**CLEAN DEVELOPMENT MECHANISM**
**PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)**
**Version 03 - in effect as of: 22 December 2006**

**CONTENTS**



**Annexes**

**Revision history of this document**

| Version Number | Date | Description and reason of revision |
|---|---|---|
| 01 | 21 January 2003 | Initial adoption |
| 02 | 8 July 2005 | • The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document.<br>• As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>. |
| 03 | 22 December 2006 | • The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM. |

## SECTION A. General description of small-scale project activity

### A.1 Title of the small-scale project activity:

ANAEROBIC DIGESTION SWINE WASTEWATER TREATMENT WITH ON-SITE POWER PROJECT (ADSW RP2002)
- Version 4
-Completed 8 September 2008

### A.2. Description of the small-scale project activity:

The Anaerobic Digestion Swine Wastewater Treatment With On-Site Power Project (ADSW RP2002) (hereafter, the "Project") that is being developed by Hacienda Bio-Energy Corporation (hereafter referred to as the "Project Developer" or "HBC") is an anaerobic digestion swine wastewater treatment project coupled with an on-site power generator at Empire Farm, Inc. (hereafter referred to as the "Empire Farm" or the "Farm"). Philippine Bio-Sciences Co., Inc. (hereafter referred to as "PhilBIO") has been contracted for the design, engineering, operations and management of the Project.

The farm, located at Barangay Pilpila, Sta. Ignacia, Tarlac, is owned and managed by the Empire Farms, Inc. The farm employs normal scraping and hose-down cleaning of waste, mixing the manure with urine and wastewater leading to a series of open lagoons. Such lagoon-based treatment is standard practice in the South East Asian region. This waste material is left to decay in the facility's open lagoon system, producing significant amounts of biogas methane that is emitted directly to the atmosphere. This biogas emission contributes to significant air (odour) and water pollution in the areas close to the farms.

The Project introduces a method of utilizing biological treatment to enhance the farm's wastewater treatment. The Project has four principle objectives:

(a) Manage the farms wastewater, and reduce the organic loading of the wastewater;
(b) Reduce odour that is a significant issue for local people;
(c) Project power from captured biogas; and
(d) Reduce harmful emission of greenhouse gases.

The 'Covered In-Ground Anaerobic Reactor' (or the 'CIGAR®[1]'), effectively breaks down organic contaminants through a multi-step biological treatment of the wastewater in the absence of oxygen. High density polyethylene (HDPE) liner and cover are used to provide for a 'air tight' and to prevent leachate from percolating through the ground and polluting local ground water aquifer resources. The results: around 95% destruction of harmful biochemical oxygen demand (BOD), and 80% reduction of chemical oxygen demand (COD). Suspended solids are to be reduced and colour is to be improved in the CIGAR® system. The digester is designed to maintain a 30 days retention time (number of days in the CIGAR®), and this continued exposure to temperature in the order of 35°C to effectively reduce pathogenic material. The effluent is then sent to a final treatment lagoon where normal facultative aerobic process

[1] CIGAR is a duly registered trademark owned by PhilBIO with the Intellectual Property Office (IPO) of the Philippine Bureau of Trademarks.

predominates. If there is any case a need of effluent discharge to the local watercourse, it will do so well within the Department of Environment and Natural Resources (the 'DENR') standards.

In this system, biogas is recovered through its CIGAR® design. Methane, a potent greenhouse gas and potential energy source, is on average 65% of the biogas by volume emitted from the current lagoon based treatment to atmosphere and captured utilising the CIGAR®. In the farm's CIGAR®, the wastewater is expected to produce an average of 1,485 $m^3$ of biogas per day from the system all year around.

The biogas produced in the farm's anaerobic digesters will be used to generate electricity for use on-site. A biogas-fuelled 200 KW generator, producing 1,533MWh of electricity annually (conservative estimate), will be installed.

The capacity of the generator set is designed to match the actual peak demand of the farm. This peak demand may alter (increasing and decreasing) year on year as a result of a variety of factors such as demand for pork and disease, etc (it is not necessarily a static demand). The design of the project to match actual peak demand is deliberate as the host farm is the only potential buyer of power generated at present, there is an inability to export surplus energy to the grid with possible surplus biogas having to be flared. This is due to the regulatory restrictions on small private power producers exporting to the grid at the time of project development in the Philippines[2].

Due to the changes of the power demand in the farm throughout the course of the day, the maximum power generation capacity of the project will not be reached. It is the characteristic of the generator set that its output is automatically adjustable to the power demand instantaneously. Thus the electrical output of the project activity will never be greater than the actual captive demand of the host farm.

The CIGAR® has been designed with some gas storage capacity. Any surplus biogas, where produced, will be kept inside the CIGAR®. A methane destruction system will be installed, for example an open flare or an additional generator set, when regulatory barriers are removed to allow the export of surplus electrical energy to the local distribution grid.

The Project will make a significant contribution to helping the Host Country meet its sustainable development goals outlined in the Philippine Agenda 21 with the following benefits observed:

***Macro Level Benefits***

- Clean technology both in wastewater management and in renewable energy will be demonstrated and may be replicated throughout the country's livestock sector as well as in the Asian region;
- National energy self-sufficiency is increased with the use of renewable and indigenous energy resources, which correspondingly decreases dependence on imported fossil fuel and a reduction in negative impacts of fuel imports on the nations balance of payments;
- Global environmental protection is supported by the capture of fugitive GHGs; specifically methane, and the reduction in energy related emissions;
- A New Financial Mechanism for financing in the renewable energy and waste management sectors via the Clean Development Mechanism (CDM) is positively demonstrated and shown to

[2] Also refer to section B.5 for more information on the export restriction.

present an alternative development path through the improvement in the financial viability of marginal projects; and
- Incremental reduction on the need for new build power plants at a national level.

***Micro Level Benefits***
- Control of leachate that would otherwise pollute groundwater resources;
- Reduction in wastewater emissions to local water resources;
- A Healthier and Safer Work Place is developed with improvements in local air quality, and control of highly combustible methane emissions;
- Considerable reduction in odour from the existing treatment facility that currently affects local communities;
- Increased energy self sufficiency of the project host;
- Improvement in the viability of rural enterprises, enterprises that support local employment in the agricultural sector; and
- Generation of locally produced energy to provide a more reliable energy source than the current grid system.

## A.3. Project participants:

| **Name of Party involved (*) ((host) indicates a host Party)** | **Private and/or public entity(ies) Project participants(*) (as applicable)** | **Kindly indicate if the Party involved wishes to be considered as project participant** |
|---|---|---|
| The Philippines (host) | Hacienda Bio-Energy Corporation | No |
| The United Kingdom | Trading Emissions PLC | No |

Trading Emissions PLC (TEP) is the official contact for the CDM project activity and Focal Point for all communication with the CDM EB. Further contact information of project participants is provided in Annex 1.

## A.4. Technical description of the small-scale project activity:

*Figure 1 Lagoon, The Local Common Practice*

HBC proposes an alternative manure waste management system to recover methane gas emissions as an alternative to the current open lagoon systems. Wastewater treated in these lagoons is often at an ambient temperature of around 35ºC, and under anaerobic conditions. The result of this is that biogas methane is emitted continuously from lagoons as can be seen in this typical farm lagoon system image.

Through its engineering product, the CIGAR®, the biogas recovered from each farm will be used to provide fuel for each farm’s on site electric power plant.

The CIGAR® breaks down organic contaminants through a three-step biological process where wastewater is treated in the absence of oxygen. The anaerobic bacteria present inside the CIGAR® digests the organic content, specifically the total solids of the wastewater. This effectively minimizes the amount of sludge left inside the CIGAR. With proven experience, desludging is hardly required for the system. If the need arises, the sludge will be bagged, weighed, and properly disposed of through composting.

The effluent is retained in the reactor where complex microbial consortia breakdown the waste to methane and carbon dioxide which is used as biogas for electricity generation on site (*Figure 2 the CIGAR System*). The biogas stored in the CIGAR will be used to start-up the biogas engine, eliminating the need to use grid-fed electricity or diesel fuel, during start-ups.

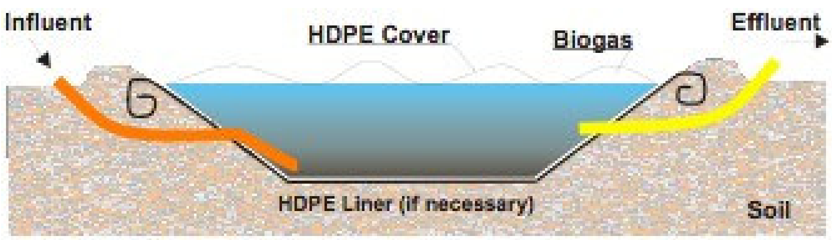


*Figure 2 The CIGAR® System*

HDPE liner and cover are used to provide an 'air-tight' system to prevent leachate from escaping to the underground aquifer and to prevent methane from escaping to the atmosphere. The CIGAR® system is 'covered' 100% of the time with 1.0mm HDPE liners. This process results in at least 95% destruction of harmful BOD, and 80% reduction of COD. Suspended solids are reduced and colour is improved in the CIGAR®. The internal environment of 35$^{o}$C reduces pathogenic material of the wastewater. The effluent is then sent to a final treatment lagoon where normal facultative aerobic process predominates. Methane gas makes up at least 65% of the biogas by volume. The biogas produced from the farm will be used to generate electricity through the electricity generation unit located within the farm's boundary.

**A.4.1. Location of the small-scale project activity:**

**A.4.1.1. Host Party(ies):**

Philippines

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

Region III, Tarlac

**A.4.1.3. City/Town/Community etc:**

Barangay Pilpila, Sta. Ignacia

**A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale project activity:**

The Project is located at Empire Farm at Barangay Pilpila at the municipality of Sta. Ignacia, Tarlac, Region III. The GPS coordinates are N15°36.205', E120°28.710'. Please refer to *A.2. Description of the small-scale project activity* and *Figure 3 Location Maps* for the farm's specific location.

Tarlac is a province located at Central Luzon, Region III. Tarlac borders are Pangasinan (North), Nueva Ecija (East), Zambales (South to South-East), and Pampanga (South). The Province has a population of 1,068,783 divided into 17 municipalities (subdivided into 510 barangays) and one city (Tarlac City). The province, being a 75% plain geography, has agriculture, as it's primary economy. Its primary products are rice and sugarcane. Other major crops are corn, coconut; vegetables such as eggplant, garlic, onion; and fruit bearers such as mango, banana, and calamansi. On its west side major economic privileges are timber for logging and soil minerals such as iron and manganese. The province is also known for its industries in cottage and ceramics[2].

Sta Ignacia is a 4th class municipality in the province of Tarlac. The Municipality has a population of 38,301 people divided into 24 barangays on a total of 8,145 households (as of year 2000).


*Figure 3 Location Maps*[3]

**A.4.2. Type and category(ies) and technology/measure of the small-scale project activity:**

The categories for the project activities according to the UNFCCC's published Appendix B of the simplified modalities and procedures for small-scale CDM project activities are:

[3] Source: Wikepedia, The Free Encyclopedia, www.en.wikepedia.org

- Type I.D (reference AMS-I.D v.12)– "*Grid connected renewable electricity generation*" – for the electricity generation component; and,

- Type III.D (reference AMS-III.D v.13) – *"Methane recovery in agricultural and agro industrial activities"* – for the methane recovery component.

The project activities conform to project category III.D since the Project will reduce anthropogenic emissions by sources, directly emit less than 15kt of carbon dioxide equivalent annually, and result in emission reductions lower than or equal to 60kt$CO_2$e annually. The project activities conform to project category I.D since the renewable generating units will displace electricity from an electricity distribution system and supply an individual user with a small amount of electricity and the capacity will not exceed 15 MW. A detailed discussion of the technology of the project activities can be found in *Section A.4*.

### A.4.3 Estimated amount of emission reductions over the chosen crediting period:

| **Years** | **Annual estimation of emission reductions in tonnes of $CO_2$e** |
|---|---|
| Year 2008 (June to December) | 3,378 |
| Year 2009 | 5,790 |
| Year 2010 | 5,790 |
| Year 2011 | 5,790 |
| Year 2012 | 5,790 |
| Year 2012 | 5,790 |
| Year 2013 | 5,790 |
| Year 2014 (January to May) | 2,412 |
| **Total estimated reductions (tonnes of $CO_2$e)** | 40,530 |
| **Total number of crediting years** | 7 (renewable up to 21 years) |
| **Annual average over the crediting period of estimated reductions (tonnes of $CO_2$e)** | 5,790 |

### A.4.4. Public funding of the small-scale project activity:

The host farm for the project will provide land and the wastewater, while the project developer (HBC) will fund the Project entirely. The Project has not received and will not seek public funding.

### A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large-scale project activity:

Based on the information provided in Appendix C of the simplified modalities and procedures for small-scale CDM project activities, this project activities is not a debundled component of a larger project activity since the project participants have not registered nor operated another project in the region surrounding the project boundaries.

## SECTION B. Application of a baseline and monitoring methodology

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

Project activity type I.D (reference AMS-I.D/version 12) – *Grid connected renewable electricity generation*; and,

Project activity type III.D (reference AMS-III.D/version 13) – *Methane recovery in agricultural and agro industrial activities.*

### B.2 Justification of the choice of the project category:

The Project conforms to project category III.D since the Project will reduce anthropogenic emissions by sources, directly emit less than 15kt of carbon dioxide equivalent annually, and result in emission reductions lower than or equal to 60kt$CO_2$e annually. The Project conforms to project category I.D. since the renewable generating unit will displace electricity from an electricity distribution system and supply an individual user with a small amount of electricity and the capacity will not exceed 15 MW. A detailed discussion of the technology of the project activity can be found in *Section A.4*.

These selections are appropriate because the alternative to the project activities would be to continue with the business-as-usual scenario. This scenario would continue to manage wastewater through the existing aerobic pond system, and would continue to use electricity from the electricity distribution system in the area.

### B.3. Description of the project boundary:

The project boundary for each farm is defined as the notional margin around each project within which the project's impact (in terms of carbon emission reductions) will be assessed. As referred to in Appendix B of the simplified modalities and procedures for small-scale CDM project activities:

- The project boundary for type I.D (AMS-I.D) is the physical, geographical site of the renewable generation source.

- The project boundary for type III.D (AMS-III.D) projects is the physical, geographical site of the methane recovery facility.

For the purposes of this analysis, different boundaries were applied in relation to the elements contributing to project and baseline emissions:

- Electricity and Fuel Oil Displacement/Emissions: The boundaries are assumed to be the physical, geographical site of the generating unit.

- Wastewater Methane Emissions/Mitigation: The boundaries are assumed to be physical, geographical site of the methane recovery facility at each farm's facility.

**B.4. Description of baseline and its development:**

As specified in Appendix B:

- The appropriate baseline for project category Type I.D (AMS-I.D) is found in paragraphs 9.
- The appropriate baseline for project category Type III.D (AMS-IIID) is found in paragraphs 7 and 8.
- Date of completing the final draft of this baseline section *(DD/MM/YYYY)*: 04/07/07

For AMS-I.D:
Baseline electricity generation emissions are given by:

$$E_{baseline} = EP_{BIO} \times CEF_{grid}$$

Where:
$E_{baseline}$: Baseline electricity generation emissions ($tCO_2e$/year)
$EP_{BIO}$: Electricity produced by the biogas generator unit for grid electricity replacement (MWh)
$CEF_{grid}$: Emission coefficient for electricity grid (kg $CO_2e$/kWh). The calculation of CEF is provided in a separate spreadsheet.

For AMS-III.D:
Baseline fugitive GHG emissions are:

$$FE_{baseline} = FM_{baseline} \times GWP$$

Where:
$FE_{baseline}$: Baseline fugitive GHG emissions ($tCO_2e$/year)
$FM_{baseline}$: Baseline fugitive methane emissions (t/year)
$GWP$: Global warming potential for methane ($tCO_2e$/t)

Baseline fugitive methane emissions are:

$$FM_{baseline} = EF_i \times Pop$$

Where:
$FM_{baseline}$: Baseline fugitive methane emissions ($tCO_2e$/year)
$EF_i$: Annual emission factor of the animal type i (i.e. swine for this document) (kg)
*Pop*: Swine population

Annual emission factor for swine is:

$$EF_i = VS_i \times 365 \text{ days/year} \times B_{oi} \times 0.67 \text{ kg/m}^3 \times \sum MCF \times MS\%$$

Where:
*$EF_i$*: Annual emission factor for swine (kg)
*$VS_i$*: Daily volatile solid excreted for swine (kg)
*$B_{oi}$*: Maximum methane producing capacity ($m^3$/kg of VS) for manure produced by swine
*MCF*: Methane conversion factor for the swine manure management system
*MS%*: Fraction of swine manure handled using manure system

$$VS = [GE \times (1-DE\%/100) + (UE \times GE)] \times (1-ASH\%/18.45)$$

Where:
*VS:* Volatile solid excretion per day on a dry weight basis (kg)
*GE*: Estimated daily average feed intake (MJ/day)
*UE x GE*: Urinal energy expressed as fraction of GE (MJ/day)
*DE%:* Digestibility of the feed (%)
*ASH%*: Ash content of the manure (%)

Therefore, total baseline emissions ($TB_{emissions}$) are:

$$TB_{emissions} = FE_{baseline} + E_{baseline}$$

**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 small-scale CDM project activity:**

*Market Situation & National Policies*

The Philippines has approximately 5 million farms, covering approximately 9.7 million hectares and over 12.14 million pigs, with a total volume of 1.78 million metric tonnes of pork. The bulk of the pig population comes from smallholder farm, which accounts for about 85% of the total hog inventory. According to the Philippine Bureau of Agricultural Statistics, the livestock sub-sectors grew by about 2.37 percent in 2005 from 2004's negative performance. Hog production represents about 80 percent of the total Philippine livestock industry. Among the regions, Central Luzon accounted for the biggest contribution in swine production. In 2005, the swine sector grew by 3.6 percent. Due to continued strong domestic consumption of pork, hog production is likely to continue to grow at a rate of 3 to 4 percent in 2006 and beyond despite increased feed cost in the world market. The early part of 2006 showed a 7.5% increase from 2005. Filipinos are large consumers of pork meat and are known to generally prefer pork to chicken or beef[4], and significant quantities can be exported to the Chinese market, where demand is extremely high.

The industry faces a number of obstacles including the spread of economically devastating diseases as experienced in 2004 and 2005, high marketing and transaction costs, erratic supply of imported feed ingredients, supplements and biologics, and the limited availability of genetically superior breeding stock.[5]

[4] Moog, F. A., "Promotion and utilization of polyethylene biodigester in small hold farming systems in the Philippines", Research Division, Bureau of Animal Industry, Manila, Philippines, 1997

[5] Abuel-Ang, Pia, "Philippines Livestock and Products Annual 2004", USDA Foreign Agricultural Service, September 2004

The main regulatory agencies that monitor the industry are the Bureau of Animal Industry (BAI) and the National Meat Inspection Commission (NMIC) under the Philippine Department of Agriculture (DA). Environmental regulations are monitored and enforced by the Department of Environment and Natural Resources (DENR). The primary environmental laws applicable to the project are the Clean Water Act (2003), the Clean Air Act (1999) and the Ecological Solid Waste Management Act (2000).

With the continued rise of the Philippine hog industry, HBC and PhilBIO's core business is to provide wastewater treatment facilities to the numerous hog farms, with a provision for biogas capture for on-site power generation, with a principal view to generating CERs.

PhilBIO developed its very first Philippines pig wastewater project in Rocky Farm in 1999, as the project initiator/developer and primary contractor. This particular project has been used as one of the case studies in the CDM capacity building in the Philippines.[6] The project was developed as a demonstration project to showcase this alternative wastewater and bio-energy resource approach in the Philippines. In the following 5 years PhilBIO developed over 20 turnkey projects with the assistance of CDM financing. All the projects have gone into the CDM registration process, among which 14 projects have been successfully registered as of April 2008.[7] The services offered by the PhilBIO clearly matched the criteria for CDM.

The uptake of such CDM projects on a turnkey basis however has been slow, even with the added incentive of CDM finance, as few farmers (generally relatively small family run enterprises) are willing to take risk with their own capital. The time taken to develop each project having a considerable lead time as PhiBio educated the prospective farm owner as to the risks and benefits of a turnkey approach, as can be demonstrated by the number of projects developed since the first demonstration project at Rocky Farms.

As a result Trading Emission PLC (a listed UK carbon investor) worked with PhilBio to develop a programme to accelerate the development of these small scale projects across the Philippines, and South East Asia. In doing so, HBC was established to develop a programme of projects in the Philippines with CDM as the motivating major driving force. All of the HBC projects are packaged as CDM projects. HBC's initial investment has financed the development of 25 wastewater CDM projects in 2007, with further investments committed. This first tranche of projects is in the order of the total number of projects developed in the preceding 6 years. Project financing documents prepared by the fund manager in December 2006 will be submitted on a confidential basis to the DOE for validation review and in support of CDM registration.

*Barrier approach*

Evidence as to why the proposed projects are additional is offered under the following categories of barriers: (a) investment barrier, (b) technological barrier and (c) common practice.

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[6] A Dalusung contracted by UNDP and the Department of Environment and Natural Resources, 1999, Capacity Building in Clean Development Mechanism Project Activities: Philippines.

[7] Gold Farm (Ref 0612), Joliza Farm (0607), Uni-Rich Farm (Ref 0609), Gaya Lim Farm (Ref 0611), Paramount Farm (Ref 0605), D&C Farm (Ref 1206), Bondoc Farm (Ref 1205), Superior Farm (Ref 1208), Goldi-Lion Farm (Ref 1207), and Sunjin and Chonas bundled project (Ref 1325)

*a) Access-to-finance Barrier*

Small swine farms have a difficult time securing both internal (own resources) and external (external investments or debt) financing for the implementation of biogas wastewater management projects. The following factors contribute to the investment barrier that these kinds of project face and are perceived by the farm owners themselves and external lending institutions:

- Perceived Risk – Most local banks are not interested in these projects primarily because of lack of knowledge and experience with the technology.

- Bias Against Renewable Energy Projects – Renewable energy projects do not have access to government guarantees like conventional energy projects do, receiving low priority in financing programmes due to the absence of an integrated programme for the development of renewable energy sources. There is also an unfair financing treatment accorded to renewable energy technologies. Most of the attractive financing packages such as extended repayment period apply only to conventional energy projects. Shorter repayment periods for renewable energy projects effectively increase the front-end costs for potential renewable energy project investors. Few renewable energy projects, with the exception of some large-scale hydro and geothermal projects, have reached financial closure because of lack of participation of local lending institutions.[8]

- Current Practice – The current pond-based treatment method is considered standard operating practice in the Philippines and in the region for wastewater treatment. Moreover, for the project owners, the current pond system (business-as-usual scenario) is extremely financially attractive, given that it works to required specification and requires virtually no management input or investment capital to achieve the key parameters. All required lands are appropriated and the current system has sufficient capacity to handle additional waste.

- Lowest Cost – The current system represents the lowest cost option, with the only cost being the opportunity cost of alternative land use.

- General Culture – The project requires investment capital into a part of the business that is not seen as core to the farmers. Culturally, the often family-owned farm holdings will see investment prioritised into areas that directly benefit the farm and it's expansion of inventory. The farms owners perceive a significant link to technological risks from what to many is an unknown technology which further drives a reluctance for investment utilising their own resources. These risks are expanded upon below.

PhilBIO and subsequently HBC, as the technology provider and developer, have sought financing from local lending institutions. Due principally to the factors listed above, the process of securing bank lending has been unsuccessful. A rejection letter from a local bank is quoted that "… our Unit is not yet in a position to finance small scale RE project, and in particular biogas projects that PhilBIO is currently developing in the countryside on BOT arrangement and on unsecured basis. Such projects, on a stand alone are often seen as potentially risky." As a result, the project is entirely financed by TEP as a result of its core interest in the CERs.

[8] J.C. Elauria, M.L.Y. Castro and M.M. Elauria, "Biomass Energy Technologies in the Philippines: A Barrier and Policy Analysis", Energy for Sustainable Development, Volume VI, No. 3, September 2002, pp.45-46

HBC believes CDM eligibility is clearly demonstrated under such a financing environment, and also as a result of its investment in HBC to accelerate this programme of project development specifically as a result of the CDM.

Furthermore, even there is a power generation element of the project, the investor cannot enjoy much commercial benefit from its production. In the Philippines, small private power producers are restricted from export to the grid due to the lack of establishment of open access under the Electric Power Industry Reform Act (EPIRA). The EPIRA Law was enacted in 2001 with the aim to provide open access to fair and free competition. However, 7 years on, the implementation has never actually taken place. Given rigorous conditions for any enactment, there is no expectation that distribution liberalization will occur in the immediate future.[9] As a result, the installation of 200 kW is designed to match with the demand of the farm. Even there is potential to utilise surplus biogas to generate additional electricity, the sales outside of the farm cannot be realised at this time.

The project investor feels electricity sales alone do not provide sufficient incentive to attract investment in power production in this sector. The inclusion of CER revenues has therefore become an integral aspect of the Project Developer's implementation and financing strategy. The lack of appetite of the project host to undertake this project and hence the project's additionality, is further demonstrated through the need to attract third party, international, finance through foreign investment in this project, whose objective is to seek access to CERs.

*b) Technology Barrier*

The standard and well characterised technology for piggery wastewater management in the Philippines is through a series of lagoons. Biological treatment of wastewater to produce biogas is a new and relatively unknown technology in the Phillipines. The lack of available knowledge and confidence in the technology, especially among small, privately owned swine farms, makes this type of development difficult to establish. As a result, most swine farm owners view this technology as risky and prefer to maintain their farms in the traditional fashion. This risk is reflected in the fact that there are not many projects of this type in the Philippines. Moreover, many farmers are concerned that a bio-digester project is too complex to operate and maintain. The anaerobic digestion and biogas system that will be utilized in the Project is quite different than previous experience in the Philippines in relation to wastewater treatment. The project activity represent a significantly more technologically advanced alternative to the business-as-usual scenario, and one that carries higher perceived risks.

Anaerobic digestion systems are perceived as relatively high risk, being based upon the function of a biological system that is neither 100% characterized, nor performance-guaranteed. The biological system is at constant risk of chemical shocks that can wipe out the anaerobes and biological activity (and subsequently, the waste management and energy production regimes, which are both keys to commercial operations). The Piggeries industry is prone to disease due to the close confinement of animal populations, and the biological and pharmaceutical agents used to as preventative disease measures, and in disease treatments, are all substances that will shock a digester and the bacterial cultures required to generate biogas within them, often killing the population during the period such materials are being used. Anaerobic digestion systems require constant and on-going precise management of a variety of elements

[9] http://www.congress.gov.ph/download/cpbd/Occasional_Paper_05_EPIRA.pdf

- water flows, pH levels, etc, and the skills to manage such systems are not readily available. Overall, the project scenario involves higher perceived risks due to the performance uncertainty and a low market share of the new technology.

*c) Common Practice*

The CIGAR® technology that will be utilized in the project activities is not a common practice in the Philippines and represents a higher risk alternative to the business-as-usual scenario. At present, lagoon-based treatment is the standard practice in the Philippines and in the regions for swine farms. There is little experience in utilizing aerobic or anaerobic technologies in the Philippine context, and therefore, these are not considered a high management priority. The highest priority for most in the sector is the management of their waste discharges to simply maintain compliance with local regulations. From the operator's perspective, the lagoon system is a cheap and sufficient way to clean the wastewater.

*Summary*

The current and expected practice in the host nation, which relies almost exclusively on lagoon-based wastewater treatment facilities for piggeries, as well as the combination of lack of access to financing and perceived risks of the selected technology, clearly demonstrate that the Project is additional and therefore not the baseline scenario. The prohibitive barriers that exist in the Philippines are confirmed by the observed trend in current piggery wastewater management practices.

The barrier analysis above clearly demonstrates that the most plausible baseline scenario is the prevailing practice of lagoon-based systems. The most significant barriers facing the Project are technology familiarity, perceived risk of the technology and the relative lack of investment interest among the key business constituency.

## B.6. Emission reductions:

### B.6.1. Explanation of methodological choices:

**Emission reductions**

AMS-I.D:
The electricity generated by the biogas times the $CO_2$ emission coefficient for the displaced electricity from the grid and of the displaced fossil fuel.

AMS-III.D:
The lower of the two values of (1) actual monitored amount of methane captured and destroyed by the project activity (2) the methane emissions calculated ex ante using the amount of waste or raw material that would decay anaerobically in the absence of the project activity, with the most recent IPCC tier 2 approach.

**Project direct emissions**

AMS-I.D:

As the Project is utilising biogas with biogenic origins to produce renewable energy, and the design of the system does not include many electrical appliance except for one blower (consuming 3.2 MWh per annum supplied by the system itself). The anthropogenic emissions from this component are considered to be zero.

AMS-III.D:
Project emissions consist of CO2 emissions from use of fossil fuels or electricity for the operation of the facility. As stated in the paragraph above, the systems' design only utilizes one blower, on which the anthropogenic emissions are considered negligible.

As a conservative manner, a number of potential sources are taken into consideration for project emissions, including:

- Physical leakage from the system

The methane recovery facility, the Project, is designed and constructed to collect all the biogas from the digester. First of all, the digester is designed to operate with negative pressure, so that biogas is efficiently sent to the generator. Secondly, the perimeter of the digester employs an 'anchor-trench' lining design, where the liner of the digester exceeds the perimeter by approximately one meter. The gas-impermeable cover of the digester also extends beyond the perimeter of the digester in order to meet the liner. The liner and cover are then sealed at the perimeter of the digester and the overlapped portion (approximately one meter) is then buried and compacted with soil to further anchor the liner and cover. It is very unlikely biogas generated in the digestion process will not be captured by the CIGAR.

Physical leakage from the pipeline is considered to be zero, as the pipeline from collection point to the combustion points is short (less than 1km, and for on site delivery only).

- Methane captured and not flared

It is unlikely that there will be any leakage from the flares, as the flares will only be in use when there is more biogas than can be combusted in the generator. Nonetheless, ex post determination will be defined after the measurement of the flare efficiency is attempted.

It is unlikely that there will be any un-combusted methane from the generator, given the generator has been designed for high performance. Combustion efficiency test will be conducted on the generator each year.

- CO2 emission from combustion of non-biogenic methane

Not applicable. No other fuel than biogas will be used.

- If the sludge is treated and/or disposed anaerobically, the resulting methane emissions shall be considered as project emissions.

Not applicable to ex-ante estimate. No sludge is anticipated to be leaving the system during the crediting period based on the developer's experience. However, the aerobic treatment and/or proper soil application of the sludge leaving the digester in the project activity shall also be ensured and monitored.

**<u>Leakage</u>**

AMS-I.D, paragraph 12, states that no leakage calculation is required since the equipment is not being transferred to or from another activity.

AMS-III.D, paragraph 9, states that no leakage calculation is required.

**Baseline**

The total baseline emissions ($TB_{emissions}$) are:

$$TB_{emissions} = FE_{baseline} + E_{baseline}$$

Therefore, the total emission reductions are:

$$ER = FE_{baseline} + E_{baseline} - PE_{project}$$

Refer to section B.4 for details of the calculations of each source.

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

| **Data / Parameter:** | **$CEF_{grid}$** |
|---|---|
| Data unit: | $tCO_2/MWh$ |
| Description: | Emission coefficient of the electricity distribution system |
| Source of data used: | Philippine Department of Energy (PDOE) – www.doe.gov.ph |
| Value/s applied: | 0.557 (Luzon grid) |
| Justification of the choice of data or description of measurement methods and procedures actually applied: | Calculated according to the most recent ACM0002, using publicly available statistic data. At the time of the PDD validation submission in 2007, the PDOE has published the energy statistics up to 2005. |
| Any comment: | Computations of grid CEFs are attached as a separate excel spreadsheet. |

| **Data / Parameter:** | **Pop** |
|---|---|
| Data unit: | Heads |
| Description: | Animal population in the Farm |
| Source of data used: | Farm Specific |
| Value/s applied: | 10,000 |
| Justification of the choice of data or description of measurement methods and procedures actually applied: | The current animal population of the farm is used for the ex-ante estimation of emission reductions.<br>For each year during the crediting period, emission reductions will be the lower value of the two, (1) the monitored methane captured and destroyed and (2) the ex-ante estimate number. |

| | |
|---|---|
| Any comment: | |

| **Data / Parameter:** | **Capacity** |
|---|---|
| Data unit: | kW |
| Description: | Installed generator capacity in the Farm |
| Source of data used: | Project design |
| Value/s applied: | 200 |
| Justification of the choice of data or description of measurement methods and procedures actually applied: | |
| Any comment: | |

| **Data / Parameter:** | **Manure management system usage** |
|---|---|
| Data unit: | % |
| Description: | Fraction of manure being treated by the system |
| Source of data used: | Project design |
| Value/s applied: | 100 |
| Justification of the choice of data or description of measurement methods and procedures actually applied: | |
| Any comment: | |

| **Data / Parameter:** | **Operation rate** |
|---|---|
| Data unit: | % |
| Description: | Fraction of time generator is operational |
| Source of data used: | PhilBIO's experience |
| Value/s applied: | 87.5 |
| Justification of the choice of data or description of measurement methods and procedures actually applied: | To enhance conservativeness, the operation rate adopted is at 87.5% based on project developer's experience. |
| Any comment: | |

| **Data / Parameter:** | **Feed mass intake** |
|---|---|
| Data unit: | kg/day |
| Description: | The average mass of feed intake per head per day |
| Source of data used: | Philippine Department of Agriculture http://www.geocities.com/zambo_da9/tip_swine_raising.html |

| | |
|---|---|
| Value/s applied: | 2.66 |
| Justification of the choice of data or description of measurement methods and procedures a ctually applied: | |
| Any comment: | |

| **Data / Parameter:** | **Bo** |
|---|---|
| Data unit: | $m^3$ $CH_4$ / kg VS |
| Description: | Maximum methane producing capacity for manure produced by livestock category |
| Source of data used: | IPCC 2006 Table A10-8 |
| Value/s applied: | 0.29 |
| Justification of the choice of data or description of measurement methods and procedures actually applied: | Default value for Asia used |
| Any comment: | |

| **Data / Parameter:** | **MCF** |
|---|---|
| Data unit: | % |
| Description: | Methane Correction Factor |
| Source of data used: | IPCC 2006 Table A10-8 |
| Value/s applied: | 80 |
| Justification of the choice of data or description of measurement methods and procedures actually applied: | Default factor for Lagoon-based manure management system at 27$^o$C annual average temperature in the Philippines |
| Any comment: | |

| **Data / Parameter:** | **T** |
|---|---|
| Data unit: | °C |
| Description: | Average annual temperature |
| Source of data used: | Philippine Atmospheric, Geophysical & Astronomical Services Administration http://www.pagasa.dost.gov.ph/cab/climate.htm |
| Value/s applied: | 27 |
| Justification of the choice of data or description of measurement methods and procedures | |

| | |
|---|---|
| actually applied: | |
| Any comment: | |

| **Data / Parameter:** | **UE*GE** |
|---|---|
| Data unit: | % |
| Description: | Unrinary energy expressed as fraction of energy intake |
| Source of data used: | IPCC 2006 page 10.42 |
| Value/s applied: | 2% |
| Justification of the choice of data or description of measurement methods and procedures actually applied: | 0.02 has been selected according to the description of equation 10.24 of the IPCC. |
| Any comment: | |

| **Data / Parameter:** | **DE** |
|---|---|
| Data unit: | % |
| Description: | Digestibility |
| Source of data used: | IPCC 2006 Table 10.2 |
| Value/s applied: | 80% |
| Justification of the choice of data or description of measurement methods and procedures actually applied: | The lower end of the feed digestibility for growing swine has been selected. |

### B.6.3 Ex-ante calculation of emission reductions:

AMS-I.D:
**Baseline emissions are calculated as the following:**
Based on the Project Developers assumptions and observations on the project's engine running time, the total annual amount of electricity from the grid displaced is estimated at 1,533MWh.

The Farm will utilise a 200 kW generator engine, which is connected to the Luzon Grid[10], therefore,

*Table B.6.3.a AMS-I.D Baseline*

| | Value | Source |
|---|---|---|
| a. Installed Capacity (kW) | 200 | Project |

[10] Source of the emission coefficient factors of the electricity grids of the Philippines: (1) "CDM Baseline Construction for the Electricity Grids in the Philippines", prepared by the Klima Climate Change Center of the Manila Observatory for the Environmental Management Bureau of the DENR; and (2) 2005 energy date published by the Philippine Department of Energy on http://www.doe.gov.ph/power/Power%20Stat%202005%20update042406.htm

| | | |
|---|---|---|
| b. Genset Operating Rate | 87.50% | Measured |
| c. Daily Electricity Generation (kWh/day) | 4,200 | Calculated (a x b x 24 hrs) |
| d. Annual Electricity Generation (MWh/year) | 1,533 | Calculated (c x 365/1000) |
| e. Emissions Coefficient (tonne CO2e/MWh) | 0.557 | Refer to the CEF spreadsheet and Annex 3 |
| **Annual CO2 emission reductions from electricity generation (tonne CO2e/year)** | **854** | Calculated (d x e) |

Estimated annual baseline emission of the electricity displacement component of the project activities is **854 tonnes $CO_2$e/year.**

**Project emissions:**
As the Project is utilising biogas with biogenic origins to produce renewable energy, and the design of the system does not include many electrical appliance except for one blower (consuming 3.2 MWh per annum supplied by the system itself). The anthropogenic emissions from this component are considered to be zero.

**Leakage:**
AMS-I.D, paragraph 12, states that no leakage calculation is required since the equipment is not being transferred to or from another activity.

AMS-III.D:
**Baseline emission is calculated as follows:**

Country specific value for feed intake per day is:
Feed mass (kg/day) x energy per mass unit (kcal/lb) x conversion factor
Therefore,
GE (MJ/day) = 2.66 (kg/day) x 3250 (kcal/kg) x 0.0041868 (MJ/kcal) = **36 (MJ/day)**[11],

*Table B.6.3.b AMS-III.D Baseline*

| | **Value** | **Source** |
|---|---|---|
| Pig population | 10,000 | Farm |
| Daily Intake per Head (MJ/day) | 36 | Calculated |
| Digestibility | 80% | IPCC T10.2 |
| Urinary Energy | 0.02 | IPCC page10.42 |

[11] Source of the daily feed intake: (1) Philippine daily feed mass, Deparment of Agriculture (Zamboanga Region, Philippines) http://www.goecities.com/zambo_da9/tip_swine_raising.html; (2) energy per mass unit, Herr et al. (2000), Evaluating Variable Feed Energy Levels for Grow-Finish Pigs, http://www.ansc.purdue.edu/swine/swineday/sday00/8.pdf; (3) mass unit conversion factor, www.onlineconversion.com; (4) feed intake rate affected by temperature, Effect of Environment on Nutrient Requirements of Domestic Animals, http://www.fermat.nap.edu/openbook.php?record_id=49638&page=32)

| | | |
|---|---|---|
| Ash Content | 4% | IPCC1996 page4.23 |
| Daily Volatile Solids Excretion (kg/day) | 0.41 | Calculated based on IPCC tier 2 |
| Bo, Maximum Methane-Producing Capacity (m3/kg VS) | 0.29 | IPCC T10.A |
| MCF, Methane Conversion Factor | 80% | IPCC T10.A |
| EF, Annual Emission Factor (kg) | 23.51 | Calculated |
| Annual Methane Capture (tonnes) | 235 | Calculated |
| Methane Density (kg/m3) | 0.667 | Default |
| Methane Content | 65% | Project specific |
| Daily Biogas Offtake (m3/day) | 1,485 | Calculated |
| GWP Methane | 21 | Approved Global Warming Potential for CH4 |
| **Annual Baseline (tonnes CO2e/year)** | **4,936** | **Calculated** |

Estimated annual baseline emissions of the methane component of the project activities is **4,936 tonnes $CO_2$e/year**

Due to the lack of evidence of animal population throughout the crediting period, the existing animal population of 2007 is used for estimation for 2008. The yearly methane generation potential of the year y during the crediting period will be calculated based on the equations above.

**Project emission due to project activities is:**

*Table B.6.3.c AMS-III.D Project Emissions*

| | **Value** | **Source** |
|---|---|---|
| CO2 emissions from use of fossil fuel (tCO2e/year) | 0 | Negligible. Please refer to section B.6.1. for detailed justification. |
| **Total project emissions (t CO2/year)** | **0.0** | **Calculated** |

Direct project emissions are **negligible.**

**Leakage:**
AMS-III.D, paragraph 9, states that no leakage calculation is required.

**Total emission reductions are:**

854 (AMS-I.D) + 4,936 (AMS-III.D) **-** 0 (Project Emissions) = **5,790 tonnes $CO_2$e/year**

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

Due to the lack of evidence of animal population throughout the crediting period, the existing animal population of 2007 is used for estimation for 2008. The yearly methane generation potential of the year y during the crediting period will be calculated based on the equations in B.4 and B.6.3.

| Year | Baseline (tCO2) | | Project Emissions (tCO2e) | Leakage (tCO2e) | ER (tCO2e) |
|---|---|---|---|---|---|
| | Methane Capture | Power | | | |
| 2008 | 4,936 | 854 | 0.0 | 0.0 | 5,790 |
| 2009 | 4,936 | 854 | 0.0 | 0.0 | 5,790 |
| 2010 | 4,936 | 854 | 0.0 | 0.0 | 5,790 |
| 2011 | 4,936 | 854 | 0.0 | 0.0 | 5,790 |
| 2012 | 4,936 | 854 | 0.0 | 0.0 | 5,790 |
| 2013 | 4,936 | 854 | 0.0 | 0.0 | 5,790 |
| 2014 | 4,936 | 854 | 0.0 | 0.0 | 5,790 |
| **Total** | **34,552** | **5,978** | **0.0** | **0.0** | **40,530** |

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

Metering the electricity generated and monitoring the amount of methane used as fuel or combusted as described in Appendix B of the simplified modalities and procedures for small-scale CDM project activities. The approved monitoring methodologies applied to this project are as follows:

AMS-I.D Grid Connected Renewable Electricity Generation – (13) Monitoring shall consist of metering the electricity generated by the renewable technology.

AMS-III.D Methane Recovery in Agricultural and Agro Industrial Activities – (11) The amount of methane recovered and fuelled or flared shall be monitored ex-posed, using flow meters. The fraction of methane in the biogas should be measured with a continuous analyser or, alternatively, with a periodical measurements at a 95% confidence level. Temperature and pressure of the biogas are required to determine the density of methane combusted. (12) Regular maintenance should ensure optimal operation of flares. The flare efficiency, defined as the fraction of time in which the gas is combusted in the flare, multiplied by the efficiency of the flaring process, shall be monitored; (15) Flow meters, sampling devices and gas analyzers shall be subject to regular maintenance, testing and calibration to ensure accuracy; and (17) The monitoring plan should include on site inspection for each individual farm included in the project boundary where the project activity is implemented for each verification period.

The methodology was selected as suggested by the simplified monitoring methodologies for small-scale CDM projects. Measuring the amount of methane recovered and metering the amount of electricity generated are the most appropriate methods of monitoring the project activity.

**B.7.1 Data and parameters monitored:**

| **Data / Parameter:** | **Electricity** |
|---|---|
| Data unit: | kWh |

| | |
|---|---|
| Description: | Actual electricity generated by the project |
| Source of data to be used: | Electricity meter |
| Value of data | |
| Description of measurement methods and procedures to be applied: | Electricity will be metered through the use of an electricity meter at each farm everyday. |
| QA/QC procedures to be applied: | Electricity meters will be subject to regular maintenance and testing regime to ensure accuracy once a year. The maintenance and calibration shall be conducted based on the supplier's specification and local government's calibration standards published by the Bureau of Product Standards. |
| Any comment: | |

| **Data / Parameter:** | **Biogas** |
|---|---|
| Data unit: | Nm3 |
| Description: | Amount of biogas (normalised) captured and used as fuel for the generator |
| Source of data to be used: | Flow meter |
| Value of data | |
| Description of measurement methods and procedures to be applied: | Biogas used by the generator will be monitored through the use of biogas flow meter at each farm continuously. The flow meter automatically measures temperature and pressure, expressing biogas volumes in normalized cubic meters (Nm3), therefore no separate monitoring of temperature and pressure would be necessary. |
| QA/QC procedures to be applied: | Gas flow meters will be subject to regular maintenance and testing regime to ensure accuracy once a year. . The maintenance and calibration shall be conducted based on the supplier's specification and local government's calibration standards published by the Bureau of Product Standards. |
| Any comment: | |

| **Data / Parameter:** | **Methane content** |
|---|---|
| Data unit: | % |
| Description: | The fraction of methane in the biogas |
| Source of data to be used: | Gas analyzer |
| Value of data | |
| Description of measurement methods and procedures to be applied: | This will be monitored through the use of a gas analyser at the farm. In the event that the methane content of the samples varies significantly, the samples will be taken on a more frequent basis.<br><br>The project participant will conduct frequent methane test at the initial operational stage of the project to assure 95% confidence level of the monitoring. In the case 95% confidence level cannot be achieved during the initial stage, the project participant will adjust the monitoring frequency throughout the crediting period. |

| | |
|---|---|
| QA/QC procedures to be applied: | Gas analyser will be subject to regular maintenance and testing regime to ensure accuracy once a year. The maintenance and calibration shall be conducted based on the supplier's specification and local government's calibration standards published by the Bureau of Product Standards. |
| Any comment: | |

| **Data / Parameter:** | **Biogas flared** |
|---|---|
| Data unit: | Nm3 |
| Description: | Amount (normalised) of biogas sent to the flare |
| Source of data to be used: | Flow meter |
| Value of data | |
| Description of measurement methods and procedures to be applied: | Biogas sent to the flare will be monitored through the use of biogas flow meter continuously. The flow meter automatically measures temperature and pressure, expressing biogas volumes in normalized cubic meters (Nm3), therefore no separate monitoring of temperature and pressure would be necessary. |
| QA/QC procedures to be applied: | This parameter will only be monitored when there is surplus gas from the Project and a flare is installed. |
| Any comment: | |

| **Data / Parameter:** | **Flare efficiency** |
|---|---|
| Data unit: | % |
| Description: | The fraction of methane destroyed. The flare efficiency is defined as the fraction of time in which the gas is combusted in the flare, multiplied by the efficiency of the flaring process. |
| Source of data to be used: | Default value from the methodology |
| Value of data | 50% (for an open flare. If any case a closed flare is installed, the flare efficiency will be adjusted according to the Tool to determine project emissions from flaring gases containing methane.) |
| Description of measurement methods and procedures to be applied: | Continuous check of compliance with the manufacturers specification of the flare device (temperature, biogas flow rate) should be done. If in any specific hour any parameters is out of the range of specification 50% of default value should be used for this specific hour. For open flare 50% default value should be used, as it is not possible in this case to monitor the efficiency. If at any given time the temperature of the flare is below 500 °C, 0% default value should be used for this period. |
| QA/QC procedures to be applied: | Maintenance of the flare is to be conducted once a year to ensure optimal operation. |
| Any comment: | |

| **Data / Parameter:** | **Generator combustion efficiency** |
|---|---|
| Data unit: | % |
| Description: | The fraction of methane destroyed. |
| Source of data to be used: | Methodological default value |

| | |
|---|---|
| Value of data | 90% |
| Description of measurement methods and procedures to be applied: | Continuous check of compliance with manufacturers specification of the generator set will be done. 90% will be used as combustion efficiency for ex-post CER estimate. Based on the approved methodology ACM0008, the efficiency of methane destroyed through power generation is 99.5%. As conservative approach, 90% is adopted for this small scale project activity. |
| QA/QC procedures to be applied: | Maintenance of the generator set will be conducted based on supplier's requirements. |
| Any comment: | |

| **Data / Parameter:** | **Sludge from the CIGAR** |
|---|---|
| Data unit: | kg |
| Description: | It is not anticipated desludging will be take place during the crediting period based on the developer's experience. However, if in any case sludge is removed from the system, it shall be weighed and recorded. |
| Source of data to be used: | Farm record |
| Value of data | |
| Description of measurement methods and procedures to be applied: | |
| QA/QC procedures to be applied: | Farm manager's signature is required on the record. |
| Any comment: | |

| **Data / Parameter:** | **CIGAR cover** |
|---|---|
| Data unit: | n/a |
| Description: | CIGAR cover check |
| Source of data to be used: | Onsite monitoring record |
| Value of data | |
| Description of measurement methods and procedures to be applied: | The operation should walk over the CIGAR daily to conduct leakage inspection. Observation should be logged and submitted to the farm manager. |
| QA/QC procedures to be applied: | Farm manager's signature is required on the record. This will be used for cross-checking with the gas flow meter reading on the quantity of gas captured and sent to the generator. |
| Any comment: | |

During crediting period, the certified emission reduction will be claimed based on the lower one of the ex-ante estimate or the amount of methane used as fuel or combusted monitored as described above.

### B.7.2 Description of the monitoring plan:

Shift Operator → Shift Manager → Farm General Manager

Project Participants monitor biogas production and electricity generation as part of standard operating procedure for the project activities. PhilBIO has developed a monitoring workbook that the farm owners must use to rigorously input and monitor these data. Project participants will keep electronic copies and paper copies for back-up purposes.

Furthermore, the operator personnel will be trained in equipment operation, data recording, reporting, and operation, maintenance, and emergency procedures. CIGAR Operators assigned on the project site will work on 8-hour shifts to record hourly power and biogas flow data and to perform engine maintenance procedures. A checklist of maintenance activities for the operators is posted in every site to ensure smooth operations.

Cluster O & M Supervisors visit each farm every week for regular performance inspections. The O&M Supervisors are responsible for reporting any system malfunction to the O&M Manager and the Chief Operating Officer. The daily data sheets are collected every week and inputted in a Monitoring Workbook by the O&M Coordinator.

The CDM Manager and the Chief Technology Officer conduct the internal audits of the GHG project compliance and operational performance respectively. The monitoring reports will be prepared by the project coordinator, reviewed by the CDM Manager prior to the verification.

A monitoring team will make regular site audits to ensure that monitoring and operational procedures are being observed in accordance with the monitoring plan and monitoring protocol.

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

28/09/2007 by Dafei Huang, dafei.huang@eeafm.com and Philippine Bio-Sciences Co., Inc., west.stewart@philbio.com.ph, Tel: +632 638 2074/6092

## 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:

03/03/2007

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

21y-0m

**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:**

01/06/2008 or the date of CDM registration, whichever is later.

**C.2.1.2. Length of the first crediting period:**

7y-0m

**C.2.2. Fixed crediting period:**

Not selected

**C.2.2.1. Starting date:**

N/A

**C.2.2.2. Length:**

N/A

## SECTION D. Environmental impacts

**D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:**

The host country does not require an analysis of the environmental impacts of the project activities. The host country has issued each farm an Environmental Compliance Certificate (ECC).

It should be noted, however, that the project activities will generate considerable environmental benefits. The CIGAR® system decreases GHG emissions through two significant avenues. Prior to the project activity, the Projects rely on the grid for its electricity provision. With the implementation of the project activities, biogas collected from the degradation of swine-farm waste is used for electricity generation, thus eliminating the demand for grid-fed electricity. In addition to directly reducing the emission of GHGs by eliminating a source of fossil fuel combustion, the project activities will capture methane ($CH_4$) from an agro-industrial source, preventing its release into the atmosphere. Methane is an extremely potent GHG whose greenhouse-warming equivalent is 21 times that of carbon dioxide ($CO_2$).

In addition to reducing GHG emissions, this closed system of energy production will produce considerable improvements in waste management at each farm. Wastewater discharge from swine farms can be hazardous to aquatic ecosystems. The extent to which wastewater discharge threatens aquatic ecosystems depends on the amount of organic material and solid material contained within the wastewater as measured by biological oxygen demand (BOD), chemical oxygen demand (COD), suspended solids, and colour indicators. The CIGAR® system, owing to its anaerobic digestions properties, reduces COD by approximately 80%, destroys approximately 95% of harmful BOD, diminishes suspended solids, significantly reduce odour, and improves the colour quality of the wastewater. The CIGAR® system also provides a solution to odour, which is a common nuisance to the surrounding residents of these swine farms.

There are no safety regulations in the Philippines regarding the use of biogas. However, the operation safety has been taken account during the development of operation manual and its implementation. The operators see to it that the perimeter is kept free of fire hazards. The biogas generator set employed has a fail-safe mechanism, which allows for automatic shutdown in cases of low biogas flow or low methane content. Furthermore, daily checklists are provided for the operators for the proper maintenance of the generator set. The system is designed to ensure 100% containment of wastes and biogas. The system's inflatable cover is designed for gas storage. The pressure inside the digester does not build up.

**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:**

Not applicable

## SECTION E. Stakeholders' comments

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

PhilBIO, in cooperation with Empire Farms, Inc., conducted a CDM stakeholders' consultation for the farm's anaerobic digestion swine wastewater treatment with on-site power project for its application as a CDM project. The stakeholders' meeting was conducted last April 2, 2007 (9am -11am) at the Barangay Hall of Pillpila, Sta Ignacia Tarlac.

For the registration of Gold Standard CDM, the consultation was conducted in line with the Gold Standard requirements. Invitations were sent out to the stakeholders' concerned through phone calls and letters personally sent by the farm personnel. The consultation was also announced through the local government unit's bulletin boards, emails for the NGOs, and PhilBIO's website to give an opportunity for other stakeholders' to give their comments on the project. After the meeting, meeting report with the PDD was sent to the stakeholders for further comments.

PhilBIO's CDM Project Manager Engr. Ellen May Zanoria gave the presentations, while PhilBIO's CDM Project Manager, Engr. Angel Flores III facilitated the consultation.

The consultations were conducted in conformity with the requirement of the United Nations Framework Convention on Climate Change (UNFCCC) that clean technology projects that wish to be considered for CDM should have public or stakeholders' consultations.

**Participants:**

The stakeholders' consultations were well attended with a number of participants coming from the local government units (LGUs) and residents from each farm's location. The LGUs consisted of representatives from the following:

- Farm representatives
- Department of Agriculture's technologists
- Municipal Heads of Government (Agriculture, Environment and Sanitation)
- Barangay Local Government Units (Barangay Captain, Secretary, and Councillors)
- Barangay representatives.
- Local Organizations (Parents-Teachers Community Association)

There were also participants from other farms who are interested to adopt an environmentally friendly technology such as the CIGAR® and know more about the CDM.

**Purpose of the Meeting**

The purpose of the stakeholders' consultations was to present the benefits of the anaerobic digestion swine wastewater treatment with on-site power project to the environment, swine farm owner and the community where the farm is located, and to explain what CDM is and its processes, aims and benefits. The consultations wished to stress the conformity of the projects in attaining the sustainable development goals of the country through the enhanced wastewater treatment system that will be utilized by the farm. More importantly, the consultations served as venues for stakeholders to ask questions or give comments about the projects and CDM.

**Agenda**

The consultations started with an invocation led by a selected local participant. Then, a representative from the municipal government or LGU gave a brief message to welcome the participants.

The highlight of the consultations was a presentation on CDM by PhilBIO. The presentations gave an overview of the issues concerning climate change; CDM and its processes, aims and benefits; and the CIGAR project and why it is considered as a CDM project. The presentation focused on the following topics:

- Climate Change
- Clean Development Mechanism (CDM)
- The Process of CDM
- PhilBIO's Methane Gas Mitigation Technology
- The CDM Project

After each presentation, the presenter conducted an open forum where a number of questions were asked and comments were voiced out. Further details will be found in succeeding texts.

After the open forum, the facilitator thanked the participants and adjourned the meetings.

| **E.2.** | **Summary of the comments received:** |
|---|---|

The stakeholders' consultation was attended by 19 people from Empire Farm, Municipal Agriculture Office, local Department of Agriculture, Barangay Pillpila local government officials and residents, Municipal Environment and Natural Resources Office, Municipal Sanitation Office, Fire Department, and Parents-Teachers Community Association. The stakeholders focused mainly on the electricity generation and the CIGAR's technology, design and construction. Summarized below were the issues raised during consultation.

| Issue/s Raised | Response/Recommended Measures to Address the Issue/s |
|---|---|
| Would the communities of Pillpila also benefit the supply of electricity? | The Project is designed for self-supply for the farm's electricity use only. |
| What will happen after the BOT contract terminates? Can the farm then distribute the power produced? | PhilBIO explained that the contract is renewable. In the case renewal will not be done, the power plant will be owned by the farm but still, the power produced may not be transmitted outside the vicinity unless agreements with the local power supply company are reached. |
| Is the liner liable for the gas storage? Are the liner and cover made with the same material? | PhilBIO explained that the liner and cover are made with high grade high density polyethylene (HDPE), which is known for its strength, stability, non-permeability and flexibility. |
| In the case of prolonged maintenance, what will happen to the accumulating gas? | PhilBIO explained that the gas will stay in the digester. The system is designed with gas storage function. Field engineers are always on call and near the site so that no operational problems are left unsolved for a long period of time. |
| Are there any emergency outlets? | Yes. Flare will be installed to burn excess gas if needed. The genset will be operated at the optimised level to maximise gas utilisation. In addition, the CIGAR that will be constructed is designed to hold a few days worth of biogas. |
| Will the CIGAR be full of sludge at a certain time or period? | No. Based on PhilBio's experience, desludging is rarely required for the CIGAR system. However, in the case there is a need, the sludge will be removed from the bottom through pumping. The sludge will be dried before disposal. |
| Can you explain why it is possible that it will not be full at a certain period? | The microorganisms are active and constantly digesting solids in the system. |
| Will there be possible leaks, corrosion, and others problems after the contract period? | During the contract period, we will make sure proper maintenance is implemented so that the system is operated at its optimized condition over time. At the end of the contract period, the farm owners can contact PhilBio for after sales service. PhilBIO have satellite offices to address the problems immediately. |

| | |
|---|---|
| Do you have regular monitoring? | Yes. HBC and PhilBIO will conduct regular monitoring of the amount of biogas, gas analysis. Wastewater discharge parameters are required to be tested to maintain the Permit to Discharge. |
| How will the CIGAR improve the odour issue? | The system is closed and bounded by non-permeable lining. Therefore, it reduces the odour impact to the surrounding areas from the existing wastewater treatment system. |

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

No comments opposing the projects were received.

## Annex 1

## CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

| | |
|---|---|
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| | |
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| | |
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## Annex 2

### INFORMATION REGARDING PUBLIC FUNDING

Not ODA has been used in the project. No public funding has been sought.

The project developer obtained financing from Trading Emission PLC for the project development.

## Annex 3

## BASELINE INFORMATION

**CEF Calculation**
The calculations were made in March 2007, with 2005 power statistics as the most recent available data published in the Philippine Department of Energy's website. According to AMS I.D version 10, the baseline emission coefficient can be calculated as a Combined Margin (CM) according to the steps prescribed in ACM0002 version 6.

*Step 1. Calculate the Operating Margin emission factor* ($EF_{OM,y}$)
The *Simple OM* method was used because low-cost/must run resources (like hydro, geothermal, wind) constitute less than 50% of total grid generation in average of the five most recent years (see Table A3.1 and Table A3.2).

**Table A3.1Gross Power Generation of Luzon 2003-2005 (source: Department of Energy, Philippines)**

| Plant | 2003 | 2004 | 2005 | Average 2003-2005 | Percentage | |
|---|---|---|---|---|---|---|
| Oil Based | 3,595,860 | 4,590,814 | 2,021,641 | 3,402,772 | 8.65% | |
| *Combined Cycle* | *438,755* | *738,437* | *90,608* | *422,600* | *1.07%* | |
| *Diesel* | *2,317,101* | *2,688,194* | *1,910,774* | *2,305,356* | *5.86%* | |
| *Gas Turbine* | *1,737* | *183* | *1,433* | *1,118* | *0.0028%* | 82.32% |
| *Oil Thermal* | *838,268* | *1,164,000* | *18,826* | *673,698* | *1.71%* | |
| Coal | 14,351,121 | 15,548,335 | 14,653,275 | 14,850,910 | 37.75% | |
| Natural Gas | 13,139,410 | 12,384,467 | 16,860,917 | 14,128,265 | 35.91% | |
| Geothermal | 2,600,465 | 3,033,417 | 2,742,203 | 2,792,028 | 7.10% | |
| Hydro | 3,847,774 | 4,296,879 | 4,331,224 | 4,158,626 | 10.57% | 17.68% |
| Renewable (Wind) | 0 | 0 | 17,469 | 5,823 | 0.0148% | |
| **TOTAL** | 37,534,631 | 39,853,912 | 40,626,729 | 39,338,424 | 100.00% | 100% |

**Table A3.2Calculations of Emissions from Luzon Grid**

| | (A) | (B) | (C ) | (D) | (E) | (F) | (G) | (H) | (I) |
|---|---|---|---|---|---|---|---|---|---|
| Item | 2003-2005 Electricity Generation | Heat Rate | Fuel Consumption Impact | | Cbon Emsn Factor | Unadjusted Annual Cbn Emission Impact | Combu stion Efficie ncy | Actual Carbon Emission Impact | Annual Carbon Dioxide Emission Impact |
| Source | PDOE Powerstat | PDOE | AxB | (Cx105 5)/10^1 2 | IPCC | DxE | IPCC | FxG | Hx(44/12) |
| Unit | kWh/yr | BTU/k Wh | BTU/yr | TJ/yr | tC/TJ | tC/yr | % | tC/yr | tCO2/yr |
| Oil Based | | | | | | | | | |
| *Combined Cycle* | 422,600,000 | 6,550 | 2.76803E+12 | 2,920 | 20.2 | 58,990 | 99.00% | 58,400 | 214,131 |
| *Diesel* | 2,305,356,333 | 8,900 | 2.05177E+13 | 21,646 | 20.2 | 437,252 | 99.00% | 432,880 | 1,587,225 |
| *Gas Turbine* | 1,117,667 | 14,400 | 1.60944E+10 | 17 | 20.2 | 343 | 99.00% | 340 | 1,245 |
| *Oil Thermal* | 673,698,000 | 8,600 | 5.7938E+12 | 6,112 | 21.1 | 128,973 | 99.00% | 127,683 | 468,172 |
| Coal | 14,850,910,333 | 8,900 | 1.32173E+14 | 139,44 3 | 26.8 | 3,737,062 | 98.00% | 3,662,321 | 13,428,510 |
| Natural Gas | 14,128,264,667 | 6,550 | 9.25401E+13 | 97,630 | 15.3 | 1,493,737 | 99.50% | 1,486,268 | 5,449,649 |
| TOTAL | 32,381,947,000 | | | | | | | | 21,148,933 |

The Simple OM factor is calculated as the generation weighted average emissions per electricity unit of all generating sources serving the system, not including low-operating and must-run power plants:

$$EF_{OM,y} = 0.653$$

*Step 2. Calculate the Build Margin Emission Factor ($EF_{BM,y}$).* The Build Margin emission factor was calculated ex-ante based on the most recent information on the five power plants that have been built most recently (Refer to Table A3.3 and Table A3.4).

**Table A3.3 Last 5 Most Recently Built Plants in Luzon**

| Plant Name | Date of Commissioning | Location | 2005 Power Generation (MWh) |
|---|---|---|---|
| | | | |
| San Roque Hydro | May-03 | Benguet | 605,767 |
| San Lorenzo CCGT | Sep-02 | Sta. Rita, Batangas | 3,441,158 |
| Ilijan CCGT | Jun-02 | Ilijan, Batangas City | 6,550,741 |
| Cawayan Hydro | Jun-02 | Guinlajon, Sorsogon | 916 |
| Casecnan Hydro | Apr-02 | Pantabangan, Nueva Ecija | 402,584 |
| **Total Generation** | | | **11,001,166** |
| | | **% of Total Generation** | **27.08%** |

**Table A3.4 The emissions of the Last 5 Most Recently Built Plants in Luzon**

| Plant | 2005 Power Generation (MWh) | Heat Rate | Fuel Consumption Impact | Carbon Emission Factor | | Unadjusted Annual Carbon Emission Impact | Combustion Efficiency | Actual Carbon Emission Impact | Annual Carbon Dioxide Emission Impact |
|---|---|---|---|---|---|---|---|---|---|
| | | BTU/kWh | BTU/yr | TJ/yr | tC/TJ | tC/yr | % | tC/yr | tCO2/yr |
| San Roque Hydro | 605,767 | | | | | | | | |
| San Lorenzo CCGT | 3,441,158 | 6,550 | 2.254E+13 | 23,779 | 20.2 | 480,341 | 99% | 475,538 | 1,743,638 |
| Ilijan CCGT | 6,550,741 | 6,550 | 4.291E+13 | 45,267 | 20.2 | 914,399 | 99% | 905,255 | 3,319,267 |
| Cawayan Hydro | 916 | | | | | | | | |
| Casecnan Hydro | 402,584 | | | | | | | | |
| **Total Generation** | **11,001,166** | | | | | | | | 5,062,905 |

Based on the above data, the OM is calculated as:

$EF_{BM,y}$ **= 0.460**

Step 3. Calculate the baseline emission factor (**EF,y**). The baseline emission factor is calculated as a combined margin consisting of the combination of operating margin, $\mathbf{EF_{OM,y}}$, and build margin, $\mathbf{EF_{OM,y}}$. Default weights of 50% are used.

$$EF,y = 0.557$$

The project has chosen to calculate the baseline emission factor ex-ante.

**<u>Annex 4</u>**

**MONITORING INFORMATION**

Refer to section B.7.