{N2O,D,y}$ Are the direct nitrous oxide emissions in kg of N2O per year.
$EF_{N2O,D,j}$ Is the direct N2O emission factor for the treatment system j of the manure management system in kg N2O-N/kg N (estimated with site-specific, regional or national data if such data is available, otherwise use default EF3 from table 10.21, chapter 10, volume 4, in the IPCC 2006).
$NEX_{LT,y}$ Is the annual average nitrogen excretion per head of a defined livestock population in kg N/animal/year estimated as described in Annex 2 of the methodology ACM 0010.

$MS\%_{Bl,j}$ Fraction of manure handled in system j, in %
N_{LT} Number of animals of type LT for the year y, expressed in numbers.

$$E_{N2O,ID,y} = \sum_{j,LT} (EF_{N2O,ID,j} * F_{gasm} * NEX_{LT,y} * N_{LT} * MS\%_{Bl,j}) \quad (13)$$

where:

$E_{N2O,ID,y}$ Are the indirect nitrous oxide emissions in kg of N2O per year.
$EF_{N2O,ID,j}$ Is the indirect N2O emission factor for N2O emissions from atmospheric deposition of nitrogen on soils and water surfaces, kg N2O-N/kg NH3-N and NOx-N emitted, estimated with site-specific, regional or national data if such data is available. Otherwise, default values for EF4 from table 11.3, chapter 11, volume 4 of IPCC 2006 can be used.
$NEX_{LT,y}$ Is the annual average nitrogen excretion per head of a defined livestock population in kg N/animal/year estimated as described in Annex 2 of the methodology ACM 0010.
$MS\%_{Bl,j}$ Fraction of manure handled in system j
F_{gasm} Percent of managed manure nitrogen for livestock category that volatilises as NH3 and NOx in the manure management system.
N_{LT} Number of animals of type LT for the year y, expressed in numbers.

For subsequent treatment stages, the reduction of the nitrogen during a treatment stage is estimated based on referenced data for different treatment types. Emissions from the next treatment stage are then calculated following the approach outlined above, but with nitrogen adjusted for the reduction from the previous treatment stages by multiplying by ($1-R_N$), where R_N is the relative reduction of nitrogen from the previous stage. The relative reduction (R_N) of nitrogen depends on the treatment technology and should be estimated in a conservative manner. These values are provided in Annex 1 of the ACM0010 baseline methology.

(iv) Physical Leakage from distribution network of the captured methane in (PE_{PL})

This refers to leaks in the biogas system from the biogas pipeline delivery system. The sum of the quantities of captured methane fed to the flare, to the power plant and to the boiler (measured as per the monitoring plan) must be compared annually with the total methane generated as measured by meter at the outlet of the methane generating digester. The difference between the monitored value of methane generated and that consumed in flare/electricity generation/heat shall be accounted as leakage from the pipelines.
In the case where biogas is just flared and the pipeline from collection point to flare is short (i.e., less than 1 km, and for on site delivery only), one flow meter can be used. In such cases the physical leakage may be considered as zero. .

(v) Project emissions from flaring of the residual gas stream ($PE_{flare,y}$)

$$PE_{Flare,y} = \sum_{h=1}^{8760} TM_{RG,h} * (1-\eta_{flare,h}) * GWP_{CH4} / 1000 \quad (14)$$

Where:

$PE_{Flare,y}$ Project emissions from flaring of the residual gas stream in t CO2 e/y
$TM_{RG,h}$ Mass flow rate of methane in the residual gas in the hour h in kg/h.
$\eta_{flare,h}$ Flare efficiency in hour h
GWP_{CH4} Global Warming Potential (GWP) for CH_4 valid for the commitment period.

The variables $TM_{RG,h}$ e $\eta_{flare,h}$ shall be determined according to the "*Tool to determine project emissions from flaring gases containing methane*"

(vi) Project emissions from heat use and electricity use (PEelec/heat):

$$PEelec/heat,y = EL_{Pr,y} * CEF_d + HG_{Pr,\ y} * CEF_{Pr,\ therm,y} \quad (15)$$

where,

$EL_{Pr,y}$ is the amount of electricity in the year y that is consumed at the project site in the project case (MWh).
CEF_d is the carbon emissions factor for electricity consumed at the project site during the project activity (tCO2/MWh), estimated as described below. Factor is zero if biogas is used to produce electricity.
$HG_{Pr,\ y}$ is the quantity of thermal energy consumed in year y at the project site in the project case (MJ).
$CEF_{Pr,\ therm,y}$ is the CO2 emissions intensity for thermal energy generation (tCO2e/MJ),. Factor is zero if biogas is used for generating thermal energy.

Determination of CEF_d:

- In case the electricity is generated in an on-site fossil fuel fired power plant in the baseline, the default emission factor for a diesel generator with a capacity of more than 200 kW for small-scale project activities should be used (0.8 tCO2/MWh, see Table I.D.1 in the simplified baseline and monitoring methodology AMS.I.D for selected small-scale CDM project activity categories).

- In case the electricity is imported from the grid, CEF_d should be calculated according to methodology ACM0002 ("Consolidated baseline methodology for grid-connected electricity generation from renewable sources"). If electricity generation is less than small scale threshold (15 GWh/year), the method for the calculation of the grid emission factor in the small scale methodology AMS.I.D could be used.

Leakage

Leakage covers the emissions from land application of treated manure, outside the project boundary. These emissions are estimated as net of those released under project activity and those released in the baseline scenario. Net leakage of N2O and CH4 are only considered if they are positive.
.

$$LE_y = (LE_{P,N2O} - LE_{B,N2O}) (LE_{P,CH4} - LE_{B,CH4}) \quad (16)$$

Where:

$LE_{P,N2O}$ Are the N2O emissions released during project activity from land application of the treated manure, in tCO2e/year.
$LE_{B,N2O}$ Are the N2O emissions released during baseline scenario from land application of the treated manure, in tCO2e/year.
$LE_{P,CH4}$ Are the CH4 emissions released during project activity from land application of the treated manure, in tCO2e/year.
$LE_{B,CH4}$ Are the CH4 emissions released during baseline scenario from land application of the treated manure, in tCO2e/year.

(i) Estimation of N2O emissions:

The baseline case N2O emissions are estimated using the following equations:

$$LE_{N2O,y} = GWP_{N2O} * CF_{N2O-N,N} * 1/1000 * (LE_{N2O,land} + LE_{N2O,\ runoff} + LE_{N2O,vol}) \quad (17)$$

$$LE_{N2O,land} = EF_1 * \prod (1- R_{N,n})*\sum NEX_{LT,y} * N_{LT} \quad (18)$$

$$LE_{N2O,\ runoff} = EF_5 * F_{leach} * \prod (1- R_{N,n})*\sum NEX_{LT,y} * N_{LT} \quad (19)$$

$$LE_{N2O,vol} = EF_4 * \prod (1- R_{N,n})* F_{gasm} * \sum NEX_{LT,y} * N_{LT} \quad (20)$$

Where:

$LE_{N2O,land}$ Direct nitrous oxide emission from application of manure waste, in Kg N2O-N/year.
$LE_{N2O,runoff}$ Nitrous oxide emission due to leaching and run-off, in Kg N2O-N/year.
F_{gasm} Fraction of animal manure N that volatizes as NH3 and NOX in kg NH3-N and NOX-N per kg of N, estimated with site-specific, regional or national data if such data is available. Otherwise, default values from table 11.3, chapter 11, volume 4 of IPCC 2006 guidelines can be used.
N_{LT} Number of animals of type LT
NEX_{LT} Average annual N excretion per head per animal category LT in kg - N/animal-year (estimated as in annex 2)
EF_1 Emission factor for direct emission of N2O from soils in Kg N2O-N/kg N, estimated with site-specific, regional or national data if such data is available. Otherwise, default values from table 11.1, chapter 11, volume 4 of IPCC 2006 guidelines can be used.
EF_5 Emission factor for indirect emission of N2O from runoff in Kg N2O-N/kg N, estimated with site-specific, regional or national data if such data is available.
Otherwise, default values from table 11.3, chapter 11, volume 4 of IPCC 2006 guidelines can be used.
EF_4 Emission factor for N2O emissions from atmospheric deposition of N on soils and water surfaces, [kg N- N2O / (kg NH3-N + NOx-N volatilized)], estimated with sitespecific, regional or national data if such data is available. Otherwise, default values from table 11.3, chapter 11, volume 4 of IPCC 2006 guidelines can be used.
F_{leach} Fraction of all N added to/mineralised in managed soils in regions where leaching/runoff occurs that is lost through leaching and runoff should be estimated with site-specific, regional or national data if such

data is available. Otherwise, default values from table 11.3, chapter 11, volume 4 of IPCC 2006 guidelines can be used.
$CF_{N20-N,N}$ Conversion factor (= 44/28).
$R_{N,n}$ Fraction of NEX in manure waste that is reduced in the Baseline AWMS. The relative reduction of nitrogen depends on the treatment technology and should be estimated in a conservative manner. Default values for different treatment technologies can be found in Annex 1.

The project case N2O emissions are estimated using the following equations:

$$LE_{P,N2O,y} = GWP_{N2O} * CF_{N2O-N,N} * 1/1000 * (LE_{N2O,land} + LE_{N2O, runoff} + LE_{N2O,vol}) \quad (21)$$

$$LE_{N2O,land} = EF_1 * \prod (1- R_{N,n})*\sum NEX_{LT,y} * N_{LT} \quad (22)$$

$$LE_{N2O, runoff} = EF_5 * F_{leach} * \prod (1- R_{N,n})*\sum NEX_{LT,y} * N_{LT} \quad (23)$$

$$LE_{N2O,vol} = EF_4 * \prod (1- R_{N,n})* F_{gasm} * \sum NEX_{LT,y} * N_{LT} \quad (24)$$

Where:

$LE_{N2O,land}$ Direct nitrous oxide emission from application of manure waste, in Kg N2O-N/year.
$LE_{N2O,runoff}$ Nitrous oxide emission due to leaching and run-off, in Kg N2O-N/year.
$LE_{N2O,runoff}$ Nitrous oxide emission from atmospheric deposition of N on soils and water surface, in Kg N2O-N/year.

F_{gasm} Fraction of animal manure N that volatizes as NH3 and NOX in kg NH3-N and NOX-N per kg of N, estimated with site-specific, regional or national data if such data is available. Otherwise, default values from table 11.3, chapter 11, volume 4 of IPCC 2006 guidelines can be used.
N_{LT} Number of animals of type LT
NEX_{LT} Average annual N excretion per head per animal category LT in kg - N/animal-year (estimated as in annex 2)
EF_1 Emission factor for direct emission of N2O from soils in Kg N2O-N/kg N, estimated with site-specific, regional or national data if such data is available. Otherwise, default values from table 11.1, chapter 11, volume 4 of IPCC 2006 guidelines can be used.
EF_5 Emission factor for indirect emission of N2O from runoff in Kg N2O-N/kg N, estimated with site-specific, regional or national data if such data is available.
Otherwise, default values from table 11.3, chapter 11, volume 4 of IPCC 2006 guidelines can be used.
EF_4 Emission factor for N2O emissions from atmospheric deposition of N on soils and water surfaces, [kg N- N2O / (kg NH3-N + NOx-N volatilized)], estimated with site specific, regional or national data if such data is available. Otherwise, default values from table 11.3, chapter 11, volume 4 of IPCC 2006 guidelines can be used.
F_{leach} Fraction of all N added to/mineralised in managed soils in regions where leaching/runoff occurs that is lost through leaching and runoff should be estimated with site-specific, regional or national data if such data is available. Otherwise, default values from table 11.3, chapter 11, volume 4 of IPCC 2006 guidelines can be used.

$CF_{N20-N,N}$ Conversion factor (= 44/28).
$R_{N,n}$ Fraction of NEX in manure waste that is reduced in the Baseline AWMS. The relative reduction of nitrogen depends on the treatment technology and should be estimated in a conservative manner. Default values for different treatment technologies can be found in Annex 1.

It is possible to measure the quantity of manure applied to land in kg manure/yr (Q_{DM}) and the nitrogen concentration in kg N / kg manure (N_{DM}) in the manure to estimate the total quantity of nitrogen applied to land. In this case, $\prod (1- R_{N,n})*\sum NEX_{LT,y} * N_{LT}$ in equations 22, 23 and 24 above should be substituted by $Q_{DM} * N_{DM}$.

(ii) Methane emissions from disposal of treated manure
The calculation of methane emissions from land application of manure in the baseline and project cases are estimated from equations (25) and (26), below:

$$LE_{B,CH4} = GWP_{CH4} * D_{CH4} *MCF_d* [\prod (1- R_{VS,n})*\sum(B_{0,LT} * N_{LT} * VS_{LT,y}*MS\%_j) \quad (25)$$

$$LE_{P,CH4} = GWP_{CH4} * D_{CH4} *MCF_d* [\prod (1- R_{VS,n})*\sum(B_{0,LT} * N_{LT} * VS_{LT,y}*MS\%_j) \quad (26)$$

$LE_{B,CH4}$ Methane leakage emissions in the baseline (t CO2e / yr)
$LE_{P,CH4}$ Methane leakage emissions in the project case (t CO2e / yr)
$R_{VS,n}$ Fraction of volatile solid degraded in AWMS n prior to sludge being treated. Values for R_{vs} should be taken from annex 1.
GWP_{CH4} Global Warming Potential (GWP) of CH4.
D_{CH4} CH4 density (0.00067 t/m^3 at room temperature (20 ºC) and 1 atm pressure).
$B_{0,LT}$ Maximum methane producing potential of the volatile solid generated, in m^3CH4/kg_dm, by animal type LT.
N_{LT} Number of animals of type LT for the year y, expressed in numbers.
$VS_{LT,y}$ Annual volatile solids from livestock LT, on a dry matter weight basis (kg-dm/year).
MS%j Fraction of manure handled in system j
MCF_d Methane conversion factor (MCF) assumed to be equal to 1.

Emission Reduction

The emission reduction ER_y by the project activity during a given year y is the difference between the baseline emissions (BE_y) and the sum of project emissions (PE_y) and Leakage, as follows:

$$ER_y = BE_y - PE_y - LE_y \quad (27)$$

Further, in estimating emissions reduction for claiming certified emissions reductions, if the calculated CH4 baseline emissions from anaerobic lagoons are higher than the measured CH4 generated in the anaerobic digester in the project situation (this is calculated as product of biogas flow at the digester outlet and methane fraction in the biogas), then the latter shall be used to calculate the emissions reduction for claiming certified emissions reductions. Therefore, the actual methane captured from an anaerobic digester shall be compared to the ($BE_{CH4,y}$ - $PE_{AD,y}$ - $PE_{PL,y}$) and if found lower, then ($BE_{CH4,y}$ -

$PE_{AD,y}$ - $PE_{PL,y}$) (which is a component of BE_y -PE_y) in equation (27) is replaced by actual methane captured.

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B.6.2. Data and parameters that are available at validation:

Each of the following tables contain data and parameters used for the crediting period and that are not monitored, since they are determined only once and remain fixed through all crediting period.

Data / Parameter:	$R_{VS,n}$
Data unit:	Fraction of volatile solid treated in AWMS in stage n
Description:	VS degradation factor
Source of data used:	
Value applied:	The proponents shall provide the values based on proven test results and, in the absence of such values the conservative value of VS treated in Annex I of the methodology ACM 0010 shall be used
Justification of the choice of data or description of measurement methods and procedures actually applied :	All the VS of raw manure go to the digesters. According to the Annex I of the ACM 0010, the percentage decay of VS range from 40-70%.
Any comment:	Values based on proven test results shall be provided as well as the more suitable complementary treatment system, before the land application

Data / Parameter:	$EF_{N2O,D}$, $EF_{N2O,ID}$
Data unit:	kg $_{N2O\text{-}N}$ /kg $_{N}$ for $EF_{N2O,D}$ and kg $_{N2O\text{-}N}$ /kg $_{NH3\text{-}N\text{ and }NOx\text{-}N}$ for $EF_{N2O,ID}$
Description:	N2O emission factors (direct and indirect N2O emissions) used in equations 4, 5, 12 and 13
Source of data used:	Table 10.21 (IPCC, 2006) volume 4, Chapter 10, Table 11.3 (IPCC, 2006) volume 4, Chapter 11
Value applied:	$EF_{N2O,D}$ = EF3=0 and $EF_{N2O,ID}$=EF4=0.01
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC 2006 default values are used, since there are no country specific data or region specific data available
Any comment:	Archive electronically during project plus 5 years

Data / Parameter:	F_{gasm}
Data unit:	Fraction
Description:	Fraction of N lost due to volatilization
Source of data used:	Table 11.3 (IPCC, 2006) volume 4, Chapter 11
Value applied:	0.2
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC 2006 default values are used, since there are no country specific data or region specific data available
Any comment:	Archive electronically during project plus 5 years

Data / Parameter:	EF1, EF4, EF5
Data unit:	kg $_{N2O\text{-}N}$ /kg $_{N}$ for EF1 and EF5; and kg $_{N2O\text{-}N}$ /kg $_{NH3\text{-}N\ and\ NOx\text{-}N}$ for EF4
Description:	N2O emission factor from soil and runoff water
Source of data used:	EF1 from table 11.1 (IPCC, 2006); EF4 from table 11.3 (IPCC, 2006); and EF5 from table 11.3 (IPCC, 2006), volume 4, Chapter 11
Value applied:	EF1=0.01; EF4=0.01; and EF5=0.0075
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC 2006 default values are used, since there are no country specific data or region specific data available
Any comment:	Archive electronically during project plus 5 years

Data / Parameter:	F_{leach}
Data unit:	Fraction
Description:	Fraction of N leached
Source of data used:	Table 11.3 (IPCC, 2006) volume 4, Chapter 11
Value applied:	0.3
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC 2006 default values are used, since there are no country specific data or region specific data available
Any comment:	Archive electronically during project plus 5 years

Data / Parameter:	$CEF_{BL,therm,y}$
Data unit:	tCO2/MJ
Description:	Emission factor of baseline heat use
Source of data used:	Calculated as per procedure described in the baseline methodology
Value applied:	0 (zero)
Justification of the choice of data or description of measurement methods and procedures actually applied :	No thermal energy is consumed in the AMWS project boundary
Any comment:	Confirmation needed

Data / Parameter:	$EG_{BL,y}$
Data unit:	MWh
Description:	Electricity consumption by baseline AWMS
Source of data used:	Electricity account of each baseline AWMS participant
Value applied:	The consumption varies according to the energy consumed by each baseline AWMS participant
Justification of the choice of data or description of measurement methods and procedures actually applied :	Even though the electricity account refers to all activities performed into each farm, it is conservative to consider that the full electricity consumption measured is consumed by each baseline AWMS.
Any comment:	Estimation is based on three years data prior to start of the project.

Data / Parameter:	n_{dy}
Data unit:	Number
Description:	Number of days treatment plant was operational in year y
Source of data used:	
Value applied:	365
Justification of the choice of data or description of measurement methods and procedures actually applied :	The pig farms work every day in the year, so that the AWMS are operational 365 days/year
Any comment:	Archive electronically during project plus 5 years

	$MS\%_{BL,j}$

Data / Parameter:	
Data unit:	%
Description:	Fraction of manure handled in systemj in the baseline
Source of data used:	
Value applied:	100%
Justification of the choice of data or description of measurement methods and procedures actually applied :	All the flow manure goes to the unique baseline system: anaerobic lagoons
Any comment:	Archive electronically during project plus 5 years

Data / Parameter:	GWP_{CH4}
Data unit:	tCO2e/tCH4
Description:	Global Warming Potential for CH4
Source of data used:	IPCC
Value applied:	21 for the commitment period. Shall be updated according to any future COP/MOP decisions
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Archive electronically during project plus 5 years

Data / Parameter:	GWP_{N2O}
Data unit:	tCO2e/tN2O
Description:	Global Warming Potential for N2O
Source of data used:	IPCC
Value applied:	310 for the commitment period. Shall be updated according to any future COP/MOP decisions
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Archive electronically during project plus 5 years

Data / Parameter:	D_{CH4}
Data unit:	Tonnes/m^3
Description:	Density of methane
Source of data used:	Baseline methodology ACM0010
Value applied:	0.00067 t/m^3 at room temperature (20°C and 1 atm pressure)
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Archive electronically during project plus 5 years

Data / Parameter:	MCF_d
Data unit:	
Description:	Methane conversion factor for leakage calculation assumed to be equal 1
Source of data used:	Leakage section, baseline methodology ACM0010
Value applied:	1
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Archive electronically during project plus 5 years

Data / Parameter:	$CF_{N2O-N,N}$
Data unit:	
Description:	Conversion factor N2O-N =44/28
Source of data used:	Technical literature
Value applied:	44/28
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Archive electronically during project plus 5 years

B.6.3 Ex-ante calculation of emission reductions:

>>

Following instructions outlined in the baseline methodology ACM0010, *ex-ante* emission reductions estimated for methane destruction are projected for reference purposes only. The project activity, once registered in EB of CDM, will determine emission reductions on an *ex-post* by measuring project data basis as stipulated in the monitoring plan. This data will be used to calculate emission reductions for the project activity.

In order to calculate the GHG emissions *ex-ante*, it is assumed that GHG emissions are CO2 emissions generated from the full combustion of the methane captured by digester and flared;

Equations explained in the section 6.1 are used to calculate *ex-ante* GHG emissions. In the following tables are reported the values ex-ante of baseline emissions, project emissions and leakage emissions expected during the credit period.

Table 6.3.1: Detailed baseline emissions

EQ.	Description	2008	2009	2010	2011	2012
2	baseline methane emissions in t CO2e/y ($BE_{CH4,y}$**)**	**112,905**	**112,905**	**112,905**	**112,905**	**112,905**
3	Baseline N2O emissions in t CO2e / yr ($BE_{N2O,y}$**)**	**991**	**991**	**991**	**991**	**991**
6	Baseline Co2 emissions from electricity and/or hest used in the baseline, in tCO2e/year ($BE_{elec/heat,y}$)	**1,672**	**1,672**	**1,672**	**1,672**	**1,672**
(1)	Baseline emissions in year y, in tCO2e/year. (BE_y)	**115,568**	**115,568**	**115,568**	**115,568**	**115,568**

Table 6.3.2. Deatailed project emissions

EQ.	Description	2008	2009	2010	2011	2012
8	Leakage from AWMS systems that capture's methane in t CO2e/yr ($PE_{AD, y}$)	**15,014**	**15,014**	**15,014**	**15,014**	**15,014**
9	Methane emissions from AWMS that aerobically treats the manure in t CO2e/yr ($PE_{Aer,y}$)					
11	Nitrous oxide emission from project manure waste management system in t CO2e/yr ($PE_{N2O,y}$)					
	Physical leakage of emissions from biogas network to flare the captured methane in t CO2e/yr ($PE_{PL,y}$)					
14	Project emissions from flaring of the residual gas stream in t CO2e/yr ($PE_{flare,y}$)	**15,014**	**15,014**	**15,014**	**15,014**	**15,014**
15	Project emissions from electricity and/or hest used in the baseline, in tCO2e/year ($PE_{elec/heat,y}$)	**1,672**	**1,672**	**1,672**	**1,672**	**1,672**
7	Project emissions in year y, in tCO2e/year. (PE_y)	**31,700**	**31,700**	**31,700**	**31,700**	**31,700**

B.6.4 Summary of the ex-ante estimation of emission reductions:

Table 1 - Emission reductions over the crediting period

Years	**Baseline emissions** (tons of CO_2e)	**Project activity emissions** (tons of CO_2e)	**Leakage emissions** (tons of CO_2e)	**Annual estimation of emission reductions** (tons of CO_2e)
2008	115,568	31,700		83,868
2009	115,568	31,700		83,868
2010	115,568	31,700		83,868
2011	115,568	31,700		83,868
2012	115,568	31,700		83,868
2013	115,568	31,700		83,868
2014	115,568	31,700		83,868
2015	115,568	31,700		83,868
2016	115,568	31,700		83,868
2017	115,568	31,700		83,868
Total (tons of CO_2e)	**1,155,682**	**316,999**		**838,683**

>>

B.7 Application of the monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

Data / Parameter:	**MCF**
Data unit:	Fraction
Description:	Methane correction factor
Source of data to be used:	IPCC 2006 Guidelines, Table 10.17
Value of data applied for the purpose of calculating expected emission reductions in section B.5	MCF for anaerobic lagoon: values ranging from 75% up to 78%, depending on the average annual local temperature of each AWMS participant (ranges from 16°C up to 20°C)
Monitoring frequency	Annually
Description of measurement methods and procedures to be applied:	The methane conversion factor MCF varies by manure management system and average annual temperature. The average annual temperature shall be calculated from official data source.
QA/QC procedures to be applied:	Not applicable, since this value is calculated based on official data sources to be monitored (average annual temperature)
Any comment:	Data will be annually recorded and archived electronically during project plus 5 years

Data / Parameter:	**B_{0LT}**
Data unit:	Fraction
Description:	Maximum methane production
Source of data to be used:	Table 10A-7 and 10A-8 of IPCC 2006
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.29
Monitoring frequency	Annually
Description of measurement methods and procedures to be applied:	Country specific B_0 measurements are not available, so that default values are taken from tables 10A7 and 10A-8. The parameter will be updated on latest available public data source
QA/QC procedures to be applied:	Not applicable, since this value is calculated based on official data sources to be monitored (average annual temperature)
Any comment:	Data will be annually recorded and archived electronically during project plus 5 years

Data / Parameter:	**$VS_{LT,y}$**
Data unit:	Kg dry matter/animal/year
Description:	Volatile solid excretion per animal per day
Source of data to be used:	IPCC 2006 Guidelines, Table 10.17
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Average=217.09
Monitoring frequency	annually
Description of measurement methods and procedures to be applied:	Scaling default IPCC value $VS_{default}$ for Latin America to adjust for a site-specific average animal weight W_{site}, according to equation 4, from baseline methodology ACM0010
QA/QC procedures to be applied:	Not applicable for VS default data and $W_{default}$, taken from the table 10A-7 from IPCC 2006; Applicable for animal weight data collection (W_{site}); data collection, documenting and archiving shall be applied for W_{site}.
Any comment:	Data will be annually recorded and archived electronically during project plus 5 years

Data / Parameter:	**$CEF_{BL,elec,y}$**
Data unit:	tCO2/MWh
Description:	Emission factor of baseline electricity use
Source of data to be used:	Refer to baseline methodology
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.8
Monitoring frequency	At start of the project
Description of measurement methods and procedures to be applied:	According to the baseline methodology ACM0010, in cases where electricity would, in the absence of the project activity, be purchased from the grid, the default emission factor for a diesel generator with a capacity of more than 200 kW (0.8 tCO2/MWh) shall be use if the electricity consumption is less than small scale threshold (15 GWh/yr).
QA/QC procedures to be applied:	
Any comment:	Archive electronically during project plus 5 years

Data / Parameter:	**CEF_{grid}**
Data unit:	tCO2/MWh
Description:	Emission factor of exported electricity
Source of data to be used:	Refer to baseline methodology
Value of data applied for the purpose of calculating expected emission reductions in section B.5	
Monitoring frequency	Annually
Description of measurement methods and procedures to be applied:	The generation capacity is less than the small-scale project activity (15 MW) so that the method for calculation of the grid emission factor in the simplified baseline methodology for small-scale CDM project activity AMS.I.D is used. Calculated as per procedure described in the baseline methodology. Public data source will be used
QA/QC procedures to be applied:	
Any comment:	Data will be recorded annually and archived electronically during project plus 5 years

Data / Parameter:	**CEF_d**
Data unit:	tCO2/MWh
Description:	Emission factor for project activity consumption
Source of data to be used:	**ONS - Brazilian** National Electric Grid **Operator**
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0,2611
Monitoring frequency	Annually
Description of measurement methods and procedures to be applied:	In case the electricity is imported from the grid, CEF_d should be calculated according to methodology ACM0002 (Consolidated baseline methodology for grid-connected electricity generation from renewable sources)
QA/QC procedures to be applied:	
Any comment:	Data will be annually recorded and archived electronically during project plus 5 years

Data / Parameter:	$CEF_{Pr,therm}$
Data unit:	tCO2/MJ
Description:	Emission factor for thermal energy
Source of data to be used:	Refer to baseline methodology
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0
Monitoring frequency	At the start of the project activity
Description of measurement methods and procedures to be applied:	No heat is produced, so that the factor is zero
QA/QC procedures to be applied:	
Any comment:	Calculated as per the procedure described in the baseline methodology.

Data / Parameter:	LF_{AD}
Data unit:	Fraction
Description:	Fraction of methane leakage from anaerobic digester
Source of data to be used:	IPCC 2006 and ACM0010
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.15*05%=0.09750
Monitoring frequency	Annually
Description of measurement methods and procedures to be applied:	IPCC default of 0.15 or less if methane percentage in biogas documented evidence can be provided
QA/QC procedures to be applied:	Not applicable, since this value is calculated based on official data source to be monitored
Any comment:	Data will be annually record and archived electronically during project plus 5 years

Data / Parameter:	**$R_{N,n}$**
Data unit:	%
Description:	Nitrogen degradation factor
Source of data to be used:	Refer to Annex 1 of the methodology ACM0010
Value of data applied for the purpose of calculating expected emission reductions in section B.5	$R_{N,AL}$ (anaerobic lagoon) =50 $R_{N,AD}$ (anaerobic digester) = 0
Monitoring frequency	Annually
Description of measurement methods and procedures to be applied:	Estimated from Table provided in Annex 1. The most conservative value for the technology applied must be used.
QA/QC procedures to be applied:	Not applicable since this value is calculated based on official data sources to be monitored
Any comment:	Data will be annually recorded and archived electronically during project plus 5 years

Data / Parameter:	**Type**
Data unit:	
Description:	Type of barn and AWMS
Source of data to be used:	Project participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Swine
Monitoring frequency	Barn and AWMSlayout and configuration
Description of measurement methods and procedures to be applied:	
QA/QC procedures to be applied:	
Any comment:	Archived electronically during project plus 5 years

Data / Parameter:	**CP**
Data unit:	%
Description:	Crude protein percent
Source of data to be used:	Project proponents
Value of data applied for the purpose of calculating expected emission reductions in section B.5	
Monitoring frequency	Not monitored because equation (2) of Annex 2 of ACM 0010 is used
Description of measurement methods and procedures to be applied:	equation (2) of Annex 2 of ACM 0010
QA/QC procedures to be applied:	
Any comment:	Data will be annually recorded and archived electronically during project plus 5 years

Data / Parameter:	**GE**
Data unit:	MJ/d
Description:	Gross energy intake of the anim
Source of data to be used:	Project proponents
Value of data applied for the purpose of calculating expected emission reductions in section B.5	
Monitoring frequency	Not monitored because equation (2) of Annex 2 of ACM 0010 is used
Description of measurement methods and procedures to be applied:	equation (2) of Annex 2 of ACM 0010
QA/QC procedures to be applied:	
Any comment:	Data will be annually recorded and archived electronically during project plus 5 years

Data / Parameter:	**T**
Data unit:	°C
Description:	Annual Average ambient temperature at Project site
Source of data to be used:	Project proponents
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Ranging from 16 up to 20 °C
Monitoring frequency	Monthly
Description of measurement methods and procedures to be applied:	data collection from official sources
QA/QC procedures to be applied:	
Any comment:	Data will be annually recorded and archived electronically during project plus 5 years; Used to select the annual MCF from IPCC 2006 guidelines

Data / Parameter:	**$EG_{d,y}$**
Data unit:	MWh/y
Description:	Electricity exported to grid
Source of data to be used:	Project proponents
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0 (no electricity is exported to grid)
Monitoring frequency	Annual
Description of measurement methods and procedures to be applied:	
QA/QC procedures to be applied:	Electricity meters will undergo maintenance/calibration subject to appropriate industry standards. The accuracy of the meter readings will be verified by receipts issued by the purchasing power company.
Any comment:	Data will be annually recorded and archived electronically during project plus 5 years

Data / Parameter:	Regulations
Data unit:	
Description:	Existence and enforcement of relevant regulation
Source of data to be used:	Project proponents
Value of data applied for the purpose of calculating expected emission reductions in section B.5	
Monitoring frequency	At start of crediting period
Description of measurement methods and procedures to be applied:	Quality control for the existence and enforcement of relevant regulations and incentives is beyond the bounds of the project activity. Instead, the DOE will verify the evidence collected.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	N_{LT}
Data unit:	Number
Description:	Average livestock population used in both baseline and project case emissions estimation.
Source of data to be used:	Project proponents
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Finishing (25-100)=67,270 Gestating = 20,022 nursing sows (amamentação/ leitões) = 33,959 boars= 596 Piglets (creche) = 52,003
Monitoring frequency	Monthly
Description of measurement methods and procedures to be applied:	The system on monitoring the number of livestock population is based on exhaustive counting of the pigs heads and on the entrance and the exit of animals to and from the barns
QA/QC procedures to be applied:	
Any comment:	Data will be monthly recorded and archived electronically during project plus 5 years

Data / Parameter:	**W_{site}**
Data unit:	Kg
Description:	Weight of livestock
Source of data to be used:	Project proponents
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Finishing (25-100 kg): average = 61.08kg Gestating (200 -250 kg): average = 220 kg nursing sows (1 – 6 kg): average = 3.9 kg boars= 250 kg Piglets (creche) : (6-25): average = 14.52
Monitoring frequency	Monthly
Description of measurement methods and procedures to be applied:	The system is based on monitoring the weight and number of livestock population by lot (stage) of animals periodically;
QA/QC procedures to be applied:	
Any comment:	Data will be annually recorded and archived electronically during project plus 5 years

Data / Parameter:	**F_{AD}**
Data unit:	%
Description:	Fraction of volatile solids directed to **anaerobic digesters**
Source of data to be used:	Project proponents
Value of data applied for the purpose of calculating expected emission reductions in section B.5	100
Monitoring frequency	Annually
Description of measurement methods and procedures to be applied:	All VS produced goes to anaerobic digesters
QA/QC procedures to be applied:	
Any comment:	Data will be annually recorded and archived electronically during project plus 5 years

Data / Parameter:	F_{Aer}
Data unit:	%
Description:	Fraction of volatile solids directed to aerobic treatment
Source of data to be used:	Project proponents
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0
Monitoring frequency	Annually
Description of measurement methods and procedures to be applied:	There is no aerobic treatment
QA/QC procedures to be applied:	
Any comment:	Data will be annually recorded and archived electronically during project plus 5 years

Data / Parameter:	$EL_{Pr,y} = EL_{IMP}$
Data unit:	MWh
Description:	Electricity used in Project AWMS
Source of data to be used:	Electricity account of each project AWMS participant
Value of data applied for the purpose of calculating expected emission reductions in section B.5	The consumption varies according to the energy consumed by each project AWMS participant
Monitoring frequency	Annually
Description of measurement methods and procedures to be applied:	Even though the electricity account refers to all activities performed into each farm, it is conservative to consider that the full electricity consumption measured/registered by farm is consumed by AWMS.
QA/QC procedures to be applied:	
Any comment:	Data will be annually recorded and archived electronically during project plus 5 years

Data / Parameter:	**$HG_{Pr,y}$**
Data unit:	MJ
Description:	Heat used by project AWMS
Source of data to be used:	Project proponent
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0
Monitoring frequency	At start of project
Description of measurement methods and procedures to be applied:	No heat is generated in project AWMS
QA/QC procedures to be applied:	Fuel purchase records to be cross checked with estimates
Any comment:	Data will be annually recorded and archived electronically during project plus 5 years

Data / Parameter:	**$FV_{RG,h}$**
Data unit:	m^3/h
Description:	Volumetric flow rate of the residual gas in dry basis at normal conditions in the hour *h*
Source of data to be used:	Measurements by project participants using a flow meter
Value of data applied for the purpose of calculating expected emission reductions in section B.5	
Monitoring frequency	Continuously. Values to be averaged hourly or at a shorter time interval
Description of measurement methods and procedures to be applied:	Ensure that the same basis (dry or wet) is considered for this measurement and the measurement of volumetric fraction of all components in the residual gas ($fv_{i,h}$) when the residual gas temperature exceeds 60°C
QA/QC procedures to be applied:	Flow meters will undergo maintenance / calibration subject to appropriate industry standards
Any comment:	Data will be continuously by flow meter and reported cumulatively on week basis and archived electronically during project plus 5 years

Data / Parameter:	**$fv_{CH4,RG,h}$**
Data unit:	Fraction
Description:	Volumetric fraction of methane in the residual gas on dry basis in hour h (NB: this corresponds to $fv_{i,RG,h}$ where i refers to methane).
Source of data to be used:	Measurements by project participants using a continuous gas analyser
Value of data applied for the purpose of calculating expected emission reductions in section B.5	
Monitoring frequency	Continuously. Values to be averaged hourly or at a shorter time interval
Description of measurement methods and procedures to be applied:	Ensure that the same basis (dry or wet) is considered for this measurement and the measurement of the volumetric flow rate of the residual gas ($FV_{RG,\ h}$) when the residual gas temperature exceeds 60 ºC
QA/QC procedures to be applied:	Analysers must be periodically calibrated according to the manufacturer's recommendation. A zero check and a typical value check should be performed by comparison with a standard certified gas.
Any comment:	As a simplified approach, project participants may only measure the methane content of the residual gas and consider the remaining part as N2. Archived electronically during project plus 5 years

Data / Parameter:	**$PE_{flare,,y}$**
Data unit:	tCO_2e
Description:	Project emissions from flaring of the residual gas stream in the year y
Source of data to be used:	
Value of data applied for the purpose of calculating expected emission reductions in section B.5	
Monitoring frequency	
Description of measurement methods and procedures to be applied:	The parameters used for determining the project emissions from flaring of the residual gas stream in year y ($PE_{flare,y}$) should be monitored as per "*Tool to determine project emissions from flaring gases containing methane*"
QA/QC procedures to be applied:	The parameters used for determining the project emissions from flaring of the residual gas stream in year y ($PE_{flare,y}$) should use the QA/QC procedures as per the "*Tool to determine project emissions from flaring gases containing methane*"
Any comment:	Archived electronically during project plus 5 years

Data / Parameter:	**N_{DM}**

Data unit:	kg N20-N/KG effluent
Description:	N concentration in disposed manure
Source of data to be used:	Project proponents
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Value applied only if the quantity of manure **Q_{DM}** applied to land is measured to estimate the quantity of N applied to land.
Monitoring frequency	Every batch disposed
Description of measurement methods and procedures to be applied:	
QA/QC procedures to be applied:	
Any comment:	Data will be recorded every batch and archived electronically during project plus 5 years

Data / Parameter:	**Q_{DM}**
Data unit:	Kg
Description:	Mass of manure disposed outside project boundary
Source of data to be used:	Project proponents
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Value applied only if the quantity of N applied to land **Q_{DM}** is measured and not estimated by formula.
Monitoring frequency	Every batch disposed
Description of measurement methods and procedures to be applied:	
QA/QC procedures to be applied:	
Any comment:	Data will be annually recorded and archived electronically during project plus 5 years

Data / Parameter:	**MS%**
Data unit:	Fraction
Description:	Fraction of manure handled in system j in project activity
Source of data to be used:	Project proponents
Value of data applied for the purpose of calculating expected emission reductions in section B.5	100
Monitoring frequency	
Description of measurement methods and procedures to be applied:	All the manure goes into a unique system
QA/QC procedures to be applied:	
Any comment:	Data will be annually recorded and archived electronically during project plus 5 years

Data / Parameter:	**NEX_{LT}=NEX_{site}**
Data unit:	Kg N/animal/year
Description:	Annual average nitrogen excretion per head of a defined livestock population in Kg N/animal/year estimated as described in Annex 2.
Source of data to be used:	Refer to Annex 2 of methodology ACM0010
Value of data applied for the purpose of calculating expected emission reductions in section B.5	
Monitoring frequency	annually
Description of measurement methods and procedures to be applied:	In absence of availability of project specific information on Protein intake, which should be justified in the CDM-PDD, site-specific national or regional data should be used for the nitrogen excretion NEX, if available. In the absence of such data, default values from table 10.19 of the IPCC 2006, volume 4, chapter 10.) may be used and should be corrected for the animal weight at the project site
QA/QC procedures to be applied:	
Any comment:	Data will be annually recorded and archived electronically during project plus 5 years

Data / Parameter:	**GE_{LT}**
Data unit:	MJ/day
Description:	Daily average gross energy intake in MJ/day
Source of data to be used:	Project peoponents
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not monitored
Monitoring frequency	Not monitored because equation 4 of ACM 0010 is applied
Description of measurement methods and procedures to be applied:	
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	**DE_{LT}**
Data unit:	%
Description:	Digestible energy of the feed in percentage
Source of data to be used:	
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not monitored
Monitoring frequency	Not monitored
Description of measurement methods and procedures to be applied:	
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	**UE**
Data unit:	Fraction of GE
Description:	Urinary energy expressed as fraction of GE
Source of data to be used:	
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not monitored
Monitoring frequency	Not monitored because equation 4 of ACM 0010 is applied
Description of measurement methods and procedures to be applied:	
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	**ASH**
Data unit:	Fraction of dry matter feed intake
Description:	Ash content of the manure calculated as a fraction of the dry matter feed intake
Source of data to be used:	
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not monitored
Monitoring frequency	Not monitored because equation 4 is applied
Description of measurement methods and procedures to be applied:	
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	**ED_{LT}**
Data unit:	MJ/kg
Description:	Energy density of the feed in MJ/kg fed to livestock type LT
Source of data to be used:	
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not monitored
Monitoring frequency	Not monitored because equation 4 of ACM0010 is applied
Description of measurement methods and procedures to be applied:	
QA/QC procedures to be applied:	
Any comment:	

B.7.2 Description of the monitoring plan:

B.8 Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies)

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SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

>>01/January/2008

C.1.2. Expected operational lifetime of the project activity:

>>10 years

C.2 Choice of the crediting period and related information:

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

>>

C.2.1.2. Length of the first crediting period:

>>

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>01/January/2008

C.2.2.2. Length:

>>10 years

SECTION D. Environmental impacts

>>

D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

>> Anaerobic lagoons are widely used to treat and store liquid manure from confined swine production facilities in Brazil. Even though they are in compliance with Brazilian legislation, environmental and health concerns with the lagoon technology still persists because the system is considered unable to reduce ammonia emissions, odors, pathogens, and water quality deterioration (Vanotti et al., 2006).

Vinotti et al. (2006) consider as environmentally superior technology (EST) any technology, or combination of any feasible technologies that meet the following environmental performance standards: 1. Eliminate the discharge of animal waste to surface waters and groundwater through direct discharge, seepage, or runoff; 2. Substantially eliminate atmospheric emissions of ammonia; 3. Substantially eliminate the emission of odor that is detectable beyond the boundaries of the swine farm; 4. Substantially eliminate the release of disease-transmitting vectors and airborne pathogens; 5. Substantially eliminate contamination of soil and groundwater by manure residues.

Although anaerobic lagoon meets most of these performance standards, it fails mainly regarding items 3 and 4. Differently, anaerobic digester fits well in all these performance standards, so that it is why this system is considered an advanced technology. Besides, it is a more efficacious system as the time required for lowering the wastewater COD concentration is reduced, when compared to the anaerobic lagoon.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

>>

SECTION E. Stakeholders' comments

>>

E.1. Brief description how comments by local stakeholders have been invited and compiled:

>>

E.2. Summary of the comments received:

>>

E.3. Report on how due account was taken of any comments received:

>>

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	
Street/P.O.Box:	
Building:	
City:	
State/Region:	
Postfix/ZIP:	
Country:	
Telephone:	
FAX:	
E-Mail:	
URL:	
Represented by:	
Title:	
Salutation:	
Last Name:	
Middle Name:	
First Name:	
Department:	
Mobile:	
Direct FAX:	
Direct tel:	
Personal E-Mail:	

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

Annex 3

BASELINE INFORMATION

Annex 4

MONITORING INFORMATION

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