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

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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. • 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:

Project Title: La Calera Biodigesters Project
Version: 1.4
Date: 08/05/2011

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

The proposed project is located at La Calera Farm, Chincha, Ica, Peru. The main activity of the farm is egg production with around 4 million hens and the production of fruits. The amount of produced eggs corresponds to 20% of the total Peruvian egg production.

Currently, La Calera has around 4 million chickens. The number of animals increases annually on average by 5%. The confined waste of chickens drops under the hen cages. After the lifetime of the hens in one compartment - around one year - the accumulated manure is removed manually before a new hen population is put into a cage. Currently the daily manure production is 154 tons.

In the baseline situation a main part of this manure is deposited at the so-called "guano valley" inside the property. After 40 to 50 days the guano is used partially as fertilizer on the farm and partially sold. The semi-dry guano in this valley causes methane, nitrous oxide and particulate matter emissions. Another part of the guano is pasteurized in a drum drier and blended with some fresh corn to chickenfeed. 16 tons of the daily manure goes to the existing two anaerobic digesters where biogas is produced for heat required for chicken breeding. 27 tons of guano per day is mixed with water and stored in open lagoons in order to produce "Biol" - a fluid fertilizer for fruit plantations.

In the baseline situation equivalent to current practice La Calera uses coal and fuel oil for the guano pasteurization process, the production of egg cartons and the pre-heating of the two old biodigesters. The production of refined fish oil - a chickenfeed additive - is powered through Liquefied Petroleum Gas (LPG). For the heating of the chicken breeding units LPG and the biogas from the two old digesters are used (see figures 2 and 5).

The purpose of the project is to reduce the methane emissions through an improved manure management: Four new biogas digesters will be built during the two project phases in order to eliminate the open lagoon system and to process part of the guano from the guano valley. The open lagoon will be covered through a membrane and will be used as a follow-up digestion in order to eliminate the remaining organic matter in the wastewater and recover the biogas from this digestion. The liquid and the solid phases of the digestion process will be used as fertilizer in the fruit production. The produced biogas will substitute the coal and LPG used at the chicken breeding unit and for egg carton production. In emergency cases the biogas will be flared in an enclosed flare.

In absence of the project, the existing lagoon systems and the existing biogas digesters would be kept, the remaining guano would go to the “guano valley” and heat would be generated with coal and LPG. With the project activity methane emissions are avoided and GHG emissions from fossil fuel usage are reduced.

The project activities contribute to sustainable development:

- The digester technology used in the project activity will be unique for chicken farms in Peru. Thus this project contributes to technology transfer from Germany.
- The production of Biol in the open lagoons causes serious odor nuisance in the neighborhood of the farm. Lagoon coverage reduces substantially this problem.
- The amount of guano in the guano valley will be reduced and therefore the fine particulate mater emission from this site will be decreased too.
- By substitution of coal the soil contamination through coal particles will be stopped. Furthermore, there will be less local air pollution through the reduction of fuel transports to the farm and through reduced air emissions from the burning of fossil fuels.
- There are many poultry farms in the Chincha province. La Calera is the first chicken farm in Peru that introduces the improved manure management through biogas digesters. The project has a potential replication effect which could lead to the dissemination of environmentally sound technology within this sector.

The improvement of the manure management, the use of the renewable energy and the technology improvement will lead to a total estimated emission reduction of 21,935 tons of CO_2 equivalent per year.

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 (Yes/No)
Peru (host)	La Calera S.A.C. (private entity)	No
Peru (host)	Estuardo Masías Marrou (private entity)	No
Peru	Corporación Andina de Fomento - CAF	No

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

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

A.4.1.1. Host Party(ies):

Peru

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

Region of Ica, Province of Chincha

A.4.1.3. City/Town/Community etc:

District of Alto Laran, Chincha city.

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

The project is located in La Calera Farm, Chincha Alta, Alto Laran district, Chincha Province, Peru. The farm is located around 200 km south of Lima, in the coastal area of central Peru. The exact location of the plant is 13°27.193'S / 76° 01.820'W.

A map indicating the location of the project is provided in Figure 1.

Figure 1. Location of Chincha Alta

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

Type and Categories of the Project

Type III: Other project activities
Category D: Methane recovery in animal manure management systems
Sectoral scope 15: Agriculture

As well as:

Type I: Renewable energy projects
Category C: Thermal energy production with or without electricity
Sectoral scope 1: Energy industries (renewable-, non-renewable sources)

Currently, the hen population of La Calera consists of around 4 million chickens, the main part being layers. Since various years the number of animals increases annually by around 5%.

The **baseline scenario** for the guano flow is illustrated in figure 2. The confined waste of the chickens drops under the hen cages. After the lifetime of the hens in one compartment - around one year - the accumulated manure is removed manually before a new hen population is put into the cage. At present the daily manure production is 154 tons. Around 85 tons of this manure goes to the so-called "guano valley" inside the property, where it is stocked. After 40 to 50 days the guano is air dried and used partially as fertilizer on the farm and partially sold. The semi-dry guano in this valley causes methane, nitrous oxide

and particulate matter emissions. The amount of stocked guano in this valley varies between 3,500 and 4,500 tons.

Around 27 tons of guano is daily mixed with water and stored in two open lagoons in order to produce "Biol" - a fluid fertilizer for the fruit tree plantations. The open lagoon system causes GHG emissions through methane releases.

25 tons of guano is daily pasteurized in a drum dryer and blended with fresh corn to chickenfeed.

About 16 tons of fresh guano goes to the existing two anaerobic digesters where biogas is produced for the heating of the chicken breeding. The two biodigesters are working with a low efficiency and need an important amount of reaction heat supplied through a coal boiler. The pasteurization and the old bio-digesters are not within the project boundary.

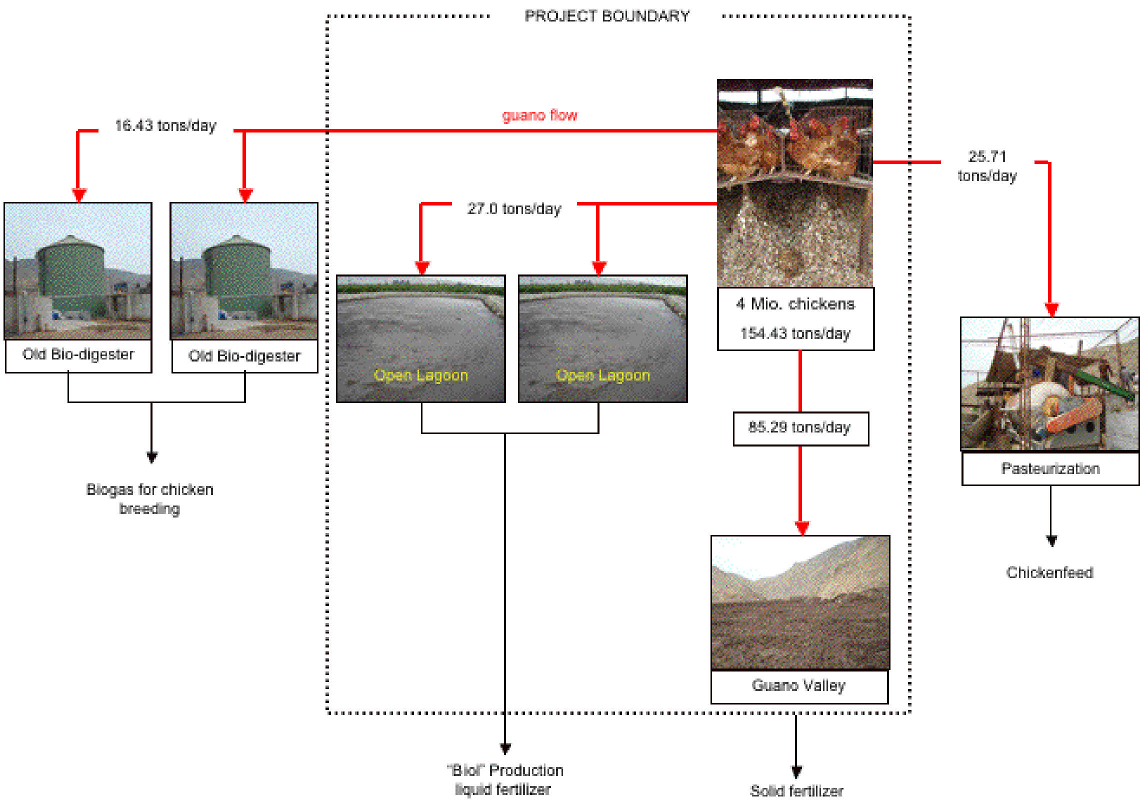

Figure 2. Guano Flow, Baseline Scenario (guano flow 2009)

The project activity will be implemented in two phases. 2009 two new biodigesters will be constructed which will be operational in 2010 (Phase 1). One of the old reactors will be changed into a storage tank for the guano-water mix before it is fed to the digesters. The two open lagoons will be upgraded to Covered Anaerobic Reactors. In order to calculate the baseline emissions it is assumed that without project activities the guano flow to the two old digesters would be stable over the years. Therefore, the guano flow to both old digesters is integrated into the calculation. In practice only around 8 tons guano per day

will flow into the old digesters with the project activity as one of the digesters will be used as storage tank as mentioned above.

Figure 3 shows the Guano-flow after operational start of the first two reactors.

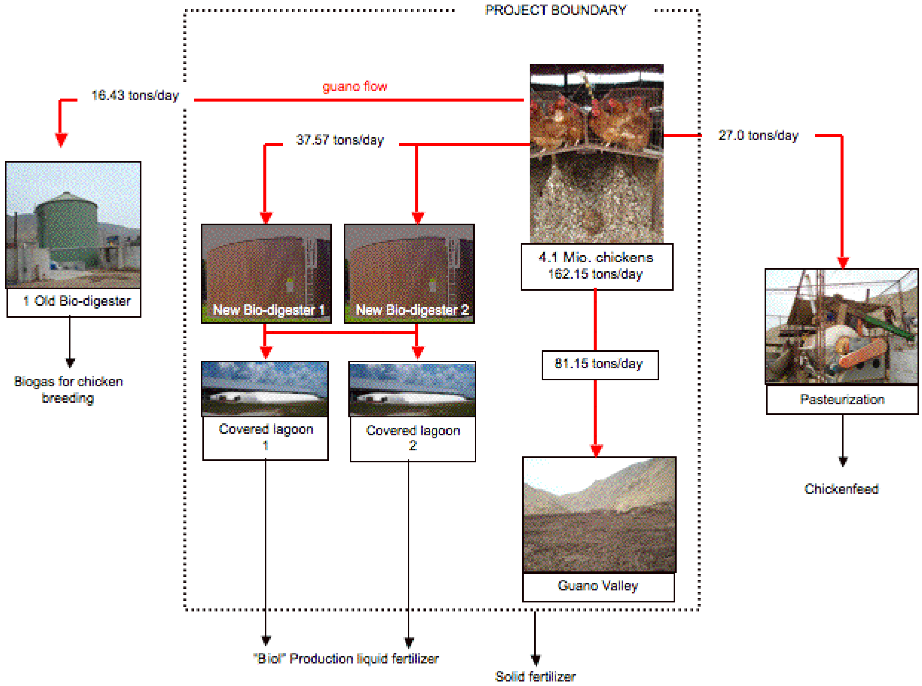

Figure 3. Guano Flow, 2010, phase 1 with two new biodigesters

Beginning of the year 2013 phase 2 of the project activity starts: 2 more digesters will be put into operation. A third covered lagoon will be constructed in order to increase the digestion capacity. The number of chicken and therefore the guano amount continues to increase continuously by 5% per year. Also the amount of guano for pasteurization will increase by this factor. The remaining guano will go to the guano valley (detailed guano flow see annex 3). Figure 4 shows the Guan-flow in Phase II.

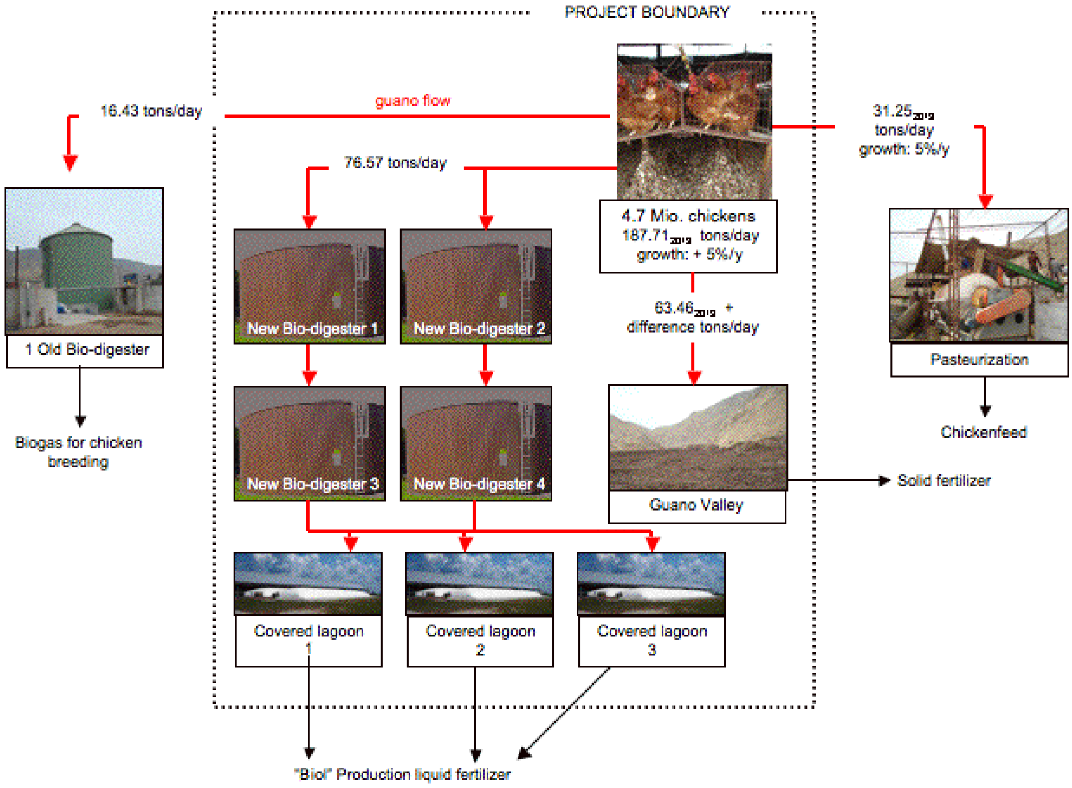

Figure 4. Guano Flow, 2013 and following years (phase 2) with total four new bio digesters

Apart of the biogas from the two old digesters La Calera farm uses coal and LPG for their different production units included in the project boundary (see figure 5 and 6). The baseline scenario includes the following production units:

- Egg carton production: The coal is currently used for the gasification. The produced gas is used for the drying of wet carton.
- Chicken breeding using LPG and biogas for the heating lamps.

Other processes like pasteurization and fish-oil production will not be included in the project activities due to the limited biogas amount.

The energy consumption of the baseline scenario is showed in figure 5.

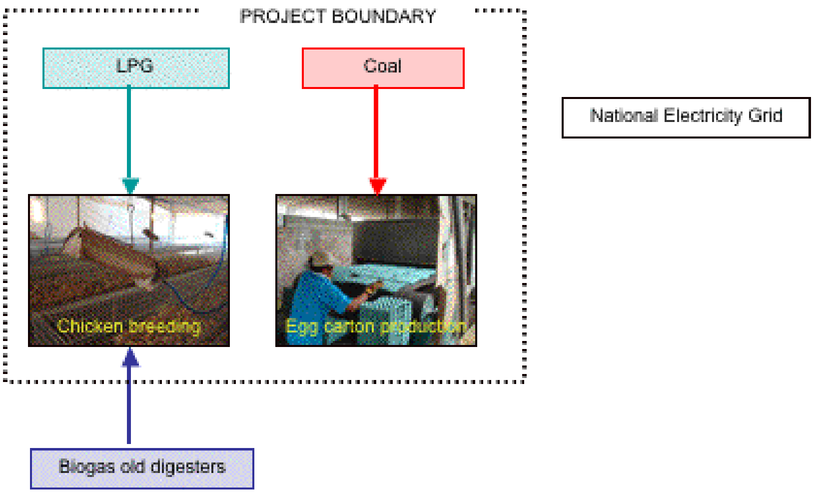

Figure 5. Energy usage in the baseline scenario

In the project activities the biogas from the new digesters will be used for the substitution a) of the coal for the egg carton production and b) of LPG for the chicken breeding. The detailed fuel consumption and the energy input into the different production processes can be seen in annex 3. Figure 6 shows the energy usage in the project case.

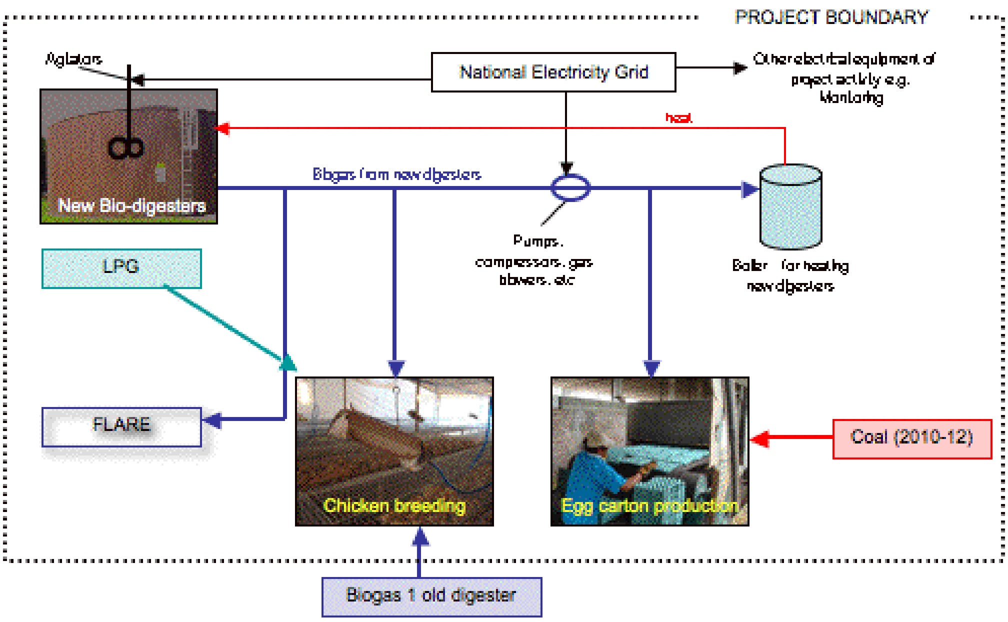

Figure 6. Energy usage in the project scenario

In phase 1 two new biodigesters are installed. In phase 2 two additional reactors will be installed. The open lagoon will be covered with a membrane as follow-up digesters. The process of the project scenario is shown in figure 7. Each single process step is described below.

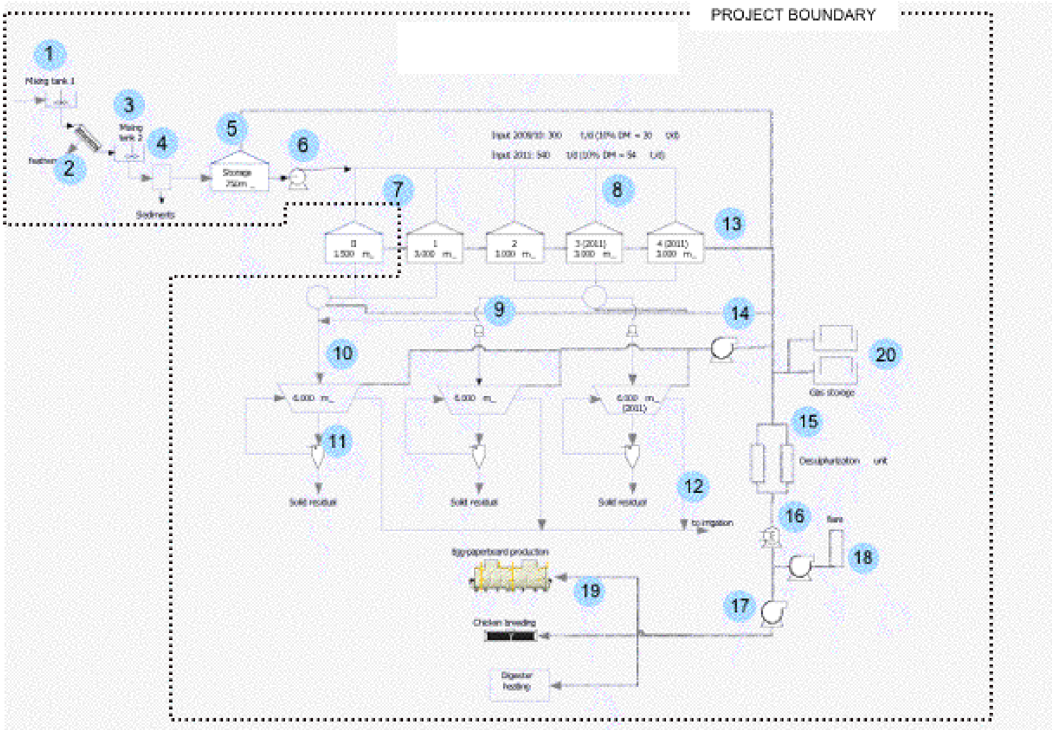

Figure 7. Technology and process steps integrated in the project scenario (see description below)

1. The chicken manure will be mixed with water in mixing tank No.1. Prior to mixing the manure will be balanced to monitor mass input.
   After mixing the substrate is fed to a means for feather removal. The daily feed ratio for the plant will be mixed from 7am to 5pm.
2. In order to decrease floating layers in the digester, a means for feather removal will be installed.
3. After the feathers have been removed from the substrate, mixing tank No. 2 is used in order to ensure a stable mass flow to process step No. 4 (removal of sand).
4. In order to reduce sedimentation in the digesters a means for removal of sand and other non-organic material is installed, like e.g. a hydrocyclone, sedimentation tank or pre-digester.
5. The old digester No. I will be used as storage tank for the input in order to realize a stable mass flow to all digesters even during nighttime. This will enable a constant gas production.
6. A pump station that is continuously working over 24 hours per day is used to distribute the input flow equally over all digesters.
7. In 2009/2010 the input flow of manure will be digested to biogas in one old digester (No. II) and two new digesters (1+2) with a volume of 3.000 m³ each. The old digester is not part of the project activity and therefore the production of the biogas from this digester is measured separately.
8. In 2012 another two new digesters (3+4) of 3.000 m³ each will be constructed thus expanding the biogas plant.

9. The liquid digestate of the digesters will be collected in small tanks that will be covered and connected to the gas system. From the tanks the digestate is led or pumped to the covered lagoons.
10. Within the covered lagoons the rest potential of biogas will be captured and led to the gas system. Furthermore, the material will be separated by sedimentation in a liquid and a sludge phase.
11. The sludge of the lagoons will be either used directly as fertilizer or will be further separated in a solid phase that will be used as fertilizer and a liquid phase that will be recycled to the lagoons.
12. The clarified water from the lagoons will be used in the irrigation system. If necessary a process step for further clarification is introduced. A produced solid phase would be composted.
13. The gas of all digesters is collected in one gas transfer pipe. The amount of the gas from the old digester will be measured separately because this reactor is not part of the project activities.
14. The gas of the lagoons is collected as well in one gas transfer pipe. Gas pressure within the lagoon system will be controlled through a compressor. Then the system is connected to the gas transfer pipe of the digesters.
15. A desulphurization unit will decrease the H_2S content of the biogas
16. The gas will be dewatered within a cooling trap.
17. Another compressor brings the gas pressure to the needed level for the production process.
18. In case the amount of produced gas exceeds the demand or in emergency cases, an enclosed gas flare ensures that no CH_4 is emitted to the atmosphere.
19. Each production process will be connected to the biogas plant by an individual gas pipeline. The individual gas consumption of each production process will be measured by a gas flowmeter.
20. A gas storage will balance the variable biogas consumption over the day.

The sludge from the lagoons will be separated in a liquid and in a solid phase:
The biol coming from the digesters goes directly to the hill lagoon were it sediments. La Calera takes the biol from the upper levels of the lagoon and brings it to the second lagoon (river lagoon) that acts as deposit of the biol going to the irrigation system. The sludge from the lower part of the lagoon near the river will be pumped to a centrifuge. The most liquid part of this process goes back to the lagoon and the solid (biosol) part is brought to the fields as solid fertilizer.

The solid phase will be distributed on the fields as fertilizer. As the hydraulic retention time in the biogas plant will be over 50 days the solid phase will not contain relevant amounts of organic material anymore as this material was decomposed within the digesters and the lagoons. Additional, due to the distribution on the fields minor rests of organic material will be decomposed by aerobic processes. Therefore, the planned sludge management does not cause CH_4 emissions.

The biodigesters are environmentally sound technologies and have novel aspects:

- The concrete digesters tanks are equipped with a new agitator technology in order to reduce the sedimentation in the digesters.
- The feather and sediment removal step prior to the digester is a new technology which has never been realized in this size until now.
- It is a new approach of the German supplier that the residuals of the digesters can be separated into a liquid and a solid fraction in order to use the liquid one directly in the irrigation system of the farm.

According to the La Calera Farm that is the hugest egg producer in Peru, no chicken farm in the country is using biogas technology. There are many chicken and egg producers in the area of La Calera. The new applied technology might have a replication effect in other farms.

The production of liquid fertilizer in the digester instead of the biol coming from the open lagoon reduces the GHG drastically. Furthermore, through the digestions the odor emissions of the liquid fertilizer is reduced considerably.

The German engineering company will train the staff of La Calera to run and maintain the new biogas digester system. The project thus contributes to technology transfer from Germany.

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

Years	**Annual estimation of emission reductions in tonnes of CO_{2e}**
2011/8months	13,629
2012	19,832
2013	19,832
2014	23,034
2015	23,034
2016	23,153
2017	23,212
2018/4months	7,758
Total estimated reductions (tonnes of CO_{2e})	**153,544**
Total number of crediting years	**7**
Annual average over the crediting period of estimated reductions (tonnes CO_{2e})	**21,935**

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

Neither public funding nor official development assistance will be utilized to finance the project activity. The project activity is entirely financed by the project participants through private means and anticipated revenues of carbon credits.

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

Debundling is defined in appendix C of the "Simplified Modalities and Procedures for Small-Scale CDM project activities" as follows:

"A proposed small-scale project activity shall be deemed to be a debundled component of a large project activity if there is a registered small-scale CDM project activity or an application to register another small-scale CDM project activity:

- *With the same project participants;*
- *In the same project category and technology/measure; and*
- *Registered within the previous 2 years; and*
- *Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point."*

La Calera has not applied for another small-scale CDM-project. This is the first CDM-project of La Calera. Thus, the project is not a debundled activity of a larger project.

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:

The following small-scale methodologies are used:

AMS-III.D "Methane Recovery in animal manure management systems", Version 15, EB 48
AMS-I.C "Thermal energy production with or without electricity", Version 16, EB 51

Additionally the following tools are used:
- "Tool to determine project emissions from flaring gases containing methane" (Annex 13, EB 28)
- "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (Version 01, EB 39).
- "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (Version 02, EB 41)

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

Table 1 lists the applicability criteria for the two involved methodologies and the corresponding project conditions.

Table 1: Applicability of Methodologies Used for the Project Situation

Reference	Applicability condition	Project situation	Documentary source/proof
AMS-III.D 1(a)	The livestock population in the farm is managed under confined conditions;	The poultry populations in La Calera Farm are managed under confined conditions.	See project description and current plant operations
AMS-III.D 1(b)	Manure or the streams obtained after treatment are not discharged into natural water resources (e.g. river or estuaries), otherwise AMS-III.H. shall be applied;	The liquid phase of the treatment system is not released to an open river. The liquid phase is collected and it is used with a drip irrigation system for the fruit tree plantation. That means that the irrigation is controlled and no wastewater reaches natural water resources.	See project description and current plant operations
AMS-III.D 1(c)	The annual average temperature of baseline site where anaerobic manure treatment facility is located is higher	The annual average temperature (1.1.2006 - 31.12.2007) at the Farm's site is 20.94°C.	File 1: Temperature measured by La Calera Farm conti-

	than 5°C		nuously
AMS-III.D 1(d)	In the baseline scenario the retention time of manure waste in the anaerobic treatment system is greater than 1 month, and in case of anaerobic lagoons in the baseline, their depths are at least 1 m;	The amount of guano stocked in the guano valley is between 3'500 and 4,500 tons. The daily input is currently around 84 tons. Therefore the retention time in the guano valley is around 30 to 40 days. The thickness of the layer in the guano valley is between 1 and 2 meter. 27 tons of the guano goes daily to the lagoon system. The guano is diluted 10 times that means about 270 m^3 watered guano will be fed to the lagoons. The Volume of the two lagoons is 12'000 m^3 and therefore the retention time is around 45 days. The depth of the first lagoon is 2 to 4 m, the second one 8 to 10 meters.	File 2: Process description of SMART Utilities Solution
AMS-III.D 1(e)	No methane recovery and destruction by flaring, combustion or gainful use takes place in the baseline scenario.	There are currently two old digesters working on the farm. But the guano flow to these reactors and therefore the two reactors themselves are not part of the baseline scenario and are not integrated within the project boundary. The biogas which will be produced by one of these old digesters will be measured with a flowmeter in order to exclude this biogas amount from the project activity.	See project description and current plant operations
AMS-III.D 2(a)	The final sludge must be handled aerobically. In case of soil application of the final sludge the proper conditions and procedures (not resulting in methane emissions) must be ensured.	The sludge from the lagoons will be separated in a liquid and in a solid phase. The solid phase will be distributed on the fields as fertilizer. As the hydraulic retention time in the biogas plant will be over 50 days the solid phase will not contain relevant amounts of organic material anymore as this material was decomposed within the digesters and the lagoons. Additional, due to the distribution on the fields minor rests of organic material will be decomposed by aerobic processes.	File 2: Process description of SMART Utilities Solution
AMS-III.D 2(b)	Technical measures shall be used (including a flare for exigencies) to ensure that all biogas produced by the digester is used or flared.	For exigencies and emergency cases the biogas will be incinerated in an enclosed flare.	File 2: Process description of SMART Utilities Solution
AMS-III.D 2(c)	The storage time of the manure after removal from the animal barns, including transportation, should not	When the guano is removed under the hens cages the dry matter content of the guano is over 70 %. Thus	File 12: Analyzes of the dry matter content of guano

	exceed 24 hours before being fed into the anaerobic digester. If the project proponent can demonstrate that the dry matter content of the manure when removed from the animal barns is larger than 20%, this time constraint will not apply.	this time constraint is not applicable for the manure management of La Calera.	
AMS-III.D 7	Measures are limited to those that result in aggregate emission reductions of less than or equal to 60 kt CO_2 equivalent annually	Emission reductions in all years are below 60ktCO_2. ERs are on average 21,935 tCO_2/a	File 16: ER-spreadsheet
AMS-I.C. paragraph 1	This category comprises renewable energy technologies that supply users with thermal energy that displaces fossil fuel use.	Biogas produced by the project displaces coal and partially LPG	Files 13/15: Invoice for coal and LPG
AMS-I.C. paragraph 3	The total installed/rated thermal energy generation capacity of the project equipment is equal to or less than 45 $MW^{thermal}$	The inbuilt capacity the egg carton ovens is far less than 20 MW. Each boiler for the digester heatings will have an in-built capacity of 160 kW, thus in total 320 kW. There are 800 lamps for the chicken breeding with each around 2 kW inbuilt capacity, totally around 2MW capacity. Therefore the total installed thermal energy capacity for the project equipment is far below 45 MW.	File 2: Process description of SMART Utilities Solution

The biogas generated in the new digesters is used for thermal energy generation in the farm used in the chicken breeding and egg carton production facilities and for the heating of the digesters.

All for the project relevant applicability criteria of the methodologies used are thus fulfilled.

B.3. Description of the project boundary:

Gases included are CO_2 and CH_4.

Figures 2 to 7 (see above) describe the baseline and the project scenarios concerning the guano flow as well as regarding the energy management systems. The spatial project boundary includes the geographical site of the livestock and manure management system, as well as all units using fossil fuels on the farm and which under the project case will use biogas. The project boundary (see Figure 8) is defined according to paragraph 8 of AMS-III.D.

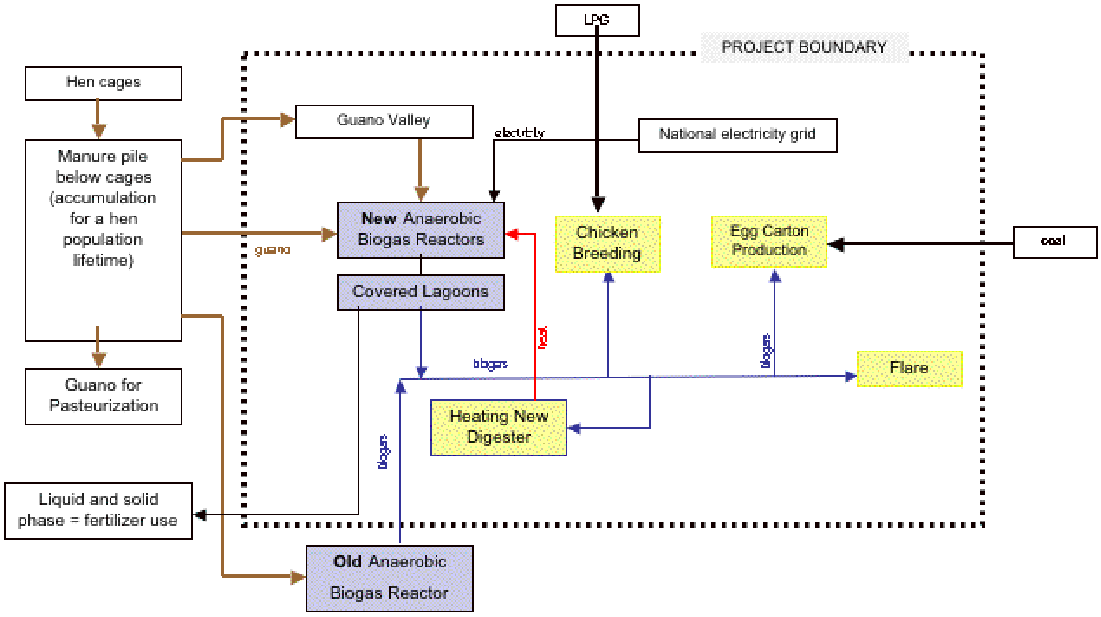

Figure 8. Project Boundary

The two open lagoons of the baseline scenario will be covered with a membrane and then used as follow-up digesters of the reactors. Through this measure the CH_4-emissions of the lagoons can be eliminated. Furthermore, part of the guano that will be stocked in the baseline scenario will be digested in the biogas reactors and therefore CH_4-emssions in the guano valley will be reduced through the project activities.
The biogas that will be produced in the anaerobic biogas reactors will be used for the heat generation in the chicken breeding, egg carton production as well as for the heating of the new reactors. In emergency cases the biogas will be flared in an enclosed flare.

The old anaerobic biogas reactor is not integrated within the project boundary. The produced biogas from the old reactor is not calculated in the emission reduction. Therefore, this biogas will be measured with a flowmeter before it is fed to the biogas network of the new digesters (see annex 4).

The egg carton production situated on the farm is within the project boundary. The carton production will increase according to the growth of the egg production due to market demand and not due to project activities.

The national electricity grid of Peru is integrated into the project boundary. The electricity consumption of the digester stirrers, some pumps and blowers as well as all the monitoring equipment are part of the project emissions.

B.4. Description of baseline and its development:

Baseline determination for manure management

The evaluation of the alternative scenarios to the proposed CDM project activity was carried out according to table 10.18 of the IPCC guidelines 2006, volume 4, chapter 10. The baseline definition with alternatives scenarios is summarized in the table below.

Table 2: Evaluation of baseline scenarios concerning alternative manure management systems

	Possible alternatives	Realistic	Justification
1	Anaerobic Digester	No	This is the project scenario.
2	Daily spread	No	Currently the manure falls down under the hen cages and is removed after the lifetime of a population. To remove the guano daily would need too much labour work and would be too expensive. This is also not common practice in Peru.
3	Solid storage	Yes	This is the current situation in the guano valley. This is thus a credible and realistic alternative.
4	Dry lot	No	The manure which falls under the hen cages is piling up and therefore cannot dry completely. When the guano is removed from the soil under the hen cages to the guano valley, lagoons, digester or to the pasteurization the water content is still around 20% (see file 12). Manure management according to "dry lot" would imply that the chicken production would be according to open land practice. The chicken could move around and the manure in this area would dry because of the thin manure layer. This manure layer would then be removed periodically. The open land production is currently not a realistic option due to costs involved. It is also not common practice for hen farms in Peru.
5	Liquid/slurry	No	The manure is stored in tanks or in earthen ponds. Because the manure is flushed with water from the barns the consistency of the manure is very thin, the water content therefore high. There is no plan to install such manure storage facilities and this manure management is not realistic and much too expensive because the farm is too big to integrate all hen cages placed all over the hills. The guano in the guano valley is not wet enough to be defined as liquid slurry (Definition according to IPCC: max. 20% dry matter).
6	Uncovered anaerobic lagoon	Yes	Currently 27 tons of guano is inserted daily to open lagoons where water is added. In these lagoons the manure is digested in order to produce liquid fertilizer (so-called Biol). Without the project the Biol production would be kept due to the excellent fertilizer quality of Biol.
7	Pit storage below animal confinements	No	There are no pits for storage under the hen cages. The cages are outdoor - not enclosed, therefore.

			The pit storage will not be an alternative to the project case. There is simply no need and no benefit to do it.
8	Burned for fuel	No	With the burning of the poultry manure the guano would loose a lot of the fertilizer quality that is required for the fruit tree plantations of La Calera. Therefore, burning of guano is no attractive alternative scenario.
9	Composting	No	The moisture content of the guano in the guano valley is too high for common composting systems. Furthermore, the composting needs some investment in order guarantee a regular aeration. Composting needs more labor work than the solid storage system and the benefit from compost is not higher then from the current manure system.
10	Poultry manure with litter	No	This management system is comparable to cattle and swine deep bedding that is usually combined with dry lot or pasture. This system can be used for meat type chickens such as broilers. For the intensive egg production in non walkable cages this management systems is not used because all eggs had to be removed from the litter within the cages and could not drop under the cages.
11	Poultry manure without litter	Yes	Currently, the manure drops down to the soil under the hen cages where it is piled for around one year. This high-rise manure system (see IPCC) will be kept also in the project case. Therefore, this manure management system is not considered because it will be the same in the baseline and the project case.
12	Aerobic treatment	No	Normally the poultry manure is not stocked as liquid manure, except for the Biol production (see option 6, open lagoon). The open lagoons are working anaerobically because of their deepness. The slurry from the biodigesters will be used without anaerobic ponds. Aerobic ponds are no alternative to biodigesters because there is no advantage (no biogas, no better quality of fertilizer, etc.).

Therefore, the baseline scenario is the current situation of manure management under anaerobic conditions; methane from decay of guano in the guano valley (solid stock) and from the open lagoon system (Biol production). The methane is released to the atmosphere without recovery.

Based on the above analysis, the alternative to the new biodigesters is the continuation of the current system (alternative 3 and 6). The "poultry manure without litter" is equal in the project and the baseline case and is thus not further considered.

Baseline determination for heat generation

Baseline options available are either a continuation of usage of coal and LPG for heat generation or project implementation in absence of the CDM i.e. using at least partially biogas recovered from the la-

goons. The 2nd option is not feasible as shown in section B.5. The baseline is thus a continuation of usage of coal and LPG as fuel for heat generation.

Baseline emissions of the manure management are calculated in accordance with paragraph 9 of AMS-III.D.

Baseline emissions of fossil fuel usage for heat generation are calculated based on paragraph 11 of AMS-I.C. i.e. the simplified baseline is the fuel consumption of the technologies that would have been used in the absence of the project activity times an emission factor for the fossil fuel displaced.

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:

The additionality of this CDM project was demonstrated through an investment analysis (see answers on request 1) according to the rules of UNFCCC (see: "Tool for the Demonstration and Assessment of Additionality" Version 5.2. Annex 10, EB 39).

The project starting date is before validation start. Project starting date is after August 2nd 2008. According to the "Guidelines on the Demonstration and Assessment of Prior Consideration of the CDM", version 03 (EB 49) new project activities starting after August 2nd 2008 must notify the DNA and the UNFCCC in writing of the commencement of the project activity[1]. The project was announced to the UNFCCC secretariat. October 30, 2008. The UNFCCC confirmed reception of the announcement. As the project was subsequently stopped and changed in technology a new announcement was made at 6th of August 2009 to UNFCCC. Furthermore, the project was announced on 7th of September 2009 to the Secretary of Environment (DNA of Peru).

Alternatives have been studied under B.4. All alternatives proposed comply with all applicable legal and regulatory requirements.

Alternatives Identified

Section B4 identified the alternatives. Therefore only the conclusion of B4 is added in this section.

For manure management the baseline scenario is the current situation of manure management under anaerobic conditions; methane from decay of guano in the guano valley (solid stock) and from the open lagoon system (Biol production). The methane is released to the atmosphere without recovery.

Based on the above analysis, the alternative to the new biodigesters is the continuation of the current system (alternative 3 and 6). The "poultry manure without litter" is equal in the project and the baseline case and is thus not further considered.

For heat generation baseline options available are either a continuation of usage of coal and LPG for heat generation or project implementation in absence of the CDM i.e. using at least partially biogas recovered

[1] Version 01 of the Tool (EB 41) listed that the DNA and/or the UNFCCC should be advised in writing. At the moment of the letter only one of both organizations had to be advised.

from the lagoons. The 2nd option is not feasible as shown in section B.5. The baseline is thus a continuation of usage of coal and LPG as fuel for heat generation.

Investment Barrier

This section determines if the project activity is financially feasible in absence of CER revenues.[2] The steps used and the procedures follow the Guidance on the Assessment of Investment Analysis as included as Annex in the methodological tool "Tool for the Demonstration and Assessment of Additionality" Version 5.2. Annex 10, EB 39.

Determine Appropriate Analysis Method

Options as listed in the additionality tool include:

1. Simple cost analysis
2. Investment comparison analysis
3. Benchmark analysis

The project activity generates income (savings) other than CER revenues. Thus option 1 is not appropriate. The option 2 included are the project with or without revenue of CER. The baseline case has no investment. Thus the investment comparison analysis is not appropriate. Therefore the option 3 - benchmark analysis - is chosen as appropriate analysis method.

Determine Suitable Indicator

The financial/economic indicator chosen is the IRR as it is considered as the most suitable indicator for the project type. The IRR is taken as it can be easily compared to a financial benchmark. The IRR is capable of comparing the investment decision of the project with a financial benchmark and thus gives an indication of the financial profitability of the investment. The NPV is also calculated for information purposes.

The benchmark analysis is based on a standard market parameter as benchmark. As benchmark the local commercial lending rate (active interest rate) for Peruvian Soles as published by the Central Reserve Bank of Peru for the time of investment decision is taken[3]. This benchmark is appropriate as it is public and thus verifiable, a standard market parameter and relevant for the project. It is also in accordance with the recommendation given in the EB tool paragraph 11.

Following principles are used for all calculations:

- The period of assessment taken is 20 years. This is in accordance with the Annex to the Tool point 3 where a maximum of 20 years is considered as appropriate. The technical lifetime of the equipment used in the project is 25 years.

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[2] As the 2 options identified are the project with or without CER revenues the assessment of the most financially attractive option is not required.

[3] http://estadisticas.bcrp.gob.pe/resultados.asp?sIdioma=1&sTipo=1&sChkCount=133&sFrecuencia=M)

- The fair value at the end of the period is considered as proportional to the remaining technical life-span of the equipment following GAAP (FAS157).
- Depreciation and other non-cash items such as amortization are not included when calculating the IRR and the NPV. The financial calculations are made excluding depreciation and finance costs. This is in accordance with the Annex to the Tool point 5.
- All calculations are based on data available as of June 15th 2008 i.e. before project start. This is in accordance with the Annex to the Tool point 6.
- The detailed data is available to the Validator, the EB and the UNFCCC secretariat but are not public domain, due to containing sensitive contractual data.
- The project cannot be developed by another entity as La Calera is the owner of the farms, the Guano, the space and also uses the biogas for internal purposes. However for case of transparency the local commercial lending rates are used to determine the financial viability of the project.
- Sensitivity analysis is made for all variables which constitute more than 20% of cost respectively revenue in accordance with the Annex to the Tool points 16 and 17assuming 10% change of investment costs, 10% change of Guano value (affects income as well as expenses), 10% change of savings due to coal and 10% change of savings due to LPG.

Table 3 shows the core data used for the financial assessment of the project.

Table 3: Core Financial Data La Calera

Item	Unit	Value	Data Source
Local commercial lending rate	percentage	24%	Central Reserve Bank of Peru[4]
Period of assessment	years	20	
Salvage value	PEN[5]	variable	Proportional to remaining technical life-span
Coal quantities saved	tons	variable	See table 5
LPG quantities saved	tons	variable	See table 6
Cost of coal	PEN/t	513	File 13: coal prices paid by La Calera on average 2007 to June 2008
Cost of LPG	PEN/gallon	5.56	File 15: LPG average price paid by La Calera 2006 to June 2008
Value of Guano used in biodigester	PEN/t	50	Lower value of average sales price of Guano by La Calera
Input amount of Guano to biodigester	tons	variable	See table 7
Solid material out of biodigester as percentage of input	%	56%	SMART Utilities based on dry matter out/dry matter in
Depreciation rate per annum	%	10%	Peruvian accounting principles
Income tax rate	%	15%	Tax rate paid by La Calera
CERs per annum	tons	variable	See A.4.3.; constant after 2017
Price of CERs	PEN	86	EEX average CER future price of June 2008[6]; Euro to PEN exchange rate based on median exchange rate 15.6.2008 from www.oanda.com/convert/classic
Conversion LPG	gallons per ton	506	IEA Energy Statistics Manual, 2005 (1,915 liters per ton LPG (table A.3.8)and 3.785

[4] http://estadisticas.bcrp.gob.pe/resultados.asp?sIdioma=1&sTipo=1&sChkCount=133&sFrecuencia=M)

[5] Peruvian New Soles

[6] www.eex.com

			liter per US gallon (table A.3.2))
Exchange rate PEN to USD	PEN per USD	2.89	Central Reserve Bank of Peru BCRP for 6/2008

Table 4: Coal Savings La Calera Egg Carton Production Plant

Year	Baseline Emissions tCO_2	EF coal tCO_2/TJ	NCV coal TJ/Gg	t coal
2011	827	98.30	26.7	315
2012	1,056	98.30	26.7	402
2013	1,056	98.30	26.7	402
2014	2,893	98.30	26.7	1,102
2015	3,059	98.30	26.7	1,166
2016	3,224	98.30	26.7	1,228
2017	3,389	98.30	26.7	1,291
2018 and following	3,558	98.30	26.7	1,356

Data sources:

- Baseline emissions: CER spreadsheet File 16
- EF coal: IPCC, 2006 (Vol. 2, table 1.4.)
- NCV coal: IPCC 2006 (Vol. 2, table 1.2.)

Table 5: LPG Savings La Calera Chicken Breeding

Year	Baseline Emissions tCO_2	EF LPG tCO_2/TJ	NCV LPG TJ/Gg	t LPG
2011	840	63.10	47.3	281
2012	833	63.10	47.3	279
2013	833	63.10	47.3	279
2014	1,649	63.10	47.3	552
2015	1,542	63.10	47.3	517
2016	1,436	63.10	47.3	481
2017	1,330	63.10	47.3	446
2018 and following	1,221	63.10	47.3	409

Data sources:

- Baseline emissions: CER spreadsheet File 16
- EF LPG: IPCC, 2006 (Vol. 2, table 1.4.)
- NCV LPG: IPCC 2006 (Vol. 2, table 1.2.)

Table 6: Guano In/Out of New Biodigesters La Calera

Year	tons Guano entering biodigesters	tons solid material leaving biodigesters
2011	13,713	7,621
2012	13,713	7,621
2013	13,713	7,621
2014 and following	27,948	15,532

Data sources:

- Tons entering biodigesters: 2010 to 2012: 37.57t/d with 365 days (see Figure 3); 2013 onwards 76.57t/d with 365 days (see Figure 4)
- Solid material leaving biodigesters based on 56% of material entering biodigester (see Table 4)

Table 7 resumes the financial data of the project.

Table 7: Core Financial Data (Summarized) La Calera in tsd PEN

Item	tsd PEN	Remarks
Investment	8,197	Distributed over 4 years Includes construction costs, covered anaerobic lagoon, gas collecting equipment (pipeline, flare, flow-meter, gas blower etc), biodigesters, studies, design, supervision, testing and auxiliary expenses
Average annual cost	1,279	Average value for 20 years Based on operational costs (average 116 tsd PEN per annum) and value of guano entering biodigesters (average 1,163 tsd PEN per annum)
Average annual savings	2,225	Average value for 20 years Based on coal savings (average 542 tsd PEN per annum), LPG savings (average1,037 tsd PEN per annum) and value of solid material out of biodigester (average 646 tsd PEN per annum)

Source: Financial Spreadsheets

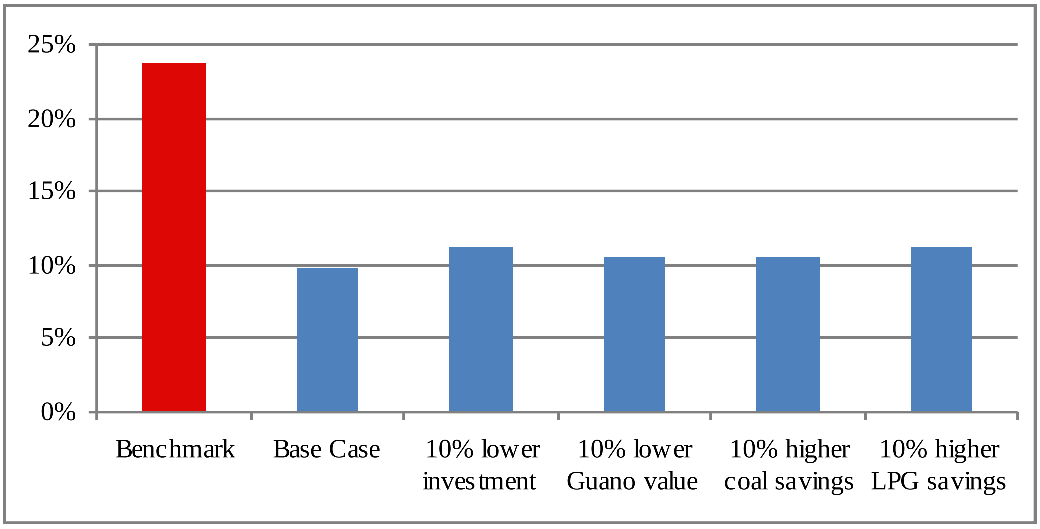
Table 8 and figure 9 show the financial profitability of the investment in absence of the CER including the sensitivity analysis and comparing the values with the benchmark.

Table 8: NPV and IRR Base Case and Sensitivity to Parameter Changes Excluding CER Revenues

	IRR	NPV in tsd PEN[7]
Base case	10 %	- 2,591
10% lower investment cost	11 %	- 2,132
10% lower Guano value	10 %	- 2,482
10% higher coal savings	10 %	- 2,493
10% higher LPG savings	11 %	- 2,343
Benchmark	**24 %**	

[7] For information purpose only based on a discount value of 24% (benchmark interest rate)

Figure 9: Profitability of the Project in Absence of CER Revenues



In all cases the IRR is clearly much lower than the benchmark i.e. the project in absence of CDM is financially non-feasible.

With CDM the project is however profitable and financially feasible as can be seen in the following table.

Table 9: IRR with and without CER Revenues

Case	IRR
IRR base case without CER revenues	10%
IRR with CER revenues	34%
Benchmark	24%

While the project is not profitable without CER revenues it gives an excellent return above the benchmark if CDM is included. The access to CDM finance is thus decisive for project success and implementation.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

The emission reductions of the project activity due to manure management are calculated according to the small-scale methodology AMS-III.D. The emission reduction due to fuel substitution is based on the small-scale methodologies AMS-I.C.

BASELINE EMISSIONS

Baseline emissions are the sum of baseline from manure management emissions (calculated using AMS.III.D.) and from fossil fuel consumption emissions (calculated using AMS.I.C.).

$$BE_y = BE_{CH4,y} + BE_{therm,y} \quad \textbf{1}$$

where:

BE_y	Baseline emissions in year y (tCO_2e)
$BE_{CH4,y}$	Baseline emissions in year y due to manure management (tCO_2e)
$BE_{therm,y}$	Baseline emissions in year y due to thermal heat generation for production facility (tCO_2e)

Baseline emission due to manure management

Baseline emissions from manure management according to paragraph 9 of AMS-III.D.:

$$BE_{CH4,y} = GWP_{CH4} * D_{CH4} * D_{CH4} * UF_b * \sum_{j,LT} MCF_j * B_{0,LT} * N_{LT,y} * VS_{LT,y} * MS\%_{BL,j,y} \quad \textbf{2}$$

where:

BE_{CH4y}	Baseline emissions in year “y” (tCO_2e)
GWP_{CH4}	Global Warming Potential (GWP) of CH_4 (21)
D_{CH4}	CH_4 density (0.00067 t/m^3 at room temperature (20 ºC) and 1 atm pressure resp. 0.000717 t/m3 at 0°C and 1 atm).
LT	Index for all types of livestock
j	Index for animal waste management system
MCF_j	Annual methane conversion factor (MCF) for the baseline animal waste management system “j”
$B_{0,LT}$	Maximum methane producing potential of the volatile solid generated for animal type “LT” (m^3 CH_4/kg dm)
$N_{LT,y}$	Annual average number of animals of type “LT” in year “y” (numbers)
$VS_{LT,y}$	Volatile solids for livestock “LT” entering the animal manure management system in year “y” (on a dry matter weight basis, kg dm/animal/year)
$MS\%_{Bl,j,y}$	Fraction of manure handled in baseline animal manure management system “j” in the year y
UF_b	Model correction factor to account for model uncertainties (0.94)[8]

Due to lack of country-specific data concerning the maximum methane-producing capacity of the manure (B_0) default values were used according to paragraph 10 of the AMS-III.D.

There are neither country-specific volatile solids (VS) published nor country-specific intake rates for poultry available. Therefore, the default value of table 10A-9 in the annex of chapter 10, volume 4 of the IPCC guidelines 2006 has been used.

The methane conversion factors (MCF) are chosen according to table 10-17 of the 2006 IPCC guidelines for National GHG inventories, volume 4, chapter 10. The manure system was selected according to the evaluation made in table 2 above. The annual average temperature at La Calera is 20.9°C (source: File 1). Two MCF were selected: 4% for solid storage, 78% for open lagoons.

The fraction of manure handled is calculated in annex 3. The baseline values for both, the lagoon system as well as the solid storage manure management change over time due to the increasing animal population and therefore also the increasing manure amount. The absolute amount of manure to the *new* diges-

[8] Reference: FCCC/SBSTA/2003/10/Add.2, page 25.

ters is stable for phase 1 and for phase 2 (start operation of new digester 3/4) of the project (46 resp. 85 tons/d). The details of the $MS\%_{baseline}$ for the two systems are listed in annex 3.

Both $B_{0,LT}$ and the volatile solids (VS) are the default values listed in table 10A-9. For B_0 and VS the values of developed countries have been applied according to paragraph 13 of AMS-III.D. La Calera fulfils all four conditions mentioned in this paragraph:

- The livestock originates from France (source: file 23).
- The farm uses formulated feed rations (FFR) for the different chickens and the different age of the chickens (source: file 24)
- The use of the FFR is proved and can be validated.
- The average weight of the layers of La Calera is even higher then the default value given for layers in the developed countries (sources: file 3 and files 20).

The annual average number of animals ($N_{LT,y}$) are determined according to paragraph 16 of AMS-III.D.:

$$N_{LT,y} = N_{da,y} * \left[\frac{N_{p,y}}{365} \right] \qquad \mathbf{3}$$

Where:

$N_{LT,Y}$	Annual average number of animals in the year "y" (numbers)
$N_{da,y}$	Number of days animal is alive in the farm in the year "y" (numbers)
$N_{p,y}$	Number of animals produced annually of type "LT" for the year "y" (numbers)

The number of hens in La Calera Farm increases by 5% annually and thus also the amount of manure. Details are listed in annex 3.

Baseline emissions due to the use of fossil fuel

In the baseline heat required for the production process of the factory is produced by coal for the egg-carton production. Furthermore, part of the heat generation of the chicken breading is based on LPG. In the project activity the fossil fuels of the two processes will be substituted through biogas from the new digesters. The biogas from the old digester is not integrated in the baseline calculation as mentioned before.

The determination of baseline emissions due to fossil fuel usage follows AMS.I.C. and includes three components:

$$BE_{therm,y} = BE_{cartonheat,y} + BE_{chickheat,y} \qquad \mathbf{4}$$

where:

$BE_{therm,y}$	Baseline emissions from steam/heat displaced by the project activity during the year y; (tCO_{2e})
$BE_{cartonheat,y}$	Baseline emissions from heat displaced by the project activity in the egg-carton production during the year y; (tCO_{2e})
$BE_{chickheat,y}$	Baseline emissions from heat displaced by the project activity in the chicken breeding during the year y; (tCO_{2e})

The baseline emissions of the thermal heat consumption are determined as per paragraph 15 of AMS-I.C.

$$BE_{thermal,CO_2,y} = \frac{EG_{thermal,y}}{\eta_{BL,thermal}} x EF_{FF,CO_2} \quad (5)$$

Where:

$BE_{\text{thermal, CO2,y}}$	Baseline emissions from steam/heat displaced by the project activity during the year y; (tCO_{2e})
$EG_{\text{thermal,y}}$	Net quantity of steam/heat supplied by the project activity during the year y; TJ
$EF_{\text{FF,CO2}}$	CO_2 emission factor of the fossil fuel that would have been used in the baseline plant; tCO_2 / TJ
$\eta_{\text{BL,thermal}}$	Efficiency of the plant using fossil fuel that would have been used in the absence of the project activity

The $EG_{\text{thermal,y}}$ in both production units is calculated based on the biogas with a methane concentration of 60% and the NCV of methane. The methane concentration is assumed by the technology supplier (see file 2)

In the chicken breeding a part of the LPG will be substituted through the biogas of the new digesters. The biogas amount of the old digesters which is used since years for the chicken breeding is not included in the baseline calculation.

The equipment efficiency in the chicken breeding and egg carton production is assumed as 100% (*default efficiency in accordance with Paragraph 18c of AMS.I.C). This approach is conservative.

The new digesters will also be heated with the biogas of the new digesters. The heating energy for the new digesters is not integrated in the baseline calculation as this heating is based on the project activity therefore being project emissions.

PROJECT ACTIVITY EMISSIONS

The project activity emissions in La Calera consist of all three components mentioned in paragraph 17 of the small-scale methodology AMS-III.D.:

(a) Physical leakage of biogas in the manure management systems which includes production, collection and transport of biogas to the point of flaring/combustion or gainful use ($PE_{PL,y}$);

(b) Emissions from flaring or combustion of the gas stream ($PE_{flare,y}$);

(c) CO_2 emissions from use of fossil fuels or electricity for the operation of all the installed facilities ($PE_{power,y}$).

$$PE_y = PE_{PL,y} + PE_{flare,y} + PE_{power,y} \quad (6)$$

where

PE_y	Project emissions in year "y" (tCO_2e)
$PE_{PL,y}$	Emissions due to physical leakage of biogas in year "y" (tCO_2e)
$PE_{flare,y}$	Emissions from flaring or combustion of the biogas stream in the year "y" (tCO_2e)
$PE_{power,y}$	Emissions from the use of fossil fuel or electricity for the operation of the installed facilities in

the year "y" (tCO_2e)

The project emissions due to physical leakage of biogas ($PE_{PL,y}$) are calculated according to paragraph 18 of AMS-III.D. It is 10% of the maximum of the methane producing potential of the manure management systems.

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$$PE_{PL,y} = 0.1 * GWP_{CH4} * D_{CH4} * \sum_{i,LT} B_{0,LT} * N_{LT,y} * VS_{LT,y} * MS\%_{i,y}$$

where:

$PE_{PL,y}$	Project emissions in year "y" (tCO_2e)
GWP_{CH4}	Global Warming Potential (GWP) of CH_4 (21)
D_{CH4}	CH_4 density (0.00067 t/m^3 at room temperature (20 ºC) and 1 atm pressure).
LT	Index for all types of livestock
i	Index for animal waste management system
$B_{0,LT}$	Maximum methane producing potential of the volatile solid generated for animal type "LT" (m^3 CH_4/kg dm)
$N_{LT,y}$	Annual average number of animals of type "LT" in year "y" (numbers)
$VS_{LT,y}$	Volatile solids for livestock "LT" entering the animal manure management system in year "y" (on a dry matter weight basis, kg dm/animal/year)
$MS\%_{Bl,i}$	Fraction of manure handled in baseline system "i" in year "y".

The flaring emissions are calculated based on the "Tool to determine project emissions from flaring gases containing methane". The tool is applicable for the project activity because the gas stream does not consist of other gases than methane, carbon monoxide and hydrogen. Furthermore the obtained gases are from the decomposition of a biodigester. The operation of the flare will be controlled through the continuous measurement of the temperature and of recording the time when the flare is working. The default value of 0.9 for enclosed flares will be used for the calculation of the flare emissions and therefore equation 15 of the tool is applied.

$$PE_{flare,y} = \sum_{h=1}^{8760} TM_{RG,h} x(1 - \eta_{flare,h}) x \frac{GWP_{CH4}}{1'000}$$

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Where:

$PE_{flare,y}$	Project emissions from flaring of the residual gas stream in year y; (tCO_2e)
$TM_{RG,h}$	Mass flow rate of methane in the residual gas in the hour h; (kg/h)
$\eta_{flare,h}$	Flare efficiency in hour *h* (0.9, if any of the parameters are out of the limit of manufacturer's specification in a specific hour = 0.5) during the hour *h*
GWP_{CH4}	Global Warming Potential of methane valid for the commitment period; (tCO_2e/tCH_4)
"h"	Amount of hours during the biogas will be destroyed in the flaring system (flare in the project activity only for emergency cases (h estimated for ex ante calculation = 1% of 8760 = 88 h / or 1% of the recovered biogas estimated in the ex-ante calculation)

The new digester will be heated to around 38°C in order to have an improved digestion. The heating for the new digesters is realized with biogas. Therefore, no fossil fuel will be used for the project activity and therefore no project emissions due to heating occur.

The new digesters will use mechanical agitators. Furthermore the new biogas installation will need some additional pumps, compressors, control equipment, a gas cooling system, sludge separators and feather removals which consume electricity.

The project emissions due to electricity consumption are calculated according to the small-scale methodology AMS-I.D.

$$PE_{power} = EC_{consumption} * EF_{grid} \quad \textbf{9}$$

Where:

$PE_{power,y}$	Emissions from electricity consumption for the project facilities in the year y; tCO_2e
$EG_{consumption,y}$	Electricity consumption for the project facilities in the year y; MWh
$EF_{grid,y}$	Emission factor of the grid supplying the factories in year y; tCO_2e/MWh

For the calculation of the electricity emissions the conservative default value as listed in option A2(a) of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (Version 01) is used. This is applicable as electricity consumption applies only to project electricity consumption sources but not to baseline electricity consumption sources. Furthermore it is assumed that all new equipment for the project activity is working all the time during the year. Additional 10% is added to integrate distribution losses. This is conservative and in accordance with the tool.

No project emissions are included for the fuel switching from fossil fuel to biogas part in accordance with AMS.I.C.

LEAKAGE

No leakage calculation is required according to paragraph 21 of the small-scale methodology AMS.III-D.

No leakage is considered for the fuel switching part in accordance with AMS.I.C paragraph 28 as the energy efficiency technology equipment is not transferred from another activity.

EMISSION REDUCTIONS

The emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y \quad \textbf{10}$$

Where:

ER_y	Emission reductions in the year y (tCO_2e)
BE_y	Baseline emissions in the year y (tCO_2e)
PE_y	Project activity emissions in the year y (tCO_2e)

Ex post emission reductions are calculated based on the lowest value of the following:

(i) The amount of biogas fuelled, flared or gainfully used (*MDy*) minus the electricity consumption due to the project activity during each year of the crediting period, that is monitored *ex post*

(ii) *Ex post* calculated baseline minus project emissions based on actual monitored data for the project activity ($N_{LT,y}$, MS% $_{i,y}$ and W_{site}).

For $BE_{y,ex-post}$ the project will monitor the amount of all species of animal as well as the average during the whole year in order to calculate the annual average number of animals ($N_{LT,y}$,). Furthermore, for the volatile solids (VS) the farm will collect reference about the genetic source of the hens, monitor the formulated feed ratio and will monitor the average amount of all types of hens in the animal population. The guano flow in the whole farm will be weighted in order to assess the fractions of guano which will go to the new digesters and which is going to the guano valley (details see B.7.1). The use of electricity ($PE_{y,ex-post}$) will be calculated over the total inbuilt capacity of all electrical equipment (see B.7.1).
The monitoring of the second term is descript below.

$$ER_{y,es-post} = \min\left[\left(BE_{y,ex-post} - PE_{y,ex-post}\right),\left(MD_y - PE_{power,y,ex-post}\right)\right] \quad \textbf{11}$$

Where:

$ER_{y,ex-post}$	Emission reductions achieved by the project activity based on monitored values for year “y” (tCO_2 e)
$BE_{y,ex-post}$	Baseline emissions calculated using formula 2 using ex post monitored values of $N_{LT,y}$ and if applicable $VS_{LT,y}$
$PE_{y,ex-post}$	Project emissions calculated using formula 6 using ex post monitored values of $N_{LT,y}$,MS% $_{i,y}$ and if applicable $VS_{LT,y}$
MD_y	Methane captured and destroyed or used gainfully by the project activity in year “y” (tCO_2e)
$PE_{power,y,ex-post}$	Emissions from the use of fossil fuel or electricity for the operation of the installed facilities based on monitored values in the year “y” (tCO_2e)

The project uses gainfully the methane in the egg carton production and chicken breading. All the combusted biogas in these processes will be measured separately. The efficiencies of these two processes is each 1.0. Furthermore, in emergency cases the biogas will be flared using the conditions of the flaring process. The flare efficiency will be monitored over the temperature of the enclosed flare in operation. The methane content in the biogas will be monitored with a continuously measuring infrared gas-analyzer (details see annex 4).

MD_y will be calculated as follows:

$$MD_y = BG_{burnt,y} \times w_{CH4,y} \times D_{CH4,y} \times FE_y \times GWP_{CH4} \quad \textbf{12}$$

Where:

MD_y	Methane captured and destroyed/gainfully used by the project activity in the year *y* (tCO_2e)
$BG_{burnt,y}$	Biogas flared/combusted in year *y* (m^3)
$w_{CH4,y}$	Methane content in the biogas in the year *y* (mass fraction)
D_{CH4}	Density of methane at the temperature and pressure of the biogas in the year y ($tonnes/m^3$)
FE_y	Flare efficiency in year *y* (fraction)

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

Data / Parameter:	$B_{0, LT}$
Data unit:	CH_4/kg dry matter VS
Description:	Maximum methane producing potential of the volatile solid generated for animal type LT
Source of data used:	Table 10A-9 of the annex of chapter 10, volume 4 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.
Value applied:	0.39 LT: (Layers dry / Layers wet)
Justification of the choice of data or description of measurement methods and procedures actually applied :	The egg production of the La Calera farm corresponds to international standards and is comparable to developed countries. All four conditions mentioned in paragraph 13 of AMS-III.D are fulfilled and can be proven. Therefore, the use of the default values of the developed countries is appropriate. (see file 3/21/23/24)
Any comment:	

Data / Parameter:	$VS_{LT,y}$
Data unit:	kg dm/animal and year
Description:	Volatile solids for livestock “LT”
Source of data used:	Default value from table 10A-9 of the annex of chapter 10, volume 4 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.
Value applied:	0.02 ($VS_{default}$) LT: (Layers dry / Layers wet)
Justification of the choice of data or description of measurement methods and procedures actually applied :	The egg production of the La Calera farm corresponds to international standards and is comparable to developed countries. All four conditions mentioned in paragraph 13 of AMS-III.D are fulfilled and can be proven. Therefore, the use of the default values of the developed countries is appropriate. . (see file 3/21/23/24)
Any comment:	

Data / Parameter:	$EF_{FF,CO2}$
Data unit:	tCO_2/TJ
Description:	Emission Factor of coal, IPCC default value
Source of data used:	IPCC, 2006 default value (Vol. 2, table 1.4)
Value applied:	98.3
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC value of “anthracite” (stone coal as used by La Calera is another term for anthracite)
Any comment:	-

Data / Parameter:	MCF_j
Data unit:	%

Description:	Methane conversion factor
Source of data used:	2006 IPCC guidelines for National GHG Inventories, Volume 4, Chapter 10, table 10-17
Value applied:	4 (solid storage for poultry) 78 (uncovered anaerobic lagoon for poultry at 21°C)
Justification of the choice of data or description of measurement methods and procedures actually applied :	The guano valley is according to the IPCC guidelines a solid storage (see also baseline definition). Therefore this default value of table 10-17 has been selected. For the open lagoons the default value of "uncovered anaerobic lagoons has been chosen. The annual average temperature at site is 21°C (source: file 1)
Any comment:	

Data / Parameter:	$EF_{FF,CO2}$
Data unit:	tCO_2/TJ
Description:	Emission Factor of LPG, IPCC default value
Source of data used:	IPCC, 2006 default value (Vol. 2, table 1.4)
Value applied:	63.1
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC default value according to methodology.
Any comment:	-

Data / Parameter:	$NCV_{methane}$
Data unit:	MJ/kg equivalent to TJ/Gg
Description:	Net calorific value of methane (net)
Source of data used:	IEA Energy Statistics Manual 2005, p.182
Value applied:	50.03
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	The value is applied in order to calculate the energy content of the recovered methane which can be used in the chicken breading and also for the egg-carton production for heat generation.

Data / Parameter:	$EF_{grid,y}$
Data unit:	tCO_2/MWh
Description:	Emission factor for project electricity consumption sources
Source of data used:	Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (Version 01), Option A2(a)
Value applied:	1.3

Justification of the choice of data or description of measurement methods and procedures actually applied :	The value according to the used tool.
Any comment:	-

B.6.3 Ex-ante calculation of emission reductions:

The ex-ante emission reduction is estimated as follows:

$$ER_{y,exante} = BE_{y,exante} - PE_{y,exante}$$

Where:

$ER_{y,\ ex\ ante}$	*Ex ante* emission reduction in year *y*; (tCO_2e)
$BE_{y,\ ex\ ante}$	*Ex ante* baseline emissions in year *y calculated as per paragraph 16*; (tCO_2e)
$PE_{y,\ ex\ ante}$	*Ex ante* project emissions in year *y* calculated as paragraph 26; (tCO_2e)

BASELINE EMISSIONS ($BE_{y,ex\ ante}$)

The baseline emissions due to the manure managements are increasing due to increasing animal population. The detailed calculations are listed in annex 3.

Table 11: Estimated Baseline Emissions (tCO_2/yr)

	2011/8months	2012	2013	2014	2015	2016	2017	2018/4m
$BE_{CH4,y}$	14,223	21,334	21,334	22,883	22,883	22,883	22,883	7,628
$BE_{therm,y}$	1,546	1,708	1,708	4,361	4,420	4,479	4,538	1,533
$BE_{,y}$	**15,769**	**23,042**	**23,042**	**27,244**	**27,303**	**27,362**	**27,421**	**9,161**

PROJECT EMISSIONS ($PE_{y,\ ex\ ante}$)

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

The detailed calculations are listed in Annex 3

Table 12: Estimated Project Activity Emissions (tCO_2/yr)

	2011/8months	2012	2013	2014	2015	2016	2017	2018/4m
$PE_{PL,y}$	1,513	2,270	2,270	2,434	2,434	2,434	2,434	811
$PE_{flare,y}$	21	32	32	34	34	34	34	11
$PE_{power,y}$	605	908	908	1,741	1,741	1,741	1,741	580
PE_y	**2,140**	**3,209**	**3,209**	**4,210**	**4,210**	**4,210**	**4,210**	**1,403**

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

Year	Estimation of baseline emissions (tCO_2)	Estimation of project activity emissions (tCO_2)	Estimation of overall emission reductions (tCO_2)
2011/8months	15,769	2,140	13,629
2012	23,042	3,209	19,832
2013	23,042	3,209	19,832
2014	27,244	4,210	23,034
2015	27,303	4,210	23,094
2016	27,362	4,210	23,153
2017	27,421	4,210	23,212
2018/4months	9,161	1,403	7,758
TOTAL tCO_2	**180,344**	26,800	**153,544**

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

B.7.1 Data and parameters monitored:

Data / Parameter:	**nd_y**
Data unit:	days
Description:	Number of days per year that the manure treatment system is in operation
Source of data to be used:	La Calera
Value of data:	365 days The guano valley and the open lagoon system for the manure treatment of the baseline scenario are in operation during the whole year. The egg production is continuously running without any breaks during the year.
Description of measurement methods and procedures to be applied:	The flow of the biogas from the new digesters is measured continuously. Based on this measurement the number of days that the manure treatment system is in operation will be deducted.
QA/QC procedures to be applied:	If the biogas flow coming from the new digesters is zero at one day the treatment system is not working.
Any comment:	

Data / Parameter:	**$MS\%_{,j,y}$**
Data unit:	%
Description:	Fraction of manure handled in animal manure management system j in year y
Source of data to be used:	La Calera
Value of data:	See Table A.3.2. in Annex 3 The amount of guano to which is directed to the digester is stable over the crediting period (27 t guano 70% dm/day). The total amount of guano is increasing

	due to the increasing animal population. Therefore, the percentage ($MS\%_{baseline,lagoon}$) is decreasing over the years (see details in annex 3, table A3-2) In the solid storage manure management system we have the same effect. In year 2013 two additional new digesters will be installed. Therefore, the part of $MS\%_{baseline,solid\ storage}$ will increase and will afterwards decrease according to the increasing total amount of guano (details about MS% see annex 3, table A3-2).
Description of measurement methods and procedures to be applied:	The total amount of guano produced must be assessed after removing from the hen cages. The guano from the hen cages must be weighted before it is used resp. stored: it must be weighted before pasteurization, before feeding the old and the new digester and before it is deposited in the guano valley. Based on these figures the real $MS\%_{j,y}$ can be calculated for the open lagoon and for the solid storage manure management system. The guano flow will be controlled according to annex 4 (Details see Figure A4-2; Table A4-1 and Figure A4-3 of Annex 4).
QA/QC procedures to be applied:	The total amount of guano must be compared to the hen population and compared with historical data. significant differences in these comparisons must be explained. The weighting equipment must be calibrated annually through an independent and accredited institute.
Any comment:	

Data / Parameter:	$W_{CH4new,y}$
Data unit:	%V
Description:	Volume percentage of methane in the biogas produced in the new digesters
Source of data to be used:	La Calera will measure the fraction of the methane in biogas quarterly for one day
Value of data:	60% on a wet base For the ex-ante emission reduction calculation no value was applied because the reduction was calculated according to the recovered methane (over a methane-conversion factor) and not to biogas.
Description of measurement methods and procedures to be applied:	The methane fraction will be measured and registered quarterly within a measurement campaign. The measurement will be made with a continuous infrared analyzer over 24 hours (10-20 values / hour). For the fraction of methane (CH_4) the lower 95% confidence interval will be taken of measurements realized. Measured on a **wet** base.
QA/QC procedures to be applied:	Calibration as per manufacturer's recommendations or at least every year. Calibrations must be done by analysis of accredited laboratories. Maintenance will be done in strict compliance with the maintenance schedule recommended by the supplier.
Any comment:	Used to calculate from the volumetric flow rate of the biogas the methane amount

Data / Parameter:	$W_{CH4old,y}$
Data unit:	%V
Description:	Volume percentage of methane in the biogas of the old digester
Source of data to be used:	La Calera will measure the fraction of the methane in biogas quarterly for one day.

Value of data:	60% on a wet base For the ex-ante emission reduction calculation no value was applied because the reduction was calculated according to the recovered methane (over a methane-conversion factor) and not to biogas.
Description of measurement methods and procedures to be applied:	The methane fraction will be measured and registered quarterly within a measurement campaign. The measurement will be made with a continuous infrared analyzer over 24 hours (10-20 values / hour). For the fraction of methane (CH_4) the lower 95% confidence interval will be taken of measurements realized. Measured on a wet base.
QA/QC procedures to be applied:	Calibration as per manufacturer's recommendations or at least every year. Calibrations must be done by analysis of accredited laboratories. Maintenance will be done in strict compliance with the maintenance schedule recommended by the supplier.
Any comment:	Used to calculate from the volumetric flow rate of the biogas the methane amount

Data / Parameter:	$W_{CH4totdry,y}$
Data unit:	%V
Description:	Volume percentage of methane in the total dry biogas before used for different processes
Source of data to be used:	La Calera will measure the fraction of the methane in biogas continuously with a gas detector
Value of data:	60% on a dry base For the ex-ante emission reduction calculation no value was applied because the reduction was calculated according to the recovered methane (over a methane-conversion factor) and not to biogas.
Description of measurement methods and procedures to be applied:	The methane fraction will be measured and recorded continuously. The methane concentration is measured after the drying and desulfurization before fed into the different process pipeline (see annex 4). La Calera will build a monthly average of the measured values. Based on these averages the annual concentration will be calculated.
QA/QC procedures to be applied:	Calibration as per manufacturer's recommendations or at least every year. Calibrations must be done by analysis of accredited laboratories. Maintenance will be done in strict compliance with the maintenance schedule recommended by the supplier.
Any comment:	Used to calculate from the volumetric flow rate of the biogas the methane amount

Data / Parameter:	$BG_{totalnew,y}$
Data unit:	Nm^3/yr
Description:	Volumetric flow rate of biogas produced in the new digesters in year "*y*"
Source of data to be used:	La Calera will measure the biogas amount with a flowmeter (on a wet base).
Value of data:	2010: 1,529,626 Nm^3BG/yr 2013 3,486,611 Nm^3BG/yr and the following years (see table A3-3, Annex 3 of the PDD)

Description of measurement methods and procedures to be applied:	The volumetric biogas flow will be measured and recorded continuously. The flow will be normalized (0°C, 1atm) based on continuous temperature and pressure assessment.
QA/QC procedures to be applied:	Calibration as per manufacturer's recommendations or at least every year. Calibrations must be done by analysis of accredited laboratories. Maintenance will be done in strict compliance with the maintenance schedule recommended by the supplier.
Any comment:	

Data / Parameter:	$BG_{totalold,y}$
Data unit:	Nm^3/yr
Description:	Volumetric flow rate of biogas produced in the old digesters in year "*y*"
Source of data to be used:	La Calera will measure the biogas amount with a flowmeter (on a **wet** base).
Value of data:	2011: 1,045,725 Nm^3BG/yr (based on max. technical in-built capacity) This amount is based on the max. technical in-built capacity at full load. One of the old digesters will be removed in the course of the implementation of the project activity. As baseline biogas production of the old digester this value is the minimal amount. If the measured amount is higher then the minimal amount (rarely possible) figure will be integrated into the emission reduction calculation.
Description of measurement methods and procedures to be applied:	The volumetric biogas flow will be measured and recorded continuously on a wet based. The flow will be normalized (0°C, 1atm) based on continuous temperature and pressure assessment. If the measured biogas amount is less than 585,422 Nm^3BG/yr this amount will be integrated into the emission reduction calculation (explication above).
QA/QC procedures to be applied:	Calibration as per manufacturer's recommendations or at least every year. Calibrations must be done witby analysis of accredited laboratories. Maintenance will be done in strict compliance with the maintenance schedule recommended by the supplier.
Any comment:	

Data / Parameter:	$BG_{cartonheat,y}$
Data unit:	Nm^3/yr
Description:	Volumetric flow rate of biogas used in the egg-carton production in year "*y*"
Source of data to be used:	La Calera will measure the biogas amount with a flowmeter (on a **dry** base)
Value of data:	see table A3-5, Annex 3 of the PDD This amount was calculated according to the estimated energy use for the drier with the improved efficiency (drier of the efficiency: 0.55 according to File 2)
Description of measurement methods and	The volumetric biogas flow will be measured and recorded continuously. The flow will be normalized (0°C, 1atm) based on continuous temperature and pres-

procedures to be applied:	sure assessment.
QA/QC procedures to be applied:	Calibration as per manufacturer's recommendations or at least every year. Calibrations must be done by analysis of accredited laboratories. Maintenance will be done in strict compliance with the maintenance schedule recommended by the supplier.
Any comment:	

Data / Parameter:	$BG_{chickheat,y}$
Data unit:	Nm^3/yr
Description:	Volumetric flow rate of biogas used for the chicken breeding in year "*y*"
Source of data to be used:	La Calera will measure the biogas amount with a flowmeter (on a **dry** base)
Value of data:	see table A3-5, Annex 3 of the PDD
Description of measurement methods and procedures to be applied:	The volumetric biogas flow will be measured and recorded continuously. The flow will be normalized (0°C, 1atm) based on continuous temperature and pressure assessment.
QA/QC procedures to be applied:	Calibration as per manufacturer's recommendations or at least every year. Calibrations must be done by analysis of accredited laboratories. Maintenance will be done in strict compliance with the maintenance schedule recommended by the supplier.
Any comment:	

Data / Parameter:	$BG_{digheatnew,y}$
Data unit:	Nm^3/yr
Description:	Volumetric flow rate of biogas used for the digester heating in year "*y*"
Source of data to be used:	La Calera will measure the biogas amount with a flowmeter (on a **dry** base)
Value of data:	see table A3-5, Annex 3 of the PDD
Description of measurement methods and procedures to be applied:	The volumetric biogas flow will be measured and recorded continuously. The flow will be normalized (0°C, 1atm) based on continuous temperature and pressure assessment.
QA/QC procedures to be applied:	Calibration as per manufacturer's recommendations or at least every year. Calibrations must be done by analysis of accredited laboratories. Maintenance will be done in strict compliance with the maintenance schedule recommended by the supplier.
Any comment:	

Data / Parameter:	$BG_{flare,y}$
Data unit:	Nm3/yr
Description:	Volume of flared biogas in emergency cases in the year y
Source of data to be	La Calera will measure the biogas amount with a flowmeter (on a **wet** base)

used	
Value of data:	2010: 15,296 Nm^3BG/yr 2013 and following years: 34,866 Nm^3BG/yr 1% of the total produced biogas in the new digesters (see table A3-3 of annex 3 of the PDD) will be flared. This is an assumption for the ex ante calculation.
Description of measurement methods and procedures to be applied:	The volumetric flow will be measured continuously of the **wet** biogas. Temperature and pressure will be measured in order to calculate Nm^3. The data will be recorded electronically.
QA/QC procedures to be applied:	Calibration as per manufacturer's recommendations or at least every year. Calibrations must be done by analysis of accredited laboratories. Maintenance will be done in strict compliance with the maintenance schedule recommended by the supplier.
Any comment:	-

Data / Parameter:	T_{flare}
Data unit:	°C
Description:	Flame temperature of flare burner
Source of data to be used:	Measurements through La Calera continuously by using thermocouple.
Value of data applied for the purpose of calculating expected emission reductions:	> 500
Description of measurement methods and procedures to be applied:	The temperature is measured continuously with a thermocouple sensor to demonstrate that the flare is operated in optimal condition. The data is automatically recorded and stored in the monitoring system's interface.
QA/QC procedures to be applied:	Calibration as per manufacturer's recommendations or at least every year. Maintenance will be done in strict compliance with the maintenance schedule recommended by the supplier. Calibrations must be done by analysis of accredited institute.
Any comment:	-

Data / Parameter:	$\eta_{flare,h}$
Data unit:	Fraction
Description:	Flare efficiency in hour "h"
Source of data to be used:	"Tool to determine project emissions from flaring gases containing methane" (EB 28, Meeting Report, Annex 13)
Value of data	0.9 / 0.5
Description of measurement methods and procedures to be applied:	The compliance with the manufacturer's specification of the flare (temperature, flow rate of residual gas at the inlet of the flare) as well as the working hours will be continuously monitored and recorded. If in a specific hour any of the parameters are out of the limit of the manufacturer's specifications, a 50% default value for the flare efficiency will be used for the calculation of this specific hour.

QA/QC procedures to be applied:	The time when the flare is in operation and the time the biogas is flowing through the flowmeter of the flare can be compared and should be identical. Differences must be explained.
Any comment:	-

Data / Parameter:	*EC,y*
Data unit:	MWh/yr
Description:	Electricity consumption of the year "*y*"
Source of data to be used:	La Calera Farm updates the list of equipment using electricity each year
Value of data applied for the purpose of calculating expected emission reductions:	2010 -2012: 699 2013 and following years: 1,339 The capacity of the new equipment is multiplied with 8'760 hours/year plus 10% to account for distribution losses (see paragraph 35 of AMS-III.H. The capacities of the new equipment in the two factories are: (see table below) The inbuilt capacity of the monitoring equipment is estimated for the ex-ante calculation.
Description of measurement methods and procedures to be applied:	All electrical equipments of the wastewater treatment system are listed (sort of equipment, supplier, in-built capacity). The list is updated at the end of the monitoring year. The electricity consumption is estimated according to paragraph 28 of AMS-III.D.: "*it shall be assumed that all relevant electrical equipment operate at full rated capacity, plus 10% to account for distribution losses, for 8760 hours per annum."* If there are changes during the year the estimation shall be carried out with the highest in-built capacity possible. This is conservative.
QA/QC procedures to be applied:	The list shall be controlled yearly through the CDM responsible person.
Any comment:	-

Equipment	**2010-2012**	**2013-2017**
Agitators	30 kW	60 kW
Pumps	3 kW	5 kW
Compressors	2.5 kW	5 kW
Monitoring equipment	1 kW	1 kW
Gas cooling system	23 kW	46 kW
Sludge separators	9 kW	18 kW
Feather removal system	4 kW	4 kW
Total equipment	**72.5 kW**	**139 kW**

Data / Parameter:	$Source_{genetic}$
Data unit:	Document
Description:	Genetic source of the production operations livestock
Source of data to be used:	Document of hen supplier
Value of data	None
Description of measurement methods and	The developed country VS value was used. Therefore, the genetic source of the production livestock must be proven each year through documents of the suppli-

procedures to be applied:	ers of the hens from annex 1 parties.
QA/QC procedures to be applied:	La Calera asks the annex 1 suppliers to send such confirmation letters together with the invoice. The accountant is informed that invoices are only paid if the confirmation letter is attached.
Any comment:	-

Data / Parameter:	*FFR*
Data unit:	Document
Description:	Formulated feed rations
Source of data to be used:	On-farm record keeping and feed suppliers
Value of data	None
Description of measurement methods and procedures to be applied:	The developed country VS value was used. Therefore, formulated feed rations for the various hens, for the different ages of the hens and other categories have to be recorded by the farm or documented through the feed supplier.
QA/QC procedures to be applied:	Check with the invoices for chicken feed.
Any comment:	-

Data / Parameter:	$Soil_{sludge}$
Data unit:	Document
Description:	Proper soil application of the final sludge without methane emissions
Source of data to be used:	External inspection report
Value of data	Explained in the PDD (see chapter A.4.2)
Description of measurement methods and procedures to be applied:	The application of the final sludge and solid waste coming from the digester is controlled annually through an external inspection (e.g. authority who controls the animal management system of the farm). The control report shall confirm including pictures how the solid and liquid sludge coming out of the digester is used (aerobically through drop-irrigations etc.)
QA/QC procedures to be applied:	Soil application shall be measured with an infrared methane gas analyzer in order to proof that no methane gases are emitted.
Any comment:	-

B.7.2 Description of the monitoring plan:

A monitoring manual has been made by ecotawa AG for La Calera. The manual contains responsibilities and a data sheet for all data to be measured with the following information:

- Data unit
- Data collection method including detailed procedure
- QA/QC
- Data storage
- Frequency of collection

- Information source

The monitoring system is described more detailed in Annex 4.

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

Completion date: 13/12/2009

The PDD was realized on behalf of CAF.
For CAF
Camilo Rojas Garcia
Senior Excutive PLAC+[e]
mailto:crojas@caf.com
CAF contracted ecotawa AG for the development of the PDD. Staff involved in the elaboration of this PDD at CAF Camilo Rojas, at ecotawa AG Daniel Wunderlin, Dr. Jürg M. Grütter and Susana Ricaurte Farfán.

ecotawa AG is responsible for the baseline determination of the project.

Contact person: Daniel Wunderlin
dwunderlin@ecotawa.com
http://www.ecotawa.com

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:

02/09/2008 first construction activities started for the original project. This was notified to the UNFCCC. This project was stopped and the technology was changed. The new re-formulated project activity started with the construction of the new biodigesters on 01.04.2009. This was again notified to the UNFCCC and Peruvian DNA.

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

The digesters have an expected lifetime according to the biogas engineering company (SMART UTILITIES SOLUTIONS) of 25 years. Some parts must be replaced during this time within the normal maintenance procedure.

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:

01/05/2011 or the date of registration whichever later

C.2.1.2. Length of the first crediting period:

7 years, 0 months

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Not applicable

C.2.2.2. Length:

Not applicable

SECTION D. Environmental impacts

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

All the activities from La Calera Farm, including the biodigesters project, must fulfill the current environmental legislation within the poultry industry established by the poultry health regulations. La Calera has developed the environmental suitability and management plan (Programa de Adecuación y Manejo del Medio Ambiente, PAMA) and an environmental impact assessment (Estudio de Impacto Ambiental, EIA), which will be presented for approval to the relevant authorities. In this particular case, the PAMA and the EIA must be approved by the Head of the Enironmental Affairs of the Natural Resources Institute (Instituto Nacional de Recursos Naturales, INRENA) of the Secretary of Agriculture.

The biodigesters installation for guano digestion within the biogas production has a positive impact when replacing fossil fuels used at the farm.

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:

There is no existence of significant negative impacts. However, the environmental suitability and management plan (PAMA) and the environmental impact assessment, EIA. will be submitted to the environmental authority.

The positive impacts are given by the substitution of fossil fuels and the elimination of methane emissions combined with bad odor.

SECTION E. Stakeholders' comments

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

Project Briefings have been given to La Calera Farm workers, as well as to the National Institutes of Natural Resources (INRENA) and the District Major of Alto Larán. Two meetings took place on October 16 of 2008, within La Calera installations in the Alto Larán Region. Project explanations were given at these meetings, to assistants that held discussions about it afterwards. Details concerning the meeting with the stakeholders are given in annex 3.

E.2. Summary of the comments received:

The main questions focused on the technology to be used, permanent location of the Project within the farm, possible usage of the biogas generated by the biodigesters when replacing fossil fuels in farm activities, the biodigesters residues and its usage as fertilizer.

The main concerns were centred in the method to dispose of stench odours generated by the hydrogen sulphide acid, given the effects in the workers health and birds as well as the management of biogas generated by the Project.

The project in general terms received a very positive reaction and the assistants suggested keeping an open communication channel. A detailed briefing is provided in Annex 3.

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

The project will maintain communication with the stakeholders. An invitation will be extended to the stakeholders, as well as general public for the official inaugural opening of the project. A detailed briefing of the meetings held is provided in Annex 3.

The project contemplates the disposal of sulfur content in the biogas for fuel usage, thus reducing the health risks for the community and birds. Related to the biogas management generated by the project, the biodigesters are contemplated as closed systems not allowing for any leaks plus including safety measures for any eventualities.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no Official Development Assistance (ODA) in this project and the project will not receive any public funding from Parties included in Annex I.

Annex 3

BASELINE INFORMATION

A.1. GENERAL INFORMATION

A.1.1. Guano flow in La Calera (tons per day)

Table A3-1: Guano Flow in La Calera (tons guano per day / dry matter content of 70%) based on historical data 2009 and annual increase of 5%

©	2009	2010	2011	2012	2013	2014	2015	2016	2017
	Tons per day (dry matter content: 70%)								
Total guano	154.43	162.15	170.26	178.77	187.71	197.10	206.95	217.30	228.16
Guano valley	85.29	81.16	87.91	95.01	63.46	71.28	79.50	88.12	97.18
Open lagoons	27.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
New Digesters	0.00	37.57	37.57	37.57	76.57	76.57	76.57	76.57	76.57
Old Digesters	16.43	16.43	16.43	16.43	16.43	16.43	16.43	16.43	16.43
Pasteurization	25.71	27.00	28.35	29.76	31.25	32.81	34.45	36.18	37.99

Red: not included in the baseline scenario (guano to old digester = flow for two digesters)

The increase of guano is based on the increasing animal population.

A.1.2. Fraction of manure handled in baseline animal manure management system "j" ($MS\%_{Bl,j}$)

The amount of the manure handled in the open lagoon system would be constant (27.0t/d). The fraction is changing according to the increasing amount of total guano (see table A3-1). The fraction of the solid storage fraction in the project activity is calculated as follows (see figures in table A3-1): (Amount new digester - amount open lagoons)/total guano

Table A3-2: Fraction of manure handled in baseline manure management system "j"

Manure system baseline "j"	2009	2010	2011	2012	2013	2014	2015	2016	2017
	Fraction								
Open lagoons	0.175	0.167	0.159	0.151	0.144	0.137	0.130	0.124	0.118
Solid storage	-	0.065	0.062	0.059	0.264	0.252	0.240	0.228	0.217

A.1.3. Biogas production of the new digesters

The biogas production is calculated based on file 10. The methane conversion factor of the new digesters is slightly higher than described in AMS-III.D.

Table A3-3: Biogas production of the new digesters per year (see file 2, page 21; from the total biogas the biogas of the 2 old digesters (6'252 MWh is subtracted)

	2010	2011	2012	2013	2014	2015	2016	2017	2018
MWh/yr	8'348	8'348	8'348	20'048	20'048	20'048	20'048	20'048	20'048
Nm^3/yr biogas*	1'396'339	1'396'339	1'396'339	3'353'355	3'353'355	3'353'355	3'353'355	3'353'355	3'353'355
t/yr biogas	1'001	1'001	1'001	2'404	2'404	2'404	2'404	2'404	2'404

*(based on: 60% CH_4-fraction in the biogas, density CH_4: 0.000717 t/m^3; NCV_{CH4}: 50.03 GJ/t)

A.1.4. Energy demand of the different processes and input energy sources

Table A3-4: Energy demand of the different processes and energy sources (MWh)

Energy Source	2009	2010	2011	2012	2013	2014	2015	2016	2017
Chicken Breeding [MWh/yr]									
LPG	6'794	2'086	4'586	5'231	2'317	3'496	4'710	5'962	7'264
BG New Digester	0	4'753	2'868	2'868	6'460	5'992	5'526	5'058	4'580
BG old Digester	5,455	5,455	5,455	5,455	5,455	5,455	5,455	5,455	5,455
Total	12,249	12,294	12,909	13,554	14,232	14,943	15,691	16,475	17,299

Egg Carton Production [MWh/yr]									
Coal	8,691	5,191	5,191	5,191	0	0	0	0	0
BG New Digester	0	3,504	2,985	2,985	8,176	8,644	9,110	9,578	10,056
Total	8,691	8,695	8,176	8,176	8,176	8,644	9,110	9,578	10,056
Digester Heating [MWh/yr]									
Coal (for old digest.)	971	971	971	971	971	971	971	971	971
BG New Digester	0	0	2,404	2,404	5,204	5,204	5,204	5,204	5,204
Total	971	971	3,375	3,375	6,175	6,175	6,175	6,175	6,175
Flare (Emergency cases ≈ 1% of produced biogas [MWh/yr]									
BG New Digester		91	91	91	208	208	208	208	208

BG: Biogas

Conversion factors: Biogas (BG, 60% CH_4, 0°C, 1 atm.): 1MWh = 167.2637 m^3 = 0.1199t

Table A3-5: Energy demand of the different processes and amount of biogas from old and new digester (Nm^3)

Energy Source	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Chicken Breeding [Nm3/yr]									
BG New Digester		795,017	479,720	479,720	1,080,541	1,002,260	924,314	846,033	766,080
BG old Digester	1,045,725	1,045,725	1,045,725	1,045,725	1,045,725	1,045,725	1,045,725	1,045,725	1,045,725
Total	1,045,725	1,840,742	1,525,445	1,525,445	2,126,266	2,047,985	1,970,039	1,891,758	1,811,805
Egg Carton Production [Nm3/yr]									
BG New Digester	0	586,092	499,282	499,282	1,367,548	1,445,827	1,523,772	1,602,052	1,682,004
Digester Heating [Nm3/yr]									
BG New Digester	0	0	402,102	402,102	870,440	870,440	870,440	870,440	870,440

Flare (Emergency cases ≈ 1% of produced biogas [Nm3/yr]								
BG New Digester		10,049	15,073	15,073	16,168	16,168	16,168	16,168	5,389

A.2. BASELINE EMISSIONS

A.2.1. Formulas

Baseline Emission from Manure Management

$$BE_{CH4,y} = GWP_{CH4} * D_{CH4} * UF_b * \sum_{j,LT} MCF_j * B_{0,LT} * N_{LT,y} * VS_{LT,y} * MS\%_{Bl,j}$$

where:

BE_{CH4y}	Baseline emissions in year “y” (tCO_2e)
GWP_{CH4}	Global Warming Potential (GWP) of CH_4 (21)
D_{CH4}	CH_4 density (0.00067 t/m^3 at room temperature (20 ºC) and 1 atm pressure resp. 0.000717 t/m3 at 0°C and 1 atm).
LT	Index for all types of livestock
j	Index for animal waste management system
MCF_j	Annual methane conversion factor (MCF) for the baseline animal waste management system “j”
$B_{0,LT}$	Maximum methane producing potential of the volatile solid generated for animal type “LT” (m^3 CH_4/kg dm)
$N_{LT,y}$	Annual average number of animals of type “LT” in year “y” (numbers)
$VS_{LT,y}$	Volatile solids for livestock “LT” entering the animal manure management system in year “y” (on a dry matter weight basis, kg dm/animal/year)
$MS\%_{Bl,j,y}$	Fraction of manure handled in baseline animal manure management system “j” in the year y
UF_b	Model correction factor to account for model uncertainties (0.94)[9]

$$N_{LT,y} = N_{da,y} * \left[\frac{N_{p,y}}{365} \right]$$

Where:

$N_{LT,Y}$ Annual average number of animals in the year "y" (numbers)

[9] Reference: FCCC/SBSTA/2003/10/Add.2, page 25.

$N_{da,y}$ Number of days animal is alive in the farm in the year "y" (numbers)
$N_{p,y}$ Number of animals produced annually of type "LT" for the year "y" (numbers)

Baseline Emission from Fossil Fuel Consumption

$$BE_{thermal,CO_2,y} = \frac{EG_{thermal,y}}{\eta_{BL,thermal}} x EF_{FF,CO_2}$$

Where:
$BE_{thermal, CO2,y}$ Baseline emissions from steam/heat displaced by the project activity during the year y; (tCO_{2e})
$EG_{thermal,y}$ Net quantity of steam/heat supplied by the project activity during the year y; TJ
$EF_{FF,CO2}$ CO_2 emission factor of the fossil fuel that would have been used in the baseline plant; tCO_2 / TJ
$\eta_{BL,thermal}$ Efficiency of the plant using fossil fuel that would have been used in the absence of the project activity

A.2.2. Data

Table A3-6: Data used for manure management

Parameter	Description	Value	Unit	Source
GWP_{CH4}	Global Warming Potential of CH_4	21	Factor	According to AMS-III.D.
D_{CH4}	CH_4 density (0.00067 t/m^3 at room temperature (20 ºC) and 1 atm pressure	0.000717	t/m3	Value of AMS-III.D normalized (0°C/1atm)
MCF_j	Open lagoon: 0.78 Solid storage: 0.04	0.78 0.04	fraction	Table 10-17 of the 2006 IPCC guidelines for GHG inventories, volume 4, chapter 10
$B_{0,LT}$	Maximum methane producing potential of the volatile solid generated for animal type "LT"	0.39	m^3 CH_4/kg dm	Table 10A-9 of the 2006 IPCC guidelines for GHG inventories, volume 4, chapter 10
$N_{LT,y}$	Annual average number of animals of type "LT" in year "y"	Table A3-8	number	Calculated according to AMS-III.D.
$VS_{LT,y}$	Volatile solids for livestock "LT" in year "y"	7.30	kgdm/animal/y	Table 10A-9 of the 2006 IPCC guidelines for GHG inventories, volume 4, chapter 10: 0.02 kgdm/animal/day (365 days)

$MS\%_{Bl,j,y}$	Fraction of manure handled in manure management system "j" in the year y	Table A3-9	Fraction	Calculated
UF_b	Model correction factor to account for model uncertainties	0.94	Factor	AMS-III.D: FCCC/SBSTA/2003/10/Add.2, page 25
$N_{da,y}$	Number of days animal is alive in the farm in the year "y"	490	day	
$N_{p,y}$	Number of animals produced annually of type "LT" for the year "y"	Table A3-8	number	Historical Data La Calera. 2008 = 2,700,000 every year increased by 5%

Table A3.7: Data used for the consumption of fossil fuel

Parameter	Description	Value	Unit	Source
$EG_{thermal,y}$	Net quantity of steam/heat supplied by the project activity during the year y; TJ	Table A3-9	TJ	Table xy of Annex 3
$EF_{FF,CO2}$	CO_2 emission factor of the fossil fuel that would have been used in the baseline plant; tCO_2 / TJ	LPG: 63.10 coal: 98.30	tCO_2 / TJ	IPCC, 2006 default value (Vol. 2, table 1.4)
$\eta_{BL,thermal}$	Efficiency of the plant using fossil fuel that would have been used in the absence of the project activity	1.0	fraction	Default value (conservative); For all processes i.e. digester heating, chicken breeding and for the egg carton production

Table A3-8: Annual animal production ($N_{p,y}$) and average annual animal population ($N_{LT,y}$) (Basis: 2008: 2,700,000 per year; increasing 5% per year)

Parameters	2009	2010	2011	2012	2013	2014	2015	2016	2017
	Number of animals								
$N_{p,y}$	2,835,000	2,976,750	3,125,588	3,281,867	3,445,960	3,618,258	3,799,171	3,989,130	4,188,586
$N_{LT,y}$	3,805,890	3,996,185	4,195,994	4,405,794	4,626,084	4,857,388	5,100,257	5,355,270	5,623,034

A.2.3. Results

Table A3-9: Baseline emissions

Parameter	**Unit**	**2011 (8months)**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018 (4months)**
Heat use chicken breeding[1]	TJ	11.4	10.3	10.3	23.3	21.6	19.9	18.2	5.5
Heat egg carton[1]	TJ	8.4	10.7	10.7	29.4	31.1	32.8	34.5	12.1
$MS\%_{Lagoon}$	Fraction	0.1665	0.1586	0.1510	0.1438	0.1370	0.1305	0.1243	0.1183
$MS\%_{solid}$	Fraction	0.0652	0.0621	0.0591	0.2641	0.2515	0.2395	0.2281	0.2173
BE manure management	tCO_2/y	14,223	21,334	21,334	22,883	22,883	22,883	22,883	7,628
BE fossil fuel use	tCO_2/y	1,546	1,708	1,708	4,361	4,420	4,479	4,538	1,533
Total BE	**tCO_2/y**	15,769	23,042	23,042	27,244	27,303	27,362	27,421	9,161

1 = substituted fossil through biogas from the new digester

A.3. PROJECT EMISSIONS

A.3.1. Formulas

Physical Leakage of Biogas

$$BE_{CH4,y} = 0.10 * GWP_{CH4} * D_{CH4} * \sum_{j,LT} B_{0,LT} * N_{LT,y} * VS_{LT,y} * MS\%_{i,y}$$

where:

BE_y	Baseline emissions in year "y" (tCO_2e)
GWP_{CH4}	Global Warming Potential (GWP) of CH_4 (21)
D_{CH4}	CH_4 density (0.00067 t/m^3 at room temperature (20 ºC) and 1 atm pressure).
LT	Index for all types of livestock
J	Index for animal waste management system
MCF_j	Annual methane conversion factor (MCF) for the baseline animal waste management system "j"
$B_{0,LT}$	Maximum methane producing potential of the volatile solid generated for animal type "LT" (m^3 CH_4/kg dm)

$N_{LT,y}$ Annual average number of animals of type “LT” in year “y” (numbers)
$VS_{LT,y}$ Volatile solids for livestock “LT” entering the animal manure management system in year “y” (on a dry matter weight basis, kg dm/animal/year)
$MS\%_{Bl,j}$ Fraction of manure handled in baseline system “j” in year "y".

Flaring of Biogas

$$PE_{flare,y} = \sum_{h=1}^{8760} TM_{RG,h} x (1 - \eta_{flare,h}) x \frac{GWP_{CH4}}{1'000}$$

Where:
$PE_{flare,y}$ Project emissions from flaring of the residual gas stream in year y; (tCO_2e)
$TM_{RG,h}$ Mass flow rate of methane in the residual gas in the hour h; (kg/h)
$\eta_{flare,h}$ Flare efficiency in hour *h* (0.9, if any of the parameters are out of the limit of manufacturer's specification in a specific hour = 0.5) during the hour *h*
GWP_{CH4} Global Warming Potential of methane valid for the commitment period; (tCO_2e/tCH_4)
"h" Amount of hours during the biogas will be destroyed in the flaring system

Project Emissions Due to Electricity Consumption

$$BE_{power} = EC_{consumption} * EF_{grid}$$

Where:
$PE_{power,y}$ Emissions from electricity consumption for the project facilities in the year y; tCO_2e
$EG_{consumption,y}$ Electricity consumption for the project facilities in the year y; MWh
$EF_{grid,y}$ Emission factor of the grid supplying the factories in year y; tCO_2e/MWh

A.3.2. Data

Table A3-10: Data used for project emissions

Parameter	Description	Value	Unit	Source
GWP_{CH4}	Global Warming Potential of CH_4	21	Factor	According to AMS-III.D.
D_{CH4}	CH_4 density	0.000717	t/m3	Value of AMS-III.D normalized (0°C/1atm)
MCF_j	Open lagoon: 0.78 Solid storage: 0.04	0.78 0.04	fraction	Table 10-17 of the 2006 IPCC guidelines for GHG inventories, volume 4, chapter 10
$B_{0,LT}$	Maximum methane producing potential of the volatile solid generated for animal type "LT"	0.39	m^3 CH_4/kg dm	Table 10A-9 of the 2006 IPCC guidelines for GHG inventories, volume 4, chapter 10
$N_{LT,y}$	Annual average number of animals of type "LT" in year "y"	Table A3-8	number	Calculated according AMS-III.D.
$VS_{LT,y}$	Volatile solids for livestock "LT" in year "y"	7.30	kgdm/animal/y	Table 10A-9 of the 2006 IPCC guidelines for GHG inventories, volume 4, chapter 10: 0.02 kgdm/animal/day (365 days)
$MS\%_{Bl,j,y}$	Fraction of manure handled in manure management system "j" in the year y	Table A3-9	Fraction	Calculated
UF_b	Model correction factor to account for model uncertainties	0.94	Factor	AMS-III.D: FCCC/SBSTA/2003/10/Add.2, page 25
$N_{da,y}$	Number of days animal is alive in the farm in the year "y"	490	day	Data of La Calera
$N_{p,y}$	Number of animals produced annually of type "LT" for the year "y"	Table A3-8	number	Historical Data La Calera. 2008 = 2'700'000 every year increased by 5%
$TM_{RG,h}$	Mass flow rate of methane in the residual gas in the hour h; (kg/h) Mass flow rate of methane in the residual gas in the hour h; (kg/h)	Table A3-11	kg/h	Calculated: Average of total biogas recovered per year/8760
$\eta flare,h$	Flare efficiency in hour	0.9	Fraction	0.5 if flare is not working well; accord. to flare tool
"h"	Amount of hours during the biogas will be destroyed in the flaring system	88	Hours/year	**estimated** for ex ante calculation = 1% of 8760 = 88 h / or 1% of the recovered biogas estimated

				in the ex-ante calculation
$EG_{consumption,y}$	Electricity consumption for the project facilities in the year y	Table A3-11	MWh	List of all electrical equipment with inbuilt capacity; Calculated total inbuilt cap *8760h*1.1
$EF_{grid,y}$	Emission factor of the grid supplying the factories in year y	1.3	tCO_2e/MWh	"Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (paragraph A2(a): default value

A.3.3. Results

Table 3A-11: Baseline Emissions (1=substituted fossil through biogas from the new digester)

Parameter	**Unit**	**2011 (8months)**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018 (4months)**
Mass flow rate biogas	kg/h	81.9	122.8	122.8	131.7	131.7	131.7	131.7	43.9
In-built capacity of electrical equipment	kW	72.5	72.5	72.5	139.0	139.0	139.0	139.0	139.0
Electricity consumption	MWh/y	605	908	908	1,741	1,741	1,741	1,741	580
PE physical leakage	tCO_2/y	1,513	2,270	2,270	2,434	2,434	2,434	2,434	811
PE from flaring	tCO_2/y	21	32	32	34	34	34	34	11
PE electricity consumption	tCO_2/y	605	908	908	1,741	1,741	1,741	1,741	580
Total PE	**tCO_2/y**	**2,140**	**3,209**	**3,209**	**4,210**	**4,210**	**4,210**	**4,210**	**1,403**

MINUTES OF THE STAKEHOLDER MEETINGS

A. Minute of the First Stakeholder Meeting

Date: Thursday 16.10.2008
Place: La Calera Farm, Alto de Larán, Peru
Assistants:
General Manager
Production Manager
Veterinarian Doctors

Content:

1. Introduction performed by Mauricio Flores Cabral
2. Project presentation performed by Mauricio Flores Cabral, including:
   a. Objective of the meeting
   b. Project presentation explaining current situation, new technology to be used and its technical characteristics, and the usage of the biogas produced by the biodigesters as fuel replacement for fossil fuels in the farm and other usages.
3. Discussion of the project with assistants. (Q and A)

Questions and Answers:

1. *How much of the stench odor is reduced by the new technology?*

   This depends on the technology used for the sulfur reduction level. Currently, a good percentage is eliminated by the application of oxygen.

   In all cases, the development of this project contemplates the disposal of the sulfur content found in the biogas for the use of fuel, with no major discomfort and risks for the public health and with normal development of the birds.

2. *Is it possible to use 100% of guano produced in La Calera?*

   Yes. But we have to have in mind that we have guano of different characteristics defined by the humidity level, elapsed time, sector origin, withdrawal time, etc. The mix incorporated to the reactor must be homogenous and with a specific dry matter content.

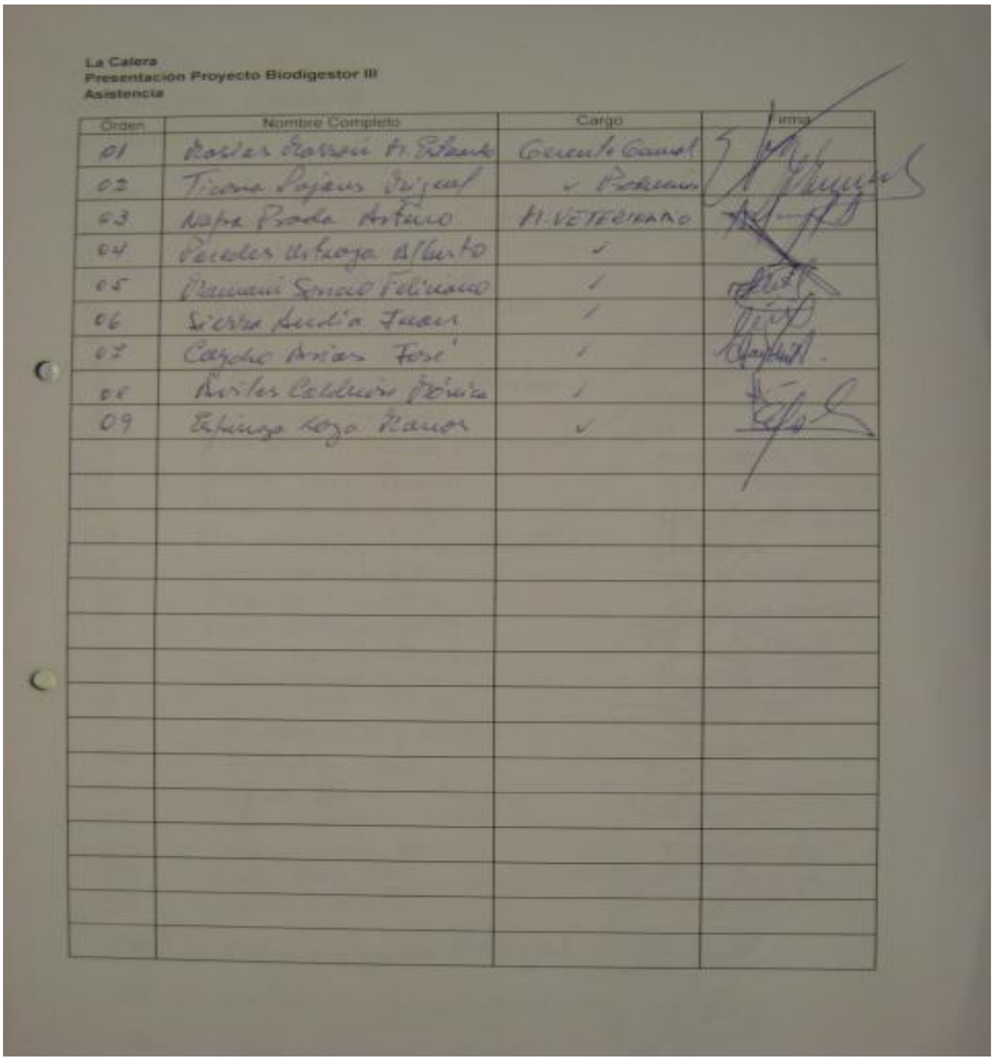
3. *What method will be used for the sulfur disposal?*

   There are several methods; the employed method is still to be defined. Regarding this matter, Engineer Estuardo Masías Marrou, emphasized that the only way to carry out the project of biogas usage in all the production units of La Calera is by means of the disposal of the hydrogen sulfide acid stench odor. The project will not be realized if it's not possible to dispose the sulfur odor for the wellbeing of the workers and the farm in general.

4. *In the biodigesters. Is it possible to use wet guano?*

   No doubt. It can be used. In fact, water is added before being introduced to the biodigester. Nonetheless, there has to be a relation between the guano humidity and the amount of added water. The mix of water and guano poured in the biodigester must have a dry matter percentage of 18% to avoid inconveniences in the biogas production.

At the highest humidity level of the organic matter (guano), the mix is composed by 80% guano and 20% water. On the other hand, the driest level for guano, the mix can be composed by 80% water and 20% guano.



La Calera
Presentación Proyecto Biodigestor III
Asistencia

Orden	Nombre Completo	Cargo	Firma
01	[illegible]	Gerente General	
02	[illegible]	[illegible]	
03	Napa Prada Arturo	M. VETERINARIO	
04	[illegible] Alberto	✓	
05	Mamani Soncco Feliciano	✓	
06	[illegible] Juan	✓	
07	Carpio Arias José	✓	
08	[illegible]	✓	
09	[illegible]	✓	

Figure A3-1: Attendance List of the First Stakeholder Meeting

B. Minute of Second Stakeholders Meeting

Date: Thursday 16.10.2008
Place: La Calera Farm, Alto de Larán, Peru
Assistants:
Working personnel of the raising area

Content:

1. Introduction performed by Mauricio Flores Cabral

2. Project presentation performed by Mauricio Flores Cabral, including:
   a. Meeting objective
   b. Project presentation explaining current situation, new technology to be used and its technical characteristics, and the usage of the biogas produced by the biodigesters as fuel replacement for fossil fuels in the farm and other usages.
3. Discussion of the project with assistants. (Q and A)

Questions and Answers

1. *How much guano is produced currently in La Calera? What is the use of the collected guano, currently?*
   Approximately 154 tons per day. 65 tons are used at the pasteurization plant, 20 tons approximately in the biodigesters and the remaining is employed at the farming lots of the farm.

2. *How much of it is used today for the biodigesters and how much will be used with the two new systems installed?*
   As I said, close to 20 tons per day are employed and the new biodigester 40 tons more per day. With the new biodigester, close to 50% of the total amount of guano will be used for the fuel generation. An equivalent amount will be employed in the pasteurization plant and the remaining will still be destined for the farming fields.

3. *Why does not all of the organic matter of the biodigesters I and II decompose? What is new in the technology of the biodigester III?*
   The biodigesters I and II are basically large tanks with a permanent mix of organic matter and water in its interior. Every day, a mixed quantity is introduced and an equal part is removed from the same tank. Even as the mix is introduced and removed from different spots, there is no guarantee that the recently introduced mix has remained the sufficient time for decomposition and production of all the gas that it could produce. Therefore, the removed mix of the biodigesters still maintains a capacity for biogas production.

   The technology from the new biodigester is more complex. The new biodigester has two chambers that maintain separated the recent mix introduced and the mix previously poured which has sufficient biogas production. In this manner it is impossible to remove recently poured mix that still maintains gas production capacity. It is certainly a complex system that turns more efficient the biogas production. More gas is produced and residues of better conditions are obtained for the improvement of the plants management.

4. *Which will be the location for the new biodigester?*
   The new biodigester will follow the two already existing, where the cleaning works for the terrain have already begun. They are found in the following order: the green biodigester (oldest), the biggest biodigester (concrete), the two bladders or accumulators and continuing towards the hill, the third biodigester which will be made with bigger dimensions.

5. *For those of us who live in the farm. Will we be able to cook with that gas?*
   A layout for a a gas distribution net for homes in La Calera is not yet contemplated however it is perfectly possible to consider this for the future, since biogas can be used for cooking purposes, substituting the propane gas used at homes. This idea can be held into account in the development of a

following stage in the project. This is also the purpose of these meetings. Ideas may rise from your opinions and concerns helping us to formulate a better project.

6. *Regarding the residue obtained from the biodigesters, the fertilizer, when is it used for the sweet potato? What is the amount to be used? What is the equivalence for a bag of this fertilizer and one of urea?*
   In reality, the fertilizer dosage to be used for each crop depends on the needs of it and its soil condition. I cannot tell you at the moment, which is the right dosage of this fertilizer for the sweet potato crop. Not only would we have to consider soil conditions but also determine the equivalence in function of the availability of elements and nutrients contained in Biosol. We will know that further ahead. What we know for sure is that it has a high concentration of elements and that it is an extraordinary fertilizer. Generally, organic matter is used as complement for chemical fertilizers. Biosol not only works as a source of nutrients but also as an improvement for the soil structure.

7. *When working with biogas, a strong odor is felt. Is that smell harmful for hens? And for the people working there?*
   Certainly, biogas has a strong odor when it is burned. The reason for it is that the biogas that we produce now has a moderate content of sulfur. Nonetheless, in spite of that low content of sulfur, at burning time it has a strong smell. That smell could be harmful (to a certain degree) for hens and for the people working there. That is the reason why the disposal of hydrogen sulfide acid is an important part of this project, for the wellbeing of the workers and an adequate development of the hens.

8. *As you said previously, the new biodigester solely will use double the amount of guano currently used, don't you think that the dump truck with which we use now to collect guano will not be large enough? Besides, we will run short of time because right now with one dump truck we just barely finish.*
   It is true. We must find or change the dump truck we use now for a bigger one or having one or two more dump trucks to attend the need of guano for the new biodigester. Surely we will have to consider employing more personnel in order to provide enough guano to the new biodigester.

9. *Will more people be needed to employ for preparing the guano mix?*
   That's right. All the units that depend on biogas, as in the case of the dump truck, will have to adjust to the growth of a bigger biogas production. Not only more dump trucks and personnel will be necessary to attend the bigger need of the biodigester, it will also be necessary a bigger capacity for residual splitting: to be able to collect a bigger bio sol quantity and distribute a bigger amount of biol. Surely a bigger amount of personnel will have to work at the Biogas plant.

10. *For producing gas, is it better to use wet or dry guano?*
    An assistant responds: We have noticed that when using dry guano, less gas is produced. It is better to transport guano when the henhouse droppers are well wet.

11. *Does this gas affect human beings? It has a strong smell in the henhouses when used.*
    As I mentioned in a previous question, it may affect people. However, an important part of this project is to remove the odour produced by the hydrogen sulfide acid contained in the biogas with no inconvenient for its usage.

12. *Where does the technology come from? Where are the engineers from?*

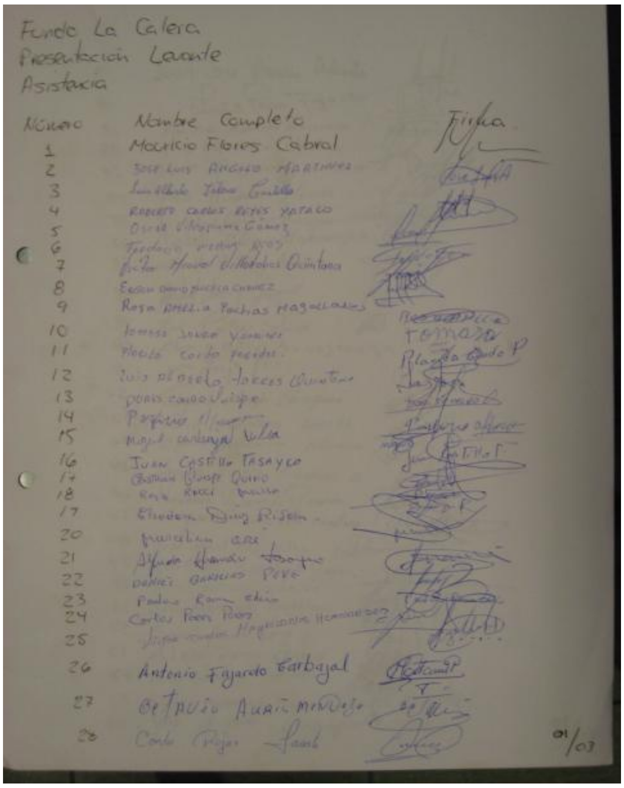
The technology from the new biodigester is owned by a Canadian enterprise, RENTEC. However, the owner of that enterprise is a German engineer and he employs engineers from several nationalities in the design of the project.
Nevertheless, as the engineering is foreign, the construction will be done here and a Peruvian metal mechanic enterprise will be in charge, with assistance of the Canadian enterprises.

13. *Is this location a good one for the cafeteria? Because of the smell, and because of the gas?*
Well surely it is not the best location because of the odor currently brought by the biol and biosol (liquid and solid parts of the residue respectively). However, with the implementation of this project, we hope to eliminate the odor that you notice from time to time.

Regarding the gas exposure, I would not be concerned insofar as the system is a closed one and no leaks exist. Nonetheless, we are not free from accidents happening. Although probabilities are low, the project that will be developed considers security systems to reduce inherent risks while working with biogas. We should not be afraid of gas fuel. Many of us cook with gas fuel in our homes with no mishaps.

14. *How did the engineer come up with this idea?*
Well little by little, initially it began with one biodigester. Today we are building the third one. This is in response to the convenience of making it. There is a big supply of organic matter that can be used for biogas production and fuel. On the other hand, the residue can also be used in the farming fields as an excellent fertilizer.

Also, we need to be aware that there is a large save in fuel consumption. Only within raising we will stop buying more than 20,000 gallons of GLP that are consumed every month. We hope also to stop buying coal and bunker for the cardboard factory, among other things.



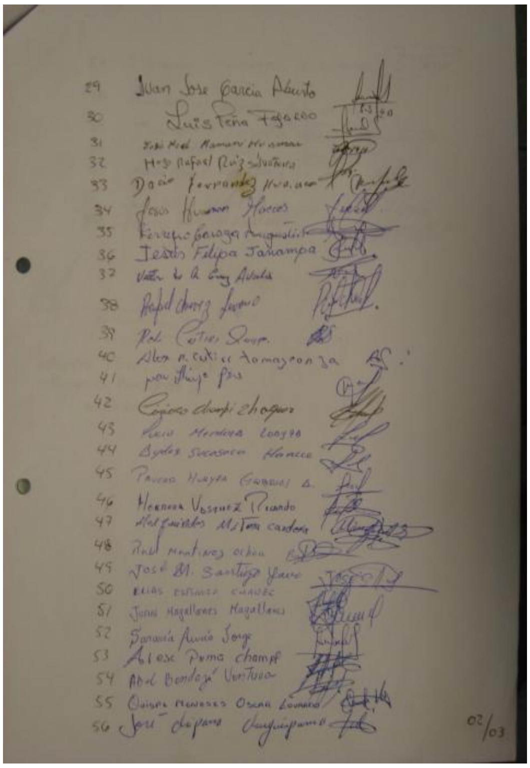


Figure A3-2: Attendance List of the 2nd Stakeholder Meeting

DOCUMENT SOURCES

Table A3-12: List of used documents

Reference	Document
File 1	La Calera Temperature Records (2006-2008)
File 2	Process layout of SMART UTILITIES SOLUTIONS, Germany
File 3	Summary concerning hen population and average weight of the hens
File 4	Guano Analysis and Batch Digestion Experiment
File 5	Egg Carton Production Plan for the Future
File 6	Egg Carton Production Historical Data (2007 - 2009)

Reference	Document
File 7	Coal analyze (NCV), November 2008
File 8	Planned hen population for the future, mail of La Calera
File 9	Records of weight of wet and dry egg carton (Jan - Jun 2009)
File 10	Monitoring manual for the egg carton production process
File 11	Summary Environmental Impact Assessment and Stakeholder Meeting
File 12	Guano flow control including dry matter content of guano (Jan - Jun 2009)
File 13	Coal consumptions and invoices (historical data)
File 14	Biogas produced in the old digesters (historical data of 2009)
File 15	Consumption and cost of LPG (2006-2008)
File 16	CER-Spreadsheet of ecotawa AG
File 17	Revision of the flowmeter for the biogas produced by the old digesters
File 18	NCV of LPG used in La Calera
File 19	Energy consumption in La Calera (different processes)
File 20	Weight of the different hen types and ages
File 22	Letter of the Ministerio de Agricultura
File 23	Solicitud
File 24	Formulated Feed Rations
Financial Assessment Files	
File Finance 1	Financial Spreadsheet by ecotawa AG, 2009; Version 1.1
File Finance 2	Not used anymore
File Finance 3	BCRP: Interest Rates Peru, 2008

Reference	Document
File Finance 4	Smart Utilities Solutions, Mass Balance Guano, 2009
File Finance 5	BCRP: Official exchange rate PEN to USD, 2008
File Finance 6	EEX: CER price, 2008

Annex 4

MONITORING PLAN

1. Introduction

The purpose of the Monitoring Plan is to provide a documented procedure by which monitoring and verification activities can be conducted of the project activity. The plan will be adhered to for the duration of the project activity. The monitoring plan ensures that accurate and valid monitoring data are obtained.

Ecotawa elaborated for La Calera a monitoring manual. The responsible persons will be trained how to monitor the project activities.

2. Operational and Monitoring Obligations

La Calera will fulfill the required operational and data collection obligations so that CERs are calculated in a transparent manner. All data required for baseline and emission reduction determination shall be monitored as directed in this PDD and in the monitoring manual.

3. Responsibilities

The responsibilities of **La Calera** are:

1. Collect in the required frequency all data for the monitoring of the CDM project.
2. Perform data and information quality control according to this manual.
3. File all documents in the manner and timing that this manual demands.
4. Realize an annual monitoring report for all years of the crediting periods
5. Answer all inquiries and additional information requests by the DOE for the verification report of the CERs. Furthermore, reply to all inquiries received during the process of issuance by UNFCCC.

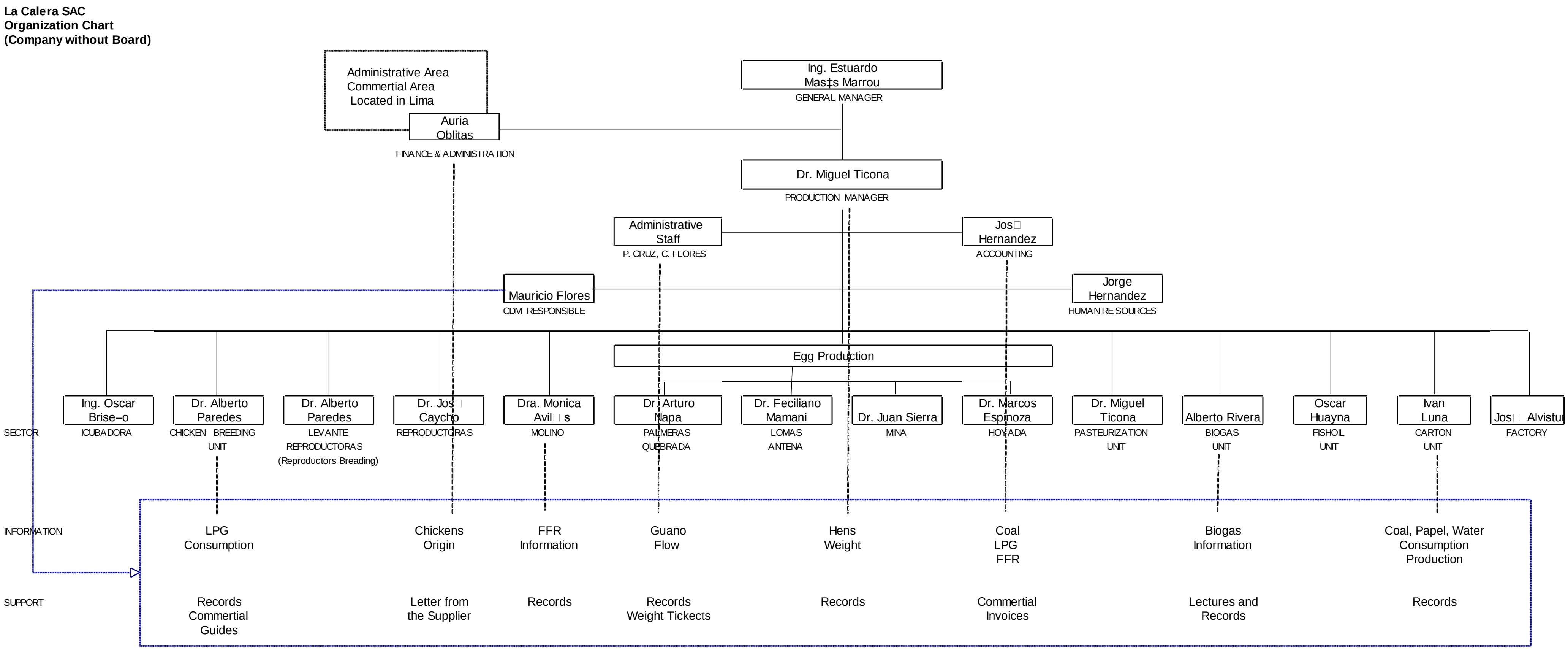


Figure A4-1. Organizational set-up for the Monitoring of La Calera

The main responsible for CDM works closely together with the general manager. Together with the financial and production sector he is responsible that all data is collected and stored safely. He is the responsible person for the SCADA (supervisory control and data acquisition) and for the monitoring report.

The main responsible for CDM supervises staff in charge who check daily the continuously measuring flowmeters for biogas, the guano flow and the egg carton production. He will check if the data is recorded in the data acquisition system. He is overall responsible for the data recording and for regular back-up copies.

All tasks are described in detail below:

RESPONSIBILITIES

CDM-Project Manager
As of the date of writing the PDD Mr. Mauricio Flores will manage the CDM-project in La Calera Farm. He is the overall responsible person. He has the following tasks:
- Organize CDM training courses (annual refreshers) for all sector responsible persons. Elaborate of training materials and work orders concerning monitoring demands.
- Supervise the CDM project responsible persons of the different sectors.
- Supervise and control that all required calibrations of the monitoring equipment are carried out. Establish an annual timeframe with deadlines for all calibrations.
- Collect the data and records from all responsible persons from the sectors.
- Quality assurance of the collected data: check if data is complete and consistent.
- Data recording and storage in the SCADA (supervisory control and data acquisition). All records will be archived electronically and also in paper form for at least two years after finishing the seven year crediting period.
- Write the annual monitoring report. Mandate a verification company and support the verification process until the CERs are issued.
- Design of an emergency plan (e.g. monitoring equipment out of order, electricity breaks, etc.)

CDM responsible persons on sector levels
There are 8 sector responsible persons. In general the sector responsible persons have the following tasks.
- Write work orders for their staff, how to monitor and collect data.
- Carry out annual training courses for the involved staff - organize trainings of new staff.
- Regular control of the monitoring equipment and its maintenance.
- Organize the requested calibrations. Deliver all corresponding documents to the main responsible.
- Data collection and quality assurance - monthly submission of records to the main responsible.
- Submission of copies of referenced documents to the main responsible.

Below the specific duties of the different sector responsible persons:

Dr. Alberto Paredes (as of time of PDD writing): Chicken Breeding Unit
- Collect the metered LPG consumption for the chicken breeding. The data is not needed for the emission reduction calculation but for quality assurance (compare used biogas/LPG with amount of bred chicken).

Mrs Auria Oblitas (as of time of PDD writing): Finance & Administration
- Ask all chicken suppliers to submit origin of the delivered chicken with their genetic source.
- Submit all collected letters to the main responsible

Dr. Monica Aviles (as of time of PDD writing): Feed Mill
- Collect all data concerning the composition of the chicken feed. The data shall be stored electronically and submitted monthly to the main responsible.

Mr. P. Cruz/Mr. C. Flores (as of time of PDD writing): Administration
- Organize the weighing of the complete guano flow and take guano samples according to this monitoring program. The moisture content of the guano has to be analyzed accordingly.
- Control and supervise the weighing equipment and its maintenance, supervision of the laboratory concerning moisture content.
- Collect weighing tickets, record the data electronically.
- Quality assurance of the tickets.
- Control of the flowmeters for the liquid guano. Data collection and storage of flowmeter data.
- Annual calibration of the flowmeters for the liquid guano.
- Submission of the records to the main responsible.

Dr. Miguel Ticona (as of time of PDD writing): Production Manager
- Organize the regular weighing of hens (based on type and ages).
- Supervise the weighing, quality assurance
- Data storage electronically, monthly submission to the main responsible

Mr. José Hernandez (as of time of PDD writing): Accounting
- Collect fuel invoices (coal and LPG). The invoices shall be compared with the records of other sectors. The fuel consumption is only needed for QA not for emission reduction calculation.
- Collect all invoices for chicken feed (QA for the feed composition, FFR).
- Submission of all invoices to the main responsible, annually.

Mr. Alberto Rivera (as of time of PDD writing): Biogas Unit
- Control and maintenance of the biogas unit.
- Weekly meter-reading - comparison to the electronic records.
- Record all readings electronically
- Submit SCADA data of continuous reading and meter- reading data to the main responsible
- Measure methane content (wet and dry content of old and new digesters according to figure A4-2.)
- Organize the calibration of all biogas meters and the methane analyzer
- Control and maintenance of the flare (working and temperature)
- Organize the calibration of the flare temperature measurement equipment

Mr. Ivan Luna (as of time of PDD writing): Carton Unit
- Counte the carton production (units per carton model), control the water and paper content for QA of biogas and coal consumption in this unit.
- Meter-reading of the biogas meter of the carton unit: weekly (compare it with SCADA-data).

Training Plan

The different trainings are summarized in the table below.

Time	Training	Participants	Content

		(Conducted by)	***(Documents)***
Before project start	Initial monitoring training	CDM-manager of LC, sector responsible person *(ecotawa)*	The whole monitoring strategy of the project will be explained. Tasks and procedure for all sectors defined, demonstration of excel spreadsheets *(Monitoring Manual, spreadsheet for emission reduction/data collection/calibration and monitoring control)*
Before project start	Training for sector responsibilities	Sector responsible persons and their deputies *(Mr. Mauricio Flores)*	General duties of all sector responsible persons Specific duties of each sector Timeframe (who?what? when?) Data transfer and storage / Documentation / data transfer *(Work orders, timeframe)*
Before project start	Training for staff in the sectors	Staff of all sectors. *(Sector responsible persons, see above)*	Each sector responsible makes trainings of the staff in their sector. *(Work orders, timeframe)*
Annually after drafting the monitoring report	Refreshment/Improvement training	Sector responsible persons (Mr. Mauricio Flores)	Feedback about monitoring, improvement of all steps (draft monitoring report, spreadsheet of the year)
Annually after verification	Adaptation	Staff of sectors (Mr. Mauricio Flores)	Improvement requests acccording to last verification (Verification report / improvement measures)

Monitoring Parameters

The monitoring parameters are shown in the figure below.

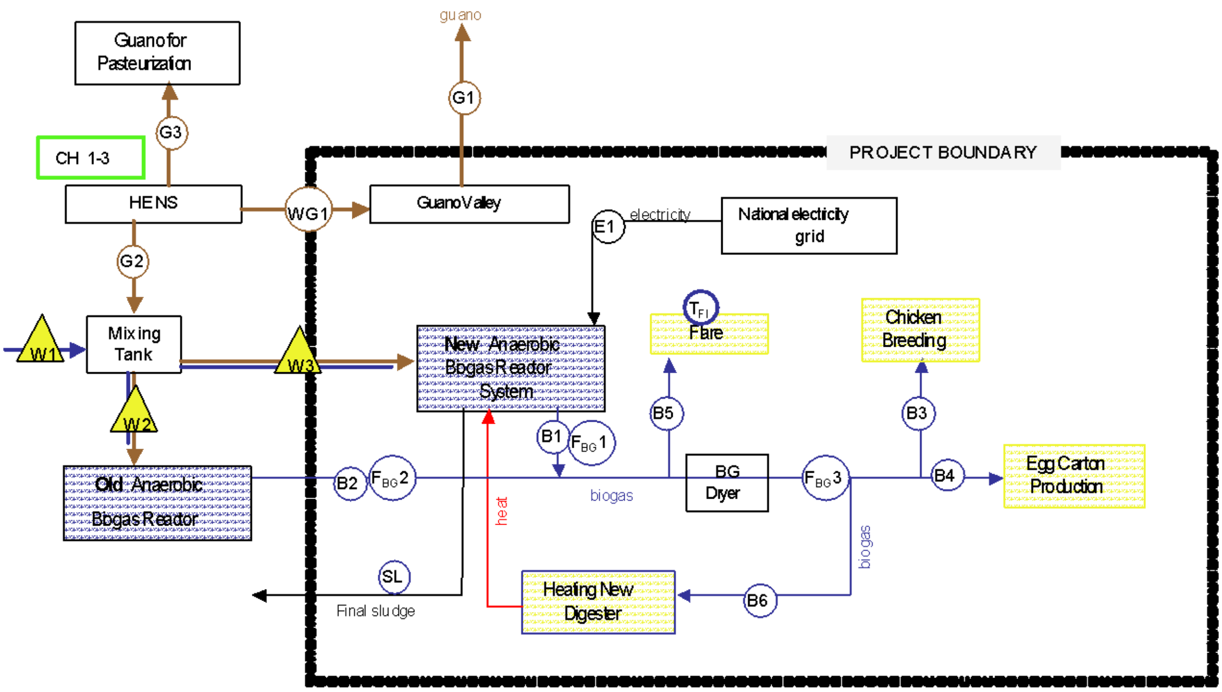


Figure A4-2. Monitoring plan for La Calera Farm

Based on figure A4-2 the parameters are listed below. The table A4-1 shows also the reference parameter according to B.7.1.

Table A4-1. Data and Parameter to be monitored by La Calera

Site (Graph)	Data /Parameter (see B.7.1.)	Unit	Description
B1	$BG_{totalnew,y}$	Nm^3/yr	Total biogas (on a **wet** base) produced by the new digester system in the year y. The biogas amount is measured continuously with a flowmeter with integrated pressure and temperature measurement.
B2	$BG_{totalold,y\ y}$	Nm^3/yr	Total biogas (on a **wet** base) produced by the old digester in the year y. The biogas amount is measured continuously with a flowmeter with integrated pressure and temperature measurement. Because one of the old digester is removed during the implementation of the new digester system the minimal amount calculated for the emission reduction is 585'422 Nm^3BG/yr. (= historical amount of two old digesters).
B3	$BG_{chickheat,y}$	Nm^3/yr	Total biogas (on a **dry** base) used for the chicken breeding in the year y. The biogas amount is measured continuously with a flowmeter with integrated pressure and temperature measurement. Recorded by SCADA.
B4	$BG_{cartonheat,y}$	Nm^3/yr	Total biogas (on a **dry** base) used for the egg carton production in the year y. The biogas amount is measured continuously with

			a flowmeter with integrated pressure and temperature measurement. Recorded by SCADA.
B5	$BG_{flare,y}$	Nm^3/yr	Total biogas (on a **wet** base) used for flaring in emergency cases in the year y. The biogas amount is measured continuously with a flowmeter with integrated pressure and temperature measurement. Recorded by SCADA.
B6	$BG_{digheatold,y}$	Nm^3/yr	Total biogas used for the heating of the new digester system in the year y. The biogas amount is measured continuously with a flowmeter with integrated pressure and temperature measurement. Recorded by SCADA.
$F_{BG}1$	$W_{CH4new,y}$	%V	Volume percentage of CH_4 in **wet** biogas produced in the new digesters. The measurement will be made with a continuous infrared analyzer over 24 hours (10-20 values / hour). For the fraction of methane (CH_4) the lower 95% confidence interval will be taken of measurements realized.
$F_{BG}2$	$W_{CH4old,y}$	%V	Volume percentage of CH_4 in **wet** biogas produced in the old digesters. The measurement will be made with a continuous infrared analyzer over 24 hours (10-20 values / hour). For the fraction of methane (CH_4) the lower 95% confidence interval will be taken of measurements realized.
$F_{BG}3$	$W_{CH4,y}$	%V	Volume percentage of CH_4 in dry biogas (after drying and desulfurization) produced in the both -new and old digesters, continuously with a gas monitor, recorded by SCADA
T_{Fl}	T_{flare} / $\eta_{flare,h}$	°C / h	Flame temperature of flare: measured when biogas is flowing. In the same time the hours in which the flare is in operation is recorded in order to calculate the flare efficiency.
G1	*MS%*	t/year	The amount of guano going out of the guano valley must be weighted. Furthermore, the moisture content of the incoming guano must be measured. The MS% is calculated.
G2	*MS%*	t/year	The amount of guano coming from the hen cages to the mixing tank that is feeding the old and the new digesters must be weighted. Furthermore, the moisture content of the incoming guano must be measured. The MS% is calculated
G3	*MS%*	t/year	In order to have the total amount of guano produced also the part of guano going from the hen cages to the pasteurization must be weighted. Furthermore, the moisture content of the guano must be measured.
WG4	*MS%*	t/year	The moisture content of the guano coming from the hen cages to the guano valley must be analyzed regularly.
W1	*MS%*	m^3/year	Water input to the mixing tank. In order to control the liquid guano flow the input water is measured. This parameter is only for QA issues for W2 and W3.
W2	*MS%*	m^3/year	In order to calculate the guano input into the old digester the guano-water flow must be measured continuously with flowmeters. The guano flow is calculated with G2.
W3	*MS%*	m^3/year	In order to calculate the guano input into the new digesters the guano-water flow must be measured continuously with flowme-

			ters. The guano flow in tons is calculated with G2.
CH1-3	$N_{LT,y}$ $Source_{genetic}$ FFR	Number Document Document	The total number of all chickens must be counted throughout the year (CH1). The genetic source from developed country must be proved annually through confirmation letters of the suppliers (CH2). The formulated feed ratios for the different species, different ages and categories must be recorded and documented (CH3)
SL	$Soil_{sludge}$	Document	The proper soil application of the final sludge of the digesters must be monitored in order to guarantee that no methane gases are emitted through final sludge management.
E1	*EC,y*	MWh/yr	List of all electrical equipment of project activity: value calculated based on in-built capacity and workload of 110%

The guano monitoring is described in the figure A4-3. In order to define the guano input to the guano valley it is assumed that during one year the input and output of guano in the valley is the same. Thus, the guano valley has a stable size - not increasing and not decreasing within the crediting periods.

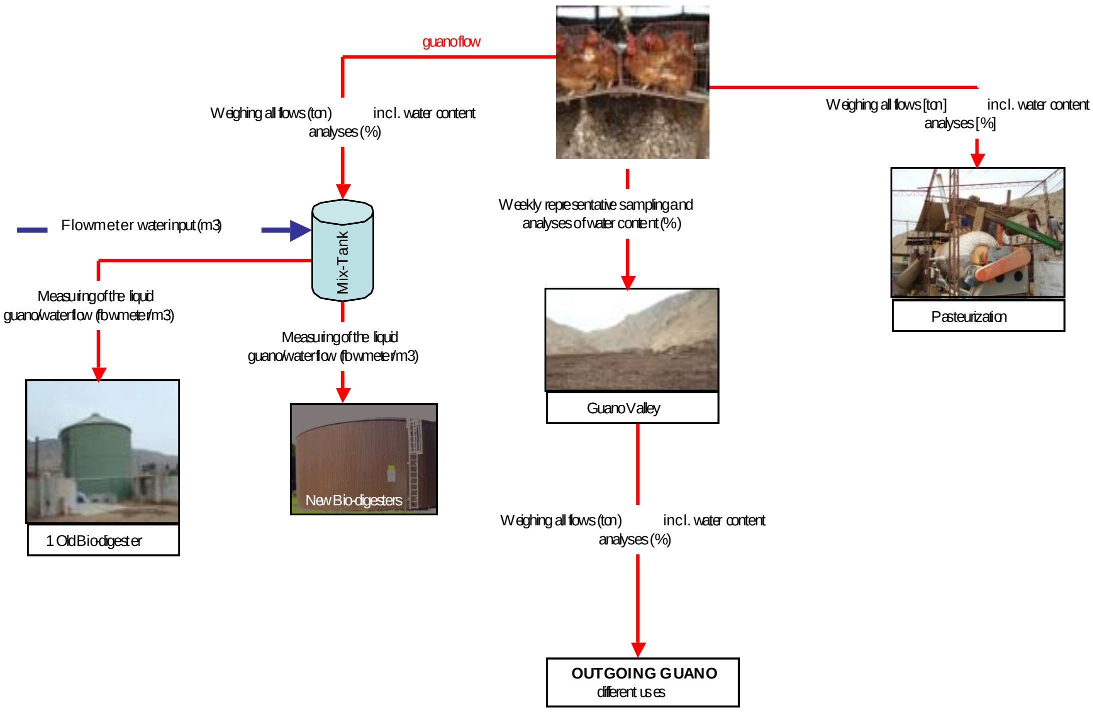


Figure A4-3. Monitoring of the guano flow (moisture content) for La Calera Farm

The produced biogas from the old digester and the new digester system will be led to the same gas distribution system. The amount of biogas from the old digester and the new system will be measured on a wet base continuously with flowmeters (B1 /B2) incl. temperature and pressure. In order to know the methane concentrations of the biogas coming from both sources the CH_4 concentration will be measured for the wet biogas of the old and of the new digesters ($F_{BG}1$, $F_{BG}2$). The methane concentration will be monitored quarterly during one day measurement campaigns. The measurement will be made with a continuous infrared analyzer over 24 hours (10-20 values / hour). For the fraction of methane (CH_4)

the lower 95% confidence interval will be taken of measurements realized. In order to know the methane concentration of the dried biogas, the biogas will be measured continuously with a infrared analyzer before it is distributed to the different processes.

The number of days on which the new manure system is working (see chapter 7.1, nd_y) will be assessed through B1. If the biogas flow coming from the new digester system is zero at one day the treatment system is not working.

The flare will be started automatically if the pressure in the gas system is too high. Then the flame will start and the temperature will be measured in order to ensure that the flare is working properly without biogas loss. The flare operation time will be registered automatically through the SCADA. With the recorded time and the temperature the flare efficiency - default value - 0.9 or 0.5 - is assessed.

The electricity consumption will be calculated according to the inbuilt capacity of the equipment of the new wastewater facility (project activity). It is assumed that the equipment is running all the time during one year. The electricity loss is assumed to be 10%. That means that the calculated load of the electrical equipment is 110%.The list will be adjusted annually.

The number of the animal population must be recorded continuously. Furthermore, it must be proved annually that the genetic source of the animal population is from a developed country. The formulated feed ratios for the different species, categories and ages must be recorded and documented through the farm.
The proper soil application of the final sludge must be controlled in order to prove that no methane gases are emitted through this application.

Quality Control

The total guano flow can be compared to the hen population. Big differences must be explicable.

The biogas consumption in the egg carton production and the chicken breeding can be compared with the produced egg cartons resp. with the amount of bred chickens. If there are big differences compared to the former years the differences must be explicable.

The calibration for the different instruments such as flowmeters, methane gas monitor and other instrument is organized through the main CDM responsible person of La Calera.

Data Storage

The data from the six biogas flowmeters will be electronically acquired. The data will be stored in the SCADA. The SCADA will record also the time the flare is running as well as the temperature of the flare flame.

The guano flow, the egg carton production and the statistics about the hen population will be recorded in each sector. The CDM responsible person of La Calera will make the quality assurance and take over the data for the central electronic data storage.

Monitoring Manual

A monitoring manual will be elaborated. The staff and the management of La Calera farm will be trained on its usage. The main responsible person of La Calera will realize an annual monitoring report.

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