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

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Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

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FEDEPALMA SECTORAL CDM UMBRELLA PROJECT FOR METHANE CAPTURE, FOSSIL FUEL DISPLACEMENT AND COGENERATION OF RENEWABLE ENERGY. V.9

Date: December 10, 2008.

A.2. Description of the project activity:

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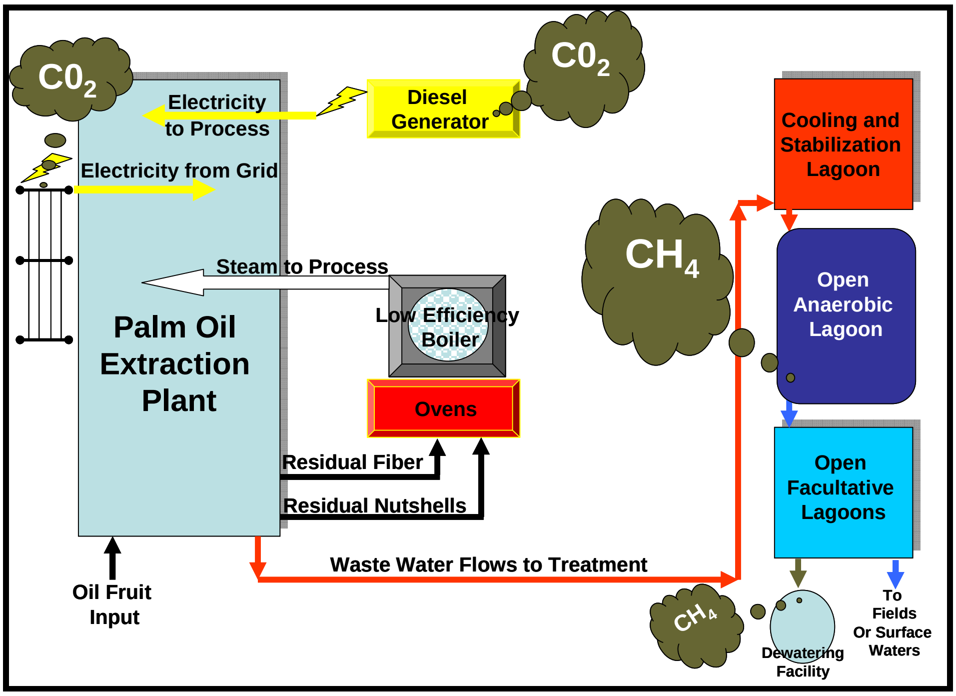
In Colombia, the Palm Oil producer association FEDEPALMA is leading its member firms in the development of a bundled CDM project, with the objective of leading the Palm Oil Extraction Plants towards zero GHG emissions and converting the participating plants from fossil to renewable energy. The sectoral CDM project includes 82% of national palm oil processing production in 2005. Standard processing conditions in the baseline case found throughout the extraction plants participating in this bundle of 32 extractors include:

- *Open lagoon wastewater treatment ponds:* All processing plants in FEDEPALMA have wastewater treatment ponds installed that fully comply with Colombian environmental regulations. Required by Environmental Law 1594 of 1984 to control Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD), they also pay water pollution taxes on BOD released to surface waters. The high COD in the wastewater is decomposed in open methanogenic lagoons by cultivated bacteria. Although they are efficient in reducing BOD and COD, the open anaerobic lagoons emit constant streams of biogas, of which 50 to 65% are CH_4, a powerful greenhouse gas, into the atmosphere.
- *Diesel-powered electricity generation plants.* Many of the processing plants and related facilities are located off-grid, and use diesel fuel for electricity generation, which results in constant CO_2 emissions. The subsidized petroDiesel is often transported over long distances, using truck, river or marine vehicles to reach the extraction plants, increasing the CO_2 emissions from diesel usage.
- *Electricity from the national grid.* Some processing plants purchase electrical energy from the interconnected grid, where a significant proportion of the generating plants use fossil fuels.

The CDM prefeasibility study carried out by FEDEPALMA in 2003 identified three technological options to reduce the GHG and set the foundation for the implementation of a sector-wide CDM umbrella project. It demonstrated how aggregation of the small and medium sized plants under a single large scale CDM project could dramatically reduce CDM transactions costs and project investment costs per firm, while generating multiple benefits and certainties to participants. The 32 plants participating in the FEDEPALMA CDM Project Bundle now plan to implement one or more of the following technological options to mitigate the greenhouse gases and convert the extraction plants to renewable energy, relying on expected CER revenues to make the project economically feasible:

- *Technology Option I: Methane Mitigation Only.* Methane mitigation for CER generation is the economic foundation of the entire project because of the significant methane flows and the high CER multiplier of 21/1. A covered anaerobic digester must be installed over existing anaerobic ponds, or new anaerobic plants built and covered, to optimize wastewater treatment efficiency and to capture the entire biogas/methane flow produced. An improved dewatering facility will include gravity based drainage for removal of excess water from the sludge, with daily transport of the dewatered sludge to the palm growing fields. The excess water from the sludge will be re-injected into the anaerobic digester. The sludge will be dispersed in the growing fields in the most aerobic conditions possible. CH_4 will be efficiently mitigated by burning either in enclosed flares or in existing boiler ovens. The new covered digesters and burners will conform with national laws and will be designed on the basis of the acceptability criteria and the "*tool to determine project emissions from flaring gases containing methane*" of the approved methodology AM0013 v.4.

Figure 1: Business as Usual Technologies and Flows

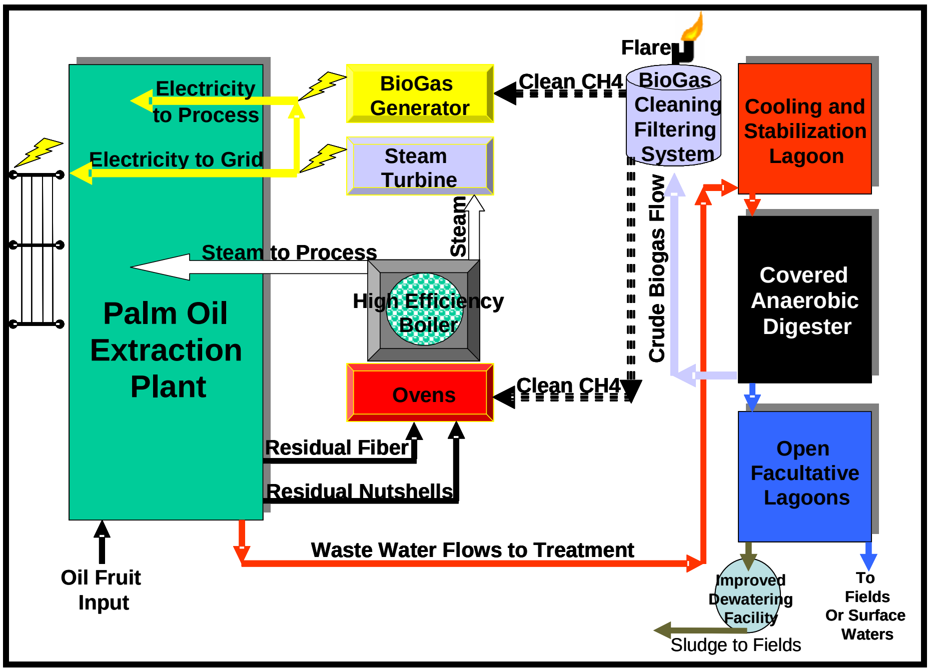


- *Technology Option II: Methane Mitigation plus Electricity Generation for Internal Use.* In addition to the methane capture technology implemented in Technology Option I, biogas cleaning systems and biogas/methane driven electricity generation plants are to be implemented. CO2 that previously resulted from diesel-driven electricity generation plants or from purchasing energy from the national grid is displaced by generating electricity with cleaned biogas/methane from the covered anaerobic digester. Properly operated, this option will mitigate GHG emissions of the 32 extraction plants to near zero.
- *Technology Option III: Cogeneration of heat and power.* In addition to the methane capture technology implemented in Technology Option I, this option adds Cogeneration of heat, steam and electricity from renewable biogas and biomass (residual fiber, residual palm nut shells, used fruit bunches). Plants will use either existing low efficiency boilers or install new high efficiency boilers for high pressure steam generation, and invest in new high efficiency steam turbines to generate electricity. Properly operated, this option will mitigate GHG emissions to near zero.

This PDD only seeks CDM Accreditation for Technology Option I, the implementation of new covered anaerobic digesters to capture and mitigate the methane in the biogas. After registration and implementation of the project activity, if and only if Technology Option I is technically successful and the incomes from CER sales are sufficient to support further investments in cogeneration of renewable energy, then the Project Participants will either present a second PDD (or request permission to modify this one if that is permitted by CDM regs) and present in very specific terms the individual technology packages which will have been chosen by each of the 32 participating plants for generation of renewable energy. This PDD includes complete references to Technology Options II

and III, in order to represent the additionality and the incremental financial decision-making process in the most transparent and historically correct manner.

Figure 2: CDM Project Activity Technologies and Flows, All III Technology Options Included



View of the project participants on the contribution of the project activity to sustainable development:

FEDEPALMA began a major environmental protection program for all member firms in the mid 1990s, oriented towards the mitigation of pollution flows, conservation of natural resources and impacts on biodiversity, in accordance with national law. The CDM prefeasibility study carried out by this producer association in 2003-4 identified the contributions to sustainable development, which include:

Improved Waste Water Effluent Quality. As the production of biogas will become the main source of CER income and energy self-sufficiency, plants will work to maximize the efficiency of their wastewater treatment in the new anaerobic digesters, in order to optimize biogas production. This should result in substantial improvements in the quality of final water effluents. In addition, odors are eliminated by capturing, cleaning and burning the biogas. As such, the implementation and operation of biogas capture and mitigation will produce net positive benefits locally and globally with regard to water effluents and to local and global airborne emissions from wastewater treatment.

Reduction in Local and Global Emissions from Fossil-Generated Electricity. As biogas and biomass displace diesel and grid electricity, a number of collateral emissions will be displaced in addition to GHG, locally and globally. These include heavy and fine particulates, SO_2, NOx and CO among others. This elimination of fossil fuel emissions through the generation of renewable energy from biomass and biogas should improve the local environment in general, as well as workplace conditions. However, increased burning of residual fiber and residual nutshells in the cogeneration process which will occur in some of the plants may result in increased emissions of dark smoke, consisting of organic particulates, which may be controlled with new investments in technology such as Cyclones.

Conversion to Renewable Energy: The impacts of converting 32 plants from fossil to renewable energy conserves natural resources and greatly improves the sustainability of palm oil production.

Authority and responsibility of project management:
Each of the 32 participating plants has signed a binding long term contract (No. 044 of March 1, 2006) with FEDEPALMA that clearly sets out the responsibilities of the producer association in the management of the project and the responsibilities of each participating plant. FEDEPALMA's responsibilities include coordination, capacity building, legal representation of the project for UNFCCC Registration and commercial purposes, quality control programs, emergency repair and maintenance, monitoring, reporting and Verification, among others. Participating plants have the responsibility for engineering design, construction, operation and monitoring of their CDM systems. FEDEPALMA's project management responsibilities are stipulated in clauses 6 and 7 of the contract, and participating plants' responsibilities are included in clauses 4 and 5.

A.3. Project participants:

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Name of Party involved (Host) indicates a Host Party	Private and/or public entities involved as project participants	Kindly indicate if the Host Party wishes to be involved as a project participant (yes/no)
The Republic of Colombia is the Host Party	FEDEPALMA	No
The Republic of Colombia	Andean Center for Economics in the Environment	No
Further contact information on the project participants involved in the project is included in Annex 1.		

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

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A.4.1.1. Host Party(ies):

>>
The Republic of Colombia

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

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The 32 participating extraction plants are located in the four major palm oil production regions, which are North; Central; Eastern; and Western Regions.

A.4.1.3. City/Town/Community etc:

>>The cities and towns where each participating plant is located are included in the Table 1 below.

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

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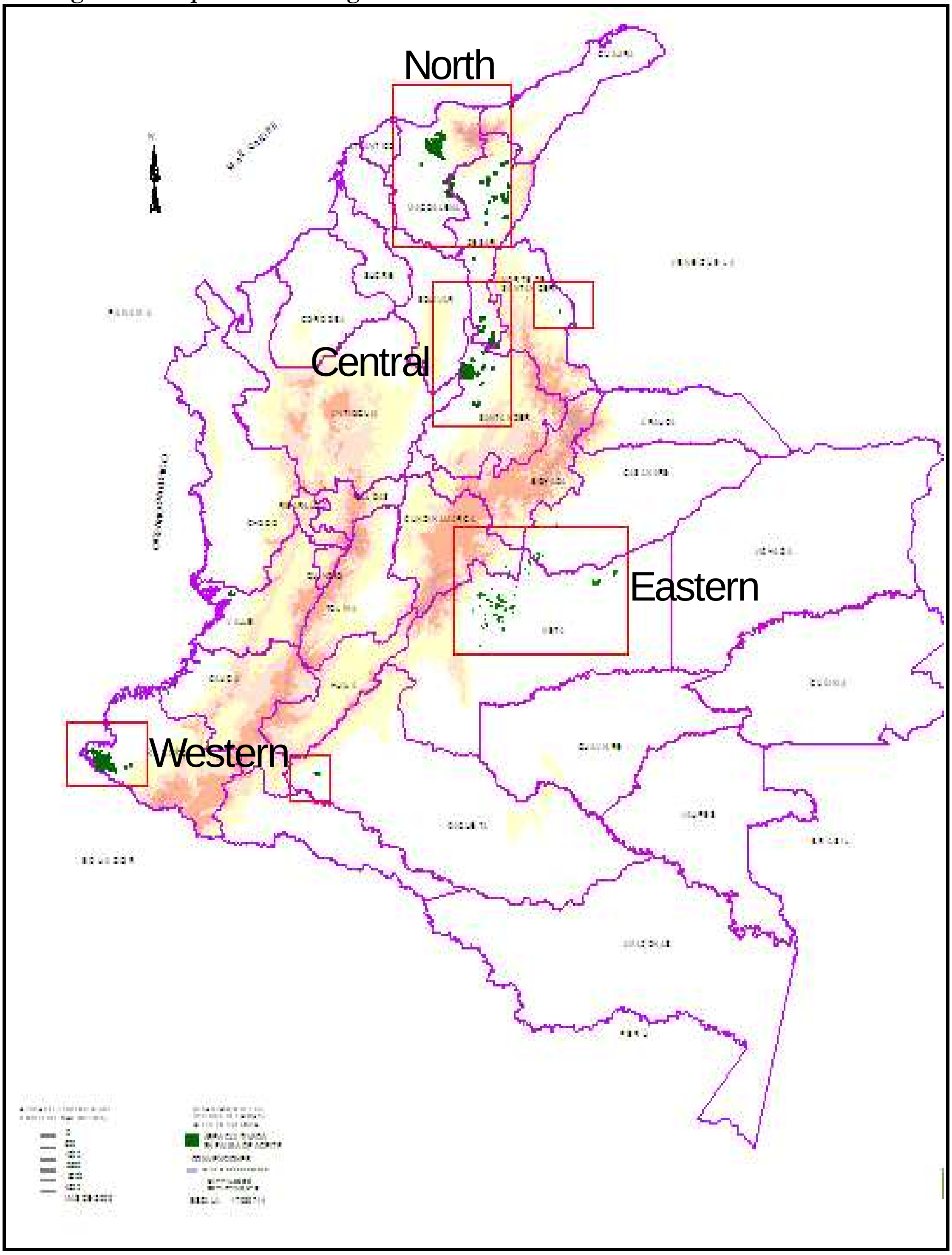
The following Table 1 includes the town, department and GPS locator of each of the 32 palm oil extraction plants. The national map that follows shows where the palm oil extraction activity is located in the four main production regions.

Table 1: Location of Each Participating Extraction Plant

	Region	Palm Oil Extraction Plant	Town, Dept.	GPS Coordinates
1	Central	Bucarelia S.A.	Puerto Wilches, Santander	7 15' 6"N, 73 50'08"W
2	Central	Extractora Monterrey S.A.	Puerto Wilches, Santander	7 17' 52"N , 73 53'02"W
3	Central	Oleaginosas Las Brisas S.A.	Puerto Wilches, Santander	7 30'20"N , 74 02'19"W
4	Central	Palmeras de Puerto Wilches S.A.	Puerto Wilches, Santander	7 14'30"N , 73 49'55"W
5	Central	Extractora Central S.A.	Puerto Wilches, Santander	7 15' 30"N , 73 40' 00"W
6	Central	Palmas del Cesar S.A.	San Alberto, Cesar	7 53'34"N , 73 27'20"W
7	Central	Indupalma S.A.	San Alberto, Cesar	7 42' 26"N, 73 27'20"W
8	Central	Agroince Ltda. y Cia. S.C.A	San Martin, Cesar	8 07'35"N , 73 35'24"W
9	Eastern	Agropecuaria La Loma Ltda.	Acacias, Meta	3 59'25"N, 73 35'23"W
10	Eastern	Palmeras del Llano S.A.	Acacias, Meta	3 59'25"N, 73 30'07"W
11	Eastern	Inversiones La Mejorana Ltda.	Acacias, Meta	3 59'25"N, 73 30'07"W
12	Eastern	Guaicaramo S.A.	Barranca de Upia, Meta	4 29'13"N, 72 57'53"W
13	Eastern	Hacienda La Cabaña S.A.	Cumaral, Meta	4 17' 41"N, 73 21'55"W
14	Eastern	Plantaciones Unipalma de los Llanos	Cumaral, Meta	4 13' 50"N, 73 15'31"W
15	Eastern	Sapuga S.A.	Puerto Gaitan, Meta	4 8'59"N , 72 1'8"W
16	Eastern	Aceites Manuelita S. A.	San Carlos de Guaroa, Meta	3 54'2"N , 73 23'9"W
17	Eastern	Oleaginosas San Marcos Ltda.	San Carlos de Guaroa, Meta	3 44' 02"N, 73 20'57"W
18	Eastern	Palmeras El Morichal Ltda	San Carlos de Guaroa, Meta	3 51' 43"N, 73 27'41"W
19	Eastern	Entrepalmas S.A.	San Martin, Meta	03 33' 52"N, 73 34'45"W
20	Eastern	Palmeras San Pedro Ltda.	San Martin, Meta	3 32' 29"N, 73 19' 59"W
21	Eastern	Palmeras Santana Ltda.	Villanueva, Casanare	4 33' 04"N, 72 55'0"W
22	Eastern	Extractora Sur del Casanare S.A.	Villanueva, Casanare	4 29'46"N , 72 50'6"W
23	North	C.I. Tequendama S.A.	Aracataca, Magadalena	10 32'56"N , 74 10'53"W
24	North	Oleoflores Ltda.	Codazzi, Cesar	10 05'30"N , 73 14'29"W
25	North	Aceites S.A.	El Reten, Magdalena	10 44'13"N, 74 10'39"W
26	North	C.I. El Roble S.A.	Tucurinca, Magdalena	10 37'30"N , 74 13'23"W
27	North	Frupalma S.A.	Tucurinca, Magdalena	10 42'18"N , 74 11'42"W
28	Western	Astorga S.A.	Tumaco, Nariño	1 41' 34"N, 78 44'10"W
29	Western	Palmas de Tumaco S.A.	Tumaco, Nariño	1 31'56"N , 78 44'08"W
30	Western	Palmeiras S.A.	Tumaco, Nariño	1 27' 33"N, 78 41'10"W
31	Western	Palmar Santa Elena Ltda.	Tumaco, Nariño	1 29' 27"N, 78 39'26"W
32	Western	Palmas Santafé Ltda.	Tumaco, Nariño	1 28' 46"N, 78 39'45"W

Figure 3: Map of 4 Main Regions where Palm Oil Extraction Plants are Located.



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

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This project activity belongs to sectoral scope 13, WASTE HANDLING AND DISPOSAL, as listed in the sectoral scopes for accreditation of operational entities.

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

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Each of the participating plants will implement one or more of the three CDM options described in section A.4.4 below. Given that the palm oil extraction process is very similar from plant to plant, varying primarily in scale, the technology to be used to implement options I, II and III will be similar across plants, but will vary in terms of scale and some technology parameters may change among plants because each is free to purchase the technology from the supplier which offers the best conditions. For each of the three greenhouse gas mitigation options, the new technology to be implemented will be described below. Clearly, this is all environmentally safe and sound technology. It is also leading edge technology that will be used in the project.

This PDD only seeks CDM Accreditation for Technology Option I, the implementation of new covered anaerobic digesters to capture and mitigate the biogas. After registration and implementation of the project activity, if and only if Technology Option I is technically successful and the incomes from CER sales are sufficient to support further investments in cogeneration of renewable energy, then the Project Participants will either present a second PDD (or request permission to modify this one if that is permitted by CDM regs) and present in very specific terms the individual technology packages which will have been chosen by each of the 32 participating plants for generation of renewable energy. This PDD includes complete references to Technology Options II and III, in order to represent the additionality and the incremental financial decision-making process in the most transparent and historically correct manner.

Technology Option I: methane mitigation only. A covered anaerobic digester must be built to optimize wastewater treatment efficiency and to capture the entire biogas/methane flow produced. This will be done in one of two ways. A) Retrofit and cover the existing methanogenic lagoon, to convert it into a covered anaerobic digester with adequate sludge management capability, and capture and burn the methane in a high efficiency flare or in the industrial oven. B) A new covered anaerobic digester is built and the old anaerobic lagoon is decommissioned. The new digester is built to conform to national waste water treatment laws and regulations, and is designed on the basis of the acceptability criteria of the approved methodology AM0013. To burn the methane, firms will choose between either an enclosed flare system or by adapting existing industrial burners to burn the biogas. New technologies required to implement this option include:

- Anaerobic digesters equipped with high-density geomembrane and structural supports to ensure that waste waters are fully contained and controlled in within the digester[1].
- Encasing the digester perimeters to contain the wastewater in a rigid manner and to provide stable and solid surfaces to attach the geotextile digester cover in an airtight manner, in order to capture the entire biogas-methane flow.
- Continual flow meter and COD Analyzer at the entrance and exit of the anaerobic digester to measure the amount of COD before and after anaerobic treatment, to determine the amount of COD decomposed by the treatment system.
- Real time temperature meters to monitor the ambient temperature of the anaerobic digester.

[1] The geomembrane floor and wall covering may be avoided if the ground composition is of dense clay, sufficiently impermeable, which is found in some parts of Colombia.

- Real time biogas flow meters to measure the flow of biogas being transported from the digester outlet to the biogas cleaning and filtering system.
- Real time gas analyzers to determine the composition of the biogas flow being transported from the digester outlet to the biogas cleaning and filtering system consistent with the methodology AM0013 v.4 and the latest version of the "*tool to determine project emissions from flaring gases containing methane*".
- A modern sludge extraction system with pumping and field management equipment;
- Continual flow meter and COD analyzer at the exit of the sludge dewatering facility.
- Biogas cleaning and filtering systems. These filters are required to remove unwanted components commonly found in biogas (CO_2: 30-40%; H_2S: 0.10-0.20%) in order to burn the methane flow efficiently in flares or in the industrial ovens. Various types of filtering system technologies are available.
- Biogas storage tank systems to store cleaned gas generated during hours that plant is not operative, for burning in boilers or gensets when the plant is operating.
- Gas analyzers to determine the composition of the biogas and the amount of methane at the outlet of the biogas cleaning and filtering systems.
- High efficiency burners adapted into existing industrial ovens to mitigate methane during plant operations.
- High efficiency enclosed flares to fully mitigate the residual methane when plant is not operating.
- Real time flow meters to measure the amount of methane entering each destination: flares and ovens.
- Run time meter to measure the duration of burning by the enclosed flares and ovens.
- Real time flow meters to measure the amount of residual methane being emitted after burning the methane, placed in the stack of the enclosed flare or in the stack of the industrial oven.
- Gas analyzers to determine the composition of the biogas gas after burning by the enclosed flares or in the oven stacks consistent with the methodology AM0013 v.4 and the latest version of the "*tool to determine project emissions from flaring gases containing methane*".
- Data monitoring, recovery and transmission systems to central databases. These automated systems will gather data flows of waste water COD, temperature in the digester, and gas flows and composition before and after burning. They will organize it according to AM0013 monitoring requirements, and transmit it by hard line to data bases in plant offices and by internet to FEDEPALMA CDM UMBRELLA PROJECT operating center.

Palm Oil growers will choose one of the following alternatives for sludge management based on their particular soil conditions:

4) Where soil conditions are not adequate to directly apply wet sludge over the growing fields, improved shallow sludge drying beds will be constructed. The shallow sludge drying bed will consist of the following elements:
    a. A drying bed covered by a protective clear plastic roof and dimensioned to receive the sludge directly from the anaerobic digester. The sludge depth in the drying beds will be no greater than 0.30m. According to IPCC recommendations, methane conversion factors and methane producing capacity equals zero in depths lower than 1m.
    b. The walls and floor of these sludge drying beds will be covered by an impermeable textile. The floor of the sludge drying beds will have a filtrating cap directing excess water to a pipeline in the bottom of the sludge drying bed that will channel the wastewater back into the anaerobic digester.
    c. The solid sludge will remain in the drying bed for 8 to 10 days until final humidity halves the initial humidity of the sludge.
    d. Once the sludge is dried, it will be manually disposed into a carriage moved by animal traction to apply it over the growing field.

4) Where soil conditions are adequate to directly apply wet sludge over the growing fields, Palm Oil Extraction plants may use one the following alternatives:
   a. Sludge irrigation systems will drive sludge directly from the anaerobic lagoon, by means of a sludge pump, throughout a piping system to selected fields where growing productivity is desired to be increased. Once the sludge reaches the growing fields it will be manually distributed to ensure sludge caps no higher than 0,05m.
   b. Trailers equipped with sludge pumps. The trailers will extract the wet sludge directly from the anaerobic digester and transport the sludge to the desired growing field where the sludge will be distributed by means of the sludge pump.

Technology Option II: Methane Mitigation plus Electricity Generation for Internal Use. The implementation of a biogas electricity generation plant running on cleaned biogas-methane, obtained from the covered anaerobic digester, requires investment in all the technology of Technology Option I, plus the purchase and implementation of the following technology:

- Biogas-driven electricity generation plant. The model currently favored for the project is the Caterpillar model G3512 LE, with a generation capacity 500 kW, which was selected for the CDM pilot project and has delivered good performance. (However this may change from plant to plant as other manufacturers are now being considered).
- High efficiency enclosed flares to fully mitigate the residual methane when plant is not operating.
- Real time biogas flow meters to measure the flow of biogas entering the biogas electricity generation plant, and after combustion.
- Gas analyzers to determine the composition of the biogas-methane after burning in the biogas electricity generation plant.
- Cooling system with heat exchangers to regulate the operating temperature of the generation plant.
- Real time flow meters to measure Diesel fuel use in standby generators in the event the biogas system stops operating for any reason.
- Data monitoring, recovery and transmission systems to central databases. These automated systems will gather data on gas flows and their composition before and after burning in the generator, generation of electricity by the plant, and other related variables. It will organize the data according to AM0013, and transmit it by hard line to data bases in plant offices and by internet to FEDEPALMA CDM operating center.

Technology Option III: Cogeneration of heat and power. In addition to the methane capture technology implemented in Technology Option I and described above, in addition this cogeneration option would require investment and implementation of the following technology:

- New High Efficiency Boilers. Some plants could operate with existing low efficiency boilers, but much energy will be wasted. Most plants that implement the full cogeneration option with the objective of optimizing generation of renewable electricity and the production of CERs, will install new high efficiency boilers for optimal high pressure steam generation.
- New high efficiency small scale steam turbines to generate electricity.
- High efficiency enclosed flares to fully mitigate the residual methane when plant is not operating.
- Electricity control and distribution technology.
- Technology and equipment for interconnection to the grid.
- Data monitoring, recovery and transmission systems to central databases. These systems organize the data accordingly, and transmit it by hard line to data bases in plant offices and by internet to FEDEPALMA CDM operating center.

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

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Table 2: Estimated Annual Emission Reductions for the Bundled Project for Technology Option I, Capture and Mitigation of Methane Emissions from WWT Open Lagoons by reconversion to Covered Anaerobic Digesters with Flaring Systems.

Year	Estimation ANNUAL Emission reductions (TONS OF CO_2e)
2008-9	**604.140**
2009-10	**652.737**
2010-11	**700.856**
2011-12	**764.159**
2012-13	**818.291**
2013-14	**861.902**
2014-15	**897.381**
Total estimated reductions	**5.299.466**
Number of crediting years, 1st Period	**7**
Annual average over the crediting period	**757.067**
Note: this project is formulated with 7 year crediting periods, renewable two times.	

A.4.5. Public funding of the project activity:

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There is no public funding associated with this project activity.

SECTION B. Application of a baseline and monitoring methodology

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

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Title: Avoided methane emissions from organic waste-water treatment (AM0013/version 4) including the Revision to Approved Baseline Methodology AM0013 /Version 04 (UNFCCC website)[2].

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

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The above approved methodology as described in Annex -3 has been chosen since the project activity meets the following applicability conditions of the methodology:

1. The project activity aggregates a bundle of similar methane recovery projects, each of which has at least one organic wastewater treatment plant.The existing wastewater treatment systems consist of open lagoons with an "active" anaerobic condition complemented with cooling and facultative lagoons. (see photos below) The existing wastewater treatment systems are characterized as follows:

    a. The depth of the open anaerobic lagoons participating in this bundled project are, in all cases, more than 1m;
    b. The residence time of the organic matter in the open lagoons participating in this bundled project is, in all cases, more than thirty days; and,
    c. The temperature of the organic matter in the open lagoons participating in this bundled project is, in all cases, higher than 10ºC.

2. The project activity involves extraction and utilization of methane from covered anaerobic digesters implemented at each palm oil extraction facility, thereby reducing GHG emissions from the open anaerobic lagoons.

3. The project activity involves no sludge storage before land application. The following options are to be implemented at each palm oil extraction plant for sludge management:

    a. Where soil conditions are not adequate to directly apply the sludge over the growing fields, improved shallow sludge drying beds will be constructed. The shallow sludge drying bed will consist of the following elements:
        i. A drying bed covered by a protective roof and dimensioned to receive the sludge directly from the anaerobic digester. The sludge depth in the sludge drying beds will be no higher than 0.30m. According to IPCC recommendations[3], in open lagoons with depths lower than 1m methane conversion factors and methane producing capacity equals zero or nearly zero. Since the shallow sludge drying bed will not overpass 0.30m it is expected that organic matter will decompose by means of aerobic processes.

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[2] http://cdm.unfccc.int/UserManagement/FileStorage/CDMWF_AM_TUXV2ZCTQVGAZTGOKEJZK88YMRMRCR

[3] IPCC (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 5. Chapter 6. Section 6.1. page 6.8. Paragraph 2: "Shallow lagoons, less than 1 metre in depth, generally provide aerobic conditions and little or no CH4 is likely to be produced."

   ii. The walls and floor of these sludge drying beds will be covered by an impermeable textile. The floor of the sludge drying beds will have a filtrating cap directing excess water to a pipeline in the bottom of the sludge drying bed that will channel the wastewater back into the anaerobic digester.
   iii. The solid sludge will remain in the drying bed for 8 to 10 days until final humidity halves the initial humidity of the sludge.
   iv. Once the sludge is dewatered, it will be manually disposed into a carriage moved by animal traction to apply it over the growing field.

b. Where soil conditions are adequate to directly apply the sludge over the growing fields, Palm Oil Extraction plants may use one the following alternatives:
   i. Sludge irrigating systems will drive sludge directly from the anaerobic lagoon, by means of a sludge pump, throughout a piping system to selected fields where productivity is desired to be increased. Once the sludge reaches the growing fields it will be manually distributed to ensure sludge caps no higher than 0,05m.
   ii. Trailers equipped with sludge pumps. The trailers will extract the wet sludge directly from the anaerobic digester and transport the sludge to the desired growing field where the sludge will be distributed by means of the sludge pump.

4. The captured methane is either flared, used for renewable heat generation, or for electricity production for on-site use. Biogas will substitute fossil fuel for electricity and heat generation. Both heat generation and electricity generation account for less than 15 MW power generation capacity in each facility.

The photos below show the existing baseline operating conditions in the 32 plants: open anaerobic lagoons for waste water treatment with highly active methanogenic activity, and electricity generating power plants using diesel (some plants are interconnected to the grid but maintain diesel plants for use during power outages). A complete photographic record of the baseline conditions, taken during the prefeasibility study and the data gathering visits, documents these baseline conditions in the participating plants, conditions that will continue to operate until this project is approved and registered.

Open Anaerobic Lagoons Used Throughout Colombian Palm Oil Sector to Treat Wastewaters


Palmas de Tumaco S.A.	Extractora Sur de Casanare

C.I. El Roble S.A.	Palmeras de Puerto Wilches S.A.

Electricity Generation with Diesel Power Plants are Standard Throughout the Sector

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

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The project boundary related to the baseline methodology is demonstrated below. Consistent with the methodology, the physical delineation of the project is defined as the extraction plant site including the waste water treatment and sludge management system. The gases and sources included in the project boundary related to the baseline methodology are presented below.

Figure 4: Project Boundary, baseline case.

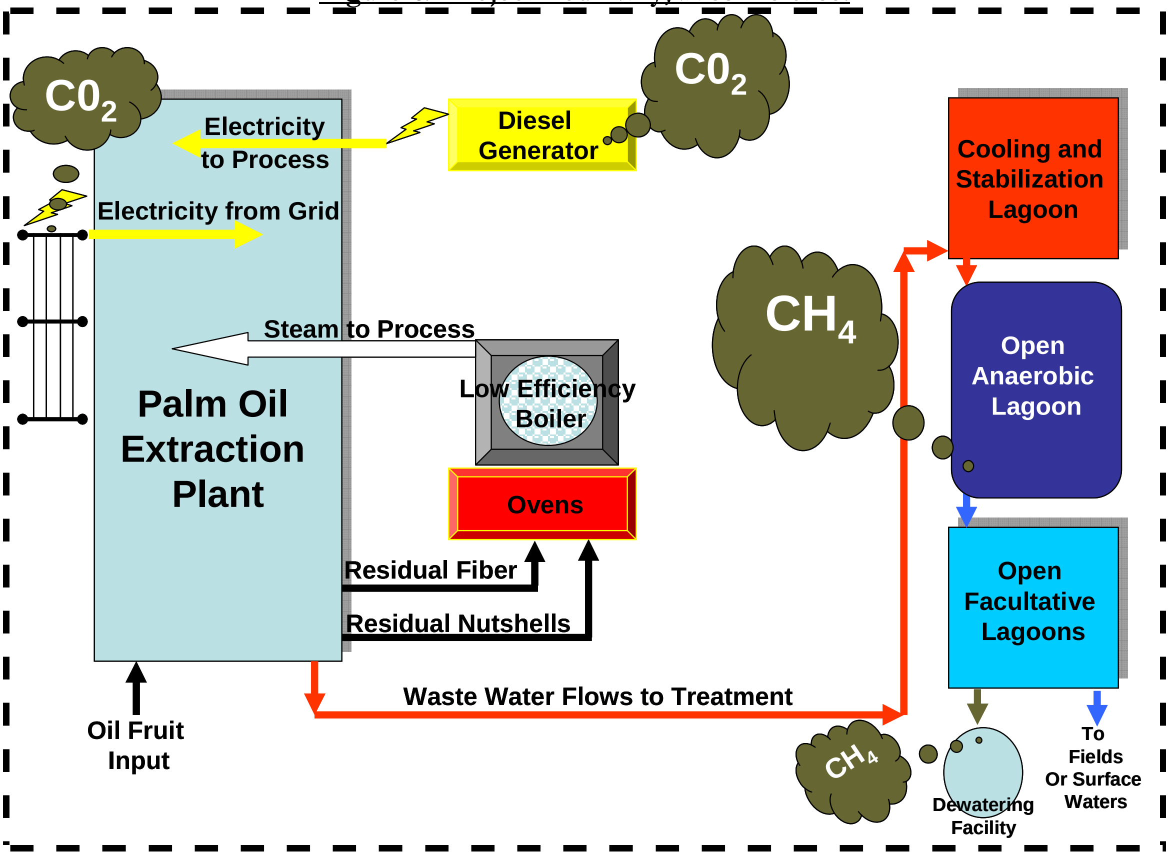

Table 3: Gases and Sources Included in the Project Boundary

	Source	Gas		Justification / Explanation
Baseline	Direct emissions from the waste treatment processes.	CH_4	Included	The major source of emissions in the baseline
		N_2O	Excluded	Excluded for simplification. This is conservative.
		CO_2	Excluded	CO_2 emissions from the decomposition of organic waste are not accounted.
	Emissions from electricity consumption / generation	CO_2	Included	Electricity may be consumed from the grid or generated onsite In the baseline scenario.
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is conservative.
	Emissions from thermal energy generation	CO_2	Included	If thermal energy generation is included in the project activity
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is conservative.
Project Activity	On-site fossil fuel consumption due to the project activity	CO_2	Included	May be an important emission source
		CH_4	Excluded	Excluded for simplification. This emission source is assumed To be very small.
		N_2O	Excluded	Excluded for simplification. This emission source is assumed To be very small.
	Emissions from on-site electricity use	CO_2	Included	May be an important emission source. If electricity is generated from collected biogas, these emissions are not accounted for.
		CH_4	Excluded	Excluded for simplification. This emission source is assumed To be very small.
		N_2O	Excluded	Excluded for simplification. This emission source is assumed To be very small.
	Direct emissions from the waste treatment processes.	N_2O	Excluded	Excluded for simplification. Not an important emission source.
		CO_2	Excluded	CO2 emissions from the decomposition of organic waste are not accounted.
		CH_4	Included	The emission from uncombusted methane and also leakage in case of anaerobic digesters. In case of dewatering and land application, conservative estimates of methane are included.

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

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Comparison of Baseline Alternatives for WWT and Sludge Management[4]

As documented in the participating plants' survey, in the photographic evidence of the 32 WWT systems, in the validation field visits to the extraction plants, in the CDM prefeasibility study, and in the FEDPALMA WWT manuals, open lagoons with deep pit sludge management systems comprise the baseline case, without a doubt, for all of the 32 plants involved in the CMD umbrella project. As required in the methodology,

[4] Methodology AM0013 v4 specifically requires in section B a comparison of WWT and sludge management alternatives to assist in determining the baseline conditions.

other options for WWT and Sludge management are listed below, discussed and compared to determine if they could possibly be the baseline condition.

WWT alternatives: as presented in the additionality section of this PDD, the net present value without CERs of the project activity with respect to WWT--Anaerobic Covered Digesters with Methane Capture and flaring—was found to be negative ($166,103), with a negative IRR. Without CER revenues, investment in this WWT alternative produces negative returns, because there are no other revenues associated with the investment other than CERs. With CER revenues estimated at a price of US$6, the activity becomes economically attractive and justifies the conversion of the existing open lagoon waste water treatment system to the CDM project activity of covered anaerobic digesters. In comparison, the investment and operating costs of treating the immense flows of waste waters from the Palm Oil extraction plants with UASB reactors is conclusively considered by all waste water treatment professionals (both domestic and international) to be exorbitant and non-economic, especially given the large land areas which are available for treatment with low cost open Lagoon WWT. Not one single UASB reactor is used in the sector after more than a decade of compliant WWT. Given that the Open Lagoon WWT Systems required by FEDEPALMA and operating at every one of the 32 plants since the mid 1990s are a sunk investment cost with very low marginal operating costs, the economic comparison of the three options are:

- least costly: existing open lagoon WWT. This is confirmed to be the baseline case.
- the next higher cost option is Anaerobic Covered Digesters with Methane Capture and flaring, which would not be implemented by anyone in the absence of the CDM incentive, with a VPN of negative ($166,103).
- The highest cost WWT option is the construction of massive UASB reactors, which would have exorbitant investment costs and very high operating costs.

Therefore it can be concluded without a doubt that the project activity case-- Anaerobic Covered Digesters with Methane Capture and flaring--is not the baseline case for WWT in the Colombian Palm Oil sector.

Sludge Management Alternatives: With regard to sludge management, which has a minute GHG emissions profile when compared to the methane emissions from the open lagoon system, the comparison of the baseline alternatives is divided here into two sub-components to compare current management with possible improved management alternatives. Sludge management is not regulated in Colombia, and there is no Association requirement to that effect. First, dewatering alternatives are listed and compared, followed by a comparison of sludge usage options.

Among the sludge dewatering alternatives, the one used by all 32 participating plants historically and at the time of validation is deep sludge pits. Sludge is removed periodically from the open lagoons with backhole or bulldozer equipment and deposited into sludge pits to dry and eventually transport to growing fields as organic fertilizer. However, this is not a rigorous operation, and there are no set standards or timetables, either from regulators or from FEDEPALMA or CENIPALMA. The only objectives are cost minimization and practicality. This is the least cost and most practical of all the alternatives listed and is the common practice. The next highest cost alternative is that of the project activity--Shallow Drying Beds with clear plastic roofs and specific drying and transport schedules. The clear plastic roof will prevent rains from wetting the sludge and will concentrate the sun's radiation for more rapid drying. This option will require engineering design, training, efficient operation, and maintenance, significantly increasing investment and operating costs, which represent barriers in the current context, and would not be undertaken in the absence of CER revenues. Even higher cost alternatives for dewatering include mechanized dewatering and thermal drying, but these are not considered viable under any scenario because of the very large investments and the associated barriers and costs related to design, training, efficient operation, labor costs, and maintenance. Therefore it can be concluded that the project activity case-- Shallow Drying Beds --is not the baseline case in the Colombian Palm Oil sector regarding sludge dewatering.

Among sludge usage alternatives, standard procedure is storage in deep sludge pits for undetermined time periods (landfilling), then it may be transported to fields either by animal traction or by tractor, for use as organic fertilizer in some cases. These are the lowest cost and most practical alternatives in the absence of CDM, and they are common practice throughout the sector. Sludge usage is not a regulated activity, and growers are free to use the sludge as they see fit. The alternatives of piped irrigation of wet sludge to fields, mechanized distribution of wet sludge to fields, or aerobic composting and distribution to fields, are the object of research and pilot projects, but are not common practice at all. The project activity may use any of them, including manual distribution of dried sludge transported with animal traction: the key condition is that the sludge may not be managed in deep pits, and may not be stored for any significant periods of time before land application, in order to avoid methane emissions. It can be concluded that the project activity is not the baseline condition.

Comparison of Baseline Alternatives for WWT and Sludge Management

BASELINE ALTERNATIVES		National Law and Regulation	FEDEPALMA CENIPALMA Programs and Policies	Common Practice	Cost	Barriers	Baseline?
WASTE WATER TREATMENT							
1	Open Lagoons	Complies with concentration limits	Required	Yes	Low	None	YES
2	UASB Reactors	Complies with concentration limits	Not recommended because of costs	No	Very High	Complex Design, Training, Difficult Operation, Maintenance	NO
3	Anaerobic Covered Digesters	Complies with concentration limits	Not required	No	High	Complex Design, Training, Difficult Operation, Maintenance	NO
	With Methane Capture	Complies with concentration limits	Not required	No	High	Complex Design, Training, Difficult Operation, Maintenance	NO
SLUDGE MANAGEMENT							
Dewatering							
1	Deep Sludge Pits	Not regulated	Recommended	No	Low	None	YES
2	Shallow Drying Beds	Not regulated	Not required	No	Medium	None	NO
3	Mechanized Dewatering	Not regulated	Not required	No	High	Complex Design,	NO

						Training, Difficult Operation, Maintenance	
4	Thermal drying	Not regulated		No	High	Complex Design, Training, Difficult Operation, Maintenance	NO
Sludge Usage							
1	Landfilling	Not regulated	Optional	Yes	Low	None	YES
2	Animal Traction Distribution to fields	Not regulated	Recommended option	Yes	Medium	None	NO
3	Piped Irrigation to fields	Not regulated	Recommended option	No	High	Complex Design, Training, Difficult Operation, Maintenance	NO
4	Mechanized Distribution to fields	Not regulated	Recommended option	No	High	Complex Design, Training, Difficult Operation, Maintenance	NO
5	Aerobic Composting	Not regulated	Recommended option	No	High	Training, Difficult Operation	NO

Additionality Analysis: Three options are examined in the additionality tests. First, continuation with BAU, which implies known technology and processes, and is profitable as is. Second, implementation of the CDM technologies and processes without CDM, which in the absence of CER incomes is economically unviable. Third, implementation of the new technologies and processes with CDM, which makes the project economically viable when CER revenues are considered.

Taken individually, none of the extraction plants would have attempted to implement the CDM project activity by itself because the individual CER income generation potential is perceived as low when compared to the high transactions and investment costs of applying the CDM to an individual plant. Even under small scale CDM rules, each firm would face high consulting fees for CDM feasibility studies, PDD formulation, and professional assistance in managing the complex and lengthy regulatory process; when the costs of validation (DOE fees plus professional time to address the requested clarifications and modifications), registry fees, monitoring costs, verification costs (DOE fees plus professional time to address the requested clarifications and modifications), CER administration fees and contributions to the adaptation fund are added, the costs, time and complexity are not worth the effort for a small amount of CERS to the individual palm oil producer.

Taken individually, the extraction plants would not have undertaken the emission reduction and renewable energy investments that are the subject of the FEDEPALMA CDM Umbrella Project presented in this PDD without the expectations of additional revenues from the sale of CERs under the CDM. The investment and operating costs of implementing these emissions reduction options are high, and the economic returns from implementing them without CER revenues are very low or inexistent, as demonstrated with the additionality tool kit in section B.3. Without CDM this project would not have occurred.

The aggregation of the 32 plants under a single large-scale CDM project bundle by the producer association FEDEPALMA is the reason that the plants have decided to apply the CDM. The aggregation increases information and certainty on the optimal technology, CDM regulations and CER markets; it greatly reduces all the CDM-related transactions costs per firm; it lowers the costs of acquisition of materials, equipment, technology and construction, as these are purchased under competitive bidding for multiple units; reduces costs and complexity of CDM monitoring through automated monitoring and data management of the project; and allows the participants to optimize the sale price of CERs through aggregation of a large amount of CERs under a highly competitive and flexible CER marketing program. The aggregation under the CDM Project Bundle also reduces risk and uncertainties through the Association's leadership, research and information dissemination. This is clearly demonstrated by the FEDEPALMA introduction of the CDM into the Associations Cleaner Production Strategy in 2001, its promotion of the CDM pilot/demonstration project, and the development of the CDM pre-feasibility study in 2003-4. Without the FEDEPALMA CDM umbrella program, these plants would not have implemented CDM individually and would not have implemented the emission reduction and renewable energy investments. Business as usual in the Palm Oil sector is profitable, certain, and well understood. Major technological change is difficult, financially risky, and uncertain, in the absence of additional incomes such as that from the CDM.

Given the improvement in benefits and certainty vs. costs and risks, following the recommendations provided by the FEDEPALMA umbrella project through its CDM prefeasibility study, the 32 plants participating in the FEDEPALMA CDM project BUNDLE plan to implement one or more of the following technological options to mitigate greenhouse gases and convert the extraction plants to renewable energy. All will implement Technology Option I (methane capture and mitigation), which is the foundation for the CDM project, and some will implement options II or III to generate renewable energy, depending on site specific conditions and needs. ***This PDD only seeks CDM Accreditation for Technology Option I, the implementation of new covered anaerobic digesters to capture and mitigate the biogas. After registration and implementation of the project activity, if and only if Technology Option I is technically successful and the incomes from CER sales are sufficient to support further investments in cogeneration of renewable energy, then the Project Participants will either present a second PDD (or request permission to modify this one if that is permitted by CDM regs) and present in very specific terms the individual technology packages which will have been chosen by each of the 32 participating plants for generation of renewable energy. This PDD includes complete references to Technology Options II and III, in order to represent the additionality and the incremental financial decision-making process in the most transparent and historically correct manner.***

Therefore the most likely course of action in the absence of the CDM economic incentives would be to continue with the existing technological framework and process, both at the plant and sector level.

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

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Project Additionality Test

Revision to the Approved Methodology AM0013 / Version 4 requires addressing the additionality of theproject activity through EITHER of the following options:

Option A) By determining the most likely course of action, taking into account economic attractiveness and barriers
OR
Option B) Using the latest version of the "Tool for the demonstration and assessment of Additionality" established by the CDM Executive Board[5].

Option B is used to establish additionality for each of the three Technology Options of this project activity. After reviewing each of the three Technology Options that will be implemented in successive stages by the participating plants, an explanation is presented as to why the emissions reductions would not have occurred at the individual plant in the absence of the CDM project activity and the expected CER revenues, using the latest version (3) of the Additionality Tool.

The timeline of the FEDEPALMA UMBRELLA CDM Project is as follows:

- Participation by the Environmental Director of FEDEPALMA in the meetings and conferences conducted by the National Strategy Study for Implementation of CDM, 1999-2000.
- CDM established as a strategic goal in the Sectoral Clean Production Plan, FEDEPALMA, 2001.
- Andean Center presentation to firm owners on the Opportunities for the Sector Related to the Kyoto Protocol, January 2002, at "Tertulia Palmera".
- Presentation by the Andean Center to the Board of Directors of the potential of a FEDEPALMA CDM project, October 2002.
- Decision by the Board of Directors of the Fondo de Fomento Palmero (Palm Sector Promotion Fund) to finance a CDM UMBRELLA PROJECT pre-feasibility study, December 2002.
- Participation by FEDEPALMA and multiple firm owners in the Andean Center-Natsource CDM forum, April 2003.
- Implementation of pilot CDM technology project in second semester of 2003.
- Presentations by the President of FEDEPALMA and the Andean Center on the plan to implement a CDM umbrella project during the Annual International Oil Palm Congress in Cartagena, September 2003.
- FEDEPALM CDM UMBRELLA PROJECT prefeasibility study finished august 2004.
- Regional presentations throughout the sector of the results of the FEDEPALM CDM UMBRELLA PROJECT prefeasibility study, carried out by the FEDEPALMA and the Andean Center, Sept-Oct 2004.
- Legal relationships established between FEDEPALMA and 32 participating extraction plants authorizing FEDEPALMA to lead the Bundled CDM project and represent the participants before the UNFCCC in the regulatory approval process. Jan-March 2006.
- In January 2006 FEDEPALMA began inviting extraction plants to participate in the CDM Umbrella Project. Engineering design and costing begins by participating firms.
- ~~Beginning of first accreditation period: August 15, 2008~~

APPLICATION OF THE ADDITIONALITY TOOL TO TECHNOLOGY OPTION I

This PDD only seeks CDM Accreditation for Technology Option I, the implementation of new covered anaerobic digesters to capture and mitigate the biogas. After registration and implementation of the

[5] UNFCCC, Tool for the demonstration and assessment of additionality, version 3, EB 29, UNFCCC web site.

project activity, if and only if Technology Option I is technically successful and the incomes from CER sales are sufficient to support further investments in cogeneration of renewable energy, then the Project Participants will either present a second PDD (or request permission to modify this one if that is permitted by CDM regs) and present in very specific terms the individual technology packages which will have been chosen by each of the 32 participating plants for generation of renewable energy. This PDD will includes complete references to Technology Options II and III, in order to represent the additionality and the incremental financial decision-making process in the most transparent and historically correct manner.

Technology Option I: methane mitigation only. A covered anaerobic digester must be built to optimize waste water treatment efficiency and to capture the entire biogas/methane flow produced. This will be done in one of two ways. A) Retrofit and cover the existing methanogenic lagoon, to convert it into a covered anaerobic digester with adequate sludge management capability, and capture and burn the methane in a high efficiency flare or in the industrial oven. B) A new covered anaerobic digester is built and the old anaerobic lagoon is decommissioned. The new digester is built to conform with national waste water treatment laws and regulations, and is designed on the basis of the acceptability criteria of the approved methodology AM0013. To burn and mitigate the methane, firms will choose between an enclosed flare system or adapting existing industrial burners to burn the biogas.

The investment in the construction of a modern, covered anaerobic digester to capture and mitigate the methane would not have been carried out in the absence of CDM because the investment is very costly and there is no other economic justification for the large investment without the existence of CDM, the Kyoto markets and the expected revenues from CER sales. In addition, the business as usual system for waste water treatment is environmentally efficient, cost-effective, conforms with all laws and norms, and is a well known high-certainty technology.

The application of the Additionality Tool below illustrates this from a financial perspective.

Tool for the demonstration and assessment of additionality[6]:

Step 1. Identification of alternatives to the project activity consistent with current laws and regulations

Realistic and credible alternatives to the project activity(s) that can be (part of) the baseline *scenario are analyzed as follows:*

Sub-step 1a. Define alternatives to the project activity:

First Alternative: Continue with business as usual technology and processes. In the absence of CDM, the sector would continue with the business as usual technologies and methods of treating their wastewater and sludge, and acquiring their energy from diesel generation or from the interconnected grid. These are cost-effective, proven technologies and processes that conform with all national environmental regulations, and are very well established practices throughout the sector. All of the plants in the sector today maintain and operate their open lagoon treatment system in order to comply with national laws and regulations. These include the sludge management techniques of dewatering in sludge pits and then distributing the sludge on the land. Only the CDM pilot plant has implemented and operates the desired new technology, which was implemented with FEDEPALMA to prepare for the SECTORAL CDM UMBRELLA PROJECT. Without the economic incentive of CER sales to support the investments in conversion from the existing systems to

[6] UNFCCC, Tool for the demonstration and assessment of additionality version 3, EB 29, UNFCCC web site.

new anaerobic digesters to capture the methane, business as usual would continue in the 32 plants now participating in the project activity.

Second Alternative: Implement the technological options proposed by this project activity without CDM or CER revenues. There is no precedent for the conversion to these technologies without CDM. Nowhere in the country, or in the region, is this package of methane capture technology being introduced without CDM, with the exception of the CDM PILOT PROJECT. As the financial analysis below indicates, the NPV and IRR of carrying out this conversion is negative without CDM and therefore is not feasible or sustainable without CER sales incomes. With regard to sludge management, alternatives such as aerobic composting, landfilling, methane recovery or electricity generation are not consistent or are more costly than their common operating model of dewatering in sludge pits and distribution on the land. In the BAU process, the sludge can be maintained for days and weeks before being moved to the land. In the the project activity in the sludge will be immediately distributed to the agricultural land in order to ensure aerobic decomposition on the land and elimination of the possibility of N2O emissions.

Third Alternative: Implement the technological options proposed by this project activity ***with*** *CDM and CER revenues.* The CDM prefeasibility study conducted in 2004 by the Biomass Technology Group (Netherlands) carried out an extensive financial analysis of the costs and benefits associated with converting to the methane capture technology in 16 representative extraction plants located in the 4 regions of Colombia. The investment and cost analyses were carried out with the managers of the plants[7] to ensure the reality of the cost information. As shown in the simple financial analysis below, without CER revenues, investment in Technology Option I produces negative returns, because there are no other revenues associated with the investment other than CERs. With CER revenues estimated at a price of US$6, the projects become economically attractive and justify the conversion of the existing open lagoon waste water treatment system to the CDM project activity of covered anaerobic digesters. These analyses of the Prefeasibility Study, disseminated by FEDEPALMA, were key factors for individual firms in the decision to participate in the FEDEPALMA Umbrella CDM project.

Sub-step 1b. Enforcement of applicable laws and regulations:

Technology Option I complies with all applicable legal and regulatory requirements, even those laws and regulations that have objectives other than GHG reductions, e.g. to mitigate local air pollution. FEDEPALMA has a very strong environmental program, closely linked to the national and regional environmental authorities, and as such has ensured that all firms in the sector fully comply with all environmental regulations.

There is no law, regulation or decree that would have required the adoption of this technology.

The conversion of an open methanogenic lagoon wastewater treatment system to a covered anaerobic digester, or the construction of a new anaerobic digester, does not create any impacts that are subject to regulation. In fact, the conversion to covered anaerobic digesters should increase the efficiency of COD degradation and therefore improve the quality of the final water effluent. As the CDM prefeasibility study demonstrates, the project activity will also mitigate odors that were prevalent in the open anaerobic lagoons, improving the air quality of the local area.

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[7] ESTUDIO DE PREFACTIBILIDAD PARA LA IDENTIFICACION Y EVALUACION DEL POTENCIAL DE GENERACION DE CERTIFICADOS DE REDUCCION DE EMISIONES A TRAVES DEL MECANISMO DE DESARROLLO LIMPIO PARA EL SECTOR PALMERO EN COLOMBIA. Biomass Technology Group BTG for Fedepalma, August 2004.

Tightening of the waste water treatment regulations is not foreseen by the environmental authority. Current controls under national decree 1594, combined with the water pollution tax on final effluent discharges, are perceived as rigorous and sufficient controls. Even if stricter controls were be imposed sometime in the future, the extraction plants would be able to comply with the construction of more open treatment lagoons because there is abundant space available for expansion in these rural areas of Colombia.

The implementation of Technology Option I is thus a voluntary investment, not required by any law or regulation of any type in Colombia, that would not have occurred in the absence of CDM and expected CER revenues.

Step 2. Investment analysis

Determine whether the proposed project activity is the economically or financially less attractive than other alternatives without the revenue from the sale of certified emission reductions (CERs). To conduct the investment analysis, use the following sub-steps:

Sub-step 2a. Determine appropriate analysis method

Determine whether to apply simple cost analysis, investment comparison analysis or benchmark analysis (sub-step 2b). If the CDM project activity generates no financial or economic benefits other than CDM related income, then apply the simple cost analysis (Option I). Otherwise, use the investment comparison analysis (Option II) or the benchmark analysis (Option III).

Technology Option I includes generates no financial or economic benefits other than CER revenues. This project activity simply captures the methane, cleans it, and burns the methane in high-efficiency enclosed flares or in the industrial ovens of the extraction plant in combination with the abundant residual fibers and nut shells. Given that CER revenue is the only economic reason to carry out this investment, the simple cost analysis applies.

Sub-step 2b. – Option I. Apply simple cost analysis

Document the costs associated with the CDM project activity and demonstrate that the activity produces no economic benefits other than CDM related income.

The capture of methane for immediate burning and mitigation offers no revenues different than CER sales. The results of the investment analysis conclude that without CER revenues, the investment and operation of the technology option I produce negative returns. With CER revenues estimated at a price of US$6, the projects become economically attractive and justify the conversion of the open lagoon waste water treatment system to the CDM greenhouse gas mitigation project activity. Table 4 presents the results of the investment analysis for Technology Option I with and without CER revenues.

Table 4: Financial Indicators: TECHNOLOGY OPTION I, Methane Capture and Mitigation

<table>
<tr><td colspan="3">TECHNOLOGY OPTION I,
Methane Capture And Mitigation.
Financial Indicators:</td></tr>
<tr><td>INVESTMENT</td><td colspan="2">NPV</td></tr>
<tr><td rowspan="2">US$ 101,458</td><td>W/O CER</td><td>WITH CER</td></tr>
<tr><td>($166,103)</td><td>199,138</td></tr>
<tr><td colspan="3">Note that parentheses indicate a negative value. IRR of project without CER is also negative. Validation report includes audit details of the financial analyses on which project investment decisions were based.</td></tr>
</table>

Step 4. Common Practice Analysis

Sub-step 4a. Analyze other activities similar to the proposed project activity:

Provide an analysis of any other activities implemented previously or currently underway that are similar to the proposed project activity. Projects are considered similar if they are in the same country/region and/or rely on a broadly similar technology, are of a similar scale, and take place in a comparable environment with respect to regulatory framework, investment climate, access to technology, access to financing, etc. Other CDM project activities are not to be included in this analysis. Provide quantitative information where relevant.

Outside the FEDEPALMA CDM project bundle, in the palm oil sector there are no similar models to Technology Option I, converting open anaerobic lagoons to capture the methane and mitigate it. There are no similar models in other agro-industrial sectors nor in other industrial sectors of Colombia.

Sub-step 4b. Discuss any similar options that are occurring:

In the absence of CDM, the sector would continue with the business as usual technologies and methods of treating their wastewater, sludge management, and acquiring their energy from diesel generation or from the interconnected grid. These are cost-effective, proven technologies and processes that conform with all national environmental regulations, and are very well established practices throughout the sector. All of the 52 plants in the sector today maintain and operate their open lagoon wastewater treatment system in order to comply with national laws and regulations, and do so under guidance from FEDEPALMA. Only the CDM pilot plant has implemented and operates the desired new technology, which was implemented with FEDEPALMA to prepare for the SECTORAL CDM UMBRELLA PROJECT. Without the economic incentive of CER sales to support the investments in conversion from the existing systems to new anaerobic digesters to capture the methane, business as usual would continue in these 32 plants and throughout the palm oil sector.

Selection of appropriate and conservative baseline scenario and Determination of additionality:

New investments in Colombia are hindered by security and labor market. The importation of new technologies are affected by exchange risks. New investments must be sufficiently attractive to overcome these basic country risks. The economic incentive provided by the sale of CERs is the only reason that the conversion to Technology Option I would occur in Colombia in the Palm Oil extraction sector. The high CER multiplier applied to methane based on its global warming potential, at market prices at US$6 or above, combined with the certainty and the cost reductions produced by the aggregation of 32 projects into a single large scale CDM project, make the technological conversion very financially attractive, with low risks. In practice, the great majority of the firms will only implement this option at project initiation in order to evaluate the experience in practice.

If the operation is successful and the CER revenues are sufficient, producers will then invest in Technology Options II or III. The approval and registration of the project activity as a CDM activity are the determining factor to enable the project activity to be undertaken.

From the analysis in the above sections, it can be determined that the First Alternative - "No project activity and continuation with the business as usual system - Open Lagoon waste water treatment with existing sludge management systems - is the most likely baseline scenario and has been considered as the business as usual scenario for the baseline emission calculations. Technology Option I of the project activity is therefore determined to be additional.

APPLICATION OF THE ADDITIONALITY TOOL TO TECHNOLOGY OPTION II

Technology Option II: Methane Mitigation plus Electricity Generation for Internal Use. In addition to the methane capture technology implemented in Technology Option I, biogas cleaning systems and methane driven electricity generation plants are purchased and installed. CO2 that previously resulted from either diesel-driven electricity generation plants or from purchasing energy from the grid is displaced by generating electricity with methane in specially designed biogas power plants.

The investment in the purchase and implementation in biogas treatment systems and new biogas generators is very costly; to carry out this option the plant owner would have to carry out option I investments as well to capture the methane.

Step 1. Identification of alternatives to the project activity consistent with current laws and regulations

The following analysis defines realistic and credible alternatives to the project activity(s) that can be (part of) the baseline scenario through the following sub-steps:

Sub-step 1a. Define alternatives to the project activity:
Identify realistic and credible alternative(s) available to the project participants or similar project developers that provide outputs or services comparable with the proposed CDM project activity. These alternatives are:

First Alternative: Continue with business as usual, the generation of electricity for use by the extraction plant with diesel power plants located on-site, or the purchase of electricity from the interconnected grid.
Palm Oil extraction firms located away from the interconnected grid rely on diesel power plants to provide their electricity needs: many have several units. Colombia is an oil producer with its own refineries to produce fuels, and diesel has long been subsidized by the national government. Diesel generation is a tried and true technology and there is a stable source of petrodiesel. Palm Oil extraction plants located near the national electricity grid prefer to purchase their energy from the grid, being a stable and cost-effective source. All of the plants in the sector have at least one diesel power plant, even if they are interconnected, to ensure electricity supply if the grid goes down. Outside the FEDEPALM CDM pilot project, there are no plants in Colombia operating with power plants designed for operation only with methane from biogas. Given the novelty, technology risks, the risks of innovation, the costs of converting the waste water treatment system to a covered methane capture system, and the high costs of purchasing and installing power plants designed for operation with methane from biogas which are twice the cost of diesel plants, palm oil extraction firms would clearly continue with business as usual: the trusted diesel power plants or the interconnection to the grid.

Second alternative: Purchase and implement biogas-methane electricity generation plants along with the required connection and operation equipment, and biogas cleaning technology, without the expectation of revenues from CER sales, and disconnect diesel generation equipment. As demonstrated below, this investment is not justifiable without the expectation of CER revenues.

Third alternative: Purchase and implement biogas-methane electricity generation plants along with the required equipment, infrastructure and technology, on the basis of the expectation of revenues from CER sales, and disconnect diesel generation equipment.

Sub-step 1b. Enforcement of applicable laws and regulations:

The alternative(s) shall be in compliance with all applicable legal and regulatory requirements, even if these laws and regulations have objectives other than GHG reductions, e.g. to mitigate local air pollution. *(This sub-step does not consider national and local policies that do not have legally-binding status.)*

There are no laws, regulations or decrees that require palm oil mills to generate renewable energy with biogas, or that would have required the extractor plants to adopt this technology. The purchase and implementation of biogas-methane electricity generation plants along with the required equipment, infrastructure and technology, are in complete compliance with all national and local laws and regulations.

Step 2. Investment analysis

Determine whether the proposed project activity is the economically or financially less attractive than other alternatives without the revenue from the sale of certified emission reductions (CERs). To conduct the investment analysis, use the following sub-steps:

Sub-step 2a. Determine appropriate analysis method

Determine whether to apply simple cost analysis, investment comparison analysis or benchmark analysis (sub-step 2b). If the CDM project activity generates no financial or economic benefits other than CDM related income, then apply the simple cost analysis (Option I). Otherwise, use the investment comparison analysis (Option II) or the benchmark analysis (Option III).

Technology Option II of the Project Activity does generate an economic benefit other than CDM related income: the reduction in the costs of diesel fuel or the reduction of purchase of electricity from the interconnected grid. As a result, Option II, the Investment Comparison Analysis, is used in step 2b, as recommended by the Additionality Tool.

Sub-step 2b. – Option II. Apply investment comparison analysis

Identify the financial indicator, such as IRR, NPV, cost benefit ratio, or unit cost of service (e.g., levelized cost of electricity production in $/kWh or levelized cost of delivered heat in $/GJ) most suitable for the project type and decision-making context.

The CDM prefeasibility study carried out by the Biomass Technology group utilized both IRR and NPV to compare the investment required for Technology Option II with CERs revenue and without CER revenue, in contrast to continuing with the business as usual which requires no incremental investment. These analyses take into account the savings from not having to purchase diesel fuel or electricity from the grid.

***Sub-step 2c. Calculation and comparison of financial indicators (only applicable to options II and* III):**

The CDM prefeasibilty study calculated the suitable financial indicator for Technology Option II of the proposed CDM project activity and for the other alternatives. It included all relevant costs (for example, the investment cost, the operations and maintenance costs), and revenues (excluding CER revenues, but including subsidies/fiscal incentives where applicable), and, as appropriate, non-market cost and benefits in the case of public investors.

The results of the investment analysis are presented below in a transparent manner with all the relevant assumptions in the CDM-PDD, so that a reader can reproduce the analyses and obtain the same results. These include critical techno-economic parameters and assumptions (such as capital costs, fuel prices, lifetimes, and discount rate or cost of capital). Assumptions are justified and/or cited in a manner that can be validated by the DOE. In calculating the financial indicator, the project's risks can be included through the cash flow pattern, subject to project-specific expectations and assumptions (e.g. insurance premiums can be used in the calculation to reflect specific risk equivalents).

Assumptions and input data for the investment analysis do not differ across the project activity and its alternatives.

Table 5: Financial Indicators, TECHNOLOGY OPTION II, Methane Mitigation plus Electricity Generation for Internal Use.

<table>
<tr><td colspan="3">TECHNOLOGY OPTION II
Methane Mitigation plus Electricity Generation for Internal Use.
Financial Indicators</td></tr>
<tr><td rowspan="2">INITIAL INVESTMENT</td><td colspan="2">NPV</td></tr>
<tr><td>W/O CER</td><td>WITH CER</td></tr>
<tr><td>US$ 601,283</td><td>($212,370)</td><td>99,389</td></tr>
<tr><td colspan="3">Note that parentheses indicate a negative value. IRR of project without CER is also negative. Validation report includes audit details of the financial analyses on which project investment decisions were based.</td></tr>
</table>

Sub-step 2d. Sensitivity analysis (only applicable to options II and III):

A sensitivity analysis is included that shows whether the conclusion regarding the financial *attractiveness is robust to reasonable variations in the critical assumptions. The investment analysis provides a valid argument in favor of additionality only if it consistently supports (for a realistic range of assumptions) the conclusion that the project activity is unlikely to be the most financially attractive (as per step 2c para 8a) or is unlikely to be financially attractive (as per step 2c para 8b).*

Critical assumptions and variables considered in the sensitivity analysis include:

- The cost of diesel fuel including transport, which has risen greatly since the prefeasibility study was prepared;
- The price of grid-supplied electricity, which could increase over time significantly;
- The price of CERs over time.

The sensitivity analysis concluded that the most important variable for the adoption of Technology Option II is the price of CERs. As CER prices rise above US$5, the attractiveness of the CDM project activity Option II increases significantly. In the absence of CER incomes, even with steady increases in the prices of diesel fuel and grid supplied electricity, technology option II does not become financially attractive.

Step 4. Common practice analysis

The above generic additionality tests shall be complemented with an analysis of the extent to which the proposed project type (e.g. technology or practice) has already diffused in the relevant sector and region. This test is a credibility check to complement the investment analysis (Step 2) or barrier analysis (Step 3).

Identify and discuss the existing common practice through the following sub-steps:

Sub-step 4a. Analyze other activities similar to the proposed project activity:

Provide an analysis of any other activities implemented previously or currently underway that are similar to the proposed project activity. Projects are considered similar if they are in the same country/region and/or rely on a broadly similar technology, are of a similar scale, and take place in a comparable environment with respect to regulatory framework, investment climate, access to technology, access to financing, etc. Other CDM project activities are not to be included in this analysis. Provide quantitative information where relevant.

There are no other activities implemented or under way in Colombia that are similar to the Technology Option II of the project activity.

Selection of appropriate and conservative baseline scenario and Determination of additionality:

New investments in Colombia are hindered by security and labor markets. The importation of new technologies is affected by exchange risks. New investments must be sufficiently attractive to overcome these basic country risks.

The sale of CERs which is enabled by CDM registration is the dominant decision variable for the FEDEPALMA UMBRELLA CDM project to be implemented. As demonstrated in the above investment analysis, the value of CER flow from this methane mitigation and fossil fuel displacement project are by far the major economic rationale for undertaking this project. As the sensitivity analysis shows, the additional benefits of not having to purchase diesel fuel or electricity from the grid are insufficient incentive to cause the extraction plants to adopt Technology Option II. The registration of the project activity as CDM will be the factor that takes the project activity from planning to reality.

From the above sections, it can be determined that the First Alternative - continue with business as usual, the generation of electricity for the extraction plant with diesel power generators located on-site or the purchase of electricity from the grid - is the most likely baseline scenario and has been considered as the business as usual scenario for the baseline emission calculations. Technology Option II of the project activity is therefore determined to be additional.

APPLICATION OF THE ADDITIONALITY TOOL TO TECHNOLOGY OPTION III

Technology Option III: Cogeneration of heat and power. In addition to the methane capture technology investments for Technology Option I, this option includes either the retrofitting of existing low efficiency boilers or the investment in new high efficiency boilers for high pressure steam generation, and the purchase of new high efficiency steam turbines to generate electricity. It converts the plants from fossil to renewable energy for electricity, heat and steam, utilizing the flows of biogas/methane, residual fiber and residual palm nut shells, all biomass by-products of the Palm Oil extraction process.[8]

The investment in the purchase and implementation of new high efficiency ovens, boilers and steam turbines to generate electricity is extremely costly and would not have been carried out in the absence of CDM, because the investment in new ovens, boilers and turbines, is very expensive, and it is more economic to generate electricity with diesel or purchase it from the national grid. Even with high diesel or electricity prices this option is not economically justifiable without CER revenues. The application of the additionality tool kit in section _ below illustrates this. As the financial analysis in the pre-feasibility study shows, this option will probably not be implemented until the price of CERs rises above US$13.

Step 1. Identification of alternatives to the project activity consistent with current laws and regulations

The following analysis defines realistic and credible alternatives to the project activity(s) that can be (part of) the baseline scenario through the following sub-steps:

Sub-step 1a. Define alternatives to the project activity:

Identify realistic and credible alternative(s) available to the project participants or similar project developers that provide outputs or services comparable with the proposed CDM project activity. These alternatives are:

First Alternative: Continue with business as usual, the generation of electricity for use by the extraction plant with diesel power plants located on-site or the purchase of electricity from the grid.

Palm Oil extraction firms located away from the interconnected grid rely on diesel power plants to provide their electricity needs: many have several units. Colombia is an oil producer with its own refineries to produce fuels, and diesel has long been subsidized by the national government. Diesel generation is a tried and true technology and there is a stable source of petrodiesel. Palm Oil extraction plants located near the national electricity grid prefer to purchase their energy from the grid, being a stable and cost-effective source. All of the plants in the sector have at least one diesel power plant, even if they are interconnected, to ensure electricity supply if the grid goes down.

There are no plants in Colombia operating with cogeneration systems designed to capture the methane, residual fiber and nutshells flows that are sub-produces of the extraction process, and employ them in an efficient manner to cogenerate heat, vapor, and electricity for own use. Given the novelty, technology risks, the risks of innovation, the costs of converting the waste water treatment system to a methane capture system, and the high costs of purchasing and installing cogeneration technologies which are many times the cost of diesel plants, palm oil extraction firms would clearly continue with business as usual: the trusted diesel power plants or the interconnection to the grid.

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[8] Given that AM 0013 does not include displacements from renewable energy sold into the grid, that component will be the subject of a second PDD with the appropriate methodology.

Second alternative: Purchase and implement high pressure boilers, steam turbines, and the required connection and operation equipment, infrastructure and technology for cogeneration, without the expectation of revenues from CER sales, and disconnect diesel generation equipment or cease purchasing electricity from the grid.

Third alternative: Purchase and implement high pressure boilers, steam turbines, and the required connection and operation equipment, infrastructure and technology for cogeneration, on the basis of the expectation of revenues from CER sales, and disconnect diesel generation equipment or cease purchasing electricity from the grid.

Sub-step 1b. Enforcement of applicable laws and regulations:

The alternative(s) shall be in compliance with all applicable legal and regulatory requirements, *even if these laws and regulations have objectives other than GHG reductions, e.g. to mitigate local air pollution. (This sub-step does not consider national and local policies that do not have legally-binding status.)*

The purchase and implementation of high pressure boilers, steam turbines, and the required equipment, infrastructure and technology for cogeneration, are in complete compliance with all national and local laws and regulations.

Step 2. Investment analysis

Determine whether the proposed project activity is the economically or financially less attractive than other alternatives without the revenue from the sale of certified emission reductions (CERs). To conduct the investment analysis, use the following sub-steps:

Sub-step 2a. Determine appropriate analysis method

Determine whether to apply simple cost analysis, investment comparison analysis or benchmark analysis (sub-step 2b). If the CDM project activity generates no financial or economic benefits other than CDM related income, then apply the simple cost analysis (Option I). Otherwise, use the investment comparison analysis (Option II) or the benchmark analysis (Option III).

Technology Option III of the Project Activity does generate economic benefits other than CDM related income, including: the reduction in the costs of diesel fuel; or, the reduction of purchase of electricity from the interconnected grid; and, it creates the possibility of selling surplus electricity generated with biomass to the national grid. As a result, for Option III, the Investment Comparison Analysis is used in step 2b, as recommended by the Additionality Tool.

Sub-step 2b. – Option II. Apply investment comparison analysis

Identify the financial indicator, such as IRR, NPV, cost benefit ratio, or unit cost of service *(e.g., levelized cost of electricity production in $/kWh or levelized cost of delivered heat in $/GJ) most suitable for the project type and decision-making context.*

The CDM prefeasibility study carried out by the Biomass Technology group utilized both IRR and NPV to compare the investment required for Technology Option III with CERs revenue and without CER revenue, in contrast to continuing with the business as usual, with requires no incremental investment.

***Sub-step 2c. Calculation and comparison of financial indicators (only applicable to options II and* III):**

The CDM prefeasibilty study calculated the suitable financial indicator for Technology Option III of the proposed CDM project activity and for the other alternatives. It included all relevant costs (including, for example, the investment cost, the operations and maintenance costs), and revenues (excluding CER revenues, but including subsidies/fiscal incentives where applicable), and, as appropriate, non-market cost and benefits in the case of public investors.

The investment analysis is presented below in a transparent manner with all the relevant assumptions in the CDM-PDD, so that a reader can reproduce the analysis and obtain the same results. These include critical techno-economic parameters and assumptions (such as capital costs, fuel prices, lifetimes, and discount rate or cost of capital). Assumptions are justified and/or cited in a manner that can be validated by the DOE. In calculating the financial indicator, the project's risks can be included through the cash flow pattern, subject to project-specific expectations and assumptions (e.g. insurance premiums can be used in the calculation to reflect specific risk equivalents).

Assumptions and input data for the investment analysis do not differ across the project activity *and its alternatives.*

Table 6: Financial Indicators, TECHNOLOGY OPTION III, ***Cogeneration of heat and power*.**

<table>
<tr><th colspan="3">TECHNOLOGY OPTION III:
COGENERATION OF HEAT AND POWER
Financial Indicators</th></tr>
<tr><th>INITIAL INVESTMENT</th><th colspan="2">NPV</th></tr>
<tr><td rowspan="2">US$ US$ 3,332,938</td><td>W/O CER</td><td>WITH CER</td></tr>
<tr><td>($ 1,830,322)</td><td>(1,194,345)</td></tr>
<tr><td colspan="3">Note that parentheses indicate a negative value. Validation report includes audit details of the financial analyses on which project investment decisions were based.</td></tr>
</table>

Sub-step 2d. Sensitivity analysis (only applicable to options II and III):

A sensitivity analysis is included that shows whether the conclusion regarding the financial attractiveness is robust to reasonable variations in the critical assumptions. The investment analysis provides a valid argument in favor of additionality only if it consistently supports (for a realistic range of assumptions) the conclusion that the project activity is unlikely to be the most financially attractive (as per step 2c para 8a) or is unlikely to be financially attractive (as per step 2c para 8b).

Critical assumptions and variables considered in the sensitivity analysis include:

- The cost of diesel fuel including transport, which has risen greatly since the prefeasibility study was prepared;
- The price of grid-supplied electricity, which could increase over time significantly;
- As with technology option II, the sensitivity analysis concludes that the most important variable related to the adoption of technology option III is the price of CERs. As CER prices rise above US$13, the attractiveness of the CDM project activity Option III increases significantly. In the absence of CER incomes, even with steady increases in the prices of diesel fuel and grid supplied electricity, Technology Option III does not become financially attractive.

Step 4. Common practice analysis
The above generic additionality tests shall be complemented with an analysis of the extent to which the proposed project type (e.g. technology or practice) has already diffused in the relevant sector and region. This test is a credibility check to complement the investment analysis (Step 2) or barrier analysis (Step 3).

Identify and discuss the existing common practice through the following sub-steps:

Sub-step 4a. Analyze other activities similar to the proposed project activity:

Provide an analysis of any other activities implemented previously or currently underway that are similar to the proposed project activity. Projects are considered similar if they are in the same country/region and/or rely on a broadly similar technology, are of a similar scale, and take place in a comparable environment with respect to regulatory framework, investment climate, access to technology, access to financing, etc. Other CDM project activities are not to be included in this analysis. Provide quantitative information where relevant.

There are no other activities implemented or under way that are similar to the Technology Option III, cogeneration with biomass and biogas for heat and power—of the project activity.

Selection of appropriate and conservative baseline scenario and Determination of additionality:
The sale of CERs which is enabled by CDM registration is the dominant decision variable for the FEDEPALMA UMBRELLA CDM project to be implemented. As demonstrated in the above investment analysis, the value of CER flow from this methane mitigation and cogeneration project are by far the major economic rationale for undertaking this project. As the financial analyses show, the additional benefits of not having to purchase diesel fuel or electricity from the grid are insufficient incentive to cause the extraction plants to adopt Technology Option III. The project is additional, but significantly higher CER prices and-or electricity sales prices will be required to make Option III viable even with CDM.

From the analyses in the above sections, it can be determined that the First Alternative - continue with business as usual, the generation of electricity for the extraction plant with diesel power generators located on-site or the purchase of electricity from the grid - is the most likely baseline scenario and has been considered as the business as usual scenario for the baseline emission calculations. Technology Option III of the project activity is therefore determined to be additional.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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The project activity emissions consist of:

- the residual methane emitted from the facultative lagoons,
- physical leakage from the digester,
- stack emissions from the flare, industrial boiler or the biogas generation plant alter burning the methane,
- emissions from heat use and electricity use due to the project activity using fossil fuel, for example if there is insufficient biogas or biomass available at any point in time;
- emissions related to energy consumption in auxiliary equipment needed to operate the digester, the filtering systems, and to manage the sludge,
- Emissions from land application of sludge,

- Emissions from wastewater removed in the dewatering process.

Residual methane emissions from facultative lagoons

In accordance with methodology AM0013 v.4, although the majority of the COD is degraded by the anaerobic digester, the treated water will then pass through a series of facultative lagoons for stabilization before being sent to irrigation or to release to surface waters. The facultative lagoons are open-air, and function in an aerobic fashion. Traditionally the methane conversion factor (MCF) for aerobic conditions is 0 (zero); however, the methodology requires further monitoring. For this reason the residual methane emissions from the facultative lagoons are calculated in the same manner as in the base line, using the same values for Bo and the same MCF; but taking into account the much reduced COD exiting the anaerobic digester.

CH_4 emissions from the lagoons = (Kg/yr)	COD_{dig_out} (Kg COD/yr, calc. from data #11)	Bo (Kg CH_4/Kg COD)	x	MCF_{dig_out}
CO_2e emissions from the lagoons = (Kg/yr)	CH_4 emissions from the lagoons (Kg/yr)	X		GWP

Where:

COD_{dig_out}	Is Chemical Oxygen Demand of effluent entering lagoons from anaerobic digester output (measured and converted from data # 11)
B_o	Is maximum methane producing capacity
MCF_{dig_out}	Is methane conversion factor (fraction) estimated as described in the baseline section.
GWP	Global Warming Potential for methane = 21

In case there is an effluent from the lagoons in the baseline, $COD_{baseline}$ values should be adjusted by multiplying $COD_{baseline}$ by the following factor AD:

$$AD = 1 - \left(\frac{COD_{a,out}}{COD_{a,in}} \right)$$

Where:

CODa,ou t	is the COD that leaves the lagoon with the effluent
CODa,in	is the COD that enters the lagoon

MCFbaseline,m is estimated as the product of the fraction of anaerobic degradation due to depth (fd) and the fraction of anaerobic degradation due to temperature (ft):

$$MCF_{baseline,m} = f_d * f_{t,monthly} * 0.89$$

Where:

Fd is the fraction of anaerobic degradation due to depth. The default values of fraction due to depth are:

Deep > 5m	Medium depth 1-5 m	Small depth<1m

Fraction of degradation under anaerobic conditions due to depth of sludge pit	70%	50%	0

Ft is the fraction of anaerobic degradation due to temperature. ft,monthly is calculated as follows: ft,monthly is calculated as follows:

$$f_{t,monthly} = \exp[\frac{E * (T_2 - T_1)}{R * T_1 * T_2}]$$

Where:

T1	303.16 (273.16° + 30°)
T2	Ambient temperature (Kelvin) for the climate
E	Activation energy constant (15,175 cal/mol)
ft	monthly anaerobic degradation factor due to temperature
R	Ideal gas constant (1.987 cal/ K mol)

0.89 is an uncertainty conservativeness factor (for an uncertainty range of 30% to 50%) toaccount for the fact that the equation used to estimate ft,monthlyassumes full anerobic degradation at 30 oC.

It is the possible to calculate the MCF both monthly and annual. Annual MCF can be estimated from the following equation:

$$MCF_{annual} = \frac{\sum_{m=1}^{12} CH_{4,m}}{B_0 * \sum_{m=1}^{12} COD_{baseline,m}}$$

$$CH_{4,m} = B_0 * COD_{available,m} * MCF_{monthly}$$

Where:

$CH_{4,m}$	estimated monthly methane production
B_0	is the maximum methane producing potential of organic waste
$COD_{baseline,m}$	monthly COD entering the digester or directed to land application.
$COD_{available,m}$	Monthly COD available for conversion (monthly COD entering the digester ordirected to land application plus COD carried on from the previous month)
$MCF_{monthly}$	Monthly conversion efficiency of organic matter to CH4.

Physical Leakage from anaerobic digesters

IPCC guidelines specify physical leakage from anaerobic digesters as being 15% of total biogas production as a conservative measure.

Stack emissions from the enclosed flare, industrial boiler or the biogas generation plant

Methane contained in the residual biogas collected from the anaerobic digester outlets will be mitigated in two possible ways:

1. In generation of electricity in gensets, or of heat in boilers, during the mill's operating hours; or,
2. In the flaring system when the mill is not operating and gas is not stored in storage tanks.

When biogas is used to generate electricity or heat in the gensets or the boilers, the project will only use new equipment withmanufacturers specifications that ensure that methane mitigation efficiencies are higher than 99%. The equipment to be used shall include full monitoring systems to measure the methane content of the stack gases. Ex ante project emissions of methane from the stacks is calculated using the provided “tool to determine project emissions from flaring gases containing methane[9]”, but the project activity will measure, monitor and verify actual project emissions from the stacks.

When the mill is not operating and gas is not stored in storage tanks then biogas is mitigated at the flaring system, where only enclosed high efficiency flares will be used. However, assuming that potential inefficiencies in combustion of biogas may sometimes occur, ex ante residual emissions of methane from the flares will be calculated using the provided “tool to determine project emissions from flaring gases containing methane”, as follows.

For enclosed flare efficiency, the project will use option a), 90% default values with compliance of manufacturer’s specifications and parameters.

The minimum specifications for the flaring system are as follows:

- Biogas composition at the inlet of the flaring system: 30% to 65% methane (CH_4); values are taken from Data #19 $\mathbf{P_{CH4,bio}}$
- Operating temperature: 760ºC to 982 ºC (1093 ºC shutdown), taken in Data # **21.4 T** flare
- Retention time: 0.7 seconds at 982 ºC (minimum) taken with Data **#20** $\mathbf{FR_{f,inlet}}$ and Data # **21.4 T** flare

Project activity emissions from the enclosed flare’s emissions of the residual gas stream are to be calculated based on the flare efficiency and the mass flow rate of methane in the residual gas stream to be flared.

The flare efficiency in the hour *h* (h *flare,h*) is calculated as:

- 0% if the temperature in the exhaust gas of the flare (T_{flare}) is below 500 °C for more than 20 minutes during the hour *h* .
- 50%, if the temperature in the exhaust gas of the flare (T_{flare}) is above 500 °C for more than 40 minutes during the hour *h,* but the manufacturer’s specifications on proper operation of the flare are not met at any point in time during the hour *h*.
- 90%, if the temperature in the exhaust gas of the flare (T_{flare}) is above 500 °C for more than 40 minutes during the hour *h* and the manufacturer’s specifications on proper operation of the flare are met continuously during the hour *h*.

Project emissions from flaring the residual gas stream in year y are determined by multiplying the methane flow rate in the residual gas by the flare efficiency for each hour of operations the year.

$$PE_{flare,y} = \sum_{h=1}^{8760} TM_{RG,h} \times \left(1 - \eta_{flare,h}\right) \times \frac{GWP_{CH4}}{1000}$$

Where:

$PE_{flare,y}$	TCO_2e	Project emissions from flaring of the residual gas stream in year y
$TM_{RG,h}$	Kg/h	Mass flow rate of methane in the residual gas in the hour *h*
$\eta_{flare,h}$		Flare efficiency in hour *h*
GWP_{CH4}	tCO_2e/tCH_4	Global warming potential of methane valid for the commitment period.

[9] Please refer to http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html

Emissions from heat and electricity use due to the project activity using fossil fuel [10]

$PE_{elec/heat} = \mathbf{El_{p,y}} * CEF_d + \mathbf{HG_{pr,y}} * CEF_{Pr,therm,y}$

Where:

$El_{p,y}$ (Data #12) Amount of electricity in the year y that is consumed at the project site for the project activity, in MWh.

CEF_d is the CO_2 emissions factor for electricity consumed at the project site during the project activity (tCO_2/MWh), estimated as described below. Factor is zero if biogas is used to produce electricity.

$HG_{Pr,y}$ (Data #13) is the quantity of thermal energy consumed in year y at the project site due to the project activity *using fossil fuel* (MJ). This data is determined on the basis of the fossil fuel used and the calorific value of the fuel. If fossil fuels are used for Start-up ignition of the biomass in the industrial ovens, that fuel will be measured.

$CEF_{Pr,therm,y}$ is the CO_2 emissions intensity for thermal energy generation (tCO_2e/MJ), estimated as per method described for baseline thermal energy use. Factor is zero if biogas is used for generating thermal energy.

Determination of CEFd:

For Technology Options II and III, CEF_d should be chosen as follows [10]**:**

- In case the electricity is generated on-site with a fossil fuel fired power plant, the default emission factor for a diesel generator with a capacity of more than 200 kW for small-scale project activities shall be used (0.8 tCO_2/MWh; see AMS 1.D.1 in the simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories).
- In case the electricity is sourced from the grid in the baseline, the CEF_d should be calculated according to methodology ACM0002 ("Consolidated baseline methodology for grid-connected electricity generation from renewable sources"). If total electricity consumption is less than the small scale threshold (15 GWh/year), AMS. 1.D.1 may be used.

Emissions from land application of sludge

An MCF of 0.05 will be used for conservativeness to estimate possible methane emissions from the land application treatment process to account for any possible anaerobic pockets in the sludge. These emissions are to be estimated using the following equation:

[10] ***This PDD only seeks CDM Accreditation for Technology Option I, the implementation of new covered anaerobic digesters to capture and mitigate the biogas. After registration and implementation of the project activity, if and only if Technology Option I is technically successful and the incomes from CER sales are sufficient to support further investments in cogeneration of renewable energy, then the Project Participants will either present a second PDD (or request permission to modify this one if that is permitted by CDM regs) and present in very specific terms the individual technology packages which will have been chosen by each of the 32 participating plants for generation of renewable energy. This PDD will includes complete references to Technology Options II and III, in order to represent the additionality and the incremental financial decision-making process in the most transparent and historically correct manner.***

$$\underset{(kg/yr)}{CH4\ emissions} = \underset{(kg\ COD/yr)}{Total\ COD_{la}} \times \underset{(kg\ CH4/kg\ COD)}{B_o} \times MCF_{la}$$

Where:

COD_{la}	(Data #15) Is Chemical Oxygen Demand of the sludge used for land application after dewatering (measured)
B_o	Is maximum methane producing capacity
MCF_{la}	Is methane conversion factor (fraction) assumed to be equal to 0.05

Nitrous oxide emissions from land application of sludge are to be estimated as follows:

$$\underset{(kg/yr)}{N_2O\ emissions} = \underset{(kg\ sludge/yr)}{S_a} \times \underset{(kg\ N/kg\ sludge)}{NC} \times EF_{N2O}$$

where:

S_a	(Data # 32) is the amount of sludge applied to land in kg per year
NC	(Data # 33) is the nitrogen content in the sludge in (Kg N/Kg sludge)
EF_{N2O}	Is the emission factor of nitrogen from sludge applied to land to be assumed 0.016 kg N_2O/kg N[11]

(vi) Emissions from wastewater removed in the dewatering process

The wastewater removed from the dewatering process may contain some organic matter that has not been degraded/removed. Emissions from such wastewater should be estimated from the following equation:

$$\underset{(kg/yr)}{CH_4\ emissions} = \underset{(kg\ COD/yr)}{Total\ \mathbf{COD_{dw}}} \times \underset{(kg\ CH_4/kg\ COD)}{B_o} \times MCF_{dw}$$

Where:

COD_{dw}	(determined by data #17) Is Chemical Oxygen Demand in the wastewater from the dewatering process (measured)
B_o	Is maximum methane producing capacity
MCF_{dw}	Is methane conversion factor (fraction) estimated as described in the baseline section.

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

Data / Parameter:	**D3 / $COD_{a,out}$**
Data unit:	Kg/yr
Description:	--COD that leaves the anaerobic lagoon with the effluent --Activity Level: Open Lagoon.
Source of data used:	Field Measurement
Value applied:	See table An.3.3 in Annex 3.

[11] Based on Stehfest, E. and Bouwman, A.F. N2O and NO emission from agricultural fields and soils under natural vegetation: summarizing available measurement data and modelling of global annual emissions. Nutr. Cycl. 29 Agroecosyst., in press. The average emission factor used is 0.01 kg N_2O-N / kg N.

Justification of the choice of data or description of measurement methods and procedures actually applied:	Equipment used:	Standard Sampling and Laboratory equipment.
	How the measurement is undertaken:	The measurements have been made following standard sampling procedures.
	Accuracy of the measurement method:	High
	Responsible person/entity that should undertake the measurements:	External Designated Laboratory in places where a recognized accredited laboratory is available in the region. Otherwise trained personnel from the mills perform the sampling method and report results to the mill manager and to the regional environmental authority.
Any comment:	Analysis of this variable is contracted by each mill yearly with designated laboratories according to the reporting requirements for organic load discharged to rivers regulated by the each regional environmental authority. Data presented is based on 2005 information.	

Data / Parameter:	**D4 / $COD_{a,in}$**	
Data unit:	Kg/yr	
Description:	--COD that enters the lagoon which is assumed to be equal to the COD input to the digester or directed to land application. --Activity Level: Open Lagoon.	
Source of data to be used:	Measurement	
Value applied	See table An.3.4 in Annex 3.	
Description of measurement methods and procedures to be applied:	Equipment used:	Standard Sampling and Laboratory equipment.
	How the measurement is undertaken:	The measurements have been made following standard sampling procedures.
	Accuracy of the measurement method:	High
	Responsible person/entity that should undertake the measurements:	External Designated Laboratory in places where a recognized accredited laboratory is available in the region. Otherwise trained personnel from the mills perform the sampling method and report results to the mill manager and to the regional environmental authority.
Any comment:	Analysis of this variable is contracted by each mill yearly with designated laboratories according to the reporting requirements for organic load discharged to rivers regulated by the each regional environmental authority. Data presented is based on 2005 information.	

Data / Parameter:	**Bo**
Data unit:	kg CH_4/kg COD
Description:	Maximum methane producing capacity
Source of data to be used:	IPCC. (2006). *Guidelines for National Greenhouse Gas Inventories*. Volume 5. Section 6.2.2.2. (p.6.12) and section 6.2.3.2. (p.6.21). IPCC suggest 0.25 for Bo. For conservative reasons AM0013 v4 suggest 0.21 for Bo.
Value applied	0.21
Description of measurement methods and procedures to be applied:	Equipment used: N/A How the measurement is undertaken: N/A Accuracy of the measurement method: N/A Responsible person/entity that should undertake the measurements: N/A
Any comment:	

Data / Parameter:	**D7 / EG_y**
Data unit:	MWh
Description:	--Amount of electricity in the year y that would be consumed at the project site in the absence of the project activity --Activity Level: Electricity Use.
Source of data used:	Measurement
Value applied:	See Table An 3.7 in Annex 3.
Justification of the choice of data or description of measurement methods and procedures actually applied:	Equipment used: Energy meter. Accuracy of the measurement method: High Responsible person/entity that should undertake the measurements: Extraction plant's metric analyst.
Any comment:	Table An 3.7 presents information on electricity consumption from those mills willing to build and operate power generation equipment and wanting to credit emission reductions from this activity. Their willingness to include electricity generation within the CDM project activity was determined according to their answers to the survey performed in 2006. Recent positive developments regarding CDM markets have resulted in greater interest. Some of the mills that responded negatively to incorporate electricity generation in 2006, are now moving towards introducing power generation capacity in their mills. The monitoring reports to be presented in the project's verifications will include the updated information on all plants that effectively built and operated power capacity in their mills as a result of the CDM incentive. ***This PDD only seeks CDM Accreditation for Technology Option I, the implementation of new covered anaerobic digesters to capture and mitigate the biogas. After registration and implementation of the project activity, if and only if Technology Option I is technically successful and the incomes from CER sales are sufficient to support further investments in cogeneration of renewable energy, then the Project Participants will either present a second***

	PDD (or request permission to modify this one if that is permitted by CDM regs) and present in very specific terms the individual technology packages which will have been chosen by each of the 32 participating plants for generation of renewable energy. This PDD will includes complete references to Technology Options II and III, in order to represent the additionality and the incremental financial decision-making process in the most transparent and historically correct manner.

Data / Parameter:	CEFBl,elec,y (On-site diesel generator)
Data unit:	tCO_2e/MWh
Description:	--CO_2 emission factor for electricity produced with diesel gensets at the project site in the absence of the project activity --Activity Level: electricity use
Source of data used:	AMS 1.D.1
Value applied:	0,8
Justification of the choice of data or description of measurement methods and procedures actually applied:	Equipment used: Accuracy of the measurement method: Responsible person/entity that should undertake the measurements:
Any comment:	In cases where electricity is generated on-site with a fossil fuel fired power plant, the default emission factor for a diesel generator with a capacity of more than 200 kW for small-scale project activities shall be used (0.8 tCO_2/MWh; see AMS 1.D.1).

Data / Parameter:	**D9/$HG_{bl,y}$**
Data unit:	MJ
Description:	Quantity of thermal energy that would be consumed in year y at the project site in the absence of the project activity using fossil fuel Activity level: Thermal Consumption.
Source of data to be used:	Measurement of the fuel used.
Value applied	0
Description of measurement methods and procedures to be applied:	Equipment used: How the measurement is undertaken: Calibration procedures are applied: Accuracy of the measurement method: Responsible person/entity that should undertake the measurements: Measurement interval:
Any comment:	None of the project participants use fossil fuels for thermal energy production purposes. Since the heating generation equipment uses environmentally sustainable

	biomass as fuel, the combustion process results in zero net CO_2 emissions. The CO2 emissions of the combustion process will be consumed by growing biomass representing a cyclic process of carbon sequestration. For this reason, this variable will not be included in the monitoring procedure.

Data / Parameter:	**$CEF_{Bl,therm}$**
Data unit:	tCO2e/MJ
Description:	CO2 emissions intensity for thermal energy generation Activity level: Thermal Consumption.
Source of data to be used:	Mills information
Value applied	0
Description of measurement methods and procedures to be applied:	Equipment used: How the measurement is undertaken: Calibration procedures are applied: Accuracy of the measurement method: Responsible person/entity that should undertake the measurements: Measurement interval:
QA/QC procedures to be applied:	
Any comment:	No fossil fuels are used for thermal energy production. Since the heating generation equipment uses environmentally sustainable biomass as fuel, the combustion process results in zero CO_2 emissions. The CO2 emissions of the combustion process will be consumed by growing biomass representing a cyclic process of carbon sequestration. For this reason, this variable will not be included in the monitoring procedure.

B.6.3 Ex-ante calculation of emission reductions:

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Emission reductions are calculated as the difference between baseline and project emissions, taking into account any adjustments for leakage. The calculation based on ex ante information is the following:

Baseline emissions (tCO_2/yr)	=	Baseline emissions from open lagoons (t CO_2e/yr)	+	Baseline emissions from grid electricity generation (tCO_2/yr)	+	Baseline emissions from the portion of fossil fuel displaced by biogas used in heating equipment (tCO_2/yr)

Emission reductions (tCO_2/yr)	=	Baseline emissions (tCO_2e/yr)	-	Leakage (t CO_2e/yr)	-	Project emissions (t CO_2e/yr)

Since leakage is defined as zero in the methodology, the ex-ante estimate of methane emissions reductions is the difference between "Baseline emissions from open lagoons" and "Project emission" (=$ER\_CH_{4exante}$). Ex-post monitoring of the actual amount of CH_4 captured and flared or fed to the electricity generator and/or to the heating equipment leads to an ex-post estimate of methane emissions reductions (=$ER\_CH_{4expost}$).

The ex-ante baseline and project methane emissions to be reported in the CDM-PDD are based on estimation equations defined earlier. Whereas, for the purpose of claiming emissions reductions, the lower of the two shall be assumed as the baseline emissions:

(i) baseline methane emissions less the physical leakage

(ii) the actual methane captured and flared/used for energy generation

If (ii) above is the baseline emissions then physical leakage from anaerobic digester for estimating emissions reduction shall be taken as zero. The value of the actual methane captured and flared should be multiplied by the flare efficiency. Flare efficiency is estimated as per procedure explained above and monitored as per the monitoring methodology.

Methane emissions are calculated as shown in the following formulae:

CH4e,m = {CODbl + CODav,m - CODav,m * MCF - CODremovedSP} * (1-CODa,out/CODa,in) * 0.21 * Fd * exp{15175 * (T1-303.16)/[1.987 * (T1-303.16)]}* 0.89

Where:

CODbl = the total COD inflow to the open lagoon system

CODav,m= COD available from previous wastewater inflow and remaining as sludge/organic matter in the lagoons.

MCF= Methane Conversion factor

CODremovedSP = monthly amount of COD removed from the lagoon system. Sludge is removed yearly from lagoons. Methodology accepts for the calculation of this variable the yearly removal of sludge.

Bo = maximum CH_4 producing capacity is defined to be 0.21 in a conservative fashion by the methodology.

Fd = Depth factor of the anaerobic lagoons

T1 = Ambient temperature at each participating palm oil extraction plant

CO2 emissions from electricity use and thermal energy production were calculated with the following formulae:

BEelec/heat = EGy * CEFBl,elec,y + EGd,y * CEFgrid + HGBl,y * CEFBl,therm,y

Where:

$BE_{elec/heat}$ = Baseline emission of electricity and heat

Eg_y = is the amount of electricity in the year y that would be consumed at the project site in the absence of the project activity (MWh). Three sources of electricity can be used by any of the project participants in the absence of the project activity: 1) Consumption of electricity from the grid; 2) own production of electricity by means diesel fired gensets; 3) consumption of both electricity from the grid and own generation. Details on the source of electricity consumed by each project participant is recorded in a spreadsheet file named "baseline modified.xls" containing the sources of electricity and the amount of electricity used per project participant. A summary of electricity consumption per project participant and the electricity source used to satisfy electricity consumption is presented later in this PDD, in Table An 3.9.

$CEF_{Bl,elec,y}$= is the CO_2 emission factor for electricity consumed at the project site in the absence of the project activity (tCO_2/MWh).[12]

$CEF_{Bl,elec,y}$ value depends upon the source of electricity used by each project participant. When the electricity grid provides electricity for the project participant, CEFBl,elec,y is calculated according to ACM002 v6. $CEF_{Bl,elec,y}$ was calculated using the Colombian government's Dispatch Data Analysis Operating Margin (DDAOM) as presented in the document "Promedios Horarios de Emisión para el Cálculo de la Metodología Consolidada de Línea Base ACM002 para Proyectos de Generación de Escala Completa [13] (Hourly baseline emission averages for calculating full scale project activity projects based upon ACM002). This method was established by national decree by the UPME (Ministry of Mines and Energy Planning Unit) which is the National Authority in charge of establishing guidelines and parameters for all energy based project activities, including energy- based CDM projects.

The process to determine $CEF_{Bl,elec,y}$ included the calculation of the following equations:

$$EF_{DD,h} = \frac{\sum_{j,n} HR_{j,i,n} \cdot GEN_{j,n,h} \cdot EF_{CO_2,i} \cdot OXID_i}{\sum_{j,n} GEN_{j,n,h}}$$

$$E_{OM,y} = \sum_{h} EG_h \cdot EF_{DD,h}$$

$$EF_{OM,DIspatch.Data,y} = \frac{E_{OM,y}}{EG_y}$$

Where:

$EF_{DD,h}$	Hourly weighted average of CO2e per electricity unit that comprises 10% of the final merit order dispatched plants.
$HR_{i,j,n}$	Heat rate of the j generating plant using the fuel i and is part of the 10% of the final merit order dispatched plants
GENj,n,h	Amount of electricity produced by the j generating plant and is part of the10% of the final merit order dispatched plants
$EF_{CO2,i}$	CO2 emissions factor per unit of fuel i
$OXID_i$	Is the oxidation factor of fuel i
EG_h	Amount of electricity produced in the hour h by the project activity
$EO_{M,y}$	Are the emissions associated with the Operating Margin in year y

[12] ***This PDD only seeks CDM Accreditation for Technology Option I, the implementation of new covered anaerobic digesters to capture and mitigate the biogas. After registration and implementation of the project activity, if and only if Technology Option I is technically successful and the incomes from CER sales are sufficient to support further investments in cogeneration of renewable energy, then the Project Participants will either present a second PDD (or request permission to modify this one if that is permitted by CDM regs) and present in very specific terms the individual technology packages which will have been chosen by each of the 32 participating plants for generation of renewable energy. This PDD will includes complete references to Technology Options II and III, in order to represent the additionality and the incremental financial decision-making process in the most transparent and historically correct manner.***

[13] Unidad de Planeación Minero Energética –UPME- del Ministerio de Minas y Energía de Colombia. Promedios Horarios de Emisión para el Cálculo de la Metodología Consolidada de Línea Base ACM002 para Proyectos de Generación de Escala Completa. 2005. Disponible en http://www.upme.gov.co/sima/documentos/documentacion/sector_electrico/linea_base_full_escala_2005.pdf. Consultado en Junio 22 de 2007

EG_y	Is the amount of electricity produced by the project activity in year y
$EF_{OM,Dispatch\ Data,y}$	Is the emissions factor associated with the Operating Margin in year y, obtained by means of option C (Dispatch Data analysis)

When electricity is provided by own electricity generation by means of diesel fired gensets, since aggregated electricity generation of all project participants is far less than 15GWh/y, $CEF_{Bl,elec,y}$ equals 0.8 tCO2/MWh following AMS 1.D.1. This is the procedure indicated by AM0013v.4 on page 10.

EGd,y= is the amount of electricity generated utilizing the biogas collected during project activity and exported to the grid during the year y (MWh)

CEFgrid= is the CO_2 emission factor for the grid where electricity is exported (tCO_2/MWh)

HGBl,y= is the quantity of thermal energy that would be consumed in year y at the project site in the absence of the project activity (MJ) using fossil fuel.

CEFBl,therm,y= is the CO_2 emissions intensity for thermal energy generation (tCO_2 e/MJ)

The above equations were calculated for each project participating extraction plant and then aggregated to estimate the baseline for the project activity bundle. Demonstration of the application of the set of equations required by the methodology is presented below using the case of a typical plant, AGROINCE LTDA & CIA S.C.A.

BASELINE EMISSIONS (tCO2e) FOR AGROINCE LTDA. Y CIA S. C. A. (BASE YEAR = 2005)

	CH4e,m [kg CH4/mo]	CODbl [kg CH4/mo]	CODout [kg CH4/mo]	CODav,prev,m [kg CH4/mo]	MCF	CODremovedSP [kg CH4/mo]	Fd	T1 [°K]	T1 [°C]
MONTH 1	39.661	504.618,66	7.132,0	-	0,3796	-	0,5	301	28,1
MONTH 2	40.934	323.487,56	7.530,9	313.051	0,3828	-	0,5	301	28,2
MONTH 3	53.585	324.598,23	7.556,8	512.696	0,4128	-	0,5	302	29,1
MONTH 4	64.094	365.112,55	8.500,0	703.287	0,3877	-	0,5	302	28,4
MONTH 5	63.616	236.160,85	5.497,9	926.848	0,3733	-	0,5	301	27,9
MONTH 6	68.273	198.015,26	4.609,9	1.074.852	0,3764	-	0,5	301	28,0
MONTH 7	73.692	181.275,08	4.220,2	1.198.325	0,3828	-	0,5	301	28,2
MONTH 8	76.746	165.950,57	3.863,4	1.310.202	0,3702	-	0,5	301	27,8
MONTH 9	84.811	204.775,45	4.767,3	1.414.725	0,3702	-	0,5	301	27,8
MONTH 10	90.023	190.252,72	4.429,2	1.543.701	0,3702	-	0,5	301	27,8
MONTH 11	93.858	173.971,26	4.050,1	1.663.531	0,3640	-	0,5	301	27,6
MONTH 12	102.939	217.580,44	5.065,4	1.774.183	0,3670	-	0,5	301	27,7
Subtotal (tCO2e)	17.896,90								

Total AGROINCE's Emission Reductions [tCO2e in 2005]
18.601,90

EMISSIONS DUE TO ELECTRICITY CONSUMPTION	
EGbl,elec,grid,y [MWh]	1.086,5
CEFbl,grid,elec,y [tCO2e/MWh]	0,5
EGbl,elec,diesel,y [MWh]	137,5
CEFbl,elec,diesel,y [tCO2e/MWh]	0,8
EGd,y [MWh]	
CEFgrid [tCO2e/MWh]	
HGBl,y [TJ]	
CEFBl,therm,y [tCO2e/TJ]	
BEelec/heat [tCO2e]	705,0

Each of the participating extraction plants is represented in an individual summary table and was reviewed by the DOE. The variables were obtained from each participating extraction plant using the questionnaire presented in Appendix 3. Site visits were carried out to each of the plants to ensure the quality of the information.

Project Emissions:

Project emissions are estimated to reflect conditions when the plants are operating, and when then plants are not operating (nights, Sundays and holidays).

When the plants are operating, project activity emissions are estimated at 20% of the baseline emissions as a conservative measure. Calculations on each of the following parameters, based upon the value of the variables presented in section B.6.2, were performed resulting in index numbers to serve as a baseline to evaluate the overall emissions from the project activity[14]. Each source of project activity emissions are described below, and aggregated to compose the 20% calculation as follows:

- Methane emissions from open facultative lagoons: 1%
- Physical Leakage from biodigesters: 15%

[14] All calculations performed to determine project activity emissions are presented in attached excel files

- Stack emissions from the flare or energy generation: 1%, because mitigating and monitoring technologies have been chosen to ensure efficient (99%) mitigation in the boilers and the generation plant where all of the methane flow will be mitigated during operating hours.
- Emissions from heat use and electricity use: 1%
- Emissions from land application of sludge: 1%
- Emissions from wastewater removed in the dewatering process: 1%

When the plants are not operating, project activity emissions are estimated at 29% of the baseline emissions as a conservative measure. Calculations on each of the following parameters, based upon the value of the variables presented in section B.6.2, were performed resulting in index numbers to serve as a baseline to evaluate the overall emissions from the project activity[15]. Each source of project activity emissions are described below, and aggregated to compose the 29% calculation as follows:

- Methane emissions from open facultative lagoons: 1%
- Physical Leakage from biodigesters: 15%
- Stack emissions from the flare or energy generation: 10%, according the "*tool to determine project emissions from flaring gases containing methane*", because the methane is only burned in the Flaring system, which applies monitoring parameters which ensure mitigation at a 90% level.
- Emissions from heat use and electricity use: 1%
- Emissions from land application of sludge: 1%
- Emissions from wastewater removed in the dewatering process: 1%

Methane emissions from open lagoons

$$\underset{(kg/yr)}{CH_4 \text{ emissions from the lagoons}} = \underset{(kg\ COD/yr)}{COD_{dig\_out}} \times \underset{(kg\ CH_4/kg\ COD)}{B_o} \times MCF_{dig\_out}$$

where:
COD_{dig_out} = Chemical Oxygen Demand of effluent entering lagoons (measured)
Bo = maximum methane producing capacity
MCF_{dig_out}= methane conversion factor (fraction) estimated as described in the baseline section above

Calculation of methane emissions from the open facultative lagoons as part of the project activity emissions will depend upon measured data from the above mentioned variables after the project activity is implemented. At present, on average 2% of the COD inflow leaves the WWT systems. Once implemented the project activity, COD effluents after wastewater treatment are considered to be significantly lower than current COD effluent releases, due to the increase in efficiency of the new covered anaerobic digesters that are the center of the project activity. Thus, project emissions from methane emissions from open facultative lagoons are considered negligible. For ex-ante calculation purposes, 1% of the baseline emissions are used to estimate methane emissions from open facultative lagoons in the project activity as a conservative measure.

Physical Leakage from biodigesters

IPCC guidelines specify physical leakage from anaerobic digesters as being 15% of total biogas production. As a conservative measure, according to the methodology, 15% of the calculated baseline emissions assumed for calculating the physical leakage from biodigesters.

[15] All calculations performed to determine project activity emissions are presented in attached excel files

Stack emissions from the flare or energy generation[16]

Residual gas collected after the digester outlet will be mitigated in two possible ways:

1. In electricity or heat generators during mill's operating hours; or,
2. In the flaring system in hours when the mill is not operating.

As per residual gas used to generate electricity or heat, especifications from manufacturers of the equipment to be installed, report methane mitigation efficiencies higher than 99%. These equipments includes full monitoring appliances to measure the methane content of the stack gases. Stack emissions from the energy generation equipment will be measured by automated continuous monitoring systems measuring the percentage of methane flowing in and out of the flaring system Residual emissions of methane from the stacks will be calculated using the provided "tool to determine project emissions from flaring gases containing methane[17]".

As per residual gas to flared at the flaring system, according to the "Tool to determine project emissions from flaring gases containing methane" when using enclosed flares and continuous monitoring the flare efficiency will be 0% if the flare temperature is below 500°C during more than 20 minutes during a measured hour. If the temperature of the exhaust gas of the flare is above 500°C during the measured hour, the flare efficiency is calculated by means of the following algorithm:

$$\eta_{flare,h} = 1 - \frac{TM_{FG,h}}{TM_{RG,h}}$$

Providers of flaring systems to the bundled project are required to ensure that residual gas is flared at the highest possible efficiency. Since ex-ante *calculations following manufactirer's specifications resulted in a lesser estimative of projects emissions from the flaring system, the suggested 90% efficiency default value for enclosed flares is used. Thus, baseline emissions are discounted by 10% due to stack emissions from the flaring system or burner where methane is mitigated.*

Emissions from heat use and electricity use due to the project activity (PEelec/heat):

PE elec/heat = EL y* CEF d + HG Pr,y * CEF Pr,therm,y

where,

ELP,y is the amount of electricity in the year y that is consumed at the project site for the project activity (MWh).

CEFd is the CO2 emissions factor for electricity consumed at the project site during the project activity (tCO2/MWh), estimated as described below. Factor is zero if biogas is used to produce electricity.

[16] ***This PDD only seeks CDM Accreditation for Technology Option I, the implementation of new covered anaerobic digesters to capture and mitigate the biogas. After registration and implementation of the project activity, if and only if Technology Option I is technically successful and the incomes from CER sales are sufficient to support further investments in cogeneration of renewable energy, then the Project Participants will either present a second PDD (or request permission to modify this one if that is permitted by CDM regs) and present in very specific terms the individual technology packages which will have been chosen by each of the 32 participating plants for generation of renewable energy. This PDD will includes complete references to Technology Options II and III, in order to represent the additionality and the incremental financial decision-making process in the most transparent and historically correct manner.***

[17] Please refer to http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html

HGPr,y is the quantity of thermal energy consumed in year y at the project site due to the project activity (MJ).

CEFPr, therm,y is the CO2 emissions intensity for thermal energy generation (tCO2e/MJ), estimated as per method described for baseline thermal energy use. Factor is zero if biogas is used for generating thermal energy.

Increase of electricity use is expected to be negligible since additional use of electricity by the project activity will not be higher than 1% from the current electricity use. According to AM0013, electricity generation and thermal generation are required to be calculated if methane is used to generate electricity and/or heat and project participants wish to claim emission reductions from this activity. As per electricity generation, project participants willing to install power plants will implement power capacity enough to become self sufficient in electricity consumption. Therefore, CEF_d is expected to be zero. Accordingly, As per heat generation, project participants willing to produce heat from the methane content in the biogas, at present use biomass from Fresh Fruit Bunches to produce heat. Therefore, $CER_{Pr,therm,y}$ is expected to be zero, as well. As a conservative measure, 1% of the baseline emissions were assumed for the calculation of emissions from heat use and electricity use due to the project activity.

Emissions from land application of sludge

These emissions are to be estimated from the following equation once the project becomes operational:

CH4 emissions (kg/yr)	=	Total CODla (kg COD/yr)	x	Bo (kg CH4/kg COD)	x	MCFla

where:

CODla Is Chemical Oxygen Demand of the sludge used for land application after dewatering (measured)
Bo Is maximum methane producing capacity
MCFla Is methane conversion factor (fraction) assumed to be equal to 0.05 to estimate possible methane emissions from the land application treatment process to account for any possible anaerobic pockets

Nitrous oxide emissions from land application of sludge are to be estimated as follows:

N2O emissions (kg/yr)	=	Sa (kg sludge/yr)	x	NC (kg N/kg sludge)	x	EFN2O

where:

Sa Is the amount of sludge applied to land in kg per year
NC Is the nitrogen content in the sludge in (Kg N/Kg sludge)
EF_{N2O} Is the emission factor of nitrogen from sludge applied to land to be assumed 0.016 kg N_2O/ Kg N3

Until present, no measurement of sludge COD_{la} nor S_a has been performed by any participating extraction plants. Since the sludge from the lagoons is currently removed yearly, it is assumed that only the COD inflow from the last month which was turned into sludge at the bottom of the anaerobic lagoon is able to degrade to methane. The conventional method to remove sludge is by pumping it from the anaerobic lagoon to a sludge reservoir involving aerobic degradation of the sludge in the process. Subsequently, the sludge is taken to the palm oil growing fields to serve as organic fertilizer, a process which involves a second aerobic degradation of potential methane pockets and sludge nitrogen content with potential to generate nitrous oxide emissions.
The project activity will improve sludge management and ensure aerobic degradation of the sludge both in the dewatering facility and in land application. Thus, anaerobic COD degradation from sludge and formation

of nitrous oxide is assumed to be negligible in the project activity. As a conservative measure, 1% of the calculated baseline emissions are deducted due to emissions from sludge management.

Emissions from wastewater removed in the dewatering process

Emissions from wastewater should be estimated from the following equation once the project becomes operational:

CH4 emissions (kg/yr)	=	Total CODdw (kg COD/yr)	x	Bo (kg CH4/kg COD)	x	MCFdw

where:

CODdw Is Chemical Oxygen Demand in the wastewater from the dewatering process (measured)
Bo Is maximum methane producing capacity
MCFdw Is methane conversion factor (fraction) estimated as described in the baseline section above

COD in the wastewater from the dewatering process has not been measured to date in the base case in any of the participating extraction plants. Once the project activity is implemented, WWT efficiencies will be improved and less COD will occur in the final effluent; in addition, there will not exist a dewatering facility but, instead, the final effluent from dewatering will be send to land application. Thus, CH4 emissions from the dewatering process are assumed to be negligible. As a conservative measure, emissions from wastewater removed in the dewatering process are calculated as 1% of the baseline emissions.

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

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Table 7: Ex-Ante Estimation of Project Activity Emissions Reductions for Technology Option I, Capture and Mitigation of Methane Emissions from WWT Open Lagoons by reconversion to Covered Anaerobic Digesters with Flaring Systems.

Year	Estimation of Project Activity Emissions	Baseline emissions	Estimation of Leakage	Estimation of overall Emission reductions
	all data below in Tonnes of CO2e			
2008-9	192.689	796.829	-	604.140
2009-10	208.189	860.926	-	652.737
2010-11	223.536	924.392	-	700.856
2011-12	243.726	1.007.885	-	764.159
2012-12	260.992	1.079.283	-	818.291
2013-14	274.901	1.136.804	-	861.902
2014-15	286.217	1.183.598	-	897.381
Total (tons of CO2e)	1.690.250	6.989.716	-	5.299.466

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

This project applies the monitoring methodology AM0013 version 4, entitled "Avoided Methane Emissions from organic waste-water treatment". References have been obtained from the Approved Baseline and Monitoring Methodologies in the UNFCCC website[18]

The monitoring plan includes 37 monitoring parameters. Each is presented in the format required by the PDD. Table 8 summarizes the parameters that are described in the following tables. Complete information on the data and each parameter is included in Annex 4.

Table 8: Summary of Monitoring Data and Parameters Included in Monitoring Plan

Activity level	Data ID	Description
Open lagoon	**D1 / F_{dig}**	Flow rate of organic wastewater into the digester
Open Lagoon	**D2 / $COD_{c,Bl}$**	COD Concentration of organic wastewater into the digester
Open Lagoon	**D3 / $COD_{a,out}$**	COD that leaves the anaerobic lagoon with the effluent
Open Lagoon	**D4 / $COD_{a,in}$**	COD that enters the lagoon which is assumed to be equal to the COD input to the digester or directed to land application.
Open lagoon	**D5 / T_{lag}**	Ambient Temperature of lagoon
open lagoon	**D6 / D_{lag}**	Level/Depth of lagoon
Electricity Use	**D7 / EG_y**	Amount of electricity in the year y that would be consumed at the project site in the absence of the project activity
Electricity Use	**D8 / $EG_{d,y}$**	Amount of electricity generated using biogas collected during project activity and exported to the grid during the year
Thermal Consumption	**D9/$HG_{bl,y}$**	Quantity of thermal energy that would be consumed in year y at the project site in the absence of the project activity using fossil fuel
Open lagoon	**D10 / $F_{dig,out}$**	Flow rate of organic wastewater into the digester
Covered Anaerobic Digester	**D11 / COD_{c,dig_out}**	Concentration of organic wastewater into the anaerobic covered digester.
Electricity Consumption	**D12/$EL_{p,y}$**	Amount of electricity in the year $_y$ that is consumed at the project site for the project activity
Heat Consumption	**D13/$HG_{Pr,y}$**	Quantity of thermal energy consumed in year y at the project site due to the project activity using fossil fuel. Heating Equipment will not and doesn't use fossil fuel
Land application	**D14/F_{la}**	Flow rate of sludge used for land application after dewatering

18 http://cdm.unfccc.int/UserManagement/FileStorage/CDMWF_AM_TUXV2ZCTQVGAZTGOKEJZK88YMRMRCR

Land application	**D15/COD** $_{C,la}$	Wastewater from the dewatering process
Dewatering	**D16/F** $_{c,dw}$	Flow rate of organic wastewater from dewatering process
Dewatering	**D17/COD** $_{c,dw}$	**COD** $_{c,dw}$ of the wastewater from the dewatering process. Activity level: *Dewatering*
Covered Anaerobic Digester	**D18 / FR** $_{bio}$	Amount of biogas collected in the outlet of the biodigester
Covered Anaerobic Digester	**D19/P** $_{CH4,bio}$	Percentage of methane in the biogas in the outlet of the biodigester
Flaring	**D20 / FR** $_{f,inlet}$ **(FV** $_{RG,h}$**)**	Flow rate of the biogas entering the flare **(FV** $_{RG,h}$ in the tool for emissions from flare**)**
Flaring	**D21 / PE** $_{flare,y}$	Project Emissions from flaring of the residual gas stream in year y. Parameters used will be monitored as per the "*tool to determine project emissions from flaring gases containing methane*", using option a), taking a 90% default value, performing continuous monitoring, in compliance with flares' manufacturer specifications.
Flaring	**D21.1/fv** $_{i,h}$	Volumetric fraction of component i in the residual gas
Flaring	**D21.2/T** $_{o2,h}$	Volumetric fraction of O2 in the exhaust gas of the flare
Flaring	**D21.3/ fv** $_{CH4,FG,h}$	Concentration of methane in the exhaust gas of the flare in dry basis at normal conditions in the hour h.
Flaring	**D21.4/T** flare	Temperature in the exhaust gas of the flare
Flaring	**D21.5/ TVn,FG,h**	Volumetric Flow rate of the enclosed high efficiency flare stack gases in a dry basis at normal conditions in the hour h.
Electricity Generation	**D22 / FR** $_{e,inlet}$	Flow rate of the biogas entering the electricity generation equipment
Electricity Generation	**D23 / FR** $_{e,s}$	Flow rate of the electricity generation equipment stack gases
Electricity generation	**D24/P** $_{CH4,e,s}$	Methane content in stack gas of electricity generation equipment
Electricity generation	**D25/T** $_{comb,e}$	Fraction of time gas is combusted in the electricity generation equipment
Heat generation	**D26 / FR** $_{h,inlet}$	Flow rate of the biogas entering the heat generation equipment
Heat generation	**D27 / FR** $_{h,s}$	Flow rate of the heat generation equipment stack gases
Heat Generation	**D27.1 / T** Boiler	Temperature in the exhaust gas of the boiler
Heat Generation	**D27.2/T** $_{O2,h}$	Volumetric fraction of O2 in the exhaust gas of the boiler in the hour h
Heat generation	**D28/P** $_{CH4,h,s}$	Methane content in stack gas of heat generation equipment
Heat generation	**D29/T** $_{comb,h}$	Fraction of time gas is combusted in the heat generation equipment
Land application	**D30/S** $_{e}$	Amount of dewatered sludge applied to land
Land application	**D31 / NC**	Nitrogen Content in the sludge

Regulations	**D32**	Regulations and incentives relevant to effluent

Complete information on the data and each parameter is included in Annex 4.

B.7.1 Data and parameters monitored:

Data / Parameter:	**D1 / F_{dig}**	
Data unit:	m^3/yr	
Description:	Flow rate of organic wastewater into the digester Activity Level: Open lagoon.	
Source of data to be used:	Field Measurement	
Value applied	See table An.3.1 in Annex 3.	
Justification of the choice of data or description of measurement methods and procedures actually applied:	Equipment used:	Volumetric manual method performed by an accredited laboratory
	How the measurement is undertaken:	Standard sampling procedures
	Accuracy of the measurement method:	High
	Responsible person/entity that should undertake the measurements:	External Designated Laboratory in places where a recognized accredited laboratory is available in the region. Otherwise trained personnel from the mills perform the sampling method and report results to the mill manager and to the regional environmental authority.
Any comment:	Analysis of this variable is contracted by each mill yearly with designated laboratories according to the reporting requirements for organic load discharged to rivers regulated by the each regional environmental authority. Data presented is based on 2005 information.	

Data / Parameter:	**D2 / $COD_{c,Bl}$**	
Data unit:	Kg/m3	
Description:	--COD Concentration of organic wastewater into the digester --Activity Level: Open Lagoon.	
Source of data to be used:	Measurement	
Value applied	See table An.3.2 in Annex 3.	
Description of measurement methods and procedures to be applied:	Equipment used:	The laboratory procedure for determining COD is based upon Standard Methods for the Examination of Water and Wastewater. 20th edition, 1998.
	How the measurement is undertaken:	based upon Standard Methods for the Examination of Water and Wastewater. 20th edition, 1998.

	Accuracy of the measurement method:	High
	Responsible person/entity that should undertake the measurements:	External Designated Laboratory in places where a recognized accredited laboratory is available in the region. Otherwise trained personnel from the mills perform the sampling method and report results to the mill manager and to the regional environmental authority.
Any comment:	Analysis of this variable is contracted by each mill yearly with designated laboratories according to the reporting requirements for organic load discharged to rivers regulated by the each regional environmental authority. Data presented is based on 2005 information.	

Data / Parameter:	**D5 / T_{lag}**	
Data unit:	ºK	
Description:	Ambient Temperature of lagoon --Activity Level: open lagoon	
Source of data used:	Measurement	
Value applied:	Table An 3.5 presents average annual temperature values.	
Justification of the choice of data or description of measurement methods and procedures actually applied:	Equipment used:	Thermometer.
	Accuracy of the measurement method:	High
	Responsible person/entity that should undertake the measurements:	Nearest regional airport available. The temperature information is reported by airports to IDEAM which is the National Meteorological Information entity in charge of the compilation of this information.
Any comment:	Where no regional temperature information is available at IDEAM, temperature information was taken from mill's registries. For the calculation of the total amount of methane generated in the open lagoons, monthly Average temperature at each region/mill was used.	

Data / Parameter:	**D6 / D_{lag}**	
Data unit:	**M**	
Description:	--Depth of lagoon --Activity Level: open lagoon.	
Source of data used:	**Measurement**	
Value applied:	See values per mill in Table 3.6 in Annex 3	
Justification of the choice of data or description of measurement methods and procedures actually applied:	Equipment used:	Level meter.
	Accuracy of the measurement method:	High
	Responsible person/entity that should undertake the measurements:	Extraction plant's metric analyst.

Any comment:	Information presented in Table An 3.6 corresponds to the average depth of all existing open lagoons at each mill.

Data / Parameter:	**D7.1/** $EG_{PJ,h}$
Data unit:	MWh
Description:	Electricity displaced by the project activity in hour h of year y
Source of data:	Measurement
Measurement procedures (if any):	Equipment that will be used: Energy meter How the measurement is undertaken: An automated instrument will measure the energy and transmit the information to a local database using an industrial communication method. Calibration procedures are applied: The calibration procedures for the energy use meter will be made in a Reference Laboratory accredited by international Standards according to indications of the manufacturer. The Reference laboratory must supply a Certificate of Calibration specifying the status, identification of instrument, date of calibration, and next calibration. Accuracy of the measurement method: High Responsible person/entity that should undertake the measurements: Extraction plant's metric analyst.
Monitoring frequency:	Hourly
QA/QC procedures:	The maintenance, frequency of calibration and control procedures programming for the electricity meter are established by the plant QA/QC department. Calibration and maintenance are subject to procedures established by instrument manufacturer.
Any comment:	This PDD only seeks CDM Accreditation for Technology Option I, the implementation of new covered anaerobic digesters to capture and mitigate the biogas. After registration and implementation of the project activity, if and only if Technology Option I is technically successful and the incomes from CER sales are sufficient to support further investments in cogeneration of renewable energy, then the Project Participants will either present a second PDD (or request permission to modify this one if that is permitted by CDM regs) and present in very specific terms the individual technology packages which will have been chosen by each of the 32 participating plants for generation of renewable energy. This PDD will includes complete references to Technology Options II and III, in order to represent the additionality and the incremental financial decision-making process in the most transparent and historically correct manner. The "Tool to calculate the emissions factor for an electricity system" will be used in order to determine the amount of electricity displaced from the grid by the project activity. Equation 9 of the tool utilizes EGpj,h to calculate the grid emissions factor

	(EFgrid,OM-DD,y). The grid emissions factor calculated by means of the tool will be used once the project activity becomes operational. The calculation of the grid emissions factor will follow Dispatch Data OM analyses procedure. The data will be archived minimum two years after each issuance of CERs

Data / Parameter:	**D8 / $EG_{d,y}$**
Data unit:	kWh
Description:	--Amount of electricity generated using biogas collected during project activity and exported to the grid during the year --Activity Level: Electricity Use.
Source of data used:	Measurement
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied:	Equipment used: Electricity meter. Accuracy of the measurement method: High Responsible person/entity that should undertake the measurements: Extraction plant's metric analyst.
Any comment:	So far, none of the project participants have expressed interest in generating power to feed into the grid. According to the pre-feasibility study performed by CAEMA, the investment required for feeding electricity is high. On the other hand, prices paid to power producers for delivering electricity to the grid (US$0.02) are not attractive to investors. Therefore, IRR is negative. Due to the amount of biomass residues and the availability of biogas from lagoons, recent developments in this project have shown to project participants the benefits of reducing electricity costs by producing power in-site. If conditions change in the future, producers may elect to sell excess electricity into the grid. Hence, in future verifications this parameter may be recalculated and evaluated according to the monitoring reports on electricity fed into the grid by project participants. This PDD only seeks CDM Accreditation for Technology Option I, the implementation of new covered anaerobic digesters to capture and mitigate the biogas. After registration and implementation of the project activity, if and only if Technology Option I is technically successful and the incomes from CER sales are sufficient to support further investments in cogeneration of renewable energy, then the Project Participants will either present a second PDD (or request permission to modify this one if that is permitted by CDM regs) and present in very specific terms the individual technology packages which will have been chosen by each of the 32 participating plants for generation of renewable energy. This PDD will includes complete references to Technology Options II and III, in order to represent the additionality and the incremental financial decision-making process in the most transparent and historically correct manner.

Data / Parameter:	**CEF_{grid}**
Data unit:	tCO2e/MWh
Description:	--CO2 emissions factor for the grid where electricity is exported --Activity Level: Electricity Use.

Source of data used:	Calculation
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied:	Equipment used: Accuracy of the measurement method: High Responsible person/entity that should undertake the measurements: National Dispatch Center
Any comment:	This PDD only seeks CDM Accreditation for Technology Option I, the implementation of new covered anaerobic digesters to capture and mitigate the biogas. After registration and implementation of the project activity, if and only if Technology Option I is technically successful and the incomes from CER sales are sufficient to support further investments in cogeneration of renewable energy, then the Project Participants will either present a second PDD (or request permission to modify this one if that is permitted by CDM regs) and present in very specific terms the individual technology packages which will have been chosen by each of the 32 participating plants for generation of renewable energy. This PDD will includes complete references to Technology Options II and III, in order to represent the additionality and the incremental financial decision-making process in the most transparent and historically correct manner. So far, none of the project participants have expressed interest in generating power to feed into the grid. According to the pre-feasibility study performed by CAEMA, the investment required for feeding electricity is high. On the other hand, prices paid to power producers for delivering electricity to the grid (US$0.02) are not attractive to investors. Therefore, IRR is negative. Due to the amount of biomass residues and the availability of biogas from lagoons, recent developments in this project have shown to project participants the benefits of reducing electricity costs by producing power in-site. If conditions change in the future, producers may elect to sell excess electricity into the grid. Hence, in future verifications this parameter may be recalculated and evaluated according to the monitoring reports on electricity fed into the grid by project participants.

Data / Parameter:	**$CEF_{BI,elec,y}$**
Data unit:	**tCO2e/MWh**
Description:	--CO2 emissions factor for electricity consumed at the project site in the absence of the project activity --Activity Level: electricity use
Source of data used:	Calculation
Value applied:	0.2766
Justification of the choice of data or description of measurement methods and procedures actually applied:	Equipment used: Accuracy of the measurement method: High Responsible person/entity that should undertake the measurements: National Dispatch Center
Any comment:	The attached file named “factor de emisiones.xls” contains the support for the Emissions factor calculation. This calculation was performed according to

	ACM0002 v.6. The calculation performed in the attached file is only for demonstrative purposes related to the present PDD. $CEF_{Bl,elec,y}$ will be calculated ex-post in a yearly basis during the whole crediting period.

Data / Parameter:	**D9/$HG_{bl,y}$**
Data unit:	MJ
Description:	Quantity of thermal energy that would be consumed in year y at the project site in the absence of the project activity using fossil fuel Activity level: Thermal Consumption.
Source of data to be used:	Measurement of the fuel used.
Value applied	0
Description of measurement methods and procedures to be applied:	Equipment used: How the measurement is undertaken: Calibration procedures are applied: Accuracy of the measurement method: Responsible person/entity that should undertake the measurements: Measurement interval:
Any comment:	Once the project activity is in place, D9 will be measured by the same instrument used in D13 following the same measurement methode and the same quality assurance as described as in D13.

Data / Parameter:	$EG_{m,y}$, EG_y, $EG_{j,y}$, $EG_{k,y}$ and $EG_{n,h}$
Data unit:	MWh
Description:	Net electricity generated and delivered to the grid by power plant / unit m, j, k or n (or in the project electricity system in case of EG_y) in year y or hour h
Source of data:	Utility or government records or official publications. In the Colombian case XM is the information office of the National Dispatch Centre (www.xm.com.co).
Measurement procedures (if any):	Standard procedures required by the National Government to each plant delivering electricity to the grid, as the basis for billing.
Monitoring frequency:	Since this Project activity uses Dispatch data OM for calculation of CEF, the monitoring frequency will be at least on an hourly basis. Build Margin: For the first crediting period, reported annually ex-post, following the guidance included in step 4. For the second and third crediting period, only once ex-ante at the start of the second crediting period, unless otherwise indicated by new regs.
QA/QC procedures:	This is official data provided by the National Dispatch Centre, which assures quality of data.
Any comment:	This PDD only seeks CDM Accreditation for Technology Option I, the implementation of new covered anaerobic digesters to capture and mitigate the biogas. After registration and implementation of the project activity, if and only if Technology Option I is technically successful and the incomes from CER sales are

	sufficient to support further investments in cogeneration of renewable energy, then the Project Participants will either present a second PDD (or request permission to modify this one if that is permitted by CDM regs) and present in very specific terms the individual technology packages which will have been chosen by each of the 32 participating plants for generation of renewable energy. This PDD will includes complete references to Technology Options II and III, in order to represent the additionality and the incremental financial decision-making process in the most transparent and historically correct manner.

Data / Parameter:	$HR_{i,y}$
Data unit:	MBTU/MWh
Description:	Efficiency of plant i in transforming Heat into Electricity during year y
Source of data:	Yearly data report by each plant i to the Colombian Ministry of Mines and Energy, to the Mining and Energy Planning Office (UPME – Unidad de Planeción Minero Energética), and to the Commission that Controls Gas and Energy Use in Colombia (CREG – Comisión Reguladora de Energía y Gas). This information is published yearly by CREG.
Measurement procedures (if any):	-
Monitoring frequency:	Dispatch data OM: Reported <u>annually</u> for the year y in which the project activity is displacing grid electricity. Build Margin: For the first crediting period, annually ex-post, following the guidance included in step 4. For the second and third crediting period, only once ex-ante at the start of the second crediting period, , unless otherwise indicated by new regs.
QA/QC procedures:	Uses official data of high quality.
Any comment:	Follows step 2b of the "Tool to Calculate the Emission Factor for an Electricity System" using Dispatch Data Analysis, and according to the Colombian Guidelines to Calculate Hourly Averages to Determine the Emissions Factor Following ACM0002 in Large Scale Projects (http://www.upme.gov.co/siame/Default.aspx?tabid=67). Since in Colombia plants delivering electricity to the grid are obliged to report the plant's Heat Rate in a yearly basis, the calculation of $FE_{EL,n,y}$ follows B1 option of calculation where $FC_{i,m,y}*NCV_{i,y}$ is replaced by $HR_{i,m,y}*EG_{n,h}$. This PDD only seeks CDM Accreditation for Technology Option I, the implementation of new covered anaerobic digesters to capture and mitigate the biogas. After registration and implementation of the project activity, if and only if Technology Option I is technically successful and the incomes from CER sales are sufficient to support further investments in cogeneration of renewable energy, then the Project Participants will either present a second PDD (or request permission to modify this one if that is permitted by CDM regs) and present in very specific terms the individual technology packages which will have been chosen by each of the 32 participating plants for generation of renewable energy. This PDD will includes complete references to Technology Options II and III, in order to represent the additionality and the incremental financial decision-making process in the most transparent and historically correct manner.

Data / Parameter:	$EF_{CO2,i,y}$ and $EF_{CO2,m,i,y}$
Data unit:	tCO_2/GJ

Description:	CO_2emission factor of fossil fuel type in year y
Source of data:	National average presented by UPME in the FECOC (Emissions factor for Colombian Fuels) software available at http://www.upme.gov.co/siame/Portals/0/FECOCupme.xls
Measurement procedures (if any):	-
Monitoring frequency:	Dispatch data OM: Reported Annually for the year y in which the project activity is displacing grid electricity or, if available, hourly. BM: For the first crediting period, annually ex-post, following the guidance included in step 4 of the "Tool to Calculate the Emission Factor for an Electricity System". For the second and third crediting period, only once ex-ante at the start of the second crediting period, unless otherwise indicated by new regs..
QA/QC procedures:	Offical data of high quality is used.
Any comment:	-

Data / Parameter:	**D10 / F_{dig_out}**
Data unit:	m^3/year
Description:	--flow rate of organic wastewater into the digester --Activity Level: Open Lagoon
Source of data used:	Measurement for POME systems performed for calculating the Baseline Emissions
Value applied:	See Table An 3.1 in Annex 3.
Justification of the choice of data or description of measurement methods and procedures actually applied:	Equipment used: Standard On-Site flow rate measurement Accuracy of the measurement method: High Responsible person/entity that should undertake the measurements: Extraction plant's metric analyst.
Any comment:	For calculating the flow rate after project implementation, the same information used to calculate baseline emissions was used to estimate $\mathbf{F}_{dig\_out}$.

Data / Parameter:	**D11 / COD_{c,dig_out}**
Data unit:	kg/m^3
Description:	--COD Concentrations in discharged effluent from digester to estimate CH_4 emissions in the project case. --Activity Level: Anaerobic Digester
Source of data used:	Measurements for POME systems performed for calculating the Baseline Emissions
Value applied:	See Table An 3.8 in Annex 3.
Justification of the choice of data or description of measurement methods and procedures actually applied:	Equipment used: Standard COD measurement in laboratories Accuracy of the measurement method: High Responsible person/entity that should undertake the measurements: External laboratory in charge of certifying organic loads to watersheds based upon environmental authorities' requirements
Any comment:	Current POMEs systems afford a COD removal efficiency ranging between 87-99.8%. It is expected that the modifications to be implemented to turn the lagoon

	systems into anaerobic digesters will significantly improve WWT efficiencies throughout participating plants, as efficiency is the source of methane and CERs.

Data / Parameter:	**D12 / $EL_{p,y}$**
Data unit:	MWh
Description:	--Amount of electricity in the year y that is consumed at the project site for the project activity --Activity Level: Electricity Use.
Source of data used:	Estimates based upon each mill three years average (2003-2005) electricity use.
Value applied:	See Table An 3.9 in Annex 3.
Justification of the choice of data or description of measurement methods and procedures actually applied:	Equipment used: Energy meter. Accuracy of the measurement method: High Responsible person/entity that should undertake the measurements: Extraction plant's metric analyst.
Any comment:	It is expected that electricity use will increase no more than 1% due to blowers and monitoring systems incorporated in the project activity at each mill. Table An 3.9 presents information on electricity consumption after project implementation.

Data / Parameter:	**CEF_d**
Data unit:	tCO2e/MWh
Description:	--CO2 emissions factor for electricity consumed at the project site during the project activity --Activity Level: Electricity Use.
Source of data used:	Calculation
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied:	Equipment used: Accuracy of the measurement method: High Responsible person/entity that should undertake the measurements: National Dispatch Center
Any comment:	Annually, the methodology requires that the latest national grid emissions factor be calculated and applied in the monitoring report. Therefore, this parameter will be recalculated with the procedure to calculate the CO2 emissions factor according to ACM0002, latest version.

Data / Parameter:	**D13/$HG_{Pr,y}$**
Data unit:	MJ
Description:	Quantity of thermal energy consumed in year y at the project site due to the project activity. Activity level: Thermal Consumption.
Source of data to be used:	
Value applied	0

Description of measurement methods and procedures to be applied:	Equipment used: How the measurement is undertaken: Calibration procedures are applied: Accuracy of the measurement method: Responsible person/entity that should undertake the measurements: Measurement interval:
Any comment:	None of the project participants use fossil fuels for thermal energy production purposes in the baseline nor will they use fossil fuels during the project activity for thermal energy production purposes. Since the heating generation equipment uses environmentally sustainable biomass as fuel, the combustion process results in zero CO_2 emissions. The CO2 emissions of the combustion process will be consumed by growing biomass representing a cyclic process of carbon sequestration. For this reason, this variable will not be included in the monitoring procedure.

Data / Parameter:	**$CEF_{Pr,therm,y}$**
Data unit:	tCO2e/MJ
Description:	CO2 emissions intensity for thermal energy generation Activity level: Thermal Consumption.
Source of data to be used:	Mills information
Value applied	0
Description of measurement methods and procedures to be applied:	Equipment used: How the measurement is undertaken: Calibration procedures are applied: Accuracy of the measurement method: Responsible person/entity that should undertake the measurements: Measurement interval:
Any comment:	No fossil fuels will be used for thermal energy production. Since the heating generation equipment uses environmentally sustainable biomass as fuel, the combustion process results in zero CO_2 emissions. The CO2 emissions of the combustion process will be consumed by growing biomass representing a cyclic process of carbon sequestration. For this reason, this variable will not be included in the monitoring procedure.

Data / Parameter:	**D14 / F_{la}**
Data unit:	m^3/year
Description:	Flow rate of sludge used for land application after dewatering Activity level: Land application
Source of data to be	Compiled information from the prefeasibility study performed prior to starting this

used:	project activity
Value applied	See Table An 3.10 in annex 3
Description of measurement methods and procedures to be applied:	Equipment used: Weight measurement of inputs and outputs on each stream of the palm oil production How the measurement is undertaken: Mass balance on the streams entering and leaving each process to produce palm oil Calibration procedures are applied: Accuracy of the measurement method: Based in calculation performed by project participants using a load of 10 tons of fresh fuit bunches. Responsible person/entity that should undertake the measurements: Extraction plant's metric analyst. Measurement interval:
Any comment:	The F_{la} estimate was calculated based upon the average mass balance calculation performed in the prefeasibility study prior to the elaboration of this project design document for a typical palm oil extraction plant. The mass balance was performed by weighting the input and output streams to each process needed to produce palm oil. Since the streams were measured in kg and the effluent/sludge has a humidity higher than 80%, the density of the effluent is assumed to be 1000 kg/m3. Under the current definition of the project activity, all project participants agree that all the sludge leaving the digester will be directed to land application at the palm growing fields. There will be removal of water from the sludge (dewatering) before transport. F_{la} estimates will be confirmed by means of the monitoring report to be presented in the verification of this project activity.

Data / Parameter:	**D15 / $COD_{c,la}$**
Data unit:	kg/m^3
Description:	COD of the sludge used for land application after dewatering Activity level: Land application
Source of data to be used:	Information from project participants
Value applied	See Table An 3.11 in annex 3
Description of measurement methods and procedures to be applied:	Equipment used: How the measurement is undertaken: Calibration procedures are applied: Accuracy of the measurement method: Responsible person/entity that should undertake the measurements: Extraction plant's metric analyst. Measurement interval: Monthly
Any comment:	The $COD_{c,la}$ estimate was calculated based upon COD inputs presented in the baseline emissions calculation. The COD remaining in the sludge, during the project activity, is estimated as the residual COD after subtracting that which is transformed into methane emissions by bacterial activity and that which is discharged in the residual waste water. Under the current definition of the project activity, all project participants agree that all sludge will be directed to land application at the palm growing fields. Removal of excess wastewater from the sludge (dewatering) will occur before transport. Ex ante

	$COD_{c,la}$ estimates will be replaced by direct measurement in the monitoring reports to be presented in the verifications of this project activity.

Data / Parameter:	**MCF_{la}**
Data unit:	tCO2e/kg
Description:	Methane conversion factor for sludge used for land application Activity level: Land Application
Source of data to be used:	AM0013 v.4 p.12
Value applied	0.05
Description of measurement methods and procedures to be applied:	Equipment used: How the measurement is undertaken: Calibration procedures are applied: Accuracy of the measurement method: Responsible person/entity that should undertake the measurements: Measurement interval:
Any comment:	AM0013 v.4 provides the MCF_{la} factor to calculate methane emissions from sludge. Once the project starts operations, the sludge will be removed continuously. For this calculation, it is assumed that the sludge is removed monthly. The amount of COD available in the sludge was calculated by means of information from the COD removed from open lagoons. According to the 2006 Guidelines for National Greenhouse Gas Inventories (volume 6, chapter 6, p. 6.21, table 6.8) the MCF at the inside of the anaerobic digester for sludge is higher than the MCF in open lagoons (anaerobic shallow lagoons) due to the anaerobic digester conversion efficiency. For this calculation it was assumed that MCF from open lagoons accounts for half of the MCF at the inside of the anaerobic digester. Thus in the calculation for COD available for conversion into methane in the sludge leaving the digester, it was used the MCF calculated for open lagoons multiplied by 2 (the efficiency in the anaerobic digester.). Ex ante MCF_{la} estimates will be replaced by direct measurement in the monitoring reports to be presented in the verifications of this project activity.

Data / Parameter:	**D16 / $F_{c,dw}$**
Data unit:	m^3/year
Description:	Flow rate of organic wastewater from the dewatering process Activity level: Land application
Source of data to be used:	
Value applied	0
Description of measurement methods and procedures to be	Equipment used: How the measurement is undertaken: Calibration procedures are applied:

applied:	Accuracy of the measurement method: Responsible person/entity that should undertake the measurements: Measurement interval:
Any comment:	Under the current definition of the project activity, all project participants agree that all the sludge leaving the digester will be directed to land application at the palm growing fields. Therefore, there will not be removal of wastewater from the sludge (dewatering). Ex ante $F_{c,dw}$ estimates will be replaced by direct measurement in the monitoring reports to be presented in the verifications of this project activity.

Data / Parameter:	**D17 / $COD_{c,dw}$**
Data unit:	kg/m^3
Description:	COD of the wastewater from the dewatering process Activity level: Land application
Source of data to be used:	
Value applied	0
Description of measurement methods and procedures to be applied:	Equipment used: How the measurement is undertaken: Calibration procedures are applied: Accuracy of the measurement method: Responsible person/entity that should undertake the measurements: Measurement interval:
Any comment:	Under the current definition of the project activity, all project participants agree that all sludge will be directed to land application at the palm growing fields. Ex ante $COD_{c,dw}$ estimates will be replaced by direct measurement in the monitoring reports to be presented in the verifications of this project activity.

Data / Parameter:	**D18 / FR_{bio}**	
Data unit:	m^3/yr	
Description:	--Amount of Biogas collected at the outlet of the biodigester using the continuous flow meter. --Activity Level: Covered Anaerobic Digester.	
Source of data used:	See Methane emissions from each mill lagoon WWT system in table An 3.12 in Annex 3.	
Value applied:	63,953,906.88 cubic meters of biogas per year, the total expected from the 32 plants participating in the project.	
Justification of the choice of data or description of measurement methods and procedures actually applied:	Equipment used:	Calculations based upon methane conversion factors from the baseline information
	How the measurement is undertaken:	Once the Project activity is implemented the biogas flowrate will be measured by means of a high accuracy biogas flowmeter.

	Accuracy of the measurement method: Responsible person/entity that should undertake the measurements:	Based upon baseline information
Any comment:	Methane emission calculations are based on the 2006 survey to each mill. Information is based upon 2005 registries. The biogas flow rate was calculated considering the methane generation from all mills based upon 2005 production registries and average biogas composition as per D19. Methane conversion factors to obtain methane emission from lagoons were those required in AM0013 v.4. Ex-ante FR_{bio} estimates will be replaced by direct measurement in the monitoring report to be presented in the verification of this project activity	

Data / Parameter:	**D19/$P_{CH4,bio}$**
Data unit:	%
Description:	Percentage of methane in the biogas, located in the outlet of the covered anaerobic digester. Activity level: covered anaerobic digester.
Source of data to be used:	Methane contents of the biogas collected from the digester in the pilot project carried out by FEDEPALMA and included in the Prefeasibility study, from laboratory measurements by the National University and Sucromiles Labs, chapter III, pg 6.
Value applied:	0.5
Justification of the choice of data or description of measurement methods and procedures actually applied:	Equipment used: How the measurement is undertaken: Accuracy of the measurement method: Responsible person/entity that should undertake the measurements: Measurement interval:
Any comment:	Laboratory measurements by the National University and Sucromiles Labs found a methane content of 59% in the biogas. For conservativeness, this analysis uses a methane content factor of 50%.

Data / Parameter:	**D20 / $FR_{f,inlet}$ ($FV_{RG,h}$ in the** "*tool to determine project emissions from flaring gases containing methane*"**)**
Data unit:	m^3/yr
Description:	--Flow rate of biogas entering the flare --Activity Level: Flaring System
Source of data used:	See table An 3.12 in Annex 3
Value applied:	41,302,076.2
Justification of the choice of data or description of measurement methods and procedures actually	Equipment used: How the measurement is undertaken: Accuracy of the measurement method:

applied:	Responsible person/entity that should undertake the measurements:
Any comment:	This estimation is the ex ante estimation of biogas to be flared. Each project participant will have two uses for the biogas collected from the digester: 1. Generattion of heat or power, in hours when the mill is operating; and, 2. Flaring the biogas, when the mill is not operating. On average, project participants operate during 16 hours per day, from Monday to Saturday. Not operating days are either Sundays and holidays. In the file named “Emission Factor.xls”, not working hours are presented in the calculation performed for the Fedepalma’s electricity consumption table. For the whole bundled project two factors were defined to further calculate the flow rates to each use: a. percentage of working hours when the biogas is used to generate electricity or heat: 54% b. percentage of the time when the plant is not operating and the biogas is flared at the flaring system: 46%. Since some of the project participants are evaluating the possibility to incorporate a biogas storage tank in order to collect the biogas produced when the plant is not operating, the former time estimates will be replaced by direct measurement in the monitoring report to be presented in the verification of this project activity. In order to calculate ex-ante the amount of biogas diverted to the flaring system, the total biogas flow rate is multiplied by 0.46. Ex-ante $FR_{f,inlet}$ estimates will be replaced by direct measurement in the monitoring report to be presented in the verification of this project activity.

Data / Parameter:	**D21.5 /TVn,FG,h**
Data unit:	m^3/h
Description:	Volumetric Flow rate of the enclosed high efficiency flare stack gases in a dry basis at normal conditions in the hour h. Activity level: flaring
Source of data to be used:	Field Measurement, automated
Value of data applied for the purpose of calculating expected emission reductions in section B.5	High
Description of measurement methods and procedures to be applied:	Equipment that will be used: Flow meter for stack emissions with indicator, transmitter and communication. How the measurement is undertaken: The instrument will be located at the output stack of the flare. It will measure the flow and transmit the information to a local database using an industrial communication method. Calibration procedures are applied: The calibration procedures will be made in laboratory accredited by international Standards according to indications of the manufacturer. The calibration laboratory should give a Certificate of Calibration specifying the status, identification of instrument, date of calibration, and next calibration. Accuracy of the measurement method: High

	Responsible person/entity that should undertake the measurements: Measurement interval:	Extraction Plant metric analyst. Continuously
QA/QC procedures to be applied:	The uncertainty level of data is low. The instrument will generate an alarm indicating when a detectable failure is in progress. The maintenance, frequency of calibration and control procedures programming are established by the plant QA/QC department. Calibration and maintenance are subject to procedures established by instrument manufacturer.	
Any comment:	Parameter monitored continuously but aggregated monthly for calculations. The data will be archived minimum two years after each issuance of CERs.	

Data / Parameter:	**D21 $PE_{flare,y}$**
Data unit:	tCO_{2e}
Description:	--Project emissions from flaring of the residual gas stream in year y --Activity Level: Flaring
Source of data used:	Calculations based upon baseline emissions information and following the "Tool to determine project emissions from flaring gases containing methane"
Value applied:	14,643.21
Justification of the choice of data or description of measurement methods and procedures actually applied:	Equipment used: How the measurement is undertaken: Accuracy of the measurement method: Responsible person/entity that should undertake the measurements:
Any comment:	See the file named "PE emissions simulation.xls" which contains the detailed procedure to calculate Project Emissions from the biogas diverted to the flaring system using the "Tool to determine project emissions from flaring gases containing methane" Ex-ante $PE_{flare,y}$ estimates will be replaced by direct measurement in the monitoring report to be presented in the verification of this project activity.

Data / Parameter:	**D21.1/$fv_{i,h}$**	
Data unit:	--	
Description:	Volumetric fraction of component i in the residual gas in the hour h where i = CH4 , CO, CO2 , O2 , H2 , N2 .	
Source of data to be used:	Measurements	
Value of data applied for the purpose of calculating expected emission reductions in section B.6	0.5	
Description of measurement methods	Equipment that will be used: How the measurement is undertaken:	Measurement using a gas analyser continuously Ensure that the same basis (dry or wet) is considered for this measurement and the measurement of the volumetric flow rate of the residual gas (FVRG,h) when the residual

and procedures to be applied:	Calibration procedures are applied: Accuracy of the measurement method: Responsible person/entity that should undertake the measurements:	gas temperature exceeds 60 ºC. Values to be averaged hourly or at a shorter time interval.
QA/QC procedures to be applied:	Analysers must be periodically calibrated according to the manufacturer's recommendation. A zero check and a typical value check should be performed by comparison with a standard certified gas.	
Any comment:	Data will be archived electronically, minimum for two years, after last issuance of CERs. Project participants may only measure the methane content of the residual gas leaving the biodigester. According to the "tool to determine methane emissions from flaring gases containing methane" it is allowed to consider the remaining fraction part as N2 . Therefore, composition of biogas leaving the biodigester is the same as the composition at the flaring system inlet, thus **D19/$P_{CH4,bio}$** and **D21.1/$fv_{i,h}$** values will be the same.	

Data / Parameter:	**D21.2/$T_{O2,h}$**	
Data unit:		
Description:	Volumetric fraction of O2 in the exhaust gas of the flare in the hour H	
Source of data to be used:	Field Measurement, automated with a continuous flow gas analyzer.	
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.062	
Description of measurement methods and procedures to be applied:	Equipment that will be used:	Continuous gas analyzer for biogas
	How the measurement is undertaken:	The instrument will be located at the output of the anaerobic digester. It will determine the percentage of methane and transmit the information to a local database using an industrial communication bus.
	Calibration procedures are applied:	The calibration procedures will be carried out in reference laboratories, according to specifications of the manufacturer. The calibration laboratory should give a Certificate of Calibration specifying the status, identification of instrument, date of calibration, and next calibration.
	Accuracy of the measurement method:	High
	Responsible person/entity that should undertake the measurements:	Extraction plant's metric analyst will ensure performance of the analyzer.
	Measurement interval:	Continuous.
QA/QC procedures to be applied:	The instrument will generate an alarm to the plant's metric analyst indicating when a detectable failure is in progress. The maintenance, frequency of calibration and control procedures programming are established by the plant QA/QC, per procedures and specifications established by instrument manufacturer.	

Any comment:	This data will not be measured as the default efficiency value of 90% will be taken for enclosed flares. the tool for determine methane emissions from flaring was use to calculate exhaust gases from electricity generator and heat generator. See files "EG Emissions simulation.xls" and "HG emissions simulation.xls". TO2h values for heat generation equipment and electricity generation equipent is taken from " Guidance for Monitoring Landfill Gas Engine Emissions"from UK Environment Agency (http://www.environment-agency.gov.uk/commondata/acrobat/engines2002.pdf). Using a default value of 0.05. Flare value is taken from manufacturer's specification in the file "specifications_enclosed.pdf". John Zink is the most plausible technology provider to provide the flaring systems to this project activity.

Data / Parameter:	**D21.4** / **T** flare
Data unit:	ºC
Description:	Temperature in the exhaust gas of the flare Activity level: flaring
Source of data to be used:	Measurements by project participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	High
Description of measurement methods and procedures to be applied:	Equipment that will be used: Thermocouple. How the measurement is undertaken: Calibration procedures are applied: Thermocouples should be replaced or calibrated every year. Accuracy of the measurement method: High Responsible person/entity that should undertake the measurements: Extraction plant metric analyst Measurement interval: Continuously.
QA/QC procedures to be applied:	Thermocouples should be replaced or calibrated every year.
Any comment:	The data will be archived minimum two years after each issuance of CERs. A temperature above 500 ºC indicates that a significant amount of gases are still being burnt and that the flare is operating. An excessively high temperature at the sampling point (above 700 ºC) may be an indication that the flare is not being adequately operated or that its capacity is not adequate to the actual flow. In cases where a 90% default flare efficiency is taken, the operating temperatures must be between 760ºC to 982 ºC, as specified by flare manufacturer.

Data / Parameter:	**D22 / $FR_{e,inlet}$**
Data unit:	m^3/yr
Description:	--Flow rate of the biogas entering the electricity generation equipment --Activity Level: Electricity Generation
Source of data used:	See table An 3.12 in Annex 3
Value applied:	27,161,462.1
Justification of the	Equipment used:

choice of data or description of measurement methods and procedures actually applied:	How the measurement is undertaken: Accuracy of the measurement method: Responsible person/entity that should undertake the measurements:
Any comment:	The total biogas collected from the digesters is used by project participants in operating hours for either electricity or heat generation. Table An 3.12 in Annex 3 presents the use of biogas per project participant. The yearly methane emissions of each project participant willing to implement power generation equipment are added to obtain the total project activity methane emissions diverted to power generation. The total biogas flow rate used for electricity generation is calculated by assuming 50% methane content in the biogas. Ex-ante $FR_{e,inlet}$ estimates will be replaced by direct measurement in the monitoring report to be presented in the verification of this project activity This PDD only seeks CDM Accreditation for Technology Option I, the implementation of new covered anaerobic digesters to capture and mitigate the biogas. After registration and implementation of the project activity, if and only if Technology Option I is technically successful and the incomes from CER sales are sufficient to support further investments in cogeneration of renewable energy, then the Project Participants will either present a second PDD (or request permission to modify this one if that is permitted by CDM regs) and present in very specific terms the individual technology packages which will have been chosen by each of the 32 participating plants for generation of renewable energy. This PDD will includes complete references to Technology Options II and III, in order to represent the additionality and the incremental financial decision-making process in the most transparent and historically correct manner.

Data / Parameter:	**D23 / $FR_{e,s}$**	
Data unit:	m^3/yr	
Description:	--Flow rate of the electricity generation equipment stack gases --Activity Level: Electricity Generation	
Source of data used:	See table An 3.12 and support file An 3.12 calcs.xls	
Value applied:	32,270,403.8	
Justification of the choice of data or description of measurement methods and procedures actually applied:	Equipment used:	Calculations taken from baseline information and applying the tool for emissions from flaring methane.
	How the measurement is undertaken:	Once the Project Activity is implemented, the flow rate of the electricity generation equipment stack gases will be measured by a flow meter
	Accuracy of the measurement method:	High
	Responsible person/entity that should undertake the measurements:	Enterprise designed metric analyst
Any comment:	$FR_{e,s}$ is calculated considering that the biogas outflow equals the biogas inflow times the addition of air needed for a complete methane combustion resulting in 5%	

	excess oxygen, as referred to in the file named " Guidance for Monitoring Landfill Gas Engine Emissions"from UK Environment Agency (http://www.environment-agency.gov.uk/commondata/acrobat/engines2002.pdf). It also adds the nitrogen content in the incoming air (79%). Ex-ante $FR_{e,s}$ estimates will be replaced by direct measurement in the monitoring report to be presented in the verification of this project activity This PDD only seeks CDM Accreditation for Technology Option I, the implementation of new covered anaerobic digesters to capture and mitigate the biogas. After registration and implementation of the project activity, if and only if Technology Option I is technically successful and the incomes from CER sales are sufficient to support further investments in cogeneration of renewable energy, then the Project Participants will either present a second PDD (or request permission to modify this one if that is permitted by CDM regs) and present in very specific terms the individual technology packages which will have been chosen by each of the 32 participating plants for generation of renewable energy. This PDD will includes complete references to Technology Options II and III, in order to represent the additionality and the incremental financial decision-making process in the most transparent and historically correct manner.

Data / Parameter:	**D24 / $P_{CH4,e,s}$**
Data unit:	%
Description:	--Methane content in stack gas of electricity generation equipment --Activity Level: Electricity Generation
Source of data used:	*tool to determine project emissions from flaring gases containing methane*
Value applied:	0.0064%
Justification of the choice of data or description of measurement methods and procedures actually applied:	Equipment used: How the measurement is undertaken: Calculations taken from the baseline information for this project activity. The "*tool to determine project emissions from flaring gases containing methane*" was used to determine PE from electricity generation. See support of calculation in the file "EG emissions simulation.xls". Accuracy of the measurement method: Responsible person/entity that should undertake the measurements:
Any comment:	**$P_{CH4,e,s}$** is calculated considering 5% O_2 content in the exhaust gas as standard reference value indicated in the document named " Guidance for Monitoring Landfill Gas Engine Emissions"from UK Environment Agency (http://www.environment-agency.gov.uk/commondata/acrobat/engines2002.pdf). According to manufacturer's specifications (Jenbacher), 99% of the methane is mitigated. Calculations taken from the baseline information for this project activity. The "*tool to determine project emissions from flaring gases containing methane*" was used to determine PE from electricity generation. See support of calculation in the file "EG emissions simulation.xls".

	Ex-ante $\mathbf{P}_{CH4,e,s}$ estimates will be replaced by direct measurement in the monitoring report to be presented in the verification of this project activity. This PDD only seeks CDM Accreditation for Technology Option I, the implementation of new covered anaerobic digesters to capture and mitigate the biogas. After registration and implementation of the project activity, if and only if Technology Option I is technically successful and the incomes from CER sales are sufficient to support further investments in cogeneration of renewable energy, then the Project Participants will either present a second PDD (or request permission to modify this one if that is permitted by CDM regs) and present in very specific terms the individual technology packages which will have been chosen by each of the 32 participating plants for generation of renewable energy. This PDD will includes complete references to Technology Options II and III, in order to represent the additionality and the incremental financial decision-making process in the most transparent and historically correct manner.

Data / Parameter:	**D25 $\mathbf{T}_{Comb,e}$**
Data unit:	Fraction
Description:	-- Fraction of time gas is combusted in the electricity generation equipment --Activity Level: Electricity Generation
Source of data used:	
Value applied:	---To be determined in the project activity by direct measurement.
Justification of the choice of data or description of measurement methods and procedures actually applied:	The fraction of time gas is combusted in the electricity generation equipment is monitored continuously. Data will be archived electronically, minimum for two years, after last issuance of CERs.
Any comment:	The manufacturer's operation and maintenance procedures for the electricity generation equipment will be followed. Value will be measured using a run time meter connected to a flame detector or a flame continuous temperature controller. Ex-ante $\mathbf{T}_{Comb,e}$ estimates will be replaced by direct measurement in the monitoring report to be presented in the verification of this project activity. This PDD only seeks CDM Accreditation for Technology Option I, the implementation of new covered anaerobic digesters to capture and mitigate the biogas. After registration and implementation of the project activity, if and only if Technology Option I is technically successful and the incomes from CER sales are sufficient to support further investments in cogeneration of renewable energy, then the Project Participants will either present a second PDD (or request permission to modify this one if that is permitted by CDM regs) and present in very specific terms the individual technology packages which will have been chosen by each of the 32 participating plants for generation of renewable energy. This PDD will includes complete references to Technology Options II and III, in order to represent the additionality and the incremental financial decision-making process in the most transparent and historically correct manner.

Data / Parameter:	**D26 / $\mathbf{FR}_{e,inlet}$**
Data unit:	m^3/yr
Description:	-- Flow rate of the biogas entering the heat generation equipment

	--Activity Level: Heat Generation
Source of data used:	See table An 3.12 in Annex 3
Value applied:	20,857,560.7
Justification of the choice of data or description of measurement methods and procedures actually applied:	Equipment used: How the measurement is undertaken: Accuracy of the measurement method: Responsible person/entity that should undertake the measurements:
Any comment:	The total biogas collected from the digester is used by project participants in operating hours for either electricity or heat generation. Table An 3.12 in Annex 3 presents the use of biogas per project participant and the project total. The yearly methane emissions of each project participant willing to implement heat generation equipment are added to obtain the total project activity methane emissions diverted to heat generation. The total biogas flow rate used to heat generation is calculated by assuming 50% methane content in the biogas. Ex-ante $FR_{e,inlet}$ estimates will be replaced by direct measurement in the monitoring report to be presented in the verification of this project activity
Data / Parameter:	**D27 / $FR_{h,s}$**
Data unit:	M^3/yr
Description:	-- Flow rate of the heat generation equipment stack gases --Activity Level: Heat Generation
Source of data used:	See table An 3.12 in Annex 3.
Value applied:	24,780,768.6
Justification of the choice of data or description of measurement methods and procedures actually applied:	Equipment used: Calculations based upon methane conversion factors from the baseline information. How the measurement is undertaken: Once the Project activity is implemented the biogas flowrate will be measured by means of a high accuracy flowmeter. Accuracy of the measurement method: High Responsible person/entity that should undertake the measurements:
Any comment:	$FR_{e,s}$ is calculated considering 5% O_2 content in the exhaust gas as standard reference value indicated in the document named " Guidance for Monitoring Landfill Gas Engine Emissions"from UK Environment Agency (http://www.environment-agency.gov.uk/commondata/acrobat/engines2002.pdf). It also adds the nitrogen content in the air (79%). Ex-ante $FR_{e,s}$ estimates will be replaced by direct measurement in the monitoring report to be presented in the verification of this project activity

Data / Parameter:	**D27.1 / T** Boiler
Data unit:	°C
Description:	Temperature of the exhaust gas of the boiler Activity level: Heat Generation

Source of data to be used:	Measurements by project participants	
Value of data applied for the purpose of calculating expected emission reductions in section B.5	High	
Description of measurement methods and procedures to be applied:	Equipment that will be used:	Thermocouple.
	How the measurement is undertaken:	
	Calibration procedures are applied:	Thermocouples should be replaced or calibrated every year.
	Accuracy of the measurement method:	High
	Responsible person/entity that should undertake the measurements:	Extraction plant metric analyst
	Measurement interval:	Continuously.
QA/QC procedures to be applied:	Thermocouples should be replaced or calibrated every year.	
Any comment:	The data will be archived minimum two years after each issuance of CERs. In cases where a 90% default flare efficiency is selected, the operating temperatures must be between 760°C to 982 °C, as specified by flare manufacturer. A temperature above 500 °C indicates that a significant amount of gases are still being burnt and that the flare is operating. An excessively high temperature at the sampling point (above 700 °C) may be an indication that the flare is not being adequately operated or that its capacity is not adequate to the actual flow.	

Data / Parameter:	**D27.2/$T_{O2,h}$**	
Data unit:		
Description:	Volumetric fraction of O2 in the exhaust gas of the boiler in the hour h	
Source of data to be used:	Field Measurement, automated with a continuous flow gas analyzer.	
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.062	
Description of measurement methods and procedures to be applied:	Equipment that will be used:	Continuous gas analyzer for biogas
	How the measurement is undertaken:	The instrument will be located at the output of the anaerobic digester. It will determine the percentage of methane and transmit the information to a local database using an industrial communication bus.
	Calibration procedures are applied:	The calibration procedures will be carried out in reference laboratories, according to specifications of the manufacturer. The calibration laboratory should give a Certificate of Calibration specifying the status, identification of instrument, date of calibration, and next calibration.

	Accuracy of the measurement method:	High
	Responsible person/entity that should undertake the measurements:	Extraction plant's metric analyst will ensure performance of the analyzer.
	Measurement interval:	Continuous.
QA/QC procedures to be applied:	The instrument will generate an alarm to the plant's metric analyst indicating when a detectable failure is in progress. The maintenance, frequency of calibration and control procedures programming are established by the plant QA/QC, per procedures and specifications established by instrument manufacturer.	
Any comment:	This data will not be measured as the default efficiency value of 90% will be taken for enclosed boilers. The tool for determining methane emissions from flaring was used to calculate exhaust gases from the electricity generator and the heat generator. See files "EG Emissions simulation.xls" and "HG emissions simulation.xls". $T_{O2,h}$ values for heat generation equipment and electricity generation equipent are taken from " Guidance for Monitoring Landfill Gas Engine Emissions"from UK Environment Agency (http://www.environment-agency.gov.uk/commondata/acrobat/engines2002.pdf). Using a default value of 0.05.	

Data / Parameter:	**D28/ $P_{CH4,e,s}$**	
Data unit:	%	
Description:	-- Methane content in stack gas of heat generation equipment --Activity Level: Heat Generation	
Source of data used:	*tool to determine project emissions from flaring gases containing methane*	
Value applied:	0.0036%	
Justification of the choice of data or description of measurement methods and procedures actually applied:	Equipment used:	
	How the measurement is undertaken:	Calculations taken from the baseline information for this project activity. The "*tool to determine project emissions from flaring gases containing methane*" was used to determine PE from electricity generation. See support of calculation in the file "HG emissions simulation.xls".
	Accuracy of the measurement method:	
	Responsible person/entity that should undertake the measurements:	
Any comment:	$P_{CH4,e,s}$ is calculated considering 5% O_2 content in the exhaust gas as standard reference value indicated in the document named " Guidance for Monitoring Landfill Gas Engine Emissions"from UK Environment Agency (http://www.environment-agency.gov.uk/commondata/acrobat/engines2002.pdf). Ex-ante $P_{CH4,e,s}$ estimates will be replaced by direct measurement in the monitoring report to be presented in the verification of this project activity.	

Data / Parameter:	**D29 / $T_{Comb,e}$**
Data unit:	Fraction
Description:	--Fraction of time gas is combusted in the heat generation equipment

	--Activity Level: Heat Generation
Source of data used:	
Value applied:	-- To be determined in the project activity by direct measurement.
Justification of the choice of data or description of measurement methods and procedures actually applied:	Equipment used: How the measurement is undertaken: The fraction of time gas is combusted in the heat generation equipment is monitored continuously. Data will be archived electronically, minimum for two years, after last issuance of CERs. Accuracy of the measurement method: Responsible person/entity that should undertake the measurements:
Any comment:	The manufacturer's operation and maintenance procedures for the heat generation equipment will be followed. Value will be measured using a run time meter connected to a flame detector or a flame continuous temperature controller. Ex-ante $\mathbf{T_{Comb,e}}$ estimates will be replaced by direct measurement in the monitoring report to be presented in the verification of this project activity.

Data / Parameter:	**D30/ $S_{,e}$**
Data unit:	Kg/year
Description:	Amount of sludge applied to land Activity level: Land application
Source of data to be used:	
Value applied	See Table An 3.10 in annex 3
Description of measurement methods and procedures to be applied:	Equipment used: Weight measurement of inputs and outputs on each stream of the palm oil production How the measurement is undertaken: Mass balance on the streams entering and leaving each process to produce palm oil Calibration procedures are applied: Accuracy of the measurement method: Based on calculations performed by project participants using a load of 10 tons of fresh fruit bunches.
Any comment:	The S_a estimate was calculated based upon the average mass balance calculation performed in the prefeasibility study prior to the elaboration of this project design document. The prefeasibility study was performed based upon a typical palm oil extraction plant. The mass balance was performed by weighting the input and output streams to each process needed to produce palm oil. Under the current definition of the project activity, all project participants agree that all the sludge leaving the digester will be directed to land application at the palm growing fields. Ex ante S_a estimates will be replaced by direct measurement in the monitoring reports to be presented in the verifications of this project activity.

Data / Parameter:	**D31 / NC**
Data unit:	Kg N/kg Sludge
Description:	Nitrogen content in the sludge Activity level: Land application
Source of data to be used:	Due to the similarity among the projects using AM0013, the value applied to this parameter was taken from the Chimporn Palm Oil project in validation by DNV.
Value applied	0.00159
Description of measurement methods and procedures to be applied:	Equipment used: How the measurement is undertaken: Calibration procedures are applied: Accuracy of the measurement method: Responsible person/entity that should undertake the measurements: Measurement interval:
Any comment:	Ex ante estimates will be replaced by direct measurement in the monitoring reports to be presented in the verifications of this project activity.

Data / Parameter:	**EF_{N2O}**
Data unit:	Kg N2O/kg N
Description:	Emission factor of nitrogen from sludge applied to land Activity level: Land application
Source of data to be used:	AM0013 v.4
Value applied	0.016
Description of measurement methods and procedures to be applied:	Equipment used: How the measurement is undertaken: Calibration procedures are applied: Accuracy of the measurement method: Responsible person/entity that should undertake the measurements: Measurement interval:
Any comment:	Emissions factor provided by AM0013.v4.

Data / Parameter:	**D32**
Data unit:	
Description:	Existence and enforcement of relevant regulations and incentives beyond the bounds of the project activity.
Source of data to be used:	Qualitative
Value of data applied for the purpose of calculating expected emission reductions in section B.5	
Description of measurement methods and	Yearly consultation with the Ministry of the Environment and Regional Environmental Authorities about changes in wastewater, effluents and sludge management regulations

procedures to be applied:	leading to enforce the project activity.
QA/QC procedures to be applied:	
Any comment:	The data will be archived minimum two years after each issuance of CERs.

B.7.2 Description of the monitoring plan:

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The monitoring methodology contemplates all the operative variables of the project activity that influence the emission of methane and other greenhouse gasses in a secure and automated fashion, taking into account the baseline methodology as well. This PDD limits the scope of this project activity to Technology Option I and its monitoring plan, but includes references to future implementation of Technology Options II and III in order to represent the decision making process in a historically correct and transparent fashion. This methodology includes the measurement and monitoring of the variables that affect and determine the baseline emissions of the lagoons and from electricity generation by diesel power plants or the interconnected grid. In the same manner, it permits transparent and effective monitoring of the project activity emissions. The system, which will be installed by all 32 participating plants, relies on continuous emissions monitoring for all relevant applications, with fully automated data gathering and storage, with parallel reporting to the plant owner, FEDEPALMA CDM project headquarters, the Andean Center, the DOE and in the future, to the CER buyers. Automated monitoring and reporting to multiple users permits transparency, quickly identifies breakdowns, and should facilitate yearly verification.

The monitoring methodology is represented schematically in figure 5, which presents the flow of waste waters in the corresponding parts of the project and the flows of biogas captured and used in the different electricity and heat generation systems, as applicable in the project activities Technology Options I, II and III described in the above sections.

The automated monitoring system at each extraction plant will interconnect to a sector-wide computer network that will permit the capture of the information flow from each instrument, in order to save it in relational databases, which will permit the digital archiving of the emissions data for any consultation or calculations of baseline emissions, project activity emissions, and estimation of CERs being generated. To ensure the continuity of the capture and registration of the data flows, thereby reducing the risks of data loss when maintenance or calibration is carried out on the instruments, monitoring redundancy will be applied. Key data flows will have double flow monitors.

The continuously gathered emissions monitoring data will be transferred to FEDEPALMA headquarters through a satellite connection to ensure data security. Other authorized stakeholders will access the information via access to a web page. The Bundled CDM project information will be managed by FEDEPALMA who will analyze the consolidated data for the 32 plants and use it to prepare the quarterly and yearly monitoring reports required for annual verification.

Figure 5. Monitoring Methodology – Diagram based on Approved Methodology AM0013 v.4

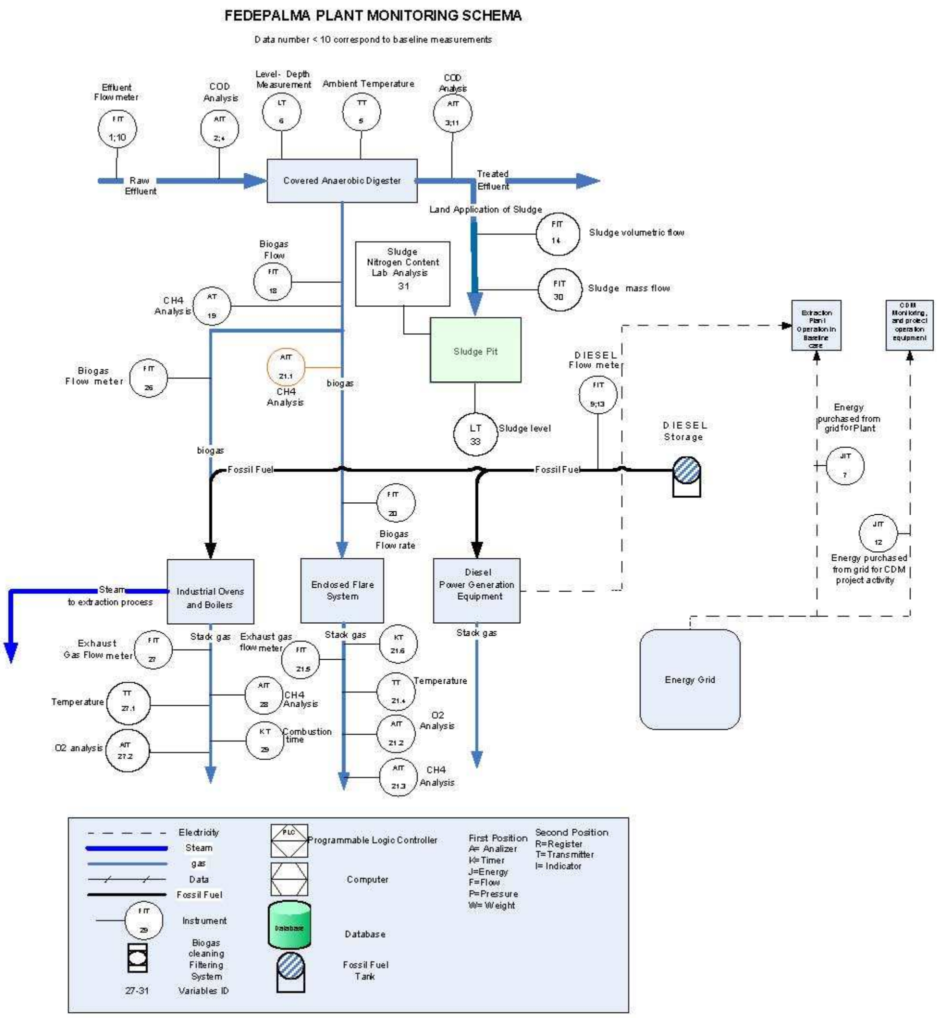
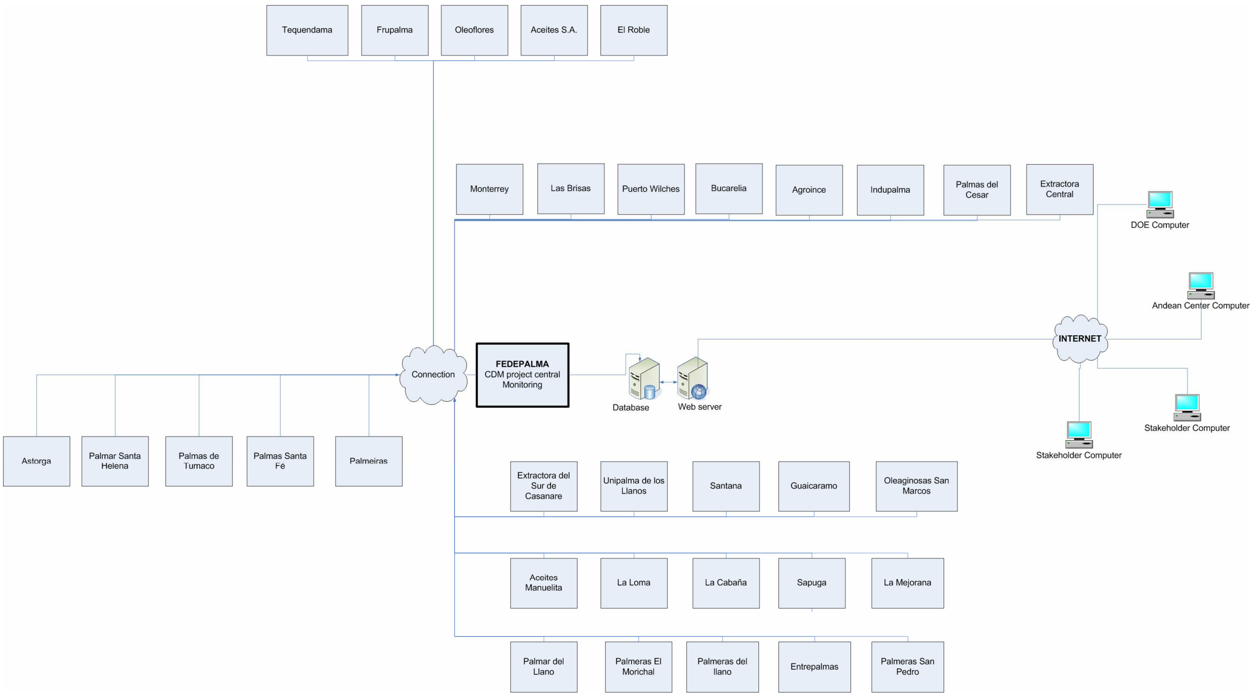


Figure 6. Monitoring Methodology – Diagram for Umbrella Project Monitoring Connection



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

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The baseline study was carried out by the Andean Center for Economics in the Environment and completed November 2006. Mr. Juan Carlos Caycedo led the baseline work and applied AM0013 v.4. Contact information: Tel. (57-1) 341 3477; email juanccaycedo@gmail.com; address K.3 No. 11-55, Int. 213, Bogotá, Colombia.

The Monitoring methodology was developed by Andean Center for Economics in the Environment. Mr. Yohanny Acosta led the work and applied the approved monitoring methodology from AM0013 v.4. Contact information: Tel. (57-1) 341 3477; email yohany.acosta@gmail.com; Address K.3 No. 11-55, Int. 213, Bogotá, Colombia.

The Andean Center for Economics in the Environment is a Project Participant.

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:

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January 1, 2009, or the date of registration, whichever occurs lates, is the expected date to begin construction of the project activity in the participating plants in the CDM umbrella project

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

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Thirty years.

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

C.2.1. Renewable crediting period

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

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01/09/2008 or the date of registration whichever occur later.

C.2.1.2. Length of the first crediting period:

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Seven years, twice renewable.

C.2.2. Fixed crediting period:

NOT APPLICABLE.

C.2.2.1. Starting date:

>>

C.2.2.2. Length:

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SECTION D. Environmental impacts

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CONSTRUCTION: The construction and implementation of the three CDM options are non-intrusive to the surrounding communities and do not negatively affect local environmental conditions. As such, the construction and implementation do not require environmental licenses or permits from the regional or national environmental authorities.

WASTE WATER QUALITY. As the production of biogas will become the main source of CER income and energy self-sufficiency, plants will work to maximize the efficiency of their wastewater treatment in the new anaerobic digesters, in order to optimize biogas production. This should result in substantial improvements in the quality of final water effluents. In addition, odors are eliminated by capturing, cleaning and burning the biogas. As such, the implementation and operation of biogas – capture and mitigation will produce net positive benefits locally and globally with regard to water effluents and to local and global emissions from waste water treatment.

LOCAL AND GLOBAL EMISSIONS. As biogas and biomass displace diesel and grid electricity, a number of collateral emissions will be displaced in addition to GHG, locally and globally. These include heavy and fine particulates, SO_2, NOx and CO among others. This elimination of fossil fuel emissions through the generation of renewable energy from biomass and biogas should improve the local environment in general, as well as workplace conditions. However, increased burning of residual fiber and residual nutshells in the cogeneration process which will occur in some of the plants may result in increased emissions of dark smoke, consisting of particulates, which may be controlled with new investments in technology such as Cyclones.

CONVERSION to RENEWABLE ENERGY: The impacts of converting 32 plants from fossil to renewable energy conserves natural resources and greatly improves the sustainability of palm oil production.
In conclusion, the environmental impacts of building, implementing and operating the project activity are positive.

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

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The environmental impact analysis of the project activity was carried out during the CDM pre-feasibility study of 2004. The entire analysis is available for review by the DOE and any other interested parties.

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:

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There are no negative environmental impacts from implementing the Project Activity. Regional environmental directors that closely regulate productive activity confirmed in writing that the plants involved in this project were in compliance with all environmental laws, regulations and rules. The Ministry of Environment confirmed to the same to the DOE.

SECTION E. Stakeholders' comments

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

>>

After all the participating extractor plants were consolidated in the CDM Project Bundle, the Palm Growers Association invited a wide range of stakeholders in the areas where the projects are located to presentations and in-depth discussions of the new CDM emissions reduction and renewable energy project. Stakeholders meetings included community representatives, municipal health and environment offices, regional environmental authorities, fishing associations, environmental NGOs, water service utility companies, community action committees, and universities, among others. Stakeholder consultations were held in each of the four major palm growing regions near the project activities. The new project activity was presented in detail, and stakeholders gave their opinions, comments and recommendations in writing. The project activity was strongly supported by the stakeholders at each of the four regional meetings. Complete documentation of the stakeholders invited, those that attended, the presentations, and their written comments on the project, are included in the project documentation and were reviewed by the DOE.

Stakeholder Consultation Regional Meetings		
Location	**Region**	**Date**
Tumaco, Nariño	Western	July 26, 2006
Villavicencio, Meta	Eastern	August 11, 2006
Puerto Wilches, Santander	Central	August 31, 2006
Aracataca, Magdalena	North	September 8, 2006

E.2. Summary of the comments received:

>>

No negative comments were received. All the stakeholders fully supported the new project, because of the environmental and social benefits which the project activity should produce.

SUMMARY OF COMMENTS AND RECOMMENDATIONS FROM STAKEHOLDER CONSULTATIONS FEDEPALMA CDM UMBRELLA PROJECT FOR METHANE CAPTURE, FOSSIL FUEL DISPLACEMENT AND COGENERATION OF RENEWABLE ENERGY. Results of 4 Stakeholder Consultation Processes: North, Central, Eastern, and Western Palm Oil Regions				
Number de written comments received: 68 stakeholders provided written comments.				
Stakeholder conclusions regarding the implementation of the new project activity:				
Positive	**Positive with comments**	**Negative**	**No response**	
64	3	0	1	
Importance of the Project's Objectives to Stakeholders:		**High**	**Medium**	**Low**
Modernization of the WWT systems		67	1	
Control of airborne emissions and water effluents		63	4	1
Displacing fossil fuels with renewable fuels		60	6	1
Stakeholder Recommendations to project participants:				
Continue with the same design and technologies as presented			41	
Modify or improve the design and technology			3	
No comment			24	
Do not implement the project			0	
Cogeneration plants should offer excess electricity to surrounding communities			12	
Participating plants should offer excess biogas to surrounding communities for cooking			1	

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

>>In response to requests for the participating plants to offer electricity from cogeneration and biogas from the anaerobic digesters to neighbouring communities, the plant operators have agreed to examine the surpluses of electricity and biogas they will have to offer, if any, once the new projects are fully operational.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	**FEDEPALMA, National Association of Palm Oil Producers**
Street/P.O.Box:	Carrera 10A No. 69A - 44.
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State/Region:	Cundinamarca
Country:	Colombia
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FAX:	Fax: 211 3508.
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URL:	**www.fedepalma.org**
Represented by:	Miguel Mazorra
Title:	Environmental Director
Salutation:	Dr.
Last Name:	Mazorra
Middle Name:	Angel
First Name:	Miguel
Department:	Environmental
Mobile:	
Direct FAX:	(57-1) 211 3508
Direct tel:	(57-1) 313-8600 ext. 5
Personal E-Mail:	mmazorra@fedepalma.org
Organization:	**Andean Center for Economics in the Environment**
Street/P.O.Box:	Carrera 3, Numero 11-55, Interior 213
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City:	Bogotá
State/Region:	Cundinamarca
Country:	Colombia
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URL:	www.andeancenter.com
Represented by:	Thomas Black-Arbeláez
Title:	Director
Salutation:	Dr.
Last Name:	Black-Arbeláez
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

NO PUBLIC FUNDING IS INVOLVED IN THIS PROJECT.

NO INTERNATIONAL ASSISTANCE MONEY IS INVOLVED IN THIS PROJECT.

Annex 3

BASELINE INFORMATION

Annex 3.1: Data gathering

To develop and quantify the baseline for the FEDEPALMA project bundle, the required data from the methodology AM0013 v.4 was obtained from each participating plant with the data gathering format presented below. Visits were carried out to each participating plant to corroborate the data and the existing baseline conditions. Then, the baseline for each plant was developed and calculated, applying the methodology. Finally, the baseline calculations were aggregated to produce the baseline for the project bundle, which was presented in section B of the PDD.

fedepalma

CAEMA

PROYECTO SOMBRILLA PARA LA CAPTURA DE BIOGAS, DESPLAZAMIENTO DE FUENTES FOSILES Y GENERACIÓN DE ENERGIA RENOVABLE

FORMULARIO DE CAPTURA DE INFORMACION FASE 1

1. DATOS GENERALES

Planta Extractora de Aceite de Palma:

Fecha: 22 - Jul - 2006

Nombre de la persona que diligencia la información:

Cargo:

2. PLANTA DE PRODUCCIÓN

Cuál es la capacidad de **producción actual** de la planta de extracción de **Aceite de Palma**?	Cuál será la capacidad de producción de extracción de **Aceite de Palma en 2014**?	Cual es la capacidad de **producción actual** de la Planta de **Palmiste**?	Cuál será la capacidad de producción de **Aceite de Palmiste en 2014**?
tn/hr	tn/hr	th/hr	tn/hr

Cual fue y será el peso de los **productos y subproductos** del proceso de extracción de Aceite (Fruta Fresca a procesar, producción de aceite de palma, palmiste, fibra y cuescos) estimados para los próximos años?

Año	tRFF/año (ton/año)	Horas Operación (hr/año)	tAPalma/año (ton/año)	tAPalmiste/año (ton/año)	tFibra/año (ton/año)	tCuescos/año (ton/año)

+ Agregar año

3. GENERACIÓN DE ENERGÍA

La empresa **planea generar electricidad** por medio del uso del Biogas que se generará?
- No
- Si

La empresa **planea Cogenerar** (electricidad y vapor) por medio del uso del biogas, la fibra y cuescos de nuez que se producirán en la empresa?
- No
- Si

Usa **Diesel para generar electricidad**?
- No
- Si

En qué cantidad la empresa usa **otras fuentes combustibles** promedio mensual? Consignar los consumos de cada uno de los combustibles utilizados a partir de enero de 2005. (Para añadir un nuevo mes haga click en ...)

Mes y año de la información		Tipo de combustible	cantidad de combustible	Unidad de medida
Ene	2005	Diesel		Galones
Ene	2005	Diesel		Galones

+ Agregar mes

Cual es la **potencia** de diseño de la(s) **plantas(s) de generación de electricidad**? (En caso de poseer más de una planta hacer click en Agregar planta y añadir una linea debajo de la anterior.)

Nr.	Potencia (kW)	Marca	modelo (Año)
1			
2			

+ Agregar planta

4. GENERACIÓN DE BIOGAS

Cual es el **tiempo de retención** en el sistema de lagunas actual?

hr.

Puede Ud. certificar, mediante documentos el tiempo de retención?

- No
- Si

Cuál es la **temperatura promedio mensual**?

Año	Mes	Temperatura (°C)

+ Agregar año

Cual es la **profundidad** de cada una de las lagunas?

Nr.	Tipo	Profundidad (m)
1		

Cuál es la carga orgánica producida mensualmente en las **laguna(s) acidogénica(s)** (o de enfriamiento o pretratamiento) a partir de enero de 2005. Por favor registre los datos de concentración y flujo de la empresa mes a mes desde enero de 2005. (Para añadir filas haga click en ...)

Fecha toma de muestras	Laguna Nr.	Concentrac.Entrada ($kgDQO/m^3$)	Flujo de entrada (m^3/h)	Concentrac.Salida ($kgDQO/m^3$)	Flujo de salida (m^3/h)
Año Mes: Día:	1				

Cuál es la carga orgánica producida mensualmente en la(s) **laguna(s) metanogénica(s)** a partir de enero de 2005. Por favor registre los los datos de concentración y flujo de la empresa mes a mes desde enero de 2005. (Para añadir filas haga click en ...)

Fecha toma de muestras	Laguna Nr.	Concentrac.Entrada ($kgDQO/m^3$)	Flujo de entrada (m^3/h)	Concentrac.Salida ($kgDQO/m^3$)	Flujo de salida (m^3/h)
Año Mes: Día:	1				

Cuál es la carga orgánica producida mensualmente en la(s) **laguna(s) facultativas(s)** a partir de enero de 2005. Por favor registre los los datos de concentración y flujo de la empresa mes a mes desde enero de 2005. (Para añadir filas haga click en ...)

Fecha toma de muestras	Laguna Nr.	Concentrac.Entrada ($kgDQO/m^3$)	Flujo de entrada (m^3/h)	Concentrac.Salida ($kgDQO/m^3$)	Flujo de salida (m^3/h)
Año Mes: Día:	1				

Cual es la carga orgánica del **agua que se envía a riego** mensualmente? Por favor registre los los datos de concentración y flujo de la empresa mes a mes desde enero de 2005. (Para añadir filas haga click en ...)

Fecha toma de muestras	Se envió agua a riego?	Concentrac. Agua Riego ($kgDQO/m^3$)	Flujo del agua a riego (m^3/h)
Año Mes: Día:	No Si		

Cuál es la carga orgánica del **lodo removido** de las lagunas de tratamiento?

Fecha en la que se removió el lodo	laguna de la que se removió el lodo	Peso del lodo húmedo removido (kg)	Tiempo de almacenamiento antes de ser secado (hr)	Tipo de secado	Peso del lodo seco (kg)	Carga orgánica del lodo (kg DQO/kg Lodo)
Año Mes: Día:						

Annex 3.2: Parameters available at validation:
Table An.3.1: Flow rate of organic wastewater into the digester

PLANTS		Flow Rate (l/s)	Flow rate (m3/y)
CENTRAL ZONE	AGROINCE LTDA & CIA S.C.A	8,6	50.657,5
	INDUPALMA S.A.	15,7	190.250,3
	PALMAS DEL CESAR S.A.	5,6	42.373,6
	OLEAGINOSAS LAS BRISAS S.A.	7,7	129.986,2
	PALMERAS DE PUERTO WILCHES S.A.	16,9	151.089,2
	PALMAS OLEAGINOSAS BUCARELIA S.A.	12,8	276.683,5
	EXTRACTORA CENTRAL	6,1	111.348,9
	EXTRACTORA MONTERREY S.A.	5,1	84.150,7
EASTERN ZONE	ACEITES MANUELITA S.A.	8,3	148.062,7
	PALMERAS SANTANA LTDA	2,1	33.407,8
	PALMERAS SAN PEDRO LTDA.	1,8	28.725,5
	SAPUGA S.A.	4,6	38.741,9
	EL PALMAR DEL LLANO S.A.	2,3	29.962,3
	PALMERAS EL MORICHAL LTDA	3,1	21.425,5
	OLEAGINOSAS SAN MARCOS LTDA	6,0	40.345,4
	INVERSIONES LA MEJORANA LTDA	4,8	26.044,3
	HACIENDA LA CABAÑA S.A.	3,4	41.310,2
	ENTREPALMAS S.A.	5,1	77.938,8
	GUAICARAMO S.A.	4,1	70.575,6
	EXTRACTORA DEL SUR DE CASANARE S.A.	7,9	125.090,7
	AGROPECUARIA LA LOMA LTDA	2,3	20.884,4
	PLANTACIONES UNIPALMA DE LOS LLANOS S.A.	6,0	75.233,2
NORTHERN ZONE	C.I. TEQUENDAMA S.A.	8,1	156.518,9
	C.I. EL ROBLE S.A.	3,1	38.780,2
	EXTRACTORA FRUPALMA S.A.	1,8	38.697,4
	ACEITES S.A.	8,5	102.729,7
	OLEOFLORES LTDA	3,6	57.867,2
WESTERN ZONE	PALMAS DE TUMACO S.A.	7,0	117.063,2
	PALMEIRAS S.A.	8,9	42.919,3
	PALMAR SANTA ELENA S.A.	2,2	55.171,7
	ASTORGA S.A.	3,7	44.607,2
	PALMAS SANTA FE S.A.	2,3	21.458,2

Table An.3.2: Concentracion of organic waste water

PLANTS		COD (mg/L)	COD (kg/m3)
CENTRAL ZONE	AGROINCE LTDA & CIA S.C.A	60.915	60,915
	INDUPALMA S.A.	43.425	43,425
	PALMAS DEL CESAR S.A.	79.917	79,917
	OLEAGINOSAS LAS BRISAS S.A.	33.275	33,275
	PALMERAS DE PUERTO WILCHES S.A.	40.975	40,975
	PALMAS OLEAGINOSAS BUCARELIA S.A.	43.875	43,875

PLANTS		COD (mg/L)	COD (kg/m3)
	EXTRACTORA CENTRAL	66.765	66,765
	EXTRACTORA MONTERREY S.A.	64.475	64,475
EASTERN ZONE	ACEITES MANUELITA S.A.	70.488	70,488
	PALMERAS SANTANA LTDA	44.176	44,176
	PALMERAS SAN PEDRO LTDA.	34.800	34,8
	SAPUGA S.A.	26.400	26,4
	EL PALMAR DEL LLANO S.A.	66.935	66,935
	PALMERAS EL MORICHAL LTDA	46.774	46,774
	OLEAGINOSAS SAN MARCOS LTDA	38.709	38,709
	INVERSIONES LA MEJORANA LTDA	45.161	45,161
	HACIENDA LA CABAÑA S.A.	59.680	59,68
	ENTREPALMAS S.A.	75.250	75,25
	GUAICARAMO S.A.	52.000	52
	EXTRACTORA DEL SUR DE CASANARE S.A.	74.852	74,852
	AGROPECUARIA LA LOMA LTDA	54.839	54,839
	PLANTACIONES UNIPALMA DE LOS LLANOS S.A.	43.651	43,651
NORTHERN ZONE	C.I. TEQUENDAMA S.A.	35.100	35,1
	C.I. EL ROBLE S.A.	86.333	86,3325
	EXTRACTORA FRUPALMA S.A.	59.306	59,3056
	ACEITES S.A.	75.788	75,7875
	OLEOFLORES LTDA	62.950	62,95
WESTERN ZONE	PALMAS DE TUMACO S.A.	52.736	52,736
	PALMEIRAS S.A.	80.750	80,75
	PALMAR SANTA ELENA S.A.	53.510	53,5104
	ASTORGA S.A.	52.113	52,1128
	PALMAS SANTA FE S.A.	72.569	72,569

Table An.3.3: COD that leaves the lagoon with the effluent

PLANTS		CODa,out (kg/y)
CENTRAL ZONE	AGROINCE LTDA & CIA S.C.A	67.222,9
	INDUPALMA S.A.	192.333,9
	PALMAS DEL CESAR S.A.	68.873,8
	OLEAGINOSAS LAS BRISAS S.A.	68.873,8
	PALMERAS DE PUERTO WILCHES S.A.	144.126,2
	PALMAS OLEAGINOSAS BUCARELIA S.A.	282.612,3
	EXTRACTORA CENTRAL	58.369,6
	EXTRACTORA MONTERREY S.A.	126.310,7
EASTERN ZONE	ACEITES MANUELITA S.A.	313.099,4
	PALMERAS SANTANA LTDA	73.791,2
	PALMERAS SAN PEDRO LTDA.	68.873,8
	SAPUGA S.A.	51.139,3
	EL PALMAR DEL LLANO S.A.	68.873,8
	PALMERAS EL MORICHAL LTDA	50.107,9
	OLEAGINOSAS SAN MARCOS LTDA	68.873,8
	INVERSIONES LA MEJORANA LTDA	58.809,4

PLANTS		CODa,out (kg/y)
	HACIENDA LA CABAÑA S.A.	68.873,8
	ENTREPALMAS S.A.	293.244,8
	GUAICARAMO S.A.	85.437,5
	EXTRACTORA DEL SUR DE CASANARE S.A.	217.981,4
	AGROPECUARIA LA LOMA LTDA	1.470,0
	PLANTACIONES UNIPALMA DE LOS LLANOS S.A.	68.873,8
NORTHERN ZONE	C.I. TEQUENDAMA S.A.	68.873,8
	C.I. EL ROBLE S.A.	100.439,7
	EXTRACTORA FRUPALMA S.A.	53.427,9
	ACEITES S.A.	181.252,6
	OLEOFLORES LTDA	68.873,8
WESTERN ZONE	PALMAS DE TUMACO S.A.	143.720,4
	PALMEIRAS S.A.	80.683,8
	PALMAR SANTA ELENA S.A.	68.873,8
	ASTORGA S.A.	164.171,4
	PALMAS SANTA FE S.A.	68.873,8

Table An.3.4: COD that enters the lagoon

PLANTS		COD (kg/y))
CENTRAL ZONE	AGROINCE LTDA & CIA S.C.A	3,085,798.64
	INDUPALMA S.A.	8,261,617.37
	PALMAS DEL CESAR S.A.	3,386,367.88
	OLEAGINOSAS LAS BRISAS S.A.	4,325,289.78
	PALMERAS DE PUERTO WILCHES S.A.	6,190,878.42
	PALMAS OLEAGINOSAS BUCARELIA S.A.	12,139,488.65
	EXTRACTORA CENTRAL	7.434.206,90
	EXTRACTORA MONTERREY S.A.	5,425,618.62
EASTERN ZONE	ACEITES MANUELITA S.A.	10,436,646.37
	PALMERAS SANTANA LTDA	1,475,823.85
	PALMERAS SAN PEDRO LTDA.	999,645.98
	SAPUGA S.A.	1,022,785.11
	EL PALMAR DEL LLANO S.A.	2,005,524.22
	PALMERAS EL MORICHAL LTDA	1,002,158.36
	OLEAGINOSAS SAN MARCOS LTDA	1,561,730.01
	INVERSIONES LA MEJORANA LTDA	1,176,187.21
	HACIENDA LA CABAÑA S.A.	2,465,394.44
	ENTREPALMAS S.A.	5,864,896.98
	GUAICARAMO S.A.	3,669,931.04
	EXTRACTORA DEL SUR DE CASANARE S.A.	9,363,291.60
	AGROPECUARIA LA LOMA LTDA	1,145,279.23
	PLANTACIONES UNIPALMA DE LOS LLANOS S.A.	3,284,004.39
NORTHERN ZONE	C.I. TEQUENDAMA S.A.	5,493,814.63
	C.I. EL ROBLE S.A.	3,347,990.21
	EXTRACTORA FRUPALMA S.A.	2,294,972.31
	ACEITES S.A.	7,785,624.59

PLANTS		COD (kg/y))
	OLEOFLORES LTDA	3,642,738.01
WESTERN ZONE	PALMAS DE TUMACO S.A.	6,173,443.97
	PALMEIRAS S.A.	3,465,735.54
	PALMAR SANTA ELENA S.A.	2,952,258.07
	ASTORGA S.A.	2,324,605.18
	PALMAS SANTA FE S.A.	1,557,201.48

Table An 3.5: Ambient Temperature at the Lagoons system (T_{lag})

PLANTS		T_{lag} (ºK)
CENTRAL ZONE	AGROINCE LTDA & CIA S.C.A	301.2
	INDUPALMA S.A.	301.2
	PALMAS DEL CESAR S.A.	301.2
	OLEAGINOSAS LAS BRISAS S.A.	302.9
	PALMERAS DE PUERTO WILCHES S.A.	301.2
	PALMAS OLEAGINOSAS BUCARELIA S.A.	303.2
	EXTRACTORA CENTRAL	301.2
	EXTRACTORA MONTERREY S.A.	301.2
EASTERN ZONE	ACEITES MANUELITA S.A.	299.2
	PALMERAS SANTANA LTDA	301.2
	PALMERAS SAN PEDRO LTDA.	299.2
	SAPUGA S.A.	298.4
	EL PALMAR DEL LLANO S.A.	300.8
	PALMERAS EL MORICHAL LTDA	301.2
	OLEAGINOSAS SAN MARCOS LTDA	303.8
	INVERSIONES LA MEJORANA LTDA	301.2
	HACIENDA LA CABAÑA S.A.	303.8
	ENTREPALMAS S.A.	301.7
	GUAICARAMO S.A.	303.8
	EXTRACTORA DEL SUR DE CASANARE S.A.	305.8
	AGROPECUARIA LA LOMA LTDA	300.4
	PLANTACIONES UNIPALMA DE LOS LLANOS S.A.	300.4
NORTHERN ZONE	C.I. TEQUENDAMA S.A.	307.2
	C.I. EL ROBLE S.A.	307.2
	EXTRACTORA FRUPALMA S.A.	307.2
	ACEITES S.A.	307.2
	OLEOFLORES LTDA	307.2
WESTERN ZONE	PALMAS DE TUMACO S.A.	299.8
	PALMEIRAS S.A.	304.5
	PALMAR SANTA ELENA S.A.	304.5
	ASTORGA S.A.	299.8
	PALMAS SANTA FE S.A.	299.1

Table An 3.6: Depth of the lagoon D_{lag}

PLANTS	D_{lag} (m)

CENTRAL ZONE	AGROINCE LTDA & CIA S.C.A	3.4
	INDUPALMA S.A.	2.5
	PALMAS DEL CESAR S.A.	3.1
	OLEAGINOSAS LAS BRISAS S.A.	3.0
	PALMERAS DE PUERTO WILCHES S.A.	2.1
	PALMAS OLEAGINOSAS BUCARELIA S.A.	2.5
	EXTRACTORA CENTRAL	3.0
	EXTRACTORA MONTERREY S.A.	1.4
EASTERN ZONE	ACEITES MANUELITA S.A.	2.8
	PALMERAS SANTANA LTDA	3.2
	PALMERAS SAN PEDRO LTDA.	2.6
	SAPUGA S.A.	3.5
	EL PALMAR DEL LLANO S.A.	2.2
	PALMERAS EL MORICHAL LTDA	2.1
	OLEAGINOSAS SAN MARCOS LTDA	2.4
	INVERSIONES LA MEJORANA LTDA	3.0
	HACIENDA LA CABAÑA S.A.	2.5
	ENTREPALMAS S.A.	2.7
	GUAICARAMO S.A.	2.3
	EXTRACTORA DEL SUR DE CASANARE S.A.	2.0
	AGROPECUARIA LA LOMA LTDA	3.4
	PLANTACIONES UNIPALMA DE LOS LLANOS S.A.	4.3
NORTHERN ZONE	C.I. TEQUENDAMA S.A.	3.3
	C.I. EL ROBLE S.A.	1.9
	EXTRACTORA FRUPALMA S.A.	1.5
	ACEITES S.A.	2.3
	OLEOFLORES LTDA	3.5
WESTERN ZONE	PALMAS DE TUMACO S.A.	1.9
	PALMEIRAS S.A.	3.3
	PALMAR SANTA ELENA S.A.	2.4
	ASTORGA S.A.	4.0
	PALMAS SANTA FE S.A.	1.6

Table An 3.7: *Amount of electricity in the year y that would be consumed at the project site in the absence of the project activity* ***EG_y (Three years average)***

FIRMS		Grid elecricity consuption MWh/y	On-site electricity production MWh/y
CENTRAL ZONE	AGROINCE LTDA & CIA S.C.A	962,9	45,8
	INDUPALMA S.A.	2.687,4	258,5
	PALMAS DEL CESAR S.A.	-	-
	OLEAGINOSAS LAS BRISAS S.A.	1.132,4	209,4

	PALMERAS DE PUERTO WILCHES S.A.	1.717,1	-
	PALMAS OLEAGINOSAS BUCARELIA S.A.	1.180,1	717,6
	EXTRACTORA CENTRAL	-	-
	EXTRACTORA MONTERREY S.A.	1.771,1	4,4
EASTERN ZONE	ACEITES MANUELITA S.A.	3.124,1	1.226,0
	PALMERAS SANTANA LTDA	465,9	-
	PALMERAS SAN PEDRO LTDA.	-	59,8
	SAPUGA S.A.	-	-
	EL PALMAR DEL LLANO S.A.	468,9	355,0
	PALMERAS EL MORICHAL LTDA	197,6	33,2
	OLEAGINOSAS SAN MARCOS LTDA	-	-
	INVERSIONES LA MEJORANA LTDA	74,9	419,9
	HACIENDA LA CABAÑA S.A.	2.196,1	35,3
	ENTREPALMAS S.A.	-	-
	GUAICARAMO S.A.	-	1.858,9
	EXTRACTORA DEL SUR DE CASANARE S.A.	-	2.615,8
	AGROPECUARIA LA LOMA LTDA	198,0	7,8
	PLANTACIONES UNIPALMA DE LOS LLANOS S.A.	1.115,2	842,7
NORTHERN ZONE	C.I. TEQUENDAMA S.A.	-	-
	C.I. EL ROBLE S.A.	1.127,6	528,6
	EXTRACTORA FRUPALMA S.A.	-	-
	ACEITES S.A.	-	-
	OLEOFLORES LTDA	4.254,0	149,6
WESTERN ZONE	PALMAS DE TUMACO S.A.	101,7	1.619,9
	PALMEIRAS S.A.	724,4	1.458,0
	PALMAR SANTA ELENA S.A.	-	1.191,3
	ASTORGA S.A.	1.141,0	2.060,4
	PALMAS SANTA FE S.A.	-	411,8

Table An 3.8: *Concentration in discharged effluent from digester to estimate CH_4 emissions in the project case* (**COD_{c,dig_out}**)

PLANTS		CODc,dig_out (mg/L)	CODc,dig_out (kg/m3)
CENTRAL ZONE	AGROINCE LTDA & CIA S.C.A	305	0,30
	INDUPALMA S.A.	217	0,22
	PALMAS DEL CESAR S.A.	400	0,40
	OLEAGINOSAS LAS BRISAS S.A.	166	0,17
	PALMERAS DE PUERTO WILCHES S.A.	205	0,20
	PALMAS OLEAGINOSAS BUCARELIA S.A.	219	0,22
	EXTRACTORA CENTRAL	401	0,40
	EXTRACTORA MONTERREY S.A.	322	0,32
EASTERN ZONE	ACEITES MANUELITA S.A.	352	0,35
	PALMERAS SANTANA LTDA	221	0,22
	PALMERAS SAN PEDRO LTDA.	174	0,17
	SAPUGA S.A.	132	0,13

	EL PALMAR DEL LLANO S.A.	335	0,33
	PALMERAS EL MORICHAL LTDA	234	0,23
	OLEAGINOSAS SAN MARCOS LTDA	194	0,19
	INVERSIONES LA MEJORANA LTDA	226	0,23
	HACIENDA LA CABAÑA S.A.	298	0,30
	ENTREPALMAS S.A.	376	0,38
	GUAICARAMO S.A.	260	0,26
	EXTRACTORA DEL SUR DE CASANARE S.A.	374	0,37
	AGROPECUARIA LA LOMA LTDA	274	0,27
	PLANTACIONES UNIPALMA DE LOS LLANOS S.A.	218	0,22
NORTHERN ZONE	C.I. TEQUENDAMA S.A.	176	0,18
	C.I. EL ROBLE S.A.	432	0,43
	EXTRACTORA FRUPALMA S.A.	297	0,30
	ACEITES S.A.	379	0,38
	OLEOFLORES LTDA	315	0,31
WESTERN ZONE	PALMAS DE TUMACO S.A.	264	0,26
	PALMEIRAS S.A.	404	0,40
	PALMAR SANTA ELENA S.A.	268	0,27
	ASTORGA S.A.	261	0,26
	PALMAS SANTA FE S.A.	363	0,36

Table An 3.9: Amount of electricity in the year y that is consumed at the project site for the project activity. (ELp,y)

(MWh)	SOURCE	TOTAL
Palmeras de Puerto Wilches	GRID	2.173
Extractora Monterrey S.A.	GRID + OWN GENERATION	2.004
Oleaginosas Las Brisas S.A.	GRID + OWN GENERATION	1.367
Palmas Oleaginosas Bucarelia S.A.	GRID + OWN GENERATION	1.025
Indupalma S.A.	GRID	4.388
Palmas del Cesar S.A.		-
Agroince ltda. y Cia S. C. A.	GRID + OWN GENERATION	1.087
C.I. Tequendama S.A.		-
C.I. El Roble S.A.	GRID	1.382
Aceites S.A.		-
Extractora Frupalma S.A.		-
Oleoflores S.A.	GRID + OWN GENERATION	4.358
Palmas de Tumaco S.A.	GRID + OWN GENERATION	102
Astorga S.A.	GRID + OWN GENERATION	1.243
Palmas Santafe S.A.		-
Palmeiras	OWN GENERATION	2.173
Palmar Santa Helena S.A.		-
Inversiones La Mejorana Ltda.		0
Sapuga S.A.		-
Palmera San Pedro Ltda.		-
Entrepalmas S.A.		-
Palmeras El Morichal Ltda.	GRID	219
Extractora del Sur de Casanare		-

Hacienda La Cabaña S.A.	GRID + OWN GENERATION	2.259
UNipalma S.A.	GRID + OWN GENERATION	1.115
Guaicaramo S.A.		-
El Palmar del Llano S.A.		-
Oleaginosas San Marcos Ltda.		-
Aceites Manuelita S.A.	GRID + OWN GENERATION	3.761
Palmeras Santana Ltda.		-
Agropecuaria La Loma Ltda.	GRID + OWN GENERATION	120
Extractora Central		-

Table An 3.10: Flow rate of sludge used for land application (D14/F_{la}) and Amount of sludge applied to land (D32/S_a)

PLANTS		S_a kg/year	F_{la} m3/year
CENTRAL ZONE	AGROINCE LTDA & CIA S.C.A	30.145.027,0	30.145,0
	INDUPALMA S.A.	77.722.320,9	77.722,3
	PALMAS DEL CESAR S.A.	34.464.028,8	34.464,0
	OLEAGINOSAS LAS BRISAS S.A.	41.929.122,0	41.929,1
	PALMERAS DE PUERTO WILCHES S.A.	59.355.928,8	59.355,9
	PALMAS OLEAGINOSAS BUCARELIA S.A.	84.098.126,0	84.098,1
	EXTRACTORA CENTRAL	10.563.468,0	10.563,5
	EXTRACTORA MONTERREY S.A.	52.519.216,5	52.519,2
EASTERN ZONE	ACEITES MANUELITA S.A.	97.021.444,0	97.021,4
	PALMERAS SANTANA LTDA	13.186.812,2	13.186,8
	PALMERAS SAN PEDRO LTDA.	4.460.333,0	4.460,3
	SAPUGA S.A.	5.006.346,0	5.006,3
	EL PALMAR DEL LLANO S.A.	16.658.809,0	16.658,8
	PALMERAS EL MORICHAL LTDA	4.423.528,0	4.423,5
	OLEAGINOSAS SAN MARCOS LTDA	13.678.036,1	13.678,0
	INVERSIONES LA MEJORANA LTDA	6.890.119,4	6.890,1
	HACIENDA LA CABAÑA S.A.	26.292.193,0	26.292,2
	ENTREPALMAS S.A.	46.621.001,8	46.621,0
	GUAICARAMO S.A.	36.980.096,5	36.980,1
	EXTRACTORA DEL SUR DE CASANARE S.A.	72.914.602,0	72.914,6
	AGROPECUARIA LA LOMA LTDA	7.890.126,0	7.890,1
	PLANTACIONES UNIPALMA DE LOS LLANOS S.A.	33.553.588,3	33.553,6
NORTHERN ZONE	C.I. TEQUENDAMA S.A.	39.918.482,2	39.918,5
	C.I. EL ROBLE S.A.	30.489.262,0	30.489,3
	EXTRACTORA FRUPALMA S.A.	21.637.608,0	21.637,6
	ACEITES S.A.	55.124.112,9	55.124,1
	OLEOFLORES LTDA	36.738.811,6	36.738,8
WESTERN ZONE	PALMAS DE TUMACO S.A.	49.328.226,0	49.328,2
	PALMEIRAS S.A.	34.796.093,9	34.796,1
	PALMAR SANTA ELENA S.A.	27.619.890,6	27.619,9
	ASTORGA S.A.	28.487.217,2	28.487,2
	PALMAS SANTA FE S.A.	15.828.748,0	15.828,7

Table An 3.11: COD of the sludge used for land application after dewatering

PLANTS		$COD_{c,la}$ kg/year
CENTRAL ZONE	AGROINCE LTDA & CIA S.C.A	2.395.653,8
	INDUPALMA S.A.	6.506.932,4
	PALMAS DEL CESAR S.A.	2.682.252,8
	OLEAGINOSAS LAS BRISAS S.A.	3.222.672,1
	PALMERAS DE PUERTO WILCHES S.A.	4.839.281,8
	PALMAS OLEAGINOSAS BUCARELIA S.A.	9.173.706,6
	EXTRACTORA CENTRAL	885.563,2
	EXTRACTORA MONTERREY S.A.	4.077.927,6
EASTERN ZONE	ACEITES MANUELITA S.A.	8.306.985,6
	PALMERAS SANTANA LTDA	1.137.483,0
	PALMERAS SAN PEDRO LTDA.	791.199,9
	SAPUGA S.A.	820.622,9
	EL PALMAR DEL LLANO S.A.	1.582.718,5
	PALMERAS EL MORICHAL LTDA	768.638,4
	OLEAGINOSAS SAN MARCOS LTDA	1.171.220,0
	INVERSIONES LA MEJORANA LTDA	922.211,3
	HACIENDA LA CABAÑA S.A.	1.820.735,4
	ENTREPALMAS S.A.	4.491.158,6
	GUAICARAMO S.A.	2.741.790,9
	EXTRACTORA DEL SUR DE CASANARE S.A.	6.544.258,6
	AGROPECUARIA LA LOMA LTDA	896.112,9
	PLANTACIONES UNIPALMA DE LOS LLANOS S.A.	2.628.154,8
NORTHERN ZONE	C.I. TEQUENDAMA S.A.	3.782.063,5
	C.I. EL ROBLE S.A.	2.305.943,3
	EXTRACTORA FRUPALMA S.A.	1.541.824,6
	ACEITES S.A.	5.324.933,6
	OLEOFLORES LTDA	2.482.335,3
WESTERN ZONE	PALMAS DE TUMACO S.A.	4.854.033,0
	PALMEIRAS S.A.	2.647.623,0
	PALMAR SANTA ELENA S.A.	2.135.705,2
	ASTORGA S.A.	1.982.745,8
	PALMAS SANTA FE S.A.	1.235.151,0

Table An 3.12: Amount of biogas collected at the outlet of the biodigester[19]

PARTICIPATING EXTRACTION PLANTS		CH4 baseline emisions	Use of Biogas	
		kg/year	Elect.	Heat
CENTRAL ZONE	AGROINCE LTDA & CIA S.C.A	852.233,4	x	
	INDUPALMA S.A.	2.204.701,6	X	

[19] Biogas used in the boilers will not displace fossil fuels because the baseline fuel of the boilers is residual biomass

PARTICIPATING EXTRACTION PLANTS		CH4 baseline emisions kg/year	Use of Biogas Elect.	Heat
	PALMAS DEL CESAR S.A.	934.686,0		X
	OLEAGINOSAS LAS BRISAS S.A.	1.110.102,1	x	
	PALMERAS DE PUERTO WILCHES S.A.	1.576.626,3	X	
	PALMAS OLEAGINOSAS BUCARELIA S.A.	3.080.216,2	X	
	EXTRACTORA CENTRAL	2.485.430,0	X	
	EXTRACTORA MONTERREY S.A.	1.483.650,1	X	
EASTERN ZONE	ACEITES MANUELITA S.A.	2.510.888,4	X	
	PALMERAS SANTANA LTDA	372.888,7		X
	PALMERAS SAN PEDRO LTDA.	231.104,8		X
	SAPUGA S.A.	230.117,1		X
	EL PALMAR DEL LLANO S.A.	548.861,2		X
	PALMERAS EL MORICHAL LTDA	248.583,1	X	
	OLEAGINOSAS SAN MARCOS LTDA	392.201,7		X
	INVERSIONES LA MEJORANA LTDA	298.038,0		X
	HACIENDA LA CABAÑA S.A.	638.669,2	X	
	ENTREPALMAS S.A.	1.379.760,8		X
	GUAICARAMO S.A.	941.694,2	X	
	EXTRACTORA DEL SUR DE CASANARE S.A.	2.228.774,3		X
	AGROPECUARIA LA LOMA LTDA	287.657,7	X	
	PLANTACIONES UNIPALMA DE LOS LLANOS S.A.	873.318,6	X	
NORTHERN ZONE	C.I. TEQUENDAMA S.A.	1.267.420,2		X
	C.I. EL ROBLE S.A.	789.802,6	X	
	EXTRACTORA FRUPALMA S.A.	485.337,7		X
	ACEITES S.A.	1.801.438,2		X
	OLEOFLORES LTDA	853.800,7	X	
WESTERN ZONE	PALMAS DE TUMACO S.A.	1.474.153,1	X	
	PALMEIRAS S.A.	876.026,5	X	
	PALMAR SANTA ELENA S.A.	735.591,8	X	
	ASTORGA S.A.	596.845,5	X	
	PALMAS SANTA FE S.A.	380.288,4		X
Total methane generation		31.976.953,4	**kg/year**	
Percent of Methane in the Biogas (**$FR_{f,inlet}$**)		0,5	**fraction**	
Total Volume of biogas leaving the digester		63.953.906,88	**m3/year**	
% of the time methane is used to generate heat or electricity		0,5	**fraction**	
% of the time methane is NOT used to generate heat or electricity		0,5	**fraction**	
Amount of methane to be used to generate heat or electricity		17.190.810,2	**kg/year**	
Amount of methane to be used to generate electricity		9.723.803,4	**kg/year**	
Amount of methane to be used to generate heat		7.467.006,7	**kg/year**	
Amount of methane to be mitigated in the flaring system		**14.786.143,3**	**kg/year**	
Density of methane	0,716	0.716	**kg/m3**	
Volume of methane used to generate heat or electricity		24.009.511,4	**m3/year**	
Volume of methane used to generate electricity		13.580.731,1	**m3/year**	
Volume of methane used to generate heat		10.428.780,4	**m3/year**	

PARTICIPATING EXTRACTION PLANTS	CH4 baseline emisions	Use of Biogas	
	kg/year	Elect.	Heat
Volume of methane to be mitigated in the flaring system	20.651.038,1	**m3/year**	
Volume of biogas to be used to generate electricity (**FR**$_{e,inlet}$)	27.161.462,1	**m3/year**	
Volume of biogas to be used to generate heat (**FR**$_{e,inlet}$)	20.857.560,7	**m3/year**	
Volume of biogas to be flared at the flaring system (**FR**$_{f,inlet}$)	41.302.076,2	**m3/year**	
hourly flow rate of methane to be used to generate heat or electricity	2.740,8	**m3/h**	
hourly flow rate of methane to be mitigated in the flaring system	2.357,4	**m3/h**	
Volume of exhaust gases leaving the power generation stack gas (**FR**$_{e,s}$)	32.270.403,78	**m3/year**	
Volume of exhaust gases leaving the heat generation stack gas (**FR**$_{e,s}$)	24780768,57	**m3/year**	
Flow rate of the electricity generation equipment stack gases(H51)	32.270.403,78	**m3/year**	
Flow rate of the heat generation equipment stack gases(H52)	24.780.768,57	**M3/year**	

Table An 3.13: Base data for calculation of the operating margin:

DATE - HOUR	TOTAL ELECTRICITY GENERATION FROM FOSSIL FUEL IN THE ELECTRICITY GRID kWh	CALCULATED OPERATING MARGIN	DATE - HOUR	TOTAL ELECTRICITY GENERATION FROM FOSSIL FUEL IN THE ELECTRICITY GRID kWh	CALCULATED OPERATING MARGIN	DATE - HOUR	TOTAL ELECTRICITY GENERATION FROM FOSSIL FUEL IN THE ELECTRICITY GRID KWh	CALCULATED OPERATING MARGIN
01/01/2006 - 00	5.316.265,06	0,3885	02/05/2006 - 08	5.491.170,04	0,2070	01/09/2006 - 16	6755130,49	0,3269
01/01/2006 - 01	4.920.823,94	0,3728	02/05/2006 - 09	5.704.926,86	0,2347	01/09/2006 - 17	6806704,54	0,3276
01/01/2006 - 02	4.749.878,66	0,3619	02/05/2006 - 10	5.990.589,11	0,2042	01/09/2006 - 18	7621729,91	0,2776
01/01/2006 - 03	4.508.475,27	0,3896	02/05/2006 - 11	6.153.830,41	0,2175	01/09/2006 - 19	7782553,71	0,2860
01/01/2006 - 04	4.070.169,54	0,3918	02/05/2006 - 12	5.891.568,22	0,2021	01/09/2006 - 20	7364710,53	0,2858
01/01/2006 - 05	3.894.629,88	0,3616	02/05/2006 - 13	5.717.874,38	0,2811	01/09/2006 - 21	6752080,61	0,3472
01/01/2006 - 06	3.491.581,42	0,3592	02/05/2006 - 14	5.898.719,96	0,2706	01/09/2006 - 22	6079967,89	0,3816
01/01/2006 - 07	3.452.417,49	0,3401	02/05/2006 - 15	5.859.884,04	0,2900	01/09/2006 - 23	5632080,74	0,3822
01/01/2006 - 08	3.586.486,00	0,3323	02/05/2006 - 16	5.762.241,23	0,3210	02/09/2006 - 00	5174407,12	0,3314
01/01/2006 - 09	3.772.180,99	0,3265	02/05/2006 - 17	5.885.439,80	0,3664	02/09/2006 - 01	4934916,06	0,3239
01/01/2006 - 10	3.904.049,86	0,3175	02/05/2006 - 18	7.184.042,90	0,4680	02/09/2006 - 02	4792769,26	0,3205
01/01/2006 - 11	3.999.598,60	0,3087	02/05/2006 - 19	7.433.662,78	0,6437	02/09/2006 - 03	4789846,96	0,3200
01/01/2006 - 12	3.997.042,12	0,3142	02/05/2006 - 20	7.058.859,87	0,7029	02/09/2006 - 04	4972217,88	0,3230
01/01/2006 - 13	3.695.652,06	0,3221	02/05/2006 - 21	6.378.900,18	0,6717	02/09/2006 - 05	5165311,14	0,3269
01/01/2006 - 14	3.410.588,88	0,3332	02/05/2006 - 22	5.392.618,66	0,7056	02/09/2006 - 06	5354739,43	0,3309
01/01/2006 - 15	3.336.941,68	0,3387	02/05/2006 - 23	4.559.886,24	0,7386	02/09/2006 - 07	5789802,93	0,3380
01/01/2006 - 16	3.300.315,46	0,3423	03/05/2006 - 00	4.169.711,42	0,5635	02/09/2006 - 08	6214322,97	0,3341
01/01/2006 - 17	3.560.368,54	0,3798	03/05/2006 - 01	3.983.211,52	0,5953	02/09/2006 - 09	6446496,42	0,3274
01/01/2006 - 18	5.099.931,21	0,3731	03/05/2006 - 02	3.895.794,96	0,5949	02/09/2006 - 10	6635994,47	0,3194
01/01/2006 - 19	5.608.080,91	0,3593	03/05/2006 - 03	3.895.376,04	0,5935	02/09/2006 - 11	6780907,76	0,3222
01/01/2006 - 20	5.360.186,01	0,3479	03/05/2006 - 04	4.202.064,84	0,5945	02/09/2006 - 12	6615713,67	0,3357
01/01/2006 - 21	5.014.267,78	0,3829	03/05/2006 - 05	4.905.381,87	0,5571	02/09/2006 - 13	6342225,33	0,3258
01/01/2006 - 22	4.634.456,13	0,3893	03/05/2006 - 06	5.247.268,49	0,4860	02/09/2006 - 14	6175171,96	0,3224
01/01/2006 - 23	4.099.295,50	0,3872	03/05/2006 - 07	5.391.146,90	0,4876	02/09/2006 - 15	6039930,99	0,3217
02/01/2006 - 00	4.034.178,92	0,2702	03/05/2006 - 08	5.806.746,10	0,4032	02/09/2006 - 16	5956267,36	0,3164
02/01/2006 - 01	3.924.416,07	0,3882	03/05/2006 - 09	5.962.696,47	0,3724	02/09/2006 - 17	5698249,31	0,3206
02/01/2006 - 02	3.851.885,18	0,3874	03/05/2006 - 10	6.147.654,35	0,3592	02/09/2006 - 18	6982075,49	0,2437
02/01/2006 - 03	3.866.778,35	0,3874	03/05/2006 - 11	6.291.136,35	0,3629	02/09/2006 - 19	7354086,25	0,2594
02/01/2006 - 04	3.994.373,33	0,3871	03/05/2006 - 12	6.047.565,95	0,3718	02/09/2006 - 20	7027707,25	0,2497
02/01/2006 - 05	4.249.437,80	0,3709	03/05/2006 - 13	5.919.797,84	0,3912	02/09/2006 - 21	6618106,1	0,3075
02/01/2006 - 06	4.468.151,25	0,3616	03/05/2006 - 14	6.025.129,53	0,3888	02/09/2006 - 22	6202614,41	0,3367
02/01/2006 - 07	4.837.921,75	0,3488	03/05/2006 - 15	5.995.826,72	0,3700	02/09/2006 - 23	5528133,3	0,3373
02/01/2006 - 08	5.312.406,97	0,3373	03/05/2006 - 16	6.014.554,28	0,3391	03/09/2006 - 00	5025156,63	0,3214
02/01/2006 - 09	5.516.682,50	0,3440	03/05/2006 - 17	6.281.218,57	0,3383	03/09/2006 - 01	4783068,01	0,3091
02/01/2006 - 10	5.780.038,92	0,3252	03/05/2006 - 18	7.385.810,01	0,3510	03/09/2006 - 02	4641435,3	0,3056
02/01/2006 - 11	6.003.048,26	0,3213	03/05/2006 - 19	7.562.276,38	0,3328	03/09/2006 - 03	4596913,55	0,3044

02/01/2006 - 12	5.930.474,47	0,3329	03/05/2006 - 20	7.179.426,66	0,3404	03/09/2006 - 04	4617526,12	0,3048
02/01/2006 - 13	5.781.852,77	0,3453	03/05/2006 - 21	6.581.670,29	0,2669	03/09/2006 - 05	4617035,86	0,3050
02/01/2006 - 14	5.684.785,96	0,3647	03/05/2006 - 22	5.635.702,91	0,1851	03/09/2006 - 06	4533038,87	0,3026
02/01/2006 - 15	5.602.604,88	0,3752	03/05/2006 - 23	4.794.554,88	0,2137	03/09/2006 - 07	4807852,59	0,3093
02/01/2006 - 16	5.706.914,35	0,3727	04/05/2006 - 00	4.518.840,88	0,2959	03/09/2006 - 08	5153011,76	0,3080
02/01/2006 - 17	5.576.297,19	0,4094	04/05/2006 - 01	4.367.558,18	0,2652	03/09/2006 - 09	5362339,75	0,3120
02/01/2006 - 18	6.918.985,68	0,4130	04/05/2006 - 02	4.298.765,82	0,2652	03/09/2006 - 10	5536661,05	0,2885
02/01/2006 - 19	7.237.099,15	0,4067	04/05/2006 - 03	4.311.684,84	0,2610	03/09/2006 - 11	5642285,11	0,2791
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27/04/2006 - 13	6.016.276,39	0,2970	27/08/2006 - 21	6031839,64	0,3225	27/12/2006 - 05	5057890,5	0,4678
27/04/2006 - 14	6.135.353,99	0,3011	27/08/2006 - 22	5471491,26	0,3069	27/12/2006 - 06	5272867,76	0,3889
27/04/2006 - 15	6.248.273,63	0,3033	27/08/2006 - 23	4902154,42	0,2769	27/12/2006 - 07	5523287,11	0,3920
27/04/2006 - 16	6.249.700,46	0,2763	28/08/2006 - 00	4733739,49	0,3044	27/12/2006 - 08	5668519,1	0,3918
27/04/2006 - 17	6.378.840,90	0,1881	28/08/2006 - 01	4557226,88	0,3016	27/12/2006 - 09	5924584,63	0,3281
27/04/2006 - 18	7.385.716,50	0,1956	28/08/2006 - 02	4482447,89	0,2983	27/12/2006 - 10	6085568,64	0,3368
27/04/2006 - 19	7.696.310,60	0,1479	28/08/2006 - 03	4501872,96	0,2989	27/12/2006 - 11	6253769,13	0,3404
27/04/2006 - 20	7.230.038,76	0,1364	28/08/2006 - 04	4783388,46	0,3052	27/12/2006 - 12	6040069,48	0,3375
27/04/2006 - 21	6.475.731,52	0,1681	28/08/2006 - 05	5491559,77	0,3463	27/12/2006 - 13	5868951,19	0,3976
27/04/2006 - 22	5.464.047,00	0,2235	28/08/2006 - 06	5795487,82	0,3751	27/12/2006 - 14	5872754,39	0,3982
27/04/2006 - 23	4.576.525,56	0,2796	28/08/2006 - 07	5970905,21	0,3763	27/12/2006 - 15	5914776,67	0,3980
28/04/2006 - 00	4.109.551,36	0,3181	28/08/2006 - 08	6155689,05	0,3515	27/12/2006 - 16	5913204,07	0,3976
28/04/2006 - 01	3.924.155,43	0,3460	28/08/2006 - 09	6200887,22	0,3418	27/12/2006 - 17	6372220,93	0,3440
28/04/2006 - 02	3.867.950,73	0,3670	28/08/2006 - 10	6491746,41	0,3287	27/12/2006 - 18	7600063,22	0,3749

28/04/2006 - 03	3.897.646,40	0,3674	28/08/2006 - 11	6636139,09	0,3670	27/12/2006 - 19	7834733,3	0,3786
28/04/2006 - 04	4.197.632,14	0,3202	28/08/2006 - 12	6446741,14	0,3737	27/12/2006 - 20	7434789,35	0,3784
28/04/2006 - 05	4.948.652,31	0,3428	28/08/2006 - 13	6290412,01	0,3628	27/12/2006 - 21	6891539,69	0,4294
28/04/2006 - 06	5.318.524,75	0,3686	28/08/2006 - 14	6352767,2	0,3702	27/12/2006 - 22	5989168,85	0,4258
28/04/2006 - 07	5.442.392,29	0,3220	28/08/2006 - 15	6425695,59	0,3744	27/12/2006 - 23	5292842,76	0,5019
28/04/2006 - 08	5.787.592,49	0,3124	28/08/2006 - 16	6441589,3	0,3748	28/12/2006 - 00	4519040,83	0,5480
28/04/2006 - 09	6.047.576,33	0,3130	28/08/2006 - 17	6525991,62	0,3718	28/12/2006 - 01	4251449,36	0,5539
28/04/2006 - 10	6.160.511,28	0,2878	28/08/2006 - 18	7461340,81	0,2704	28/12/2006 - 02	4157193,72	0,5566
28/04/2006 - 11	6.311.400,64	0,2865	28/08/2006 - 19	7760153,12	0,2799	28/12/2006 - 03	4150764,96	0,5558
28/04/2006 - 12	6.081.763,29	0,2801	28/08/2006 - 20	7364888,93	0,2727	28/12/2006 - 04	4331866,61	0,4411
28/04/2006 - 13	5.959.401,87	0,2537	28/08/2006 - 21	6711233,9	0,3714	28/12/2006 - 05	4691218,85	0,4485
28/04/2006 - 14	6.044.685,84	0,2578	28/08/2006 - 22	5973718,88	0,3242	28/12/2006 - 06	4693384,63	0,2541
28/04/2006 - 15	6.023.961,67	0,2475	28/08/2006 - 23	5279423,88	0,3183	28/12/2006 - 07	5057892,3	0,2792
28/04/2006 - 16	5.940.866,84	0,2357	29/08/2006 - 00	4953329,29	0,3090	28/12/2006 - 08	5558963,09	0,3312
28/04/2006 - 17	6.040.278,97	0,1254	29/08/2006 - 01	4744977,47	0,3035	28/12/2006 - 09	5907060,07	0,3521
28/04/2006 - 18	7.217.752,84	0,1238	29/08/2006 - 02	4645236,8	0,3009	28/12/2006 - 10	6089558,34	0,3701
28/04/2006 - 19	7.575.307,28	0,1266	29/08/2006 - 03	4707111,06	0,3026	28/12/2006 - 11	6167154,55	0,3704
28/04/2006 - 20	7.130.621,20	0,1210	29/08/2006 - 04	4998987,57	0,3053	28/12/2006 - 12	6010863,47	0,3596
28/04/2006 - 21	6.501.085,49	0,1672	29/08/2006 - 05	5748422,51	0,3681	28/12/2006 - 13	5772808,75	0,3271
28/04/2006 - 22	5.641.604,35	0,1352	29/08/2006 - 06	5993614,17	0,3774	28/12/2006 - 14	5749286,16	0,3107
28/04/2006 - 23	4.872.662,25	0,1970	29/08/2006 - 07	6117212,58	0,3700	28/12/2006 - 15	5742339,48	0,2942
29/04/2006 - 00	4.408.266,19	0,3147	29/08/2006 - 08	6508295,73	0,3409	28/12/2006 - 16	5748002,45	0,2828
29/04/2006 - 01	4.122.184,80	0,3542	29/08/2006 - 09	6692703,52	0,3784	28/12/2006 - 17	5944871,61	0,2968
29/04/2006 - 02	3.983.622,28	0,3524	29/08/2006 - 10	6962602,53	0,2911	28/12/2006 - 18	7491898,51	0,3373
29/04/2006 - 03	3.975.456,59	0,2815	29/08/2006 - 11	7098583,44	0,3376	28/12/2006 - 19	7845554,81	0,3408
29/04/2006 - 04	4.132.987,03	0,2754	29/08/2006 - 12	6778624,67	0,3376	28/12/2006 - 20	7499317,66	0,3281
29/04/2006 - 05	4.404.982,14	0,2200	29/08/2006 - 13	6678802,94	0,3498	28/12/2006 - 21	6822922,41	0,3095
29/04/2006 - 06	4.612.990,52	0,2745	29/08/2006 - 14	6757524,63	0,3449	28/12/2006 - 22	5841990,75	0,2890
29/04/2006 - 07	5.006.769,50	0,2430	29/08/2006 - 15	6437068,17	0,3413	28/12/2006 - 23	5046572,47	0,3748
29/04/2006 - 08	5.405.724,89	0,2006	29/08/2006 - 16	6393604,77	0,3416	29/12/2006 - 00	4877885,53	0,5573
29/04/2006 - 09	5.654.100,23	0,1765	29/08/2006 - 17	6559357,44	0,3419	29/12/2006 - 01	4678923,12	0,5744
29/04/2006 - 10	5.835.670,57	0,1733	29/08/2006 - 18	7454491,37	0,2744	29/12/2006 - 02	4584819,98	0,5532
29/04/2006 - 11	6.015.751,45	0,1794	29/08/2006 - 19	7707070,18	0,2952	29/12/2006 - 03	4607747,44	0,5480
29/04/2006 - 12	5.900.517,85	0,1780	29/08/2006 - 20	7342574,61	0,2792	29/12/2006 - 04	4653139,1	0,5448
29/04/2006 - 13	5.659.471,06	0,1682	29/08/2006 - 21	6672082,81	0,3176	29/12/2006 - 05	4936389,14	0,5327
29/04/2006 - 14	5.407.140,34	0,1752	29/08/2006 - 22	6108312,33	0,3346	29/12/2006 - 06	5059202,81	0,5590
29/04/2006 - 15	5.299.125,73	0,1937	29/08/2006 - 23	5498457,25	0,3206	29/12/2006 - 07	5400187,71	0,5329
29/04/2006 - 16	5.170.511,91	0,2155	30/08/2006 - 00	5005537,32	0,3106	29/12/2006 - 08	5969302,16	0,5015
29/04/2006 - 17	5.322.844,90	0,1456	30/08/2006 - 01	4798905,47	0,3056	29/12/2006 - 09	6285752,41	0,4596
29/04/2006 - 18	6.599.659,51	0,1560	30/08/2006 - 02	4704059,64	0,3035	29/12/2006 - 10	6453491,15	0,3773
29/04/2006 - 19	7.047.665,46	0,1623	30/08/2006 - 03	4684239,04	0,3029	29/12/2006 - 11	6578709,4	0,3897
29/04/2006 - 20	6.734.305,92	0,1447	30/08/2006 - 04	5042839,3	0,3110	29/12/2006 - 12	6401252,78	0,3754
29/04/2006 - 21	6.295.089,02	0,1859	30/08/2006 - 05	5716173,84	0,3682	29/12/2006 - 13	6220051,63	0,3549
29/04/2006 - 22	5.580.351,47	0,1483	30/08/2006 - 06	6007942,99	0,3745	29/12/2006 - 14	6153334,75	0,3515
29/04/2006 - 23	4.763.473,72	0,2088	30/08/2006 - 07	6219885,01	0,3610	29/12/2006 - 15	6048229,35	0,3346
30/04/2006 - 00	4.131.277,79	0,3107	30/08/2006 - 08	6583213,94	0,3406	29/12/2006 - 16	5955311,7	0,3041
30/04/2006 - 01	3.985.925,51	0,3129	30/08/2006 - 09	6768996,52	0,3641	29/12/2006 - 17	6130925,59	0,3043
30/04/2006 - 02	3.859.611,34	0,2927	30/08/2006 - 10	6968146,8	0,2835	29/12/2006 - 18	7708688,38	0,3994
30/04/2006 - 03	3.875.810,08	0,2937	30/08/2006 - 11	6700564,73	0,2798	29/12/2006 - 19	8091490,03	0,3998
30/04/2006 - 04	3.756.742,50	0,2825	30/08/2006 - 12	6350596,93	0,3452	29/12/2006 - 20	7779170,21	0,3826
30/04/2006 - 05	3.828.056,66	0,3006	30/08/2006 - 13	6267922,33	0,3627	29/12/2006 - 21	7294010,24	0,3385
30/04/2006 - 06	3.794.329,38	0,3206	30/08/2006 - 14	6359575,58	0,3719	29/12/2006 - 22	6425202,4	0,3809
30/04/2006 - 07	4.046.111,55	0,1935	30/08/2006 - 15	6395487,86	0,3751	29/12/2006 - 23	5623684,32	0,3710
30/04/2006 - 08	4.360.293,79	0,2061	30/08/2006 - 16	6409164,27	0,3738	30/12/2006 - 00	4952896,34	0,3478
30/04/2006 - 09	4.558.383,04	0,2137	30/08/2006 - 17	6519518,63	0,3422	30/12/2006 - 01	4636354,66	0,3412
30/04/2006 - 10	4.882.293,82	0,2096	30/08/2006 - 18	7325449,92	0,2560	30/12/2006 - 02	4471937,02	0,3222
30/04/2006 - 11	4.975.730,74	0,2148	30/08/2006 - 19	7623046,83	0,2684	30/12/2006 - 03	4408454,61	0,3187
30/04/2006 - 12	4.970.325,22	0,2184	30/08/2006 - 20	7401876,27	0,2716	30/12/2006 - 04	4494173,65	0,3188
30/04/2006 - 13	4.893.582,49	0,2177	30/08/2006 - 21	6838844,62	0,3187	30/12/2006 - 05	4666742,87	0,3227
30/04/2006 - 14	4.742.924,80	0,2190	30/08/2006 - 22	5972863,41	0,3296	30/12/2006 - 06	4631378,73	0,3228
30/04/2006 - 15	4.607.100,93	0,2125	30/08/2006 - 23	5312799,47	0,3203	30/12/2006 - 07	4882493,08	0,3251
30/04/2006 - 16	4.605.829,61	0,2131	31/08/2006 - 00	4909895,48	0,3071	30/12/2006 - 08	5247995,66	0,3330
30/04/2006 - 17	4.800.497,27	0,2513	31/08/2006 - 01	4773686,23	0,3039	30/12/2006 - 09	5688808,48	0,3355
30/04/2006 - 18	5.929.074,96	0,2894	31/08/2006 - 02	4700006,9	0,3020	30/12/2006 - 10	5887531,22	0,2762
30/04/2006 - 19	6.303.999,84	0,1570	31/08/2006 - 03	4742354,56	0,3031	30/12/2006 - 11	5948838,49	0,2074
30/04/2006 - 20	6.112.756,27	0,1191	31/08/2006 - 04	5031784,84	0,3097	30/12/2006 - 12	5881139,45	0,2177
30/04/2006 - 21	5.629.084,94	0,1727	31/08/2006 - 05	5791996,29	0,3775	30/12/2006 - 13	5694861,48	0,2120
30/04/2006 - 22	5.060.768,81	0,2089	31/08/2006 - 06	6024910,31	0,4069	30/12/2006 - 14	5545927,35	0,2044
30/04/2006 - 23	4.498.830,70	0,2957	31/08/2006 - 07	6187617,06	0,4213	30/12/2006 - 15	5445195,4	0,2013
01/05/2006 - 00	4.061.976,65	0,2750	31/08/2006 - 08	6555025,28	0,2818	30/12/2006 - 16	5414372,95	0,2000
01/05/2006 - 01	3.827.377,33	0,3019	31/08/2006 - 09	6777398,09	0,2893	30/12/2006 - 17	5647434,26	0,2081
01/05/2006 - 02	3.759.331,21	0,3000	31/08/2006 - 10	7010935,62	0,2813	30/12/2006 - 18	7259247,93	0,2805
01/05/2006 - 03	3.719.891,61	0,2821	31/08/2006 - 11	7134154,33	0,2768	30/12/2006 - 19	7676706,09	0,3096
01/05/2006 - 04	3.781.774,70	0,2612	31/08/2006 - 12	6777399,42	0,2874	30/12/2006 - 20	7427887,85	0,2960
01/05/2006 - 05	3.872.822,14	0,2696	31/08/2006 - 13	6741071,44	0,2895	30/12/2006 - 21	7052800,29	0,3637

01/05/2006 - 06	3.810.837,89	0,2667	31/08/2006 - 14	6841995,85	0,2971	30/12/2006 - 22	6285735,49	0,3296
01/05/2006 - 07	4.095.602,16	0,1870	31/08/2006 - 15	6861626,06	0,2996	30/12/2006 - 23	5494582,86	0,3033
01/05/2006 - 08	4.451.333,54	0,2054	31/08/2006 - 16	6859225,57	0,2910	31/12/2006 - 00	4952631,18	0,2053
01/05/2006 - 09	4.767.274,45	0,2189	31/08/2006 - 17	6637716,25	0,2908	31/12/2006 - 01	4589038,89	0,1676
01/05/2006 - 10	4.948.957,33	0,2235	31/08/2006 - 18	7631071,23	0,2484	31/12/2006 - 02	4421003,55	0,2940
01/05/2006 - 11	5.115.047,06	0,2169	31/08/2006 - 19	7787443,54	0,2514	31/12/2006 - 03	4342263,51	0,2826
01/05/2006 - 12	5.119.745,19	0,1913	31/08/2006 - 20	7538417,99	0,2531	31/12/2006 - 04	4344162,13	0,2752
01/05/2006 - 13	4.961.244,96	0,1829	31/08/2006 - 21	6988267,94	0,3129	31/12/2006 - 05	4446676,24	0,2788
01/05/2006 - 14	4.769.472,16	0,1875	31/08/2006 - 22	6376593,76	0,3390	31/12/2006 - 06	4323531,51	0,2751
01/05/2006 - 15	4.650.704,81	0,2222	31/08/2006 - 23	5576873,01	0,3382	31/12/2006 - 07	4501020,76	0,2807
01/05/2006 - 16	4.670.022,24	0,1902	01/09/2006 - 00	5077909,9	0,3292	31/12/2006 - 08	4757343,96	0,3175
01/05/2006 - 17	5.035.128,42	0,2395	01/09/2006 - 01	4878010	0,3091	31/12/2006 - 09	4972125,73	0,3370
01/05/2006 - 18	6.151.925,53	0,2580	01/09/2006 - 02	4800234,67	0,3050	31/12/2006 - 10	5098890,88	0,2180
01/05/2006 - 19	6.583.247,82	0,2118	01/09/2006 - 03	4826270,53	0,3056	31/12/2006 - 11	5151429,3	0,1411
01/05/2006 - 20	6.271.332,63	0,2013	01/09/2006 - 04	5091474,91	0,3113	31/12/2006 - 12	5126642,46	0,1414
01/05/2006 - 21	5.657.771,73	0,2754	01/09/2006 - 05	5778951,77	0,3849	31/12/2006 - 13	4996826,82	0,1326
01/05/2006 - 22	4.878.702,60	0,2297	01/09/2006 - 06	6036383,14	0,4060	31/12/2006 - 14	4878119,87	0,1233
01/05/2006 - 23	4.323.778,77	0,2887	01/09/2006 - 07	6235492,8	0,4124	31/12/2006 - 15	4825995,21	0,1211
02/05/2006 - 00	3.999.562,60	0,3667	01/09/2006 - 08	6615732,25	0,2859	31/12/2006 - 16	4838311,45	0,1231
02/05/2006 - 01	3.878.744,33	0,2743	01/09/2006 - 09	6792760,85	0,3075	31/12/2006 - 17	5144002,93	0,1414
02/05/2006 - 02	3.829.942,61	0,2593	01/09/2006 - 10	6991684,71	0,3307	31/12/2006 - 18	6766615,67	0,2080
02/05/2006 - 03	3.883.914,10	0,2252	01/09/2006 - 11	7121846,65	0,3320	31/12/2006 - 19	7146930,6	0,2177
02/05/2006 - 04	4.079.977,39	0,2266	01/09/2006 - 12	6765201,55	0,3281	31/12/2006 - 20	6884241,56	0,2147
02/05/2006 - 05	4.850.215,92	0,2318	01/09/2006 - 13	6682525,9	0,3263	31/12/2006 - 21	6654958,66	0,2979
02/05/2006 - 06	5.107.986,78	0,1907	01/09/2006 - 14	6822537,49	0,3288	31/12/2006 - 22	6260103,29	0,2587
02/05/2006 - 07	5.158.687,28	0,1818	01/09/2006 - 15	6804483,33	0,3285	31/12/2006 - 23	5967204,05	0,2503

Annex 4

MONITORING INFORMATION

Data / Parameter:	**D1 / F_{dig}**	
Data unit:	m^3/yr	
Description:	Flow rate of organic wastewater into the digester Activity Level: Open lagoon.	
Source of data to be used:	Field Measurement	
Value applied	Value applied for the baseline estimation, please see table An.3.1 in Annex 3.	
Justification of the choice of data or description of measurement methods and procedures actually applied:	Equipment used:	Volumetric manual method performed by an accredited laboratory
	How the measurement is undertaken:	Standard sampling procedures
	Accuracy of the measurement method:	High
	Responsible person/entity that should undertake the measurements:	External Designated Laboratory in places where a recognized accredited laboratory is available in the region. Otherwise trained personnel from the mills perform the sampling method and report results to the mill manager and to the regional environmental authority.
Any comment:	Once the project activity is in place, D1 will be measured by the same instrument used in D10 following the same measurement methode and the same quality assurance as described as in D10.	

Data / Parameter:	**D2 / $COD_{c,Bl}$**	
Data unit:	Kg/m3	
Description:	--COD Concentration of organic wastewater into the digester --Activity Level: Open Lagoon.	
Source of data to be used:	Measurement	
Value applied	Value applied for the baseline estimation, please see table An.3.2 in Annex 3.	
Description of measurement methods and procedures to be applied:	Equipment used:	The laboratory procedure for determining COD is based upon Standard Methods for the Examination of Water and Wastewater. 20th edition, 1998.
	How the measurement is undertaken:	based upon Standard Methods for the Examination of Water and Wastewater. 20th edition, 1998.

	Accuracy of the measurement method:	High
	Responsible person/entity that should undertake the measurements:	External Designated Laboratory in places where a recognized accredited laboratory is available in the region. Otherwise trained personnel from the mills perform the sampling method and report results to the mill manager and to the regional environmental authority.
Any comment:	Once the project activity is in place, D2 will be measured by the same instrument used in D11 following the same measurement methode and the same quality assurance as described as in D11.	

Data / Parameter:	**D3 / $COD_{a,out}$**	
Data unit:	Kg/yr	
Description:	--COD that leaves the anaerobic lagoon with the effluent --Activity Level: Open Lagoon.	
Source of data used:	Field Measurement	
Value applied:	Value applied for the baseline estimation, please see table An.3.3 in Annex 3.	
Justification of the choice of data or description of measurement methods and procedures actually applied:	Equipment used:	Standard Sampling and Laboratory equipment.
	How the measurement is undertaken:	The measurements have been made following standard sampling procedures.
	Accuracy of the measurement method:	High
	Responsible person/entity that should undertake the measurements:	External Designated Laboratory in places where a recognized accredited laboratory is available in the region. Otherwise trained personnel from the mills perform the sampling method and report results to the mill manager and to the regional environmental authority.
Any comment:	Once the project activity is in place, D3 will be measured by the same instrument used in D11 following the same measurement methode and the same quality assurance as described as in D11.	

Data / Parameter:	**D4 / $COD_{a,in}$**
Data unit:	Kg/yr
Description:	--COD that enters the lagoon which is assumed to be equal to the COD input to the digester or directed to land application. --Activity Level: Open Lagoon.

Source of data to be used:	Measurement
Value applied	Value applied for the baseline estimation, please see table An.3.4 in Annex 3.
Description of measurement methods and procedures to be applied:	Equipment used: Standard Sampling and Laboratory equipment. How the measurement is undertaken: The measurements have been made following standard sampling procedures. Accuracy of the measurement method: High Responsible person/entity that should undertake the measurements: External Designated Laboratory in places where a recognized accredited laboratory is available in the region. Otherwise trained personnel from the mills perform the sampling method and report results to the mill manager and to the regional environmental authority.
Any comment:	Once the project activity is in place, D4 will be measured by the same instrument used in D15 following the same measurement methode and the same quality assurance as described as in D15.

Data / Parameter:	**D5 / T_{lag}**
Data unit:	^oK
Description:	Ambient Temperature of lagoon --Activity Level: open lagoon
Source of data used:	Measurement
Value applied:	Value applied for the baseline estimation, please see Table An 3.5 which presents average annual temperature values.
Justification of the choice of data or description of measurement methods and procedures actually applied:	Equipment used: Thermometer. Accuracy of the measurement method: High Responsible person/entity that should undertake the measurements: Nearest regional airport available. The temperature information is reported by airports to IDEAM which is the National Meteorological Information entity in charge of the compilation of this information.
Any comment:	

Data / Parameter:	**D6 / D_{lag}**
Data unit:	**M**
Description:	--Depth of lagoon --Activity Level: open lagoon.
Source of data used:	**Measurement**
Value applied:	Value applied for the baseline estimation, please see values per mill in Table 3.6 in Annex 3
Justification of the	Equipment used: Level meter.

choice of data or description of measurement methods and procedures actually applied:	Accuracy of the measurement method: Responsible person/entity that should undertake the measurements:	High Extraction plant's metric analyst.
Any comment:	Once the project is in place the digesters depth is assumed to be fixed and in accordance to the engineering design. Supports for the engineering design for each plant will be available for verification in any moment it will be required.	

Data / Parameter:	**D7 / EG_y**	
Data unit:	MWh	
Description:	--Amount of electricity in the year y that would be consumed at the project site in the absence of the project activity --Activity Level: Electricity Use.	
Source of data used:	Measurement	
Value applied:	See Table An 3.7 in Annex 3.	
Justification of the choice of data or description of measurement methods and procedures actually applied:	Equipment used: Accuracy of the measurement method: Responsible person/entity that should undertake the measurements:	Energy meter. High Extraction plant's metric analyst.
Any comment:	Once the project activity is in place, D7 will be measured by the same instrument used in D12 following the same measurement methode and the same quality assurance as described as in D12. This PDD only seeks CDM Accreditation for Technology Option I, the implementation of new covered anaerobic digesters to capture and mitigate the biogas. After registration and implementation of the project activity, if and only if Technology Option I is technically successful and the incomes from CER sales are sufficient to support further investments in cogeneration of renewable energy, then the Project Participants will either present a second PDD (or request permission to modify this one if that is permitted by CDM regs) and present in very specific terms the individual technology packages which will have been chosen by each of the 32 participating plants for generation of renewable energy. This PDD will includes complete references to Technology Options II and III, in order to represent the additionality and the incremental financial decision-making process in the most transparent and historically correct manner.	

Data / Parameter:	**D7.1/** $EG_{PJ,h}$
Data unit:	MWh
Description:	Electricity displaced by the project activity in hour h of year y
Source of data:	Measurement

Measurement procedures (if any):	Equipment that will be used: Energy meter How the measurement is undertaken: An automated instrument will measure the energy and transmit the information to a local database using an industrial communication method. Calibration procedures are applied: The calibration procedures for the energy use meter will be made in a Reference Laboratory accredited by international Standards according to indications of the manufacturer. The Reference laboratory must supply a Certificate of Calibration specifying the status, identification of instrument, date of calibration, and next calibration. Accuracy of the measurement method: High Responsible person/entity that should undertake the measurements: Extraction plant's metric analyst.
Monitoring frequency:	Hourly
QA/QC procedures:	The maintenance, frequency of calibration and control procedures programming for the electricity meter are established by the plant QA/QC department. Calibration and maintenance are subject to procedures established by instrument manufacturer.
Any comment:	Only applicable for the dispatch data OM, The data will be archived minimum two years after each issuance of CERs This PDD only seeks CDM Accreditation for Technology Option I, the implementation of new covered anaerobic digesters to capture and mitigate the biogas. After registration and implementation of the project activity, if and only if Technology Option I is technically successful and the incomes from CER sales are sufficient to support further investments in cogeneration of renewable energy, then the Project Participants will either present a second PDD (or request permission to modify this one if that is permitted by CDM regs) and present in very specific terms the individual technology packages which will have been chosen by each of the 32 participating plants for generation of renewable energy. This PDD will includes complete references to Technology Options II and III, in order to represent the additionality and the incremental financial decision-making process in the most transparent and historically correct manner.

Data / Parameter:	**D8 / $EG_{d,y}$**
Data unit:	kWh
Description:	--Amount of electricity generated using biogas collected during project activity and exported to the grid during the year. --Activity Level: Electricity Use.
Source of data used:	Measurement
Value applied:	0
Justification of the	Equipment used: Electricity meter.

choice of data or description of measurement methods and procedures actually applied:	Accuracy of the measurement method: High Responsible person/entity that should undertake the measurements: Extraction plant's metric analyst.
Any comment:	Once the project activity is in place, D8 will be measured by the same instrument used in D22 following the same measurement methode and the same quality assurance as described as in D12. This PDD only seeks CDM Accreditation for Technology Option I, the implementation of new covered anaerobic digesters to capture and mitigate the biogas. After registration and implementation of the project activity, if and only if Technology Option I is technically successful and the incomes from CER sales are sufficient to support further investments in cogeneration of renewable energy, then the Project Participants will either present a second PDD (or request permission to modify this one if that is permitted by CDM regs) and present in very specific terms the individual technology packages which will have been chosen by each of the 32 participating plants for generation of renewable energy. This PDD will includes complete references to Technology Options II and III, in order to represent the additionality and the incremental financial decision-making process in the most transparent and historically correct manner.

Data / Parameter:	**CEF_{grid}**
Data unit:	tCO_2e/MWh
Description:	--CO2 emissions factor for the grid where electricity is exported --Activity Level: Electricity Use.
Source of data used:	Calculation
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied:	Equipment used: Accuracy of the measurement method: High Responsible person/entity that should undertake the measurements: National Dispatch Center
Any comment:	So far, none of the project participants have expressed interest in generating power to feed into the grid. According to the pre-feasibility study performed by CAEMA, the investment required for feeding electricity is high. On the other hand, prices paid to power producers for delivering electricity to the grid (US$0.02) are not attractive to investors. Therefore, IRR is negative. Due to the amount of biomass residues and the availability of biogas from lagoons, recent developments in this project have shown to project participants the benefits of reducing electricity costs by producing power in-site. If conditions change in the future, producers may elect to sell excess electricity into the grid. Hence, in future verifications this parameter may be recalculated and evaluated according to the monitoring reports on electricity fed into the grid by project participants. This PDD only seeks CDM Accreditation for Technology Option I, the implementation of new covered anaerobic digesters to capture and mitigate the

	biogas. After registration and implementation of the project activity, if and only if Technology Option I is technically successful and the incomes from CER sales are sufficient to support further investments in cogeneration of renewable energy, then the Project Participants will either present a second PDD (or request permission to modify this one if that is permitted by CDM regs) and present in very specific terms the individual technology packages which will have been chosen by each of the 32 participating plants for generation of renewable energy. This PDD will includes complete references to Technology Options II and III, in order to represent the additionality and the incremental financial decision-making process in the most transparent and historically correct manner.

Data / Parameter:	**D9/$HG_{bl,y}$**
Data unit:	MJ
Description:	Quantity of thermal energy that would be consumed in year y at the project site in the absence of the project activity using fossil fuel Activity level: Thermal Consumption.
Source of data to be used:	Measurement of the fuel used.
Value applied	0
Description of measurement methods and procedures to be applied:	Equipment used: How the measurement is undertaken: Calibration procedures are applied: Accuracy of the measurement method: Responsible person/entity that should undertake the measurements: Measurement interval:
Any comment:	Once the project activity is in place, D9 will be measured by the same instrument used in D13 following the same measurement methode and the same quality assurance as described as in D13.

Data / Parameter:	**$EG_{m,y}$, EG_{y}, $EG_{j,y}$, $EG_{k,y}$ and $EG_{n,h}$**
Data unit:	MWh
Description:	Net electricity generated and delivered to the grid by power plant / unit m, j, k or n (or in the project electricity system in case of EG_y) in year y or hour h
Source of data:	Utility or government records or official publications. In the Colombian case XM is the information office of the National Dispatch Centre (www.xm.com.co).
Measurement procedures (if any):	Standard procedures required by the National Government to each plant delivering electricity to the grid, as the basis for billing.

Monitoring frequency:	Since this Project activity uses Dispatch data OM for calculation of CEF, the monitoring frequency will be at least on an hourly basis. Build Margin: For the first crediting period, reported annually ex-post, following the guidance included in step 4. For the second and third crediting period, only once ex-ante at the start of the second crediting period, unless otherwise indicated by new regs.
QA/QC procedures:	This is official data provided by the National Dispatch Centre, which assures quality of data.
Any comment:	This PDD only seeks CDM Accreditation for Technology Option I, the implementation of new covered anaerobic digesters to capture and mitigate the biogas. After registration and implementation of the project activity, if and only if Technology Option I is technically successful and the incomes from CER sales are sufficient to support further investments in cogeneration of renewable energy, then the Project Participants will either present a second PDD (or request permission to modify this one if that is permitted by CDM regs) and present in very specific terms the individual technology packages which will have been chosen by each of the 32 participating plants for generation of renewable energy. This PDD will includes complete references to Technology Options II and III, in order to represent the additionality and the incremental financial decision-making process in the most transparent and historically correct manner.

Data / Parameter:	**$HR_{i,y}$**
Data unit:	MBTU/MWh
Description:	Efficiency of plant i in transforming Heat into Electricity during year y
Source of data:	Yearly data report by each plant i to the Colombian Ministry of Mines and Energy, to the Mining and Energy Planning Office (UPME – Unidad de Planeción Minero Energética), and to the Commission that Controls Gas and Energy Use in Colombia (CREG – Comisión Reguladora de Energía y Gas). This information is published yearly by CREG.
Measurement procedures (if any):	-
Monitoring frequency:	Dispatch data OM: Reported <u>annually</u> for the year y in which the project activity is displacing grid electricity. Build Margin: For the first crediting period, annually ex-post, following the guidance included in step 4. For the second and third crediting period, only once ex-ante at the start of the second crediting period, , unless otherwise indicated by new regs.
QA/QC procedures:	Uses official data of high quality.
Any comment:	Follows step 2b of the "Tool to Calculate the Emission Factor for an Electricity System" using Dispatch Data Analysis, and according to the Colombian Guidelines to Calculate Hourly Averages to Determine the Emissions Factor Following ACM0002 in Large Scale Projects (http://www.upme.gov.co/siame/Default.aspx?tabid=67). Since in Colombia plants delivering electricity to the grid are obliged to report the plant's Heat Rate in a yearly basis, the calculation of $FE_{EL,n,y}$ follows B1 option of calculation where $FC_{i,m,y}$*$NCV_{i,y}$ is replaced by $HR_{i,m,y}$*$EG_{n,h}$.

Data / Parameter:	$EF_{CO2,i,y}$ and $EF_{CO2,m,i,y}$
Data unit:	tCO_2/GJ
Description:	CO_2 emission factor of fossil fuel type in year y
Source of data:	National average presented by UPME in the FECOC (Emissions factor for Colombian Fuels) software available at http://www.upme.gov.co/siame/Portals/0/FECOCupme.xls
Measurement procedures (if any):	-
Monitoring frequency:	Dispatch data OM: Reported Annually for the year y in which the project activity is displacing grid electricity or, if available, hourly. BM: For the first crediting period, annually ex-post, following the guidance included in step 4 of the "Tool to Calculate the Emission Factor for an Electricity System". For the second and third crediting period, only once ex-ante at the start of the second crediting period, unless otherwise indicated by new regs..
QA/QC procedures:	Offical data of high quality is used.
Any comment:	-

Data / Parameter:	**D10 / $F_{dig,out}$**	
Data unit:	m^3/yr	
Description:	Flow rate of organic wastewater into the digester Activity Level: Open lagoon.	
Source of data to be used:	Field Measurement	
Value applied	Value applied for the baseline estimation, please see table An.3.1 in Annex 3.	
Justification of the choice of data or description of measurement methods and procedures actually applied:	Equipment used:	Volumetric manual method performed by an accredited laboratory
	How the measurement is undertaken:	Standard sampling procedures
	Accuracy of the measurement method:	High
	Responsible person/entity that should undertake the measurements:	External Designated Laboratory in places where a recognized accredited laboratory is available in the region. Otherwise trained personnel from the mills perform the sampling method and report results to the mill manager and to the regional environmental authority.
Any comment:	Once the project activity is in place, D1 will be measured by the same instrument used in D10 following the same measurement methode and the same quality assurance as described as in D10.	

Data / Parameter:	**D11 / COD_{c,dig_out}**
Data unit:	Kg/m^3
Description:	--Concentration of organic wastewater into the covered anaerobic digester --Activity Level: Digester.
Source of data to be used:	Measurement
Value of data applied for	This is a key data parameter. High value.

the purpose of calculating expected emission reductions in section B.5		
Description of measurement methods and procedures to be applied:	Equipment that will be used:	One of two options: a continuous flow COD analyzer; or, Laboratory Procedures.
	How the measurement is undertaken:	Laboratory measurement will be made following international procedures. Information of measurement results should be inserted in the local database and documentation of measurement procedure should be archived.
	Proportion of data to be monitored:	100%
	Accuracy of the measurement method:	High
	Responsible person/entity that should undertake the measurements:	Extraction plant's metric analyst.
	Measurement interval:	With automated COD meter, continuous. With laboratory sampling, monthly
QA/QC procedures to be applied:	If COD continuous flow meter is used, data uncertainty is very low. The maintenance, frequency of calibration and control procedures programming are established by the plant QA/QC department. Calibration and maintenance are subject to procedures established by instrument manufacturer. If laboratory sampling is used, the Uncertainty level of data is low. Sampling will be carried out adhering to internationally recognized procedures.	
Any comment:	The data will be archived minimum two years after each issuance of CERs	

Data / Parameter:	**D12/$EL_{p,y}$**	
Data unit:	MWh	
Description:	Amount of electricity in the year y that is consumed at the project site for the project activity Activity level: Electricity Consumption.	
Source of data to be used:	Automated Measurement by the electricity supply company.	
Value of data applied for the purpose of calculating expected emission reductions in section B.5	High value.	
Description of measurement methods and procedures to be applied:	Equipment that will be used:	Monitoring of Energy meter, confirmed by monthly bills.
	How the measurement is undertaken:	Monthly energy bills will be manually reported to local database. In the future, this could be automated. An automated instrument would measure the energy and transmit the information to a local database using an industrial communication method.

	Calibration procedures are applied:	The calibration procedures for the energy use meter will be made in a Reference Laboratory accredited by international Standards according to indications of the manufacturer. The Reference laboratory should give a Certificate of Calibration specifying the status, identification of instrument, date of calibration, and next calibration.
	Accuracy of the measurement method:	High
	Responsible person/entity that should undertake the measurements:	Extraction plant's metric analyst.
	Measurement interval:	Continuously
QA/QC procedures to be applied:	The maintenance, frequency of calibration and control procedures programming are established by the electricity provider. Calibration and maintenance are subject to procedures established by instrument manufacturer.	
Any comment:	In the future, as local electricity services providers evolve, this function may become fully automated. The data will be archived minimum two years after each issuance of CERs	

Data / Parameter:	**CEF_d**
Data unit:	tCO2e/MWh
Description:	--CO2 emissions factor for electricity consumed at the project site during the project activity --Activity Level: Electricity Use.
Source of data used:	Calculation
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied:	Equipment used: Accuracy of the measurement method: High Responsible person/entity that should undertake the measurements: National Dispatch Center
Any comment:	Annually, the methodology requires that the latest national grid emissions factor be calculated and applied in the monitoring report. Therefore, this parameter will be recalculated with the procedure to calculate the CO2 emissions factor according to ACM0002, latest version.

Data / Parameter:	$D13/HG_{Pr,y}$	
Data unit:	MJ	
Description:	Quantity of thermal energy consumed in year y at the project site due to the project activity Activity level: Thermal Consumption.	
Source of data to be used:	Measurement of the fuel used.	
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0	
Description of measurement methods and procedures to be applied:	Equipment that will be used:	Fuel Flow meter
	How the measurement is undertaken:	Continuously In the future, this could be automated. An automated instrument would measure the energy and transmit the information to a local database using an industrial communication method.
	Calibration procedures are applied:	The calibration procedures for the fuel flow meter will be made in a Reference Laboratory accredited by international Standards according to indications of the manufacturer. The Reference laboratory should give a Certificate of Calibration specifying the status, identification of instrument, date of calibration, and next calibration.
	Accuracy of the measurement method:	High
	Responsible person/entity that should undertake the measurements:	Extraction plant's metric analyst.
	Measurement interval:	Continuously
QA/QC procedures to be applied:	The maintenance, frequency of calibration and control procedures programming for the fuel flow meter are established by the plant QA/QC department. Calibration and maintenance are subject to procedures established by instrument manufacturer.	
Any comment:	Since the heating generation equipment uses environmentally sustainable biomass with methane as fuel, the combustion process results in zero net CO_2 emissions. The CO2 emissions of the combustion process will be consumed by biomass representing a cyclic process of carbon sequestration. For this reason, this variable will not be included in the monitoring procedure.	

Data / Parameter:	$CEF_{Pr,therm,y}$
Data unit:	tCO2e/MJ
Description:	CO2 emissions intensity for thermal energy generation Activity level: Thermal Consumption.
Source of data to be used:	Mills information
Value applied	0
Description of	Equipment used:

measurement methods and procedures to be applied:	How the measurement is undertaken: Calibration procedures are applied: Accuracy of the measurement method: Responsible person/entity that should undertake the measurements: Measurement interval:
Any comment:	No fossil fuels will be used for thermal energy production. Since the heating generation equipment uses environmentally sustainable biomass as fuel, the combustion process results in zero CO_2 emissions. The CO2 emissions of the combustion process will be consumed by growing biomass representing a cyclic process of carbon sequestration. For this reason, this variable will not be included in the monitoring procedure.

Data / Parameter:	**D14/F_{la}**	
Data unit:	m^3/yr	
Description:	Flow rate of sludge used for land application after dewatering Activity level: land application of sludge	
Source of data to be used:	Field Measurement	
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Medium	
Description of measurement methods and procedures to be applied:	Equipment that will be used:	After dewatering, sludge is delivered to the fields in wagons or trucks. Monthly Laboratory sampling of dewatered sludge, and a wagon-truck weighing station. In the future, automated monitoring systems may be introduced.
	How the measurement is undertaken:	2 measurements are required: 1) laboratory sample to determine density and characteristics of dewatered sludge. 2) Volume (weight and density) measured per wagonload or truckload) using the plant's weighing station. Information of measurement results should be reported monthly to the local database and documentation of measurement procedure should be archived. In the future, automated weighting systems may monitor characteristics and volume continually, and the information will be transmitted to a local database using an industrial communication bus.

	Calibration procedures are applied:	The calibration procedures for the wagon-truck weighing station will be carried out in accordance with international Standards according to indications of the manufacturer. The calibration laboratory should give a Certificate of Calibration specifying the status, identification of instrument, date of calibration, and next calibration.
	Accuracy of the measurement method:	High
	Responsible person/entity that should undertake the measurements:	Extraction plant's metric analyst.
	Measurement interval:	Monthly sampling of the dewatered sludge characteristics by the laboratory. Measurement of every load of sludge as it is sent to the fields.
QA/QC procedures to be applied:	The maintenance, frequency of calibration and control procedures programming for the weighing station are established by the plant QA/QC department. Calibration and maintenance are subject to procedures established by instrument manufacturer. Determination of sludge density will be subject to standard international procedures.	
Any comment:	The data will be archived minimum two years after each issuance of CERs	

Data / Parameter:	**D15/COD $_{C,la}$**	
Data unit:	Kg/m^3	
Description:	COD of the sludge used for land application after dewatering Activity Level: land application	
Source of data to be used:	Sampling Measurement	
Value of data applied for the purpose of calculating expected emission reductions in section B.5	High	
Description of measurement methods and procedures to be applied:	Equipment that will be used:	Laboratory Procedures,
	How the measurement is undertaken:	Monthly sampling, with Laboratory measurement following internationally recognized procedures. Information of measurement results should be reported monthly in the local database and documentation of measurement procedure should be archived.
	Proportion of data to be monitored:	100%
	Responsible person/entity that should undertake the measurements:	Extraction plant's metric analyst.
	Measurement interval:	Monthly
QA/QC procedures to be applied:	The Uncertainty level of data is low. Sampling will be carried out adhering to internationally recognized procedures.	
Any comment:	The data will be archived minimum two years after each issuance of CERs	

Data / Parameter:	**B_O**

Data unit:	kg CH_4/kg COD
Description:	Maximum methane producing capacity
Source of data to be used:	IPCC. (2006). *Guidelines for National Greenhouse Gas Inventories*. Volume 5. Section 6.2.2.2. (p.6.12) and section 6.2.3.2. (p.6.21). For conservative reasons AM0013v.4 utilizes 0,21 for Bo
Value applied	0.21
Description of measurement methods and procedures to be applied:	Equipment used: How the measurement is undertaken: Accuracy of the measurement method: Responsible person/entity that should undertake the measurements:
Any comment:	IPCC value.

Data / Parameter:	**MCF_{la}**
Data unit:	tCO2e/kg
Description:	Methane conversion factor for sludge used for land application Activity level: Land Application
Source of data to be used:	AM0013 v.4 p.12
Value applied	0.05
Description of measurement methods and procedures to be applied:	Equipment used: How the measurement is undertaken: Calibration procedures are applied: Accuracy of the measurement method: Responsible person/entity that should undertake the measurements: Measurement interval:
Any comment:	AM0013 v.4 provides the MCF_{la} factor to calculate methane emissions from sludge. Once the project starts operations, the sludge will be removed continuously. For this calculation, it is assumed that the sludge is removed monthly. The amount of COD available in the sludge was calculated by means of information from the COD removed from open lagoons. According to the 2006 Guidelines for National Greenhouse Gas Inventories (volume 6, chapter 6, p. 6.21, table 6.8) the MCF at the inside of the anaerobic digester for sludge is higher than the MCF in open lagoons (anaerobic shallow lagoons) due to the anaerobic digester conversion efficiency. For this calculation it was assumed that MCF from open lagoons accounts for half of the MCF at the inside of the anaerobic digester. Thus in the calculation for COD available for conversion into methane in the sludge leaving the digester, it was used the MCF calculated for open lagoons multiplied by 2 (the efficiency in the anaerobic digester.). Ex ante MCF_{la} estimates will be replaced by

	direct measurement in the monitoring reports to be presented in the verifications of this project activity.

Data / Parameter:	**D16/$F_{c,dw}$**	
Data unit:	m^3/yr	
Description:	Flow rate of organic wastewater from dewatering process Activity level: dewatering	
Source of data to be used:	Field Measurement	
Value of data applied for the purpose of calculating expected emission reductions in section B.5		
Description of measurement methods and procedures to be applied:	Equipment that will be used:	Flow meter for residual water with indicator, transmitter and communication.
	How the measurement is undertaken:	The instrument will be located at the output of the dewatering system. It will measure the flow and transmit the information to a local database using an industrial communication method.
	Calibration procedures are applied:	The calibration procedures will be made in laboratory accredited by international Standards according to indications of the manufacturer. The calibration laboratory should give a Certificate of Calibration specifying the status, identification of instrument, date of calibration, and next calibration.
	Accuracy of the measurement method:	High
	Responsible person/entity that should undertake the measurements:	Plant Extraction Plant's metric analyst,
	Measurement interval:	Continuously
QA/QC procedures to be applied:	The uncertainty level of data is low. The instrument will generate an alarm indicating that a detectable failure is in progress. The maintenance, frequency of calibration and control procedures programming are established by the plant QA/QC department. Calibration and maintenance are subject to procedures established by instrument manufacturer.	
Any comment:	Parameter monitored continuously but aggregated monthly for calculations. The data will be archived minimum two years after each issuance of CERs	

Data / Parameter:	**D17/$COD_{c,dw}$**	
Data unit:	Kg/m^3	
Description:	**COD** $_{c,dw}$ of the wastewater from the dewatering process Activity level: *Dewatering*	
Source of data to be used:	Measurement	
Value of data applied for the purpose of calculating expected emission reductions in section B.5		
Description of measurement	Equipment that will be used:	Laboratory Procedures,

methods and procedures to be applied:	How the measurement is undertaken: Laboratory measurement will be made following international procedures. Information of measurement results should be inserted in the local database and documentation of measurement procedure should be archived. Proportion of data to be monitored: 100% Accuracy of measurement method: High Responsible person/entity that should undertake the measurements: Enterprise engineer representative to the umbrella project Measurement interval: At least monthly
QA/QC procedures to be applied:	The Uncertainty level of data is low. Sampling will be carried out adhering to internationally recognized procedures.
Any comment:	The data will be archived minimum two years after each issuance of CERs.

Data / Parameter:	**D18 / FR_{bio}**
Data unit:	m^3/yr
Description:	Amount of biogas collected in the outlet of the biodigester Activity Level: Digester
Source of data to be used:	Field Measurement
Value of data applied for the purpose of calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	Equipment that will be used: Flow meter for biogas with indicator, transmitter and communication. How the measurement is undertaken: The instrument will be located at the biogas output of the anaerobic digester. It will measure the flow and transmit the information to a local database using an industrial communication method. Calibration procedures are applied: The calibration procedures will be made in laboratory accredited by international Standards according to indications of the manufacturer. The calibration laboratory should give a Certificate of Calibration specifying the status, identification of instrument, date of calibration, and next calibration. Accuracy of the measurement method: High Responsible person/entity that should undertake the measurements: Extraction Plant metric analyst, Measurement interval: Continuously
QA/QC procedures to be applied:	Laboratory sampling and analysis procedures conform to international standards.
Any comment:	Parameter monitored continuously but aggregated monthly for calculations. The data will be archived minimum two years after each issuance of CERs.

Data / Parameter:	D19/$P_{CH4,bio}$	
Data unit:	%	
Description:	Percentage of methane in the biogas, located in the outlet of the covered anaerobic digester. Activity level: covered anaerobic digester.	
Source of data to be used:	Field Measurement, automated with a continuous flow gas analyzer.	
Value of data applied for the purpose of calculating expected emission reductions in section B.5	High	
Description of measurement methods and procedures to be applied:	Equipment that will be used:	Continuous gas analyzer for biogas with indicator, transmitter and communication.
	How the measurement is undertaken:	The instrument will be located at the output of the anaerobic digester. It will determine the percentage of methane and transmit the information to a local database using an industrial communication bus.
	Calibration procedures are applied:	The calibration procedures will be carried out in reference laboratories, according to specifications of the manufacturer. The calibration laboratory should give a Certificate of Calibration specifying the status, identification of instrument, date of calibration, and next calibration.
	Accuracy of the measurement method:	High
	Responsible person/entity that should undertake the measurements:	Extraction plant's metric analyst will ensure performance of the analyzer.
	Measurement interval:	Continuous.
QA/QC procedures to be applied:	The instrument will generate an alarm to the plant's metric analyst indicating when a detectable failure is in progress. The maintenance, frequency of calibration and control procedures programming are established by the plant QA/QC, per procedures and specifications established by instrument manufacturer.	
Any comment:	Data to be measured at wet basis. The data will be archived minimum two years after each issuance of CERs	

Data / Parameter:	D20 / FRf,inlet	
Data unit:	m^3/yr	
Description:	Flow rate of the biogas entering the flare. Activity level: flaring of methane and the biogas.	
Source of data to be used:	Field Measurement, automated.	
Value of data applied for the purpose of calculating expected emission reductions in section B.5	High	
Description of measurement methods and	Equipment that will be used:	Flow meter for biogas with indicator, transmitter and communication.

procedures to be applied:	How the measurement is undertaken:	The instrument will be located at the biogas input of the enclosed high-efficiency flare. It will measure the flow and transmit the information to a local database using an industrial communication method.
	Calibration procedures are applied:	The calibration procedures will be carried out in laboratory accredited by international Standards, according to specifications of the manufacturer. The calibration laboratory should give a Certificate of Calibration specifying the status, identification of instrument, date of calibration, and next calibration.
	Accuracy of the measurement method:	High
	Responsible person/entity that should undertake the measurements:	Extraction Plant metric analyst
	Measurement interval:	Continuously
QA/QC procedures to be applied:	The uncertainty level of data is low. The instrument will generate an alarm indicating that a detectable failure is in progress. The maintenance, frequency of calibration and control procedures programming are established by the plant QA/QC department. Calibration and maintenance are subject to procedures established by instrument manufacturer.	
Any comment:	Parameter monitored continuously but aggregated monthly for calculations. The data will be archived minimum two years after each issuance of CERs.	

Data / Parameter:	**D21.5 / TVn,FG,h**	
Data unit:	m^3/h	
Description:	Flow rate of the enclosed high efficiency flare stack gases Activity level: flaring	
Source of data to be used:	Field Measurement, automated	
Value of data applied for the purpose of calculating expected emission reductions in section B.5	High	
Description of measurement methods and procedures to be applied:	Equipment that will be used:	Flow meter for stack emissions with indicator, transmitter and communication.
	How the measurement is undertaken:	The instrument will be located at the output stack of the flare. It will measure the flow and transmit the information to a local database using an industrial communication method.
	Calibration procedures are applied:	The calibration procedures will be made in laboratory accredited by international Standards according to indications of the manufacturer. The calibration laboratory should give a Certificate of Calibration specifying the status, identification of instrument, date of calibration, and next calibration.
	Accuracy of the measurement method:	High

	Responsible person/entity that should undertake the measurements: Extraction Plant metric analyst. Measurement interval: Continuously
QA/QC procedures to be applied:	The uncertainty level of data is low. The instrument will generate an alarm indicating when a detectable failure is in progress. The maintenance, frequency of calibration and control procedures programming are established by the plant QA/QC department. Calibration and maintenance are subject to procedures established by instrument manufacturer.
Any comment:	Parameter monitored continuously but aggregated monthly for calculations. The data will be archived minimum two years after each issuance of CERs.

Data / Parameter:	**D21 /PE flare,y**
Data unit:	tCO2
Description:	Project emissions from flaring of the residual gas stream in year y. Activity level: Flaring
Source of data to be used:	Field Measurement, automated
Value of data applied for the purpose of calculating expected emission reductions in section B.5	High
Description of measurement methods and procedures to be applied:	Equipment that will be used: How the measurement is undertaken: The parameters used for determining the project emissions from flaring of the residual gas stream in year y (PEflare,y) should be monitored as per the *"Tool to determine project emissions from flaring gases containing Methane"*. Calibration procedures are applied: Accuracy of the measurement method: High Responsible person/entity that should undertake the measurements: Extraction plant metric analyst Measurement interval: Continuous
QA/QC procedures to be applied:	The maintenance, frequency of calibration and control procedures programming are established by the plant QA/QC department. Calibration and maintenance are subject to procedures established by instrument manufacturer. The parameters used for determining the project emissions from flaring of the residual gas stream in year y ($PE_{flare,y}$) should use the QA/QC procedures as per the *"Tool to determine project emissions from flaring gases containing Methane"*.
Any comment:	Option a, using 90% default value, continuous monitoring of compliance with manufacturer's specifications. The data will be archived minimum two years after each issuance of CERs.

Data / Parameter:	**D21.1/$fv_{i,h}$**
Data unit:	--
Description:	Volumetric fraction of component i in the residual gas in the hour h where i = CH4 , CO, CO2 , O2 , H2 , N2 .
Source of data to be used:	Measurements

Value of data applied for the purpose of calculating expected emission reductions in section B.6	0.5	
Description of measurement methods and procedures to be applied:	Equipment that will be used: How the measurement is undertaken: Calibration procedures are applied: Accuracy of the measurement method: Responsible person/entity that should undertake the measurements:	Measurement using a gas analyser continuously Ensure that the same basis (dry or wet) is considered for this measurement and the measurement of the volumetric flow rate of the residual gas (FVRG,h) when the residual gas temperature exceeds 60 ºC. Values to be averaged hourly or at a shorter time interval.
QA/QC procedures to be applied:	Analysers must be periodically calibrated according to the manufacturer's recommendation. A zero check and a typical value check should be performed by comparison with a standard certified gas.	
Any comment:	Data will be archived electronically, minimum for two years, after last issuance of CERs. Project participants may only measure the methane content of the residual gas leaving the biodigester. According to the "tool to determine methane emissions from flaring gases containing methane" it is allowed to consider the remaining fraction part as N2 . Therefore, composition of biogas leaving the biodigester is the same as the composition at the flaring system inlet, thus **D19/$P_{CH4,bio}$** and **D21.1/$fv_{i,h}$** values will be the same.	

Data / Parameter:	**D21.2/$T_{O2,h}$**	
Data unit:		
Description:	Volumetric fraction of O2 in the exhaust gas of the flare in the hour H	
Source of data to be used:	Field Measurement, automated with a continuous flow gas analyzer.	
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.062	
Description of measurement methods and procedures to be applied:	Equipment that will be used: How the measurement is undertaken:	Continuous gas analyzer for biogas The instrument will be located at the output of the anaerobic digester. It will determine the percentage of methane and transmit the information to a local database using an industrial communication bus.

	Calibration procedures are applied: The calibration procedures will be carried out in reference laboratories, according to specifications of the manufacturer. The calibration laboratory should give a Certificate of Calibration specifying the status, identification of instrument, date of calibration, and next calibration. Accuracy of the measurement method: High Responsible person/entity that should undertake the measurements: Extraction plant's metric analyst will ensure performance of the analyzer. Measurement interval: Continuous.
QA/QC procedures to be applied:	The instrument will generate an alarm to the plant's metric analyst indicating when a detectable failure is in progress. The maintenance, frequency of calibration and control procedures programming are established by the plant QA/QC, per procedures and specifications established by instrument manufacturer.
Any comment:	This data will not be measured as the default efficiency value of 90% will be taken for enclosed flares. the tool for determine methane emissions from flaring was use to calculate exhaust gases from electricity generator and heat generator. See files "EG Emissions simulation.xls" and "HG emissions simulation.xls". TO2h values for heat generation equipment and electricity generation equipent is taken from " Guidance for Monitoring Landfill Gas Engine Emissions"from UK Environment Agency (http://www.environment-agency.gov.uk/commondata/acrobat/engines2002.pdf). Using a default value of 0.05. Flare value is taken from manufacturer's specification in the file "specifications_enclosed.pdf". John Zink is the most plausible technology provider to provide the flaring systems to this project activity.

Data / Parameter:	**D21.4** / **T** flare
Data unit:	ºC
Description:	Temperature in the exhaust gas of the flare Activity level: flaring
Source of data to be used:	Measurements by project participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	High
Description of measurement methods and procedures to be applied:	Equipment that will be used: Thermocouple. How the measurement is undertaken: Calibration procedures are applied: Thermocouples should be replaced or calibrated every year. Accuracy of the measurement method: High

	Responsible person/entity that should undertake the measurements: Extraction plant metric analyst Measurement interval: Continuously.
QA/QC procedures to be applied:	Thermocouples should be replaced or calibrated every year.
Any comment:	The data will be archived minimum two years after each issuance of CERs. A temperature above 500 ºC indicates that a significant amount of gases are still being burnt and that the flare is operating. An excessively high temperature at the sampling point (above 700 ºC) may be an indication that the flare is not being adequately operated or that its capacity is not adequate to the actual flow. In cases where a 90% default flare efficiency is taken, the operating temperatures must be between 760ºC to 982 ºC, as specified by flare manufacturer.

Data / Parameter:	**D22 / FRe,inlet**
Data unit:	m^3/yr
Description:	Flow rate of the biogas entering the electricity generation equipment Activity level: electricity generation
Source of data to be used:	Field Measurement, automated
Value of data applied for the purpose of calculating expected emission reductions in section B.5	High
Description of measurement methods and procedures to be applied:	Equipment that will be used: Flow meter for biogas with indicator, transmitter and communication. How the measurement is undertaken: The instrument will be located at the biogas input of the electricity generation equipment. It will measure the flow and transmit the information to a local database using an industrial communication method. Calibration procedures are applied: The calibration procedures will be made in laboratory accredited by international Standards according to indications of the manufacturer. The calibration laboratory should give a Certificate of Calibration specifying the status, identification of instrument, date of calibration, and next calibration. Accuracy of the measurement method: High Responsible person/entity that should undertake the measurements: Extraction Plant metric analyst, Measurement interval: Continuously
QA/QC procedures to be applied:	The uncertainty level of data is low. The instrument will generate an alarm indicating that a detectable failure is in progress. The maintenance, frequency of calibration and control procedures programming are established by the plant QA/QC department. Calibration and maintenance are subject to procedures established by instrument manufacturer.
Any comment:	Parameter monitored continuously but aggregated monthly for calculations. The data will be archived minimum two years after each issuance of CERs. This PDD only seeks CDM Accreditation for Technology Option I, the implementation of

	new covered anaerobic digesters to capture and mitigate the biogas. After registration and implementation of the project activity, if and only if Technology Option I is technically successful and the incomes from CER sales are sufficient to support further investments in cogeneration of renewable energy, then the Project Participants will either present a second PDD (or request permission to modify this one if that is permitted by CDM regs) and present in very specific terms the individual technology packages which will have been chosen by each of the 32 participating plants for generation of renewable energy. This PDD will includes complete references to Technology Options II and III, in order to represent the additionality and the incremental financial decision-making process in the most transparent and historically correct manner.

Data / Parameter:	**D23 / FRe,s**
Data unit:	m^3/yr
Description:	Flow rate of the electricity generation equipment stack gases Activity level: electricity generation
Source of data to be used:	Field Measurement
Value of data applied for the purpose of calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	Equipment that will be used: Flow meter for biogas with indicator, transmitter and communication. How the measurement is undertaken: The instrument will be located at the output stack of the flare. It will measure the flow and transmit the information to a local database using an industrial communication method. Calibration procedures are applied: The calibration procedures will be made in laboratory accredited by international Standards according to indications of the manufacturer. The calibration laboratory should give a Certificate of Calibration specifying the status, identification of instrument, date of calibration, and next calibration. Accuracy of the measurement method: High Responsible person/entity that should undertake the measurements: Extraction Plant metric analyst, Measurement interval: Continuously
QA/QC procedures to be applied:	The uncertainty level of data is low. The instrument will generate an alarm indicating that a detectable failure is in progress. The maintenance, frequency of calibration and control procedures programming are established by the plant QA/QC department. Calibration and maintenance are subject to procedures established by instrument manufacturer.
Any comment:	Parameter monitored continuously but aggregated monthly for calculations. The data will be archived minimum two years after each issuance of CERs. This PDD only seeks CDM Accreditation for Technology Option I, the implementation of new covered anaerobic digesters to capture and mitigate the biogas. After registration and implementation of the project activity, if and only if Technology Option I is technically successful and the incomes from CER sales are sufficient to support further investments in cogeneration of renewable energy, then the Project Participants will either present a second

	PDD (or request permission to modify this one if that is permitted by CDM regs) and present in very specific terms the individual technology packages which will have been chosen by each of the 32 participating plants for generation of renewable energy. This PDD will includes complete references to Technology Options II and III, in order to represent the additionality and the incremental financial decision-making process in the most transparent and historically correct manner.

Data / Parameter:	**D24/PCH4,e,s**	
Data unit:	%	
Description:	Methane content in stack gas of electricity generation equipment Activity level: Electricity generation.	
Source of data to be used:	Field Measurement	
Value of data applied for the purpose of calculating expected emission reductions in section B.5	High	
Description of measurement methods and procedures to be applied:	Equipment that will be used:	Continuous gas analyzer of stack gases with indicator, transmitter and communication.
	How the measurement is undertaken:	The instrument will be located on the exhaust of the generation equipment engine. It will determine the percentage of methane and transmit the information to a local database using an industrial communication bus.
	Calibration procedures are applied:	The calibration procedures will be made in laboratory accredited by international Standards according to indications of the manufacturer. The calibration laboratory should give a Certificate of Calibration specifying the status, identification of instrument, date of calibration, and next calibration.
	Accuracy of the measurement method:	High
	Responsible person/entity that should undertake the measurements:	Extraction plant metric analyst will ensure performance.
	Measurement interval:	Continuous
QA/QC procedures to be applied:	The instrument will generate an alarm indicating that a detectable failure is in progress. The maintenance, frequency of calibration and control procedures programming are established by the plant QA/QC department. Calibration and maintenance are subject to procedures established by instrument manufacturer.	
Any comment:	The data will be archived minimum two years after each issuance of CERs. This PDD only seeks CDM Accreditation for Technology Option I, the implementation of new covered anaerobic digesters to capture and mitigate the biogas. After registration and implementation of the project activity, if and only if Technology Option I is technically successful and the incomes from CER sales are sufficient to support further investments in cogeneration of renewable energy, then the Project Participants will either present a second PDD (or request permission to modify this one if that is permitted by CDM regs) and present in very specific terms the individual technology packages which will have been chosen by each of the 32 participating plants for generation of renewable energy. This PDD will includes complete references to Technology Options II and III, in order to represent the additionality and the incremental financial decision-making process in the most transparent	

	and historically correct manner.

Data / Parameter:	**D25 /Tcomb,e**	
Data unit:	Fraction	
Description:	Fraction of time gas is combusted in the electricity generation equipment Activity Level: Electricity Generation	
Source of data to be used:	Field Measurement, automated	
Value of data applied for the purpose of calculating expected emission reductions in section B.5	High	
Description of measurement methods and procedures to be applied:	Equipment that will be used:	Run time meter or combustion controller with transmitter and communication.
	How the measurement is undertaken:	The instrument, connected to the power plant, will take the run time or combustion time measurements and transmit to a local database using an industrial communications method.
	Calibration procedures are applied:	The calibration procedures will be made in laboratory accredited by international Standards according to indications of the manufacturer. The calibration laboratory should give a Certificate of Calibration specifying the status, identification of instrument, date of calibration, and next calibration.
	Accuracy of the measurement method:	High
	Responsible person/entity that should undertake the measurements:	Extraction plant's metric analyst
	Measurement interval:	Continuously
QA/QC procedures to be applied:	The instrument will generate an alarm indicating that a detectable failure is in progress. The maintenance, frequency of calibration and control procedures programming are established by the plant QA/QC department. Calibration and maintenance are subject to procedures established by instrument manufacturer.	
Any comment:	The data will be archived minimum two years after each issuance of CERs.	

Data / Parameter:	**D26/ FRh,inlet**	
Data unit:	m^3/yr	
Description:	Flow rate of the biogas entering the heat generation equipment Activity level: heat generation	
Source of data to be used:	Field Measurement, automated	
Value of data applied for the purpose of calculating expected emission reductions in section B.5	High	
Description of measurement methods and	Equipment that will be used:	Flow meter for biogas with indicator, transmitter and communication.

procedures to be applied:	How the measurement is undertaken:	The instrument will be located at the biogas input of the boiler oven. It will measure the flow and transmit the information to a local database using an industrial communication method.
	Calibration procedures are applied:	The calibration procedures will be made in laboratory accredited by international Standards according to indications of the manufacturer. The calibration laboratory should give a Certificate of Calibration specifying the status, identification of instrument, date of calibration, and next calibration.
	Accuracy of the measurement method:	High
	Responsible person/entity that should undertake the measurements:	Extraction Plant metric analyst will ensure performance.
	Measurement interval:	Continuously
QA/QC procedures to be applied:	The uncertainty level of data is low. The instrument will generate an alarm indicating that a detectable failure is in progress. The maintenance, frequency of calibration and control procedures programming are established by the plant QA/QC department. Calibration and maintenance are subject to procedures established by instrument manufacturer.	
Any comment:	Parameter monitored continuously but aggregated monthly for calculations. The data will be archived minimum two years after each issuance of CERs.	

Data / Parameter:	**D27/ FRh,s**	
Data unit:	m^3/yr	
Description:	Flow rate of the heat generation equipment stack gases Activity level: heat generation	
Source of data to be used:	Field Measurement, automated.	
Value of data applied for the purpose of calculating expected emission reductions in section B.5	High	
Description of measurement methods and procedures to be applied:	Equipment that will be used:	Flow meter stack gases with indicator, transmitter and communication.
	How the measurement is undertaken:	The instrument will be located at the output stack of the heat generation equipment. It will measure the flow and transmit the information to a local database using an industrial communication method.
	Calibration procedures are applied:	The calibration procedures will be made in laboratory accredited by international Standards according to indications of the manufacturer. The calibration laboratory should give a Certificate of Calibration specifying the status, identification of instrument, date of calibration, and next calibration.
	Accuracy of the measurement method:	High

	Responsible person/entity that should undertake the measurements:	Extraction Plant metric analyst,
	Measurement interval:	Continuously
QA/QC procedures to be applied:	The uncertainty level of data is low. The instrument will generate an alarm indicating that a detectable failure is in progress. The maintenance, frequency of calibration and control procedures programming are established by the plant QA/QC department. Calibration and maintenance are subject to procedures established by instrument manufacturer.	
Any comment:	Parameter monitored continuously but aggregated monthly for calculations. The data will be archived minimum two years after each issuance of CERs.	

Data / Parameter:	**D28/PCH4,h,s**	
Data unit:	%	
Description:	Methane content in stack gas of heat generation equipment Activity level: heat generation equipment	
Source of data to be used:	Field Measurement, automated	
Value of data applied for the purpose of calculating expected emission reductions in section B.5	High	
Description of measurement methods and procedures to be applied:	Equipment that will be used:	Continuous gas analyzer for stack gases with indicator, transmitter and communication.
	How the measurement is undertaken:	The sensing element will be located on the stack of the heat generation equipment. It will determine the percentage of methane and transmit the information to a local database using an industrial communication bus.
	Calibration procedures are applied:	The calibration procedures will be made in laboratory accredited by international Standards according to indications of the manufacturer. The calibration laboratory should give a Certificate of Calibration specifying the status, identification of instrument, date of calibration, and next calibration.
	Accuracy of the measurement method:	High
	Responsible person/entity that should undertake the measurements:	Extraction plant metric analyst
	Measurement interval:	Continuous
QA/QC procedures to be applied:	The instrument will generate an alarm indicating that a detectable failure is in progress. The maintenance, frequency of calibration and control procedures programming are established by the plant QA/QC department. Calibration and maintenance are subject to procedures established by instrument manufacturer.	
Any comment:	The data will be archived minimum two years after each issuance of CERs.	

Data / Parameter:	**D29/Tcomb,h**
Data unit:	Fraction
Description:	Fraction of time gas is combusted in the heat generation equipment Activity Level: heat generation equipment
Source of data to be used:	Field Measurement, automated

Value of data applied for the purpose of calculating expected emission reductions in section B.5	High	
Description of measurement methods and procedures to be applied:	Equipment that will be used:	Run time meter or flame continuous temperature controller with transmitter and communication.
	How the measurement is undertaken:	The instrument will be connected to the flame detector and will transmit the information to a local database using and industrial connection bus.
	Calibration procedures are applied:	The calibration procedures will be made in laboratory accredited by international Standards according to indications of the manufacturer. The calibration laboratory should give a Certificate of Calibration specifying the status, identification of instrument, date of calibration, and next calibration.
	Accuracy of the measurement method:	High
	Responsible person/entity that should undertake the measurements:	Extraction plant metric analyst
	Measurement interval:	Continuously
QA/QC procedures to be applied:	The instrument will generate an alarm indicating that a detectable failure is in progress. The maintenance, frequency of calibration and control procedures programming are established by the plant QA/QC department. Calibration and maintenance are subject to procedures established by instrument manufacturer.	
Any comment:	The data will be archived minimum two years after each issuance of CERs.	

Data / Parameter:	**D30/S,e**	
Data unit:	Kg/yr	
Description:	Amount of sludge applied to land Activity level: Land application of sludge	
Source of data to be used:	Field Measurement, in batches	
Value of data applied for the purpose of calculating expected emission reductions in section B.5	High	
Description of measurement methods and procedures to be applied:	Equipment that will be used:	Using a wagon-truck weighing station.
	How the measurement is undertaken:	Volume (weight and density) measured per wagonload or truckload) of sludge being sent to fields using the plant's weighing station.
	Calibration procedures are applied:	The calibration procedures of the weighing station will be done according to indications of the manufacturer. The calibration laboratory should give a Certificate of Calibration specifying the status, identification of instrument, date of calibration, and next calibration.

	Accuracy of the measurement method:	High
	Responsible person/entity that should undertake the measurements:	Extraction plant metric analyst
	Measurement interval:	Batch by batch
QA/QC procedures to be applied:	The maintenance, frequency of calibration and control procedures programming are established by the plant QA/QC department. Calibration and maintenance are subject to procedures established by instrument manufacturer.	
Any comment:	The data will be archived minimum two years after each issuance of CERs.	

Data / Parameter:	**D31 / NC**	
Data unit:	Kg N / Kg Sludge	
Description:	Nitrogen Content in the sludge Activity Level: land application.	
Source of data to be used:	Measurement	
Value of data applied for the purpose of calculating expected emission reductions in section B.5	High	
Description of measurement methods and procedures to be applied:	Equipment that will be used:	Standard Field sampling and Laboratory equipment.
	How the measurement is undertaken:	Standard field sampling and Laboratory measurement will be made following international procedures. Information of measurement results should be inserted monthly into the local database and documentation of measurement procedure should be archived.
	Responsible person/entity that should undertake the measurements:	Enterprise engineer representative to the umbrella project
	Measurement interval:	Monthly
QA/QC procedures to be applied:	The Uncertainty level of data is low. Sampling will be carried out adhering to internationally recognized procedures.	
Any comment:	The data will be archived minimum two years after each issuance of CERs.	

Data / Parameter:	**EF_{N2O}**
Data unit:	Kg N2O/kg N
Description:	Emission factor of nitrogen from sludge applied to land Activity level: Land application
Source of data to be used:	AM0013 v.4
Value applied	0.016
Description of measurement methods and procedures to be	Equipment used: How the measurement is undertaken: Calibration procedures are applied:

applied:	Accuracy of the measurement method: Responsible person/entity that should undertake the measurements: Measurement interval:
Any comment:	Emissions factor provided by AM0013.v4.

Data / Parameter:	**D32**
Data unit:	
Description:	Existence and enforcement of relevant regulations and incentives beyond the bounds of the project activity.
Source of data to be used:	Qualitative
Value of data applied for the purpose of calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	Yearly consultation with the Ministry of the Environment and Regional Environmental Authorities about changes in wastewater, effluents and sludge management regulations leading to enforce the project activity.
QA/QC procedures to be applied:	
Any comment:	The data will be archived minimum two years after each issuance of CERs.

ANNEX 5

2008 FINANCIAL ANALYSES OF EMISSION REDUCTION TECHNOLOGY OPTION I AT THE 32 PARTICIPATING PLANTS.

In 2008, in preparation for CDM Registration and subsequent project implementation, FEDEPALMA contracted an expert WWT consulting firm, Proyectos Civiles y Ambientales (PCA), to design the new covered anaerobic digesters (Technology Option I) for each of the 32 plants taking into account all the equipment and technologies that are required by the approved methodology AM 0013.v4. The Federation then hired a leading investment bank, INCORBANK, to undertake a complete financial feasibility study of Technology Option I with current price levels, based on the PCA designs, including cash flow analyses for the 30 year lifetime of the project. Due to the extensive requirements of the methodology, the actual investment costs are today several times higher than were originally estimated in 2004. As was found in the 2004 financial analysis study (see below), the absence of incomes from capturing and mitigating the methane result in negative cash flows and NPV, in the absence of CDM registration and CER sales. Application of the 30 year project lifetime without CER sales makes it even more negative than a 10 year time frame. This updated and complete financial analysis confirms the original financial analysis finding from 2004, that this project is completely and fully additional. It will not take place without CER incomes.

The 2008 financial analysis carried out by INCORBANK for Technology Option I at each of the 32 plants is provided as additional documentation in the excel spreadsheet entitled "cash flow 32 plants INCORBANK". Dr. Jaime Ricaurte, President of INCORBANK, welcomes any additional questions that the UNFCCC may have regarding the financial analyses of the 32 plants interested in undertaking the project activity. His contact data are found on the excel spread sheet. The summary of the aggregated financial analyses for the 32 plants to implement Technology Option I based on 30 year cash flow and NPV analysis are presented below. Afterwards, the original financial analysis for the 16 representative plants that led to the financial decision to proceed with the CDM investment opportunity is presented.

FEDEPALMA SECTORAL CDM UMBRELLA PROJECT FOR METHANE CAPTURE, FOSSIL FUEL DISPLACEMENT AND COGENERATION OF RENEWABLE ENERGY. V.9

FINANCIAL ANALYSIS FOR 32 PLANTS, TECHNOLOGY OPTION 1, METHANE MITIGATION ONLY

ITEM	Ago-Dic 08	2009	2010	2011	2012	2013	2014	2015
COSTS (USD$x10^3)								
Investment Costs								
Lagoons improvent civil engineering work	7.626,56					1.792,01		
Coverage for the Anaerobic digester	3.312,74					760,61		
Flaring system	2.557,01							
Monitoring System	6.500,28							
Conduction and filtering of the biogas collection system, and civil work supervision	1.285,13							
Administrative Costs								
Labour	171,57	386,98	400,52	413,58	426,02	439,23	452,86	466,91
Calibration of monitoring equipment	315,94	298,90	316,35	329,24	329,85	342,94	356,55	370,71
unforeseen expenses	1.040,96	1.077,80	1.114,88	1.151,00	1.186,45	1.223,00	1.260,67	1.299,49
TOTAL COSTS	22.810,17	1.763,69	1.831,75	1.893,83	1.942,32	4.557,79	2.070,08	2.137,11
INCOMES (USD$x10^3)								
Incomes	-	-	-	-	-	-	-	-
TOTAL INCOMES	0	0	0	0	0	0	0	0
NET CASH FLOW (USD$x10^3)	- 22.810,17	- 1.763,69	- 1.831,75	- 1.893,83	- 1.942,32	- 4.557,79	- 2.070,08	- 2.137,11
Financial Indexes								
NPV	- 172.028,98							
IRR	#¡DIV/0!							

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11/Feb/2008

FEDEPALMA SECTORAL CDM UMBRELLA PROJECT FOR METHANE CAPTURE, FOSSIL FUEL DISPLACEMENT AND COGENERATION OF RENEWABLE ENERGY. V.9

FINANCIAL ANALYSIS FOR 32 PLANTS, TECHNOLOGY OPTION 1, METHANE MITIGATION ONLY

2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
		2.228,11					2.465,71					3.141,15
		5.311,12					2.240,48					11.034,37
481,40	496,33	511,74	527,62	543,99	560,88	578,29	596,24	614,75	633,84	653,52	673,81	694,73
385,43	400,73	425,22	442,03	459,51	477,69	496,59	516,24	536,67	557,92	580,01	602,97	644,65
1.339,52	1.380,78	1.794,62	1.849,89	1.906,87	1.965,60	2.026,14	2.088,55	2.152,88	2.219,18	2.287,53	2.357,99	3.128,49
2.206,34	2.277,84	10.270,79	2.819,54	2.910,38	3.004,17	3.101,02	7.907,22	3.304,30	3.410,94	3.521,06	3.634,77	18.643,39
-	-	-	-	-	-	-	-	-	-	-	-	-
0	0	0	0	0	0	0	0	0	0	0	0	0
- 2.206,34	- 2.277,84	- 10.270,79	- 2.819,54	- 2.910,38	- 3.004,17	- 3.101,02	- 7.907,22	- 3.304,30	- 3.410,94	- 3.521,06	- 3.634,77	- 18.643,39

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FEDEPALMA SECTORAL CDM UMBRELLA PROJECT FOR METHANE CAPTURE, FOSSIL FUEL DISPLACEMENT AND COGENERATION OF RENEWABLE ENERGY. V.9

FINANCIAL ANALYSIS FOR 32 PLANTS, TECHNOLOGY OPTION 1, METHANE MITIGATION ONLY

2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
				3.221,82						
				3.720,36						
716,31	738,56	761,50	783,98	806,57	829,17	851,76	874,35	896,95	919,54	942,14
670,03	696,42	723,85	750,58	777,48	804,39	831,30	858,20	885,11	912,02	938,93
3.224,85	3.324,17	3.426,56	3.536,50	3.637,63	3.738,76	3.839,88	3.941,01	4.042,14	4.143,27	4.244,40
4.611,19	4.759,14	4.911,90	5.071,05	12.163,86	5.372,31	5.522,94	5.673,57	5.824,20	5.974,83	6.125,46
-	-	-	-	-	-	-	-	-	-	-
0	0	0	0	0	0	0	0	0	0	0
- 4.611,19	- 4.759,14	- 4.911,90	- 5.071,05	- 12.163,86	- 5.372,31	- 5.522,94	- 5.673,57	- 5.824,20	- 5.974,83	- 6.125,46

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11/Feb/2008

2004 FINANCIAL ANALYSES OF EMISSION REDUCTION TECHNOLOGY OPTIONS AT 16 REPRESENTATIVE PLANTS OF THE PALM OIL EXTRACTION PLANTS SECTOR

The CDM prefeasibility study performed in 2004 was based on the life cycle evaluation of the production processes at 16 palm oil extraction plants considered to be representative of the sector, in the four regions of the country where Palm Oil is produced and extracted. Through this process, the Andean Center identified the conditions, energy sources, processes and the technology in use in the sector. GHG emissions sources were identified, evaluated and ranked in terms of volume and cost per ton reduced with the best available technology options. On the basis of these evaluations, and taking into account the experience at the CDM Pilot Project at the Palmeiras plant, 6 scenarios of possible emission reduction technology packages were identified, costed out with the plant managers, and discussed with plant owners. Financial analyses of each of the 6 scenarios of the possible emission reduction technology packages were carried out for each of the 16 representative plants, which included:

REPRESENTATIVE PLANTS INCLUDED IN COSTING AND FINANCIAL ANALYSES		
	Extraction Plant	**Region**
1	Palmeiras S.A.	Western
2	Guaicaramo S.A.	Eastern
3	C.I. El Roble S.A.	Central
4	Extractora del Sur de Casanare S.A.	Eastern
5	Palmeras de Puerto Wilches S.A.	Central
6	CI Tequendama S.A.	Northern
7	Padelma	Northern
8	Palmas del Cesar	Central
9	Aceites S.A.	North
10	Palmas Santa Fe Ltda.	Western
11	Palmeras Santana Ltda.	Eastern
12	Palmas de Tumaco S.A.	Western
13	Agroince Ltda. & CIA S.C.A.	Central
14	Oleaginosas Las Brisas S.A.	Eastern
15	Promociones Agropecuarias Monterrey	Central
16	Palmas Oleaginoas Bucarelia S.A.	Central

SUMMARY NPV TABLES FOR THE PDD FROM CDM TECHNOLOGY OPTIONS I, II, AND III

The Umbrella Project CDM prefeasibility study concluded and recommended to the plant owners that Option I (Scenario 6) should be adopted by all, because it represented the lowest investment and risk, and was clearly additional because all plants use open lagoons effectively to comply with WWT regulations, and because there would be no change in the WWT systems in the absence of the CER sales incentive. In a CDM market that was highly uncertain in 2004-5, with very low and uncertain CER prices, plant owners decided to adopt an incremental adoption process beginning with Technology Option I. If CER prices rose and the market were to appear stable over the medium to long term, they would undertake CDM Technology Options II (Scenario 2) and III (Scenario 4) incrementally, based on each plant's requirements and preferences.

In order to assist the plant owners and investors with to make their investment decisions with clear, straightforward and representative data, the results of the financial analyses carried out with each of the 16 plants in the final section of this document were presented as a weighted average, both in terms of investment amount and in NPV, taking into account the production capacity of the plants. The financial results for CDM Technology Options I, II a and III were averaged and presented as follows in the CDM Project Prefeasibility Study:

CDM TECHNOLOGY OPTION I, Methane Capture and Mitigation (Scenario 6 in the financial analyses)

TECHNOLOGY OPTION I, Methane Capture And Mitigation. Financial Indicators:		
INVESTMENT	NPV	
US$ 101,458	w/o CER	WITH CER
	($166,103)	$199,138
Note that parentheses indicate a negative value. IRR of project without CER is also negative.		

CDM TECHNOLOGY OPTION II, Methane Mitigation plus Electricity Generation for Internal Use. (Scenario 2 in the financial analyses)

TECHNOLOGY OPTION II Methane Mitigation plus Electricity Generation for Internal Use. Financial Indicators		
Initial Investment	**NPV**	
US$ 601,283	**w/o CER**	**with CER**
	(-$212,370)	**$99,389**
Note that parentheses indicate a negative value. IRR of project without CER is also negative.		

TECHNOLOGY OPTION III, Cogeneration of heat and power. (Scenario 4 in the Financial Analyses)

TECHNOLOGY OPTION III: COGENERATION OF HEAT AND POWER Financial Indicators		
INITIAL INVESTMENT	NPV	
US$ US$ 3,332,938	w/o CER	WITH CER
	($ 1,830,322)	(1,194,345)
Note that parentheses indicate a negative value.		

INDIVIDUAL FINANCIAL ANALYSIS FOR EACH OF THE 16 REPRESENTATIVE PLANTS

The original Financial Analysis Tables for each of the 16 plants where the technology option packages were costed out with each plant manager are included below, beginning with the basic assumptions. From the 6 principal emissions reductions technology scenarios evaluated, the three CMD Technology Options were chosen.

BASIC ASSUMPTIONS		
Operating Costs as percent of Investment		5.1%
Price of CER (US $/CER)		6
Number of plants evaluated		16
Exchange rate (peso $/ US)		2700
Discount rate in US $		12%
Sale Price of Energy to grid ($ US /KWh)		0.02
Costs of major reparatión/repairs		35%
Financial costs		15%

FINANCIAL MODEL FOR THE CDM PROJECT AT A PALM OIL EXTRACTION PLANT
Plant: PALMEIRAS S.A.

Cost Kw/hour in the area (Pesos/ $Kw hour): 148

Scenario 1: Increased Electricty Generation 100% with Biomass - Steam. (Investment in New High Efficiency Boilers and Turbines), no biogas capture from WWT. See FEDEPALMA Prefeasibility Study, Chapter 5, Pg 1.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

	1	2	3	4		5	6	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 1.367.000	- 69.668	47.845	253.612	- 1.135.210	0	14.326	- 1.149.536
1		- 69.668	47.845	253.612	231.790	17280	19.056	230.014
2		- 69.668	47.845	253.612	231.790	17280	20.664	228.406
3		- 69.668	47.845	253.612	231.790	17280	22.684	226.386
4		- 69.668	47.845	253.612	231.790	17280	27.110	221.960
5		- 69.668	47.845	253.612	231.790	17280	20.846	228.224
6		- 69.668	47.845	253.612	231.790	17280	20.134	228.936
7		- 69.668	47.845	253.612	231.790	17280	21.060	228.009
8		- 69.668	47.845	253.612	231.790	17280	22.659	226.410
9		- 69.668	47.845	253.612	231.790	17280	23.304	225.766
10		- 69.668	47.845	253.612	231.790	17280	9.227	239.843
NPV (12%)	- 1.367.000,08	- 463.305,26	318.179,94	1.686.579,40	174.454,00	97.635,85	133.269,36	138.820,50
IRR					15,65%			14,88%
CostS Kw/hour Project (Pesos $Kw hour)					- 160			- 164

Scenario 2 (CDM OPTION II): Biogas Capture from covered WWT ponds, with electricity generación with biogás gen plants, no change to baseline boilers, no turbines. See FEDEPALMA Prefeasibility Study, Chapter 5, Pg 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión with Biogás (Mwh/yr): 3600

	1	2	3	4		5	6	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 673.730	- 80.304	23.581	253.612	- 476.840	0	14.326	- 491.166
1		- 80.304	23.581	253.612	196.889	98.448	19.056	276.282
2		- 80.304	23.581	253.612	196.889	98.448	20.664	274.674
3		- 80.304	23.581	253.612	196.889	98.448	22.684	272.653
4		- 80.304	23.581	253.612	196.889	98.448	27.110	268.227
5		- 275.405	23.581	253.612	1.788	98.448	20.846	79.390
6	- 70.370	- 80.304	28.506	253.612	131.445	98.448	20.134	209.759
7		- 80.304	28.506	253.612	201.815	98.448	21.060	279.203
8		- 80.304	28.506	253.612	201.815	98.448	22.659	277.604
9		- 80.304	28.506	253.612	201.815	98.448	23.304	276.959
10		- 80.304	28.506	253.612	201.815	98.448	9.227	291.037
NPV (12%)	- 736.560,62	- 644.742,51	166.891,62	1.686.579,40	499.346,75	556.252,65	133.269,36	922.330,05
IRR					35,45%			51,95%
Cost Kw/hour of the Project ($Kw hour)					- 137			- 79

Scenario 3: Biogas capture from covered WWT ponds, with electricity generation with Biogas Gen Plants, new turbines to cover own energy needs. See Prefeasibility study, Chapter 5, page 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

	1	2	3	4		5	6	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 673.730	- 80.304	23.581	253.612	- 476.840	0	14.326	- 491.166
1		- 80.304	23.581	253.612	196.889	98.448	19.056	276.282
2		- 80.304	23.581	253.612	196.889	98.448	20.664	274.674
3		- 80.304	23.581	253.612	196.889	98.448	22.684	272.653
4		- 80.304	23.581	253.612	196.889	98.448	27.110	268.227
5		- 275.405	23.581	253.612	1.788	98.448	20.846	79.390
6	- 70.370	- 80.304	28.506	253.612	131.445	98.448	20.134	209.759
7		- 80.304	28.506	253.612	201.815	98.448	21.060	279.203
8		- 80.304	28.506	253.612	201.815	98.448	22.659	277.604
9		- 80.304	28.506	253.612	201.815	98.448	23.304	276.959
10		- 80.304	28.506	253.612	201.815	98.448	9.227	291.037
NPV (12%)	- 736.560,62	- 644.742,51	166.891,62	1.686.579,40	499.346,75	556.252,65	133.269,36	922.330,05
IRR					35,45%			51,95%
Cost Kw/hour of the Project ($Kw hour)					- 137			- 79

Scenario 4 (CDM OPTION III): Biogas capture from covered WWT ponds, with electricity generation with Biogas Gen Plants, new high efficiency boilers and turbines, to maximize energy production and offer surplus to the grid. See Prefeasibility study, Chapter
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión (Mwh/yr): 12.126
Sale of electricity to grid (MWh/yr): 8.527

	1	2	3	4	5		6	7	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	Sales of Electricity to the Grid	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 2.637.945	- 243.960	92.328	253.612	170.540	- 2.365.425	0	14.326	- 2.379.751
1		- 243.960	92.328	253.612	170.540	272.520	124.028	19.056	377.493
2		- 243.960	92.328	253.612	170.540	272.520	124.028	20.664	375.885
3		- 243.960	92.328	253.612	170.540	272.520	124.028	22.684	373.864
4		- 243.960	92.328	253.612	170.540	272.520	124.028	27.110	369.438
5		- 439.062	92.328	253.612	170.540	77.419	124.028	20.846	180.601
6	- 70.370	- 243.960	97.254	253.612	170.540	207.076	124.028	20.134	310.971
7		- 243.960	97.254	253.612	170.540	277.446	124.028	21.060	380.414
8		- 243.960	97.254	253.612	170.540	277.446	124.028	22.659	378.815
9		- 243.960	97.254	253.612	170.540	277.446	124.028	23.304	378.170
10		- 243.960	97.254	253.612	170.540	277.446	124.028	9.227	392.248
NPV (12%)	- 2.700.776,04	- 1.733.095,36	624.078,09	1.686.579,40	1.134.129,04	- 961.906,01	700.786,86	133.269,36	- 394.388,50
IRR						1%			7,78%
Cost Kw/hour of the Project ($Kw hour)						- 165			- 101,71

Scenario 5: Biogas capture from covered WWT ponds, electricity gen with existing diesel plants modified for 40% biogás, 60% diesel (Dual Gen System). See Prefeasibility study, Chapter 5, page 2
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión with Biogás (kwh/yr): 1.440 40%

	1	2	3	4		5	6		
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM	Simple return
0	- 136.296	- 12.920	9.541	101.445	- 38.231	0	14.326	- 13.177	
1		- 12.920	9.541	101.445	98.066	39.379	19.056	118.389	
2		- 12.920	9.541	101.445	98.066	39.379	20.664	116.781	
3		- 12.920	9.541	101.445	98.066	39.379	22.684	114.761	
4	- 60.000	- 12.920	13.741	101.445	42.266	39.379	27.110	54.535	
5		- 12.920	4.200	101.445	92.725	39.379	20.846	111.259	
6	- 70.370	- 33.920	9.126	101.445	6.281	39.379	20.134	25.526	108.848
7		- 12.920	9.126	101.445	97.651	39.379	21.060	115.970	3
8	- 60.000	- 12.920	13.326	101.445	41.851	39.379	22.659	58.571	
9		- 12.920	9.126	101.445	97.651	39.379	23.304	113.726	
10		- 12.920	9.126	101.445	97.651	39.379	9.227	88.424	
NPV (12%)	- 288.673,37	- 96.560,14	63.934,58	674.631,76	407.694,01	261.880,22	133.269,36	523.625,84	
IRR					253,75%			896,63%	
Cost Kw/hour of the Project ($Kw hour)					- 92			- 59	

Scenario 6 (CDM OPTION I): Biogas capture from covered WWT Ponds, mitigation of biogas in Flares, no electricity generation from biogas. See Prefeasibility Study Chapter 5, page 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS
Without CER sales, there is no income from this scenario, IRR and NPV are negative.

	1	2	3	5	6		
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM	Simple return
0	- 81.111	- 6.164	2.839	0	14.326	- 98.763	
1		- 6.164	2.839	81.168	19.056	58.787	
2		- 6.164	2.839	81.168	20.664	57.179	
3		- 6.164	2.839	81.168	22.684	55.158	
4		- 6.164	2.839	81.168	27.110	50.732	
5		- 6.164	2.839	81.168	20.846	56.997	
6	- 55.556	- 6.164	2.839	81.168	20.134	2.153	55.948
7		- 6.164	2.839	81.168	21.060	56.782	2
8		- 6.164	2.839	81.168	22.659	55.183	
9		- 6.164	2.839	81.168	23.304	54.538	
10		- 6.164	2.839	81.168	9.227	68.616	
						-	
NPV (12%)	- 130.714,29	- 40.994,93	18.879,24	458.616,79	133.269,36	193.974,47	
IRR						54,57%	

FINANCIAL MODEL FOR THE CDM PROJECT AT A PALM OIL EXTRACTION PLANT
Plant: GUAICARAMO S.A.

Cost Kw/hour in the area (Pesos/ $Kw hour):

Scenario 1: Increased Electricty Generation 100% with Biomass - Steam. (Investment in New High Efficiency Boilers and Turbines), no biogas capture from WWT. See FEDEPALMA Prefeasibility Study, Chapter 5, Pg 1.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

	1	2	3	4		5	6	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 1.235.378	- 108.094	43.238	192.802	- 1.107.432	0	14.326	- 1.121.758
1		- 108.094	43.238	192.802	127.946	13136,64	19.056	122.027
2		- 108.094	43.238	192.802	127.946	13136,64	20.664	120.419
3		- 108.094	43.238	192.802	127.946	13136,64	22.684	118.398
4		- 108.094	43.238	192.802	127.946	13136,64	27.110	113.973
5		- 108.094	43.238	192.802	127.946	13136,64	20.846	120.237
6		- 108.094	43.238	192.802	127.946	13136,64	20.134	120.949
7		- 108.094	43.238	192.802	127.946	13136,64	21.060	120.022
8		- 108.094	43.238	192.802	127.946	13136,64	22.659	118.423
9		- 108.094	43.238	192.802	127.946	13136,64	23.304	117.779
10		- 108.094	43.238	192.802	127.946	13136,64	9.227	131.856
NPV (12%)	- 1.235.378,11	- 718.849,24	287.543,90	1.282.175,14	- 384.508,31	74.224,95	133.269,36	- 443.552,72
IRR					2,72%			1,30%
CostS Kw/hour Project (Pesos $Kw hour)					- 239			- 248

Scenario 2 (CDM OPTION II): Biogas Capture from covered WWT ponds, with electricity generación with biogás gen plants, no change to baseline boilers, no turbines. See FEDEPALMA Prefeasibility Study, Chapter 5, Pg 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión with Biogás (Mwh/yr): 2.737

	1	2	3	4		5	6	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 497.265	- 70.261	17.404	192.802	- 357.320	0	14.326	- 371.645
1		- 70.261	17.404	192.802	139.945	72.134	19.056	193.023
2		- 70.261	17.404	192.802	139.945	72.134	20.664	191.415
3		- 70.261	17.404	192.802	139.945	72.134	22.684	189.394
4		- 70.261	17.404	192.802	139.945	72.134	27.110	184.968
5		- 203.600	17.404	192.802	6.606	72.134	20.846	57.894
6	- 70.370	- 70.261	22.330	192.802	74.501	72.134	20.134	126.501
7		- 70.261	22.330	192.802	144.871	72.134	21.060	195.944
8		- 70.261	22.330	192.802	144.871	72.134	22.659	194.345
9		- 70.261	22.330	192.802	144.871	72.134	23.304	193.700
10		- 70.261	22.330	192.802	144.871	72.134	9.227	207.778
NPV (12%)	- 560.095,23	- 542.912,07	125.817,92	1.282.175,14	332.164,63	407.570,51	133.269,36	606.465,78
IRR					33,03%			47,15%
Cost Kw/hour of the Project ($Kw hour)					- 145			- 96

Scenario 3: Biogas capture from covered WWT ponds, with electricity generation with Biogas Gen Plants, new turbines to cover own energy needs. See Prefeasibility study, Chapter 5, page 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

	1	2	3	4		5	6	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 497.265	- 70.261	17.404	192.802	- 357.320	0	14.326	- 371.645
1		- 70.261	17.404	192.802	139.945	72.134	19.056	193.023
2		- 70.261	17.404	192.802	139.945	72.134	20.664	191.415
3		- 70.261	17.404	192.802	139.945	72.134	22.684	189.394
4		- 70.261	17.404	192.802	139.945	72.134	27.110	184.968
5		- 203.600	17.404	192.802	6.606	72.134	20.846	57.894
6	- 70.370	- 70.261	22.330	192.802	74.501	72.134	20.134	126.501
7		- 70.261	22.330	192.802	144.871	72.134	21.060	195.944
8		- 70.261	22.330	192.802	144.871	72.134	22.659	194.345
9		- 70.261	22.330	192.802	144.871	72.134	23.304	193.700
10		- 70.261	22.330	192.802	144.871	72.134	9.227	207.778
NPV (12%)	- 560.095,23	- 542.912,07	125.817,92	1.282.175,14	332.164,63	407.570,51	133.269,36	606.465,78
IRR					33,03%			47,15%
Cost Kw/hour of the Project ($Kw hour)					- 145			- 96

Scenario 4 (CDM OPTION III): Biogas capture from covered WWT ponds, with electricity generation with Biogas Gen Plants, new high efficiency boilers and turbines, to maximize energy production and offer surplus to the grid. See Prefeasibility study, Chapter 5, page 2..
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión (Mwh/yr): 15.654
Sale of electricity to grid (MWh/yr): 12.916

	1	2	3	4	5		6	7	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	Sales of Electricity to the Grid	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 3.214.655	- 287.273	112.513	192.802	258.320	- 2.938.293	0	14.326	- 2.952.619
1		- 287.273	112.513	192.802	258.320	276.362	132.066	19.056	389.373
2		- 287.273	112.513	192.802	258.320	276.362	132.066	20.664	387.765
3		- 287.273	112.513	192.802	258.320	276.362	132.066	22.684	385.744
4		- 287.273	112.513	192.802	258.320	276.362	132.066	27.110	381.318
5		- 420.612	112.513	192.802	258.320	143.023	132.066	20.846	254.244
6	- 70.370	- 287.273	117.439	192.802	258.320	210.918	132.066	20.134	322.850
7		- 287.273	117.439	192.802	258.320	281.288	132.066	21.060	392.294
8		- 287.273	117.439	192.802	258.320	281.288	132.066	22.659	390.695
9		- 287.273	117.439	192.802	258.320	281.288	132.066	23.304	390.050
10		- 287.273	117.439	192.802	258.320	281.288	132.066	9.227	404.128
NPV (12%)	- 3.277.485,52	- 1.986.088,21	758.311,73	1.282.175,14	1.717.885,61	- 1.478.022,38	746.204,93	133.269,36	- 865.086,81
IRR						-2%			4,30%
Cost Kw/hour of the Project ($Kw hour)						- 180			- 94,50

Scenario 5: Biogas capture from covered WWT ponds, electricity gen with existing diesel plants modified for 40% biogás, 60% diesel (Dual Gen System). See Prefeasibility study, Chapter 5, page 2
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

1440

Generatión with Biogás (kwh/yr): 1.440 40%

	1	2	3	4		5	6		
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM	Simple return
0	- 136.296	- 12.920	9.541	77.121	- 62.555	0	14.326	- 48.027	
1		- 12.920	9.541	77.121	73.741	28.853	19.056	83.539	
2		- 12.920	9.541	77.121	73.741	28.853	20.664	81.931	
3		- 12.920	9.541	77.121	73.741	28.853	22.684	79.911	
4	- 60.000	- 12.920	13.741	77.121	17.941	28.853	27.110	19.685	
5		- 12.920	4.200	77.121	68.401	28.853	20.846	76.409	
6	- 70.370	- 33.920	9.126	77.121	- 18.044	28.853	20.134	- 9.324	73.998
7		- 12.920	9.126	77.121	73.327	28.853	21.060	81.120	4
8	- 60.000	- 12.920	13.326	77.121	17.527	28.853	22.659	23.721	
9		- 12.920	9.126	77.121	73.327	28.853	23.304	78.876	
10		- 12.920	9.126	77.121	73.327	28.853	9.227	64.100	
NPV (12%)	- 288.673,37	- 96.560,14	63.934,58	512.870,06	245.932,30	191.881,61	133.269,36	295.254,54	
IRR					110,43%			166,94%	
Cost Kw/hour of the Project ($Kw hour)					- 92			- 79	

Scenario 6 (CDM OPTION I): Biogas capture from covered WWT Ponds, mitigation of biogas in Flares, no electricity generation from biogas. See Prefeasibility Study Chapter 5, page 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS
Without CER sales, there is no income from this scenario, IRR and NPV are negative.

	1	2	3	5	6		
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM	Simple return
0	- 81.111	- 6.164	2.839	0	14.326	- 98.763	
1		- 6.164	2.839	58.997	19.056	36.616	
2		- 6.164	2.839	58.997	20.664	35.008	
3		- 6.164	2.839	58.997	22.684	32.987	
4		- 6.164	2.839	58.997	27.110	28.561	
5		- 6.164	2.839	58.997	20.846	34.826	
6	- 55.556	- 6.164	2.839	58.997	20.134	- 20.018	33.777
7		- 6.164	2.839	58.997	21.060	34.611	4
8		- 6.164	2.839	58.997	22.659	33.012	
9		- 6.164	2.839	58.997	23.304	32.367	
10		- 6.164	2.839	58.997	9.227	46.445	
						-	
NPV (12%)	- 130.714,29	- 40.994,93	18.879,24	333.345,57	133.269,36	68.703,24	
IRR						28,52%	

FINANCIAL MODEL FOR THE CDM PROJECT AT A PALM OIL EXTRACTION PLANT
Plant: CI El Roble

Cost Kw/hour in the area (Pesos/ $Kw hour): 196

Scenario 1: Increased Electricty Generation 100% with Biomass - Steam. (Investment in New High Efficiency Boilers and Turbines), no biogas capture from WWT. See FEDEPALMA Prefeasibility Study, Chapter 5, Pg 1.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

	1	2	3	4		5	6	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 969.060	- 90.161	33.917	92.683	- 932.621	0	14.326	- 946.947
1		- 90.161	33.917	92.683	36.439	6916,8	19.056	24.300
2		- 90.161	33.917	92.683	36.439	6916,8	20.664	22.692
3		- 90.161	33.917	92.683	36.439	6916,8	22.684	20.671
4		- 90.161	33.917	92.683	36.439	6916,8	27.110	16.246
5		- 90.161	33.917	92.683	36.439	6916,8	20.846	22.510
6		- 90.161	33.917	92.683	36.439	6916,8	20.134	23.222
7		- 90.161	33.917	92.683	36.439	6916,8	21.060	22.295
8		- 90.161	33.917	92.683	36.439	6916,8	22.659	20.696
9		- 90.161	33.917	92.683	36.439	6916,8	23.304	20.052
10		- 90.161	33.917	92.683	36.439	6916,8	9.227	34.129
NPV (12%)	**- 969.059,85**	**- 599.588,67**	**225.556,24**	**616.359,50**	**- 726.732,77**	**39.081,46**	**133.269,36**	**- 820.920,66**
IRR					**-14,23%**			**-19,41%**
CostS Kw/hour Project (Pesos $Kw hour)					**- 241**			**- 259**

Scenario 2 (CDM OPTION II): Biogas Capture from covered WWT ponds, with electricity generación with biogás gen plants, no change to baseline boilers, no turbines. See FEDEPALMA Prefeasibility Study, Chapter 5, Pg 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión with Biogás (Mwh/yr): 2.200

	1	2	3	4		5	6	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 527.556	- 58.604	18.464	92.683	- 475.013	0	14.326	- 489.339
1		- 58.604	18.464	92.683	52.543	66.380	19.056	99.867
2		- 58.604	18.464	92.683	52.543	66.380	20.664	98.259
3		- 58.604	18.464	92.683	52.543	66.380	22.684	96.239
4		- 58.604	18.464	92.683	52.543	66.380	27.110	91.813
5		- 202.545	18.464	92.683	- 91.398	66.380	20.846	- 45.863
6	- 70.370	- 58.604	23.390	92.683	- 12.902	66.380	20.134	33.345
7		- 58.604	23.390	92.683	57.468	66.380	21.060	102.788
8		- 58.604	23.390	92.683	57.468	66.380	22.659	101.189
9		- 58.604	23.390	92.683	57.468	66.380	23.304	100.545
10		- 58.604	23.390	92.683	57.468	66.380	9.227	114.622
NPV (12%)	**- 590.386,25**	**- 471.408,48**	**132.868,40**	**616.359,50**	**- 285.387,96**	**375.063,83**	**133.269,36**	**- 43.593,49**
IRR					**-5,48%**			**9,75%**
Cost Kw/hour of the Project ($Kw hour)					**- 170**			**- 116**

Scenario 3: Biogas capture from covered WWT ponds, with electricity generation with Biogas Gen Plants, new turbines to cover own energy needs. See Prefeasibility study, Chapter 5, page 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

	1	2	3	4		5	6	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 527.556	- 58.604	18.464	92.683	- 475.013	0	14.326	- 489.339
1		- 58.604	18.464	92.683	52.543	66.380	19.056	99.867
2		- 58.604	18.464	92.683	52.543	66.380	20.664	98.259
3		- 58.604	18.464	92.683	52.543	66.380	22.684	96.239
4		- 58.604	18.464	92.683	52.543	66.380	27.110	91.813
5		- 202.545	18.464	92.683	- 91.398	66.380	20.846	- 45.863
6	- 70.370	- 58.604	23.390	92.683	- 12.902	66.380	20.134	33.345
7		- 58.604	23.390	92.683	57.468	66.380	21.060	102.788
8		- 58.604	23.390	92.683	57.468	66.380	22.659	101.189
9		- 58.604	23.390	92.683	57.468	66.380	23.304	100.545
10		- 58.604	23.390	92.683	57.468	66.380	9.227	114.622
NPV (12%)	**- 590.386,25**	**- 471.408,48**	**132.868,40**	**616.359,50**	**- 285.387,96**	**375.063,83**	**133.269,36**	**- 43.593,49**
IRR					**-5,48%**			**9,75%**
Cost Kw/hour of the Project ($Kw hour)					**- 170**			**- 116**

Scenario 4 (CDM OPTION III): Biogas capture from covered WWT ponds, with electricity generation with Biogas Gen Plants, new high efficiency boilers and turbines, to maximize energy production and offer surplus to the grid. See Prefeasibility study, Chapter 5, page 2..
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión (Mwh/yr): 13.435
Sale of electricity to grid (MWh/yr): 11.236

	1	2	3	4	5		6	7	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	Sales of Electricity to the Grid	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 2.906.067	- 265.028	101.712	92.683	224.720	- 2.751.980	0	14.326	- 2.766.306
1		- 265.028	101.712	92.683	224.720	154.087	100.087	19.056	235.118
2		- 265.028	101.712	92.683	224.720	154.087	100.087	20.664	233.510
3		- 265.028	101.712	92.683	224.720	154.087	100.087	22.684	231.489
4		- 265.028	101.712	92.683	224.720	154.087	100.087	27.110	227.064
5		- 408.969	101.712	92.683	224.720	10.146	100.087	20.846	89.387
6	- 70.370	- 265.028	106.638	92.683	224.720	88.642	100.087	20.134	168.596
7		- 265.028	106.638	92.683	224.720	159.013	100.087	21.060	238.039
8		- 265.028	106.638	92.683	224.720	159.013	100.087	22.659	236.440
9		- 265.028	106.638	92.683	224.720	159.013	100.087	23.304	235.796
10		- 265.028	106.638	92.683	224.720	159.013	100.087	9.227	249.873
NPV (12%)	**- 2.968.897,30**	**- 1.844.172,35**	**686.485,41**	**616.359,50**	**1.494.438,12**	**- 1.988.607,74**	**565.514,09**	**133.269,36**	**- 1.556.363,01**
IRR						**-11%**			**-4,31%**
Cost Kw/hour of the Project ($Kw hour)						**- 191**			**- 105,63**

Scenario 5: Biogas capture from covered WWT ponds, electricity gen with existing diesel plants modified for 40% biogás, 60% diesel (Dual Gen System). See Prefeasibility study, Chapter 5, page 2
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión with Biogás (kwh/yr): 880 40%

	1	2	3	4		5	6		
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM	Simple return
0	- 136.296	- 12.920	9.541	37.073	- 102.603	0	14.326	- 90.376	
1		- 12.920	9.541	37.073	33.694	26.552	19.056	41.190	
2		- 12.920	9.541	37.073	33.694	26.552	20.664	39.582	
3		- 12.920	9.541	37.073	33.694	26.552	22.684	37.562	
4	- 60.000	- 12.920	13.741	37.073	- 22.106	26.552	27.110	- 22.664	
5		- 12.920	4.200	37.073	28.353	26.552	20.846	34.060	
6	- 70.370	- 33.920	9.126	37.073	- 58.091	26.552	20.134	- 51.673	31.649
7		- 12.920	9.126	37.073	33.279	26.552	21.060	38.771	10
8	- 60.000	- 12.920	13.326	37.073	- 22.521	26.552	22.659	- 18.628	
9		- 12.920	9.126	37.073	33.279	26.552	23.304	36.527	
10		- 12.920	9.126	37.073	33.279	26.552	9.227	24.052	
NPV (12%)	**- 288.673,37**	**- 96.560,14**	**63.934,58**	**246.543,80**	**- 20.393,95**	**176.577,67**	**133.269,36**	**14.365,29**	
IRR					**5,03%**			**17,96%**	
Cost Kw/hour of the Project ($Kw hour)					**- 150**			**- 137**	

Scenario 6 (CDM OPTION I): Biogas capture from covered WWT Ponds, mitigation of biogas in Flares, no electricity generation from biogas. See Prefeasibility Study Chapter 5, page 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS
Without CER sales, there is no income from this scenario, IRR and NPV are negative.
Generatión with Biogás (Mwh/yr): 2.200 100%

	1	2	3	5	6		
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM	Simple return
0	- 81.111	- 6.164	2.839	0	14.326	- 98.763	
1		- 6.164	2.839	59.464	19.056	37.082	
2		- 6.164	2.839	59.464	20.664	35.474	
3		- 6.164	2.839	59.464	22.684	33.454	
4		- 6.164	2.839	59.464	27.110	29.028	
5		- 6.164	2.839	59.464	20.846	35.292	
6	- 55.556	- 6.164	2.839	59.464	20.134	- 19.551	34.243
7		- 6.164	2.839	59.464	21.060	35.078	4
8		- 6.164	2.839	59.464	22.659	33.479	
9		- 6.164	2.839	59.464	23.304	32.834	
10		- 6.164	2.839	59.464	9.227	46.911	
						-	
NPV (12%)	**- 130.714,29**	**- 40.994,93**	**18.879,24**	**335.982,36**	**133.269,36**	**71.340,04**	
IRR						**29,11%**	

FINANCIAL MODEL FOR THE CDM PROJECT AT A PALM OIL EXTRACTION PLANT
Plant: EXTRACTORA SUR DELCASANARE S.A.

Cost Kw/hour in the area (Pesos/ $Kw hour):

Scenario 1: Increased Electricty Generation 100% with Biomass - Steam. (Investment in New High Efficiency Boilers and Turbines), no biogas capture from WWT. See FEDEPALMA Prefeasibility Study, Chapter 5, Pg 1.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

	1	2	3	4		5	6	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 1.676.735	- 173.568	58.686	299.826	- 1.491.791	-	14.326	- 1.506.117
1		- 173.568	58.686	299.826	184.944	20.429	19.056	186.317
2		- 173.568	58.686	299.826	184.944	20.429	20.664	184.709
3		- 173.568	58.686	299.826	184.944	20.429	22.684	182.688
4		- 173.568	58.686	299.826	184.944	20.429	27.110	178.263
5		- 173.568	58.686	299.826	184.944	20.429	20.846	184.527
6		- 173.568	58.686	299.826	184.944	20.429	20.134	185.239
7		- 173.568	58.686	299.826	184.944	20.429	21.060	184.312
8		- 173.568	58.686	299.826	184.944	20.429	22.659	182.713
9		- 173.568	58.686	299.826	184.944	20.429	23.304	182.069
10		- 173.568	58.686	299.826	184.944	20.429	9.227	196.146
NPV (12%)	- 1.676.735,22	- 1.154.267,21	390.273,21	1.993.911,64	- 446.817,58	115.427,28	133.269,36	- 464.659,66
IRR					4,11%			3,88%
CostS Kw/hour Project (Pesos $Kw hour)					- 227			- 229

Scenario 2 (CDM OPTION II): Biogas Capture from covered WWT ponds, with electricity generación with biogás gen plants, no change to baseline boilers, no turbines. See FEDEPALMA Prefeasibility Study, Chapter 5, Pg 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión with Biogás (Mwh/yr): 4.256

	1	2	3	4		5	6	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 814.749	- 112.819	28.516	299.826	- 599.226	0	14.326	- 613.552
1		- 112.819	28.516	299.826	215.523	171.796	19.056	368.263
2		- 112.819	28.516	299.826	215.523	171.796	20.664	366.655
3		- 112.819	28.516	299.826	215.523	171.796	22.684	364.635
4		- 112.819	28.516	299.826	215.523	171.796	27.110	360.209
5		- 330.315	28.516	299.826	- 1.972	171.796	20.846	148.978
6	- 126.667	- 112.819	37.383	299.826	97.723	171.796	20.134	249.385
7		- 112.819	37.383	299.826	224.390	171.796	21.060	375.125
8		- 112.819	37.383	299.826	224.390	171.796	22.659	373.526
9		- 112.819	37.383	299.826	224.390	171.796	23.304	372.882
10		- 112.819	37.383	299.826	224.390	171.796	9.227	386.959
NPV (12%)	- 927.844,72	- 873.686,56	207.775,60	1.993.911,64	449.077,92	970.684,28	133.269,36	1.286.492,84
IRR					29,22%			56,22%
Cost Kw/hour of the Project ($Kw hour)					- 152			- 57

Scenario 3: Biogas capture from covered WWT ponds, with electricity generation with Biogas Gen Plants, new turbines to cover own energy needs. See Prefeasibility study, Chapter 5, page 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

	1	2	3	4		5	6	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 814.749	- 112.819	28.516	299.826	- 599.226	0	14.326	- 613.552
1		- 112.819	28.516	299.826	215.523	171.796	19.056	368.263
2		- 112.819	28.516	299.826	215.523	171.796	20.664	366.655
3		- 112.819	28.516	299.826	215.523	171.796	22.684	364.635
4		- 112.819	28.516	299.826	215.523	171.796	27.110	360.209
5		- 330.315	28.516	299.826	- 1.972	171.796	20.846	148.978
6	- 126.667	- 112.819	37.383	299.826	97.723	171.796	20.134	249.385
7		- 112.819	37.383	299.826	224.390	171.796	21.060	375.125
8		- 112.819	37.383	299.826	224.390	171.796	22.659	373.526
9		- 112.819	37.383	299.826	224.390	171.796	23.304	372.882
10		- 112.819	37.383	299.826	224.390	171.796	9.227	386.959
NPV (12%)	- 927.844,72	- 873.686,56	207.775,60	1.993.911,64	449.077,92	970.684,28	133.269,36	1.286.492,84
IRR					29,22%			56,22%
Cost Kw/hour of the Project ($Kw hour)					- 152			- 57

Scenario 4 (CDM OPTION III): Biogas capture from covered WWT ponds, with electricity generation with Biogas Gen Plants, new high efficiency boilers and turbines, to maximize energy production and offer surplus to the grid. See Prefeasibility study, Chapter 5, page 2..
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión (Mwh/yr): 26.398
Sale of electricity to grid (MWh/yr): 22.142

	1	2	3	4	5		6	7	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	Sales of Electricity to the Grid	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 4.649.688	- 439.532	162.739	299.826	442.840	- 4.183.815	0	14.326	- 4.198.141
1		- 439.532	162.739	299.826	442.840	465.873	238.221	19.056	685.039
2		- 439.532	162.739	299.826	442.840	465.873	238.221	20.664	683.431
3		- 439.532	162.739	299.826	442.840	465.873	238.221	22.684	681.410
4		- 439.532	162.739	299.826	442.840	465.873	238.221	27.110	676.984
5		- 657.028	162.739	299.826	442.840	248.378	238.221	20.846	465.753
6	- 126.667	- 439.532	171.606	299.826	442.840	348.073	238.221	20.134	566.161
7		- 439.532	171.606	299.826	442.840	474.740	238.221	21.060	691.900
8		- 439.532	171.606	299.826	442.840	474.740	238.221	22.659	690.301
9		- 439.532	171.606	299.826	442.840	474.740	238.221	23.304	689.657
10		- 439.532	171.606	299.826	442.840	474.740	238.221	9.227	703.734
NPV (12%)	- 4.762.783,47	- 3.046.399,14	1.100.387,53	1.993.911,64	2.944.984,77	- 1.720.976,72	1.346.001,09	133.269,36	- 508.244,98
IRR						1%			8,95%
Cost Kw/hour of the Project ($Kw hour)						- 133			- 78,42

Scenario 5: Biogas capture from covered WWT ponds, electricity gen with existing diesel plants modified for 40% biogás, 60% diesel (Dual Gen System). See Prefeasibility study, Chapter 5, page 2
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión with Biogás (kwh/yr): 1.702 40%

	1	2	3	4		5	6		
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM	Simple return
0	- 213.333	- 12.920	14.933	119.931	- 91.389	0	14.326	- 36.997	
1		- 12.920	14.933	119.931	121.944	68.718	19.056	171.606	
2		- 12.920	14.933	119.931	121.944	68.718	20.664	169.999	
3		- 12.920	14.933	119.931	121.944	68.718	22.684	167.978	
4	- 60.000	- 12.920	19.133	119.931	66.144	68.718	27.110	107.752	
5		- 12.920	4.200	119.931	111.211	68.718	20.846	159.083	
6	- 126.667	- 33.920	13.067	119.931	- 27.589	68.718	20.134	20.995	156.673
7		- 12.920	13.067	119.931	120.077	68.718	21.060	167.735	3
8	- 60.000	- 12.920	17.267	119.931	64.277	68.718	22.659	110.336	
9		- 12.920	13.067	119.931	120.077	68.718	23.304	165.491	
10		- 12.920	13.067	119.931	120.077	68.718	9.227	110.851	
NPV (12%)	- 410.589,47	- 96.560,14	93.766,93	797.564,66	454.900,77	456.992,01	133.269,36	756.497,97	
IRR					128,69%			462,06%	
Cost Kw/hour of the Project ($Kw hour)					- 99			- 25	

Scenario 6 (CDM OPTION I): Biogas capture from covered WWT Ponds, mitigation of biogas in Flares, no electricity generation from biogas. See Prefeasibility Study Chapter 5, page 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS
Without CER sales, there is no income from this scenario, IRR and NPV are negative.

	1	2	3	5	6		
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM	Simple return
0	- 150.000	- 11.400	5.250	0	14.326	- 170.476	
1		- 11.400	5.250	151.367	19.056	126.161	
2		- 11.400	5.250	151.367	20.664	124.553	
3		- 11.400	5.250	151.367	22.684	122.533	
4		- 11.400	5.250	151.367	27.110	118.107	
5		- 11.400	5.250	151.367	20.846	124.371	
6	- 100.000	- 11.400	5.250	151.367	20.134	25.083	120.911
7		- 11.400	5.250	151.367	21.060	124.157	2
8		- 11.400	5.250	151.367	22.659	122.558	
9		- 11.400	5.250	151.367	23.304	121.913	
10		- 11.400	5.250	151.367	9.227	135.990	
						-	
NPV (12%)	- 239.285,71	- 75.812,54	34.913,67	855.257,01	133.269,36	480.425,67	
IRR						70,96%	

FINANCIAL MODEL FOR THE CDM PROJECT AT A PALM OIL EXTRACTION PLANT
Plant: PALMERAS DE PUERTO WILCHES S.A.

Cost Kw/hour in the area (Pesos/ $Kw hour): 581

Scenario 1: Increased Electricty Generation 100% with Biomass - Steam. (Investment in New High Efficiency Boilers and Turbines), no biogas capture from WWT. See FEDEPALMA Prefeasibility Study, Chapter 5, Pg 1.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

	1	2	3	4		5	6	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 988.902	- 92.046	34.612	109.271	- 937.065	0	14.326	- 951.391
1		- 92.046	34.612	109.271	51.837	8.199	19.056	40.980
2		- 92.046	34.612	109.271	51.837	8.199	20.664	39.372
3		- 92.046	34.612	109.271	51.837	8.199	22.684	37.351
4		- 92.046	34.612	109.271	51.837	8.199	27.110	32.926
5		- 92.046	34.612	109.271	51.837	8.199	20.846	39.190
6		- 92.046	34.612	109.271	51.837	8.199	20.134	39.902
7		- 92.046	34.612	109.271	51.837	8.199	21.060	38.975
8		- 92.046	34.612	109.271	51.837	8.199	22.659	37.376
9		- 92.046	34.612	109.271	51.837	8.199	23.304	36.732
10		- 92.046	34.612	109.271	51.837	8.199	9.227	50.809
NPV (12%)	- 988.901,56	- 612.124,09	230.174,56	726.676,59	- 644.174,51	46.324,63	133.269,36	- 731.119,23
IRR					-9,53%			-13,23%
CostS Kw/hour Project (Pesos $Kw hour)					- 199			- 213

Scenario 2 (CDM OPTION II): Biogas Capture from covered WWT ponds, with electricity generación with biogás gen plants, no change to baseline boilers, no turbines. See FEDEPALMA Prefeasibility Study, Chapter 5, Pg 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión with Biogás (Mwh/yr): 2.719

	1	2	3	4		5	6	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 569.857	- 59.830	19.945	109.271	- 500.471	0	14.326	- 514.797
1		- 59.830	19.945	109.271	69.386	132.630	19.056	182.961
2		- 59.830	19.945	109.271	69.386	132.630	20.664	181.353
3		- 59.830	19.945	109.271	69.386	132.630	22.684	179.332
4		- 59.830	19.945	109.271	69.386	132.630	27.110	174.907
5		- 206.780	19.945	109.271	- 77.564	132.630	20.846	34.221
6	- 95.000	- 59.830	26.595	109.271	- 18.964	132.630	20.134	93.533
7		- 59.830	26.595	109.271	76.036	132.630	21.060	187.606
8		- 59.830	26.595	109.271	76.036	132.630	22.659	186.007
9		- 59.830	26.595	109.271	76.036	132.630	23.304	185.363
10		- 59.830	26.595	109.271	76.036	132.630	9.227	199.440
NPV (12%)	- 654.678,77	- 481.264,08	146.240,97	726.676,59	- 226.333,82	749.390,65	133.269,36	389.787,48
IRR					-0,54%			29,20%
Cost Kw/hour of the Project ($Kw hour)					- 146			- 36

Scenario 3: Biogas capture from covered WWT ponds, with electricity generation with Biogas Gen Plants, new turbines to cover own energy needs. See Prefeasibility study, Chapter 5, page 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

	1	2	3	4		5	6	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 569.857	- 59.830	19.945	109.271	- 500.471	0	14.326	- 514.797
1		- 59.830	19.945	109.271	69.386	132.630	19.056	182.961
2		- 59.830	19.945	109.271	69.386	132.630	20.664	181.353
3		- 59.830	19.945	109.271	69.386	132.630	22.684	179.332
4		- 59.830	19.945	109.271	69.386	132.630	27.110	174.907
5		- 206.780	19.945	109.271	- 77.564	132.630	20.846	34.221
6	- 95.000	- 59.830	26.595	109.271	- 18.964	132.630	20.134	93.533
7		- 59.830	26.595	109.271	76.036	132.630	21.060	187.606
8		- 59.830	26.595	109.271	76.036	132.630	22.659	186.007
9		- 59.830	26.595	109.271	76.036	132.630	23.304	185.363
10		- 59.830	26.595	109.271	76.036	132.630	9.227	199.440
NPV (12%)	- 654.678,77	- 481.264,08	146.240,97	726.676,59	- 226.333,82	749.390,65	133.269,36	389.787,48
IRR					-0,54%			29,20%
Cost Kw/hour of the Project ($Kw hour)					- 146			- 36

Scenario 4 (CDM OPTION III): Biogas capture from covered WWT ponds, with electricity generation with Biogas Gen Plants, new high efficiency boilers and turbines, to maximize energy production and offer surplus to the grid. See Prefeasibility study, Chapter 5, page 2..
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión (Mwh/yr): 19.788
Sale of electricity to grid (MWh/yr): 17.069

	1	2	3	4	5		6	7	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	Sales of Electricity to the Grid	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 3.643.670	- 332.813	127.528	109.271	341.380	- 3.398.304	0	14.326	- 3.412.630
1		- 332.813	127.528	109.271	341.380	245.366	183.837	19.056	410.148
2		- 332.813	127.528	109.271	341.380	245.366	183.837	20.664	408.540
3		- 332.813	127.528	109.271	341.380	245.366	183.837	22.684	406.519
4		- 332.813	127.528	109.271	341.380	245.366	183.837	27.110	402.093
5		- 479.764	127.528	109.271	341.380	98.416	183.837	20.846	261.408
6	- 95.000	- 332.813	134.178	109.271	341.380	157.016	183.837	20.134	320.720
7		- 332.813	134.178	109.271	341.380	252.016	183.837	21.060	414.793
8		- 332.813	134.178	109.271	341.380	252.016	183.837	22.659	413.194
9		- 332.813	134.178	109.271	341.380	252.016	183.837	23.304	412.549
10		- 332.813	134.178	109.271	341.380	252.016	183.837	9.227	426.627
NPV (12%)	- 3.728.491,35	- 2.296.667,13	861.694,84	726.676,59	2.270.253,14	- 2.129.842,44	1.038.722,33	133.269,36	- 1.224.389,47
IRR						-7%			2,37%
Cost Kw/hour of the Project ($Kw hour)						- 135			- 74,87

Scenario 5: Biogas capture from covered WWT ponds, electricity gen with existing diesel plants modified for 40% biogás, 60% diesel (Dual Gen System). See Prefeasibility study, Chapter 5, page 2
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión with Biogás (kwh/yr): 1.088 40%

	1	2	3	4		5	6		
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM	Simple return
0	- 170.000	- 12.920	11.900	43.708	- 127.312	0	14.326	- 88.585	
1		- 12.920	11.900	43.708	42.688	53.052	19.056	76.685	
2		- 12.920	11.900	43.708	42.688	53.052	20.664	75.077	
3		- 12.920	11.900	43.708	42.688	53.052	22.684	73.056	
4	- 60.000	- 12.920	16.100	43.708	- 13.112	53.052	27.110	12.830	
5		- 12.920	4.200	43.708	34.988	53.052	20.846	67.195	
6	- 95.000	- 33.920	10.850	43.708	- 74.362	53.052	20.134	- 41.443	64.785
7		- 12.920	10.850	43.708	41.638	53.052	21.060	73.630	6
8	- 60.000	- 12.920	15.050	43.708	- 14.162	53.052	22.659	16.231	
9		- 12.920	10.850	43.708	41.638	53.052	23.304	71.386	
10		- 12.920	10.850	43.708	41.638	53.052	9.227	32.412	
NPV (12%)	- 342.011,66	- 96.560,14	76.986,23	290.670,64	- 9.397,30	352.808,37	133.269,36	193.060,36	
IRR					9,54%			74,62%	
Cost Kw/hour of the Project ($Kw hour)					- 136			- 59	

Scenario 6 (CDM OPTION I): Biogas capture from covered WWT Ponds, mitigation of biogas in Flares, no electricity generation from biogas. See Prefeasibility Study Chapter 5, page 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS
Without CER sales, there is no income from this scenario, IRR and NPV are negative.

	1	2	3	5	6		
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM	Simple return
0	- 102.500	- 7.790	3.588	0	14.326	- 121.028	
1		- 7.790	3.588	124.432	19.056	101.173	
2		- 7.790	3.588	124.432	20.664	99.566	
3		- 7.790	3.588	124.432	22.684	97.545	
4		- 7.790	3.588	124.432	27.110	93.119	
5		- 7.790	3.588	124.432	20.846	99.383	
6	- 75.000	- 7.790	3.588	124.432	20.134	25.096	97.586
7		- 7.790	3.588	124.432	21.060	99.169	2
8		- 7.790	3.588	124.432	22.659	97.570	
9		- 7.790	3.588	124.432	23.304	96.925	
10		- 7.790	3.588	124.432	9.227	111.002	
						-	
NPV (12%)	- 169.464,29	- 51.805,24	23.857,68	703.066,02	133.269,36	401.351,77	
IRR						80,56%	

FINANCIAL MODEL FOR THE CDM PROJECT AT A PALM OIL EXTRACTION PLANT
Plant: C.I. TEQUENDAMA S.A.

Cost Kw/hour in the area (Pesos/ $Kw hour): 120

Scenario 1: Increased Electricty Generation 100% with Biomass - Steam. (Investment in New High Efficiency Boilers and Turbines), no biogas capture from WWT. See FEDEPALMA Prefeasibility Study, Chapter 5, Pg 1.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

YEAR	1 INVESTMENT COST IN US$	2 Annual Operation and Maintenance Costs	3 Tax Savings from Depreciation (US$)	4 Savings from No Diesel (US $)	TOTAL without CDM	5 Income from CER (US $)	6 CDM Transaction Costs (US $)	TOTAL with CDM
0	- 1.215.500	- 113.573	42.543	89.715	- 1.196.816	0	14.326	- 1.211.141
1		- 113.573	42.543	89.715	18.685	6728,6556	19.056	6.358
2		- 113.573	42.543	89.715	18.685	6728,6556	20.664	4.750
3		- 113.573	42.543	89.715	18.685	6728,6556	22.684	2.729
4		- 113.573	42.543	89.715	18.685	6728,6556	27.110	- 1.697
5		- 113.573	42.543	89.715	18.685	6728,6556	20.846	4.568
6		- 113.573	42.543	89.715	18.685	6728,6556	20.134	5.280
7		- 113.573	42.543	89.715	18.685	6728,6556	21.060	4.353
8		- 113.573	42.543	89.715	18.685	6728,6556	22.659	2.754
9		- 113.573	42.543	89.715	18.685	6728,6556	23.304	2.110
10		- 113.573	42.543	89.715	18.685	6728,6556	9.227	16.187
NPV (12%)	- 1.215.500,41	- 755.282,72	282.917,21	596.624,29	- 1.091.241,64	38.018,40	133.269,36	- 1.186.492,59
IRR					-24,55%			-32,96%
CostS Kw/hour Project (Pesos $Kw hour)					- 297			- 315

Scenario 2 (CDM OPTION II): Biogas Capture from covered WWT ponds, with electricity generación with biogás gen plants, no change to baseline boilers, no turbines. See FEDEPALMA Prefeasibility Study, Chapter 5, Pg 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión with Biogás (Mwh/yr): 2.243

YEAR	1 INVESTMENT COST IN US$	2 Annual Operation and Maintenance Costs	3 Tax Savings from Depreciation (US$)	4 Savings from No Diesel (US $)	TOTAL without CDM	5 Income from CER (US $)	6 CDM Transaction Costs (US $)	TOTAL with CDM
0	- 668.050	- 73.822	23.382	89.715	- 628.776	0	14.326	- 643.102
1		- 73.822	23.382	89.715	39.275	121.962	19.056	142.180
2		- 73.822	23.382	89.715	39.275	121.962	20.664	140.573
3		- 73.822	23.382	89.715	39.275	121.962	22.684	138.552
4		- 73.822	23.382	89.715	39.275	121.962	27.110	134.126
5		- 255.140	23.382	89.715	- 142.043	121.962	20.846	- 40.927
6	- 95.000	- 73.822	30.032	89.715	- 49.075	121.962	20.134	52.753
7		- 73.822	30.032	89.715	45.925	121.962	21.060	146.826
8		- 73.822	30.032	89.715	45.925	121.962	22.659	145.227
9		- 73.822	30.032	89.715	45.925	121.962	23.304	144.582
10		- 73.822	30.032	89.715	45.925	121.962	9.227	158.659
NPV (12%)	- 752.871,61	- 593.818,22	169.096,12	596.624,29	- 544.277,95	689.110,26	133.269,36	11.562,95
IRR					-16,56%			12,45%
Cost Kw/hour of the Project ($Kw hour)					- 211			- 91

Scenario 3: Biogas capture from covered WWT ponds, with electricity generation with Biogas Gen Plants, new turbines to cover own energy needs. See Prefeasibility study, Chapter 5, page 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

YEAR	1 INVESTMENT COST IN US$	2 Annual Operation and Maintenance Costs	3 Tax Savings from Depreciation (US$)	4 Savings from No Diesel (US $)	TOTAL without CDM	5 Income from CER (US $)	6 CDM Transaction Costs (US $)	TOTAL with CDM
0	- 668.050	- 73.822	23.382	89.715	- 628.776	0	14.326	- 643.102
1		- 73.822	23.382	89.715	39.275	121.962	19.056	142.180
2		- 73.822	23.382	89.715	39.275	121.962	20.664	140.573
3		- 73.822	23.382	89.715	39.275	121.962	22.684	138.552
4		- 73.822	23.382	89.715	39.275	121.962	27.110	134.126
5		- 255.140	23.382	89.715	- 142.043	121.962	20.846	- 40.927
6	- 95.000	- 73.822	30.032	89.715	- 49.075	121.962	20.134	52.753
7		- 73.822	30.032	89.715	45.925	121.962	21.060	146.826
8		- 73.822	30.032	89.715	45.925	121.962	22.659	145.227
9		- 73.822	30.032	89.715	45.925	121.962	23.304	144.582
10		- 73.822	30.032	89.715	45.925	121.962	9.227	158.659
NPV (12%)	- 752.871,61	- 593.818,22	169.096,12	596.624,29	- 544.277,95	689.110,26	133.269,36	11.562,95
IRR					-16,56%			12,45%
Cost Kw/hour of the Project ($Kw hour)					- 211			- 91

Scenario 4 (CDM OPTION III): Biogas capture from covered WWT ponds, with electricity generation with Biogas Gen Plants, new high efficiency boilers and turbines, to maximize energy production and offer surplus to the grid. See Prefeasibility study, Chapter 5, page 2..
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión (Mwh/yr): 16.575
Sale of electricity to grid (MWh/yr): 14.331

YEAR	1 INVESTMENT COST IN US$	2 Annual Operation and Maintenance Costs	3 Tax Savings from Depreciation (US$)	4 Savings from No Diesel (US $)	5 Sales of Electricity to the Grid	TOTAL without CDM	6 Income from CER (US $)	7 CDM Transaction Costs (US $)	TOTAL with CDM
0	- 3.492.243	- 317.513	122.229	89.715	286.620	- 3.311.193	0	14.326	- 3.325.519
1		- 317.513	122.229	89.715	286.620	181.050	164.955	19.056	326.950
2		- 317.513	122.229	89.715	286.620	181.050	164.955	20.664	325.342
3		- 317.513	122.229	89.715	286.620	181.050	164.955	22.684	323.321
4		- 317.513	122.229	89.715	286.620	181.050	164.955	27.110	318.895
5		- 498.831	122.229	89.715	286.620	- 267	164.955	20.846	143.842
6	- 95.000	- 317.513	128.879	89.715	286.620	92.700	164.955	20.134	237.522
7		- 317.513	128.879	89.715	286.620	187.700	164.955	21.060	331.595
8		- 317.513	128.879	89.715	286.620	187.700	164.955	22.659	329.996
9		- 317.513	128.879	89.715	286.620	187.700	164.955	23.304	329.352
10		- 317.513	128.879	89.715	286.620	187.700	164.955	9.227	343.429
	- 3.587.243	- 3.673.962	1.377.764	986.864	3.152.820	- 1.743.757	1.649.552	221.069	- 315.274
NPV (12%)	- 3.577.064,80	- 2.214.417,52	826.449,13	596.624,29	1.906.086,92	- 2.425.630,51	932.033,92	133.269,36	- 1.626.865,95
IRR						-11%			-1,75%
Cost Kw/hour of the Project ($Kw hour)						- 156			- 95,01
	- 3.587.243	- 3.673.962					1.649.552	221.069	

Scenario 5: Biogas capture from covered WWT ponds, electricity gen with existing diesel plants modified for 40% biogás, 60% diesel (Dual Gen System). See Prefeasibility study, Chapter 5, page 2
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión with Biogás (kwh/yr): 897 40%

YEAR	1 INVESTMENT COST IN US$	2 Annual Operation and Maintenance Costs	3 Tax Savings from Depreciation (US$)	4 Savings from No Diesel (US $)	TOTAL without CDM	5 Income from CER (US $)	6 CDM Transaction Costs (US $)	TOTAL with CDM	Simple return
0	- 170.000	- 12.920	11.900	35.886	- 135.134	0	14.326	- 100.675	
1		- 12.920	11.900	35.886	34.866	48.785	19.056	64.595	
2		- 12.920	11.900	35.886	34.866	48.785	20.664	62.987	
3		- 12.920	11.900	35.886	34.866	48.785	22.684	60.966	
4	- 60.000	- 12.920	16.100	35.886	- 20.934	48.785	27.110	741	
5		- 12.920	4.200	35.886	27.166	48.785	20.846	55.105	
6	- 95.000	- 33.920	10.850	35.886	- 82.184	48.785	20.134	- 53.533	52.695
7		- 12.920	10.850	35.886	33.816	48.785	21.060	61.540	7
8	- 60.000	- 12.920	15.050	35.886	- 21.984	48.785	22.659	4.141	
9		- 12.920	10.850	35.886	33.816	48.785	23.304	59.297	
10		- 12.920	10.850	35.886	33.816	48.785	9.227	24.589	
NPV (12%)	- 342.011,66	- 96.560,14	76.986,23	238.649,71	- 61.418,22	324.428,75	133.269,36	114.033,82	
IRR					-4,50%			47,81%	
Cost Kw/hour of the Project ($Kw hour)					- 165			- 85	

Scenario 6 (CDM OPTION I): Biogas capture from covered WWT Ponds, mitigation of biogas in Flares, no electricity generation from biogas. See Prefeasibility Study Chapter 5, page 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS
Without CER sales, there is no income from this scenario, IRR and NPV are negative.

YEAR	1 INVESTMENT COST IN US$	2 Annual Operation and Maintenance Costs	3 Tax Savings from Depreciation (US$)	5 Income from CER (US $)	6 CDM Transaction Costs (US $)	TOTAL with CDM	Simple return
0	- 102.500	- 7.790	3.588	0	14.326	- 121.028	
1		- 7.790	3.588	115.233	19.056	91.975	
2		- 7.790	3.588	115.233	20.664	90.367	
3		- 7.790	3.588	115.233	22.684	88.346	
4		- 7.790	3.588	115.233	27.110	83.920	
5		- 7.790	3.588	115.233	20.846	90.185	
6	- 75.000	- 7.790	3.588	115.233	20.134	15.897	88.387
7		- 7.790	3.588	115.233	21.060	89.970	2
8		- 7.790	3.588	115.233	22.659	88.371	
9		- 7.790	3.588	115.233	23.304	87.727	
10		- 7.790	3.588	115.233	9.227	101.804	
						-	
NPV (12%)	- 169.464,29	- 51.805,24	23.857,68	651.092,67	133.269,36	349.378,42	
IRR						72,53%	

FINANCIAL MODEL FOR THE CDM PROJECT AT A PALM OIL EXTRACTION PLANT
Plant: PADELMA LTDA (PALMAS OLEAGINOSAS DEL MAGDALENA LTDA)

Cost Kw/hour in the area (Pesos/ $Kw hour): 120

Scenario 1: Increased Electricty Generation 100% with Biomass - Steam. (Investment in New High Efficiency Boilers and Turbines), no biogas capture from WWT. See FEDEPALMA Prefeasibility Study, Chapter 5, Pg 1.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

	1	2	3	4		5	6	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 1.391.215	- 130.265	48.693	133.320	- 1.339.468	-	14.326	- 1.353.794
1		- 130.265	48.693	133.320	51.747	10.009	19.056	42.700
2		- 130.265	48.693	133.320	51.747	10.009	20.664	41.093
3		- 130.265	48.693	133.320	51.747	10.009	22.684	39.072
4		- 130.265	48.693	133.320	51.747	10.009	27.110	34.646
5		- 130.265	48.693	133.320	51.747	10.009	20.846	40.911
6		- 130.265	48.693	133.320	51.747	10.009	20.134	41.623
7		- 130.265	48.693	133.320	51.747	10.009	21.060	40.696
8		- 130.265	48.693	133.320	51.747	10.009	22.659	39.097
9		- 130.265	48.693	133.320	51.747	10.009	23.304	38.452
10		- 130.265	48.693	133.320	51.747	10.009	9.227	52.529
NPV (12%)	- 1.391.214,59	- 866.293,87	323.816,05	886.606,49	- 1.047.085,91	56.554,26	133.269,36	- 1.123.801,01
IRR					-14,38%			-17,02%
CostS Kw/hour Project (Pesos $Kw hour)					- 229			- 239

Scenario 2 (CDM OPTION II): Biogas Capture from covered WWT ponds, with electricity generación with biogás gen plants, no change to baseline boilers, no turbines. See FEDEPALMA Prefeasibility Study, Chapter 5, Pg 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión with Biogás (Mwh/yr): 3.326

	1	2	3	4		5	6	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 768.267	- 84.673	26.889	133.320	- 692.730	0	14.326	- 707.056
1		- 84.673	26.889	133.320	75.537	82.480	19.056	138.961
2		- 84.673	26.889	133.320	75.537	82.480	20.664	137.353
3		- 84.673	26.889	133.320	75.537	82.480	22.684	135.332
4		- 84.673	26.889	133.320	75.537	82.480	27.110	130.906
5		- 292.640	26.889	133.320	- 132.431	82.480	20.846	- 70.797
6	- 112.593	- 84.673	34.771	133.320	- 29.174	82.480	20.134	33.172
7		- 84.673	34.771	133.320	83.418	82.480	21.060	144.837
8		- 84.673	34.771	133.320	83.418	82.480	22.659	143.238
9		- 84.673	34.771	133.320	83.418	82.480	23.304	142.594
10		- 84.673	34.771	133.320	83.418	82.480	9.227	156.671
NPV (12%)	- 868.796,16	- 681.097,38	194.941,31	886.606,49	- 424.859,56	466.027,66	133.269,36	- 92.101,26
IRR					-5,92%			8,67%
Cost Kw/hour of the Project ($Kw hour)					- 164			- 115

Scenario 3: Biogas capture from covered WWT ponds, with electricity generation with Biogas Gen Plants, new turbines to cover own energy needs. See Prefeasibility study, Chapter 5, page 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

	1	2	3	4		5	6	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 768.267	- 84.673	26.889	133.320	- 692.730	0	14.326	- 707.056
1		- 84.673	26.889	133.320	75.537	82.480	19.056	138.961
2		- 84.673	26.889	133.320	75.537	82.480	20.664	137.353
3		- 84.673	26.889	133.320	75.537	82.480	22.684	135.332
4		- 84.673	26.889	133.320	75.537	82.480	27.110	130.906
5		- 292.640	26.889	133.320	- 132.431	82.480	20.846	- 70.797
6	- 112.593	- 84.673	34.771	133.320	- 29.174	82.480	20.134	33.172
7		- 84.673	34.771	133.320	83.418	82.480	21.060	144.837
8		- 84.673	34.771	133.320	83.418	82.480	22.659	143.238
9		- 84.673	34.771	133.320	83.418	82.480	23.304	142.594
10		- 84.673	34.771	133.320	83.418	82.480	9.227	156.671
NPV (12%)	- 868.796,16	- 681.097,38	194.941,31	886.606,49	- 424.859,56	466.027,66	133.269,36	- 92.101,26
IRR					-5,92%			8,67%
Cost Kw/hour of the Project ($Kw hour)					- 164			- 115

Scenario 4 (CDM OPTION III): Biogas capture from covered WWT ponds, with electricity generation with Biogas Gen Plants, new high efficiency boilers and turbines, to maximize energy production and offer surplus to the grid. See Prefeasibility study, Chapter 5, page 2..
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión (Mwh/yr): 25.072
Sale of electricity to grid (MWh/yr): 21.746

	1	2	3	4	5		6	7	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	Sales of Electricity to the Grid	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 4.565.619	- 417.197	159.797	133.320	434.920	- 4.254.779	0	14.326	- 4.269.105
1		- 417.197	159.797	133.320	434.920	310.840	147.717	19.056	439.501
2		- 417.197	159.797	133.320	434.920	310.840	147.717	20.664	437.893
3		- 417.197	159.797	133.320	434.920	310.840	147.717	22.684	435.872
4		- 417.197	159.797	133.320	434.920	310.840	147.717	27.110	431.446
5		- 625.164	159.797	133.320	434.920	102.872	147.717	20.846	229.743
6	- 112.593	- 417.197	167.678	133.320	434.920	206.129	147.717	20.134	333.712
7		- 417.197	167.678	133.320	434.920	318.721	147.717	21.060	445.378
8		- 417.197	167.678	133.320	434.920	318.721	147.717	22.659	443.779
9		- 417.197	167.678	133.320	434.920	318.721	147.717	23.304	443.134
10		- 417.197	167.678	133.320	434.920	318.721	147.717	9.227	457.211
NPV (12%)	- 4.666.147,93	- 2.892.457,81	1.078.804,57	886.606,49	2.892.315,00	- 2.657.393,49	834.632,18	133.269,36	- 1.956.030,67
IRR						-7%			-0,73%
Cost Kw/hour of the Project ($Kw hour)						- 134			- 88,51

Scenario 5: Biogas capture from covered WWT ponds, electricity gen with existing diesel plants modified for 40% biogás, 60% diesel (Dual Gen System). See Prefeasibility study, Chapter 5, page 2
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión with Biogás (kwh/yr): 1.331 40%

	1	2	3	4		5	6		
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM	Simple return
0	- 194.074	- 12.920	13.585	53.328	- 140.081	0	14.326	- 121.415	
1		- 12.920	13.585	53.328	53.993	32.992	19.056	67.929	
2		- 12.920	13.585	53.328	53.993	32.992	20.664	66.321	
3		- 12.920	13.585	53.328	53.993	32.992	22.684	64.301	
4	- 60.000	- 12.920	17.785	53.328	- 1.807	32.992	27.110	4.075	
5		- 12.920	4.200	53.328	44.608	32.992	20.846	56.754	
6	- 112.593	- 33.920	12.081	53.328	- 81.103	32.992	20.134	- 68.245	54.344
7		- 12.920	12.081	53.328	52.489	32.992	21.060	64.421	8
8	- 60.000	- 12.920	16.281	53.328	- 3.311	32.992	22.659	7.022	
9		- 12.920	12.081	53.328	52.489	32.992	23.304	62.177	
10		- 12.920	12.081	53.328	52.489	32.992	9.227	43.263	
NPV (12%)	- 380.110,44	- 96.560,14	86.308,84	354.642,59	30.910,24	219.402,87	133.269,36	106.421,27	
IRR					18,89%			39,02%	
Cost Kw/hour of the Project ($Kw hour)					- 120			- 98	

Scenario 6 (CDM OPTION I): Biogas capture from covered WWT Ponds, mitigation of biogas in Flares, no electricity generation from biogas. See Prefeasibility Study Chapter 5, page 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS
Without CER sales, there is no income from this scenario, IRR and NPV are negative.

	1	2	3	5	6		
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM	Simple return
0	- 117.778	- 8.951	4.122	0	14.326	- 136.933	
1		- 8.951	4.122	72.470	19.056	48.586	
2		- 8.951	4.122	72.470	20.664	46.978	
3		- 8.951	4.122	72.470	22.684	44.957	
4		- 8.951	4.122	72.470	27.110	40.531	
5		- 8.951	4.122	72.470	20.846	46.796	
6	- 88.889	- 8.951	4.122	72.470	20.134	- 41.381	44.464
7		- 8.951	4.122	72.470	21.060	46.581	5
8		- 8.951	4.122	72.470	22.659	44.982	
9		- 8.951	4.122	72.470	23.304	44.337	
10		- 8.951	4.122	72.470	9.227	58.415	
						-	
NPV (12%)	- 197.142,86	- 59.526,89	27.413,70	409.473,40	133.269,36	81.279,20	
IRR						26,49%	

FINANCIAL MODEL FOR THE CDM PROJECT AT A PALM OIL EXTRACTION PLANT
Plant: PALMAS DEL CESAR

Cost Kw/hour in the area (Pesos/ $Kw hour): 165

Scenario 1: Increased Electricty Generation 100% with Biomass - Steam. (Investment in New High Efficiency Boilers and Turbines), no biogas capture from WWT. See FEDEPALMA Prefeasibility Study, Chapter 5, Pg 1.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

YEAR	1 INVESTMENT COST IN US$	2 Annual Operation and Maintenance Costs	3 Tax Savings from Depreciation (US$)	4 Savings from No Diesel (US $)	TOTAL without CDM	5 Income from CER (US $)	6 CDM Transaction Costs (US $)	TOTAL with CDM
0	- 1.793.572	- 168.489	62.775	148.280	- 1.751.007	-	14.326	- 1.765.333
1		- 168.489	62.775	148.280	42.566	10.566	19.056	34.076
2		- 168.489	62.775	148.280	42.566	10.566	20.664	32.468
3		- 168.489	62.775	148.280	42.566	10.566	22.684	30.447
4		- 168.489	62.775	148.280	42.566	10.566	27.110	26.021
5		- 168.489	62.775	148.280	42.566	10.566	20.846	32.286
6		- 168.489	62.775	148.280	42.566	10.566	20.134	32.998
7		- 168.489	62.775	148.280	42.566	10.566	21.060	32.071
8		- 168.489	62.775	148.280	42.566	10.566	22.659	30.472
9		- 168.489	62.775	148.280	42.566	10.566	23.304	29.827
10		- 168.489	62.775	148.280	42.566	10.566	9.227	43.905
NPV (12%)	- 1.793.572,30	- 1.120.491,88	417.467,95	986.094,78	- 1.510.501,45	59.698,56	133.269,36	- 1.584.072,24
IRR					-19,88%			-22,38%
CostS Kw/hour Project (Pesos $Kw hour)					- 281			- 290

Scenario 2 (CDM OPTION II): Biogas Capture from covered WWT ponds, with electricity generación with biogás gen plants, no change to baseline boilers, no turbines. See FEDEPALMA Prefeasibility Study, Chapter 5, Pg 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión with Biogás (Mwh/yr): 3.500

YEAR	1 INVESTMENT COST IN US$	2 Annual Operation and Maintenance Costs	3 Tax Savings from Depreciation (US$)	4 Savings from No Diesel (US $)	TOTAL without CDM	5 Income from CER (US $)	6 CDM Transaction Costs (US $)	TOTAL with CDM
0	- 961.881	- 109.518	33.666	148.280	- 889.454	0	14.326	- 903.780
1		- 109.518	33.666	148.280	72.428	211.833	19.056	265.205
2		- 109.518	33.666	148.280	72.428	211.833	20.664	263.597
3		- 109.518	33.666	148.280	72.428	211.833	22.684	261.576
4		- 109.518	33.666	148.280	72.428	211.833	27.110	257.151
5		- 378.510	33.666	148.280	- 196.564	211.833	20.846	- 5.577
6	- 126.667	- 109.518	42.533	148.280	- 45.372	211.833	20.134	146.327
7		- 109.518	42.533	148.280	81.294	211.833	21.060	272.067
8		- 109.518	42.533	148.280	81.294	211.833	22.659	270.468
9		- 109.518	42.533	148.280	81.294	211.833	23.304	269.823
10		- 109.518	42.533	148.280	81.294	211.833	9.227	283.901
NPV (12%)	- 1.074.976,57	- 880.952,89	242.021,68	986.094,78	- 678.891,03	1.196.903,92	133.269,36	384.743,53
IRR					-11,79%			21,99%
Cost Kw/hour of the Project ($Kw hour)					- 198			- 51

Scenario 3: Biogas capture from covered WWT ponds, with electricity generation with Biogas Gen Plants, new turbines to cover own energy needs. See Prefeasibility study, Chapter 5, page 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

YEAR	1 INVESTMENT COST IN US$	2 Annual Operation and Maintenance Costs	3 Tax Savings from Depreciation (US$)	4 Savings from No Diesel (US $)	TOTAL without CDM	5 Income from CER (US $)	6 CDM Transaction Costs (US $)	TOTAL with CDM
0	- 961.881	- 109.518	33.666	148.280	- 889.454	0	14.326	- 903.780
1		- 109.518	33.666	148.280	72.428	211.833	19.056	265.205
2		- 109.518	33.666	148.280	72.428	211.833	20.664	263.597
3		- 109.518	33.666	148.280	72.428	211.833	22.684	261.576
4		- 109.518	33.666	148.280	72.428	211.833	27.110	257.151
5		- 378.510	33.666	148.280	- 196.564	211.833	20.846	- 5.577
6	- 126.667	- 109.518	42.533	148.280	- 45.372	211.833	20.134	146.327
7		- 109.518	42.533	148.280	81.294	211.833	21.060	272.067
8		- 109.518	42.533	148.280	81.294	211.833	22.659	270.468
9		- 109.518	42.533	148.280	81.294	211.833	23.304	269.823
10		- 109.518	42.533	148.280	81.294	211.833	9.227	283.901
NPV (12%)	- 1.074.976,57	- 880.952,89	242.021,68	986.094,78	- 678.891,03	1.196.903,92	133.269,36	384.743,53
IRR					-11,79%			21,99%
Cost Kw/hour of the Project ($Kw hour)					- 198			- 51

Scenario 4 (CDM OPTION III): Biogas capture from covered WWT ponds, with electricity generation with Biogas Gen Plants, new high efficiency boilers and turbines, to maximize energy production and offer surplus to the grid. See Prefeasibility study, Chapter 5, page 2..
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión (Mwh/yr): 27.417
Sale of electricity to grid (MWh/yr): 23.917

YEAR	1 INVESTMENT COST IN US$	2 Annual Operation and Maintenance Costs	3 Tax Savings from Depreciation (US$)	4 Savings from No Diesel (US $)	5 Sales of Electricity to the Grid	TOTAL without CDM	6 Income from CER (US $)	7 CDM Transaction Costs (US $)	TOTAL with CDM
0	- 5.057.673	- 462.112	177.019	148.280	478.340	- 4.716.147	0	14.326	- 4.730.473
1		- 462.112	177.019	148.280	478.340	341.526	283.583	19.056	606.053
2		- 462.112	177.019	148.280	478.340	341.526	283.583	20.664	604.445
3		- 462.112	177.019	148.280	478.340	341.526	283.583	22.684	602.425
4		- 462.112	177.019	148.280	478.340	341.526	283.583	27.110	597.999
5		- 731.104	177.019	148.280	478.340	72.534	283.583	20.846	335.272
6	- 126.667	- 462.112	185.885	148.280	478.340	223.726	283.583	20.134	487.175
7		- 462.112	185.885	148.280	478.340	350.393	283.583	21.060	612.915
8		- 462.112	185.885	148.280	478.340	350.393	283.583	22.659	611.316
9		- 462.112	185.885	148.280	478.340	350.393	283.583	23.304	610.672
10		- 462.112	185.885	148.280	478.340	350.393	283.583	9.227	624.749
NPV (12%)	- 5.170.768,47	- 3.225.782,96	1.195.349,22	986.094,78	3.181.067,68	- 2.985.117,79	1.602.305,75	133.269,36	- 1.516.081,39
IRR						-7%			3,50%
Cost Kw/hour of the Project ($Kw hour)						- 137			- 78,01

Scenario 5: Biogas capture from covered WWT ponds, electricity gen with existing diesel plants modified for 40% biogás, 60% diesel (Dual Gen System). See Prefeasibility study, Chapter 5, page 2
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión with Biogás (kwh/yr): 1.400 40%

YEAR	1 INVESTMENT COST IN US$	2 Annual Operation and Maintenance Costs	3 Tax Savings from Depreciation (US$)	4 Savings from No Diesel (US $)	TOTAL without CDM	5 Income from CER (US $)	6 CDM Transaction Costs (US $)	TOTAL with CDM	Simple return
0	- 194.074	- 12.920	13.585	53.328	- 140.081	0	14.326	- 121.415	
1		- 12.920	13.585	53.328	53.993	32.992	19.056	67.929	
2		- 12.920	13.585	53.328	53.993	32.992	20.664	66.321	
3		- 12.920	13.585	53.328	53.993	32.992	22.684	64.301	
4	- 60.000	- 12.920	17.785	53.328	- 1.807	32.992	27.110	4.075	
5		- 12.920	4.200	53.328	44.608	32.992	20.846	56.754	
6	- 112.593	- 33.920	12.081	53.328	- 81.103	32.992	20.134	- 68.245	54.344
7		- 12.920	12.081	53.328	52.489	32.992	21.060	64.421	8
8	- 60.000	- 12.920	16.281	53.328	- 3.311	32.992	22.659	7.022	
9		- 12.920	12.081	53.328	52.489	32.992	23.304	62.177	
10		- 12.920	12.081	53.328	52.489	32.992	9.227	43.263	
NPV (12%)	- 380.110,44	- 96.560,14	86.308,84	354.642,59	30.910,24	219.402,87	133.269,36	106.421,27	
IRR					18,89%			39,02%	
Cost Kw/hour of the Project ($Kw hour)					- 114			- 93	

Scenario 6 (CDM OPTION I): Biogas capture from covered WWT Ponds, mitigation of biogas in Flares, no electricity generation from biogas. See Prefeasibility Study Chapter 5, page 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS
Without CER sales, there is no income from this scenario, IRR and NPV are negative.

YEAR	1 INVESTMENT COST IN US$	2 Annual Operation and Maintenance Costs	3 Tax Savings from Depreciation (US$)	5 Income from CER (US $)	6 CDM Transaction Costs (US $)	TOTAL with CDM	Simple return
0	- 130.000	- 9.880	4.550	0	14.326	- 149.656	
1		- 9.880	4.550	201.267	19.056	176.882	
2		- 9.880	4.550	201.267	20.664	175.274	
3		- 9.880	4.550	201.267	22.684	173.253	
4		- 9.880	4.550	201.267	27.110	168.827	
5		- 9.880	4.550	201.267	20.846	175.092	
6	- 100.000	- 9.880	4.550	201.267	20.134	75.804	172.332
7		- 9.880	4.550	201.267	21.060	174.877	1
8		- 9.880	4.550	201.267	22.659	173.278	
9		- 9.880	4.550	201.267	23.304	172.633	
10		- 9.880	4.550	201.267	9.227	186.711	
						-	
NPV (12%)	- 219.285,71	- 65.704,20	30.258,51	1.137.205,36	133.269,36	787.827,20	
IRR						116,50%	

FINANCIAL MODEL FOR THE CDM PROJECT AT A PALM OIL EXTRACTION PLANT
Plant: ACEITES S.A.

Cost Kw/hour in the area (Pesos/ $Kw hour): 150

Scenario 1: Increased Electricty Generation 100% with Biomass - Steam. (Investment in New High Efficiency Boilers and Turbines), no biogas capture from WWT. See FEDEPALMA Prefeasibility Study, Chapter 5, Pg 1.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

YEAR	1 INVESTMENT COST IN US$	2 Annual Operation and Maintenance Costs	3 Tax Savings from Depreciation (US$)	4 Savings from No Diesel (US $)	TOTAL without CDM	5 Income from CER (US $)	6 CDM Transaction Costs (US $)	TOTAL with CDM
0	- 1.427.893	- 133.750	49.976	147.716	- 1.363.951	-	14.326	- 1.378.277
1		- 133.750	49.976	147.716	63.942	11.172	19.056	56.059
2		- 133.750	49.976	147.716	63.942	11.172	20.664	54.451
3		- 133.750	49.976	147.716	63.942	11.172	22.684	52.430
4		- 133.750	49.976	147.716	63.942	11.172	27.110	48.004
5		- 133.750	49.976	147.716	63.942	11.172	20.846	54.269
6		- 133.750	49.976	147.716	63.942	11.172	20.134	54.981
7		- 133.750	49.976	147.716	63.942	11.172	21.060	54.054
8		- 133.750	49.976	147.716	63.942	11.172	22.659	52.455
9		- 133.750	49.976	147.716	63.942	11.172	23.304	51.810
10		- 133.750	49.976	147.716	63.942	11.172	9.227	65.888
NPV (12%)	**- 1.427.892,98**	**- 889.466,22**	**332.353,24**	**982.343,71**	**- 1.002.662,26**	**63.124,19**	**133.269,36**	**- 1.072.807,43**
IRR					**-11,84%**			**-13,89%**
CostS Kw/hour Project (Pesos $Kw hour)					**- 214**			**- 222**

Scenario 2 (CDM OPTION II): Biogas Capture from covered WWT ponds, with electricity generación with biogás gen plants, no change to baseline boilers, no turbines. See FEDEPALMA Prefeasibility Study, Chapter 5, Pg 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión with Biogás (Mwh/yr): 3.654

YEAR	1 INVESTMENT COST IN US$	2 Annual Operation and Maintenance Costs	3 Tax Savings from Depreciation (US$)	4 Savings from No Diesel (US $)	TOTAL without CDM	5 Income from CER (US $)	6 CDM Transaction Costs (US $)	TOTAL with CDM
0	- 822.680	- 86.937	28.794	147.716	- 733.107	0	14.326	- 747.433
1		- 86.937	28.794	147.716	89.572	120.092	19.056	190.609
2		- 86.937	28.794	147.716	89.572	120.092	20.664	189.001
3		- 86.937	28.794	147.716	89.572	120.092	22.684	186.980
4		- 86.937	28.794	147.716	89.572	120.092	27.110	182.555
5		- 300.468	28.794	147.716	- 123.958	120.092	20.846	- 24.711
6	- 140.741	- 86.937	38.646	147.716	- 41.317	120.092	20.134	58.642
7		- 86.937	38.646	147.716	99.424	120.092	21.060	198.456
8		- 86.937	38.646	147.716	99.424	120.092	22.659	196.857
9		- 86.937	38.646	147.716	99.424	120.092	23.304	196.213
10		- 86.937	38.646	147.716	99.424	120.092	9.227	210.290
NPV (12%)	**- 948.340,93**	**- 699.315,95**	**211.636,53**	**982.343,71**	**- 399.318,90**	**678.549,15**	**133.269,36**	**145.960,89**
IRR					**-3,53%**			**16,73%**
Cost Kw/hour of the Project ($Kw hour)					**- 158**			**- 85**

Scenario 3: Biogas capture from covered WWT ponds, with electricity generation with Biogas Gen Plants, new turbines to cover own energy needs. See Prefeasibility study, Chapter 5, page 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

YEAR	1 INVESTMENT COST IN US$	2 Annual Operation and Maintenance Costs	3 Tax Savings from Depreciation (US$)	4 Savings from No Diesel (US $)	TOTAL without CDM	5 Income from CER (US $)	6 CDM Transaction Costs (US $)	TOTAL with CDM
0	- 822.680	- 86.937	28.794	147.716	- 733.107	0	14.326	- 747.433
1		- 86.937	28.794	147.716	89.572	120.092	19.056	190.609
2		- 86.937	28.794	147.716	89.572	120.092	20.664	189.001
3		- 86.937	28.794	147.716	89.572	120.092	22.684	186.980
4		- 86.937	28.794	147.716	89.572	120.092	27.110	182.555
5		- 300.468	28.794	147.716	- 123.958	120.092	20.846	- 24.711
6	- 140.741	- 86.937	38.646	147.716	- 41.317	120.092	20.134	58.642
7		- 86.937	38.646	147.716	99.424	120.092	21.060	198.456
8		- 86.937	38.646	147.716	99.424	120.092	22.659	196.857
9		- 86.937	38.646	147.716	99.424	120.092	23.304	196.213
10		- 86.937	38.646	147.716	99.424	120.092	9.227	210.290
NPV (12%)	**- 948.340,93**	**- 699.315,95**	**211.636,53**	**982.343,71**	**- 399.318,90**	**678.549,15**	**133.269,36**	**145.960,89**
IRR					**-3,53%**			**16,73%**
Cost Kw/hour of the Project ($Kw hour)					**- 158**			**- 85**

Scenario 4 (CDM OPTION III): Biogas capture from covered WWT ponds, with electricity generation with Biogas Gen Plants, new high efficiency boilers and turbines, to maximize energy production and offer surplus to the grid. See Prefeasibility study, Chapter 5, page 2..
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión (Mwh/yr): 19.340
Sale of electricity to grid (MWh/yr): 15.686

YEAR	1 INVESTMENT COST IN US$	2 Annual Operation and Maintenance Costs	3 Tax Savings from Depreciation (US$)	4 Savings from No Diesel (US $)	5 Sales of Electricity to the Grid	TOTAL without CDM	6 Income from CER (US $)	7 CDM Transaction Costs (US $)	TOTAL with CDM
0	- 3.807.927	- 341.557	133.277	147.716	313.720	- 3.554.771	0	14.326	- 3.569.096
1		- 341.557	133.277	147.716	313.720	253.157	167.150	19.056	401.250
2		- 341.557	133.277	147.716	313.720	253.157	167.150	20.664	399.643
3		- 341.557	133.277	147.716	313.720	253.157	167.150	22.684	397.622
4		- 341.557	133.277	147.716	313.720	253.157	167.150	27.110	393.196
5		- 555.087	133.277	147.716	313.720	39.626	167.150	20.846	185.930
6	- 140.741	- 341.557	143.129	147.716	313.720	122.268	167.150	20.134	269.284
7		- 341.557	143.129	147.716	313.720	263.008	167.150	21.060	409.098
8		- 341.557	143.129	147.716	313.720	263.008	167.150	22.659	407.499
9		- 341.557	143.129	147.716	313.720	263.008	167.150	23.304	406.854
10		- 341.557	143.129	147.716	313.720	263.008	167.150	9.227	420.931
NPV (12%)	**- 3.933.588,47**	**- 2.392.591,65**	**906.476,20**	**982.343,71**	**2.086.307,97**	**- 2.296.694,52**	**944.432,33**	**133.269,36**	**- 1.485.531,54**
IRR						**-8%**			**0,61%**
Cost Kw/hour of the Project ($Kw hour)						**- 145**			**- 90,31**

Scenario 5: Biogas capture from covered WWT ponds, electricity gen with existing diesel plants modified for 40% biogás, 60% diesel (Dual Gen System). See Prefeasibility study, Chapter 5, page 2
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión with Biogás (kwh/yr): 1.462 40%

YEAR	1 INVESTMENT COST IN US$	2 Annual Operation and Maintenance Costs	3 Tax Savings from Depreciation (US$)	4 Savings from No Diesel (US $)	TOTAL without CDM	5 Income from CER (US $)	6 CDM Transaction Costs (US $)	TOTAL with CDM	Simple return
0	- 232.593	- 12.920	16.281	59.086	- 170.145	0	14.326	- 136.434	
1		- 12.920	16.281	59.086	62.448	48.037	19.056	91.429	
2		- 12.920	16.281	59.086	62.448	48.037	20.664	89.821	
3		- 12.920	16.281	59.086	62.448	48.037	22.684	87.801	
4	- 60.000	- 12.920	20.481	59.086	6.648	48.037	27.110	27.575	
5		- 12.920	4.200	59.086	50.366	48.037	20.846	77.558	
6	- 140.741	- 33.920	14.052	59.086	- 101.523	48.037	20.134	- 73.619	75.148
7		- 12.920	14.052	59.086	60.218	48.037	21.060	87.195	7
8	- 60.000	- 12.920	18.252	59.086	4.418	48.037	22.659	29.796	
9		- 12.920	14.052	59.086	60.218	48.037	23.304	84.951	
10		- 12.920	14.052	59.086	60.218	48.037	9.227	50.992	
NPV (12%)	**- 441.068,49**	**- 96.560,14**	**101.225,02**	**392.937,48**	**31.342,06**	**319.456,64**	**133.269,36**	**202.062,72**	
IRR					**17,70%**			**54,41%**	
Cost Kw/hour of the Project ($Kw hour)					**- 121**			**- 73**	

Scenario 6 (CDM OPTION I): Biogas capture from covered WWT Ponds, mitigation of biogas in Flares, no electricity generation from biogas. See Prefeasibility Study Chapter 5, page 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS
Without CER sales, there is no income from this scenario, IRR and NPV are negative.

YEAR	1 INVESTMENT COST IN US$	2 Annual Operation and Maintenance Costs	3 Tax Savings from Depreciation (US$)	5 Income from CER (US $)	6 CDM Transaction Costs (US $)	TOTAL with CDM	Simple return
0	- 142.222	- 10.809	4.978	0	14.326	- 162.379	
1		- 10.809	4.978	108.920	19.056	84.034	
2		- 10.809	4.978	108.920	20.664	82.426	
3		- 10.809	4.978	108.920	22.684	80.405	
4		- 10.809	4.978	108.920	27.110	75.979	
5		- 10.809	4.978	108.920	20.846	82.244	
6	- 111.111	- 10.809	4.978	108.920	20.134	- 28.155	79.056
7		- 10.809	4.978	108.920	21.060	82.029	3
8		- 10.809	4.978	108.920	22.659	80.430	
9		- 10.809	4.978	108.920	23.304	79.785	
10		- 10.809	4.978	108.920	9.227	93.863	
						-	
NPV (12%)	**- 241.428,57**	**- 71.881,52**	**33.103,33**	**615.424,97**	**133.269,36**	**244.862,85**	
IRR						**46,12%**	

FINANCIAL MODEL FOR THE CDM PROJECT AT A PALM OIL EXTRACTION PLANT
Plant: PALMAS SANTA FE LTDA.

Cost Kw/hour in the area (Pesos/ $Kw hour): 148

Scenario 1: Increased Electricty Generation 100% with Biomass - Steam. (Investment in New High Efficiency Boilers and Turbines), no biogas capture from WWT. See FEDEPALMA Prefeasibility Study, Chapter 5, Pg 1.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

	1	2	3	4		5	6	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 645.837	- 33.899	22.604	51.115	- 606.017	0	14.326	- 620.343
1		- 33.899	22.604	51.115	39.820	3.536	19.056	24.301
2		- 33.899	22.604	51.115	39.820	3.536	20.664	22.693
3		- 33.899	22.604	51.115	39.820	3.536	22.684	20.672
4		- 33.899	22.604	51.115	39.820	3.536	27.110	16.246
5		- 33.899	22.604	51.115	39.820	3.536	20.846	22.511
6		- 33.899	22.604	51.115	39.820	3.536	20.134	23.223
7		- 33.899	22.604	51.115	39.820	3.536	21.060	22.296
8		- 33.899	22.604	51.115	39.820	3.536	22.659	20.697
9		- 33.899	22.604	51.115	39.820	3.536	23.304	20.052
10		- 33.899	22.604	51.115	39.820	3.536	9.227	34.130
NPV (12%)	- 645.836,76	- 225.438,98	150.323,55	339.927,13	- 381.025,07	19.981,08	133.269,36	- 494.313,34
IRR					-6,99%			-14,58%
CostS Kw/hour Project (Pesos $Kw hour)					- 373			- 441

Scenario 2 (CDM OPTION II): Biogas Capture from covered WWT ponds, with electricity generación with biogás gen plants, no change to baseline boilers, no turbines. See FEDEPALMA Prefeasibility Study, Chapter 5, Pg 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión with Biogás (Mwh/yr): 737

	1	2	3	4		5	6	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 309.791	- 27.911	10.843	51.115	- 275.744	0	14.326	- 290.070
1		- 27.911	10.843	51.115	34.047	65.864	19.056	80.856
2		- 27.911	10.843	51.115	34.047	65.864	20.664	79.248
3		- 27.911	10.843	51.115	34.047	65.864	22.684	77.227
4		- 27.911	10.843	51.115	34.047	65.864	27.110	72.802
5		- 112.486	10.843	51.115	- 50.528	65.864	20.846	- 5.509
6	- 35.185	- 27.911	13.306	51.115	1.325	65.864	20.134	47.056
7		- 27.911	13.306	51.115	36.510	65.864	21.060	81.314
8		- 27.911	13.306	51.115	36.510	65.864	22.659	79.715
9		- 27.911	13.306	51.115	36.510	65.864	23.304	79.071
10		- 27.911	13.306	51.115	36.510	65.864	9.227	93.148
NPV (12%)	- 341.206,35	- 233.601,56	77.144,13	339.927,13	- 144.147,21	372.148,19	133.269,36	94.731,63
IRR					-2,81%			19,71%
Cost Kw/hour of the Project ($Kw hour)					- 270			- 110

Scenario 3: Biogas capture from covered WWT ponds, with electricity generation with Biogas Gen Plants, new turbines to cover own energy needs. See Prefeasibility study, Chapter 5, page 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

	1	2	3	4		5	6	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 309.791	- 27.911	10.843	51.115	- 275.744	0	14.326	- 290.070
1		- 27.911	10.843	51.115	34.047	65.864	19.056	80.856
2		- 27.911	10.843	51.115	34.047	65.864	20.664	79.248
3		- 27.911	10.843	51.115	34.047	65.864	22.684	77.227
4		- 27.911	10.843	51.115	34.047	65.864	27.110	72.802
5		- 112.486	10.843	51.115	- 50.528	65.864	20.846	- 5.509
6	- 35.185	- 27.911	13.306	51.115	1.325	65.864	20.134	47.056
7		- 27.911	13.306	51.115	36.510	65.864	21.060	81.314
8		- 27.911	13.306	51.115	36.510	65.864	22.659	79.715
9		- 27.911	13.306	51.115	36.510	65.864	23.304	79.071
10		- 27.911	13.306	51.115	36.510	65.864	9.227	93.148
NPV (12%)	- 341.206,35	- 233.601,56	77.144,13	339.927,13	- 144.147,21	372.148,19	133.269,36	94.731,63
IRR					-2,81%			19,71%
Cost Kw/hour of the Project ($Kw hour)					- 270			- 110

Scenario 4 (CDM OPTION III): Biogas capture from covered WWT ponds, with electricity generation with Biogas Gen Plants, new high efficiency boilers and turbines, to maximize energy production and offer surplus to the grid. See Prefeasibility study, Chapter 5, page 2..
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión (Mwh/yr): 9.427
Sale of electricity to grid (MWh/yr): 8.691

	1	2	3	4	5		6	7	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	Sales of Electricity to the Grid	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 2.418.047	- 228.195	84.632	51.115	173.820	- 2.336.675	0	14.326	- 2.351.001
1		- 228.195	84.632	51.115	173.820	81.372	91.937	19.056	154.254
2		- 228.195	84.632	51.115	173.820	81.372	91.937	20.664	152.646
3		- 228.195	84.632	51.115	173.820	81.372	91.937	22.684	150.625
4		- 228.195	84.632	51.115	173.820	81.372	91.937	27.110	146.199
5		- 312.770	84.632	51.115	173.820	- 3.203	91.937	20.846	67.889
6	- 35.185	- 228.195	87.095	51.115	173.820	48.650	91.937	20.134	120.454
7		- 228.195	87.095	51.115	173.820	83.835	91.937	21.060	154.712
8		- 228.195	87.095	51.115	173.820	83.835	91.937	22.659	153.113
9		- 228.195	87.095	51.115	173.820	83.835	91.937	23.304	152.468
10		- 228.195	87.095	51.115	173.820	83.835	91.937	9.227	166.546
NPV (12%)	- 2.449.462,45	- 1.565.537,01	567.857,20	339.927,13	1.155.941,77	- 1.937.683,93	519.466,71	133.269,36	- 1.551.486,58
IRR						-16,98%			-8,14%
Cost Kw/hour of the Project ($Kw hour)						- 145			- 124,58

Scenario 5: Biogas capture from covered WWT ponds, electricity gen with existing diesel plants modified for 40% biogás, 60% diesel (Dual Gen System). See Prefeasibility study, Chapter 5, page 2
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión with Biogás (kwh/yr): 295 40%

	1	2	3	4		5	6		
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM	Simple return
0	- 87.407	- 7.600	6.119	20.446	- 68.443	0	14.326	- 56.423	
1		- 7.600	6.119	20.446	18.965	26.346	19.056	26.255	
2		- 7.600	6.119	20.446	18.965	26.346	20.664	24.647	
3		- 7.600	6.119	20.446	18.965	26.346	22.684	22.626	
4	- 30.000	- 7.600	8.219	20.446	- 8.935	26.346	27.110	- 9.700	
5		- 7.600	2.100	20.446	14.946	26.346	20.846	20.446	
6	- 49.259	- 18.100	5.548	20.446	- 41.365	26.346	20.134	- 35.153	20.136
7		- 7.600	5.548	20.446	18.394	26.346	21.060	23.680	10
8	- 30.000	- 7.600	7.648	20.446	- 9.506	26.346	22.659	- 5.819	
9		- 7.600	5.548	20.446	18.394	26.346	23.304	21.436	
10		- 7.600	5.548	20.446	18.394	26.346	9.227	9.168	
NPV (12%)	- 174.815,71	- 55.861,32	39.425,38	135.970,85	- 24.010,81	175.205,01	133.269,36	9.442,22	
IRR					-0,39%			18,56%	
Cost Kw/hour of the Project ($Kw hour)					- 266			- 228	

Scenario 6 (CDM OPTION I): Biogas capture from covered WWT Ponds, mitigation of biogas in Flares, no electricity generation from biogas. See Prefeasibility Study Chapter 5, page 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS
Without CER sales, there is no income from this scenario, IRR and NPV are negative.

	1	2	3	5	6		
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM	Simple return
0	- 62.778	- 4.771	4.394	0	14.326	- 77.480	
1		- 4.771	4.394	62.328	19.056	42.896	
2		- 4.771	4.394	62.328	20.664	41.288	
3		- 4.771	4.394	62.328	22.684	39.267	
4		- 4.771	4.394	62.328	27.110	34.841	
5		- 4.771	4.394	62.328	20.846	41.106	
6	- 38.889	- 4.771	- 2.722	62.328	20.134	- 4.188	38.501
7		- 4.771	- 2.722	62.328	21.060	33.774	3
8		- 4.771	- 2.722	62.328	22.659	32.175	
9		- 4.771	- 2.722	62.328	23.304	31.531	
10		- 4.771	- 2.722	62.328	9.227	45.608	
						-	
NPV (12%)	- 97.500,00	- 31.728,95	14.667,27	352.167,11	133.269,36	119.355,97	
IRR						48,38%	

FINANCIAL MODEL FOR THE CDM PROJECT AT A PALM OIL EXTRACTION PLANT
Plant: PALMAS SANTANA LTDA.

Cost Kw/hour in the area (Pesos/ $Kw hour):

Scenario 1: Increased Electricty Generation 100% with Biomass - Steam. (Investment in New High Efficiency Boilers and Turbines), no biogas capture from WWT. See FEDEPALMA Prefeasibility Study, Chapter 5, Pg 1.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

YEAR	1 INVESTMENT COST IN US$	2 Annual Operation and Maintenance Costs	3 Tax Savings from Depreciation (US$)	4 Savings from No Diesel (US $)	TOTAL without CDM	5 Income from CER (US $)	6 CDM Transaction Costs (US $)	TOTAL with CDM
0	-599.794	-32.708	20.993	91.582	-519.927	0	14.326	-534.253
1		-32.708	20.993	91.582	79.867	6.240	19.056	67.052
2		-32.708	20.993	91.582	79.867	6.240	20.664	65.444
3		-32.708	20.993	91.582	79.867	6.240	22.684	63.423
4		-32.708	20.993	91.582	79.867	6.240	27.110	58.997
5		-32.708	20.993	91.582	79.867	6.240	20.846	65.262
6		-32.708	20.993	91.582	79.867	6.240	20.134	65.974
7		-32.708	20.993	91.582	79.867	6.240	21.060	65.047
8		-32.708	20.993	91.582	79.867	6.240	22.659	63.448
9		-32.708	20.993	91.582	79.867	6.240	23.304	62.803
10		-32.708	20.993	91.582	79.867	6.240	9.227	76.881
NPV (12%)	**-599.794,25**	**-217.514,23**	**139.606,79**	**609.042,56**	**-68.659,13**	**35.257,39**	**133.269,36**	**-166.671,09**
IRR					**8,68%**			**3,82%**
CostS Kw/hour Project (Pesos $Kw hour)					**-199**			**-232**

Scenario 2 (CDM OPTION II): Biogas Capture from covered WWT ponds, with electricity generación with biogás gen plants, no change to baseline boilers, no turbines. See FEDEPALMA Prefeasibility Study, Chapter 5, Pg 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión with Biogás (Mwh/yr): 1.300

YEAR	1 INVESTMENT COST IN US$	2 Annual Operation and Maintenance Costs	3 Tax Savings from Depreciation (US$)	4 Savings from No Diesel (US $)	TOTAL without CDM	5 Income from CER (US $)	6 CDM Transaction Costs (US $)	TOTAL with CDM
0	-325.402	-26.929	11.389	91.582	-249.360	0	14.326	-263.686
1		-26.929	11.389	91.582	76.042	40.789	19.056	97.776
2		-26.929	11.389	91.582	76.042	40.789	20.664	96.168
3		-26.929	11.389	91.582	76.042	40.789	22.684	94.147
4		-26.929	11.389	91.582	76.042	40.789	27.110	89.721
5		-100.116	11.389	91.582	2.855	40.789	20.846	22.799
6	-70.370	-26.929	16.315	91.582	10.597	40.789	20.134	31.253
7		-26.929	16.315	91.582	80.968	40.789	21.060	100.697
8		-26.929	16.315	91.582	80.968	40.789	22.659	99.098
9		-26.929	16.315	91.582	80.968	40.789	23.304	98.453
10		-26.929	16.315	91.582	80.968	40.789	9.227	112.531
NPV (12%)	**-388.232,73**	**-220.614,99**	**85.815,58**	**609.042,56**	**113.189,30**	**230.469,46**	**133.269,36**	**210.389,40**
IRR					**22,75%**			**30,14%**
Cost Kw/hour of the Project ($Kw hour)					**-159**			**-120**

Scenario 3: Biogas capture from covered WWT ponds, with electricity generation with Biogas Gen Plants, new turbines to cover own energy needs. See Prefeasibility study, Chapter 5, page 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

YEAR	1 INVESTMENT COST IN US$	2 Annual Operation and Maintenance Costs	3 Tax Savings from Depreciation (US$)	4 Savings from No Diesel (US $)	TOTAL without CDM	5 Income from CER (US $)	6 CDM Transaction Costs (US $)	TOTAL with CDM
0	-325.402	-26.929	11.389	91.582	-249.360	0	14.326	-263.686
1		-26.929	11.389	91.582	76.042	40.789	19.056	97.776
2		-26.929	11.389	91.582	76.042	40.789	20.664	96.168
3		-26.929	11.389	91.582	76.042	40.789	22.684	94.147
4		-26.929	11.389	91.582	76.042	40.789	27.110	89.721
5		-100.116	11.389	91.582	2.855	40.789	20.846	22.799
6	-70.370	-26.929	16.315	91.582	10.597	40.789	20.134	31.253
7		-26.929	16.315	91.582	80.968	40.789	21.060	100.697
8		-26.929	16.315	91.582	80.968	40.789	22.659	99.098
9		-26.929	16.315	91.582	80.968	40.789	23.304	98.453
10		-26.929	16.315	91.582	80.968	40.789	9.227	112.531
NPV (12%)	**-388.232,73**	**-220.614,99**	**85.815,58**	**609.042,56**	**113.189,30**	**230.469,46**	**133.269,36**	**210.389,40**
IRR					**22,75%**			**30,14%**
Cost Kw/hour of the Project ($Kw hour)					**-159**			**-120**

Scenario 4 (CDM OPTION III): Biogas capture from covered WWT ponds, with electricity generation with Biogas Gen Plants, new high efficiency boilers and turbines, to maximize energy production and offer surplus to the grid. See Prefeasibility study, Chapter 5, page 2..
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión (Mwh/yr): 8.652
Sale of electricity to grid (MWh/yr): 7.351

YEAR	1 INVESTMENT COST IN US$	2 Annual Operation and Maintenance Costs	3 Tax Savings from Depreciation (US$)	4 Savings from No Diesel (US $)	5 Sales of Electricity to the Grid	TOTAL without CDM	6 Income from CER (US $)	7 CDM Transaction Costs (US $)	TOTAL with CDM
0	-2.095.898	-195.127	73.356	238.608	147.020	-1.832.040	0	14.326	-1.846.366
1		-195.127	73.356	238.608	147.020	263.858	62.843	19.056	307.646
2		-195.127	73.356	238.608	147.020	263.858	62.843	20.664	306.038
3		-195.127	73.356	238.608	147.020	263.858	62.843	22.684	304.017
4		-195.127	73.356	238.608	147.020	263.858	62.843	27.110	299.592
5		-268.314	73.356	238.608	147.020	190.671	62.843	20.846	232.669
6	-70.370	-195.127	78.282	238.608	147.020	198.414	62.843	20.134	241.124
7		-195.127	78.282	238.608	147.020	268.784	62.843	21.060	310.567
8		-195.127	78.282	238.608	147.020	268.784	62.843	22.659	308.968
9		-195.127	78.282	238.608	147.020	268.784	62.843	23.304	308.324
10		-195.127	78.282	238.608	147.020	268.784	62.843	9.227	322.401
NPV (12%)	**-2.158.728,74**	**-1.339.163,36**	**497.912,35**	**1.586.799,63**	**977.715,79**	**-408.285,46**	**355.079,09**	**133.269,36**	**-186.475,73**
IRR						**6,24%**			**9,47%**
Cost Kw/hour of the Project ($Kw hour)						**-137**			**-124,16**

Scenario 5: Biogas capture from covered WWT ponds, electricity gen with existing diesel plants modified for 40% biogás, 60% diesel (Dual Gen System). See Prefeasibility study, Chapter 5, page 2
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión with Biogás (kwh/yr): 520 40%

YEAR	1 INVESTMENT COST IN US$	2 Annual Operation and Maintenance Costs	3 Tax Savings from Depreciation (US$)	4 Savings from No Diesel (US $)	TOTAL without CDM	5 Income from CER (US $)	6 CDM Transaction Costs (US $)	TOTAL with CDM	Simple return
0	-116.296	-7.600	8.141	36.633	-79.123	0	14.326	-77.133	
1		-7.600	8.141	36.633	37.174	16.316	19.056	34.434	
2		-7.600	8.141	36.633	37.174	16.316	20.664	32.826	
3		-7.600	8.141	36.633	37.174	16.316	22.684	30.805	
4	-30.000	-7.600	10.241	36.633	9.274	16.316	27.110	-1.521	
5		-7.600	2.100	36.633	31.133	16.316	20.846	26.603	
6	-70.370	-18.100	7.026	36.633	-44.812	16.316	20.134	-48.629	26.293
7		-7.600	7.026	36.633	36.059	16.316	21.060	31.314	9
8	-30.000	-7.600	9.126	36.633	8.159	16.316	22.659	1.815	
9		-7.600	7.026	36.633	36.059	16.316	23.304	29.071	
10		-7.600	7.026	36.633	36.059	16.316	9.227	26.832	
NPV (12%)	**-220.534,25**	**-55.861,32**	**50.612,51**	**243.617,02**	**55.238,06**	**108.503,56**	**133.269,36**	**25.219,02**	
IRR					**32,09%**			**22,68%**	
Cost Kw/hour of the Project ($Kw hour)					**-177**			**-207**	

Scenario 6 (CDM OPTION I): Biogas capture from covered WWT Ponds, mitigation of biogas in Flares, no electricity generation from biogas. See Prefeasibility Study Chapter 5, page 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS
Without CER sales, there is no income from this scenario, IRR and NPV are negative.

YEAR	1 INVESTMENT COST IN US$	2 Annual Operation and Maintenance Costs	3 Tax Savings from Depreciation (US$)	5 Income from CER (US $)	6 CDM Transaction Costs (US $)	TOTAL with CDM	Simple return
0	-81.111	-6.164	5.678	0	14.326	-95.924	
1		-6.164	5.678	34.549	19.056	15.007	
2		-6.164	5.678	34.549	20.664	13.399	
3		-6.164	5.678	34.549	22.684	11.378	
4		-6.164	5.678	34.549	27.110	6.953	
5		-6.164	5.678	34.549	20.846	13.217	
6	-55.556	-6.164	-3.889	34.549	20.134	-51.193	9.329
7		-6.164	-3.889	34.549	21.060	3.436	15
8		-6.164	-3.889	34.549	22.659	1.837	
9		-6.164	-3.889	34.549	23.304	1.192	
10		-6.164	-3.889	34.549	9.227	15.269	
						-	
NPV (12%)	**-130.714,29**	**-40.994,93**	**18.190,38**	**195.212,07**	**133.269,36**	**-70.119,12**	
IRR						**-19,42%**	

FINANCIAL MODEL FOR THE CDM PROJECT AT A PALM OIL EXTRACTION PLANT
Plant: PALMAS DE TUMACO

Cost Kw/hour in the area (Pesos/ $Kw hour): 148

Scenario 1: Increased Electricty Generation 100% with Biomass - Steam. (Investment in New High Efficiency Boilers and Turbines), no biogas capture from WWT. See FEDEPALMA Prefeasibility Study, Chapter 5, Pg 1.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

	1	2	3	4		5	6	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 1.259.397	- 71.556	44.079	218.900	- 1.067.974	-	14.326	- 1.082.300
1		- 71.556	44.079	218.900	191.423	14.915	19.056	187.282
2		- 71.556	44.079	218.900	191.423	14.915	20.664	185.674
3		- 71.556	44.079	218.900	191.423	14.915	22.684	183.653
4		- 71.556	44.079	218.900	191.423	14.915	27.110	179.227
5		- 71.556	44.079	218.900	191.423	14.915	20.846	185.492
6		- 71.556	44.079	218.900	191.423	14.915	20.134	186.204
7		- 71.556	44.079	218.900	191.423	14.915	21.060	185.277
8		- 71.556	44.079	218.900	191.423	14.915	22.659	183.678
9		- 71.556	44.079	218.900	191.423	14.915	23.304	183.033
10		- 71.556	44.079	218.900	191.423	14.915	9.227	197.111
NPV (12%)	**- 1.259.396,76**	**- 475.864,73**	**293.134,43**	**1.455.733,53**	**13.606,47**	**84.272,22**	**133.269,36**	**- 35.390,67**
IRR					**12,31%**			**11,20%**
CostS Kw/hour Project (Pesos $Kw hour)					**- 138**			**- 143**

Scenario 2 (CDM OPTION II): Biogas Capture from covered WWT ponds, with electricity generación with biogás gen plants, no change to baseline boilers, no turbines. See FEDEPALMA Prefeasibility Study, Chapter 5, Pg 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión with Biogás (Mwh/yr): 2385 60%

	1	2	3	4		5	6	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 449.574	- 48.961	15.735	168.044	- 314.755	0	14.326	- 329.081
1		- 48.961	15.735	168.044	134.818	62.871	19.056	178.633
2		- 48.961	15.735	168.044	134.818	62.871	20.664	177.026
3		- 48.961	15.735	168.044	134.818	62.871	22.684	175.005
4		- 48.961	15.735	168.044	134.818	62.871	27.110	170.579
5		- 162.237	15.735	168.044	21.542	62.871	20.846	63.567
6	- 77.407	- 48.961	21.154	168.044	62.829	62.871	20.134	105.567
7		- 48.961	21.154	168.044	140.237	62.871	21.060	182.047
8		- 48.961	21.154	168.044	140.237	62.871	22.659	180.448
9		- 48.961	21.154	168.044	140.237	62.871	23.304	179.804
10		- 48.961	21.154	168.044	140.237	62.871	9.227	193.881
NPV (12%)	**- 518.687,37**	**- 389.875,34**	**115.725,06**	**1.117.529,52**	**354.588,63**	**355.233,90**	**133.269,36**	**576.553,18**
IRR					**37,17%**			**49,59%**
Cost Kw/hour of the Project ($Kw hour)					**- 133**			**- 87**

Scenario 3: Biogas capture from covered WWT ponds, with electricity generation with Biogas Gen Plants, new turbines to cover own energy needs. See Prefeasibility study, Chapter 5, page 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

	1	2	3	4		5	6	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 964.737	- 97.901	33.766	218.900	- 809.973	0	14.326	- 824.298
1		- 97.901	33.766	218.900	154.765	66.336	19.056	202.045
2		- 97.901	33.766	218.900	154.765	66.336	20.664	200.437
3		- 97.901	33.766	218.900	154.765	66.336	22.684	198.416
4		- 97.901	33.766	218.900	154.765	66.336	27.110	193.990
5		- 211.178	33.766	218.900	41.488	66.336	20.846	86.978
6	- 77.407	- 97.901	39.184	218.900	82.776	66.336	20.134	128.978
7		- 97.901	39.184	218.900	160.183	66.336	21.060	205.459
8		- 97.901	39.184	218.900	160.183	66.336	22.659	203.860
9		- 97.901	39.184	218.900	160.183	66.336	23.304	203.215
10		- 97.901	39.184	218.900	160.183	66.336	9.227	217.292
NPV (12%)	**- 1.033.850,89**	**- 715.340,81**	**235.633,39**	**1.455.733,53**	**- 27.928,02**	**374.812,49**	**133.269,36**	**213.615,11**
IRR					**11,14%**			**18,12%**
Cost Kw/hour of the Project ($Kw hour)					**- 151**			**- 121**

Scenario 4 (CDM OPTION III): Biogas capture from covered WWT ponds, with electricity generation with Biogas Gen Plants, new high efficiency boilers and turbines, to maximize energy production and offer surplus to the grid. See Prefeasibility study, Chapter 5, page 2..
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión (Mwh/yr): 12.928
Sale of electricity to grid (MWh/yr): 8.928

	1	2	3	4	5		6	7	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	Sales of Electricity to the Grid	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 2.599.820	133.281	90.994	218.900	178.560	- 1.978.085	0	14.326	- 1.992.411
1		- 132.591	90.994	218.900	178.560	355.863	93.121	19.056	429.928
2		- 132.591	90.994	218.900	178.560	355.863	93.121	20.664	428.320
3		- 132.591	90.994	218.900	178.560	355.863	93.121	22.684	426.300
4		- 132.591	90.994	218.900	178.560	355.863	93.121	27.110	421.874
5		- 245.867	90.994	218.900	178.560	242.586	93.121	20.846	314.862
6	- 77.407	- 132.591	96.412	218.900	178.560	283.874	93.121	20.134	356.862
7		- 132.591	96.412	218.900	178.560	361.281	93.121	21.060	433.342
8		- 132.591	96.412	218.900	178.560	361.281	93.121	22.659	431.743
9		- 132.591	96.412	218.900	178.560	361.281	93.121	23.304	431.098
10		- 132.591	96.412	218.900	178.560	361.281	93.121	9.227	445.176
NPV (12%)	**- 2.668.933,28**	**- 680.162,76**	**616.211,58**	**1.455.733,53**	**1.187.463,82**	**- 59.790,35**	**526.155,37**	**133.269,36**	**333.095,66**
IRR						**11%**			**15,98%**
Cost Kw/hour of the Project ($Kw hour)						**- 89**			**- 68,36**

Scenario 5: Biogas capture from covered WWT ponds, electricity gen with existing diesel plants modified for 40% biogás, 60% diesel (Dual Gen System). See Prefeasibility study, Chapter 5, page 2
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión with Biogás (kwh/yr): 1.243 31%

	1	2	3	4		5	6		
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM	**Simple return**
0	- 125.926	- 6.800	8.815	87.560	- 36.351	0	14.326	- 24.143	
1		- 6.800	8.815	87.560	89.575	26.534	19.056	97.053	
2		- 6.800	8.815	87.560	89.575	26.534	20.664	95.446	
3		- 6.800	8.815	87.560	89.575	26.534	22.684	93.425	
4	- 60.000	- 6.800	13.015	87.560	33.775	26.534	27.110	33.199	
5		- 6.800	4.200	87.560	84.960	26.534	20.846	90.649	
6	- 77.407	- 27.800	9.619	87.560	- 8.029	26.534	20.134	- 1.628	88.239
7		- 6.800	9.619	87.560	90.379	26.534	21.060	95.852	4
8	- 60.000	- 6.800	13.819	87.560	34.579	26.534	22.659	38.453	
9		- 6.800	9.619	87.560	90.379	26.534	23.304	93.609	
10		- 6.800	9.619	87.560	90.379	26.534	9.227	81.152	
NPV (12%)	**- 283.912,88**	**- 55.860,77**	**62.011,33**	**582.293,41**	**360.936,97**	**176.459,34**	**133.269,36**	**395.583,61**	
IRR					**243,24%**			**398,60%**	
Cost Kw/hour of the Project ($Kw hour)					**- 91**			**- 81**	

Scenario 6 (CDM OPTION I): Biogas capture from covered WWT Ponds, mitigation of biogas in Flares, no electricity generation from biogas. See Prefeasibility Study Chapter 5, page 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS
Without CER sales, there is no income from this scenario, IRR and NPV are negative.

	1	2	3	5	6		
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM	**Simple return**
0	- 87.222	- 6.629	3.053	0	14.326	- 105.124	
1		- 6.629	3.053	54.886	19.056	32.254	
2		- 6.629	3.053	54.886	20.664	30.646	
3		- 6.629	3.053	54.886	22.684	28.626	
4		- 6.629	3.053	54.886	27.110	24.200	
5		- 6.629	3.053	54.886	20.846	30.464	
6	- 61.111	- 6.629	3.053	54.886	20.134	- 29.935	29.202
7		- 6.629	3.053	54.886	21.060	30.250	5
8		- 6.629	3.053	54.886	22.659	28.651	
9		- 6.629	3.053	54.886	23.304	28.006	
10		- 6.629	3.053	54.886	9.227	42.083	
						-	
NPV (12%)	**- 141.785,71**	**- 44.083,59**	**20.301,65**	**310.118,85**	**133.269,36**	**34.884,55**	
IRR						**20,25%**	

FINANCIAL MODEL FOR THE CDM PROJECT AT A PALM OIL EXTRACTION PLANT
Plant: AGROINCE LTDA

Cost Kw/hour in the area (Pesos/ $Kw hour): 216

Scenario 1: Increased Electricty Generation 100% with Biomass - Steam. (Investment in New High Efficiency Boilers and Turbines), no biogas capture from WWT. See FEDEPALMA Prefeasibility Study, Chapter 5, Pg 1.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

	1	2	3	4		5	6	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 690.502	- 63.698	24.168	40.756	- 689.277	0	14.326	- 703.603
1		- 63.698	24.168	40.756	1.226	2890	19.056	- 14.940
2		- 63.698	24.168	40.756	1.226	2890	20.664	- 16.548
3		- 63.698	24.168	40.756	1.226	2890	22.684	- 18.569
4		- 63.698	24.168	40.756	1.226	2890	27.110	- 22.995
5		- 63.698	24.168	40.756	1.226	2890	20.846	- 16.730
6		- 63.698	24.168	40.756	1.226	2890	20.134	- 16.018
7		- 63.698	24.168	40.756	1.226	2890	21.060	- 16.945
8		- 63.698	24.168	40.756	1.226	2890	22.659	- 18.544
9		- 63.698	24.168	40.756	1.226	2890	23.304	- 19.188
10		- 63.698	24.168	40.756	1.226	2890	9.227	- 5.111
NPV (12%)	- 690.502,15	- 423.603,94	160.719,77	271.034,41	- 682.351,92	16.329,14	133.269,36	- 799.292,13
IRR					#¡VALOR!			#¡DIV/0!
CostS Kw/hour Project (Pesos $Kw hour)					- 402			- 458

Scenario 2 (CDM OPTION II): Biogas Capture from covered WWT ponds, with electricity generación with biogás gen plants, no change to baseline boilers, no turbines. See FEDEPALMA Prefeasibility Study, Chapter 5, Pg 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión with Biogás (Mwh/yr): 933

	1	2	3	4		5	6	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 397.218	- 41.404	13.903	40.756	- 383.963	0	14.326	- 398.289
1		- 41.404	13.903	40.756	13.255	41.735	19.056	35.934
2		- 41.404	13.903	40.756	13.255	41.735	20.664	34.327
3		- 41.404	13.903	40.756	13.255	41.735	22.684	32.306
4		- 41.404	13.903	40.756	13.255	41.735	27.110	27.880
5		- 143.096	13.903	40.756	- 88.438	41.735	20.846	- 67.548
6	- 63.333	- 41.404	18.336	40.756	- 45.645	41.735	20.134	- 24.043
7		- 41.404	18.336	40.756	17.688	41.735	21.060	38.363
8		- 41.404	18.336	40.756	17.688	41.735	22.659	36.764
9		- 41.404	18.336	40.756	17.688	41.735	23.304	36.119
10		- 41.404	18.336	40.756	17.688	41.735	9.227	50.197
NPV (12%)	- 453.765,22	- 333.045,80	101.523,64	271.034,41	- 389.791,98	235.813,84	133.269,36	- 287.247,50
IRR					-25,62%			-9,59%
Cost Kw/hour of the Project ($Kw hour)					- 294			- 238

Scenario 3: Biogas capture from covered WWT ponds, with electricity generation with Biogas Gen Plants, new turbines to cover own energy needs. See Prefeasibility study, Chapter 5, page 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

	1	2	3	4		5	6	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 397.218	- 41.404	13.903	40.756	- 383.963	0	14.326	- 398.289
1		- 41.404	13.903	40.756	13.255	41.735	19.056	35.934
2		- 41.404	13.903	40.756	13.255	41.735	20.664	34.327
3		- 41.404	13.903	40.756	13.255	41.735	22.684	32.306
4		- 41.404	13.903	40.756	13.255	41.735	27.110	27.880
5		- 143.096	13.903	40.756	- 88.438	41.735	20.846	- 67.548
6	- 63.333	- 41.404	18.336	40.756	- 45.645	41.735	20.134	- 24.043
7		- 41.404	18.336	40.756	17.688	41.735	21.060	38.363
8		- 41.404	18.336	40.756	17.688	41.735	22.659	36.764
9		- 41.404	18.336	40.756	17.688	41.735	23.304	36.119
10		- 41.404	18.336	40.756	17.688	41.735	9.227	50.197
NPV (12%)	- 453.765,22	- 333.045,80	101.523,64	271.034,41	- 389.791,98	235.813,84	133.269,36	- 287.247,50
IRR					-25,62%			-9,59%
Cost Kw/hour of the Project ($Kw hour)					- 294			- 238

Scenario 4 (CDM OPTION III): Biogas capture from covered WWT ponds, with electricity generation with Biogas Gen Plants, new high efficiency boilers and turbines, to maximize energy production and offer surplus to the grid. See Prefeasibility study, Chapter 5, page 2..
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión (Mwh/yr): 7.431
Sale of electricity to grid (MWh/yr): 6.494

	1	2	3	4	5		6	7	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	Sales of Electricity to the Grid	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 2.041.492	- 183.808	71.452	170.703	129.880	- 1.853.265	0	14.326	- 1.867.591
1		- 183.808	71.452	170.703	129.880	188.227	61.227	19.056	230.399
2		- 183.808	71.452	170.703	129.880	188.227	61.227	20.664	228.791
3		- 183.808	71.452	170.703	129.880	188.227	61.227	22.684	226.770
4		- 183.808	71.452	170.703	129.880	188.227	61.227	27.110	222.344
5		- 285.501	71.452	170.703	129.880	86.534	61.227	20.846	126.916
6	- 63.333	- 183.808	75.886	170.703	129.880	129.327	61.227	20.134	170.421
7		- 183.808	75.886	170.703	129.880	192.660	61.227	21.060	232.827
8		- 183.808	75.886	170.703	129.880	192.660	61.227	22.659	231.228
9		- 183.808	75.886	170.703	129.880	192.660	61.227	23.304	230.584
10		- 183.808	75.886	170.703	129.880	192.660	61.227	9.227	244.661
NPV (12%)	- 2.098.039,88	- 1.280.070,30	484.241,41	1.135.214,35	863.730,97	- 870.462,47	345.948,70	133.269,36	- 657.783,13
IRR						-1%			2,58%
Cost Kw/hour of the Project ($Kw hour)						- 230			- 139,42

Scenario 5: Biogas capture from covered WWT ponds, electricity gen with existing diesel plants modified for 40% biogás, 60% diesel (Dual Gen System). See Prefeasibility study, Chapter 5, page 2
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión with Biogás (kwh/yr): 933 100%

	1	2	3	4		5	6		
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM	Simple return
0	- 106.667	- 12.920	7.467	16.302	- 95.818	0	14.326	- 81.290	
1		- 12.920	7.467	16.302	10.849	28.853	19.056	20.647	
2		- 12.920	7.467	16.302	10.849	28.853	20.664	19.039	
3		- 12.920	7.467	16.302	10.849	28.853	22.684	17.018	
4	- 60.000	- 12.920	11.667	16.302	- 44.951	28.853	27.110	- 43.208	
5		- 12.920	4.200	16.302	7.582	28.853	20.846	15.590	
6	- 63.333	- 33.920	8.633	16.302	- 72.318	28.853	20.134	- 63.598	13.180
7		- 12.920	8.633	16.302	12.016	28.853	21.060	19.809	22
8	- 60.000	- 12.920	12.833	16.302	- 43.784	28.853	22.659	- 37.590	
9		- 12.920	8.633	16.302	12.016	28.853	23.304	17.565	
10		- 12.920	8.633	16.302	12.016	28.853	9.227	2.789	
NPV (12%)	- 253.433,86	- 96.560,14	54.553,24	108.413,76	- 134.710,51	191.881,61	133.269,36	- 85.388,28	
IRR					-45,05%			-48,36%	
Cost Kw/hour of the Project ($Kw hour)					- 131			- 112	

Scenario 6 (CDM OPTION I): Biogas capture from covered WWT Ponds, mitigation of biogas in Flares, no electricity generation from biogas. See Prefeasibility Study Chapter 5, page 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS
Without CER sales, there is no income from this scenario, IRR and NPV are negative.

933 100%

	1	2	3	5	6		
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM	Simple return
0	- 75.000	- 5.700	2.625	0	14.326	- 92.401	
1		- 5.700	2.625	38.845	19.056	16.715	
2		- 5.700	2.625	38.845	20.664	15.107	
3		- 5.700	2.625	38.845	22.684	13.086	
4		- 5.700	2.625	38.845	27.110	8.660	
5		- 5.700	2.625	38.845	20.846	14.925	
6	- 50.000	- 5.700	2.625	38.845	20.134	- 34.363	14.090
7		- 5.700	2.625	38.845	21.060	14.710	9
8		- 5.700	2.625	38.845	22.659	13.111	
9		- 5.700	2.625	38.845	23.304	12.466	
10		- 5.700	2.625	38.845	9.227	26.544	
						-	
NPV (12%)	- 119.642,86	- 37.906,27	17.456,84	219.484,70	133.269,36	- 34.565,65	
IRR						1,60%	

FINANCIAL MODEL FOR THE CDM PROJECT AT A PALM OIL EXTRACTION PLANT
Plant: OLEAGINOSAS LAS BRISAS S.A.

Cost Kw/hour in the area (Pesos/ $Kw hour): 163

Scenario 1: Increased Electricty Generation 100% with Biomass - Steam. (Investment in New High Efficiency Boilers and Turbines), no biogas capture from WWT. See FEDEPALMA Prefeasibility Study, Chapter 5, Pg 1.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

	1	2	3	4		5	6	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 828.497	- 76.807	28.997	51.020	- 825.286	0	14.326	- 839.612
1		- 76.807	28.997	51.020	3.211	3.833	19.056	- 12.012
2		- 76.807	28.997	51.020	3.211	3.833	20.664	- 13.620
3		- 76.807	28.997	51.020	3.211	3.833	22.684	- 15.640
4		- 76.807	28.997	51.020	3.211	3.833	27.110	- 20.066
5		- 76.807	28.997	51.020	3.211	3.833	20.846	- 13.802
6		- 76.807	28.997	51.020	3.211	3.833	20.134	- 13.090
7		- 76.807	28.997	51.020	3.211	3.833	21.060	- 14.017
8		- 76.807	28.997	51.020	3.211	3.833	22.659	- 15.616
9		- 76.807	28.997	51.020	3.211	3.833	23.304	- 16.260
10		- 76.807	28.997	51.020	3.211	3.833	9.227	- 2.183
NPV (12%)	- 828.496,79	- 510.784,98	192.839,09	339.297,22	- 807.145,45	21.658,68	133.269,36	- 918.756,12
IRR					-36,58%			#¡VALOR!
CostS Kw/hour Project (Pesos $Kw hour)					- 377			- 418

Scenario 2 (CDM OPTION II): Biogas Capture from covered WWT ponds, with electricity generación with biogás gen plants, no change to baseline boilers, no turbines. See FEDEPALMA Prefeasibility Study, Chapter 5, Pg 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión with Biogás (Mwh/yr): 1.200

	1	2	3	4		5	6	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 490.719	- 49.925	17.175	51.020	- 472.448	0	14.326	- 486.774
1		- 49.925	17.175	51.020	18.271	53.131	19.056	52.346
2		- 49.925	17.175	51.020	18.271	53.131	20.664	50.738
3		- 49.925	17.175	51.020	18.271	53.131	22.684	48.717
4		- 49.925	17.175	51.020	18.271	53.131	27.110	44.291
5		- 172.547	17.175	51.020	- 104.351	53.131	20.846	- 72.066
6	- 87.963	- 49.925	23.333	51.020	- 63.535	53.131	20.134	- 30.537
7		- 49.925	23.333	51.020	24.428	53.131	21.060	56.499
8		- 49.925	23.333	51.020	24.428	53.131	22.659	54.900
9		- 49.925	23.333	51.020	24.428	53.131	23.304	54.255
10		- 49.925	23.333	51.020	24.428	53.131	9.227	68.332
NPV (12%)	- 569.257,34	- 401.589,26	126.813,32	339.297,22	- 470.762,47	300.200,15	133.269,36	- 303.831,67
IRR					-24,09%			-6,06%
Cost Kw/hour of the Project ($Kw hour)					- 281			- 212

Scenario 3: Biogas capture from covered WWT ponds, with electricity generation with Biogas Gen Plants, new turbines to cover own energy needs. See Prefeasibility study, Chapter 5, page 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

	1	2	3	4		5	6	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 490.719	- 49.925	17.175	51.020	- 472.448	0	14.326	- 486.774
1		- 49.925	17.175	51.020	18.271	53.131	19.056	52.346
2		- 49.925	17.175	51.020	18.271	53.131	20.664	50.738
3		- 49.925	17.175	51.020	18.271	53.131	22.684	48.717
4		- 49.925	17.175	51.020	18.271	53.131	27.110	44.291
5		- 172.547	17.175	51.020	- 104.351	53.131	20.846	- 72.066
6	- 87.963	- 49.925	23.333	51.020	- 63.535	53.131	20.134	- 30.537
7		- 49.925	23.333	51.020	24.428	53.131	21.060	56.499
8		- 49.925	23.333	51.020	24.428	53.131	22.659	54.900
9		- 49.925	23.333	51.020	24.428	53.131	23.304	54.255
10		- 49.925	23.333	51.020	24.428	53.131	9.227	68.332
NPV (12%)	- 569.257,34	- 401.589,26	126.813,32	339.297,22	- 470.762,47	300.200,15	133.269,36	- 303.831,67
IRR					-24,09%			-6,06%
Cost Kw/hour of the Project ($Kw hour)					- 281			- 212

Scenario 4 (CDM OPTION III): Biogas capture from covered WWT ponds, with electricity generation with Biogas Gen Plants, new high efficiency boilers and turbines, to maximize energy production and offer surplus to the grid. See Prefeasibility study, Chapter 5, page 2..
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión (Mwh/yr): 12.786
Sale of electricity to grid (MWh/yr): 11.586

	1	2	3	4	5		6	7	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	Sales of Electricity to the Grid	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 2.971.525	- 268.960	104.003	51.020	231.720	- 2.853.741	0	14.326	- 2.868.067
1		- 268.960	104.003	51.020	231.720	117.784	53.131	19.056	151.859
2		- 268.960	104.003	51.020	231.720	117.784	53.131	20.664	150.251
3		- 268.960	104.003	51.020	231.720	117.784	53.131	22.684	148.230
4		- 268.960	104.003	51.020	231.720	117.784	53.131	27.110	143.805
5		- 412.900	104.003	51.020	231.720	- 26.157	53.131	20.846	6.128
6	- 87.963	- 268.960	110.161	51.020	231.720	35.979	53.131	20.134	68.976
7		- 268.960	110.161	51.020	231.720	123.942	53.131	21.060	156.012
8		- 268.960	110.161	51.020	231.720	123.942	53.131	22.659	154.413
9		- 268.960	110.161	51.020	231.720	123.942	53.131	23.304	153.768
10		- 268.960	110.161	51.020	231.720	123.942	53.131	9.227	167.846
NPV (12%)	- 3.050.063,35	- 1.870.317,76	704.240,29	339.297,22	1.540.989,68	- 2.301.880,33	300.200,15	133.269,36	- 2.134.949,54
IRR						-15%			-11,93%
Cost Kw/hour of the Project ($Kw hour)						- 171			- 123,57

Scenario 5: Biogas capture from covered WWT ponds, electricity gen with existing diesel plants modified for 40% biogás, 60% diesel (Dual Gen System). See Prefeasibility study, Chapter 5, page 2
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión with Biogás (kwh/yr): 880 40%

	1	2	3	4		5	6		
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM	Simple return
0	- 160.370	- 12.920	11.226	20.408	- 141.656	0	14.326	- 134.730	
1		- 12.920	11.226	20.408	18.714	21.252	19.056	20.911	
2		- 12.920	11.226	20.408	18.714	21.252	20.664	19.303	
3		- 12.920	11.226	20.408	18.714	21.252	22.684	17.282	
4	- 60.000	- 12.920	15.426	20.408	- 37.086	21.252	27.110	- 42.944	
5		- 12.920	4.200	20.408	11.688	21.252	20.846	12.095	
6	- 87.963	- 33.920	10.357	20.408	- 91.117	21.252	20.134	- 89.999	9.685
7		- 12.920	10.357	20.408	17.846	21.252	21.060	18.037	38
8	- 60.000	- 12.920	14.557	20.408	- 37.954	21.252	22.659	- 39.362	
9		- 12.920	10.357	20.408	17.846	21.252	23.304	15.794	
10		- 12.920	10.357	20.408	17.846	21.252	9.227	8.619	
NPV (12%)	- 326.772,15	- 96.560,14	73.257,19	135.718,89	- 154.883,28	141.332,33	133.269,36	- 153.662,97	
IRR					-34,55%			-45,31%	
Cost Kw/hour of the Project ($Kw hour)					- 163			- 166	

Scenario 6 (CDM OPTION I): Biogas capture from covered WWT Ponds, mitigation of biogas in Flares, no electricity generation from biogas. See Prefeasibility Study Chapter 5, page 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS
Without CER sales, there is no income from this scenario, IRR and NPV are negative.

2.200 100%

	1	2	3	5	6		
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM	Simple return
0	- 96.389	- 7.326	3.374	0	14.326	- 114.667	
1		- 7.326	3.374	49.297	19.056	26.290	
2		- 7.326	3.374	49.297	20.664	24.682	
3		- 7.326	3.374	49.297	22.684	22.661	
4		- 7.326	3.374	49.297	27.110	18.235	
5		- 7.326	3.374	49.297	20.846	24.500	
6	- 69.444	- 7.326	3.374	49.297	20.134	- 44.232	22.916
7		- 7.326	3.374	49.297	21.060	24.285	7
8		- 7.326	3.374	49.297	22.659	22.686	
9		- 7.326	3.374	49.297	23.304	22.041	
10		- 7.326	3.374	49.297	9.227	36.119	
						-	
NPV (12%)	- 158.392,86	- 48.716,58	22.435,27	278.541,47	133.269,36	- 12.580,80	
IRR						9,06%	

FINANCIAL MODEL FOR THE CDM PROJECT AT A PALM OIL EXTRACTION PLANT
Plant: PROMOC. AGROPECUARIA MONTERREY

Cost Kw/hour in the area (Pesos/ $Kw hour): 191,82

Scenario 1: Increased Electricty Generation 100% with Biomass - Steam. (Investment in New High Efficiency Boilers and Turbines), no biogas capture from WWT. See FEDEPALMA Prefeasibility Study, Chapter 5, Pg 1.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

	1	2	3	4		5	6	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 1.206.510	- 112.718	42.228	71.852	- 1.205.148	0	14.326	- 1.219.474
1		- 112.718	42.228	71.852	1.362	5.394	19.056	- 12.299
2		- 112.718	42.228	71.852	1.362	5.394	20.664	- 13.907
3		- 112.718	42.228	71.852	1.362	5.394	22.684	- 15.928
4		- 112.718	42.228	71.852	1.362	5.394	27.110	- 20.354
5		- 112.718	42.228	71.852	1.362	5.394	20.846	- 14.089
6		- 112.718	42.228	71.852	1.362	5.394	20.134	- 13.377
7		- 112.718	42.228	71.852	1.362	5.394	21.060	- 14.304
8		- 112.718	42.228	71.852	1.362	5.394	22.659	- 15.903
9		- 112.718	42.228	71.852	1.362	5.394	23.304	- 16.548
10		- 112.718	42.228	71.852	1.362	5.394	9.227	- 2.470
NPV (12%)	**- 1.206.510,32**	**- 749.603,04**	**280.824,70**	**477.835,09**	**- 1.197.453,57**	**30.479,89**	**133.269,36**	**- 1.300.243,04**
IRR					**-45,07%**			**#¡DIV/0!**
CostS Kw/hour Project (Pesos $Kw hour)					**- 372**			**- 397**

Scenario 2 (CDM OPTION II): Biogas Capture from covered WWT ponds, with electricity generación with biogás gen plants, no change to baseline boilers, no turbines. See FEDEPALMA Prefeasibility Study, Chapter 5, Pg 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión with Biogás (Mwh/yr): 1.776

	1	2	3	4		5	6	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 664.154	- 73.267	23.245	71.852	- 642.324	0	14.326	- 656.650
1		- 73.267	23.245	71.852	21.831	45.842	19.056	48.618
2		- 73.267	23.245	71.852	21.831	45.842	20.664	47.010
3		- 73.267	23.245	71.852	21.831	45.842	22.684	44.989
4		- 73.267	23.245	71.852	21.831	45.842	27.110	40.563
5		- 253.221	23.245	71.852	- 158.123	45.842	20.846	- 133.126
6	- 95.000	- 73.267	29.895	71.852	- 66.519	45.842	20.134	- 40.810
7		- 73.267	29.895	71.852	28.481	45.842	21.060	53.263
8		- 73.267	29.895	71.852	28.481	45.842	22.659	51.664
9		- 73.267	29.895	71.852	28.481	45.842	23.304	51.019
10		- 73.267	29.895	71.852	28.481	45.842	9.227	65.097
NPV (12%)	**- 748.975,90**	**- 589.352,74**	**168.189,36**	**477.835,09**	**- 655.612,72**	**259.020,12**	**133.269,36**	**- 529.861,96**
IRR					**-26,06%**			**-13,35%**
Cost Kw/hour of the Project ($Kw hour)					**- 265**			**- 229**

Scenario 3: Biogas capture from covered WWT ponds, with electricity generation with Biogas Gen Plants, new turbines to cover own energy needs. See Prefeasibility study, Chapter 5, page 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

	1	2	3	4		5	6	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 664.154	- 73.267	23.245	71.852	- 642.324	0	14.326	- 656.650
1		- 73.267	23.245	71.852	21.831	45.842	19.056	48.618
2		- 73.267	23.245	71.852	21.831	45.842	20.664	47.010
3		- 73.267	23.245	71.852	21.831	45.842	22.684	44.989
4		- 73.267	23.245	71.852	21.831	45.842	27.110	40.563
5		- 253.221	23.245	71.852	- 158.123	45.842	20.846	- 133.126
6	- 95.000	- 73.267	29.895	71.852	- 66.519	45.842	20.134	- 40.810
7		- 73.267	29.895	71.852	28.481	45.842	21.060	53.263
8		- 73.267	29.895	71.852	28.481	45.842	22.659	51.664
9		- 73.267	29.895	71.852	28.481	45.842	23.304	51.019
10		- 73.267	29.895	71.852	28.481	45.842	9.227	65.097
NPV (12%)	**- 748.975,90**	**- 589.352,74**	**168.189,36**	**477.835,09**	**- 655.612,72**	**259.020,12**	**133.269,36**	**- 529.861,96**
IRR					**-26,06%**			**-13,35%**
Cost Kw/hour of the Project ($Kw hour)					**- 265**			**- 229**

Scenario 4 (CDM OPTION III): Biogas capture from covered WWT ponds, with electricity generation with Biogas Gen Plants, new high efficiency boilers and turbines, to maximize energy production and offer surplus to the grid. See Prefeasibility study, Chapter 5, page 2..
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión (Mwh/yr): 13.139
Sale of electricity to grid (MWh/yr): 11.363

	1	2	3	4	5		6	7	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	Sales of Electricity to the Grid	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 3.080.173	- 278.366	107.806	299.114	227.260	- 2.724.360	0	14.326	- 2.738.686
1		- 278.366	107.806	299.114	227.260	355.813	79.932	19.056	416.689
2		- 278.366	107.806	299.114	227.260	355.813	79.932	20.664	415.081
3		- 278.366	107.806	299.114	227.260	355.813	79.932	22.684	413.061
4		- 278.366	107.806	299.114	227.260	355.813	79.932	27.110	408.635
5		- 458.321	107.806	299.114	227.260	175.859	79.932	20.846	234.945
6	- 95.000	- 278.366	114.456	299.114	227.260	267.463	79.932	20.134	327.261
7		- 278.366	114.456	299.114	227.260	362.463	79.932	21.060	421.335
8		- 278.366	114.456	299.114	227.260	362.463	79.932	22.659	419.736
9		- 278.366	114.456	299.114	227.260	362.463	79.932	23.304	419.091
10		- 278.366	114.456	299.114	227.260	362.463	79.932	9.227	433.168
NPV (12%)	**- 3.164.994,91**	**- 1.953.309,95**	**730.536,64**	**1.989.172,81**	**1.511.329,69**	**- 850.574,25**	**451.631,60**	**133.269,36**	**- 532.212,00**
IRR						**4%**			**7,02%**
Cost Kw/hour of the Project ($Kw hour)						**- 173**			**- 119,99**

Scenario 5: Biogas capture from covered WWT ponds, electricity gen with existing diesel plants modified for 40% biogás, 60% diesel (Dual Gen System). See Prefeasibility study, Chapter 5, page 2
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión with Biogás (kwh/yr): 880 40%

	1	2	3	4		5	6		
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM	Simple return
0	- 170.000	- 12.920	11.900	28.741	- 142.279	0	14.326	- 138.268	
1		- 12.920	11.900	28.741	27.721	18.337	19.056	27.002	
2		- 12.920	11.900	28.741	27.721	18.337	20.664	25.394	
3		- 12.920	11.900	28.741	27.721	18.337	22.684	23.374	
4	- 60.000	- 12.920	16.100	28.741	- 28.079	18.337	27.110	- 36.852	
5		- 12.920	4.200	28.741	20.021	18.337	20.846	17.512	
6	- 95.000	- 33.920	10.850	28.741	- 89.329	18.337	20.134	- 91.126	15.102
7		- 12.920	10.850	28.741	26.671	18.337	21.060	23.948	25
8	- 60.000	- 12.920	15.050	28.741	- 29.129	18.337	22.659	- 33.451	
9		- 12.920	10.850	28.741	26.671	18.337	23.304	21.704	
10		- 12.920	10.850	28.741	26.671	18.337	9.227	17.444	
NPV (12%)	**- 342.011,66**	**- 96.560,14**	**76.986,23**	**191.134,04**	**- 108.933,90**	**121.945,03**	**133.269,36**	**- 126.162,24**	
IRR					**-18,07%**			**-28,76%**	
Cost Kw/hour of the Project ($Kw hour)					**- 168**			**- 180**	

Scenario 6 (CDM OPTION I): Biogas capture from covered WWT Ponds, mitigation of biogas in Flares, no electricity generation from biogas. See Prefeasibility Study Chapter 5, page 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS
Without CER sales, there is no income from this scenario, IRR and NPV are negative.

	1	2	3	5	6		
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM	Simple return
0	- 102.500	- 7.790	3.588	0	14.326	- 121.028	
1		- 7.790	3.588	60.986	19.056	37.728	
2		- 7.790	3.588	60.986	20.664	36.120	
3		- 7.790	3.588	60.986	22.684	34.099	
4		- 7.790	3.588	60.986	27.110	29.673	
5		- 7.790	3.588	60.986	20.846	35.938	
6	- 75.000	- 7.790	3.588	60.986	20.134	- 38.350	34.140
7		- 7.790	3.588	60.986	21.060	35.723	5
8		- 7.790	3.588	60.986	22.659	34.124	
9		- 7.790	3.588	60.986	23.304	33.479	
10		- 7.790	3.588	60.986	9.227	47.557	
						-	
NPV (12%)	**- 169.464,29**	**- 51.805,24**	**23.857,68**	**344.583,93**	**133.269,36**	**42.869,68**	
IRR						**20,86%**	

FINANCIAL MODEL FOR THE CDM PROJECT AT A PALM OIL EXTRACTION PLANT
Plant: PALMAS OLEAGINOSAS BUCARELIA S.A.

Cost Kw/hour in the area (Pesos/ $Kw hour): 163

Scenario 1: Increased Electricty Generation 100% with Biomass - Steam. (Investment in New High Efficiency Boilers and Turbines), no biogas capture from WWT. See FEDEPALMA Prefeasibility Study, Chapter 5, Pg 1.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

	1	2	3	4		5	6	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 1.142.227	- 106.612	39.978	141.391	- 1.067.470	-	14.326	- 1.081.796
1		- 106.612	39.978	141.391	74.758	14.915	19.056	70.617
2		- 106.612	39.978	141.391	74.758	14.915	20.664	69.009
3		- 106.612	39.978	141.391	74.758	14.915	22.684	66.988
4		- 106.612	39.978	141.391	74.758	14.915	27.110	62.562
5		- 106.612	39.978	141.391	74.758	14.915	20.846	68.827
6		- 106.612	39.978	141.391	74.758	14.915	20.134	69.539
7		- 106.612	39.978	141.391	74.758	14.915	21.060	68.612
8		- 106.612	39.978	141.391	74.758	14.915	22.659	67.013
9		- 106.612	39.978	141.391	74.758	14.915	23.304	66.369
10		- 106.612	39.978	141.391	74.758	14.915	9.227	80.446
NPV (12%)	- 1.142.227,31	- 708.990,88	265.862,32	940.283,86	- 645.072,02	84.272,22	133.269,36	- 694.069,16
IRR					-6,00%			-7,35%
CostS Kw/hour Project (Pesos $Kw hour)					- 223			- 230

Scenario 2 (CDM OPTION II): Biogas Capture from covered WWT ponds, with electricity generación with biogás gen plants, no change to baseline boilers, no turbines. See FEDEPALMA Prefeasibility Study, Chapter 5, Pg 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión with Biogás (Mwh/yr): 2.803 100%

	1	2	3	4		5	6	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 679.632	- 46.198	23.787	141.391	- 560.652	0	14.326	- 574.978
1		- 46.198	23.787	141.391	118.980	135.708	19.056	235.632
2		- 46.198	23.787	141.391	118.980	135.708	20.664	234.024
3		- 46.198	23.787	141.391	118.980	135.708	22.684	232.004
4		- 46.198	23.787	141.391	118.980	135.708	27.110	227.578
5		- 216.403	23.787	141.391	- 51.224	135.708	20.846	63.638
6	- 126.667	- 46.198	32.654	141.391	1.180	135.708	20.134	116.754
7		- 46.198	32.654	141.391	127.847	135.708	21.060	242.494
8		- 46.198	32.654	141.391	127.847	135.708	22.659	240.895
9		- 46.198	32.654	141.391	127.847	135.708	23.304	240.250
10		- 46.198	32.654	141.391	127.847	135.708	9.227	254.328
NPV (12%)	- 792.727,07	- 403.807,97	176.325,91	940.283,86	- 31.003,32	766.778,99	133.269,36	602.506,32
IRR					10,60%			35,34%
Cost Kw/hour of the Project ($Kw hour)					- 143			- 34

Scenario 3: Biogas capture from covered WWT ponds, with electricity generation with Biogas Gen Plants, new turbines to cover own energy needs. See Prefeasibility study, Chapter 5, page 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

	1	2	3	4		5	6	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 679.632	- 46.198	23.787	141.391	- 560.652	0	14.326	- 574.978
1		- 46.198	23.787	141.391	118.980	135.708	19.056	235.632
2		- 46.198	23.787	141.391	118.980	135.708	20.664	234.024
3		- 46.198	23.787	141.391	118.980	135.708	22.684	232.004
4		- 46.198	23.787	141.391	118.980	135.708	27.110	227.578
5		- 216.403	23.787	141.391	- 51.224	135.708	20.846	63.638
6	- 126.667	- 46.198	32.654	141.391	1.180	135.708	20.134	116.754
7		- 46.198	32.654	141.391	127.847	135.708	21.060	242.494
8		- 46.198	32.654	141.391	127.847	135.708	22.659	240.895
9		- 46.198	32.654	141.391	127.847	135.708	23.304	240.250
10		- 46.198	32.654	141.391	127.847	135.708	9.227	254.328
NPV (12%)	- 792.727,07	- 403.807,97	176.325,91	940.283,86	- 31.003,32	766.778,99	133.269,36	602.506,32
IRR					10,60%			35,34%
Cost Kw/hour of the Project ($Kw hour)					- 143			- 34

Scenario 4 (CDM OPTION III): Biogas capture from covered WWT ponds, with electricity generation with Biogas Gen Plants, new high efficiency boilers and turbines, to maximize energy production and offer surplus to the grid. See Prefeasibility study, Chapter 5, page 2..
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión (Mwh/yr): 22.392
Sale of electricity to grid (MWh/yr): 19.589

	1	2	3	4	5		6	7	
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	Sales of Electricity to the Grid	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM
0	- 4.144.572	- 375.368	145.060	141.391	391.780	- 3.841.708	0	14.326	- 3.856.034
1		- 375.368	145.060	141.391	391.780	302.864	194.475	19.056	478.283
2		- 375.368	145.060	141.391	391.780	302.864	194.475	20.664	476.675
3		- 375.368	145.060	141.391	391.780	302.864	194.475	22.684	474.654
4		- 375.368	145.060	141.391	391.780	302.864	194.475	27.110	470.228
5		- 545.572	145.060	141.391	391.780	132.659	194.475	20.846	306.288
6	- 126.667	- 375.368	153.927	141.391	391.780	185.064	194.475	20.134	359.405
7		- 375.368	153.927	141.391	391.780	311.730	194.475	21.060	485.145
8		- 375.368	153.927	141.391	391.780	311.730	194.475	22.659	483.546
9		- 375.368	153.927	141.391	391.780	311.730	194.475	23.304	482.901
10		- 375.368	153.927	141.391	391.780	311.730	194.475	9.227	496.979
NPV (12%)	- 4.257.667,35	- 2.592.857,41	982.817,81	940.283,86	2.605.424,38	- 2.273.076,75	1.098.826,59	133.269,36	- 1.307.519,52
IRR						-5%			2,95%
Cost Kw/hour of the Project ($Kw hour)						- 135			- 82,56

Scenario 5: Biogas capture from covered WWT ponds, electricity gen with existing diesel plants modified for 40% biogás, 60% diesel (Dual Gen System). See Prefeasibility study, Chapter 5, page 2
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS

Generatión with Biogás (kwh/yr): 1.121 40%

	1	2	3	4		5	6		
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Savings from No Diesel (US $)	TOTAL without CDM	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM	Simple return
0	- 193.333	- 6.800	13.533	56.557	- 130.043	0	14.326	- 90.086	
1		- 6.800	13.533	56.557	63.290	54.283	19.056	98.517	
2		- 6.800	13.533	56.557	63.290	54.283	20.664	96.909	
3		- 6.800	13.533	56.557	63.290	54.283	22.684	94.889	
4	- 60.000	- 6.800	17.733	56.557	7.490	54.283	27.110	34.663	
5		- 6.800	4.200	56.557	53.957	54.283	20.846	87.394	
6	- 126.667	- 27.800	13.067	56.557	- 84.843	54.283	20.134	- 50.694	84.984
7		- 6.800	13.067	56.557	62.823	54.283	21.060	96.046	5
8	- 60.000	- 6.800	17.267	56.557	7.023	54.283	22.659	38.647	
9		- 6.800	13.067	56.557	62.823	54.283	23.304	93.802	
10		- 6.800	13.067	56.557	62.823	54.283	9.227	53.597	
NPV (12%)	- 390.589,47	- 55.860,77	88.114,64	376.113,54	88.496,73	360.994,69	133.269,36	298.744,36	
IRR					32,18%			100,63%	
Cost Kw/hour of the Project ($Kw hour)					- 129			- 52	

Scenario 6 (CDM OPTION I): Biogas capture from covered WWT Ponds, mitigation of biogas in Flares, no electricity generation from biogas. See Prefeasibility Study Chapter 5, page 2.
Values in 2003 US dollars and Col Pesos, as marked
CASH FLOW ANALYSIS
Without CER sales, there is no income from this scenario, IRR and NPV are negative.

2803 100%

	1	2	3	5	6		
YEAR	INVESTMENT COST IN US$	Annual Operation and Maintenance Costs	Tax Savings from Depreciation (US$)	Income from CER (US $)	CDM Transaction Costs (US $)	TOTAL with CDM	Simple return
0	- 130.000	- 9.880	4.550	0	14.326	- 149.656	
1		- 9.880	4.550	125.037	19.056	100.651	
2		- 9.880	4.550	125.037	20.664	99.044	
3		- 9.880	4.550	125.037	22.684	97.023	
4		- 9.880	4.550	125.037	27.110	92.597	
5		- 9.880	4.550	125.037	20.846	98.862	
6	- 100.000	- 9.880	4.550	125.037	20.134	- 426	96.101
7		- 9.880	4.550	125.037	21.060	98.647	2
8		- 9.880	4.550	125.037	22.659	97.048	
9		- 9.880	4.550	125.037	23.304	96.403	
10		- 9.880	4.550	125.037	9.227	110.480	
						-	
NPV (12%)	- 219.285,71	- 65.704,20	30.258,51	706.487,55	133.269,36	357.109,39	
IRR						63,30%	